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U.S. Bureau of Mines

MINERALS YEARBOOK

1948

Prepared under the direction of

E. W. PEHRSON

Chief, Economics and Statistics Division

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UNITED STATES DEPARTMENT OF THE INTERIOR

OSCAR L. CHAPMAN, *Secretary*

BUREAU OF MINES

JAMES BOYD, *Director*

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FOREWORD

The appearance of MINERALS YEARBOOK each year invariably marks a milestone of achievement. The record of our minerals industry becomes part of history.

The Bureau of Mines has always considered that the publication of this factual document constitutes one of its most important assignments, and with the passing of the years the position of the YEARBOOK has become more important not only to industry but to the Nation. Many future decisions will be based upon data available in these pages, and the editors are ever striving to make the YEARBOOK a more authoritative and a more useful tool.

The 1948 edition marks a turning point in the publication history of this document. The importance of foreign minerals to our domestic economy in both peace and war has been recognized; consequently, the YEARBOOKS of the future must be expanded to meet new factual requirements. There is also increased need for presentation of minerals data on a domestic regional and State basis; future issues of MINERALS YEARBOOK will take this into account.

The Bureau of Mines trusts that the 1948 issue will at least partially satisfy these many requirements and that industry and the public will find the presentation both interesting and authoritative. The editors deeply appreciate the assistance rendered to them by the many industrial concerns and State agencies that have made possible this contribution to the work of the Bureau of Mines.

JAMES BOYD, *Director*.

INTRODUCTION

Among the principal objectives of the Bureau of Mines is publication of Minerals Yearbook within the year following the year of review. Minerals Yearbook, 1948, represents an 8-month step-up in the publication schedule. Further progress is expected to result in issue of Minerals Yearbook, 1949, before the end of 1950.

This 1948 edition of Minerals Yearbook culminates a series of nine volumes prepared under the direction of Elmer W. Pehrson, whose services are now devoted to other Bureau of Mines problems. Among the improvements in Minerals Yearbook during Mr. Pehrson's tenure, more data on consumption were added, strategic materials were covered more fully, estimates were developed for figures not available, State tables were made current with the rest of the volume, charts were clarified, the typography was improved, and uniformity of presentation was achieved.

The 1948 volume was checked for statistical precision and consistency by John Hozik, statistical editor, assisted principally by K. Joyce D'Amico and, later in the program, by Vane N. L. Glendening. Wording of the manuscript was enhanced by the editing of Mabel E. Winslow, of the Office of Mineral Reports, who also applied type specifications and prepared the comprehensive index. To the more than 100 charts graphically indicating mineral-industry trends, 17 new charts were added. Most of these were drafted by Adelaide B. Palmer, of the Minerals Yearbook Section, and others were prepared under the supervision of Louis F. Perry, Region VIII, Pittsburgh, Pa.

Arrangements for printing Minerals Yearbook, 1948, were under the able guidance of John H. Ady, Chief of Publications of the Department of the Interior and liaison officer between the Department and the Government Printing Office.

Completion of questionnaires by the mineral industry is the valued source of most of the facts comprising this volume. Other information is obtained from business magazines, trade associations, scientific journals, and Government agencies. In particular, data on foreign trade and foreign production are received from the United States Department of Commerce and the United States Department of State, respectively. The following officials cooperated with the Bureau of Mines in compiling production data for their respective States:

Alabama: Walter B. Jones, State geologist, University.
Alaska: B. D. Stewart, commissioner of mines, Department of Mines, Juneau.
California: Olaf P. Jenkins, chief, and Charles V. Averill, supervising mining engineer, California Division of Mines, San Francisco 11.
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Georgia: Garland Peyton, director, Department of Mines, Mining and Geology, Atlanta.
Illinois: M. M. Leighton, chief, and Walter H. Voskuil, mineral economist, State Geological Survey Division, Urbana.
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South Dakota: E. P. Rothrock, State geologist, Vermillion.
Texas: John T. Lonsdale, director, Bureau of Economic Geology, University of Texas, Austin.
Utah: Arthur L. Crawford, director, Utah Geological and Mineralogical Survey, Salt Lake City.
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Bureau of Mines statisticians and researchers who rendered substantial assistance to the authors of this volume include the following: In Washington, D. C.—Hope Anderson, Ivan F. Avery, Dorothy M. Burch, Leon W. Geyer, Marjorie Kahn, Naomi W. Kearney, James G. Kirby, Lena M. Lunsford, Ann C. Mahoney, Annie L. Marks, Edith D. McKinney, Lena Mohme, Robert C. Morris, Virginia M. Oliver, Elizabeth Parker, Carribel Rockwell, Emma M. Seeley, and Virginia E. Wrenn. In Juneau, Alaska—Opal Y. Sharman. In Los Angeles, Calif.—Edward T. Knudsen, Adele B. Esser, and Harry L. Scarborough. In Denver, Colo.—Helen G. Post and Florence H. Scott. In Salt Lake City, Utah—Alice K. Feltch, Virginia C. Halverson, and LaRu T. Shepherd.

ALLAN F. MATTHEWS.

APRIL 1950.

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PART I. GENERAL REVIEWS

Review of the Mineral Industries in 1948

By ALLAN F. MATTHEWS

MINES and smelters in the United States had a record output in 1948 valued at $15,670,000,000. The dollar value was 26 per cent larger and the physical volume 4 percent larger than in the previous peak year 1947. This output was matched by a record consumption of petroleum, natural gas, sulfur, fertilizer, and many building materials, but not of coal and metals. Mineral prices in 1948 averaged double those of 1940, but the inflation was generally appreciably less than for farm products. Imports of minerals by the United States increased more than one-half, and exports declined. The mineral industry operated in 1948 with the best safety record to date. World production of tin, chromite, and bauxite gained more than one-fourth over 1947 outputs.

PRODUCTION

Value of Production.—The United States mined and processed in 1948 mineral products worth 15.7 billion dollars, an all-time high and one-fourth greater than the previous record in 1947. Over two-thirds of the gain was contributed by a 29-percent expansion in the value of fuels output. Production of metals and nonmetallic minerals (other than fuels) increased 21 and 16 percent, respectively. Of these three major mineral groups in 1948, fuels were valued at 10.3 billion dollars (66 percent of the total), other nonmetallics at 1.9 billion dollars (12 percent), and metals at 3.5 billion dollars (22 percent).

While the value of mineral output was gaining 26 percent in 1948, the value of agricultural products increased 2 percent, all products combined 11 percent, and national income 12 percent. The basis of this comparison are Bureau of Agricultural Economics reports on cash receipts from farm marketings (30,545 million dollars in 1948 and 30,014 million dollars in 1947, excluding Government payments) and Bureau of Foreign and Domestic Commerce reports on gross national product (262.4 billion dollars in 1948 and 235.7 billion dollars in 1947) and national income (226.2 billion dollars in 1948 and 201.7 billion dollars in 1947).

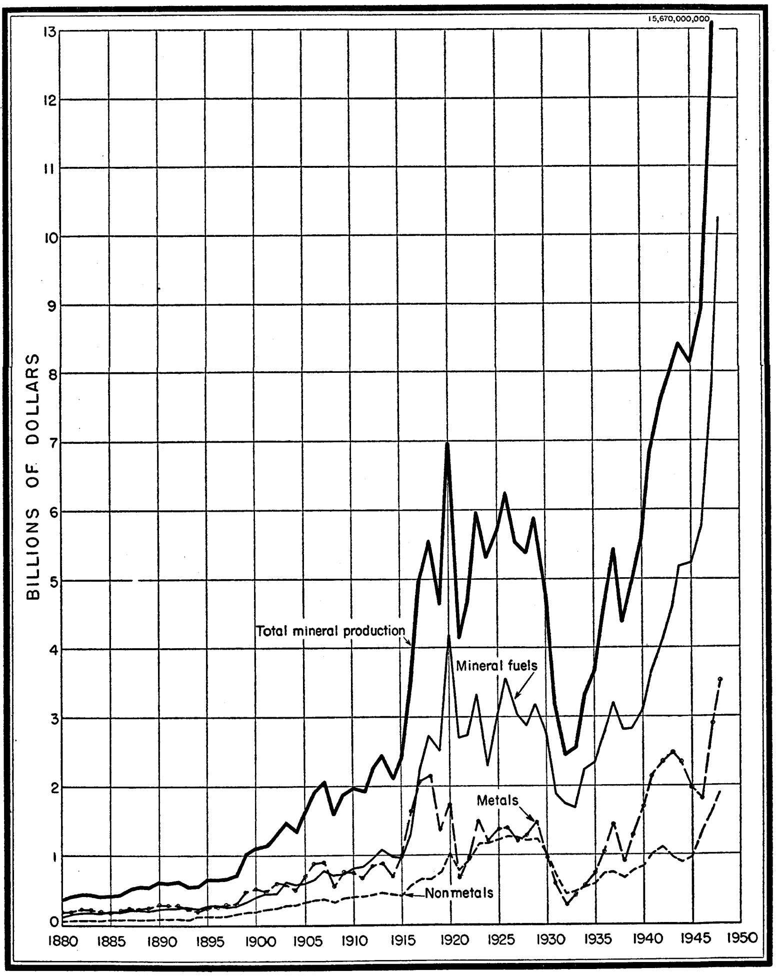

FIGURE 1.—Trends in value of mineral production in the United States, 1880–1948.

Volume of Production.—The physical volume of production in 1948 compared with 1947 increased 4 percent for minerals and 3 percent for manufactures but decreased nearly 1 percent for agricultural products, according to the Federal Reserve Board. The Board's index of mineral production (1935–39=100) reached a record annual high of 155 in 1948 and a record monthly high of 162 (adjusted for seasonal variation) in May.

Mineral fuels, as a group, were produced in 1948 in quantities 5 percent greater than in 1947. Petroleum and natural gas established new records by advancing 9 and 12 percent, respectively, in a volume of output. Mining bituminous coal and lignite, on the other hand, declined 6 percent because of work stoppages in March and April 1948 and declines in domestic and export demand in the latter half of the year. Anthracite production, influenced by abnormally mild weather in the Northeastern States in November and December 1948, was little changed from 1947.

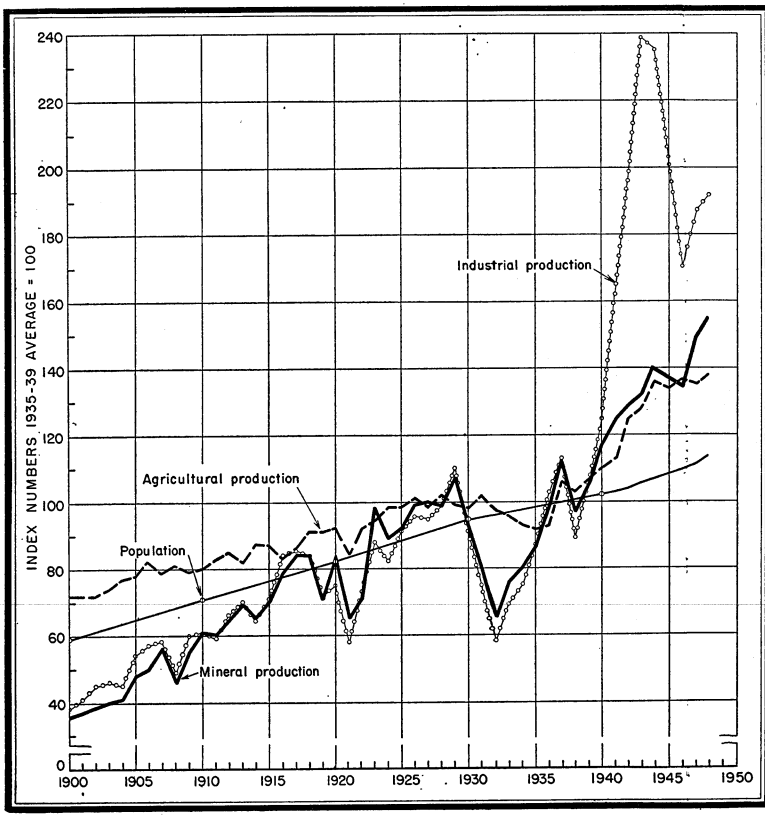

FIGURE 2.—Physical volume of mineral production compared with agricultural and industrial production (manufactures and minerals) and population, 1900–48. Sources: Federal Reserve Board, U. S. Department of Agriculture, and Bureau of the Census.

The metals group gained 3 percent in 1948, partly because steel operations were the third greatest in history. The tonnage yields of iron ore, pig iron, and ferro-alloys were up 8, 3, and 6 percent, respectively. A record was established in output of stainless steels. Among the ferro-alloy-metal ores, there was no appreciable improvement in domestic manganese and chromium supplies, although mines shipped a third more tungsten and molybdenum. Copper was in strong demand during 1948, but a strike of mine-locomotive engineers in the Nation's largest mine resulted in a 2-percent decline in copper output. Eleven percent less lead was refined from domestic ores, but a 5-percent increase in zinc materialized. Gold mining slumped 6 percent in 1948 because of rising production costs of the price-pegged metal, whereas silver mining gained 2 percent in response to the second full year of a higher Treasury purchase price. Output of bauxite and aluminum reached peacetime records 21 and 9 percent, respectively, above those of 1947. Shipments of magnesium metal in 1948 recovered from the previous year's low but remained relatively small because of heavy stocks of war scrap and limited consumer acquaintance with its advantageous properties. Mercury recovery in 1948 was 38 percent lower than in 1947 and by December was at a rate lower than for any year in the preceding century. Unabated demand for white pigments, on the other hand, resulted in ilmenite (titanium) shipments 14 percent larger than ever before.

Nonmetallic minerals (other than fuels) showed a composite gain in 1948 of 8 percent, greater than for any other major group. The insistent demand for building materials pushed the output of cement, sand and gravel, stone, and gypsum to all-time highs. Production records were also made in mining chemical raw materials such as sulfur, lime, salt, and potash, although 4-percent declines were noted for phosphate rock and barite. Fluorspar and pyrites rates were little changed. Demand from ceramics plants influenced more active mining of clay, a steadying of feldspar quarrying, and smaller recovery of boron.

Number of Firms.—According to the Department of Commerce, 35,500 mining firms were active in the United States in the fall of 1948. Of these, 48 percent were petroleum and gas producers, 40 percent metal and coal producers, and 12 percent nonmetallics producers. During 1948, 4,800 mining firms discontinued business, but 5,900 new firms were organized.[1]

Mining and related manufacturing firms in the United States on Sept. 30, 1944–48

[U. S. Department of Commerce]

Year	Mining firms				Mineral manufacturing firms			
	Metal and coal mining	Petroleum and natural gas	Nonmetallic mining	Total mining	Metal smelting and refining	Fabricated metal products	Products of petroleum and coal	Stone, clay, and glass products
1944	11, 900	15, 200	3, 900	31, 000	4, 500	12, 400	1, 200	7. 200
1945	11, 700	15, 900	3, 700	31, 300	5, 000	13, 700	1, 300	7, 900
1946	12, 200	16, 500	4, 200	32, 900	6, 000	16, 300	1, 400	12, 600
1947	13, 000	16, 800	4, 400	34, 200	6, 200	17, 900	1, 400	13, 100
1948	14, 200	16, 900	4, 400	35, 500	6, 200	18, 000	1, 400	12, 000

National Income.—Of the national income of the United States, 2.2 percent originated at mines in 1948 compared with 2.0 in 1947, according to the United States Department of Commerce. To the national income in 1948, food and raw-materials producers contributed 27 billion dollars—81.3 percent from farms, 17.9 percent from mines, 0.6 percent from fisheries, and 0.2 percent from forests. Of the

[1] Churchill, Betty C., Revised Estimates of the Business Population, 1929–48: Survey of Current Business, vol. 29, No. 6, June 1949, pp. 19–24.

5-billion-dollar mine income, 47 percent was from coal mining, 33 percent from oil and gas extraction, 11 percent from metal mining, and 9 percent from nonmetallic minerals.

National income is defined as the aggregate earnings of labor and property that arise from the current production of goods and services by the Nation's economy. Its five principal components, with the value of each for the mining industry in 1948, in millions of dollars, are as follows: Wages and salaries, 3,344; supplements to wages and salaries (employer contributions for social insurance and private pensions funds, pay of military reserve, etc.), 191; income of corporate and unincorporated enterprises before taxes, 1,438; inventory adjustment, —86; net interest, 16; total, 4,903.

National income originating in mining and related manufacturing industries in the United States, 1944–48, in millions of dollars

[U. S. Department of Commerce]

Industry	1944	1945	1946	1947	1948
Bituminous coal and lignite	1, 271	1, 204	1, 248	1, 718	1, 976
Anthracite	238	219	281	304	346
Petroleum and natural gas	800	795	930	1, 199	1, 606
Metals	417	349	324	507	561
Nonmetallic minerals	224	222	293	363	414
Total mining	2, 950	2, 789	3, 076	4, 091	4, 903
Iron and steel products [1]	9, 081	7, 376	5, 544	7, 607	8, 653
Nonferrous metal products	1, 942	1, 659	1, 774	2, 136	2, 264
Products of petroleum and coal	1, 360	1, 326	1, 684	2, 253	3, 228
Stone, clay, and glass products	1, 137	1, 147	1, 562	1, 910	2, 174

[1] Including ordnance.

Equipment and Materials.—Expenditures on new plant and equipment by the mining industry in the United States totaled $800,000,000 in 1948 compared with $690,000,000 in 1947, the United States Department of Commerce reports. In both years the outlay constituted 4 percent of the total spent on expansion and replacement by all domestic industries.

In underground bituminous-coal and lignite mines, the tonnage cut by machines first reached 25 percent in 1900, 50 percent in 1913, 75 percent in 1927, and 91 percent in 1944, and it was 91 percent in 1948. In these underground soft-coal mines, the quantity mechanically loaded first exceeded 10 percent in 1930, 25 percent in 1938, and 50 percent in 1944, and it established a record of 64 percent in 1948. Bituminous-coal and lignite mines purchased 723 mobile loaders, 17 scrapers, 1,025 mechanical-loading conveyors, and 230 "mother" haulage conveyors in 1948, according to the Bureau of Mines.

Industrial explosives sold for consumption in the United States in 1948 reached a new high of 725,227,173 pounds compared with 651,390,937 pounds in 1947 (revised to include liquid-oxygen explosive). Of the 1948 total, 126,282,153 pounds were permissible high explosives, 550,085,616 pounds were high explosives other than permissible, 33,239,700 pounds were black blasting powder, and 16,561,539 pounds were liquid-oxygen explosives. Coal mining used 46 percent of these explosives, construction (railway and other) 18 percent, nonmetal mining (including quarrying) 17 percent, metal mining 16 percent, and other activities 3 percent.

Productivity.—Production of bituminous coal and lignite in 1948 for the third successive year exceeded 6 net tons per man-day, although Bureau of Mines data indicate a somewhat lower productivity in 1948 (final figures) than in 1946–47. The rate of output of anthracite in 1948—2.8 tons per man-day—was higher than in any year before 1939 but lower than the 1941 record of 3 tons. Anthracite productivity is only half that for soft coal because anthracite seams are steeply pitching and thus less adaptable to mechanical cutting and loading. About 1.47 gross tons of usable iron ore per man-hour were produced in 1948, according to preliminary Bureau of Mines figures; this represents greater efficiency than in any year since 1941.

TRANSPORTATION

Railroads.—More than half of all rail freight in the United States is mineral. Class I railroads in 1948 loaded 1,508 million short tons of revenue freight, of which 430 were bituminous coal, 48 anthracite, 23 coke, and 344 were other products of mines (including petroleum). These compare with 1,538, 446, 49, 23, and 330, respectively, in 1947, according to the Interstate Commerce Commission.

Pipe Lines.—Interstate and export movements of natural gas (including gas stored or lost in transmission) in 1947 were 1,402 billion cubic feet, over one-third of the total marketed production of the United States. Natural-gas pipe lines now exceed railroads in milage. Petroleum refineries received a total (intrastate and interstate) of 1,475 million barrels of crude by pipe line in 1948 compared with 1,363 million barrels in 1947.

Shipments of various mineral products in the United States, by method of transportation, 1947–48, in thousands of short tons

Mineral product	1947				1948			
	Railroad	Boat	Truck	Total	Railroad	Boat	Truck	Total
Cement	28, 898	713	5, 637	35, 248	31, 243	673	6, 493	38, 409
Coal:								
Bituminous	527, 282	29, 803	55, 859	612, 944	498, 194	26, 735	58, 260	583, 189
Pennsylvania anthracite	48, 240	------	6, 962	55, 202	47, 299	------	7, 610	54, 909
Coke (including breeze)	30, 344	1, 161	2, 077	33, 582	30, 193	1, 100	2, 010	33, 303
Fluorspar	269	60	------	329	260	72	------	332
Fuel briquets [1]	2, 596	------	741	3, 337	2, 550	------	713	3, 263
Iron and manganiferous ore	20, 300	85, 200	------	105, 500	22, 700	91, 400	------	114, 100
Petroleum	[2] 6, 852	66, 577	(2)	[3] 73, 429	[2] 8, 460	76, 720	(2)	[3] 85, 180
Sand and gravel	75, 942	19, 003	182, 478	[4] 277, 423	78, 889	18, 839	211, 231	[4] 308, 959
Slag—iron blast furnace	11, 218	284	7, 640	19, 142	11, 066	145	9, 216	20, 427
Stone, crushed	74, 360	22, 259	97, 898	[5] 194, 517	80, 114	25, 243	108, 744	[5] 214, 101

[1] Including packaged fuel.
[2] Transportation by truck included with railroads.
[3] In addition, 202, 949 thousand tons in 1947 and 219,646 thousand tons in 1948 were transported by pipe line.
[4] In addition, method of transportation not specified for following, in thousands of tons: 1947—10,237; 1948—10,308.
[5] In addition, method of transportation not specified for following, in thousands of tons: 1947—11,620; 1948—9,762.

CONSUMPTION AND SELF-SUFFICIENCY

Record consumption of the following important minerals was achieved in 1948: Petroleum, natural gas, natural gasoline (with liquefied petroleum gases), sulfur, salt, phosphate rock, potash, lime, gypsum, cement, sand and gravel, stone, barite, ilmenite, and feldspar. Not a single metal was consumed in tonnages equal to previous highs, although use of lead was greater in 1948 than in any year except 1947.

Consumption of bituminous coal declined 5 percent in 1948 compared with 1947, but anthracite increased 4 percent. The gain by petroleum was 9 percent, natural gas 12 percent, and natural gasoline and liquefied petroleum gases 9 percent. Consumption of iron ore, manganese ore, and molybdenum was 5, 8, and 24 percent, respectively, greater in 1948. Of the base metals (primary and secondary), 3 to 4 percent more zinc and tin were used in 1948 but 3 percent less copper and lead than in 1947. Consumption of virgin aluminum was 27 percent greater in 1948 but was still below demand, particularly for building products such as roofing and siding. Apparent consumption of major chemical and fertilizer minerals increased in 1948 as follows: Sulfur, fluorspar, potash, and barite, 7 to 9 percent; phosphate rock, 4 percent; and salt, 2 percent. Sales of carbon black for domestic use dropped 7 percent, reflecting a smaller demand for rubber and a lower ratio of synthetic to natural rubber output. Cement, lime, sand and gravel, stone, and clay gained 7 to 12 percent, and calcined gypsum 25 percent.

A detailed study of consumption of slab zinc by uses, grades, and regions during World War II was published.[2]

Consumption and self-sufficiency of the United States in various mineral products in primary form in 1948

Mineral	Unit	Mine production	Consumption (primary)	Self-sufficiency (percent) [1]
Antimony	Short tons	5,970	15,455	39
Bauxite	Thousand long tons (dried equivalent).	1,457	2,725	53
Cement	Thousand barrels (376 pounds)	208,889	202,040	103
Chromite	Short tons	3,619	875,033	(2)
Coal:				
Bituminous and lignite [3]	Thousand short tons	594,000	531,161	112
Pennsylvania anthracite	do	57,140	50,200	114
Cobalt	Short tons	290	2,525	11
Copper	Thousand short tons	835	1,214	69
Diamonds, industrial	Thousand carats		[4] 10,418	
Fluorspar	Short tons	333,900	406,269	82
Graphite	do	9,949	20,770	48
Iron ore (usable)	Thousand gross tons	101,003	100,499	101
Lead	Thousand short tons	390	655	60
Manganese ore	do	131	1,538	9
Mercury	Flasks (76 pounds)	14,388	46,253	31
Mica, sheet and punch	Short tons	135	5,505	2
Molybdenum	do	13,353	12,578	106
Nickel	do	883	93,558	1
Petroleum [3]	Million barrels	2,016	2,108	96
Phosphate rock	Thousand long tons	9,388	7,700	122
Platinum group	Troy ounces	13,741	250,227	5
Potash	Thousand short tons K_2O	1,140	1,108	103
Quartz, radio-grade	Pounds		61,600	
Sulfur, native	Thousand long tons	4,869	3,720	131
Tin	Long tons	6	59,863	(2)
Tungsten	Short tons	2,003	4,427	45
Zinc	do	629,977	923,000	68

1 Ratio of production to consumption.
2 Less than 0.5 percent.
3 Preliminary figures.
4 Imports for consumption.

2 Ransome, Alfred L., Consumption of Slab Zinc in the United States by Industries, Grades, and Geographic Divisions, 1940-45, Including a Summary of Consumption Since 1900: Bureau of Mines Inf. Circ. 7450, 1948, 46 pp.

United States consumption of coal, sulfur, cement, phosphate rock, potash, and molybdenum in 1948 was more than equaled by domestic production, leaving important tonnages for export. In addition, the Nation met its needs in iron ore and nearly so in petroleum. Of crucial importance is the fact that the United States in 1948 had to import more than 90 percent of its requirements of manganese, chromium, uranium, tin, nickel, platinum, tantalum, sheet mica, industrial diamonds, asbestos, and radio-grade quartz.

STOCKS

Bituminous-coal inventories held by consumers were enlarged 33 percent and those of anthracite in the hands of producers were increased 37 percent during 1948, continuing the trends of 1947.

Industry stocks of pig iron, primary lead in all forms, and tin in concentrates or pig were 62, 16, and 19 percent larger, respectively, at the end of 1948 than at the beginning of the year. (The tin figure includes metal owned by the Reconstruction Finance Corporation.) On the other hand, producers' and fabricators' holdings of refined copper decreased 8 percent, producers' stocks of aluminum declined 15 percent, and industry stocks of slab zinc fell 21 percent.

Producers of nonmetallic minerals lowered their stocks of sulfur 4 percent and potash 24 percent in 1948, following the 1947 trend. But producers increased by 11 and 61 percent, respectively, the tonnages of portland cement and phosphate rock on hand.

PRICES

Mineral prices gained another 20 percent in 1948 and reached a level double those of 1940, according to the Bureau of Mines index of producers' realizations on 24 minerals representing all but a few percent of the total value of United States mineral production. As a group, fuels duplicated their 24-percent price rise of 1947, metals were up 15 percent, and nonmetallics (other than fuels) 9 percent.

Of the 24 major minerals, the sharpest price advances in 1948 were for natural gasoline and cycle products (44 percent), crude petroleum (34 percent), lead (24 percent), and pig iron (22 percent). Rises of 10 to 20 percent were made in the unit prices of bituminous coal, ferro-alloys, cement, phosphate rock, anthracite, zinc, and lime. The only notable price decline was for potash—5 percent.

Weighted average price index of 24 major mineral commodities, 1942–48

[1940=100]

Group	1942	1943	1944	1945	1946	1947	1948 [1]
Minerals (all groups)	114.7	119.7	122.7	125.3	138.7	168.5	202.8
Metals [2]	114.2	117.1	118.0	120.9	132.4	156.6	180.5
Mineral fuels	116.2	122.6	126.9	129.5	145.3	181.7	226.0
Nonmetals (other than fuels)	108.8	112.0	113.7	115.4	122.2	134.6	146.0

[1] Preliminary.
[2] Includes bonus payments on copper, lead, and zinc, 1942–47.

Wholesale prices of all commodities as a group, according to the Bureau of Labor Statistics index (1926=100), rose 9 percent from 152.1 in 1947 to 165.1 in 1948 and for farm products alone 4 percent from 181.2 to 188.3. The indexes for various mineral products were as follows:

Product	1947	1948	Product	1947	1948
Anthracite	117.6	130.3	Fertilizer materials	105.6	116.1
Bituminous coal	157.6	187.0	Iron and steel	133.7	155.2
Brick and tile	140.0	156.3	Nonferrous metals	140.3	157.5
Cement	115.7	130.5	Paint and materials	162.6	159.8
Chemicals	118.7	126.1	Petroleum products	90.2	122.1
Coke	166.6	207.1	Structural steel	134.5	163.7

EMPLOYMENT, WAGES, AND SAFETY

Employees in the mining industry in 1948 averaged 985,000, 5 percent more than in 1947 and 13 percent more than in 1946, according to the Bureau of Labor Statistics.

Earnings per full-time employee in the mining industry in 1948 averaged $3,395, 9 percent greater than in 1947 and 25 percent greater than in 1946.

Number of employees and average earnings in mining and related manufacturing industries, 1946–48

[U. S. Bureau of Labor Statistics]

Industry	Number of full-time equivalent employees (thousands)			Average annual earnings per full-time employee		
	1946	1947	1948	1946	1947	1948
Bituminous coal and lignite	391	428	447	$2,724	$3,213	$3,387
Anthracite	82	80	82	2,890	3,125	3,427
Petroleum and natural gas	221	234	258	2,819	3,167	3,574
Metals	88	100	101	2,636	2,990	3,347
Nonmetallic minerals	89	95	97	2,371	2,663	2,979
Total mining	871	937	985	2,719	3,114	3,395
Iron and steel products [1]	1,670	1,863	1,866	2,696	3,063	3,392
Nonferrous metal products	498	483	461	2,717	2,963	3,273
Products of petroleum and coal	219	228	237	3,183	3,610	4,063
Stone, clay, and glass products	474	503	521	2,380	2,674	2,919

[1] Including ordnance.

The average number of days worked by the mining and metallurgical industries (exclusive of petroleum and steelmaking) was 250 (preliminary figure) in 1948 compared with 260 in 1947 and 240 in 1946, according to the Bureau of Mines.

The safety record of the mineral industries in 1948 was the best in the 37 years for which statistics are available. The injury frequency rate improved from 53.3 per million man-hours in 1947 to 50.8 in 1948. The number of fatalities decreased from 1,414 in 1947 to 1,229 in 1948.

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FOREIGN TRADE [3]

Imports of mineral products by the United States in 1948 were a third more than exports—a reversal of the foreign trade balance in 1947 and a return to the usual situation. This resulted primarily from a decline in coal shipments abroad and from larger entries of foreign petroleum, tin, and other nonferrous metals. The principal mineral imports, in order of value in 1948, were petroleum, copper, tin, diamonds, and lead. The leading exports were coal, petroleum, and copper.

Principal mineral products imported into and exported from the United States, 1946–48

[U. S. Department of Commerce]

Mineral	Quantity			Value (thousand dollars)		
	1946	1947	1948	1946	1947	1948
IMPORTS						
Fuels: Petroleum (thousand barrels)	89, 210	99, 284	128, 431	101, 656	161, 535	282, 965
Ores and concentrates:						
Bauxite (long tons)	852, 005	1, 821, 580	2, 488, 915	5, 965	11, 870	15, 821
Chromite (short tons)	757, 391	1, 106, 180	1, 542, 125	11, 459	18, 867	33, 051
Copper (short tons of metal)	22, 666	48, 823	47, 291	5, 293	19, 165	17, 525
Iron ore (thousand long tons)	2, 754	4, 903	6, 109	10, 371	22, 096	27, 330
Lead (short tons of metal)	28, 377	[1] 44, 419	33, 932	3, 056	[1] 8, 559	8, 351
Manganese ore(thousand short tons)	1, 515	1, 298	1, 473	29, 658	21, 291	23, 320
Tin (long tons of metal)	[1] 38, 138	[1] 28, 365	37, 492	[1] 50, 716	[1] 42, 577	72, 170
Tungsten (short tons of metal)	3, 435	3, 009	3, 774	5, 929	6, 422	7, 777
Metals (including scrap):						
Aluminum (short tons)	57, 100	31, 329	160, 877	12, 236	6, 300	41, 798
Copper (short tons)	272, 071	339, 846	418, 821	66, 436	133, 281	174, 668
Lead (short tons)	103, 345	[1] 176, 493	284, 902	[1] 14, 413	[1] 41, 540	92, 684
Nickel (short tons)	104, 734	88, 408	106, 939	[1] 49, 854	[1] 45, 590	61, 034
Platinum group (troy ounces)	339, 836	265, 486	243, 433	11, 940	9, 885	13, 022
Tin (long tons)	15, 520	24, 899	49, 196	18, 507	42, 685	103, 323
Zinc (short tons)	108, 152	[1] 77, 169	102, 940	[1] 16, 775	[1] 15, 262	26, 147
Nonmetallic minerals:						
Asbestos (short tons)	456, 688	594, 839	647, 881	18, 731	29, 822	37, 974
Diamonds (thousand carats):						
Gem	[1] 1, 611	[1] 1, 344	1, 302	[1] 159, 135	[1] 96, 061	100, 705
Industrial	4, 625	[1] 3, 999	10, 418	14, 298	[1] 13, 313	32, 522
Mica (short tons)	13, 944	11, 685	17, 896	7, 119	7, 469	15, 546
EXPORTS						
Fuels:						
Anthracite (thousand short tons)	6, 497	8, 510	6, 676	63, 844	90, 220	86, 203
Bituminous coal (thousand short tons)	41, 209	[1] 68, 667	45, 925	238, 087	[1] 528, 700	392, 869
Petroleum (thousand barrels)	42, 574	46, 356	39, 737	74, 132	99, 074	116, 763
Metals (including scrap):						
Aluminum (short tons)	17, 334	63, 121	49, 471	10, 132	33, 188	29, 003
Copper (short tons)	97, 475	196, 999	206, 567	[1] 37, 102	[1] 99, 875	109, 773
Iron, scrap (thousand short tons)	149	194	242	3, 385	[1] 9, 854	12, 516
Molybdenum (short tons)	282	1, 495	2, 066	371	2, 232	2, 999
Nickel (short tons)	7, 977	12, 037	8, 184	[1] 6, 760	[1] 11, 036	8, 004
Zinc (short tons)	61, 070	117, 567	73, 101	12, 691	27, 051	19, 189
Nonmetallic minerals:						
Cement (thousand barrels)	5, 163	6, 970	5, 922	13, 485	21, 667	20, 917
Phosphate rock (long tons)	633, 340	753, 317	1, 141, 364	5, 453	7, 005	10, 485
Potash materials (short tons)	120, 727	124, 909	128, 068	8, 039	8, 686	8, 289
Sulfur, native (thousand long tons)	[1] 1, 189	[1] 1, 299	1, 263	[1] 21, 590	[1] 25, 388	26, 779

[1] Revised figure.

[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.

INCOME AND TAXATION

The income of all enterprises in the mining industry was 1,438 million dollars in 1948 compared with 1,102 in 1947 and 687 in 1946. These totals are before deduction of depletion charges and taxes. Federal and State taxes on corporate income in the mining industry ranged between 27 and 34 percent in 1942–48 and were 33 percent in 1948.

Income and corporation taxes of mining and related manufacturing enterprises in the United States in 1948, in millions of dollars [1]

[U. S. Department of Commerce]

Industry	Corporate income				Income of unincorporated enterprises	Grand total
	Taxes (Federal and State)	Dividend payments	Undistributed	Total		
Bituminous coal and lignite	113	73	110	296	57	353
Anthracite	17	19	12	48	3	51
Petroleum and natural gas	145	128	181	454	201	655
Metals	75	96	69	240	9	249
Nonmetallic minerals	36	31	56	123	7	130
Total mining	386	347	428	1,161	277	1,438
Iron and steel products [2]	1,006	418	1,028	2,452	110	2,562
Nonferrous metal products	282	155	316	753	78	831
Products of petroleum and coal	662	439	1,182	2,283	6	2,289
Stone, clay, and glass products	227	135	217	579	57	636

[1] Before deduction of depletion charges.
[2] Including ordnance.

MINERAL POLICY DEVELOPMENTS

Economic Cooperation with Europe.—The European Recovery Program (Marshall Plan) was defined and implemented by passage of the Economic Cooperation Act of 1948 (title I, Public Law 472, 80th Cong.), approved April 3, 1948; the Foreign Aid Appropriation Act, 1949 (Public Law 793, 80th Cong.), approved June 28, 1948; and various bilateral treaties between the United States and each of the 16 participating European countries. The legislation established the Economic Cooperation Administration and provided it with $5,000,000,000 to promote industrial and agricultural production in the participating countries, to further the soundness of European finances, and to stimulate international trade.

Commodity procurements authorized by ECA during its first year, ended April 2, 1949, totaled 1.3 billion dollars, of which 41 percent was for food and feed, 29 percent for mineral products, 7 percent for machinery and vehicles, and 23 percent for textiles, forest products, tobacco, and chemicals. Of the 363 million dollars authorized for mineral products, 179 were for nonferrous metals, 153 for petroleum and products, 17 for iron and steel, and 14 for nonmetallic minerals. In addition, 17 million dollars were allotted to rehabilitate coal, iron, and nickel mines, 59 million to build steel mills, and 2 million for an aluminum plant.

In each participating country the person or firm receiving ECA commodities pays his respective government for them in local currency. Thus each cooperating government has a "counterpart fund" in its own currency that equals the dollar grants made to the country as ECA aid. Such funds may be used for exploration, development, plant modernization, plant expansion, or transportation. In this way facilities are being improved for producing coal and nitrate in France and for completing steel plants begun in Italy during World War II. At least 5 percent of each counterpart fund is to be spent for strategic materials exported to the United States.[4] Among the first of such shipments arranged for was graphite from Madagascar and palm oil from Indonesia.

Stock Piling.—Meeting the objectives of the National Stock Pile is expected to cost $3,217,000,000. About one-fourth of this had been either spent ($242,000,000) or obligated ($540,000,000) by the end of 1948.

The strategic and critical materials subject to stock piling are defined by the Munitions Board as "those raw or semiprocessed materials that are required for essential uses in a war emergency, and whose procurement in adequate quantities, quality or time is sufficiently uncertain for any reason to require prior provision for their supply." Such materials are classified by the Munitions Board into three groups.

Group 1–a comprises "those strategic and critical materials for which stock piling is deemed necessary to insure an adequate supply for a future emergency primarily because of a dependence on foreign sources of supply." As of September 23, 1948 (Munitions Board Circular 53), the strategic materials in group 1–a consisted of 18 agricultural materials and some 33 minerals and metals. The latter were as follows:

Antimony.
Asbestos:
  Chrysotile.
  Amosite.
Bauxite:
  Metal grade.
  Abrasive grade.
Beryl.
Bismuth.
Cadmium.
Celestite.
Chromite:
  Metallurgical grade.
  Refractory grade:
    Type A.
    Type B.
Cobalt.
Columbite.
Copper.
Corundum.
Diamonds, industrial.
Graphite:
  Amorphous lump.
  Crystalline flake:
    Crucible grade.
    Lubricant and packing grade.
Iodine.
Kyanite.
Lead.
Manganese ore:
  Battery grade.
  Metallurgical grade.
Mercury.
Mica:
  Muscovite block, good stained and better.
  Muscovite film.
  Muscovite splittings.
  Phlogopite splittings.
Monazite.
Nickel.
Platinum-group metals:
  Iridium.
  Platinum.
Quartz crystals.
Rutile.
Talc, steatite, block.
Tantalite.
Tin.
Tungsten.
Vanadium.
Zinc.
Zirconium ores:
  Baddeleyite.
  Zircon.

[4] Falco, Tom, ECA's Strategic Materials Division: Eng. and Min. Jour., vol. 149, No. 9, September 1948, pp. 70–74.

Group 1–b is stated to include "those strategic and critical materials for which stock piling is deemed necessary to insure an adequate supply for a future emergency primarily because of the lack of the means for obtaining adequate domestic production to meet emergency needs." This definition is so inexact that it literally includes everything in group 1–a. It was meant to cover only those stock-piled semiprocessed materials whose existing processing capacity represents a rate of domestic production inadequate to meet emergency requirements. On the group 1–b list September 23, 1948, were no agricultural products and two mineral products:

Jewel bearings:
- Instrument jewels, except vee jewels.
- Sapphire and ruby vee jewels.

Jewel bearings—Continued
- Watch and time-keeping device jewels.
- Sapphire and ruby.

Group 2 materials, although strategic, "are not recommended for stock-pile purchase but offer supply problems which will require either further study before a final determination can be made on stock piling or other action to assure adequate supplies in a future emergency." Materials relegated to group 2 as of September 23, 1948, include 15 agricultural products and 24 mineral products. The latter were:

Aluminum.
Asbestos, Canadian chrysotile.
Barite.
Chalk, English.
Chromite, chemical grade.
Cryolite, natural.
Diamond dies.
Emery.
Fluorspar:
- Acid grade.
- Metallurgical grade.

Glass, optical.
Graphite, crystalline fines.
Iron ore.
Magnesium.
Mica:
- Muscovite block, stained and lower.
- Phlogopite block.

Molybdenum.
Petroleum and petroleum products.
Platinum-group metals:
- Osmium.
- Palladium.
- Rhodium.
- Ruthenium.

Radium.
Scrap, iron and steel.
Selenium.
Talc, steatite, ground.

Mining Subsidies.—Under the Premium Price Plan in effect February 1, 1942, to June 30, 1947, the Federal Government subsidized overquota mine production of copper, lead, and zinc. A report contains an organization summary, chronology of activities, and fifteen statistical tables on metal recoveries, premiums paid, and costs.[5]

TECHNOLOGY

A review of 37 ore deposits developed in North America in the past decade was published in 1948.[6] Papers were written on the thickness of coal seams,[7] the making of blast holes by means of a flame,[8] and progress in heavy-medium separation.[9] Reports were made on research in fuel production and utilization,[10] including synthetic

[5] Olund, Henning E., and Gustavson, Samuel A., The Premium Price Plan—Its Cost and Its Results: Eng. and Min. Jour., vol. 149, No. 12, December 1948, pp. 72–78.

[6] Joralemon, Ira B., Geology and the New Mines: Min. and Met., vol. 29, No. 496, April 1948, pp. 226–232.

[7] Young, W. H., and Anderson, R. L., Thickness of Bituminous Coal and Lignite Seams Mined in the United States in 1945: Bureau of Mines Inf. Circ. 7442, 1948, 17 pp.

[8] Zimmerman, J. H., Jet-Piercing Up-to-Date: Eng. and Min. Jour., vol. 149, No. 3, March 1948, pp. 74–76.

[9] Beall, John V., Recent Developments in Heavy-Density Separation: Min. and Met., vol. 29, No. 501, September 1948, pp. 488–492.

[10] Cattell, R. A., and others, Report of Petroleum and Natural-Gas Division, Fiscal Year 1947: Bureau of Mines Inf. Circ. 7484, 1949, 65 pp.; Fiscal Year 1948: Inf. Circ. 7532, 1949, 64 pp.

Fieldner, A. C., and others, Annual Report of Research and Technologic Work on Coal, Fiscal Year 1947: Bureau of Mines Inf. Circ. 7446, 1948, 113 pp.; Fiscal Year 1948: Inf. Cir. 7518, 1949, 87 pp.

Klosky, Simon, An Index of Shale-Oil Patents: Bureau of Mines Bull. 467, 1948, 332 pp.

liquid fuels.[11] The Bureau of Mines published a series of 18 reports containing core-drill data from a $2,250,000 wartime investigation of Arkansas bauxite deposits.[12] An issue of Mining and Metallurgy was devoted largely to the operations of the United States Smelting, Refining & Mining Co.[13] German innovations in metallurgy were described.[14]

In the field of health and safety in the mineral industry, the Bureau of Mines published a bibliography,[15] lists of equipment rated as permissible in coal mining,[16] and reports of research in recent years.[17]

WORLD REVIEW

World production of petroleum, chromite, cement, native sulfur, and phosphate rock were at record heights in 1948. The largest gains in 1948 over 1947 were made by tin concentrates (33 percent) and chromite and bauxite (each 27 percent). World output of iron ore, petroleum, cement, native sulfur, salt, and fluorspar increased 10 to 20 percent. The only drastic decline was in mercury recovery (27 percent).

North America.—A number of descriptions of the Quebec-Labrador iron-ore occurrences [18] were published in 1948. Plans were under way for developing a deposit near Allard Lake, Quebec, containing 125 million tons of ore averaging 30 to 40 percent titanium dioxide.[19] Known reserves of high-grade bauxite (50 percent Al_2O_3 and 2 percent SiO_2) on Caribbean islands total 350 million tons, 90 percent of which is in Jamaica and the remainder in Haiti and the Dominican Republic.[20] The status of mine taxation in Mexico was outlined.[21]

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[11] Bureau of Mines, Synthetic Liquid Fuels 1948 Annual Report of the Secretary of the Interior: Rept. of Investigations 4456–4458, 1949, 143 pp.
Howard, Frank A., Conversion of Coal to Oil and Gas: Min. and Met., vol. 29, No. 499, July 1948, pp. 388–395.

[12] Malamphy, M. C., and others, Investigation of Arkansas Bauxite: Bureau of Mines Rept. of Investigations 4251–4268, 1948, 1,837 pp.

[13] Mining and Metallurgy, vol. 29, No. 502, October 1948, pp. 427–582.

[14] Tyler, Paul M., German Metallurgical Practice Reviewed: Min. and Met., vol. 29, No. 498, sec. 1, June 1948, pp. 326–329.

[15] Davenport, Sara J., Bibliography of Bureau of Mines Publications Dealing with Health and Safety in the Mineral and Allied Industries, 1910–46: Bureau of Mines Tech. Paper 705, 1948, 154 pp.

[16] Hooker, A. B., Permissible Mine Equipment Approved to January 1, 1947, with Appended List of Available Flame-Lamp Fuels: Bureau of Mines Inf. Circ. 7432, 1948, 44 pp.
Hooker, A. B., Permissible Mine Equipment Approved During the Calendar Yer 1947: Bureau of Mines Inf. Circ. 7465, 1948, 5 pp.

[17] Harrington, D., Activities of the Health and Safety Division, Bureau of Mines, United States Department of the Interior, During the War Years, 1941–45: Bureau of Mines Inf. Circ. 7487, 1949, 40 pp.
Lewis, Bernard, Report of Research and Technologic Work on Explosives, Explosions, and Flames, Fiscal Years 1947 and 1948: Bureau of Mines Rept. of Investigations 4502, 1949, 92 pp.

[18] Engineering and Mining Journal, That Labrador Iron Ore: Vol. 149, No. 11, November 1948, pp. 88–92.
Melcher, Norwood B., Quebec-Labrador as a Future Supply of Iron Ore for the United States: Bureau of Mines Mineral Trade Notes, vol. 27, No. 4, suppl. 29, October 1948, 11 pp., 8 figs.
Retty, J. A., Labrador—North America's Newest Great Iron-Ore Field: Min. and Met., vol. 29, No. 501, September 1948, pp. 480–483.

[19] Mining and Metallurgy, Rich Titanium Strike Enters Development Stage: Vol. 29, No. 503, November 1948, pp. 615–617.

[20] Schmedeman, O. C., Caribbean Aluminum Ores: Eng. and Min. Jour., vol. 149, No. 6, June 1948, pp. 78–82.

[21] Bratter, Herbert, Mexico's Tax Jumble: Eng. and Min. Jour., vol. 149, No. 10, October 1948, pp. 92–94.
Burnham, J. Kellogg, Mining Taxes in Mexico: Bureau of Mines Mineral Trade Notes, vol. 26, No. 4, suppl. 25, April 1948, 19 pp.

Comparison of world and United States production of principal minerals in 1947 and 1948 [1]

[Compiled by B. B. Mitchell and P. Roberts]

Minerals	1947 World	1947 United States		1948 World	1948 United States	
	Thousand metric tons	Thousand metric tons	Percent of world	Thousand metric tons	Thousand metric tons	Percent of world
Fuels:						
Anthracite	118,908	51,882	44	120,815	51,836	43
Bituminous coal and lignite	1,533,092	572,089	37	1,568,185	538,865	34
Petroleum (thousand barrels)	3,021,668	1,856,987	61	3,425,283	2,016,282	59
Metals: [2]						
Aluminum	1,084	519	48	1,265	566	45
Antimony	35	4	11	41	5	12
Arsenic, white [3]	53	17	32	53	18	34
Bauxite	6,488	1,221	19	8,246	1,481	18
Chromite	1,658	1	(4)	2,113	3	(4)
Copper	2,210	769	35	2,321	757	33
Copper (smelter)	2,251	857	38	2,341	840	36
Gold (thousand troy oz.)	28,900	2,165	7	29,600	2,025	7
Iron ore	184,000	94,586	51	211,000	102,855	49
Iron, pig (incl. ferro-alloys)	98,500	54,559	55	112,700	56,214	50
Lead (smelter)	1,283	400	31	1,288	363	28
Magnesium	20	11	55	19	9	47
Manganese ore	3,900	119	3	3,900	119	3
Mercury (thousand flasks)	164	23	14	120	14	12
Molybdenum (Mo content)	14	12	86	14	12	86
Nickel	139	1	1	150	1	1
Platinum group (thousand troy oz.)	499	18	4	520	19	4
Silver (thousand troy oz.)	165,600	38,587	23	171,000	39,228	23
Tin (thousand long tons)	114	(5)	(4)	152	(5)	(4)
Tin (smelter; thousand long tons)	125	33	26	153	37	24
Tungsten concentrates [6]	25	3	12	32	4	13
Zinc (smelter) [3]	1,596	728	46	1,692	715	42
Nonmetallic minerals:						
Asbestos	867	22	3	989	34	3
Cement	84,565	32,315	38	97,130	35,626	37
Diamonds, gem (thousand carats)	9,742	------	----	10,028	------	----
Fluorspar	664	299	45	790	301	38
Gypsum [3]	13,350	5,632	42	15,000	6,581	44
Magnesite	1,850	341	18	2,000	(7)	(7)
Mica [3]	65	45	69	73	47	64
Phosphate rock [3]	16,745	9,172	55	16,982	8,808	52
Potash (K_2O equivalent)	3,000	934	31	3,000	1,034	34
Pyrites	8,500	956	11	9,000	943	10
Salt, common	38,751	14,564	38	42,488	14,881	35
Sulfur, native (thousand long tons)	4,800	4,441	93	5,300	4,869	92
Talc and pyrophyllite [3]	980	468	48	1,070	471	44

1 Partly estimated, particularly as regards U. S. S. R.
2 Outputs designated as smelter are from both imported and domestic ores.
3 Exclusive of U. S. S. R.
4 Less than 0.5 percent.
5 1 ton in 1947 and 6 tons in 1948.
6 60 percent WO_3 basis.
7 Bureau of Mines not at liberty to publish figures.

Europe.—A series of articles on the status of mining in Austria, Belgium, Denmark, France, Germany, Italy, Luxembourg, Netherlands, and Portugal and in their overseas territories appeared in Engineering and Mining Journal (October–December 1948). Various minerals in France,[22] coal in Spitzbergen,[23] and mercury in Spain [24]

22 Wright, Charles Will, French Mineral Position: Min. and Met., vol. 29, No. 501, September 1948, pp. 497–499.
23 Ljone, Odmund, Spitzbergen—Norway's Arctic Coal Treasure: Min. and Met., vol. 29, No. 498, Sect. 1, June 1948, pp. 330–332.
24 Bennett, Evan, Almaden—World's Greatest Mercury Mine: Min. and Met., vol. 29, No. 493, January 1948, pp. 6–8.

were described. The Bureau of Mines reviewed coal and coke practices in Germany.[25]

Asia.—An exhaustive study of the mineral resources of China was published.[26] Supplements to Bureau of Mines Mineral Trade Notes in 1948 included reports on Asiatic bauxite, Chinese aluminum and magnesium, and Japanese manganese (metallurgy), cement, copper, mercury, gold, and silver. Other notable papers described coke [27] and sponge iron [28] in Japan, rehabilitation of Philippine mines,[29] Middle East petroleum (including forecasts for 1951),[30] and undeveloped Turkish reserves of coal, petroleum, chromite, manganese, and nonferrous metals.[31]

Mine production index numbers for various countries, 1943 and 1947–48

[United Nations index numbers, 1937=100]

Country	1943	1947	1948	Country	1943	1947	1948
Algeria	27	130	(1)	Morocco, French	51	171	192
Belgium [2]	(1)	95	105	Netherlands (coal only)	92	71	77
Canada	113	107	122	Southern Rhodesia	92	74	(1)
Chile	120	118	124	Sweden [3]	126	145	150
Czechoslovakia	(1)	104	113	Tunisia	14	82	96
Greece (1939=100)	(1)	16	20	Turkey	120	139	150
Hungary (1937–38=100) [4]	(1)	117	134	United Kingdom	(1)	77	82
Italy (1938=100)	(1)	95	88	United States	118	133	138
Japan	131	60	71	Yugoslavia	(1)	186	(1)
Mexico [5]	96	99	94				

1 Figure not available.
2 Comprises coal, coke, petroleum products, gas, and electricity.
3 Comprises metal mining, metallurgy, and metal products.
4 Includes iron smelting.
5 Includes nonferrous metallurgy.

25 Lowry, H. H., and Rose, H. J., Some Observations on German Coal Research and Developments: Bureau of Mines Inf. Circ. 7422, 1948, 27 pp.
Reed, Frank H., Some Observations on Coking Practice in Germany: Bureau of Mines Inf. Circ. 7462, 1948, 74 pp.
Rhodes, E. O., German High-Temperature Coal-Tar Industry: Bureau of Mines Inf. Circ. 7409, 1948, 117 pp.

26 Dickerman, Nelson, Mineral Resources of China: Bureau of Mines Foreign Minerals Survey, vol. 2, No. 7, January 1948, 226 pp.

27 Reid, William T., Low-Temperature Carbonization of Coal in Japan: Bureau of Mines Inf. Circ. 7430, 1948, 82 pp.

28 Johnston, Theo. L., Sponge Iron in Japan: Bureau of Mines Inf. Circ. 7440, 1948, 12 pp.

29 Boericke, W. F., Rehabilitation of Mines in the Philippines Progresses: Eng. and Min. Jour., vol. 149, No. 3, March 1948, pp. 60–63.

30 Bauer, C. J., Middle East Oil and World Markets: Min. and Met., vol. 29, No. 500, August 1948, pp. 436–442.

31 Lorenz, Emil-Paul, The Undeveloped Mineral Reserves of the Turkish Republic: Min. and Met., vol. 29, No. 504, sec. 1, December 1948, pp. 654–657.

Statistical Summary of Mineral Production

(General United States Summary and Detailed Production by States)

By JOHN HOZIK AND K. JOYCE D'AMICO

THIS statistical summary corresponds in form and content with those presented in preceding editions of Minerals Yearbook. Fuel statistics for 1948, 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; that is, they exclude products from scrap. 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. The Bureau of Mines does not canvass producers of gem stones, carbon dioxide, and mineral waters, but estimates for gem stones and mineral waters are included in the United States total.

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 fluctuations 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 output. However, totals have not been derived strictly for the crude stage alone, largely because of the impracticability 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 United States total includes: (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, lead, copper, and zinc mint, refinery, or smelter production rather than mine output; (4) natural gas valued at points of consumption instead of at wells;[1] (5) 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; (6) estimates for gem stones and mineral waters, for which no canvasses are conducted; and (7) 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.

Planned Revisions.—The general United States totals are to be improved in the near future by revisions that will eliminate virtually all of the inadequacies indicated in the three preceding paragraphs.

GENERAL TABLES

The following tables present salient production data of the mineral industry of the United States as a whole.

Value of mineral products of the United States, 1880–1948 [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

See footnotes at end of table.

[1] Both the United States total and the State totals include natural gas valued at points of consumption for years before 1943.

Value of mineral products of the United States, 1880–1948 [1]—Continued

Year	Metallic	Nonmetallic			Grand total
		Fuels [2]	Other	Total	
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	542,320,000
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	1,975,000,000	5,212,000,000	954,000,000	6,166,000,000	8,141,000,000
1946	1,825,000,000	5,760,000,000	1,311,000,000	7,071,000,000	8,896,000,000
1947 [3]	2,909,000,000	7,941,000,000	1,634,000,000	9,575,000,000	12,484,000,000
1948 [3]	3,510,000,000	10,266,000,000	1,894,000,000	12,160,000,000	15,670,000,000
Total 1880–1948	65,954,027,000	130,682,252,000	38,503,510,000	169,185,762,000	235,139,789,000

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

Mineral products of the United States, 1946–48 [1]

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
METALLIC						
Aluminum .... short tons (2,000 pounds)	409,630	$115,812,000	571,750	$161,626,000	623,456	$180,755,000
Antimonial lead .... do	[2] 50,480	(2)	[2] 86,075	(2)	[2] 100,764	(2)
Antimony:						
Metal .... do	(3)	(3)	(3)	(3)	(3)	(3)
Ore and concentrates .... do	13,962	797,715	20,020	3,272,079	16,239	4,378,398
Bauxite .... long tons (dried equivalent)	1,104,054	6,892,864	1,202,055	6,884,666	1,457,148	8,696,708
Beryllium concentrates .... short tons	100	17,787	145	25,214	99	26,600
Cadmium:						
Metal .... pounds	6,180,265	6,094,572	7,852,907	12,358,526	7,639,113	12,679,571
In compounds .... do	270,789	267,033	500,859	788,352	192,696	319,875
Chromite .... short tons	4,107	105,041	948	(4)	3,619	(4)
Cobalt .... pounds	506,884	(4)	(4)	(4)	(4)	(4)
Copper (smelter output from domestic ores) .... short tons	599,656	[5] 172,701,000	862,872	[5] 360,680,000	842,477	[5] 365,635,000
Ferro-alloys .... do	1,551,624	176,273,655	1,841,682	220,021,974	1,952,246	273,450,420
Gold (mint output) [6] .... troy ounces	1,462,354	51,182,390	2,165,318	75,786,130	2,025,480	70,891,800
Indium .... do	9,667	16,618	13,908	23,901	12,202	16,741
Iron:						
Ore [7] .... long tons (2,240 pounds)	70,090,410	[7] 215,006,427	93,314,635	[7] 320,864,981	100,821,714	[7] 394,460,751
Pig .... short tons	45,075,890	1,103,928,986	58,367,510	1,770,658,663	60,051,350	2,232,121,837
Lead (refinery output from domestic ores) .... do	293,309	[5] 49,276,000	381,109	[5] 108,997,000	339,413	[5] 121,510,000
Magnesium (new ingot) .... do	8,916	3,654,164	5,264	(4)	8,489	3,480,496
Manganese ore (35 percent or more Mn) .... do	143,635	4,811,068	131,627	4,200,947	131,100	4,390,199
Manganiferous ore (5 to 35 percent Mn) .... do	1,171,183	3,126,711	1,174,355	3,447,149	1,340,565	(4)
Mercury .... flasks (76 pounds net)	25,348	2,490,188	23,244	1,946,453	14,388	1,100,538
Molybdenum .... pounds	16,786,600	11,529,000	22,189,800	15,178,000	29,669,000	20,418,000
Nickel .... short tons	352	(4)	646	(4)	883	(4)
Ores (crude), old tailings, etc.:						
Copper .... do	61,741,000	(8)	87,633,000	(8)	84,120,000	(8)
Dry and siliceous (gold and silver) .... do	2,995,000	(8)	4,235,000	(8)	4,202,000	(8)
Lead .... do	5,651,000	(8)	6,165,000	(8)	5,866,000	(8)
Lead-copper .... do	144,000	(8)	183,000	(8)	208,000	(8)
Zinc .... do	14,895,000	(8)	10,045,000	(8)	6,798,000	(8)
Zinc-copper .... do	654,000	(8)	350,000	(8)	710,000	(8)
Zinc-lead .... do	12,730,000	(8)	12,530,000	(8)	10,668,000	(8)
Zinc-lead-copper .... do	12,000	(8)	11,000	(8)	152,000	(8)
Platinum metals (refined) (value at New York City) .... troy ounces	30,237	1,802,000	17,442	990,000	17,067	1,239,000
Radium .... milligrams	200	3,700	16,400	303,400	3,510	63,180
Selenium .... pounds	405,226	(4)	489,415	(4)	570,718	(4)
Silver (mint output) [9] .... troy ounces	21,103,269	19,099,524	38,587,069	34,923,246	39,228,468	35,503,744
Tantalum concentrates .... pounds	3,475	8,793	3,259	8,677	500	(4)
Tellurium .... do	38,523	(4)	71,300	(4)	78,788	(4)
Tin (metal content of ore) .... short tons	--------	--------	1	2,200	6	12,780

Titanium concentrates:						
Ilmenite ... do	282,708	4,878,917	336,061	5,029,490	381,508	5,793,973
Rutile ... do	7,514	996,989	5,157	533,548	9,907	647,334
Tungsten concentrates ... short tons (60 percent WO_3 basis)	5,193	6,283,413	3,094	4,349,851	4,005	6,312,161
Vanadium ... pounds	1,272,148	710,582	2,117,962	1,285,026	(4)	(4)
Zinc (smelter output from domestic ores) ... short tons	459,205	[5] 81,738,000	510,058	[5] 109,152,000	537,966	[5] 143,099,000
Other metallic [10]		1,851,846		2,636,551		3,235,659
Total value of metallic products (approximate)		1,825,000,000		2,909,000,000		3,510,000,000
NONMETALLIC						
Arsenious oxide (white arsenic) ... short tons	12,039	655,077	18,188	1,533,756	15,516	1,267,603
Asbestos ... do	14,075	504,764	24,035	918,558	37,092	1,806,261
Asphalt:						
Native ... do	845,898	4,262,886	1,071,922	5,503,048	1,136,126	5,025,630
Oil (including road oil) [7] ... do	7,056,882	[7] 82,910,877	8,165,631	[7] 116,002,372	8,006,196	[7] 149,168,720
Barite (crude) ... do	724,362	5,242,755	834,082	6,171,342	799,848	6,693,413
Boron minerals ... do	430,689	9,575,866	501,935	11,844,108	450,932	11,147,735
Bromine ... pounds	42,780,925	8,560,434	78,177,650	14,837,104	76,047,551	14,844,152
Calcium-magnesium chloride ... short tons	262,147	2,278,954	271,206	2,650,205	301,936	3,902,788
Cement ... barrels (376 pounds net)	172,100,699	296,551,514	190,419,754	361,978,374	207,679,797	453,412,362
Clay:						
Products, heavy clay (other than pottery and refractories)		[11] 178,756,000		[11] 219,004,000		[11] 268,081,000
Raw (sold or used) ... short tons	[12] 30,265,194	[12] 57,160,315	[12] 33,270,405	[12] 69,612,873	[12] 37,385,900	[12] 80,074,421
Coal:						
Bituminous [13] ... do	533,922,068	1,835,539,476	630,623,722	2,622,634,946	594,000,000	2,941,417,000
Pennsylvania anthracite ... do	60,506,873	413,417,070	57,190,009	413,019,486	57,139,948	467,051,800
Coke [7] ... do	58,497,848	[7] 486,729,382	73,445,850	[7] 776,405,520	74,861,928	[7] 928,281,854
Diatomite ... do	(14)	(14)	(14)	(14)	(14)	(14)
Emery ... do	6,188	62,099	5,798	66,927	5,405	69,408
Feldspar (crude) ... long tons	508,380	2,594,099	459,910	2,410,940	460,713	2,564,387
Flint lining for tube mills ... short tons	2,375	44,247	1,496	40,303	1,297	41,555
Fluorspar ... do	277,940	9,038,969	329,484	10,954,875	331,749	11,227,452
Fuller's earth ... do	298,752	3,702,993	329,068	4,660,614	342,081	5,273,851
Garnet for abrasive purposes ... do	7,743	570,186	8,722	614,071	8,039	587,797
Gem stones		(15)		(15)		(15)
Graphite (amorphous and crystalline) ... short tons	4,844	252,596	5,207	221,260	9,871	450,759
Grindstones and pulpstones ... do	11,677	505,324	10,696	481,787	7,954	404,767
Gypsum (crude) ... do	5,629,398	12,441,829	6,208,216	16,529,884	7,254,535	19,112,669
Helium [16] ... cubic feet	63,403,345	478,654	63,198,650	541,307	67,486,567	641,848
Iodine ... pounds	(14)	(14)	(14)	(14)	(14)	(14)
Kyanite ... short tons	(14)	(14)	(14)	(14)	(14)	(14)
Lime ... do	5,992,700	51,032,517	6,778,979	63,826,387	7,263,976	75,162,879
Lithium minerals ... do	3,065	303,892	2,441	151,113	3,191	185,952
Magnesite (crude) ... do	324,640	2,225,850	375,993	2,596,747	(14)	(14)
Magnesium compounds [17] ... short tons (MgO equivalent)	215,372	8,316,300	155,713	9,529,000	165,800	11,467,000
Marl:						
Calcareous ... short tons	213,448	248,530	176,187	235,190	114,759	145,712
Greensand ... do	5,140	424,900	8,337	432,980	7,269	392,959

See footnotes at end of table.

Mineral products of the United States, 1946–48 [1]—Continued

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
NONMETALLIC—continued						
Mica:						
Scrap ..... short tons	53,602	$1,041,423	49,797	$1,095,578	52,157	$1,091,698
Sheet ..... pounds	1,078,867	217,955	415,589	116,110	270,042	45,940
Millstones	------	14,780	------	23,189	------	17,733
Mineral pigments:						
Natural pigments and manufactured iron oxide pigments ..... short tons	115,097	10,004,150	115,367	11,167,161	111,317	10,957,422
Zinc and lead pigments [18] ..... do	[18] 225,822	[18] 32,354,517	[18] 242,230	[18] 46,508,398	[18] 218,399	[18] 49,411,004
Mineral waters	(15)	(15)	(15)	(15)	(15)	(15)
Natural gas (valued at point of consumption) ..... M cubic feet	4,030,605,000	885,878,000	[19] 4,444,693,000	[19] 1,032,200,000	[19] 4,963,853,000	[19] 1,197,550,000
Natural gasoline and allied products:						
Natural gasoline and cycle products ..... gallons	3,451,688,000	146,202,000	3,659,449,000	228,174,000	3,929,429,000	351,576,000
Liquefied petroleum gases ..... do	1,409,345,000	36,079,000	1,891,818,000	66,820,000	2,180,698,000	112,042,000
Oilstones, etc. ..... short tons	(14)	(14)	(14)	(14)	(14)	(14)
Olivine ..... do	7,649	92,868	10,838	129,094	4,766	86,230
Peat ..... do	140,707	1,006,231	136,232	868,979	129,581	929,560
Pebbles for grinding ..... do	4,652	102,043	5,860	122,883	4,026	101,583
Perlite (crude or refined) (sales) ..... do	3,022	46,103	9,265	94,309	9,868	184,306
Petroleum ..... barrels (42 gallons)	1,733,939,000	2,442,550,000	1,856,987,000	3,577,890,000	2,016,282,000	5,196,034,000
Phosphate rock ..... long tons	6,860,713	31,043,821	9,027,030	46,638,837	8,668,769	50,501,598
Potassium salts ..... short tons (K_2O equivalent)	928,374	32,175,716	1,053,266	34,716,051	1,143,339	35,998,758
Pumice ..... short tons	319,883	1,585,753	442,552	2,021,880	607,746	2,501,906
Pyrites ..... long tons	813,372	3,228,000	940,652	4,070,000	928,531	3,950,000
Quartz ..... short tons	73,179	293,852	101,317	424,525	161,861	750,667
Salt (sodium chloride) ..... do	15,132,145	44,912,586	16,053,882	52,191,688	16,403,293	54,331,782
Sand and gravel:						
Glass sand ..... do	4,848,602	9,541,405	5,321,247	11,395,245	4,542,260	10,770,845
Sand (molding, building, etc.) and gravel ..... do	249,282,000	161,845,000	282,338,000	205,474,000	314,724,000	241,727,000
Sand and sandstone (ground) ..... do	575,888	4,125,398	651,120	5,181,113	702,572	5,814,664
Slate ..... do	759,770	8,844,106	876,010	11,685,554	799,400	12,880,929
Sodium carbonate (natural) ..... do	215,625	3,427,086	293,051	5,862,178	[20] 288,769	[20] 6,623,280
Sodium sulfate (natural) ..... do	198,781	1,695,413	257,294	3,329,094	265,862	4,248,613
Stone [21] ..... do	178,852,360	234,339,486	207,554,790	289,344,482	225,535,390	328,984,571
Strontium minerals ..... do	243	3,726	------	------	------	------
Sulfur ..... long tons	4,128,212	66,100,000	4,828,103	85,200,000	4,978,912	89,600,000
Sulfuric acid (basis, 100 percent) (byproduct) [22] ..... short tons	716,216	8,226,751	725,197	9,178,402	641,445	8,584,051
Sulfur ore ..... long tons	6,344	95,531	4,303	65,124	1,700	30,220
Talc, pyrophyllite, and ground soapstone [23] ..... short tons	457,066	6,445,344	516,094	7,682,481	518,746	8,265,363
Topaz, industrial ..... do	700	10,500	2,294	45,873	200	4,000
Tripoli ..... do	28,955	549,099	34,578	751,422	26,845	705,523

Vermiculite ... do	86,390	867,973	131,385	1,338,572	138,635	1,387,233
Other nonmetallic [24]		(14)		(14)		(14)
Total value of nonmetallic products (approximate)		7,071,000,000		9,575,000,000		12,160,000,000
SUMMARY						
Total value:						
Metallic		1,825,000,000		2,909,000,000		3,510,000,000
Nonmetallic:						
Fuels		5,760,000,000		7,941,000,000		10,266,000,000
Other		1,311,000,000		1,634,000,000		1,894,000,000
Grand total approximate value of mineral products		8,896,000,000		12,484,000,000		15,670,000,000

1 In this general statement most of the figures represent shipments rather than quantity mined, and some of the figures for 1948 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 Value included in total value of metallic products; Bureau of Mines not at liberty to publish figure.

5 Value does not include premiums paid to miners by the Government. Total over-ceiling payments for copper, lead, and zinc amounted to approximately $77,000,000 in 1946, and $21,000,000 in 1947. In addition, exploration premiums totaling $6,213,545 were paid to miners from July 1, 1946, through Dec. 31, 1947, to encourage exploration and development of copper, lead, and zinc deposits.

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

7 Value not included in total value.

8 Value figure not available.

9 According to Bureau of the Mint.

10 Includes value of bismuth, columbium (1948), germanium, thallium, and zircon.

11 Figures obtained through cooperation with Bureau of the Census.

12 Value of clay used in cement and heavy clay products is included here but is not included in total value of nonmetallic products.

13 Includes brown coal and lignite, and anthracite mined elsewhere than in Pennsylvania.

14 Value included in total value of nonmetallic products. Bureau of Mines not at liberty to publish figure.

15 No canvass. Estimate of value included in total value of nonmetallic products.

16 Figures cover fiscal year ended June 30 of year stated.

17 Includes compounds from raw sea water, well brines, sea-water bitterns, brucite, and serpentine only. Data for 1946 are not quite comparable with 1947–48 in that the former are on a gross-weight basis and include some compounds made from a combination of sea water and dolomite, and of well brines and dolomite.

18 Includes sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide except that in 1946–48 data for sublimed blue and white lead are excluded from this grouping; however, the value is included in the total value of nonmetallic products.

19 Estimate.

20 Excludes production from Wyoming; value is included in total value of nonmetallic products.

21 Excludes limestone for cement and lime.

22 From copper, lead, and zinc smelters and zinc roasters.

23 Figures for soapstone used as dimension stone included in figures for stone.

24 Includes andalusite (1947–48), crude aplite, monazite (1948), and wollastonite.

Value of mineral products of the United States, 1944–48, by States [1]

State	1944	1945	1946	1947	1948
Alabama	$109,149,000	$110,360,000	$123,029,000	$162,663,000	$182,987,000
Alaska	6,903,000	10,174,000	12,426,000	18,458,000	13,201,000
Arizona	115,592,000	98,574,000	118,086,000	186,767,000	201,244,000
Arkansas	64,079,000	58,257,000	65,985,000	92,289,000	123,138,000
California	506,216,000	515,214,000	592,294,000	859,039,000	1,174,674,000
Colorado	79,137,000	77,236,000	77,573,000	104,828,000	129,326,000
Connecticut	4,496,000	3,498,000	5,584,000	5,677,000	6,745,000
Delaware	182,000	131,000	491,000	613,000	717,000
District of Columbia	111,000	229,000	710,000	746,000	835,000
Florida	21,896,000	24,928,000	31,093,000	45,924,000	53,877,000
Georgia	19,005,000	19,988,000	30,449,000	37,037,000	42,662,000
Idaho	51,321,000	44,348,000	44,444,000	66,941,000	79,330,000
Illinois	329,147,000	330,184,000	358,628,000	436,770,000	523,422,000
Indiana	89,760,000	88,802,000	107,479,000	143,298,000	166,803,000
Iowa	22,452,000	25,008,000	35,957,000	38,951,000	45,129,000
Kansas	170,560,000	166,644,000	194,563,000	267,046,000	363,362,000
Kentucky	250,735,000	250,919,000	272,558,000	428,507,000	506,249,000
Louisiana	217,733,000	222,413,000	273,882,000	405,576,000	593,403,000
Maine	2,150,000	2,521,000	4,389,000	6,049,000	8,482,000
Maryland	15,264,000	15,329,000	21,991,000	26,125,000	27,922,000
Massachusetts	5,263,000	5,450,000	9,745,000	11,859,000	13,844,000
Michigan	140,520,000	127,869,000	133,310,000	169,597,000	205,954,000
Minnesota	170,488,000	167,138,000	155,734,000	219,685,000	268,813,000
Mississippi	18,675,000	21,370,000	33,672,000	68,986,000	119,635,000
Missouri	72,890,000	74,347,000	88,357,000	107,878,000	113,506,000
Montana	82,290,000	68,829,000	62,114,000	88,231,000	103,125,000
Nebraska	5,060,000	4,963,000	7,277,000	7,405,000	9,432,000
Nevada	51,800,000	31,307,000	35,454,000	42,639,000	45,110,000
New Hampshire	1,164,000	802,000	1,451,000	1,574,000	1,732,000
New Jersey	33,828,000	31,267,000	33,518,000	44,245,000	51,092,000
New Mexico	112,180,000	104,234,000	111,938,000	157,652,000	221,022,000
New York	84,286,000	88,678,000	103,571,000	130,667,000	156,140,000
North Carolina	22,199,000	14,766,000	20,428,000	23,754,000	27,885,000
North Dakota	4,334,000	4,505,000	5,118,000	6,330,000	8,581,000
Ohio	174,582,000	179,682,000	221,356,000	291,960,000	328,228,000
Oklahoma	225,833,000	243,314,000	263,282,000	355,750,000	503,654,000
Oregon	9,657,000	9,463,000	11,807,000	16,573,000	24,871,000
Pennsylvania	962,208,000	913,232,000	1,074,004,000	1,269,762,000	1,407,347,000
Rhode Island	612,000	508,000	561,000	785,000	1,450,000
South Carolina	4,192,000	5,043,000	8,189,000	10,362,000	12,105,000
South Dakota	5,471,000	7,137,000	18,389,000	23,604,000	24,296,000
Tennessee	63,994,000	58,672,000	68,031,000	85,664,000	95,863,000
Texas	1,133,756,000	1,150,597,000	1,313,003,000	1,954,351,000	2,809,071,000
Utah	148,308,000	127,961,000	95,506,000	206,970,000	204,752,000
Vermont	7,672,000	8,249,000	12,096,000	14,818,000	16,132,000
Virginia	86,951,000	81,965,000	90,823,000	133,953,000	157,724,000
Washington	36,483,000	31,301,000	33,029,000	39,924,000	50,498,000
West Virginia	547,851,000	537,212,000	588,925,000	862,980,000	1,008,299,000
Wisconsin	22,798,000	22,217,000	28,596,000	34,942,000	37,641,000
Wyoming	68,034,000	74,620,000	78,745,000	117,594,000	172,818,000

[1] ... iron ore ... iron, is taken as the basis of iron valuation.

Mineral products of the United States and principal producing States in 1948 [1]

Rank in value	Product	Principal producing States [2]: In order of quantity	Principal producing States [2]: In order of value
14	Aluminum	Washington, Tennessee, New York, Oregon	Rank same as for quantity.
100	Andalusite	Nevada	Do.
(3)	Antimonial lead	Not separable by States	Not separable by States.
48	Antimony ore	Idaho, Nevada, Alaska, California	Rank same as for quantity.
81	Aplite (crude)	Virginia	Do.
62	Arsenious oxide	Not separable by States	Not separable by States.
58	Asbestos	Vermont, Arizona, Georgia, California	Rank same as for quantity.
	Asphalt:		
46	Native	Texas, Kentucky, Alabama, Oklahoma	Texas, Utah, Kentucky, Oklahoma..
15	Oil	Not separable by States	Not separable by States.
40	Barite (crude)	Arkansas, Missouri, Georgia, Nevada	Rank same as for quantity.
36	Bauxite	Arkansas, Georgia, Alabama	Do.
96	Beryllium concentrates	South Dakota, New Hampshire, Colorado, Maine	New Hampshire, South Dakota, Colorado, Maine.
54	Bismuth	Not separable by States	Not separable by States.
34	Boron minerals	California	Rank same as for quantity.
29	Bromine	Texas, Michigan, California, West Virginia	Texas, Michigan, West Virginia, California.
30	Cadmium	Not separable by States	Not separable by States.
52	Calcium-magnesium chloride	Michigan, West Virginia, California, Ohio	Michigan, California, West Virginia, Ohio.
6	Cement	Pennsylvania, California, Texas, New York	Rank same as for quantity.
88	Chromite	Oregon, California	Do.
	Clay:		
12	Products, heavy clay (other than pottery and refractories).		Ohio, Pennsylvania, California, Illinois.
19	Raw (sold or used by producers)	Ohio, Pennsylvania, California, Illinois	Georgia, Pennsylvania, Ohio, Missouri.
2	Coal:		
	Bituminous	West Virginia, Pennsylvania, Kentucky, Illinois	Rank same as for quantity.
	Pennsylvania anthracite	Pennsylvania	Do.
78	Cobalt	do	Do.
4	Coke	Pennsylvania, Ohio, Indiana, Alabama	Pennsylvania, Ohio, Indiana, New York.
105	Columbium ores	Maine	Rank same as for quantity.
8	Copper	Arizona, Utah, New Mexico, Montana	Do.
44	Diatomite	California, Oregon, Nevada, Washington	Do.
91	Emery	New York	Do.
55	Feldspar (crude)	North Carolina, Colorado, South Dakota, New Hampshire	North Carolina, New Hampshire, South Dakota, Colorado.
11	Ferro-alloys	Pennsylvania, New York, Ohio, West Virginia	Pennsylvania, New York, West Virginia, Ohio.
93	Flint lining for tube mills	Minnesota, Wisconsin, North Carolina	Rank same as for quantity.
33	Fluorspar	Illinois, Kentucky, Colorado, New Mexico	Illinois, Kentucky, New Mexico, Colorado.
45	Fuller's earth	Georgia, Texas, Florida, Illinois	Rank same as for quantity.
74	Garnet (abrasive)	New York, Idaho	Do.
(4)	Gem stones	No canvass for 1948	No canvass for 1948.
89	Germanium	Not separable by States	Not separable by States.
21	Gold	California, South Dakota, Utah, Alaska	Rank same as for quantity.
76	Graphite:		
	Amorphous	Rhode Island	Do.
	Crystalline	Texas, Alabama	Do.
79	Grindstones and pulpstones	Ohio, West Virginia, Washington	Do.

See footnotes at end of table.

Mineral products of the United States and principal producing States in 1948 [1]—Continued

Rank in value	Product	Principal producing States [2]	
		In order of quantity	In order of value
28	Gypsum (crude)	Michigan, New York, California, Texas	Rank same as for quantity.
73	Helium	Texas	Do.
98	Indium	Not separable by States	Not separable by States.
60	Iodine (natural)	California	Rank same as for quantity.
	Iron:		
7	Ore	Minnesota, Michigan, Alabama, Utah	Minnesota, Michigan, Alabama, New York.
3	Pig	Pennsylvania, Ohio, Indiana, Illinois	Rank same as for quantity.
75	Kyanite	Virginia, Georgia, South Carolina	Do.
17	Lead	Missouri, Idaho, Utah, Arizona	Do.
20	Lime	Ohio, Pennsylvania, Missouri, West Virginia	Do.
82	Lithium minerals	South Dakota, California, Maine	California, South Dakota, Maine.
56	Magnesite (crude)	Washington, Nevada, California	Rank same as for quantity.
53	Magnesium	Texas	Do.
32	Magnesium compounds (natural)	Nevada, California, Michigan, Texas	Michigan, Nevada, California, Texas.
47	Manganese ore	Montana, Virginia, Arizona, Arkansas	Rank same as for quantity.
49	Manganiferous ore	Minnesota, New Mexico, Nevada, Montana	Do.
66	Manganiferous zinc residuum	New Jersey	Do.
	Marl:		
85	Calcareous	Virginia, West Virginia, Indiana, Minnesota	Virginia, Nevada, West Virginia, Indiana.
80	Greensand	New Jersey	Rank same as for quantity.
65	Mercury	California, Oregon, Nevada, Idaho	Do.
64	Mica	North Carolina, Colorado, South Dakota, Georgia	Do.
	Scrap	do	Do.
	Sheet	North Carolina, New Mexico, Georgia	Do.
97	Millstones		North Carolina, New York, Virginia.
	Mineral pigments:		
35	Natural pigments and manufactured iron oxide pigments.	Pennsylvania, Illinois, New Jersey, Virginia	Pennsylvania, Illinois, New Jersey, Ohio.
23	Lead and zinc pigments	Pennsylvania, Kansas, Illinois, Ohio	Rank same as for quantity.
([4])	Mineral waters	No canvass for 1948	No canvass for 1948.
27	Molybdenum	Utah, Colorado, New Mexico, California	Rank same as for quantity.
101	Monazite sand	Idaho	Do.
9	Natural gas [5]	Texas, Louisiana, California, Oklahoma	Texas, California, West Virginia, Louisiana.
5	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.
71	Nickel	Not separable by States	Not separable by States.
84	Oilstones, etc	Arkansas, Indiana, Ohio, New Hampshire	Arkansas, New Hampshire, Indiana, Ohio.
90	Olivine	North Carolina, Washington	Rank same as for quantity.
([6])	Ores (crude), etc.:		
	Copper	Arizona, Utah, New Mexico, Nevada	Value not available.
	Dry and siliceous (gold and silver)	South Dakota, Idaho, Nevada, Colorado	Do.
	Lead	Missouri, Idaho, Oklahoma, Colorado	Do.
	Lead-copper	Missouri, Arizona, New Mexico, Nevada	Do.
	Zinc	Oklahoma, Kansas, Tennessee, New Jersey	Do.
	Zinc-copper	Washington, Arizona	Do.
	Zinc-lead	Idaho, Oklahoma, Montana, Utah	Do.
	Zinc-lead-copper	Colorado, Arizona, Utah	Do.

68	Peat	Florida, New Jersey, Ohio, Michigan	New Jersey, Ohio, Michigan, Illinois.
87	Pebbles for grinding	Minnesota, Wisconsin, Texas, North Carolina	Rank same as for quantity.
83	Perlite (crude or refined)	Oregon, Colorado, Arizona, California	Oregon, Arizona, Colorado, Pennsylvania.
1	Petroleum	Texas, California, Louisiana, Oklahoma	Rank same as for quantity.
24	Phosphate rock	Florida, Tennessee, Idaho, Montana	Do.
63	Platinum metals	Alaska, California	Do.
25	Potassium salts	New Mexico, California, Utah, Michigan	Do.
57	Pumice	California, New Mexico, Oregon, Idaho	Do.
51	Pyrites	Tennessee, Virginia, California, Colorado	Do.
69	Quartz	Washington, North Carolina, California, Wisconsin	Washington, North Carolina, California, Arizona.
92	Radium	Colorado, Utah, Arizona	Rank same as for quantity.
22	Salt	Michigan, New York, Ohio, Louisiana	Michigan, New York, Louisiana, Ohio.
13	Sand and gravel	California, Michigan, Wisconsin, Illinois	California, Pennsylvania, Ohio, Illinois.
67	Selenium	Not separable by States	Not separable by States.
42	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.
31	Slate		Pennsylvania, Vermont, New York, Virginia.
39	Sodium carbonates (natural)	California, Wyoming	Rank same as for quantity.
50	Sodium sulfates (natural)	California, Texas, Wyoming	Do.
10	Stone	Pennsylvania, Ohio, Michigan, Illinois	Pennsylvania, Ohio, Illinois, New York.
18	Sulfur	Texas, Louisiana	Rank same as for quantity.
37	Sulfuric acid from copper, lead, and zinc smelters and zinc roasters.	Pennsylvania, Illinois, Indiana, Utah	Do.
95	Sulfur ore	Colorado, Texas, Nevada, California	Colorado, Nevada, Texas, California.
38	Talc, pyrophyllite and ground soapstone [7]	New York, North Carolina, California, Vermont	New York, California, North Carolina, Vermont.
104	Tantalum concentrates	South Dakota	Rank same as for quantity.
86	Tellurium	Not separable by States	Not separable by States.
94	Thallium	do	Do.
99	Tin	Alaska, South Dakota	Rank same as for quantity.
	Titanium concentrates:		
43	Ilmenite	New York, Florida, Virginia, North Carolina	New York, Virginia, Florida, North Carolina.
72	Rutile	Florida, Virginia	Rank same as for quantity.
102	Topaz (industrial)	South Carolina	Do.
70	Tripoli	Missouri, Illinois, Pennsylvania	Do.
41	Tungsten concentrates	California, North Carolina, Nevada, Colorado	California, Nevada, North Carolina, Colorado.
59	Vanadium	Colorado, Idaho, Utah, New Mexico	Rank same as for quantity.
61	Vermiculite	Montana, South Carolina, North Carolina, Wyoming	Do.
103	Wollastonite	New York	Do.
16	Zinc	Idaho, New Jersey, Montana, Arizona	Do.
77	Zircon	Florida	Do.

[1] Revisions in the corresponding table for 1947, published in Minerals Yearbook, 1947, pages 29–32, are as follows:

Rank in value (original rank shown in parentheses): Aplite 77 (76), iodine 62 (63), kyanite 78 (77), magnesium 54 (55), magnesium compounds 35 (37), natural gasoline and allied products 8 (9), platinum metals 63 (64), pumice 55 (54), selenium 64 (62), silica, quartz 76 (78), sodium salts 36 (35), stone 9 (8), and sulfuric acid 37 (36).

Principal producing States in order of quantity: Magnesium compounds—Nevada, California, Michigan, and Texas. Silica (quartz)—North Carolina, Washington, California, and Wisconsin.

Principal producing States in order of value: Magnesium compounds—Michigan, California, Nevada, and Texas. Silica (quartz)—North Carolina, California, Washington, and Arizona.

[2] Rank of States in metal production (except aluminum, ferro-alloys, and pig iron) arranged according to mine reports, not smelter output.

[3] Separate figures for antimonial lead from primary sources not available.

[4] No canvass for 1948.

[5] The rank of natural gas in this table (in contrast to corresponding tables in editions prior to Minerals Yearbook, 1947) is based on value at wells rather than value at points of consumption.

[6] Value not available.

[7] Exclusive of soapstone used as dimension stone (all from Virginia), which is included in figures for stone.

States and their principal mineral products in 1947[1]

State	Rank	Percent of total value for United States	Principal mineral products in order of value
Alabama	15	1.65	Coal, iron ore, cement, clay products.
Alaska	38	.19	Gold, sand and gravel, coal, stone.
Arizona	13	1.90	Copper, zinc, lead, silver.
Arkansas	23	.94	Petroleum, coal, bauxite, natural gasoline.
California	4	8.73	Petroleum, natural gas, natural gasoline, cement.
Colorado	22	1.07	Petroleum, coal, zinc, molybdenum.
Connecticut	46	.06	Clay products, stone, sand and gravel, lime.
Delaware	50	.01	Clay products, sand and gravel, stone.
District of Columbia	49	.01	Clay products, raw clay.
Florida	28	.47	Phosphate rock, stone, cement, sand and gravel.
Georgia	33	.38	Raw clay, stone, clay products, cement.
Idaho	27	.68	Lead, zinc, silver, phosphate rock.
Illinois	5	4.44	Coal, petroleum, stone, cement.
Indiana	17	1.46	Coal, cement, petroleum, stone.
Iowa	32	.40	Cement, clay products, stone, coal.
Kansas	10	2.72	Petroleum, cement, natural gas, zinc.
Kentucky	6	4.36	Coal, petroleum, natural gas, stone.
Louisiana	7	4.12	Petroleum, natural gasoline, natural gas, sulfur.
Maine	45	.06	Cement, stone, sand and gravel, slate.
Maryland	35	.27	Coal, sand and gravel, cement, clay products.
Massachusetts	41	.12	Stone, sand and gravel, clay products, lime.
Michigan	14	1.72	Iron ore, petroleum, cement, salt.
Minnesota	11	2.23	Iron ore, sand and gravel, stone, manganiferous ore.
Mississippi	26	.70	Petroleum, natural gas, sand and gravel, clay products.
Missouri	21	1.10	Lead, cement, coal, stone.
Montana	24	.90	Copper, petroleum, zinc, coal.
Nebraska	43	.07	Cement, sand and gravel, clay products, stone.
Nevada	30	.43	Copper, zinc, gold, tungsten ore.
New Hampshire	47	.02	Sand and gravel, stone, clay products, feldspar.
New Jersey	29	.45	Zinc, clay products, sand and gravel, stone.
New Mexico	16	1.60	Petroleum, potassium salts, copper, zinc.
New York	19	1.33	Cement, petroleum, iron ore, stone.
North Carolina	36	.24	Clay products, stone, sand and gravel, talc and pyrophyllite.
North Dakota	44	.06	Coal, sand and gravel, clay products, natural gas.
Ohio	9	2.97	Coal, clay products, stone, lime.
Oklahoma	8	3.62	Petroleum, natural gasoline, natural gas, coal.
Oregon	39	.17	Sand and gravel, stone, cement, clay products.
Pennsylvania	2	12.91	Coal, cement, petroleum, stone.
Rhode Island	48	.01	Stone, sand and gravel, graphite.
South Carolina	42	.10	Stone, clay products, raw clay, sand and gravel.
South Dakota	37	.24	Gold, stone, raw clay, sand and gravel.
Tennessee	25	.87	Coal, cement, stone, phosphate rock.
Texas	1	19.87	Petroleum, natural gasoline, natural gas, sulfur.
Utah	12	2.10	Copper, coal, gold, lead.

Vermont	40	.15	Stone, slate, talc, copper.
Virginia	18	1.36	Coal, stone, zinc, clay products.
Washington	31	.41	Cement, coal, sand and gravel, stone.
West Virginia	3	8.78	Coal, natural gas, petroleum, natural gasoline.
Wisconsin	34	.35	Stone, sand and gravel, iron ore, zinc.
Wyoming	20	1.20	Petroleum, coal, natural gasoline, raw clay.

[1] In this table iron ore, not pig iron, is taken as the basis of iron valuation. The rank of natural gas in this table (in contrast to corresponding tables in editions before Minerals Yearbook, 1947) is based on value at wells rather than at points of consumption.

States and their principal mineral products in 1948 [1]

State	Rank	Percent of total value for United States	Principal mineral products in order of value
Alabama	16	1.47	Coal, iron ore, cement, clay products.
Alaska	41	.11	Gold, coal, platinum metals, sand and gravel.
Arizona	15	1.62	Copper, zinc, lead, silver.
Arkansas	22	.99	Petroleum, coal, bauxite, natural gasoline.
California	3	9.44	Petroleum, natural gasoline, natural gas, cement.
Colorado	21	1.04	Petroleum, coal, zinc, molybdenum.
Connecticut	46	.05	Clay products, stone, sand and gravel, lime.
Delaware	50	.01	Clay products, sand and gravel, stone, raw clay.
District of Columbia	49	.01	Clay products, raw clay.
Florida	28	.43	Phosphate rock, stone, cement, sand and gravel.
Georgia	33	.34	Raw clay, stone, clay products, cement.
Idaho	27	.64	Lead, zinc, silver, antimony ore.
Illinois	6	4.21	Coal, petroleum, stone, clay products.
Indiana	18	1.34	Coal, cement, petroleum, stone.
Iowa	31	.36	Cement, clay products, stone, coal.
Kansas	9	2.92	Petroleum, cement, natural gas, coal.
Kentucky	7	4.07	Coal, petroleum, natural gas, stone.
Louisiana	5	4.77	Petroleum, natural gasoline, natural gas, sulfur.
Maine	45	.07	Cement, sand and gravel, stone, clay products.
Maryland	35	.22	Coal, sand and gravel, cement, clay products.
Massachusetts	40	.11	Stone, sand and gravel, clay products, lime.
Michigan	13	1.65	Iron ore, petroleum, cement, salt.
Minnesota	11	2.16	Iron ore, stone, sand and gravel, manganiferous ore.
Mississippi	23	.96	Petroleum, natural gas, clay products, natural gasoline.
Missouri	24	.91	Lead, cement, coal, stone.
Montana	25	.83	Copper, petroleum, zinc, lead.
Nebraska	43	.08	Cement, sand and gravel, clay products, stone.
Nevada	32	.36	Copper, zinc, gold, lead.
New Hampshire	47	.01	Sand and gravel, clay products, feldspar, stone.
New Jersey	29	.41	Zinc, clay products, sand and gravel, stone.
New Mexico	12	1.78	Petroleum, copper, potassium salts, zinc.
New York	20	1.25	Cement, iron ore, petroleum, stone.
North Carolina	36	.22	Clay products, stone, sand and gravel, talc and pyrophyllite.

See footnote at end of table.

States and their principal mineral products in 1948 [1]—Continued

State	Rank	Percent of total value for United States	Principal mineral products in order of value
North Dakota	44	0.07	Coal (lignite), sand and gravel, clay products, natural gas.
Ohio	10	2.64	Coal, clay products, stone, lime.
Oklahoma	8	4.05	Petroleum, natural gasoline, natural gas, coal.
Oregon	37	.20	Sand and gravel, stone, cement, clay products.
Pennsylvania	2	11.31	Coal, cement, petroleum, stone.
Rhode Island	48	.01	Sand and gravel, stone, graphite.
South Carolina	42	.10	Stone, clay products, raw clay, vermiculite.
South Dakota	38	.19	Gold, stone, sand and gravel, raw clay.
Tennessee	26	.77	Coal, cement, stone, phosphate rock.
Texas	1	22.57	Petroleum, natural gasoline, natural gas, sulfur.
Utah	14	1.65	Copper, coal, lead, gold.
Vermont	39	.13	Stone, slate, asbestos, talc.
Virginia	19	1.27	Coal, stone, cement, clay products.
Washington	30	.41	Cement, coal, sand and gravel, stone.
West Virginia	4	8.10	Coal, natural gas, petroleum, natural gasoline.
Wisconsin	34	.30	Stone, sand and gravel, iron ore, cement.
Wyoming	17	1.39	Petroleum, coal, natural gasoline, raw clay.

[1] In this table iron ore, not pig iron, is taken as the basis of iron valuation. The rank of natural gas in this table (in contrast to corresponding tables in editions before Minerals Yearbook, 1947) is based on value at wells rather than at points of consumption.

STATE TABLES

Mineral products of the United States, 1946–48, by States

ALABAMA

Product	1946 Quantity	1946 Value	1947 Quantity	1947 Value	1948 Quantity	1948 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 ..... long tons (dried equivalent)	(1)	(1)	(1)	(1)	(1)	(1)
Cement ..... barrels	[3] 8,071,979	[3] $13,120,084	[3] 9,509,697	[3] $16,663,543	[3] 9,948,600	[3] $20,140,177
Clay:						
Products, heavy clay (other than pottery and refractories)	------	[4] 4,419,000	------	[4] 5,089,000	------	[4] 5,600,000
Raw (sold or used) ..... short tons	[5] 1,064,000	[5] 1,073,052	[5] 1,135,386	[5] 1,096,414	[5] 1,260,149	[5] 1,260,059
Coal ..... do	16,183,298	77,867,999	19,048,225	104,303,456	18,040,000	109,864,000
Coke ..... do	4,665,939	[2] 32,669,886	5,869,738	[2] 47,086,856	6,015,460	[2] 57,611,881
Ferro-alloys ..... do	137,042	[2] 14,510,937	132,603	[2] 15,030,000	129,615	[2] 16,817,011
Gold ..... troy ounces	1	35	------	------	------	------
Graphite, crystalline ..... pounds	(1)	(1)	(1)	(1)	(1)	(1)
Iron:						
Ore ..... long tons	5,993,800	17,458,295	7,207,556	23,436,620	8,024,052	32,543,713
Pig ..... short tons	3,145,303	[2] 66,517,978	3,928,007	[2] 110,436,827	3,980,677	[2] 145,358,582
Lime ..... do	294,654	2,164,209	345,160	2,727,464	388,197	3,275,402
Mica:						
Scrap ..... do	338	6,621	(1)	(1)	------	------
Sheet ..... pounds	289	74	(1)	(1)	------	------
Mineral waters	(6)	(6)	(6)	(6)	(6)	(6)
Peat ..... short tons	------	------	------	------	2,034	11,620
Petroleum ..... barrels	380,000	(1)	396,000	(1)	466,000	(1)
Sand and gravel ..... short tons	2,923,240	1,937,576	3,400,103	2,271,534	3,619,469	2,405,901
Stone ..... do	1,874,330	3,385,892	2,795,240	4,624,892	2,475,530	4,482,133
Miscellaneous [7]	------	10,804,325	------	14,982,280	------	18,921,153
Total value, eliminating duplications	------	123,029,000	------	162,663,000	------	182,987,000

[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] Figure obtained through cooperation with Bureau of the Census.
[5] Value of clay used in cement and heavy clay products is included here but is not included in total value for State.
[6] No canvass.
[7] Includes minerals indicated by footnotes 1 and 3 above.

Mineral products of the United States, 1946–48, by States—Continued

ALASKA

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Antimony ore (concentrates) short tons			40	$16,056	68	$29,336
Arsenic do	(1)	(1)				
Clay, raw (sold or used) do					(2)	(2)
Coal do	366,809	$2,354,952	361,220	2,554,797	410,000	(2)
Copper pounds	4,000	648	24,000	5,040	32,000	6,944
Gem stones		(3)		(3)		(3)
Gold troy ounces	226,781	7,937,335	279,988	9,799,580	248,395	8,693,825
Lead short tons	115	25,070	264	76,032	329	117,782
Mercury flasks (76 pounds)	699	68,670	127	10,635	100	7,649
Ores (crude), etc.:						
Copper short tons					14	(4)
Dry and siliceous (gold and silver) do	8,979	(4)	8,327	(4)	1,795	(4)
Lead do	1,819	(4)	5,064	(4)	4,005	(4)
Zinc do			500	(4)		
Zinc-lead do					200	(4)
Platinum metals (crude) troy ounces	22,882	(2)	13,512	(2)	(2)	(2)
Pumice short tons					(2)	(2)
Sand and gravel do	(2)	(2)	(2)	(2)	(2)	(2)
Silver troy ounces	41,793	33,769	66,150	59,866	67,341	60,947
Stone short tons	(2)	(2)	(2)	(2)	40,730	54,637
Tin do			1	2,200	6	(2)
Tungsten concentrates short tons (60-percent WO_3 basis)	19	(2)	13	(2)		
Zinc short tons			25	6,050	22	5,852
Miscellaneous [5]		2,005,241		5,927,319		4,224,112
Total value, eliminating duplications		12,426,000		18,458,000		13,201,000

[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 footnote 2 above.

ARIZONA

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Arsenious oxide ... short tons	(1)	(1)	(1)	(1)	(1)	(1)
Asbestos ... do	(2)	(2)	(2)	(2)	(2)	(2)
Barite ... do	(2)	(2)	(2)	(2)	(2)	(2)
Bismuth ... pounds	(1)	(1)	(1)	(1)	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)		[3] $479,000		[3] $752,000		[3] $917,000
Raw (sold or used) ... short tons	[4] 168,081	[4] 230,703	[4] 184,345	[4] 292,193	[4] 178,296	[4] 325,997
Coal ... do	6,414	24,304	10,060	46,415	10,000	(2)
Copper ... pounds	578,446,000	93,708,252	732,436,000	153,811,560	750,242,000	162,802,514
Diatomite ... short tons	(2)	(2)				
Feldspar (crude) ... long tons	(2)	(2)	(2)	(2)	(2)	(2)
Fluorspar ... short tons	389	7,959	1,601	(2)	1,271	(2)
Gem stones		(5)		(5)		(5)
Gold ... troy ounces	79,024	2,765,840	95,860	3,355,100	109,487	3,832,045
Gypsum (crude) ... short tons	(2)	(2)	23,980	128,725	(2)	(2)
Lead ... do	23,930	5,216,740	28,566	8,227,008	29,899	10,703,842
Lime ... do	50,354	489,091	54,562	582,074	54,608	763,296
Manganese ore ... do			133	(2)	240	(2)
Manganiferous ore ... do			62	(2)		
Mercury ... flasks (76 pounds)	95	9,333				
Mica, scrap ... short tons			(2)	(2)		
Molybdenum ... pounds	(2)	(2)	(2)	(2)	(2)	(2)
Ores (crude), etc.:						
Copper ... short tons	30,386,149	(6)	37,810,448	(6)	39,072,204	(6)
Dry and siliceous (gold and silver) ... do	53,094	(6)	73,190	(6)	56,090	(6)
Lead ... do	13,441	(6)	24,478	(6)	23,231	(6)
Lead-copper ... do	1,066	(6)	12	(6)	242	(6)
Zinc ... do	13,233	(6)	16,619	(6)	3,966	(6)
Zinc-copper ... do	63,854	(6)	82,192	(6)	101,405	(6)
Zinc-lead ... do	515,047	(6)	624,397	(6)	664,603	(6)
Zinc-lead-copper ... do	12,295	(6)	4,944	(6)	3,945	(6)

See footnotes at end of table.

Mineral products of the United States, 1946–48, by States—Continued

ARIZONA—Continued

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Perlite .... short tons..	3,022	$46,103	(2)	(2)	(2)	(2)
Quartz .... do....	(2)	(2)	(2)	(2)	(2)	(2)
Radium (refined) .... milligrams..	....	....	(2)	(2)	(2)	(2)
Sand and gravel .... short tons..	1,098,791	974,347	1,607,758	$1,368,080	2,013,769	$1,799,353
Silver .... troy ounces..	3,268,765	2,641,162	4,569,084	4,135,021	4,837,740	4,378,399
Stone .... short tons..	[7] 191,430	[7] 269,279	353,880	219,891	307,570	263,157
Sulfuric acid (basis, 100 percent) [8] .... do....	(2 9)	(2 9)	....	....	....	....
Tungsten concentrates .... short tons (60-percent WO_3 basis)..	20	27,080	13	(2)	23	30,338
Vanadium .... pounds..	(2)	(2)	(2)	(2)	(2)	(2)
Zinc .... short tons..	43,665	10,654,260	54,644	13,223,848	54,478	14,491,148
Miscellaneous [10]	....	633,805	....	712,041	....	1,007,109
Total value, eliminating duplications	....	118,086,000	....	186,767,000	....	201,244,000

[1] Figure not available.
[2] Value included with "Miscellaneous."
[3] Figure obtained through cooperation with Bureau of the Census.
[4] Value of clay used in cement and heavy clay products is included here but is 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 footnotes 2 and 7 above.

ARKANSAS

Product	1946		1947		1948	
	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	------	------	2	$669	------	------
Barite ... do	288,286	$1,844,982	376,017	2,390,643	362,470	$2,899,760
Bauxite ... long tons (dried equivalent)	1,050,347	6,578,270	1,153,563	6,583,538	1,395,341	8,299,486
Cement ... barrels	([1])	([1])	([1])	([1])	([1])	([1])
Clay:						
Products, heavy clay (other than pottery and refractories)	------	[3] 1,276,000	------	[3] 1,688,000	------	[3] 1,932,000
Raw (sold or used) ... short tons	[4] 388,606	[4] 712,906	[4] 403,137	[4] 887,112	[4] 467,453	[4] 1,096,360
Coal ... do	1,631,474	9,494,194	1,870,949	12,474,871	1,660,000	12,832,000
Gem stones	------	([5])	------	([5])	------	([5])
Gypsum (crude) ... short tons	([1])	([1])	([1])	([1])	([1])	([1])
Lead ... do	2	436	18	5,184	22	7,876
Lime ... do	([1])	([1])	([1])	([1])	([1])	([1])
Manganese ore ... do	1,101	28,237	841	([1])	212	([1])
Manganiferous ore ... do	1,964	([1])	2,094	([1])	1,165	([1])
Mercury ... flasks (76 pounds)	11	1,081	------	------	------	------
Mineral waters	([5])	([5])	([5])	([5])	([5])	([5])
Natural gas (estimated value at wells) ... M cubic feet	45,177,000	1,107,000	50,630,000	1,818,000	53,946,000	2,422,000
Natural gasoline and allied products:						
Natural gasoline ... gallons	50,830,000	2,077,000	56,787,000	3,668,000	55,408,000	4,999,000
Liquefied petroleum gases ... do	33,677,000	839,000	37,279,000	1,271,000	39,092,000	2,260,000
Oilstones and whetstones ... short tons	([1])	([1])	([1])	([1])	([1])	([1])
Ores (crude), etc.:						
Lead ... do	2	([6])	31	([6])	30	([6])
Zinc ... do	4,300	([6])	265	([6])	1,071	([6])
Zinc-lead ... do	------	------	109	([6])	------	------
Petroleum ... barrels	28,375,000	35,750,000	29,948,000	54,500,000	31,675,000	78,269,000
Sand and gravel ... short tons	[7] 2,203,647	[7] 1,821,423	[7] 2,690,163	[7] 2,267,203	[7] 2,545,104	[7] 2,078,784
Slate	------	([1])	------	([1])	------	([1])
Stone ... short tons	995,720	1,135,856	[8] 210,100	[8] 448,650	1,379,410	1,883,500
Zinc ... do	85	20,740	18	4,356	31	8,246
Miscellaneous [9]	------	9,794,737	------	15,078,989	------	15,328,550
Total value, eliminating duplications	------	65,985,000	------	92,289,000	------	123,138,000

[1] Value included with "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] Value of clay used in cement and heavy clay products is included here but is 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 unclassified stone, value for which is included with "Miscellaneous."
[9] Includes minerals indicated by footnotes 1, 7, and 8 above.

Mineral products of the United States, 1946–48, by States—Continued

CALIFORNIA

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Antimony ore (concentrates) short tons	----	----	----	----	5	$1,467
Arsenious oxide do	(1)	(1)	(1)	(1)	(1)	(1)
Asbestos do	(2)	(2)	(2)	(2)	(2)	(2)
Asphalt (native) do	(2)	(2)	(2)	(2)	----	----
Barite do	(2)	(2)	(2)	(2)	(2)	(2)
Boron minerals do	430,689	$9,575,866	501,935	$11,844,108	450,932	11,147,735
Bromine pounds	(2)	(2)	(2)	(2)	(2)	(2)
Calcite (Iceland spar) do	(3)	(3)	(3)	(3)	(3)	(3)
Calcium chloride short tons	9,979	170,994	7,968	111,950	10,009	167,610
Cement barrels	20,173,231	33,906,675	22,846,458	46,539,749	24,162,926	57,742,226
Chromite short tons	(2)	(2)	948	(2)	274	(2)
Clay:						
Products, heavy clay (other than pottery and refractories)	----	[4] 12,175,000	----	[4] 16,793,000	----	[4] 21,600,000
Raw short tons	[5] 1,670,305	[5] 2,254,164	[5] 1,950,076	[5] 2,965,360	[5] 2,673,877	[5] 3,813,329
Coke do	260,470	(2 6)	332,244	(2 6)	296,749	(2 6)
Copper pounds	8,480,000	1,373,760	4,814,000	1,010,940	962,000	208,754
Diatomite short tons	(2)	(2)	(2)	(2)	(2)	(2)
Feldspar (crude) long tons	----	----	(2)	(2)	(2)	(2)
Ferro-alloys short tons	7,414	(2 6)	5,278	(2 6)	(2 6)	(2 6)
Fuller's earth do	(2)	(2)	(2)	(2)	(2)	(2)
Gem stones	----	(3)	----	(3)	----	(3)
Gold troy ounces	356,824	12,488,840	431,415	15,099,525	421,473	14,751,555
Gypsum (crude) short tons	574,345	1,315,699	811,798	1,996,157	962,038	2,354,390
Iodine pounds	(2)	(2)	(2)	(2)	(2)	(2)
Iron:						
Ore long tons	226,062	(2)	373,574	(2)	345,863	(2)
Pig short tons	344,024	(2 6)	453,376	(2 6)	375,113	(2 6)
Kyanite do	(2)	(2)	----	----	----	----
Lead do	9,923	2,163,214	10,080	2,903,040	9,110	3,261,380
Lime do	172,623	2,144,712	181,296	2,615,599	179,257	3,026,941
Lithium minerals do	(2)	(2)	(2)	(2)	(2)	(2)
Magnesite do	(2)	(2)	(2)	(2)	(2)	(2)
Magnesium do	56	21,664	----	----	----	----
Magnesium compounds (from sea water) [7] short tons MgO equivalent	55,953	2,814,979	40,000	2,161,000	38,500	2,549,000
Mercury flasks (76 pounds)	17,782	1,746,904	17,165	1,437,397	11,188	855,770
Mica, scrap short tons	(2)	(2)	(2)	(2)	----	----
Mineral waters	(3)	(3)	(3)	(3)	(3)	(3)
Molybdenum pounds	(2)	(2)	(2)	(2)	(2)	(2)
Natural gas (estimated value at wells) M cubic feet	487,904,000	36,056,000	560,510,000	57,284,000	570,954,000	64,803,000

Natural gasoline and allied products:						
Natural gasoline and cycle products...gallons..	734,227,000	32,085,000	833,473,000	46,302,000	842,425,000	69,578,000
Liquefied petroleum gases...do....	176,311,000	4,933,000	230,635,000	7,901,000	269,644,000	16,961,000
Ores (crude), etc.:						
Copper...short tons..	86,297	(8)	15,993	(8)	152	(8)
Dry and siliceous (gold and silver)...do....	335,657	(8)	449,792	(8)	424,227	(8)
Lead...do....	57,330	(8)	87,913	(8)	22,005	(8)
Zinc...do....	45,043	(8)	49,651	(8)	5,233	(8)
Zinc-copper...do....	99,176	(8)	35,745	(8)	----------	----------
Zinc-lead...do....	4,264	(8)	9,695	(8)	75,159	(8)
Peat...do....	8,137	105,242	(2)	(2)	6,942	33,265
Pebbles for grinding...do....	74	927	(2)	(2)	(2)	(2)
Perlite...do....	----------	----------	----------	----------	(2)	(2)
Petroleum...barrels..	314,713,000	387,100,000	333,132,000	572,990,000	340,089,000	823,696,000
Platinum metals (crude)...troy ounces..	67	(2)	324	(2)	272	(2)
Potassium salts...short tons..	(2)	(2)	(2)	(2)	(2)	(2)
Pumice...do....	89,181	755,570	169,037	1,026,275	196,934	1,110,447
Pyrites...long tons..	(2)	(2)	(2)	(2)	(2)	(2)
Quartz...short tons..	(2)	(2)	(2)	(2)	(2)	(2)
Salt (sodium chloride)...do....	729,092	3,358,060	768,397	3,810,898	914,035	3,927,722
Sand and gravel...do....	27,220,849	18,396,460	31,386,826	25,338,967	33,786,520	30,592,965
Sand and sandstone (ground)...do....	(2)	(2)	(2)	(2)	(2)	(2)
Silver...troy ounces..	1,342,651	1,084,862	1,597,442	1,445,685	724,771	655,954
Slate...	----------	(2)	----------	(2)	----------	(2)
Sodium carbonate...short tons..	215,625	3,427,086	293,051	5,862,178	288,769	6,623,280
Sodium sulfate...do....	(2)	(2)	(2)	(2)	(2)	(2)
Stone...do....	[9] 8,950,320	[9] 8,452,083	[9] 12,757,790	[9] 13,012,556	[9] 11,936,240	[9] 13,155,454
Strontium minerals...do....	243	3,726	----------	----------	----------	----------
Sulfuric acid (basis, 100 percent)[10]...do....	(2 6)	(2 6)	(2 6)	(2 6)	(2 6)	(2 6)
Sulfur ore...long tons..	757	11,835	698	9,074	(2)	(2)
Talc, pyrophyllite, and ground soapstone...short tons..	78,170	1,434,978	91,537	1,595,422	98,681	1,773,764
Titanium concentrates: Ilmenite...do....	----------	----------	----------	----------	(2)	(2)
Tungsten concentrates (60-percent WO_3 basis)...do....	1,262	1,117,855	394	548,233	1,767	(2)
Zinc...do....	6,877	1,677,988	5,415	1,310,430	5,325	1,416,450
Miscellaneous[11]...	----------	21,909,443	----------	29,565,251	----------	41,595,712
Total value, eliminating duplications...	----------	592,294,000	----------	859,039,000	----------	1,174,674,000

[1] Figure not available.
[2] Value included with "Miscellaneous."
[3] No canvass.
[4] Figure obtained through cooperation with Bureau of the Census.
[5] Sold or used; value of clay used in cement and heavy clay products is included here but is not included in total value for State.
[6] Value not included in total value for State.
[7] Comprises all compounds from raw sea water and bitterns. Data for 1946 are not quite comparable with 1947-48 in that the former are on a gross-weight basis and include some compounds made from dolomite in combination with sea water. Figures for 1947-48 are partly estimated.
[8] Not valued as ore; value of recoverable metal content included with the metals.
[9] Exclusive of marble in 1946-47 and of dimension basalt in 1948, values for which are included with "Miscellaneous."
[10] From lead smelting.
[11] Includes minerals indicated by footnotes 2 and 9 above.

Mineral products of the United States, 1946–48, by States—Continued

COLORADO

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Arsenious oxide ... short tons	(1)	(1)	(1)	(1)	(1)	(1)
Beryllium concentrates ... do	---	---	(2)	(2)	(2)	(2)
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] $2,192,000	---	[3] $2,362,000	---	[3] $2,738,000
Raw (sold or used) ... short tons	[4] 301,107	[4] 367,686	[4] 377,036	[4] 478,247	[4] 458,815	[4] 607,654
Coal ... do	5,913,508	23,914,584	6,358,104	28,772,028	5,627,000	28,079,000
Coke ... do	617,306	(2 5)	871,186	(2 5)	976,504	(2 5)
Copper ... pounds	3,508,000	568,296	4,300,000	903,000	4,596,000	997,332
Feldspar (crude) ... long tons	37,312	145,975	43,676	218,593	62,497	253,227
Ferro-alloys ... short tons	---	---	11,296	(2 5)	---	---
Fluorspar ... do	32,539	925,867	32,153	950,882	27,698	831,218
Gem stones	---	(6)	---	(6)	---	(6)
Gold ... troy ounces	142,613	4,991,455	168,279	5,889,765	154,802	5,418,070
Gypsum (crude) ... short tons	(2)	(2)	(2)	(2)	(2)	(2)
Iron:						
Ore ... long tons	340	(2)	---	---	---	---
Pig ... short tons	(2 5)	(2 5)	(2 5)	(2 5)	(2 5)	(2 5)
Lead ... do	17,036	3,713,848	18,696	5,384,448	25,143	9,001,194
Lime ... do	(2)	(2)	(2)	(2)	(2)	(2)
Lithium minerals ... do	(2)	(2)	(2)	(2)	---	---
Manganiferous ore ... do	---	---	37	(2)	---	---
Mica:						
Scrap ... do	4,495	36,910	1,341	13,246	5,907	53,358
Sheet ... pounds	272	93	---	---	---	---
Mineral waters	(6)	(6)	(6)	(6)	(6)	(6)
Molybdenum ... pounds	8,670,855	(2)	10,783,200	(2)	12,630,400	(2)
Natural gas (estimated value at wells) ... M cubic feet	6,728,000	314,000	8,392,000	660,000	8,967,000	539,000
Natural gasoline ... gallons	840,000	50,000	997,000	68,000	944,000	94,000
Ores (crude), etc.:						
Copper ... short tons	8,292	(7)	16,572	(7)	5,831	(7)
Dry and siliceous (gold and silver) ... do	841,733	(7)	1,005,072	(7)	684,043	(7)
Lead ... do	19,307	(7)	47,628	(7)	69,601	(7)
Lead-copper ... do	5	(7)	6	(7)	15	(7)
Zinc ... do	172,320	(7)	223,753	(7)	168,365	(7)
Zinc-lead ... do	421,839	(7)	247,881	(7)	363,179	(7)
Zinc-lead-copper ... do	---	---	3,782	(7)	147,085	(7)
Peat ... do	(2)	(2)	(2)	(2)	(2)	(2)
Perlite ... do	---	---	---	---	(2)	(2)
Petroleum ... barrels	11,856,000	15,650,000	15,702,000	29,680,000	16,827,000	43,481,000

Pumice ... short tons	600	1,200	(2)	(2)		
Pyrites ... long tons			(2)	(2)	(2)	(2)
Radium (refined) ... milligrams	[8] 190	[8] 3,515	15,400	284,900	3,300	59,400
Sand and gravel ... short tons	2,532,946	1,796,395	3,524,653	2,323,736	4,906,299	2,657,610
Silver ... troy ounces	2,240,151	1,810,042	2,557,653	2,314,676	3,011,011	2,725,117
Stone ... short tons	612,000	818,606	1,069,250	1,406,989	2,195,250	2,490,449
Sulfur ore ... long tons	(2)	(2)	(2)	(2)	(2)	(2)
Tungsten concentrates ... short tons (60-percent WO_3 basis)	213	288,717	68	108,241	208	337,431
Vanadium ... pounds	1,036,050	584,135	1,912,158	1,110,090	(2)	(2)
Vermiculite ... short tons	(2)	(2)	(2)	(2)		
Zinc ... do	36,147	8,819,868	38,745	9,376,290	45,164	12,013,624
Miscellaneous [9]		29,236,192		54,768,097		68,675,081
Total value, eliminating duplications		77,573,000		104,828,000		129,326,000

[1] Figure not available.
[2] Value included with "Miscellaneous."
[3] Figure obtained through cooperation with Bureau of the Census.
[4] Value of clay used in cement and heavy clay products is included here but is 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] Estimated.
[9] Includes minerals indicated by footnote 2 above.

CONNECTICUT

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Beryllium concentrates ... short tons			(1)	(1)		
Clay:						
Products, heavy clay (other than pottery and refractories)		[2] $2,128,000		[2] $1,949,000		[2] $2,491,000
Raw (sold or used) ... short tons	[3] 199,238	[3] 148,053	[3] 184,751	[3] 134,802	[3] 314,569	[3] 230,026
Coke ... do	(1, 4)	(1, 4)	(1, 4)	(1, 4)	(1, 4)	(1, 4)
Feldspar (crude) ... long tons	16,555	98,407	15,408	100,152	12,110	78,772
Lime ... short tons	(1)	(1)	(1)	(1)	(1)	(1)
Mica:						
Scrap ... do	(1)	(1)			(1)	(1)
Sheet ... pounds	236,919	25,746				
Mineral waters	(5)	(5)	(5)	(5)	(5)	(5)
Peat ... short tons	4,563	27,027	5,061	25,705	4,332	24,124
Sand and gravel ... do	2,199,654	1,221,839	2,329,198	1,384,675	2,576,848	1,487,530
Stone ... do	1,324,160	1,878,793	[6] 1,362,840	[6] 1,929,548	1,525,490	2,283,298
Miscellaneous [7]		4,555,008		5,981,212		7,045,455
Total value, eliminating duplications		5,584,000		5,677,000		6,745,000

[1] Value included with "Miscellaneous."
[2] Figure obtained through cooperation with Bureau of the Census.
[3] Value of clay used in cement and heavy clay products is included here but is not included in total value for State.
[4] Value not included in total value for State.
[5] No canvass.
[6] Exclusive of dimension basalt, value for which is included with "Miscellaneous."
[7] Includes minerals indicated by footnotes 1 and 6 above.

Mineral products of the United States, 1946–48, by States—Continued

DELAWARE

Product	1946 Quantity	1946 Value	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Clay:						
Products, heavy clay (other than pottery and refractories)		(1 2)		(1 2)		(1 2)
Raw (sold or used) short tons	[3] 33,942	[3] $33,088	(2 3)	(2 3)	(2 3)	(2 3)
Sand and gravel do	187,229	123,532	235,464	$195,002	(2)	(2)
Stone do	23,070	57,662	(2)	(2)	36,390	$89,970
Miscellaneous		310,000		471,161		686,729
Total value, eliminating duplications		491,000		613,000		717,000

1 Figure obtained through cooperation with Bureau of the Census.
2 Value included with "Miscellaneous."
3 Value of clay used in cement and heavy clay products not included in total value for State.

FLORIDA

Product	1946 Quantity	1946 Value	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Cement barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)		(1 2)		(1 2)		(1 2)
Raw (sold or used) short tons	[3] 80,379	[3] $486,791	[3] 96,147	[3] $527,976	(1 3)	(1 3)
Ferro-alloys do			(1 4)	(1 4)	(1 4)	(1 4)
Fuller's earth do	(1)	(1)	(1)	(1)	(1)	(1)
Lime do	(1)	(1)	(1)	(1)	(1)	(1)
Mineral waters	(5)	(5)	(5)	(5)	(5)	(5)
Natural gas (estimated value at wells) M cubic feet	6,000	193	8,000	258	27,000	$1,000
Peat short tons	19,979	81,832	42,300	126,000	24,750	56,171
Petroleum barrels	57,000	(1)	259,000	(1)	290,000	(1)
Phosphate rock long tons	5,005,511	21,017,174	6,482,027	32,920,252	6,539,258	37,732,894
Sand and gravel short tons	1,534,667	1,320,819	2,067,401	1,880,866	2,312,131	2,432,575
Stone do	[6] 2,863,070	[6] 3,212,135	3,534,010	4,511,894	[6] 4,154,920	[6] 5,115,974
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]		5,005,456		6,015,838		8,605,393
Total value, eliminating duplications		31,093,000		45,924,000		53,877,000

[1] Value included with "Miscellaneous."
[2] Figure obtained through cooperation with Bureau of the Census.
[3] Value of clay used in cement and heavy clay products is included here but is not included in total value for State.
[4] Value not included in total value for State.
[5] No canvass.
[6] Exclusive of unclassified stone and dimension limestone in 1946, and unclassified stone in 1948, values for which are included with "Miscellaneous."
[7] Includes minerals indicated by footnotes 1 and 6 above.

GEORGIA

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Asbestos, short tons	(1)	(1)	(1)	(1)	(1)	(1)
Barite, do	69,274	$686,583	61,202	$639,865	62,781	$654,959
Bauxite, long tons (dried equivalent)	(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)		[2] 5,667,000		[2] 7,373,000
Raw (sold or used), short tons	[3] 1,641,660	[3] 10,222,165	[3] 1,918,546	[3] 13,436,317	[3] 2,216,665	[3] 15,472,110
Coal, do	113,763	534,687	7,283	39,328	7,000	(1)
Feldspar (crude), long tons	(1)	(1)	(1)	(1)	(1)	(1)
Fuller's earth, short tons	(1)	(1)	(1)	(1)	(1)	(1)
Gem stones		(4)		(4)		(4)
Gold, troy ounces	21	735	76	2,660	19	665
Iron ore, long tons	284,614	613,745	295,992	693,485	273,735	746,818
Kyanite, short tons	(1)	(1)			(1)	(1)
Lime, do	2,691	33,251	10,141	110,983	6,141	58,150
Magnesium sulfate (from serpentine), short tons MgO equivalent	(1)	(1)	(1)	(1)		
Mica:						
Scrap, short tons	1,092	30,248	1,102	22,985	785	15,683
Sheet, pounds	17,242	4,004	(1)	(1)	(1)	(1)
Mineral waters	(4)	(4)	(4)	(4)	(4)	(4)
Ores (crude), etc.:						
Dry and siliceous (gold and silver), short tons			130	(5)	36	(5)
Peat, do	3,218	51,286	(1)	(1)	(1)	(1)
Sand and gravel, do	893,290	523,102	927,330	575,115	985,729	719,771
Sand and sandstone (ground), do	4,406	25,993	11,031	57,820	11,708	53,570
Silver, troy ounces			13	12	3	3
Slate		(1)		(1)		(1)
Stone, short tons	2,417,340	8,538,435	2,960,520	9,977,938	3,631,430	10,801,355
Talc, do	36,410	380,477	49,441	673,251	53,602	624,694
Miscellaneous [6]		9,374,762		5,881,151		7,005,481
Total value, eliminating duplications		30,449,000		37,037,000		42,662,000

[1] Value included with "Miscellaneous."
[2] Figure obtained through cooperation with Bureau of the Census.
[3] Value of clay used in cement and heavy clay products is included here but is 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 footnote 1 above.

Mineral products of the United States, 1946–48, by States—Continued

IDAHO

Product	1946 Quantity	1946 Value	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Antimony ore (concentrates) ... short tons	13,732	$784,489	18,258	$3,193,806	15,941	$4,294,790
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)		[3] 149,000		[3] 131,000		[3] 214,000
Raw (sold or used) ... short tons	[4] 18,696	[4] 24,802	[4] 31,920	[4] 33,262	[4] 33,856	[4] 33,077
Copper ... pounds	2,076,000	336,312	3,280,000	688,800	3,248,000	704,816
Garnet, abrasive ... short tons	(2)	(2)	(2)	(2)	(2)	(2)
Gem stones		(5)		(5)		(5)
Gold ... troy ounces	42,975	1,504,125	64,982	2,274,370	58,454	2,045,890
Lead ... short tons	59,987	13,077,166	78,944	22,735,872	88,544	31,698,752
Mercury ... flasks (76 pounds)	868	85,272	886	74,194	543	41,534
Monazite ... short tons					40	(2)
Ores (crude), etc.:						
Copper ... do	903	(6)	3,303	(6)	1,383	(6)
Dry and siliceous (gold and silver) ... do	256,001	(6)	765,765	(6)	822,378	(6)
Lead ... do	113,175	(6)	165,218	(6)	253,648	(6)
Lead-copper ... do	119	(6)	27	(6)	5	(6)
Zinc ... do	104,585	(6)	67,133	(6)	79,674	(6)
Zinc-lead ... do	2,407,404	(6)	2,716,251	(6)	2,824,758	(6)
Phosphate rock ... long tons	(2)	(2)	(2)	(2)	431,392	2,094,197
Pumice ... short tons	108,847	163,515	98,618	119,882	79,426	93,602
Sand and gravel ... do	2,082,874	1,572,088	3,209,766	2,067,891	3,671,033	2,552,224
Silver ... troy ounces	6,491,104	5,244,812	10,345,779	9,362,930	11,448,875	10,361,810
Stone ... short tons	548,870	568,159	[7] 1,044,780	[7] 991,599	1,081,060	1,003,858
Tungsten concentrates ... short tons (60-percent WO_3 basis)	641	(2)	61	(2)	86	(2)
Vanadium ... pounds	(2)	(2)	(2)	(2)	(2)	(2)
Zinc ... short tons	71,507	17,447,708	83,069	20,102,698	86,267	22,947,022
Miscellaneous [8]		3,494,386		5,180,456		1,267,691
Total value, eliminating duplications		44,444,000		66,941,000		79,330,000

[1] Figure not available.
[2] Value included with "Miscellaneous."
[3] Figure obtained through cooperation with Bureau of the Census.
[4] Value of clay used in cement and heavy clay products is included here but is 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 unclassified stone, value for which is included with "Miscellaneous."
[8] Includes minerals indicated by footnotes 2 and 7 above.

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement...barrels	6,675,584	$11,646,747	7,155,280	$13,219,260	7,573,404	$15,200,723
Clay:						
Products, heavy clay (other than pottery and refractories)	----	[1] 12,812,000	----	[1] 12,876,000	----	[1] 15,340,000
Raw (sold or used)...short tons	[2] 2,325,047	[2] 2,248,471	[2] 2,197,240	[2] 2,560,188	[2] 2,487,633	[2] 3,061,166
Coal...do	63,468,585	165,350,367	67,860,011	213,834,014	66,500,000	243,390,000
Coke...do	3,192,395	[3] 32,241,972	3,805,374	[3] 49,267,806	3,675,284	[3] 54,396,850
Fluorspar...do	154,525	5,493,642	167,157	6,148,654	172,561	6,322,246
Fuller's earth...do	33,134	296,637	37,740	388,955	37,942	410,678
Graphite, artificial...pounds	----	----	(3 4)	(3 4)	(3 4)	(3 4)
Iron, pig...short tons	4,359,719	[3] 109,717,853	5,607,680	[3] 173,679,369	5,503,437	[3] 196,586,808
Lead...do	3,865	842,570	2,325	669,600	3,695	1,322,810
Lime...do	280,051	2,365,455	299,187	2,736,262	283,090	3,000,225
Marl, calcareous...do	7,299	7,132	(4)	(4)	2,025	1,500
Mineral paints (zinc and lead pigments)...do	(3 4)	(3 4)	(3 4)	(3 4)	(3 4)	(3 4)
Mineral waters	(5)	(5)	(5)	(5)	(5)	(5)
Natural gas (estimated value at wells)...M cubic feet	17,166,000	872,000	17,023,000	1,565,000	14,062,000	1,735,000
Natural gasoline and allied products:						
Natural gasoline...gallons	53,307,000	3,053,000	47,180,000	4,008,000	45,793,000	5,605,000
Liquefied petroleum gases...do	108,253,000	3,390,000	115,324,000	5,043,000	103,202,000	7,864,000
Ores (crude), etc.:						
Lead...short tons	40,059	(6)	35,594	(6)	----	----
Zinc...do	160,032	(6)	70,310	(6)	74,567	(6)
Zinc-lead...do	192,342	(6)	213,199	(6)	313,950	(6)
Peat...do	(4)	(4)	(4)	(4)	(4)	(4)
Petroleum...barrels	75,297,000	119,720,000	66,459,000	139,560,000	64,669,000	178,486,000
Pyrites...long tons	1,740	2,871	----	----	----	----
Sand and gravel...short tons	16,771,242	11,458,969	16,292,527	13,155,971	17,400,430	15,101,915
Sand and sandstone (ground)...do	144,753	1,061,046	198,500	1,614,173	232,971	1,943,284
Silver...troy ounces	2,302	1,860	1,790	1,620	4,047	3,663
Stone...short tons	15,635,470	16,891,933	[7] 15,545,130	[7] 18,160,506	[7] 18,533,290	[7] 22,823,138
Sulfuric acid (basis, 100 percent) [8]...do	145,306	[3] 1,825,920	173,275	[3] 2,315,685	116,773	[3] 1,649,285
Tripoli...do	15,631	321,600	14,687	271,115	(4)	(4)
Zinc...do	8,798	2,146,712	10,073	2,437,666	12,980	3,452,680
Miscellaneous [9]	----	6,088,950	----	11,603,763	----	10,012,364
Total value, eliminating duplications	----	358,628,000	----	436,770,000	----	523,422,000

[1] Figure obtained through cooperation with Bureau of the Census.
[2] Value of clay used in cement and heavy clay products is included here but is 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] Exclusive of dimension sandstone in 1947, and sandstone in 1948, values for which are included with "Miscellaneous."
[8] From zinc smelting.
[9] Includes minerals indicated by footnotes 4 and 7 above.

Mineral products of the United States, 1946–48, by States—Continued

INDIANA

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement ... barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)		[2] $7,845,000		[2] $10,377,000		[2] $13,199,000
Raw (sold or used) ... short tons	[3] 983,669	[3] 1,004,877	[3] 1,181,878	[3] 1,354,908	[3] 1,210,025	[3] 1,286,051
Coal ... do	21,696,947	56,612,162	25,449,097	82,019,363	22,500,000	89,550,000
Coke ... do	6,651,567	[4] 59,312,827	8,785,687	[4] 117,614,296	8,584,225	[4] 125,355,310
Ferro-alloys ... do			(1 4)	(1 4)	(1 4)	(1 4)
Iron, pig ... do	4,823,257	[4] 122,786,881	6,385,503	[4] 195,211,140	6,496,421	[4] 245,945,553
Lime ... do	(1)	(1)	(1)	(1)	(1)	(1)
Marl, calcareous ... do	38,175	19,080	27,412	19,666	15,839	17,031
Mineral paints (zinc and lead pigments) ... do	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)
Mineral waters	(5)	(5)	(5)	(5)	(5)	(5)
Natural gas (estimated value at wells) ... M cubic feet	1,094,000	113,000	877,000	80,000	553,000	54,000
Peat ... short tons	676	3,124	3,957	14,760	2,288	11,576
Petroleum ... barrels	6,726,000	10,690,000	6,095,000	12,800,000	6,710,000	18,647,000
Pyrites ... long tons	(1)	(1)	821	2,658	470	1,551
Rubbing stones and whetstones, etc. ... short tons	(1)	(1)	(1)	(1)	(1)	(1)
Sand and gravel ... do	8,752,267	5,656,047	9,231,649	6,687,082	9,439,358	7,091,922
Stone ... do	5,767,430	9,950,338	[6] 5,589,550	[6] 11,254,020	[6] 6,574,390	[6] 14,989,239
Sulfuric acid (basis, 100 percent) [7] ... do	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)
Miscellaneous [8]		18,169,228		23,171,979		26,370,390
Total value, eliminating duplications		107,479,000		143,298,000		166,803,000

[1] Value included with "Miscellaneous."
[2] Figure obtained through cooperation with Bureau of the Census.
[3] Value of clay used in cement and heavy clay products is included here but is not included in total value for State.
[4] Value not included in total value for State.
[5] No canvass.
[6] Exclusive of sandstone in 1947–48, values for which are included with "Miscellaneous."
[7] From zinc-roasting operation.
[8] Includes minerals indicated by footnotes 1 and 6 above.

IOWA

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement ... barrels	6,145,326	$11,312,627	6,155,670	$12,054,420	6,835,578	$14,424,526
Clay:						
Products, heavy clay (other than pottery and refractories)		[1] 7,095,000		[1] 8,526,000		[1] 9,142,000
Raw (sold or used) ... short tons	[2] 696,704	[2] 620,916	[2] 896,574	[2] 788,795	[2] 893,403	[2] 801,710
Coal ... do	1,788,133	6,573,400	1,684,055	6,428,832	1,750,000	(3)
Ferro-alloys ... do	(3 4)	(3 4)	(3 4)	(3 4)	(3 4)	(3 4)
Gypsum (crude) ... do	560,094	1,172,500	656,982	1,677,217	729,880	1,753,545
Mineral waters	(5)	(5)	(5)	(5)	(5)	(5)
Peat ... short tons	(3)	(3)	(3)	(3)	(3)	(3)
Sand and gravel ... do	7,938,572	3,059,792	6,473,087	2,795,887	8,039,601	3,729,488
Stone ... do	5,162,540	6,646,273	5,586,460	7,385,436	6,387,620	8,332,682
Miscellaneous [6]		6,129,222		7,906,208		18,327,158
Total value, eliminating duplications		35,957,000		38,951,000		45,129,000

[1] Figure obtained through cooperation with Bureau of the Census.
[2] Value of clay used in cement and heavy clay products is included here but is 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] Includes minerals indicated by footnote 3 above.

KANSAS

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement ... barrels	[1] 6,894,353	[1] $11,574,910	[1] 7,208,147	[1] $13,017,277	[1] 7,930,965	[1] $16,188,379
Clay:						
Products, heavy clay (other than pottery and refractories)		[2] 2,771,000		[2] 2,229,000		[2] 3,050,000
Raw (sold or used) ... short tons	[3] 464,033	[3] 283,350	[3] 535,777	[3] 376,961	[3] 587,435	[3] 444,822
Coal ... do	2,493,385	6,931,152	2,744,534	9,165,208	2,615,000	10,068,000
Gypsum (crude) ... do	(4)	(4)	(4)	(4)	(4)	(4)
Helium ... cubic feet	[5] 2,909,980	[5] 37,742				
Lead ... short tons	6,445	1,405,010	7,285	2,098,080	8,386	3,002,188
Mineral paints (zinc and lead pigments) ... do	(4 6)	(4 6)	(4 6)	(4 6)	(4 6)	(4 6)
Mineral waters	(7)	(7)	(7)	(7)	(7)	(7)
Natural gas (estimated value at wells) ... M cubic feet	165,725,000	8,286,000	209,321,000	10,598,000	245,189,000	12,235,000
Natural gasoline and allied products:						
Natural gasoline ... gallons	63,666,000	2,455,000	71,547,000	3,827,000	73,343,000	6,051,000
Liquefied petroleum gases ... do	18,925,000	467,000	27,648,000	978,000	28,617,000	1,731,000
Ores (crude), etc.:						
Lead ... short tons	3	(8)	774	(8)	64,063	(8)
Zinc ... do	1,893,101	(8)	1,910,215	(8)	1,426,828	(8)
Zinc-lead ... do	2,401,221	(8)	1,737,658	(8)	768,905	(8)

Mineral products of the United States, 1946–48, by States—Continued

KANSAS—Continued

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Petroleum ... barrels	97,218,000	$138,050,000	105,132,000	$202,900,000	110,833,000	$287,833,000
Pumice ... short tons	35,466	105,084	(4)	(4)	(4)	(4)
Salt ... do	815,018	4,014,919	904,398	4,534,406	831,756	4,960,828
Sand and gravel ... do	4,443,086	2,505,822	4,351,920	2,330,435	5,083,083	2,748,765
Stone ... do	3,653,640	3,908,588	4,792,850	4,867,789	5,315,680	5,481,190
Zinc ... do	47,703	11,639,532	41,497	10,042,274	35,577	9,463,482
Miscellaneous [9]	----------	5,044,818	----------	8,149,874	----------	9,749,851
Total value, eliminating duplications	----------	194,563,000	----------	267,046,000	----------	363,362,000

[1] Exclusive of natural cement, value for which is included with "Miscellaneous."
[2] Figure obtained through cooperation with Bureau of the Census.
[3] Value of clay used in cement and heavy clay products is included here but is not included in total value for State.
[4] Value included with "Miscellaneous."
[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] Includes minerals indicated by footnotes 1 and 4 above.

KENTUCKY

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
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] $1,971,000	----------	[2] $2,649,000	----------	[2] $2,998,000
Raw (sold or used) ... short tons	[3] 735,345	[3] 2,746,906	[3] 787,795	[3] 3,306,236	[3] 802,088	[3] 3,509 462
Coal ... do	66,552,977	227,154,114	84,240,682	372,128,151	82,000,000	444,440,000
Coke ... do	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)
Fluorspar ... do	63,143	1,889,454	90,256	2,713,508	84,889	2,663,377
Iron, pig ... do	624,174	(1 4)	661,925	(1 4)	799,287	(1 4)
Lead ... do	95	20,710	214	61,632	216	77,328
Mineral waters	(5)	(5)	(5)	(5)	(5)	(5)
Natural gas (estimated value at wells) ... M cubic feet	70,396,000	10,426,000	96,459,000	14,430,000	70,095,000	12,897,000
Natural gasoline and allied products:						
Natural gasoline ... gallons	9,062,000	472,000	9,577,000	656,000	10,182,000	953,000
Liquefied petroleum gases ... do	44,800,000	986,000	50,136,000	1,304,000	56,407,000	1,683,000

Ores (crude), etc.:						
Lead ... short tons	------	------	801	(6)	------	------
Zinc ... do	15	(6)	------	------	10,351	(6)
Zinc-lead ... do	12,255	(6)	18,999	(6)	35,323	(6)
Petroleum ... barrels	10,578,000	17,030,000	9,397,000	19,830,000	8,551,000	23,703,000
Sand and gravel ... short tons	2,163,734	1,802,063	2,454,492	1,997,368	2,066,993	2,068,780
Stone ... do	7 4,745,560	7 5,205,820	7 4,990,170	7 5,875,574	6,154,950	7,598,309
Zinc ... do	314	76,616	508	122,936	639	169,974
Miscellaneous 8	------	23,208,326	------	32,490,343	------	50,988,076
Total value, eliminating duplications	------	272,558,000	------	428,507,000	------	506,249,000

1 Value included with "Miscellaneous."
2 Figure obtained through cooperation with Bureau of the Census.
3 Value of clay used in cement and heavy clay products is included here but is 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 unclassified stone in 1946, and dimension limestone in 1947, values for which are included with "Miscellaneous."
8 Includes minerals indicated by footnotes 1 and 7 above.

LOUISIANA

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement ... barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)	------	2 $857,000	------	2 $915,000	------	2 $1,115,000
Raw (sold or used) ... short tons	3 178,331	3 141,526	3 215,199	3 153,236	3 248,870	3 194,956
Lime ... do	(1)	(1)	------	------	------	------
Mineral waters	(4)	(4)	(4)	(4)	(4)	(4)
Natural gas (estimated value at wells) ... M cubic feet	525,178,000	18,591,000	581,398,000	21,221,000	686,061,000	26,482,000
Natural gasoline and allied products:						
Natural gasoline and cycle products ... gallons	448,375,000	16,636,000	481,748,000	26,777,000	526,736,000	46,003,000
Liquefied petroleum gases ... do	118,421,000	4,243,000	147,097,000	7,090,000	179,442,000	11,215,000
Petroleum ... barrels	143,669,000	207,710,000	160,128,000	321,130,000	181,181,000	474,848,000
Salt ... short tons	1,846,522	4,612,359	1,955,382	5,898,828	2,223,249	6,444,751
Sand and gravel ... do	3,385,097	3,080,215	5 4,055,834	5 4,277,499	5 4,319,420	5 5,204,046
Stone ... do	(1)	(1)	892,110	827,184	(1)	(1)
Sulfur ... long tons	940,126	15,042,016	862,278	14,658,726	1,005,711	18,100,000
Miscellaneous 6	------	3,095,648	------	2,780,789	------	3,990,928
Total value, eliminating duplications	------	273,882,000	------	405,576,000	------	593,403,000

1 Value included with "Miscellaneous."
2 Figure obtained through cooperation with Bureau of the Census.
3 Value of clay used in cement and heavy clay products is included here but is not included in total value for State.
4 No canvass.
5 "Commercial." Value of "Government-and-contractor" included with "Miscellaneous."
6 Includes minerals indicated by footnotes 1 and 5 above.

Mineral products of the United States, 1946–48, by States—Continued

MAINE

Product	1946 Quantity	1946 Value	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Beryllium concentrates ... short tons			(1)	(1)	(1)	(1)
Cement ... barrels	835,736	$1,602,127	955,498	$1,970,186	1,176,051	$2,754,568
Clay:						
Products, heavy clay (other than pottery and refractories)		[2] 191,000		[2] 286,000		[2] 416,000
Raw (sold or used) ... short tons	[3] 19,128	[3] 13,377	[3] 20,865	[3] 18,865	[3] 26,906	[3] 24,552
Columbium ores ... pounds					100	(1)
Feldspar (crude) ... long tons	18,922	110,237	16,898	97,565	18,774	130,486
Gem stones		(4)		(4)		(4)
Lime ... short tons	(1)	(1)	(1)	(1)	(1)	(1)
Lithium minerals ... do	(1)	(1)			(1)	(1)
Mica:						
Scrap ... do	24	607	18	460	(1)	(1)
Sheet ... pounds	(1)	(1)	4,393	686		
Mineral waters	(4)	(4)	(4)	(4)	(4)	(4)
Peat ... short tons	22,522	92,710	2,647	72,875	1,100	29,699
Sand and gravel ... do	2,834,360	925,308	3,777,147	1,241,377	[5] 496,355	[5] 286,765
Slate		(1)		(1)		(1)
Stone ... short tons	[6] 147,680	[6] 927,588	[6] 158,150	[6] 1,557,978	288,760	2,021,035
Miscellaneous [7]		539,183		821,992		2,843,678
Total value, eliminating duplications		4,389,000		6,049,000		8,482,000

[1] Value included with "Miscellaneous."
[2] Figure obtained through cooperation with Bureau of the Census.
[3] Value of clay used in cement and heavy clay products is included here but is not included in total value for State.
[4] No canvass.
[5] "Commercial." Value of "Government-and-contractor" included with "Miscellaneous."
[6] Exclusive of basalt in 1946 and unclassified stone in 1947, values for which are included with "Miscellaneous."
[7] Includes minerals indicated by footnotes 1, 5, and 6 above.

MARYLAND

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)		[2] $2,164,000		[2] $3,153,000		[2] $3,469,000
Raw (sold or used) short tons	[3] 402,232	[3] 497,279	[3] 602,634	[3] 908,755	[3] 589,864	[3] 972,428
Coal do	2,002,545	8,290,782	2,051,282	9,836,825	1,596,000	(1)
Coke do	1,661,606	(1 4)	1,975,201	(1 4)	2,147,787	(1 4)
Feldspar (crude) long tons			(1)	(1)		
Iron, pig short tons	1,945,852	(1 4)	2,408,230	(1 4)	2,805,936	(1 4)
Lime do	83,580	692,262	71,892	673,241	69,032	654,635
Mineral waters	(5)	(5)	(5)	(5)	(5)	(5)
Potassium salts short tons (K_2O equivalent)	(1)	(1)	(1)	(1)	(1)	(1)
Quartz short tons	(1)	(1)	(1)	(1)	(1)	(1)
Sand and gravel do	4,001,071	3,720,103	4,624,094	4,792,554	5,833,559	6,158,041
Slate		(1)		(1)		(1)
Stone short tons	[6] 1,715,120	[6] 2,622,618	[6] 1,552,610	[6] 2,416,393	1,874,270	3,115,196
Talc and ground soapstone do	(1)	(1)	(1)	(1)	(1)	(1)
Miscellaneous [7]		68,301,982		98,977,584		152,845,775
Total value, eliminating duplications		21,991,000		26,125,000		27,922,000

[1] Value included with "Miscellaneous."
[2] Figure obtained through cooperation with Bureau of the Census.
[3] Value of clay used in cement and heavy clay products is included here but is not included in total value for State.
[4] Value not included in total value for State.
[5] No canvass.
[6] Exclusive of crushed unclassified stone in 1946–47, values for which are included with "Miscellaneous."
[7] Includes minerals indicated by footnotes 1 and 6 above.

Mineral products of the United States, 1946–48, by States—Continued

MASSACHUSETTS

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Clay:						
Products, heavy clay (other than pottery and refractories)		[1] $1,235,000		[1] $1,380,000		[1] $1,364,000
Raw (sold or used) short tons	[2] 100,021	[2] 81,359	[2] 132,109	[2] 110,777	[2] 137,069	[2] 112,636
Coke do	1,046,267	([3] [4])	1,196,010	([3] [4])	1,056,701	([3] [4])
Iron, pig do	9,878	([3] [4])	203,844	([3] [4])	140,575	([3] [4])
Lime do	117,709	1,136,428	113,420	1,276,693	112,271	1,302,251
Mineral waters	([5])	([5])	([5])	([5])	([5])	([5])
Peat short tons	860	9,725	820	11,000	441	6,188
Quartz do	829	7,715	1,019	9,185	792	7,288
Sand and gravel do	4,641,685	2,909,784	4,942,920	3,511,855	5,500,350	4,418,132
Sand and sandstone (ground) do	2,000	10,000	1,944	11,628	2,150	14,000
Stone do	[6] 1,976,180	[6] 4,135,238	[6] 2,565,960	[6] 5,644,821	[6] 2,367,140	[6] 6,592,952
Miscellaneous [7]		12,144,465		23,397,472		21,290,038
Total value, eliminating duplications		9,745,000		11,859,000		13,844,000

[1] Figure obtained through cooperation with Bureau of the Census.
[2] Value of clay used in cement and heavy clay products is included here but is 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 sandstone and unclassified stone in 1946 and crushed sandstone in 1947–48, values for which are included with "Miscellaneous."
[7] Includes minerals indicated by footnotes 3 and 6 above.

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Bromine ... pounds	14,541,585	$3,736,118	18,802,636	$5,054,787	17,666,243	$5,435,940
Calcium chloride ... short tons	(1)	(1)	(1)	(1)	(1)	(1)
Cement ... barrels	9,974,692	16,727,145	10,470,766	18,868,187	11,116,911	23,533,001
Clay:						
Products, heavy clay (other than pottery and refractories)	----	[2] 2,962,000	----	[2] 3,240,000	----	[2] 3,764,000
Raw (sold or used) ... short tons	[3] 1,198,563	[3] 844,576	[3] 1,182,884	[3] 864,465	[3] 1,308,170	[3] 985,740
Coal ... do	79,990	516,043	14,013	107,667	14,000	(1)
Coke ... do	2,499,664	[4] 26,191,476	2,818,941	[4] 32,406,972	2,849,601	[4] 39,637,987
Copper ... pounds	43,326,000	7,018,812	48,368,000	10,157,280	55,554,000	12,055,218
Gem stones	----	(5)	----	(5)	----	(5)
Gypsum (crude) ... short tons	1,120,070	2,171,979	1,031,157	2,760,825	1,309,331	3,617,868
Iron:						
Ore ... long tons	8,477,425	28,297,890	12,965,482	46,782,975	12,896,478	53,246,591
Pig ... short tons	1,363,950	[4] 37,081,447	1,388,402	(1 4)	1,534,911	(1 4)
Lime ... do	(1)	(1)	(1)	(1)	(1)	(1)
Magnesium ... do	362	148,500	----	----	----	----
Magnesium compounds (from well brines) [6] ... short tons MgO equivalent	61,347	3,136,998	31,700	3,034,000	34,500	3,577,000
Manganiferous ore ... short tons	1,952	(1)	----	----	----	----
Marl, calcareous ... do	(1)	(1)	4,050	3,000	----	----
Mineral waters	(5)	(5)	(5)	(5)	(5)	(5)
Natural gas (estimated value at wells) ... M cubic feet	20,879,000	2,681,000	18,812,000	2,386,000	14,981,000	2,195,000
Natural gasoline and allied products:						
Natural gasoline ... gallons	4,624,000	216,000	3,658,000	248,000	2,471,000	238,000
Liquefied petroleum gases ... do	7,713,000	210,000	629,000	17,000	46,000	3,000
Ores (crude), etc.: Copper ... short tons	4,719,994	(7)	5,129,774	(7)	4,490,236	(7)
Peat ... do	8,620	122,250	(1)	(1)	12,425	154,500
Petroleum ... barrels	17,074,000	27,660,000	16,215,000	34,540,000	16,870,000	47,860,000
Potassium salts ... short tons (K_2O equivalent)	(1)	(1)	(1)	(1)	(1)	(1)
Salt ... short tons	4,334,202	15,711,074	4,447,269	15,043,057	4,387,879	16,265,743
Sand and gravel ... do	15,593,456	8,939,969	16,845,431	10,758,243	20,671,078	14,071,712
Silver ... troy ounces	----	----	3,089	2,796	----	----
Stone ... short tons	15,432,320	9,971,003	18,600,370	12,601,288	[8] 19,704,150	[8] 14,620,527
Miscellaneous [9]	----	3,011,741	----	48,708,921	----	51,146,698
Total value, eliminating duplications	----	133,310,000	----	169,597,000	----	205,954,000

[1] Value included with "Miscellaneous."
[2] Figure obtained through cooperation with Bureau of the Census.
[3] Value of clay used in cement and heavy clay products is included here but is not included in total value for State.
[4] Value not included in total value for State.
[5] No canvass.
[6] Data for 1946 not quite comparable with those for 1947 in that the former are on a gross-weight basis and include some compounds made from dolomite in combination with well brines. Figures for 1947-48 are partly estimated.
[7] Not valued as ore; value of recoverable metal content included with the metals.
[8] Exclusive of basalt, value for which is included with "Miscellaneous."
[9] Includes minerals indicated by footnotes 1 and 8 above.

Mineral products of the United States, 1946–48, by States—Continued

MINNESOTA

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement .... barrels	([1])	([1])	([1])	([1])	([1])	([1])
Clay:						
Products, heavy clay (other than pottery and refractories)		[2] $1,122,000		[2] $1,451,000		[2] $1,716,000
Raw (sold or used) .... short tons	[3] 62,961	[3] 64,717	[3] 148,188	[3] 142,806	[3] 132,717	[3] 151,965
Coke .... do	860,754	[4] 8,468,220	897,739	[4] 10,367,425	846,246	[4] 12,425,815
Flint lining for tube mills .... do	([1])	([1])	([1])	([1])	([1])	([1])
Gem stones		([5])		([5])		([5])
Iron:						
Ore .... long tons	49,055,340	142,049,316	62,436,102	203,614,336	67,923,237	249,523,078
Pig .... short tons	540,057	([1] [4])	546,432	([1] [4])	557,252	([1] [4])
Lime .... do	([1])	([1])	([1])	([1])	([1])	([1])
Manganiferous ore .... do	1,070,694	2,609,446	1,044,961	2,739,340	1,198,523	([1])
Marl, calcareous .... do	1,500	1,200	10,100	9,575	11,262	9,209
Mineral waters	([5])	([5])	([5])	([5])	([5])	([5])
Peat .... short tons	([1])	([1])	([1])	([1])	3,000	12,900
Pebbles for grinding .... do	([1])	([1])	([1])	([1])	([1])	([1])
Sand and gravel .... do	10,814,635	3,221,434	13,510,136	4,194,268	13,722,541	4,818,983
Stone .... do	[6] 1,286,800	[6] 3,700,535	[6] 1,372,220	[6] 3,854,473	1,804,960	5,090,652
Miscellaneous [7]		16,567,825		20,493,981		28,267,578
Total value, eliminating duplications		155,734,000		219,685,000		268,813,000

[1] Value included with "Miscellaneous."
[2] Figure obtained through cooperation with Bureau of the Census.
[3] Value of clay used in cement and heavy clay products is included here but is not included in total value for State.
[4] Value not included in total value for State.
[5] No canvass.
[6] Exclusive of sandstone in 1946 and basalt in 1947, values for which are included with "Miscellaneous."
[7] Includes minerals indicated by footnotes 1 and 6 above.

MISSISSIPPI

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Clay:						
Products, heavy clay (other than pottery and refractories)		[1] $1,138,000		[1] $1,496,000		[1] $1,885,000
Raw (sold or used) .... short tons	[2] 413,562	[2] 732,131	[2] 383,593	[2] 1,067,584	[2] 453,464	[2] 1,416,293
Fuller's earth .... do			([3])	([3])	([4])	

Product	1946 Quantity	1946 Value	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Mineral waters	(5)	(5)	(5)	(5)	(5)	(5)
Natural gas (estimated value at wells) M cubic feet	7,225,000	332,000	40,037,000	1,989,000	59,899,000	3,336,000
Natural gasoline and allied products:						
Natural gasoline and cycle products gallons	----	----	16,735,000	915,000	27,167,000	1,687,000
Liquefied petroleum gases do	----	----	3,207,000	159,000	18,339,000	922,000
Petroleum barrels	24,298,000	30,130,000	34,925,000	61,470,000	45,809,000	109,025,000
Sand and gravel short tons	2,619,293	1,533,631	[6] 2,036,136	[6] 1,393,218	2,879,256	1,519,930
Stone do	(3)	(3)	(3)	(3)	24,330	27,980
Miscellaneous [7]	----	68,385	----	650,581	----	----
Total value, eliminating duplications	----	33,672,000	----	68,986,000	----	119,635,000

[1] Figure obtained through cooperation with Bureau of the Census.
[2] Value of clay used in cement and heavy clay products is included here but is not included in total value for State.
[3] Value included with "Miscellaneous."
[4] Bureau of Mines not at liberty to publish figure.
[5] No canvass.
[6] "Commercial." Value of "Government-and-contractor" included with "Miscellaneous."
[7] Includes minerals indicated by footnotes 3 and 6 above.

MISSOURI

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Asphalt (native) short tons	(1)	(1)	(1)	(1)	(1)	(1)
Barite do	270,850	$2,168,067	291,619	$2,405,249	278,071	$2,413,802
Cement barrels	6,887,517	12,142,018	8,030,939	15,066,390	8,428,343	17,911,257
Clay:						
Products, heavy clay (other than pottery and refractories)	----	[2] 3,963,000	----	[2] 4,123,000	----	[2] 5,314,000
Raw (sold or used) short tons	[3] 1,689,229	[3] 3,257,687	[3] 1,744,411	[3] 4,051,157	[3] 2,135,547	[3] 5,309,128
Coal do	3,732,815	10,432,591	4,236,427	14,093,663	4,470,000	15,779,000
Cobalt pounds	(1)	(1)	(1)	(1)	----	----
Coke short tons	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)
Copper pounds	3,714,000	601,668	3,520,000	739,200	4,740,000	1,028,580
Iron ore long tons	156,350	(1)	171,356	(1)	165,326	(1)
Lead short tons	139,112	30,326,416	132,246	38,086,848	102,288	36,619,104
Lime do	799,742	5,931,485	889,090	7,006,426	1,009,993	8,998,691
Mineral paints (zinc and lead pigments) do	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)
Mineral waters	(5)	(5)	(5)	(5)	(5)	(5)
Natural gas (estimated value at wells) M cubic feet	40,000	6,000	38,000	5,000	27,000	5,000

See footnotes at end of table.

Mineral products of the United States, 1946–48, by States—Continued

MISSOURI—Continued

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Ores (crude), etc.:						
Lead ... short tons	5,361,694	(6)	5,711,700	(6)	5,219,718	(6)
Lead-copper ... do	141,698	(6)	183,442	(6)	207,186	(6)
Zinc ... do	700,849	(6)	606,910	(6)	176,980	(6)
Zinc-lead ... do	1,297,689	(6)	804,755	(6)	94,970	(6)
Petroleum ... barrels	51,000	(1)	55,000	(1)	53,000	(1)
Sand and gravel ... short tons	5,136,904	$4,070,448	[7] 4,597,495	[7] $4,193,474	4,886,611	$4,197,922
Sand and sandstone (ground) ... do	(1)	(1)	(1)	(1)	(1)	(1)
Silver ... troy ounces	69,401	56,076	93,600	84,708	114,187	103,345
Stone ... short tons	7,258,990	8,996,440	[8] 8,438,320	[8] 11,195,993	[8] 9,020,580	[8] 12,320,220
Sulfuric acid (basis, 100 percent) [9] ... do	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)
Tripoli ... do	12,180	211,244	19,375	469,927	(1)	(1)
Tungsten concentrates ... short tons (60-percent WO_3 basis)	----	----	----	----	4	(1)
Zinc ... short tons	22,234	5,425,096	17,074	4,131,908	6,463	1,719,158
Miscellaneous [10]	----	4,520,383	----	7,271,714	----	8,148,556
Total value, eliminating duplications	----	88,357,000	----	107,878,000	----	113,506,000

[1] Value included with "Miscellaneous."
[2] Figure obtained through cooperation with Bureau of the Census.
[3] Value of clay used in cement and heavy clay products is included here but is 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] "Commercial." Value of "Government-and-contractor" included with "Miscellaneous."
[8] Exclusive of sandstone in 1947–48, values for which are included with "Miscellaneous."
[9] From zinc smelting.
[10] Includes minerals indicated by footnotes 1, 7, and 8 above.

MONTANA

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Arsenious oxide (white arsenic) ... short tons	(1)	(1)	(1)	(1)	(2)	(2)
Bismuth ... pounds	(2)	(2)	(2)	(2)	(2)	(2)
Cement ... barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)	----	[3] $191,000	----	[3] $206,000	----	[3] $281,000
Raw (sold or used) ... short tons	[4] 56,423	[4] 187,201	[4] 67,912	[4] 156,094	[4] 55,370	[4] 149,799

Coal:						
Bituminous ... do	3,682,913	6,450,781	3,139,221	6,395,054	2,800,000	5,488,000
Lignite ... do	40,013	105,331	38,669	112,198		
Copper ... pounds	116,962,000	18,947,844	115,800,000	24,318,000	116,504,000	25,281,368
Ferro-alloys ... short tons	----	----	----	----	(1 5)	(1 5)
Fluorspar ... do	----	----	----	----	318	(1)
Gem stones	----	(6)	----	(6)	----	(6)
Gold ... troy ounces	70,507	2,467,745	90,124	3,154,340	73,091	2,558,185
Gypsum (crude) ... short tons	(1)	(1)	(1)	(1)	(1)	(1)
Lead ... do	8,280	1,805,040	16,108	4,639,104	18,411	6,591,138
Lime ... do	(1)	(1)	(1)	(1)	(1)	(1)
Manganese ore ... do	137,522	4,643,050	129,689	4,153,045	130,184	4,362,066
Manganiferous ore ... do	3,816	(1)	3,671	(1)	4,135	(1)
Mineral waters	(6)	(6)	(6)	(6)	(6)	(6)
Natural gas (estimated value at wells) ... M cubic feet	30,713,000	1,419,000	34,282,000	1,560,000	36,551,000	1,696,000
Natural gasoline and allied products:						
Natural gasoline ... gallons	2,624,000	183,000	2,768,000	216,000	3,403,000	370,000
Liquefied petroleum gases ... do	1,973,000	109,000	2,988,000	208,000	5,046,000	350,000
Ores (crude), etc.:						
Copper ... short tons	1,781,895	(7)	1,838,580	(7)	1,511,069	(7)
Dry and siliceous (gold and silver) ... do	149,611	(7)	287,730	(7)	217,248	(7)
Lead ... do	5,857	(7)	12,508	(7)	25,398	(7)
Zinc ... do	73,727	(7)	10,758	(7)	34,048	(7)
Zinc-lead ... do	223,868	(7)	950,437	(7)	1,232,544	(7)
Petroleum ... barrels	8,825,000	12,710,000	8,742,000	16,960,000	9,380,000	24,238,000
Phosphate rock ... long tons	179,944	1,207,054	236,229	1,571,117	248,683	1,720,254
Pumice ... short tons	----	----	2,035	9,476	(1)	(1)
Pyrites ... long tons	(1)	(1)	(1)	(1)	(1)	(1)
Sand and gravel ... short tons	2,428,681	1,301,867	4,203,797	3,129,921	7,383,873	3,256,957
Silver ... troy ounces	3,273,140	2,644,697	6,326,190	5,725,202	6,930,716	6,272,648
Stone ... short tons	441,480	440,046	632,620	574,726	614,950	613,024
Talc ... do	(1)	(1)	(1)	(1)	(1)	(1)
Tungsten concentrates ... short tons (60-percent WO_3 basis)	84	(1)	4	(1)	----	----
Vermiculite ... short tons	(1)	(1)	(1)	(1)	(1)	(1)
Zinc ... do	16,770	4,091,880	45,679	11,054,318	59,095	15,719,270
Miscellaneous [8]	----	3,235,005	----	4,131,126	----	4,903,714
Total value, eliminating duplications	----	62,114,000	----	88,231,000	----	103,125,000

[1] Value included with "Miscellaneous."
[2] Figure not available.
[3] Figure obtained through cooperation with Bureau of the Census.
[4] Value of clay used in cement and heavy clay products is included here but is 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 footnote 1 above.

Mineral products of the United States, 1946–48, by States—Continued

NEBRASKA

Product	1946 Quantity	1946 Value	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Cement ... barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)		(1 2)		(1 2)		(1 2)
Raw (sold or used) ... short tons	[3] 130,586	[3] $112,985	[3] 98,911	[3] $88,194	[3] 158,979	[3] $129,116
Mineral waters	(4)	(4)	(4)	(4)	(4)	(4)
Petroleum ... barrels	293,000	400,000	229,000	420,000	240,000	578,000
Pumice ... short tons	4,772	45,900	4,546	43,760	4,000	34,200
Sand and gravel ... do	3,969,811	1,962,560	3,792,622	2,135,625	4,725,530	2,933,256
Stone ... do	263,930	612,120	219,780	537,824	366,110	707,327
Miscellaneous [5]		4,254,178		4,266,588		5,177,316
Total value, eliminating duplications		7,277,000		7,405,000		9,432,000

[1] Value included with "Miscellaneous."
[2] Figure obtained through cooperation with Bureau of the Census.
[3] Value of clay used in cement and heavy clay products is included here but is not included in total value for State.
[4] No canvass.
[5] Includes minerals indicated by footnote 1 above.

NEVADA

Product	1946 Quantity	1946 Value	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Andalusite ... short tons			(1)	(1)	(1)	(1)
Antimony ore (concentrates) ... do	15	$1,593	1,352	$34,119	225	$52,805
Arsenious oxide ... do	(2)	(2)	(2)	(2)	(2)	(2)
Barite ... do	(1)	(1)	37,388	261,168	(1)	(1)
Bismuth ... pounds	(2)	(2)	(2)	(2)	(2)	(2)
Clay:						
Products, heavy clay (other than pottery and refractories)		(1 3)		(1 3)		(1 3)
Raw (sold or used) ... short tons	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)
Copper ... pounds	97,232,000	15,751,584	99,206,000	20,833,260	90,484,000	19,635,028
Diatomite ... short tons	(1)	(1)	(1)	(1)	(1)	(1)
Fluorspar ... do	6,234	(1)	8,042	(1)	9,615	(1)
Fuller's earth ... do	(1)	(1)	(1)	(1)	(1)	(1)
Gem stones		(5)		(5)		(5)

Gold ... troy ounces	90,680	3,173,800	89,063	3,117,205	111,532	3,903,620
Gypsum (crude) ... short tons	490,253	1,164,083	526,972	1,377,143	519,552	1,222,070
Iron ore ... long tons	3,299	(1)	5,452	(1)	8,945	(1)
Lead ... short tons	7,175	1,564,150	7,161	2,062,368	9,777	3,500,166
Lime ... do	(1)	(1)	(1)	(1)	(1)	(1)
Magnesite ... do	(1)	(1)	(1)	(1)	(1)	(1)
Magnesium oxide (from brucite) ... do	(1)	(1)	(1)	(1)	(1)	(1)
Manganese ore ... do	1,064	(1)	67	(1)	---	---
Manganiferous ore ... do	12,468	(1)	13,117	(1)	8,707	(1)
Marl, calcareous ... do	(1)	(1)	(1)	(1)	(1)	(1)
Mercury ... flasks (76 pounds)	4,567	448,662	3,881	324,995	1,206	92,247
Mineral waters	(5)	(5)	(5)	(5)	(5)	(5)
Molybdenum ... pounds	(1)	(1)	(1)	(1)	(1)	(1)
Ores (crude), etc.:						
Copper ... short tons	5,102,212	(6)	5,828,016	(6)	6,209,049	(6)
Dry and siliceous (gold and silver) ... do	329,575	(6)	462,088	(6)	698,554	(6)
Lead ... do	14,468	(6)	24,139	(6)	32,598	(6)
Lead-copper ... do	---	---	---	---	102	(6)
Zinc ... do	11,306	(6)	3,913	(6)	186,286	(6)
Zinc-lead ... do	268,244	(6)	223,291	(6)	46,022	(6)
Zinc-lead-copper ... do	---	---	188	(6)	---	---
Perlite ... do	---	---	(1)	(1)	---	---
Salt ... do	(1)	(1)	(1)	(1)	(1)	(1)
Sand and gravel ... do	720,506	944,332	963,253	1,460,251	2,248,885	2,018,151
Silver ... troy ounces	1,250,651	1,010,526	1,377,579	1,246,709	1,790,020	1,620,058
Stone ... short tons	[7] 87,810	[7] 122,940	1,691,700	1,068,840	554,880	680,957
Sulfur ore ... long tons	42	3,396	(1)	(1)	358	7,160
Talc and pinite ... short tons	7,589	141,180	9,767	175,489	8,019	107,730
Tungsten concentrates ... short tons (60-percent WO_3 basis)	2,617	3,321,161	2,002	2,673,714	949	(1)
Vermiculite ... short tons	(1)	(1)	---	---	---	---
Zinc ... do	22,649	5,526,356	16,970	4,106,740	20,288	5,396,608
Miscellaneous [8]	---	2,280,002	---	3,915,183	---	6,876,601
Total value, eliminating duplications	---	35,454,000	---	42,639,000	---	45,110,000

1 Value included with "Miscellaneous."
2 Figure not available.
3 Figure obtained through cooperation with Bureau of the Census.
4 Value of clay used in cement and heavy clay products is included here but is 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 limestone, value for which is included with "Miscellaneous."
8 Includes minerals indicated by footnotes 1 and 7 above.

Mineral products of the United States, 1946–48, by States—Continued

NEW HAMPSHIRE

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Beryllium concentrates ... short tons	5	$365	(1)	(1)	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)	----	(1 2)	----	[2] $342,000	----	(1 2)
Raw (sold or used) ... short tons	[3] 18,108	[3] 12,381	[3] 28,605	[3] 21,456	[3] 25,262	[3] $18,960
Feldspar (crude) ... long tons	(1)	(1)	(1)	(1)	(1)	(1)
Gem stones	----	(4)	----	(4)	----	(4)
Mica:						
Scrap ... short tons	(1)	(1)	403	9,937	(1)	(1)
Sheet ... pounds	377,650	41,589	----	----	----	----
Mineral waters	(4)	(4)	(4)	(4)	(4)	(4)
Peat ... short tons	(1)	(1)	----	----	----	----
Sand and gravel ... do	[5] 1,434,880	[5] 138,789	[5] 1,737,084	[5] 198,748	2,481,658	651,042
Scythestones ... do	(1)	(1)	(1)	(1)	(1)	(1)
Stone ... do	68,530	385,828	109,230	399,879	88,430	314,353
Miscellaneous [6]	----	884,624	----	623,504	----	766,888
Total value, eliminating duplications	----	1,451,000	----	1,574,000	----	1,732,000

[1] Value included with "Miscellaneous."
[2] Figure obtained through cooperation with Bureau of the Census.
[3] Value of clay used in cement and heavy clay products is included here but is 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 footnotes 1 and 5 above.

NEW JERSEY

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Clay:						
Products, heavy clay (other than pottery and refractories)		[1] $3,780,000		[1] $6,564,000		[1] $8,149,000
Raw (sold or used) short tons	[2] 488,161	[2] 1,296,358	[2] 571,504	[2] 1,407,301	[2] 599,818	[2] 1,571,034
Coke do	1,258,854	(3 4)	1,432,210	(3 4)	1,410,941	(3 4)
Ferro-alloys do	(3 4)	(3 4)	(3 4)	(3 4)	(3 4)	(3 4)
Iron ore long tons	419,274	3,052,831	468,895	3,689,832	436,372	3,739,985
Lime short tons	(3)	(3)	(3)	(3)	(3)	(3)
Magnesium oxide (from sea water) do	(3)	(3)	(3)	(3)	(3)	(3)
Manganiferous residuum do	205,786	(3)	227,547	(3)	291,383	(3)
Marl, greensand do	5,140	424,900	8,337	432,980	7,269	392,959
Mineral paints (zinc and lead pigments) do	(3 4)	(3 4)	(3 4)	(3 4)	(3 4)	(3 4)
Mineral waters	(5)	(5)	(5)	(5)	(5)	(5)
Ores (crude), etc.: Zinc short tons	413,755	(6)	499,067	(6)	488,701	(6)
Peat do	20,902	127,550	21,640	135,300	23,102	163,056
Sand and gravel do	5,123,324	5,404,206	[7] 5,532,011	[7] 6,335,343	[7] 6,325,445	[7] 7,489,662
Sand and sandstone (ground) do	105,985	649,828	118,446	772,213	116,832	782,644
Stone do	3,419,210	5,239,342	3,857,710	6,136,857	3,591,440	6,375,877
Zinc [8] do	64,454	11,701,346	76,871	17,420,052	76,332	20,709,849
Miscellaneous [9]		15,260,706		18,293,785		22,557,682
Total value, eliminating duplications		33,518,000		44,245,000		51,092,000

[1] Figure obtained through cooperation with Bureau of the Census.
[2] Value of clay used in cement and heavy clay products is included here but is 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] Not valued as ore; value of recoverable metal content included with the metal.
[7] "Commercial." Value of "Government-and-contractor" included with "Miscellaneous."
[8] 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.
[9] Includes minerals indicated by footnotes 3 and 7 above.

Mineral products of the United States, 1946–48, by States—Continued

NEW MEXICO

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Arsenious oxide ... short tons	(1)	(1)	(1)	(1)	(1)	(1)
Beryllium concentrates ... do			(2)	(2)		
Bismuth ... pounds	(1)	(1)	(1)	(1)	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)		[3] $148,000		[3] $183,000		[3] $251,000
Raw (sold or used) ... short tons	[4] 39,013	[4] 43,487	[4] 56,772	[4] 50,400	[4] 50,459	[4] 63,140
Coal ... do	1,280,279	5,297,841	1,443,210	6,522,061	1,420,000	7,171,000
Copper ... pounds	100,382,000	16,261,884	120,410,000	25,286,100	149,374,000	32,414,158
Fluorspar ... short tons	17,584	489,607	27,526	841,095	24,968	911,682
Gem stones		(5)		(5)		(5)
Gold ... troy ounces	4,009	140,315	3,146	110,110	3,414	119,490
Gypsum (crude) ... short tons					(2)	(2)
Lead ... do	4,899	1,067,982	6,383	1,838,304	7,653	2,739,774
Lithium minerals ... do	(2)	(2)	(2)	(2)		
Manganese ore ... do	1,166	(2)	858	(2)		
Manganiferous ore ... do	72,299	(2)	97,007	(2)	122,879	(2)
Mica:						
Scrap ... do					(2)	(2)
Sheet ... pounds					(2)	(2)
Mineral waters	(5)	(5)	(5)	(5)	(5)	(5)
Molybdenum ... pounds	(2)	(2)	(2)	(2)	(2)	(2)
Natural gas (estimated value at wells) ... M cubic feet	119,262,000	1,694,000	142,740,000	2,526,000	194,749,000	5,258,000
Natural gasoline and allied products:						
Natural gasoline ... gallons	87,677,000	3,759,000	92,303,000	6,026,000	100,182,000	9,812,000
Liquefied petroleum gases ... do	15,965,000	344,000	20,748,000	703,000	31,396,000	1,234,000
Ores (crude), etc.:						
Copper ... short tons	6,044,004	(6)	6,772,030	(6)	7,139,147	(6)
Dry and siliceous (gold and silver) ... do	11,228	(6)	1,165	(6)	1,430	(6)
Lead ... do	737	(6)	12,323	(6)	12,671	(6)
Lead-copper ... do					103	(6)
Zinc ... do	487,063	(6)	489,149	(6)	454,891	(6)
Zinc-lead ... do	51,858	(6)	78,278	(6)	124,921	(6)
Petroleum ... barrels	36,814,000	44,540,000	40,926,000	72,440,000	47,969,000	117,500,000
Potassium salts ... short tons (K_2O equivalent)	789,473	27,187,228	880,605	28,035,675	967,945	29,177,328
Pumice ... short tons	62,623	432,890	85,639	512,176	177,630	812,545
Salt ... do	8,677	16,399	12,006	19,239	(2)	(2)
Sand and gravel ... do	[7] 349,688	[7] 278,442	540,794	492,583	[7] 717,088	[7] 573,385
Silver ... troy ounces	338,000	273,104	515,833	466,829	537,674	486,622
Stone ... short tons	(2)	(2)	477,970	251,080	531,300	293,858
Tantalum concentrates ... pounds	1,772	5,547	3,259	8,677		

Vanadium ... do.			(2)	(2)	(2)	(2)
Zinc ... short tons	36,103	8,809,132	44,103	10,672,926	41,502	11,039,532
Miscellaneous [8]		1,184,025		705,503		1,210,826
Total value, eliminating duplications		111,938,000		157,652,000		221,022,000

[1] Figure not available.
[2] Value included with "Miscellaneous."
[3] Figure obtained through cooperation with Bureau of the Census.
[4] Value of clay used in cement and heavy clay products is included here but is 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] Includes minerals indicated by footnotes 2 and 7 above.

NEW YORK

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Aluminum ... short tons	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)
Cement ... barrels	[3] 10,514,431	[3] $17,547,319	[3] 11,592,821	[3] $21,060,957	[3] 12,299,226	[3] $26,071,417
Clay:						
Products, heavy clay (other than pottery and refractories)		[4] 7,289,000		[4] 9,021,000		[4] 13,270,000
Raw (sold or used) ... short tons	[5] 1,137,105	[5] 840,143	[5] 1,174,134	[5] 855,385	[5] 1,465,305	[5] 1,129,484
Coke ... do.	5,042,674	[2] 44,316,777	5,670,333	[2] 58,629,308	5,687,225	[2] 72,756,957
Diatomite ... do.	(1)	(1)				
Emery ... do.	6,188	62,099	5,798	66,927	5,405	69,408
Feldspar (crude) ... long tons	(1)	(1)	(1)	(1)	(1)	(1)
Ferro-alloys ... short tons	321,817	[2] 45,255,465	346,330	[2] 52,912,305	365,067	[2] 66,185,597
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)	(1 2)	(1 2)
Gypsum (crude) ... short tons	814,999	1,961,157	949,375	2,613,094	1,228,358	3,294,973
Iron:						
Ore ... long tons	(1)	(1)	2,513,555	19,673,363	2,932,442	24,384,648
Pig ... short tons	2,801,828	[2] 63,937,403	3,675,217	[2] 101,204,575	3,744,341	[2] 122,440,520
Lead ... do.	1,073	233,914	1,496	430,848	1,231	440,698
Lime ... do.	(1)	(1)	(1)	(1)	(1)	(1)
Marl, calcareous ... do.			500	3,000		
Mica, scrap ... do.	(1)	(1)				
Millstones		(1)		(1)		(1)
Mineral waters	(6)	(6)	(6)	(6)	(6)	(6)
Natural gas (estimated value at wells) ... M cubic feet	5,084,000	1,351,000	4,600,000	1,118,000	4,705,000	1,040,000
Natural gasoline ... gallons	9,000	(1)	11,000	1,000	11,000	1,000
Ores (crude), etc.:						
Zinc ... short tons	130,069	(7)	114,995	(7)	154,361	(7)
Zinc-lead ... do.	262,197	(7)	322,898	(7)	309,688	(7)

See footnotes at end of table.

Mineral products of the United States, 1946–48, by States—Continued

NEW YORK—Continued

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Peat .... short tons..	(1)	(1)	(1)	(1)	----------	----------
Petroleum .... barrels..	4,863,000	$18,630,000	4,762,000	$20,050,000	4,621,000	$22,975,000
Pyrites .... long tons..	(1)	(1)	(1)	(1)	(1)	(1)
Salt .... short tons..	2,813,782	10,153,274	2,923,023	11,875,485	3,065,831	13,056,542
Sand and gravel .... do....	12,079,249	8,907,100	13,820,196	10,906,224	16,369,303	13,382,370
Silver .... troy ounces..	15,786	12,755	22,409	20,280	18,788	17,004
Slate	----------	1,160,404	----------	1,575,252	----------	1,532,880
Stone .... short tons..	9,939,440	12,086,748	11,197,990	14,992,064	12,687,970	17,261,486
Talc .... do....	(1)	(1)	(1)	(1)	119,716	2,613,935
Titanium concentrates: Ilmenite .... do....	209,009	(1)	(1)	(1)	(1)	(1)
Wollastonite .... do....	(1)	(1)	80	1,600	75	1,500
Zinc .... do....	32,515	7,933,660	34,116	8,256,072	34,566	9,194,556
Miscellaneous [8]	----------	37,604,558	----------	31,213,897	----------	29,808,161
Total value, eliminating duplications	----------	103,571,000	----------	130,667,000	----------	156,140,000

[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] Figure obtained through cooperation with Bureau of the Census.
[5] Value of clay used in cement and heavy clay products is included here but is 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 footnotes 1 and 3 above.

NORTH CAROLINA

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Aluminum .... short tons..	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)
Asbestos .... do....	(1)	(1)	(1)	(1)	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)	----------	[3] $6,241,000	----------	[3] $8,232,000	----------	[3] $10,615,000
Raw (sold or used) .... short tons..	[4] 914,999	[4] 1,178,030	[4] 1,068,572	[4] 1,314,976	[4] 1,204,747	[4] 1,436,417
Feldspar (crude) .... long tons..	230,367	1,200,638	220,997	1,081,514	201,774	1,116,825
Flint lining for tube mills .... short tons..	(1)	(1)	(1)	(1)	(1)	(1)
Gem stones	----------	(5)	----------	(5)	----------	(5)

Mica:						
Scrap ... short tons	39,100	887,901	38,655	844,086	44,428	992,303
Sheet ... pounds	424,791	135,505	210,816	84,275	257,926	44,678
Millstones		(1)		(1)		(1)
Mineral waters	(5)	(5)	(5)	(5)	(5)	(5)
Olivine ... short tons	6,249	(1)	7,938	(1)	3,926	(1)
Pebbles for grinding ... do	(1)	(1)	(1)	(1)	(1)	(1)
Quartz ... do	(1)	(1)	(1)	(1)	(1)	(1)
Sand and gravel ... do	4,213,795	2,933,711	4,171,553	2,956,800	4,837,437	3,522,403
Stone ... do	4,505,880	6,835,448	5,018,060	7,561,167	5,237,050	7,713,859
Talc and pyrophyllite ... do	87,718	976,524	97,484	1,186,463	104,052	1,455,691
Titanium concentrates: Ilmenite ... do	17,852	(1)	27,199	(1)	28,790	(1)
Tungsten concentrates ... short tons (60-percent WO_3 basis)	307	(1)	538	(1)	965	(1)
Vermiculite ... short tons	(1)	(1)	(1)	(1)	(1)	(1)
Miscellaneous [6]		7,685,377		8,232,649		10,498,242
Total value, eliminating duplications		20,428,000		23,754,000		27,885,000

[1] Value included with "Miscellaneous."
[2] Value not included in total value for State.
[3] Figure obtained through cooperation with Bureau of the Census.
[4] Value of clay used in cement and heavy clay products is included here but is not included in total value for State.
[5] No canvass.
[6] Includes minerals indicated by footnote 1 above.

NORTH DAKOTA

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Clay:						
Products, heavy clay (other than pottery and refractories)		(1 2)		(1 2)		(1 2)
Raw (sold or used) ... short tons	(1 3)	(1 3)	(1 3)	(1 3)	[3] 11,561	[3] $16,254
Coal (lignite) ... do	2,554,682	$4,301,603	2,759,862	$5,312,084	2,975,000	6,724,000
Mineral waters	(4)	(4)	(4)	(4)	(4)	(4)
Natural gas (estimated value at wells) ... M cubic feet	344,000	10,000	442,000	14,000	643,000	19,000
Sand and gravel ... short tons	2,304,694	726,422	2,383,021	920,111	5,244,995	1,712,827
Stone ... do					(1)	(1)
Miscellaneous [5]		90,680		95,860		125,150
Total value, eliminating duplications		5,118,000		6,330,000		8,581,000

[1] Value included with "Miscellaneous."
[2] Figure obtained through cooperation with Bureau of the Census.
[3] Value of clay used in cement and heavy clay products is included here but is not included in total value for State.
[4] No canvass.
[5] Includes minerals indicated by footnote 1 above.

Mineral products of the United States, 1946–48, by States—Continued

OHIO

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Calcium chloride……short tons					(1)	(1)
Cement……barrels	8,187,531	$13,293,126	9,296,311	$16,611,421	10,020,198	$20,496,930
Clay:						
Products, heavy clay (other than pottery and refractories)		[2] 39,729,000		[2] 51,348,000		[2] 60,918,000
Raw (sold or used)……short tons	[3] 4,047,818	[3] 6,113,837	[3] 4,562,985	[3] 7,714,329	[3] 4,963,581	[3] 8,257,821
Coal……do	32,314,262	96,670,095	37,548,204	131,344,763	36,104,000	142,972,000
Coke……do	8,451,580	[4] 69,357,225	10,069,237	[4] 98,973,704	10,562,486	[4] 128,843,686
Ferro-alloys……do	201,682	[4] 8,884,960	247,035	[4] 15,976,882	259,271	[4] 21,852,890
Grindstones……do	10,854	478,022	(1)	(1)	(1)	(1)
Gypsum (crude)……do	(1)	(1)	(1)	(1)	(1)	(1)
Iron, pig……do	9,647,981	[4] 240,218,956	12,322,330	[4] 380,383,106	12,367,227	[4] 469,653,906
Lime……do	1,469,278	12,926,310	1,774,847	17,685,220	1,936,211	21,473,401
Mineral paints (zinc and lead pigments)……do	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)
Mineral waters	(5)	(5)	(5)	(5)	(5)	(5)
Natural gas (estimated value at wells)……M cubic feet	61,570,000	11,280,000	68,946,000	13,548,000	65,619,000	12,901,000
Natural gasoline and allied products:						
Natural gasoline……gallons	6,253,000	329,000	6,940,000	499,000	6,152,000	636,000
Liquefied petroleum gases……do			144,000	5,000	203,000	11,000
Peat……short tons	18,979	161,444	17,754	143,247	19,207	162,073
Petroleum……barrels	2,908,000	7,710,000	3,108,000	10,440,000	3,300,000	13,733,000
Salt……short tons	2,645,995	4,160,011	2,975,676	6,815,639	2,752,696	5,884,343
Sand and gravel……do	13,266,074	11,105,652	15,388,990	14,195,288	15,508,815	15,149,848
Sand and sandstone (ground)……do	(1)	(1)	(1)	(1)	(1)	(1)
Scythestones, whetstones, etc……do	249	51,135	(1)	(1)	(1)	(1)
Stone……do	[6] 16,991,440	[6] 19,069,169	[6] 18,710,890	[6] 23,633,433	20,274,570	27,552,017
Sulfuric acid (basis, 100 percent) [7]……do	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)
Miscellaneous [8]		3,774,430		5,363,177		4,795,720
Total value, eliminating duplications		221,356,000		291,960,000		328,228,000

[1] Value included with "Miscellaneous."
[2] Figure obtained through cooperation with Bureau of the Census.
[3] Value of clay used in cement and heavy clay products is included here but is 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 1946, and unclassified stone in 1947, values for which are included with "Miscellaneous."
[7] From zinc-roasting operation.
[8] Includes minerals indicated by footnotes 1 and 6 above.

OKLAHOMA

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
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] $1,557,000	....	[2] $1,563,000	....	[2] $1,899,000
Raw (sold or used) .... short tons	[3] 488,973	[3] 358,922	[3] 522,704	[3] 349,000	[3] 510,316	[3] 389,903
Coal .... do	2,647,380	9,926,836	3,420,563	15,101,477	2,925,000	13,075,000
Gypsum (crude) .... do	(1)	(1)	(1)	(1)	(1)	(1)
Lead .... do	13,697	2,985,946	14,289	4,115,232	16,918	6,056,644
Lime .... do	(1)	(1)	(1)	(1)	(1)	(1)
Mineral waters	(4)	(4)	(4)	(4)	(4)	(4)
Natural gas (estimated value at wells) .... M cubic feet	380,938,000	12,342,000	419,010,000	16,509,000	480,573,000	23,356,000
Natural gasoline and allied products:						
Natural gasoline .... gallons	283,915,000	12,907,000	280,891,000	18,690,000	273,010,000	25,431,000
Liquefied petroleum gases .... do	131,076,000	2,955,000	165,602,000	5,700,000	197,131,000	10,980,000
Ores (crude), etc.:						
Lead .... short tons	2,236	(5)	103	(5)	95,686	(5)
Zinc .... do	9,067,673	(5)	4,451,405	(5)	2,375,557	(5)
Zinc-lead .... do	3,139,744	(5)	2,471,819	(5)	1,867,061	(5)
Petroleum .... barrels	134,794,000	194,100,000	141,019,000	270,760,000	154,032,000	397,865,000
Pumice .... short tons	....	....	(1)	(1)	(1)	(1)
Salt .... do	(1)	(1)	(1)	(1)	(1)	(1)
Sand and gravel .... do	1,577,138	947,283	1,670,205	1,125,322	2,004,512	1,088,003
Stone .... do	3,413,430	2,624,579	2,610,770	2,679,855	4,027,630	4,141,379
Sulfuric acid (basis, 100 percent) [6] .... do	(1 7)	(1 7)	(1 7)	(1 7)	(1 7)	(1 7)
Zinc .... do	69,552	16,970,688	51,062	12,357,004	43,821	11,656,386
Miscellaneous [8]	....	6,359,531	....	7,524,303	....	8,486,021
Total value, eliminating duplications	....	263,282,000	....	355,750,000	....	503,654,000

[1] Value included with "Miscellaneous."
[2] Figure obtained through cooperation with Bureau of the Census.
[3] Value of clay used in cement and heavy clay products is included here but is 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 footnote 1 above.

Mineral products of the United States, 1946–48, by States—Continued

OREGON

Product	1946		1947		1948	
	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	10	$1,593	33	$1,338	----	----
Cement ... barrels	([1])	([1])	([1])	([1])	([1])	([1])
Chromite ... short tons	([1])	([1])	----	----	3,345	([1])
Clay:						
Products, heavy clay (other than pottery and refractories)	----	[3] 788,000	----	[3] 1,038,000	----	[3] $1,189,000
Raw (sold or used) ... short tons	[4] 118,478	[4] 90,044	[4] 141,050	[4] 87,895	[4] 172,168	[4] 128,586
Coal ... do	17,153	75,515	----	----	----	----
Copper ... pounds	14,000	2,268	28,000	5,880	4,000	868
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	----	([5])	----	([5])	----	([5])
Gold ... troy ounces	17,598	615,930	18,979	664,265	14,611	511,385
Lead ... short tons	2	436	12	3,456	7	2,506
Lime ... do	([1])	([1])	([1])	([1])	----	----
Mercury ... flasks (76 pounds)	1,326	130,266	1,185	99,232	1,351	103,338
Mineral waters	([5])	([5])	([5])	([5])	([5])	([5])
Ores (crude), etc.:						
Copper ... short tons	152	([6])	109	([6])	----	----
Dry and siliceous (gold and silver) ... do	3,094	([6])	3,168	([6])	3,119	([6])
Perlite ... do	----	----	([1])	([1])	([1])	([1])
Pumice ... do	3,004	12,532	33,240	111,380	106,277	307,274
Quartz ... do	([1])	([1])	([1])	([1])	([1])	([1])
Sand and gravel ... do	5,419,183	4,578,672	6,020,440	5,541,373	8,384,755	10,628,889
Silver ... troy ounces	6,927	5,597	30,379	27,493	13,596	12,305
Stone ... short tons	[7] 1,472,700	[7] 2,008,374	3,002,000	4,425,847	3,682,420	5,733,658
Zinc ... do	----	----	1	242	----	----
Miscellaneous [8]	----	6,535,529	----	24,786,806	----	25,358,139
Total value, eliminating duplications	----	11,807,000	----	16,573,000	----	24,871,000

[1] Value included with "Miscellaneous."
[2] Value not included in total value for State.
[3] Figure obtained through cooperation with Bureau of the Census.
[4] Value of clay used in cement and heavy clay products is included here but is 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 dimension basalt in 1946, values for which are included with "Miscellaneous."
[8] Includes minerals indicated by footnotes 1 and 7 above.

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement .... barrels	29,686,909	$48,294,891	33,655,687	$60,998,207	38,255,543	$81,638,484
Clay:						
Products, heavy clay (other than pottery and refractories)	----------	[1] 18,764,000	----------	[1] 22,831,000	----------	[1] 29,247,000
Raw (sold or used) .... short tons	[2] 3,178,011	[2] 6,943,203	[2] 3,330,612	[2] 7,857,447	[2] 3,609,027	[2] 8,855,148
Coal:						
Anthracite .... do	60,506,873	413,417,070	57,190,009	413,019,486	57,139,948	467,051,800
Bituminous .... do	125,496,856	459,536,386	147,079,296	622,832,802	132,550,000	657,448,000
Cobalt .... pounds	(3)	(3)	(3)	(3)	(3)	(3)
Coke .... short tons	16,821,888	[4] 121,817,080	22,388,026	[4] 222,057,346	22,383,524	[4] 257,033,715
Copper [5] .... pounds	(3)	(3)	(3)	(3)	(3)	(3)
Ferro-alloys .... short tons	444,442	[4] 58,712,282	564,386	[4] 79,956,306	618,677	[4] 101,135,580
Gem stones	----------	(6)	----------	(6)	----------	(6)
Gold [5] .... troy ounces	1,150	40,250	1,518	53,130	2,200	77,000
Graphite, crystalline .... pounds	(3)	(3)	(3)	(3)	----------	----------
Iron:						
Ore .... long tons	(3)	(3)	918,038	(3)	1,122,220	(3)
Pig .... short tons	13,330,186	[4] 329,194,957	17,587,252	[4] 531,716,815	17,750,295	[4] 651,136,537
Lime .... do	972,311	8,272,202	1,045,566	9,861,812	1,085,807	11,319,685
Mineral paints (zinc and lead pigments) .... do	(3 4)	(3 4)	(3 4)	(3 4)	(3 4)	(3 4)
Mineral waters	(6)	(6)	(6)	(6)	(6)	(6)
Natural gas (estimated value at wells) .... M cubic feet	92,443,000	23,508,000	91,971,000	21,816,000	87,578,000	21,124,000
Natural gasoline and allied products:						
Natural gasoline .... gallons	10,540,000	513,000	12,420 000	831,000	11,334,000	1,105,000
Liquefied petroleum gases .... do	463,000	40,000	593,000	51,000	919,000	66,000
Peat .... short tons	2,952	9,615	(3)	(3)	(3)	(3)
Perlite .... do	----------	----------	----------	----------	(3)	(3)
Petroleum .... barrels	12,996,000	49,640,000	12,690,000	53,170,000	12,667,000	63,457,000
Pyrites .... long tons	(3)	(3)	(3)	(3)	(3)	(3)
Sand and gravel .... short tons	10,773,213	10,984,330	11,543,971	13,006,644	12,422,546	15,304,020
Sand and sandstone (ground) .... do	(3)	(3)	(3)	(3)	(3)	(3)
Silver [5] .... troy ounces	7,887	6,373	9,863	8,926	13,731	12,427
Slate	----------	3,197,745	----------	4,318,196	----------	5,351,153
Soapstone .... short tons	(3)	(3)	(3)	(3)	----------	----------
Stone .... do	18,883,740	25,872,596	[7] 22,352,810	[7] 31,938,877	23,172,190	35,189,148
Sulfuric acid (basis, 100 percent) [8] .... do	229,401	[4] 2,882,645	256,347	[4] 3,425,877	238,125	[4] 3,363,248
Tripoli (rottenstone) .... do	1,144	16,255	516	10,380	(3)	(3)
Miscellaneous [9]	----------	25,858,979	----------	33,660,156	----------	41,330,702
Total value, eliminating duplications	----------	1,074,004,000	----------	1,269,762,000	----------	1,407,347,000

[1] Figure obtained through cooperation with Bureau of the Census.
[2] Value of clay used in cement and heavy clay products is included here but is not included in total value for State.
[3] Value included with "Miscellaneous."
[4] Value not included in total value for State.
[5] The magnetite-pyrite-chalcopyrite ore from which copper, gold, and silver are recovered is classed by the Bureau of Mines as iron ore.
[6] No canvass.
[7] Exclusive of dimension basalt, value for which is included with "Miscellaneous."
[8] From zinc smelting.
[9] Includes minerals indicated by footnotes 3 and 7 above.

Mineral products of the United States, 1946–48, by States—Continued

RHODE ISLAND

Product	1946		1947		1948	
	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	(3)	(3)	(3)	(3)	(3)	(3)
Sand and gravel ... short tons	[4] 41, 659	[4] $8, 486	[4] 44, 363	[4] $25, 261	633, 436	$728, 990
Stone ... do	[5] 4, 860	[5] 274, 130	[5] 32, 090	[5] 400, 602	107, 080	536, 651
Miscellaneous [6]		2, 687, 793		3, 724, 243		3, 893, 302
Total value, eliminating duplications		561, 000		785, 000		1, 450, 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 unclassified stone, values for which are included with "Miscellaneous."
[6] Includes minerals indicated by footnotes 1, 4, and 5 above.

SOUTH CAROLINA

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Clay:						
Products, heavy clay (other than pottery and refractories)		[1] $2, 421, 000		[1] $3, 123, 000		[1] $3, 587, 000
Raw (sold or used) ... short tons	[2] 614, 403	[2] 2, 795, 123	[2] 708, 705	[2] 3, 124, 510	[2] 710, 246	[2] 3, 714, 271
Ferro-alloys ... do	(3 4)	(3 4)	(3 4)	(3 4)	(3 4)	(3 4)
Gem stones		(5)		(5)		(5)
Kyanite ... short tons					(3)	(3)
Manganese ore ... do	78	(3)				
Mica: Scrap ... do	(3)	(3)				
Mineral waters	(5)	(5)	(5)	(5)	(5)	(5)
Sand and gravel ... short tons	524, 271	214, 964	601, 313	278, 021	403, 285	198, 439
Stone ... do	1, 979, 270	2, 990, 678	2, 207, 840	3, 921, 465	2, 443, 750	4, 543, 436
Topaz, industrial ... do	700	10, 500	2, 294	45, 873	200	4, 000
Vermiculite ... do	(3)	(3)	(3)	(3)	(3)	(3)
Miscellaneous [6]		2, 843, 386		2, 820, 417		3, 386, 677
Total value, eliminating duplications		8, 189, 000		10, 362, 000		12, 105, 000

[1] Figure obtained through cooperation with Bureau of the Census.
[2] Value of clay used in cement and heavy clay products is included here but is 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] Includes minerals indicated by footnote 3 above.

SOUTH DAKOTA

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Beryllium concentrates short tons	95	$17,422	70	$11,762	45	(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 (sold or used) short tons	[2] 247,257	[3] 1,428,703	[2] 248,863	[3] 2,107,365	[2] 226,934	[3] $1,758,230
Coal (lignite) do	16,946	36,362	14,618	35,727	15,000	45,000
Feldspar (crude) long tons	74,540	299,852	58,959	284,378	54,037	270,889
Gem stones	----	(4)	----	(4)	----	(4)
Gold troy ounces	312,247	10,928,645	407,194	14,251,790	377,850	13,224,750
Gypsum (crude) short tons	(1)	(1)	(1)	(1)	(1)	(1)
Lead do	----	----	8	2,304	16	5,728
Lime do	(1)	(1)	(1)	(1)	(1)	(1)
Lithium minerals do	813	30,610	(1)	(1)	(1)	(1)
Mica:						
Scrap do	2,806	63,692	1,499	37,225	988	28,515
Sheet pounds	17,400	8,432	188,380	28,704	----	----
Mineral waters	(4)	(4)	(4)	(4)	(4)	(4)
Natural gas (estimated value at wells) M cubic feet	5,000	265	6,000	360	2,000	130
Ores (crude), etc.:						
Dry and siliceous (gold and silver) short tons	872,242	(5)	935,634	(5)	1,003,859	(5)
Zinc-lead do	----	----	3,750	(5)	1,480	(5)
Quartz do	(1)	(1)	(1)	(1)	(1)	(1)
Sand and gravel do	3,215,608	1,537,822	3,122,409	1,672,253	4,687,055	3,247,428
Silver troy ounces	86,901	70,216	111,684	101,074	94,693	85,702
Stone short tons	379,880	2,385,543	885,650	3,554,096	763,080	3,911,236
Tantalum concentrates pounds	1,703	3,246	----	----	500	(1)
Tin (metallic equivalent) short tons	----	----	----	----	(1)	(1)
Tungsten concentrates short tons (60-percent WO_3 basis)	1	(1)	----	----	----	----
Zinc short tons	----	----	19	4,598	29	7,714
Miscellaneous [6]	----	1,612,755	----	1,549,549	----	1,766,424
Total value, eliminating duplications	----	18,389,000	----	23,604,000	----	24,296,000

[1] Value included with "Miscellaneous."
[2] Figure obtained through cooperation with Bureau of the Census.
[3] Value of clay used in cement and heavy clay products is included here but is 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 footnote 1 above.

Mineral products of the United States, 1946–48, by States—Continued

TENNESSEE

Product	1946 Quantity	1946 Value	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Aluminum ... short tons	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)
Barite ... do	33,595	$272,169	31,476	$285,853	25,818	$275,242
Cement ... barrels	5,372,964	9,386,582	6,101,108	11,017,225	6,774,926	13,667,060
Clay:						
Products, heavy clay (other than pottery and refractories)	-----	[3] 3,691,000	-----	[3] 4,044,000	-----	[3] 4,527,000
Raw (sold or used) ... short tons	[4] 893,313	[4] 1,955,408	[4] 931,341	[4] 2,256,496	[4] 994,697	[4] 2,702,566
Coal ... do	5,618,352	21,556,537	6,258,483	29,840,946	5,910,000	33,214,000
Coke ... do	229,751	(1 2)	241,925	(1 2)	251,428	(1 2)
Copper ... pounds	(1)	(1)	(1)	(1)	(1)	(1)
Ferro-alloys ... short tons	63,425	[2] 6,162,051	147,704	[2] 9,196,881	144,599	[2] 11,072,047
Fuller's earth ... do	(1)	(1)	(1)	(1)	(1)	(1)
Gold ... troy ounces	95	3,325	303	10,605	156	5,460
Iron:						
Ore (sinter from copper-iron ore) ... long tons	332,756	(1)	350,518	(1)	373,980	(1)
Pig ... short tons	32,688	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)
Lead ... do	125	27,250	22	6,336	-----	-----
Lime ... do	160,698	1,232,480	181,039	1,533,737	163,098	1,442,906
Manganese ore ... do	-----	-----	39	(1)	37	(1)
Mineral waters	(5)	(5)	(5)	(5)	(5)	(5)
Natural gas (estimated value at wells) ... M cubic feet	47,000	5,000	80,000	5,000	127,000	12,000
Ores (crude), etc.:						
Copper ... short tons	1,012,910	(6)	1,050,810	(6)	1,086,810	(6)
Lead ... do	1,600	(6)	400	(6)	-----	-----
Zinc ... do	798,409	(6)	1,097,670	(6)	1,078,356	(6)
Petroleum ... barrels	10,000	(1)	8,000	(1)	8,000	(1)
Phosphate rock ... long tons	(1)	(1)	1,411,848	7,778,619	1,307,507	8,231,251
Pyrites ... do	(1)	(1)	(1)	(1)	(1)	(1)
Quartz ... short tons	(1)	(1)	(1)	(1)	(1)	(1)
Sand and gravel ... do	4,011,591	3,632,603	3,891,251	3,805,669	3,816,802	4,147,728
Silver ... troy ounces	18,016	14,557	79,147	71,628	39,692	35,923
Stone ... short tons	5,156,490	7,625,086	6,796,630	10,617,502	8,011,360	12,932,537
Sulfuric acid (basis, 100 percent) [7] ... do	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)
Zinc ... do	24,614	6,005,816	31,212	7,553,304	29,524	7,853,384
Miscellaneous [8]	-----	48,445,809	-----	49,143,383	-----	52,350,062
Total value, eliminating duplications	-----	68,031,000	-----	85,664,000	-----	95,863,000

[1] Value included with "Miscellaneous."
[2] Value not included in total value for State.
[3] Figure obtained through cooperation with Bureau of the Census.
[4] Value of clay used in cement and heavy clay products is included here but is 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] From copper smelting.
[8] Includes minerals indicated by footnote 1 above.

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Asphalt (native) ... short tons	([1])	([1])	([1])	([1])	([1])	([1])
Bromine ... pounds	([1])	([1])	([1])	([1])	([1])	([1])
Cement ... barrels	10,996,478	$19,946,600	12,349,219	$24,111,833	13,786,846	$30,352,972
Clay:						
Products, heavy clay (other than pottery and refractories)	----	[2] 7,019,000	----	[2] 7,552,000	----	[2] 9,648,000
Raw (sold or used) ... short tons	[3] 1,369,003	[3] 1,714,403	[3] 1,385,878	[3] 1,739,141	[3] 1,590,244	[3] 2,181,004
Coal (lignite) ... do	55,978	46,454	60,504	59,293	56,000	([1])
Coke ... do	----	----	263,006	([1], [4])	644,225	([1], [4])
Copper ... pounds	6,000	972	12,000	2,520	46,000	9,982
Feldspar (crude) ... long tons	([1])	([1])	([1])	([1])	----	----
Fluorspar ... short tons	1,118	([1])	1,019	([1])	906	([1])
Fuller's earth ... do	110,693	1,157,892	102,901	1,199,726	92,310	1,162,336
Gem stones	----	([5])	----	([5])	----	([5])
Gold ... troy ounces	9	315	45	1,575	57	1,995
Graphite, crystalline ... pounds	([1])	([1])	([1])	([1])	([1])	([1])
Gypsum (crude) ... short tons	771,633	1,630,929	831,633	2,000,341	893,704	2,143,539
Helium ... cubic feet	[6] 60,493,365	[6] 440,912	[6] 63,198,650	[6] 541,307	[6] 67,486,567	[6] 641,848
Iron:						
Ore ... long tons	21,458	([1])	289,273	([1])	746,274	([1])
Pig ... short tons	----	----	([1], [4])	([1], [4])	([1], [4])	([1], [4])
Lead ... do	47	10,246	78	22,464	170	60,860
Lime ... do	121,841	1,053,493	134,530	1,274,095	168,738	1,583,726
Magnesite ... do	([1])	([1])	([1])	([1])	----	----
Magnesium ... do	8,498	3,484,000	5,264	([1])	8,489	3,480,496
Magnesium compounds (from sea water) ... do	([1])	([1])	([1])	([1])	([1])	([1])
Mineral waters	([5])	([5])	([5])	([5])	([5])	([5])
Natural gas (estimated value at wells) ... M cubic feet	1,776,148,000	53,640,000	1,992,704,000	73,331,000	2,289,923,000	103,505,000
Natural gasoline and allied products:						
Natural gasoline and cycle products ... gallons	1,598,520,000	66,783,000	1,654,574,000	109,297,000	1,861,164,000	170,306,000
Liquefied petroleum gases ... do	684,459,000	15,587,000	984,860,000	32,724,000	1,123,225,000	50,433,000
Ores (crude), etc.:						
Copper ... short tons	80	([7])	68	([7])	957	([7])
Dry and siliceous (gold and silver) ... do	2,054	([7])	962	([7])	----	----
Lead ... do	221	([7])	772	([7])	893	([7])
Zinc ... do	4,350	([7])	----	----	----	----
Zinc-lead ... do	----	----	2,750	([7])	----	----
Peat ... do	([1])	([1])	([1])	([1])	1,334	19,028
Pebbles for grinding ... do	177	1,770	([1])	([1])	([1])	([1])
Petroleum ... barrels	760,215,000	1,070,400,000	820,210,000	1,597,630,000	903,318,000	2,326,209,000
Pumice ... short tons	805	13,054	([1])	([1])	([1])	([1])
Salt (sodium chloride) ... do	1,098,589	1,356,676	1,191,621	2,090,098	1,354,109	1,712,169
Sand and gravel ... do	11,188,849	8,086,097	13,198,728	10,540,980	15,137,848	12,810,573

See footnotes at end of table.

Mineral products of the United States, 1946–48, by States—Continued

TEXAS—Continued

Product	1946 Quantity	1946 Value	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Sand and sandstone...short tons..	---	---	---	---	(1)	(1)
Silver...troy ounces..	42,922	$34,681	20,547	$18,595	3,065	$2,774
Soapstone...short tons..	(1)	(1)	(1)	(1)	(1)	(1)
Sodium sulfate (natural)...do....	(1)	(1)	(1)	(1)	(1)	(1)
Stone...do....	3,285,220	3,611,118	3,786,040	4,277,404	[8] 3,844,350	[8] 4,658,720
Sulfur...long tons..	3,188,086	51,009,372	3,965,825	70,514,144	3,973,201	71,500,000
Sulfuric acid (basis, 100 percent) [9]...short tons..	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)
Sulfur ore...long tons..	5,100	71,400	2,675	37,450	(1)	(1)
Tungsten concentrates...short tons (60-percent WO_3 basis)...	1	(1)	---	---	---	---
Vermiculite...short tons..	(1)	(1)	---	---	---	---
Zinc...do....	44	10,736	22	5,324	---	---
Miscellaneous [10]...	---	7,591,305	---	24,882,744	---	50,140,362
Total value, eliminating duplications...	---	1,313,003,000	---	1,954,351,000	---	2,809,071,000

[1] Value included with "Miscellaneous."
[2] Figure obtained through cooperation with Bureau of the Census.
[3] Value of clay used in cement and heavy clay products is included here but is 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, value for which is included with "Miscellaneous."
[9] From zinc smelting.
[10] Includes minerals indicated by footnotes 1 and 8 above.

UTAH

Product	1946 Quantity	1946 Value	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Arsenious oxide (white arsenic)...short tons..	(1)	(1)	(1)	(1)	---	---
Asphalt (native)...do....	96,974	$1,615,368	99,192	$1,987,049	(1)	(1)
Bismuth...pounds..	(2)	(2)	(2)	(2)	(2)	(2)
Cement...barrels..	(1)	(1)	(1)	(1)	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)...	---	(1 3)	---	[3] 1,210,000	---	[3] $1,386,000
Raw (sold or used)...short tons..	[4] 105,621	[4] 199,775	[4] 181,876	[4] 297,520	[4] 168,050	[4] 272,420
Coal...do....	5,994,013	21,448,859	7,428,699	29,211,722	6,716,000	30,289,000
Coke...do....	492,367	(1 5)	1,043,465	(1 5)	1,247,087	(1 5)
Copper...pounds..	228,568,000	37,028,016	533,066,000	111,943,860	454,014,000	98,521,038

Fluorspar — short tons	2,370	(1)	1,730	(1)	9,523	(1)
Fuller's earth — do	(1)	(1)	(1)	(1)	(1)	(1)
Gem stones		(6)		(6)		(6)
Gold — troy ounces	178,533	6,248,655	421,662	14,758,170	368,422	12,894,770
Gypsum (crude) — short tons	(1)	(1)	(1)	(1)	(1)	(1)
Iron:						
Ore — long tons	1,321,334	1,372,109	2,821,293	2,860,739	3,233,122	3,926,058
Pig — short tons	(1 5)	(1 5)	(1 5)	(1 5)	(1 5)	(1 5)
Lead — do	30,711	6,694,998	49,698	14,313,024	55,950	20,030,100
Lime — do	29,057	271,526	47,096	366,127	40,635	352,859
Manganiferous ore — do	7,903	(1)	7,198	(1)	2,694	(1)
Molybdenum — pounds	(1)	(1)	(1)	(1)	(1)	(1)
Natural gas (estimated value at wells) — M cubic feet	4,252,000	213,000	6,040,000	324,000	6,610,000	397,000
Natural gasoline — gallons	578,000	35,000	685,000	47,000	640,000	64,000
Ores (crude), etc.:						
Copper — short tons	12,471,208	(7)	29,021,293	(7)	24,458,362	(7)
Dry and siliceous (gold and silver) — do	79,875	(7)	171,741	(7)	215,712	(7)
Lead — do	11,700	(7)	27,194	(7)	27,416	(7)
Lead-copper — do	1,236	(7)			3	(7)
Zinc — do	105,222	(7)	94,685	(7)	46,136	(7)
Zinc-lead — do	576,450	(7)	1,066,614	(7)	992,717	(7)
Zinc-lead-copper — do			1,587	(7)	1,565	(7)
Phosphate rock — long tons	(1)	(1)	(1)	(1)	(1)	(1)
Potassium salts — short tons (K_2O equivalent)	(1)	(1)	(1)	(1)	(1)	(1)
Pumice — short tons			7,500	30,000	7,618	30,472
Radium (refined) — milligrams	[8] 10	[8] 185	(1)	(1)	(1)	(1)
Salt (sodium chloride) — short tons	121,669	339,505	113,285	340,028	113,779	429,494
Sand and gravel — do	1,653,010	992,083	2,945,943	1,612,354	2,278,184	1,368,562
Silver — troy ounces	4,118,453	3,327,710	7,780,032	7,040,929	8,045,329	7,281,429
Stone — short tons	404,370	591,940	[9] 178,680	[9] 368,255	279,660	477,654
Sulfuric acid (basis, 100 percent) [10] — do	(1 5)	(1 5)	(1 5)	(1 5)	(1 5)	(1 5)
Tungsten concentrates — short tons (60-percent WO_3 basis)	27	(1)	1	(1)	3	(1)
Vanadium — pounds	63,188	37,370	48,949	(1)	(1)	(1)
Zinc — short tons	28,292	6,903,248	43,673	10,568,866	41,490	11,036,340
Miscellaneous [11]		24,794,199		49,304,670		74,453,754
Total value, eliminating duplications		95,506,000		206,970,000		204,752,000

[1] Value included with "Miscellaneous."
[2] Figure not available.
[3] Figure obtained through cooperation with Bureau of the Census.
[4] Value of clay used in cement and heavy clay products is included here but is 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] Estimated.
[9] Exclusive of sandstone, value for which is included with "Miscellaneous."
[10] From copper smelting.
[11] Includes minerals indicated by footnotes 1 and 9 above.

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Mineral products of the United States, 1946–48, by States—Continued

VERMONT

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Asbestos .... short tons	(1)	(1)	(1)	(1)	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)	-------	(1 2)	-------	(1 2)	-------	(1 2)
Raw (sold or used) .... short tons	(1 3)	(1 3)	(1 3)	(1 3)	(1 3)	(1 3)
Copper .... pounds	(1)	(1)	(1)	(1)	(1)	(1)
Gold .... troy ounces	165	$5,775	100	$3,500	104	$3,640
Lime .... short tons	(1)	(1)	(1)	(1)	22,743	308,004
Mineral waters	(4)	(4)	(4)	(4)	(4)	(4)
Ores (crude), etc.: Copper .... short tons	126,782	(5)	145,661	(5)	144,914	(5)
Sand and gravel .... do	383,576	241,289	780,192	561,862	731,687	619,069
Silver .... troy ounces	35,275	28,502	21,469	19,429	24,910	22,545
Slate	-------	(1)	-------	(1)	-------	3,631,943
Stone .... short tons	230,400	6,740,160	392,420	7,652,139	395,380	7,992,144
Talc .... do	75,144	843,247	77,327	999,704	70,922	1,014,718
Miscellaneous [6]	-------	4,243,652	-------	5,587,308	-------	2,546,628
Total value, eliminating duplications	-------	12,096,000	-------	14,818,000	-------	16,132,000

[1] Value included with "Miscellaneous."
[2] Figure obtained through cooperation with Bureau of the Census.
[3] Value of clay used in cement and heavy clay products is included here but is 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 footnote 1 above.

VIRGINIA

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Aplite (crude) .... long tons	(1)	(1)	(1)	(1)	(1)	(1)
Bauxite .... long tons (dried equivalent)	(1)	(1)	-------	-------	-------	-------
Cement .... barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)	-------	[2] $2,914,000	-------	[2] $3,936,000	-------	[2] $4,512,000
Raw (sold or used) .... short tons	[3] 325,901	[3] 328,724	[3] 443,371	[3] 400,315	[3] 518,266	[3] 470,357
Coal .... do	15,526,895	59,570,583	20,170,799	97,405,945	19,620,000	118,309,000
Coke .... do	171,242	[4] 1,619,144	211,876	[4] 2,508,223	200.911	[4] 2,886,723
Copper .... pounds	-------	-------	10,000	2,100	-------	-------

Feldspar (crude)……long tons..	32,960	204,588	41,820	261,741	34,770	231,607
Ferro-alloys……short tons..	([1,4])	([1,4])	([1,4])	([1,4])	([1,4])	([1,4])
Gem stones……	------------	([5])	------------	([5])	------------	([5])
Gypsum (crude)……short tons..	([1])	([1])	([1])	([1])	([1])	([1])
Iron:						
Ore……long tons..	([1])	([1])	6,782	([1])	2,991	([1])
Pig……short tons..	2	([1,4])	([1,4])	([1,4])	([1,4])	([1,4])
Kyanite……do….	([1])	([1])	([1])	([1])	([1])	([1])
Lead……do….	4,381	955,058	3,803	1,095,264	4,703	1,683,674
Lime……do….	181,282	1,365,931	260,663	2,138,707	382,734	3,271,053
Manganese ore……do….	1,280	([1])	------------	------------	427	([1])
Manganiferous ore……do….	87	([1])	6,208	([1])	2,462	([1])
Marl, calcareous……do….	137,122	175,389	98,970	120,995	53,597	65,601
Mica: Scrap……do….	286	6,697	([1])	([1])	------------	------------
Millstones……	------------	([1])	------------	([1])	------------	([1])
Mineral waters……	([5])	([5])	([5])	([5])	([5])	([5])
Natural gas (estimated value at wells)……M cubic feet..	57,000	5,000	64,000	6,000	74,000	7,000
Ores (crude), etc.: Zinc-lead……short tons..	490,278	([6])	505,759	([6])	519,899	([6])
Petroleum……barrels..	23,000	([1])	61,000	([1])	33,000	([1])
Phosphate rock……long tons..	([1])	([1])	([1])	([1])	------------	------------
Pyrites……do….	([1])	([1])	([1])	([1])	([1])	([1])
Salt……short tons..	([1])	([1])	([1])	([1])	([1])	([1])
Sand and gravel……do….	5,340,372	4,319,125	4,570,620	3,852,669	4,098,616	3,837,845
Sand and sandstone (ground)……do….	([1])	([1])	([1])	([1])	([1])	([1])
Slate……	------------	([1])	------------	([1])	------------	([1])
Stone [7]……short tons..	7,873,020	9,754,482	8,359,420	12,377,061	7,366,520	12,157,241
Talc and ground soapstone [7]……do….	([1])	([1])	([1])	([1])	([1])	([1])
Titanium concentrates:						
Ilmenite……do….	([1])	([1])	([1])	([1])	([1])	([1])
Rutile……do….	([1])	([1])	([1])	([1])	([1])	([1])
Zinc……do….	16,905	4,124,820	16,788	4,062,696	15,882	4,224,612
Miscellaneous [8]……	------------	11,606,349	------------	14,565,013	------------	16,696,866
Total value, eliminating duplications……	------------	90,823,000	------------	133,953,000	------------	157,724,000

[1] Value included with "Miscellaneous."
[2] Figure obtained through cooperation with Bureau of the Census.
[3] Value of clay used in cement and heavy clay products is included here but is 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] Soapstone used as dimension stone included in figures for stone.
[8] Includes minerals indicated by footnote 1 above.

Mineral products of the United States, 1946–48, by States—Continued

WASHINGTON

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Aluminum ... short tons	137,688	[1] $38,872,100	191,330	[1] $53,671,777	232,067	[1] $67,411,000
Antimony ore (concentrates) ... do	205	10,040	335	26,091	------	------
Arsenious oxide ... do	(2)	(2)	------	------	------	------
Cement ... barrels	(3)	(3)	(3)	(3)	(3)	(3)
Clay:						
Products, heavy clay (other than pottery and refractories)	------	[4] 2,216,000	------	[4] 2,112,000	------	[4] 1,967,000
Raw (sold or used) ... short tons	[5] 235,361	[5] 227,594	[5] 242,174	[5] 241,328	[5] 291,366	[5] 294,552
Coal ... do	991,127	5,417,620	1,117,926	6,691,202	1,210,000	7,732,000
Copper ... pounds	9,054,000	1,466,748	4,480,000	940,800	11,330,000	2,458,610
Diatomite ... short tons	(3)	(3)	(3)	(3)	(3)	(3)
Ferro-alloys ... do	(1 3)	(1 3)	(1 3)	(1 3)	(1 3)	(1 3)
Fluorspar ... do	38	(3)	------	------	------	------
Gem stones	------	(6)	------	(6)	------	(6)
Gold ... troy ounces	51,168	1,790,880	34,965	1,223,775	70,075	2,452,625
Iron ore ... long tons	------	------	2,268	(3)	5,364	(3)
Lead ... short tons	2,987	651,166	5,359	1,543,392	7,147	2,558,626
Lime ... do	(3)	(3)	(3)	(3)	(3)	(3)
Magnesite ... do	(3)	(3)	(3)	(3)	(3)	(3)
Manganese ore ... do	1,424	(3)	------	------	------	------
Mineral waters	(6)	(6)	(6)	(6)	(6)	(6)
Olivine ... short tons	1,400	(3)	2,900	(3)	840	(3)
Ores (crude), etc.:						
Copper ... do	43	(7)	83	(7)	52	(7)
Dry and siliceous (gold and silver) ... do	51,622	(7)	63,995	(7)	72,243	(7)
Lead ... do	6,920	(7)	7,946	(7)	15,350	(7)
Lead-copper ... do	------	------	3	(7)	------	------
Zinc ... do	39,634	(7)	25,357	(7)	364	(7)
Zinc-copper ... do	491,402	(7)	232,158	(7)	608,863	(7)
Zinc-lead ... do	268,402	(7)	346,634	(7)	277,385	(7)
Peat ... do	(3)	(3)	2,425	10,125	(3)	(3)
Pebbles for grinding ... do	21	210	(3)	(3)	(3)	(3)
Pulpstones ... do	72	3,880	76	4,976	33	2,100
Pumice ... do	14,585	56,008	26,497	74,173	26,675	47,787
Quartz ... do	(3)	(3)	(3)	(3)	(3)	(3)
Sand and gravel ... do	7,557,707	4,608,392	8,380,571	5,700,960	9,267,225	6,657,129
Sand and sandstone (ground) ... do	(3)	(3)	(3)	(3)	6,682	33,783
Silver ... troy ounces	264,453	213,678	293,736	265,831	375,831	340,146
Stone ... short tons	[8] 3,149,900	[8] 3,232,805	3,865,110	4,550,275	5,229,500	6,382,462
Talc ... do	5,084	38,051	(3)	(3)	(3)	(3)
Tungsten concentrates ... short tons (60-percent WO_3 basis)	1	(3)	------	------	------	------

Product	1946 Quantity	1946 Value	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Zinc......short tons..	11,329	2,764,276	13,800	3,339,600	12,638	3,361,708
Miscellaneous [9]......	....	11,812,187	....	14,995,629	....	18,936,646
Total value, eliminating duplications......	....	33,029,000	....	39,924,000	....	50,498,000

[1] Value not included in total value for State.
[2] Figure not available.
[3] Value included with "Miscellaneous."
[4] Figure obtained through cooperation with Bureau of the Census.
[5] Value of clay used in cement and heavy clay products is included here but is 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] Includes minerals indicated by footnotes 3 and 8 above.

WEST VIRGINIA

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Bromine......pounds..	(1)	(1)	(1)	(1)	(1)	(1)
Calcium chloride......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] $4,428,000	....	[2] $5,529,000	....	[2] $6,871,000
Raw (sold or used)......short tons..	[3] 469,024	[3] 992,673	[3] 590,680	[3] 1,117,155	[3] 590,479	[3] 976,676
Coal......do....	144,020,092	526,151,730	176,156,579	788,825,871	168,200,000	921,736,000
Coke......do....	2,383,050	[4] 14,104,420	3,200,206	[4] 28,292,720	3,650,584	[4] 37,892,068
Ferro-alloys......do....	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)
Grindstones and pulpstones......do....	751	23,422	(1)	(1)	(1)	(1)
Iron, pig......do....	1,011,753	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)
Lime......do....	409,952	3,103,183	471,914	4,050,950	490,803	4,610,157
Marl, calcareous......do....	(1)	(1)	(1)	(1)	(1)	(1)
Mineral waters......	(5)	(5)	(5)	(5)	(5)	(5)
Natural gas (estimated value at wells)......M cubic feet..	178,958,000	26,736,000	192,233,000	29,643,000	203,681,000	34,035,000
Natural gasoline and allied products:						
Natural gasoline......gallons..	60,854,000	2,496,000	52,338,000	3,339,000	53,930,000	4,908,000
Liquefied petroleum gases......do....	59,590,000	1,653,000	88,935,000	2,975,000	103,412,000	4,778,000
Petroleum......barrels..	2,929,000	9,960,000	2,617,000	10,210,000	2,687,000	12,795,000
Salt......short tons..	272,841	896,894	279,300	1,161,429	246,732	1,197,645
Sand and gravel......do....	3,457,372	4,518,325	3,796,253	5,782,988	3,974,264	6,306,898
Sand and sandstone (ground)......do....	(1)	(1)	(1)	(1)	(1)	(1)
Stone......do....	[6] 4,131,540	[6] 4,464,048	4,888,860	6,033,930	4,929,910	5,802,683
Miscellaneous [7]......	....	55,432,224	....	68,207,347	....	89,281,439
Total value, eliminating duplications......	....	588,925,000	....	862,980,000	....	1,008,299,000

[1] Value included with "Miscellaneous."
[2] Figure obtained through cooperation with Bureau of the Census.
[3] Value of clay used in cement and heavy clay products is included here but is 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] Includes minerals indicated by footnotes 1 and 6 above.

Mineral products of the United States, 1946–48, by States—Continued

WISCONSIN

Product	1946 Quantity	1946 Value	1947 Quantity	1947 Value	1948 Quantity	1948 Value
Cement ... barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)		[2] $408,000		[2] $515,000		[2] $601,000
Raw (sold or used) ... short tons	[3] 154,913	[3] 135,207	[3] 111,450	[3] 81,200	[3] 155,062	[3] 113,803
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	1,097,471	(1)	1,543,099	(1)	1,468,953	(1)
Lead ... short tons	1,588	346,184	1,166	335,808	861	308,238
Lime ... do	74,686	760,432	70,233	805,000	107,648	1,228,988
Marl, calcareous ... do	883	750	(1)	(1)	10,293	6,991
Mineral waters	(5)	(5)	(5)	(5)	(5)	(5)
Ores (crude), etc.:						
Zinc ... short tons	670,210	(6)	313,111	(6)	32,040	(6)
Zinc-lead ... do	196,574	(6)	184,899	(6)	155,186	(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)
Quartz ... short tons	(1)	(1)	(1)	(1)	(1)	(1)
Sand and gravel ... do	14,828,713	6,802,828	16,335,238	9,938,778	18,613,088	11,370,089
Sand and sandstone (ground) ... do	(1)	(1)	(1)	(1)	(1)	(1)
Stone ... do	6,193,400	11,473,119	[7] 5,897,960	[7] 11,669,611	[7] 7,224,330	[7] 12,581,046
Zinc ... do	14,276	3,483,344	12,224	2,958,208	7,864	2,091,824
Miscellaneous [8]		12,263,081		17,019,765		19,572,270
Total value, eliminating duplications		28,596,000		34,942,000		37,641,000

1 Value included with "Miscellaneous."
2 Figure obtained through cooperation with Bureau of the Census.
3 Value of clay used in cement and heavy clay products is included here but is 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 footnotes 1 and 7 above.

WYOMING

Product	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement ... barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)	-----	[2] $268,000	-----	[2] $269,000	-----	(1 2)
Raw (sold or used) ... short tons	[3] 232,835	[3] 2,003,537	[3] 274,498	[3] 2,593,782	[3] 400,636	[3] $3,692,374
Coal ... do	7,634,484	22,895,612	8,051,147	27,139,183	6,300,000	23,877,000
Copper ... pounds	2,000	324	-----	-----	-----	-----
Feldspar (crude) ... long tons	20,345	83,496	18,801	90,258	16,760	78,080
Gem stones	-----	(4)	-----	(4)	-----	(4)
Gold ... troy ounces	105	3,675	1,486	52,010	115	4,025
Gypsum (crude) ... short tons	(1)	(1)	22,643	112,238	(1)	(1)
Iron ore ... long tons	619,317	(1)	651,471	(1)	689,591	(1)
Mineral waters	(4)	(4)	(4)	(4)	(4)	(4)
Natural gas (estimated value at wells) ... M cubic feet	33,266,000	1,264,000	45,550,000	2,273,000	52,424,000	3,119,000
Natural gasoline and allied products:						
Natural gasoline ... gallons	35,787,000	2,153,000	34,817,000	2,759,000	35,134,000	3,735,000
Liquefied petroleum gases ... do	7,719,000	323,000	15,993,000	691,000	24,577,000	1,551,000
Ores (crude), etc.:						
Copper ... short tons	19	(5)	-----	-----	-----	-----
Dry and siliceous (gold and silver) ... do	42	(5)	6,059	(5)	867	(5)
Petroleum ... barrels	38,977,000	44,430,000	44,772,000	75,220,000	54,004,000	128,962,000
Phosphate rock ... long tons	-----	-----	51,845	290,484	138,946	695,110
Sand and gravel ... short tons	2,005,951	1,129,598	2,268,381	1,490,702	2,021,848	1,507,906
Silver ... troy ounces	26	21	95	86	11	10
Sodium salts (natural) ... short tons	(1)	(1)	(1)	(1)	(1)	(1)
Stone ... do	1,204,570	1,203,636	1,393,070	1,497,034	964,460	1,265,694
Vermiculite ... do	(1)	(1)	(1)	(1)	(1)	(1)
Miscellaneous [6]	-----	3,001,393	-----	3,127,596	-----	4,339,984
Total value, eliminating duplications	-----	78,745,000	-----	117,594,000	-----	172,818,000

[1] Value included with "Miscellaneous."
[2] Figure obtained through cooperation with Bureau of the Census.
[3] Value of clay used in cement and heavy clay products is included here but is 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 footnote 1 above.

Employment and Injuries

in the Mineral Industries[1]

By FORREST T. MOYER AND JOSEPH H. SCHUSTER

GENERAL SUMMARY

THE labor force in the mineral industries gained 3 percent in 1948 to an average of 722,300 men working daily. These men worked 250 days or 10 less than in 1947. The average shift worked at mineral operations in 1948 was 7.92 hours, which was nearly ¼-hour shorter than in 1947. The total man-hours of worktime in 1948 declined 3 percent from 1947 owing to the fewer days of work and the shorter shift that more than offset the increased employment. Despite the decrease in aggregate worktime, output from mineral operations in 1948 was at record levels in both tonnage and dollar volumes. It is apparent that output per man-hour was increased in 1948. The increase in productivity probably was attained principally from increased mechanization and from greater utilization of open-pit and strip-mining methods.

Salient statistics of employment and injury experience in the mineral industries in the United States, 1944–48, by industry groups

	1944	1945	1946	1947 [1]	1948 [2]
Average number of men working daily: [3]					
Coal mines	453,937	437,921	463,079	[4] 469,100	485,600
Metal mines	70,413	61,294	65,234	71,228	72,000
Nonmetal mines	11,261	10,371	11,312	12,176	12,200
Quarries	58,476	58,180	70,265	75,245	78,200
Coke plants	24,766	22,987	21,410	23,705	25,000
Metallurgical plants	58,085	46,467	44,954	49,082	49,300
Total	676,938	637,220	676,254	700,536	722,300
Average number of active mine-days: [5]					
Coal mines	281	259	224	[4] 244	229
Metal mines	289	288	249	275	277
Nonmetal mines	282	291	291	292	284
Quarries	268	264	274	279	282
Coke plants	351	344	337	350	350
Metallurgical plants	329	329	284	313	315
Total	287	271	240	260	250

See footnotes at end of table.

[1] Data on petroleum, natural gas, sand and gravel, and clay industries and on iron smelting and steel industries are excluded from this chapter.

Salient statistics of employment and injury experience in the mineral industries in the United States, 1944–48, by industry groups—Continued

	1944	1945	1946	1947 [1]	1948 [2]
Man-days worked, in thousands: [6]					
Coal mines	[7] 127,500	113,424	103,847	[4] 114,285	111,014
Metal mines	20,349	17,673	16,238	19,567	19,918
Nonmetal mines	[7] 3,173	3,016	3,297	3,555	3,470
Quarries	15,691	15,376	19,262	20,996	22,052
Coke plants	8,687	7,915	7,205	8,293	8,753
Metallurgical plants	19,113	15,268	12,783	15,353	15,514
Total	[7] 194,513	172,672	162,632	182,049	180,721
Man-hours worked, in thousands: [6]					
Coal mines [8]	1,078,474	958,591	879,628	[4] 933,190	867,500
Metal mines	163,027	141,295	130,406	157,024	160,480
Nonmetal mines	25,760	24,613	26,877	28,809	28,350
Quarries	129,302	127,168	158,528	171,979	180,440
Coke plants	69,590	64,375	57,710	66,119	69,540
Metallurgical plants	152,326	121,491	101,673	122,630	124,200
Total [8]	1,618,479	1,437,533	1,354,822	1,479,751	1,430,510
Number of injuries:					
Fatal:					
Coal mines	1,298	1,068	968	1,165	1,010
Metal mines	130	96	90	126	101
Nonmetal mines	17	16	26	12	15
Quarries	73	53	55	75	73
Coke plants	15	18	8	15	17
Metallurgical plants	38	19	20	21	13
Total	1,571	1,270	1,167	1,414	1,229
Nonfatal:					
Coal mines	63,691	57,117	55,350	58,200	54,045
Metal mines	8,894	6,922	7,345	8,293	7,515
Nonmetal mines	1,283	1,145	1,369	1,308	1,165
Quarries	4,437	4,121	5,137	5,504	5,010
Coke plants	988	835	810	926	905
Metallurgical plants	4,158	3,271	2,794	3,228	2,810
Total	83,451	73,411	72,805	77,459	71,450
Injury rates per million man-hours:					
Fatal:					
Coal mines	1.20	1.11	1.10	1.25	1.16
Metal mines	.80	.68	.69	.80	.63
Nonmetal mines	.66	.65	.97	.42	.53
Quarries	.56	.42	.35	44	.40
Coke plants	.22	.28	.14	.23	.24
Metallurgical plants	.25	.16	.20	.17	.10
Total	.97	.88	.86	.96	.86
Nonfatal:					
Coal mines	59.06	59.58	62.92	62.37	62.30
Metal mines	54.56	48.99	56.32	52.81	46.83
Nonmetal mines	49.81	46.52	50.94	45.40	41.09
Quarries	34.32	32.41	32.40	32.00	27.77
Coke plants	14.20	12.97	14.04	14.01	13.01
Metallurgical plants	27.30	26.92	27.48	26.32	22.62
Total	51.56	51.07	53.74	52.35	49.95

[1] All data are final, except that data on coal mines are preliminary.
[2] Preliminary figures based on an average of 75 percent coverage.
[3] 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.
[4] Preliminary figure based upon 70 percent coverage of the industry.
[5] Average in which operating time of each mine is weighted by average number of workers in mine.
[6] Totals of man-days and man-hours are additions of the rounded subtotals and may differ slightly from totals obtained before rounding.
[7] Revised figure.
[8] Data included for bituminous-coal mines are on portal-to-portal basis.

The safety record of the extractive industries in 1948 was the best annual record in the 37-year statistical history of these industries. The over-all frequency rate of 50.81 fatal and nonfatal injuries per million man-hours of worktime was a marked improvement over the corresponding rate of 53.30 in 1947. There were 1,229 fatal injuries during the year, 185 fewer than in 1947. The fatality rate of 0.86 per million man-hours was considerably better than the rate in the preceding year and lower than that of any year except 1946, in which the rate was also 0.86. The relatively favorable fatality experience in 1948 resulted largely from a significant reduction in the number of fatal injuries in anthracite and bituminous-coal mining. Nonfatal-injury experience was also appreciably better than in 1947. In fact, the rate of 49.95 nonfatal injuries per million man-hours was lower than that of any year for which injury statistics are available. Although most of the mineral industries improved their nonfatal-injury records in 1948, the greatest decreases in nonfatal injury-frequency rates occurred in metallurgical plants, quarries, metal mines, and nonmetal mines.

Work Stoppages.—The mineral-mining industries were affected by work stoppages to a greater extent than any other segment of the economy during 1948, largely because of prolonged labor-management disputes in the bituminous-coal industry. The 10,514,400 man-days of idleness resulting from work stoppages in mining operations amounted to more than 30 percent of the total man-days lost in the country because of stoppages, according to the United States Department of Labor. Excepting the records of 1943 and 1946, this was the largest annual total for mining since 1927. The 1948 work stoppages hampered the mining industries considerably more than in 1947, when 2,561,380 man-days of work were lost through strikes.

During the year there were 623 work stoppages in the mineral industries. Of these, 561 strikes causing a loss of 9,560,000 man-days were at bituminous-coal mines, 26 with a loss of 274,000 man-days were at anthracite mines, 11 with a loss of 473,000 days were at metal mines, and 5 causing a loss of 114,000 days were at metallurgical plants (primary smelters and refiners of nonferrous metals). Time lost through stoppages was not significant in the other mineral industries. Labor-management disputes at bituminous-coal mines accounted for more than 90 percent of the total man-days lost in the mining industries. Several stoppages in anthracite mining resulted from sympathy strikes in support of the demands of the United Mine Workers for effectuation of a welfare and pension plan for bituminous-coal miners.

The first major strike (one involving more than 10,000 men) started in the bituminous-coal industry on March 15 as a result of a dispute over activation of the miners' pension and welfare fund. President Truman appointed a board of inquiry under the national emergency provisions of the Taft-Hartley Act on March 23. The board's report was followed on April 3 by a court order instructing the union to order the miners back to work and directing the parties to resume collective bargaining. There was no immediate response to this injunction, and on April 7 the Government filed a request for contempt action against the union and its president, John L. Lewis. On April 19 the union and Mr. Lewis were found guilty of contempt of court; the union was fined $1,400,000, and its president was fined $20,000. Virtually all miners were back at their jobs on April 26. This stoppage involved 320,000 workers and lasted from March 15 to about April 25, although not all workers were idle for the entire period. It caused the loss of about 8,080,000 man-days of work. Because of this dispute, a sympathy strike started on April 6 in anthracite mines, where approximately 30,000 men remained away from work 2 to 8 days.

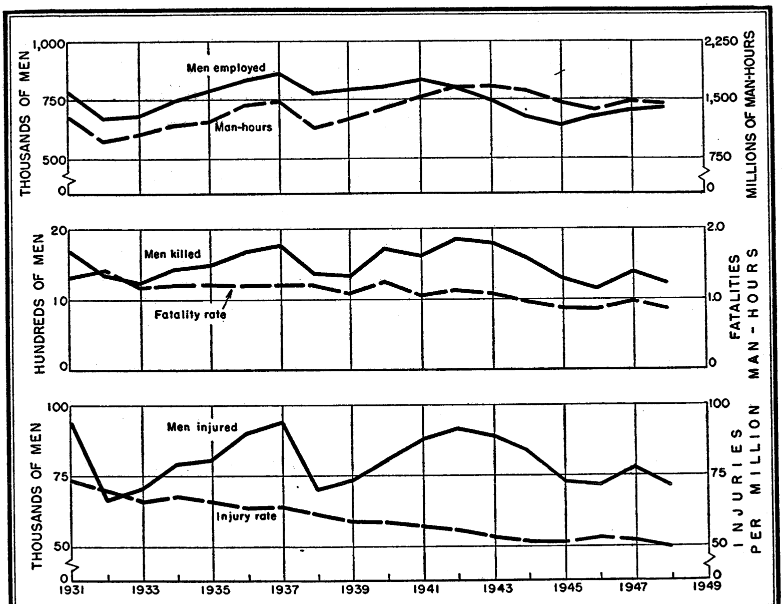

FIGURE 1.—Trends in employment and injury experience in the mineral industries of the United States, 1931–48.

Negotiations for a new wage agreement were concluded successfully by the commercial bituminous-coal operators and labor before the 1947 contract expired. The new agreement made no change in daily working time but increased the payment to the United Mine Workers of America Welfare and Retirement Fund to 20 cents per ton of coal mined for use or for sale.

However, on July 6 about 42,000 workers in "captive" bituminous-coal mines were involved in a work stoppage that lasted for 9 days when management refused to accept the union shop provision in the 1948 contract previously agreed upon with the commercial-mine operators. The captive-mine operators filed an unfair-labor-practice charge against the union with the National Labor Relations Board, contending that the provision violated the Labor-Management Relations Act (Taft-Hartley Act). About 40,000 commercial miners stopped work in a sympathy strike. The NLRB charged the union with a violation of the act and gave the union until July 13 to answer the charges. On that date the strike was settled temporarily when the operators accepted the union-shop clause with the provision that it would be modified if subsequent court rulings so required. This stoppage involved 82,000 workers and caused approximately 528,000 man-days of idleness.

Injury Experience.—All major disasters (a single accident in which five or more men are killed) in both 1948 and 1947 occurred in the coal-mining industry. The six major disasters in 1948 were in bituminous-coal mines, whereas in 1947 there were three disasters in bituminous-coal mines and three in anthracite mines. There were 49 deaths caused by the 6 major disasters in 1948, compared with 179 deaths from disasters in 1947. The Centralia mine explosion in March 1947, which killed 111 men, caused the 1947 disaster record to be extraordinarily high. Anthracite mines had no disasters in 1948, whereas 3 disasters at these mines resulted in 33 fatal injuries in 1947. The improvement of the major-disaster record of coal mines over that of 1947 was responsible, to a great extent, for the more favorable fatality experience of coal mines, as well as that of the mineral industries as a whole, in 1948.

The history of the coal-mining industry shows that progress has been made in recent years in lowering both the frequency and severity of major disasters. In the 21-year period, 1910–30, there was an average of 11 disasters with 264 deaths per year. However, in the 18 years since 1930 the annual average has been 5 disasters with 88 deaths. Thus, for the period since 1930, the frequency of disasters has been less than one-half that of the earlier period, and the severity has been one-third. Needless to say, the fact that there were six

Employment and injury experience of the mineral industries of the United States, 1931–48

Year	Men working daily	Average active days	Man-days worked	Man-hours worked	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Fatal	Nonfatal
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	747,486	277	207,350,643	1,668,340,394	1,799	88,449	1.08	53.02
1944	676,938	287	[1] 194,512,359	1,618,479,042	1,571	83,451	.97	51.56
1945	637,220	271	172,672,431	1,437,533,530	1,270	73,411	.88	51.07
1946	676,254	240	162,630,674	1,354,822,190	1,167	72,805	.86	53.74
1947 [2]	700,536	260	182,049,005	1,479,751,399	1,414	77,459	.96	52.35
1948 [3]	722,300	250	180,721,000	1,430,510,000	1,229	71,450	.86	49.95

[1] Corrected figure.
[2] Partly preliminary.
[3] Preliminary.

disasters in bituminous-coal mines in 1948 demonstrates pressing need for more intensified work to control the hazards that cause disasters in coal mines.

The number of fatal injuries declined in each of the major branches of the mineral industries except nonmetal mines and coke ovens, which together reported an increase of five fatalities over the comparable total in 1947. The greatest decrease in the number of fatal injuries occurred in bituminous-coal and anthracite mines, which had 155 fewer fatal injuries than in 1947. Metallurgical plants recorded the greatest percentage decrease in the number of deaths—13 in 1948 compared with 21 in 1947. The total of 1,229 fatal injuries was 185 less than in 1947 and was lower than that of any year except 1946, according to fatality statistics on the mineral industries first compiled in 1911.

Nonfatal-injury experience improved appreciably during 1948. The total of 71,450 nonfatal injuries in all mineral industries was lower than that of any year since 1938, when man-hours of worktime were much lower than in 1948. The nonfatal injury-frequency rate of 49.95 per million man-hours was lower than in any year for which injury statistics are available for the mineral industries of the country. In 1948 all major groups of the mineral industries had fewer nonfatal injuries and lower nonfatal injury-frequency rates than in 1947.

NATIONAL SAFETY COMPETITION

The National Safety Competition, conducted annually by the Bureau of Mines, has been an effective means of promoting accident-prevention work in the mines and quarries of the country. Many of the 509 mineral operations (a record enrollment for any contest year) achieved outstanding safety records in 1948. Of the enrolled mines and quarries, 115 operations attained injury-free records. Aggregate worktime at these injury-free plants was more than 11 million man-hours. Trophy awards for the best safety records in each of the six groups of the competition were made to the following:

Anthracite Underground Mines.—The Hunter Tunnel mine of the Philadelphia & Reading Coal & Iron Co., Ashland, Pa.

Bituminous-Coal Underground Mines.—The Reliance No. 7 mine of the Union Pacific Coal Co., Reliance, Wyo.

Metal Underground Mines.—The Fraser mine of the Oliver Iron Mining Co., Fraser, Minn.

Nonmetal Underground Mines.—The Ironton mine of the Alpha Portland Cement Co., Ironton, Ohio.

Open-Pit Mines.—The Spruce mine of the Oliver Iron Mining Co., Eveleth, Minn.

Quarries.—The Hanover mine of the Bethlehem Steel Co., Hanover, Pa.

COAL MINES

The safety record of coal mines in the United States in 1948 was better than in 1947. The preliminary frequency rate of 63.46 injuries (fatal and nonfatal) per million man-hours of worktime was lower than in any other year except 1944 and 1945. On a production basis, the injury frequency rate of 83.84 injuries (fatal and nonfatal) per million tons of coal mined was the best annual record in the statistical history of the coal-mining industry in the United States. During 1948, 1,010 fatal injuries occurred in coal mining, a reduction of 155 from the number of deaths charged to the industry in 1947. The fatality rates of 1.16 per million man-hours and 1.54 per million tons were more favorable than the corresponding rates in the preceding year. The number of nonfatal injuries for the year likewise was considerably lower than in 1947, but the nonfatal-injury frequency rates for the year were only slight improvements over the corresponding rates in the previous year, since man-hours of exposure and production declined almost as significantly as the number of injuries. The drop in man-hours of worktime in the industry resulted from a slightly lower average length of shift and a decrease in the average number of days that coal mines were active. The average miner worked a 7.81-hour shift for 229 active days during the year, compared with a shift of 8.17 hours for 244 days in 1947. The average workyear per man was 1,786 hours, 203 hours less than in 1947. The average number of men working in the industry increased to 485,600, compared with 469,100 in the preceding year.

BITUMINOUS COAL

Employment.—The number of men working daily in bituminous-coal mines averaged 404,800 for 1948, a 4-percent increase over 1947. The results of a monthly canvass of bituminous-coal operations showed little variation in employment through the year. Work stoppages occurred in March and April, and the average number of men employed dropped to 391,300 in April, the lowest during 1948. Peak employment—409,900—was attained in August. Although the labor force in bituminous-coal mines was higher than in 1947, man-hours of worktime fell to 715,720,000, a reduction of 8 percent from the total worktime in 1947. The reduced worktime resulted in part from the 8-hour portal-to-portal shift effective throughout 1948, whereas in 1947 a 9-hour shift was worked during the first 6 months. During the year the average miner worked a shift of 7.95 hours for 223 workdays, compared with the shift of 8.35 hours and 239 workdays in the previous year. Thus, the average worker in bituminous-coal mines had a total workyear of 1,768 hours, 232 hours less than in 1947. Production in 1948 was 599,518,229 tons (final figure), or 5 percent below 1947.

Injuries.—Fatality experience in bituminous-coal mines was better in 1948 than in the preceding year. The total of 870 fatalities was 120 less than the number killed in 1947. These fatalities occurred at rates of 1.22 per million man-hours and 1.45 per million tons, which were more favorable than the respective frequencies of 1.27 and 1.57 in 1947. The rate per million tons for the year was the lowest in a statistical history of the industry extending over the past 75 years.

There were nearly 4,000 fewer nonfatal injuries than in 1947. The total of 41,715 nonfatal injuries occurred at the rate of 58.28 per million man-hours, a slight improvement over the rate of 58.50 in 1947. On a tonnage basis, the frequency rate of nonfatal injuries was 69.58 per million tons, compared with 72.47 in the preceding year. The appreciable decline in the number of injuries in 1948 was partly offset by the decline in man-hours of worktime and tonnage.

Employment and injury experience at coal mines in the United States, 1944–48

Industry and year	Men working daily	Average active mine-days	Man-days worked	Man-hours worked	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Fatal	Nonfatal
Bituminous-coal mines:[1]								
1944	376,203	278	[2]104,694,601	914,925,290	1,124	51,253	1.23	56.02
1945	364,997	257	93,854,353	817,316,198	925	46,194	1.13	56.52
1946	385,142	215	82,849,738	727,994,944	795	42,817	1.09	58.81
1947 (preliminary)	390,600	239	93,510,000	781,190,000	990	45,700	1.27	58.50
1948 (preliminary)	404,800	223	90,072,000	715,720,000	870	41,715	1.22	58.28
Pennsylvania anthracite mines:								
1944	77,734	293	22,804,917	163,549,087	174	12,438	1.06	76.05
1945	72,924	268	19,569,421	141,274,969	143	10,923	1.01	77.32
1946	77,937	269	20,997,263	151,633,250	173	12,533	1.14	82.65
1947 (preliminary)	78,500	265	20,775,000	152,000,000	175	12,500	1.15	82.24
1948 (preliminary)	80,800	259	20,942,000	151,780,000	140	12,330	.92	81.24
Total coal mines:								
1944	453,937	281	[2]127,499,518	1,078,474,377	1,298	63,691	1.20	59.06
1945	437,921	259	113,423,774	958,591,167	1,068	57,117	1.11	59.58
1946	463,079	224	103,847,001	879,628,194	968	55,350	1.10	62.92
1947 (preliminary)	469,100	244	114,285,000	933,190,000	1,165	58,200	1.25	62.37
1948 (preliminary)	485,600	229	111,014,000	867,500,000	1,010	54,045	1.16	62.30

[1] Includes lignite.
[2] Revised figure.

During the year there were 6 major disasters, which resulted in the death of 49 men—3 explosions killed 32 men, 2 falls of roof resulted in the death of 12 men, and 5 men died from suffocation when gases from a surface fire were pulled underground. The total of six disasters for the year was the highest number in any year since 1943, when seven disasters occurred in bituminous-coal mines. However, the number killed in disasters was considerably lower than in 1947, when 146 men were killed in 3 disasters.

The 870 fatal injuries were distributed to the following types of operations in 1948: 773 in underground workings, 53 in surface works associated with deep mines, and 44 in stripping operations. In underground workings, falls of roof and face caused 484 deaths, haulage 154, explosions (major and local) 44, machinery 25, explosives 22, and electricity 19. Falls of roof and face was the only major cause of fatal injuries in bituminous-coal mines that proved to be a much greater hazard in 1948 than in 1947. Roof falls accounted for 56 percent of the fatalities in 1948 compared with 47 percent in 1947. The Health and Safety Division of the Bureau of Mines has established a Roof Control Section to make investigations and conduct research to find ways to control this hazard more effectively. Suspension-type roof supports or "roof bolting," advocated by the Bureau of Mines, has been standardized in some mines and is now past the experimental stage. The fatality record of bituminous-coal mines in 1948 was better than in 1947 because of the significant drop in fatal injuries caused by haulage and explosions.

ANTHRACITE

Employment.—Employment at anthracite operations during 1948 increased 3 percent over 1947 to an average of 80,800 workers in 1948. Results of a monthly canvass of the Bureau of Mines showed a gradual upward trend from a low of 78,300 workers in January to a high of

83,300 employees in November. This increased working force averaged 259 active working days during the year, compared with an average of 265 days in the preceding year. The decrease in the average number of working days offset the increase in employment; as a result, the total worktime in anthracite mines—151,780,000 man-hours—was slightly lower than in 1947. Total production of 57,139,948 tons of anthracite was only slightly less than total output in the preceding year.

Injuries.—Injury experience at anthracite mines was more favorable during 1948 than in 1947. The fatality rates of 0.92 per million man-hours and 2.45 per million tons were significantly lower than the rates of 1.15 and 3.06, respectively, for the preceding year. On the basis of both man-hours of exposure and total output of anthracite, these fatality rates stand out as the best annual records in the history of anthracite mining in the United States. Nonfatal injury-frequency rates likewise were improved in 1948. The total of 12,330 injuries for the year had frequencies of 81.24 per million man-hours and 215.79 per million tons, compared with a total of 12,500 injuries with rates of 82.24 and 218.57, respectively, in 1947.

The 140 fatal injuries at anthracite mines occurred as follows: 121 in underground workings, 12 in surface works associated with underground mines, and 7 in stripping operations. Falls of roof and face caused 85 fatalities, or 70 percent of the total in underground working. As was the case in bituminous-coal mining, the rate of occurrence of fatal injuries caused by this hazard was higher than in 1947. The relatively favorable fatality experience in anthracite mining in 1948 was due primarily to the lowering of the number of men killed in explosions from 35 in 1947 to 2 in 1948. Haulage accidents caused six fewer fatalities in 1948 than in the year preceding, but this reduction was offset by an increase of six fatalities in stripping operations in 1948.

In 1948 there were no major disasters in anthracite mines, whereas in 1947 3 disasters, all explosions, resulted in the death of 33 workers. The disaster-record of the anthracite industry has been good in recent years—8 of the past 10 years have been disaster-free.

METAL MINES

The safety record of metal mines for 1948 was much better than in 1947. The over-all injury-frequency rate (fatal and nonfatal) was 47.46 per million man-hours, which was significantly lower than the comparable rate of 53.62 for the preceding year. The safety performance of each of the metal-mining groups showed improvement over that of the year before. Nonfatal frequency rates declined in all groups. Fatality rates declined in all groups except gold-silver lode mining, in which the rate of 1.27 deaths per million man-hours was the same for both years. There was little change in employment in 1948. The 72,000 metal miners worked 160,480,000 man-hours during the year, a very slight increase over the total worktime in 1947. Metal mines worked an average shift of 8.06 hours for 277 days. Thus, the average worker had a workyear of 2,229 hours, an increase of 24 hours over 1947.

Employment and injury experience at metal mines in the United States, 1946–48, by industries

Industry and year	Men working daily	Average active mine-days	Man-days worked	Man-hours worked	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Fatal	Nonfatal
Iron mines:								
1946	24,723	227	5,603,762	45,048,416	25	1,206	0.55	26.77
1947	26,478	273	7,238,851	58,157,587	36	1,403	.62	24.12
1948 (preliminary)	26,900	284	7,651,000	61,920,000	33	1,460	.53	23.58
Copper mines:								
1946	12,969	276	3,578,349	28,622,003	23	1,457	.80	50.90
1947	15,654	305	4,782,153	38,263,818	32	1,655	.84	43.25
1948 (preliminary)	16,300	306	4,980,000	39,850,000	31	1,580	.78	39.65
Lead-zinc mines:								
1946	15,934	265	4,228,143	33,777,747	30	2,916	.89	86.33
1947	16,628	268	4,457,549	35,618,006	33	3,221	.93	90.43
1948 (preliminary)	16,400	255	4,182,000	33,470.000	19	2,925	.57	87.39
Gold-silver mines:								
1946	5,152	253	1,305,504	10,203,525	8	1,000	.78	98.01
1947	5,537	255	1,414,106	11,063,328	14	1,192	1.27	107.74
1948 (preliminary)	5,400	261	1,407,000	11,000,000	14	950	1.27	86.36
Gold placers:								
1946	3,458	212	732,683	6,438,965	1	220	.16	34.17
1947	3,920	212	830,710	7,166,257	3	230	.42	32.09
1948 (preliminary)	4,100	217	888,000	7,660,000	1	180	.13	23.50
Miscellaneous: [1]								
1946	2,998	263	789,562	6,315,410	3	546	.48	86.46
1947	3,011	280	843,616	6,755,376	8	592	1.18	87.63
1948 (preliminary)	2,900	279	810,000	6,580,000	3	420	.46	63.83

[1] Includes antimony, bauxite, chromite, cobalt, manganese, mercury, molybdenum, pyrite, titanium, tungsten, and vanadium-uranium mines.

IRON

Employment.—The average number of men at work daily in iron mines increased slightly to a total of 26,900 in 1948. Iron mines averaged 284 active days during the year and had a total of 61,920,000 hours of worktime, which was slightly higher than in 1947. The average employee in iron mines had a workyear of 2,302 hours, or 106 hours more than in the preceding year.

Injuries.—The number of fatal injuries in iron mines declined slightly to 33, compared with 36 deaths in 1947. This decline in fatal injuries, together with increased exposure time in 1948, resulted in a rate of 0.53 death per million man-hours, an improvement over the rate of 0.62 for the preceding year. The increase in nonfatal injuries to 1,460 in 1948 was more than offset by the increase in worktime over that in 1947. As a result, the nonfatal-injury rate of 23.58 per million man-hours was lower than the rate for the preceding year.

COPPER

Employment.—The number of men working in copper mines gained slightly to an average of 16,300 for the year. Copper mines averaged 306 working days during the year and provided a total of 39,850,000 man-hours of employment, a 4-percent increase over 1947. The average employee worked an 8-hour shift during the year and had 2,445 hours of work, or approximately the same as in 1947.

Injuries.—Despite the increased man-hours of worktime in 1948, both fatal and nonfatal injuries were reduced in number at copper mines. The rates of 0.78 fatality and 39.65 nonfatal injuries per million man-hours were much better than the corresponding rates in 1947.

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LEAD-ZINC

Employment.—Available reports indicate that employment in lead-zinc mines declined below that of 1947 to a total of 16,400 men. Lead-zinc mines had an average of 255 working days during the year and worked a total of 33,470,000 man-hours, a decline of 6 percent from aggregate worktime at these mines in 1947. The average work-year per man was 2,041 hours, or 101 hours less than in 1947.

Injuries.—The safety record of lead-zinc mines was much better than in 1947. Fatality experience at these mines was improved greatly. In all, 19 men were killed in 1948, compared with 33 deaths in the preceding year. The rate of 0.57 death per million man-hours was a sharp improvement over the rate of 0.93 in 1947. Similarly, the 2,925 nonfatal injuries occurred at a rate of 87.39 per million man-hours, which was lower than the rate of 90.43 for 1947.

GOLD-SILVER LODE

Employment.—The employment of 5,400 men in gold and silver lode mines during the year was a slight reduction from the average number of men working at these mines in 1947. As these mines worked an average of 261 days, compared with 255 days in 1947, the total of 11,000,000 man-hours of worktime was only slightly less than in 1947. Each employee averaged 2,037 man-hours of work during the year, or 39 more than in 1947.

Injuries.—There were 14 fatal injuries in both 1948 and 1947 in gold-silver lode mines; the fatality rate of 1.27 per million man-hours was identical in both years. However, the number of nonfatal injuries was reduced 20 percent from the 1947 total to 950. The frequency rate of 86.36 per million man-hours was appreciably better than the rate of 107.74 in 1947.

GOLD PLACER

Employment.—The average number of men working daily in gold placer mines increased slightly to 4,100 in 1948. These mines averaged 217 working days during the year, or 5 more than in 1947. Total man-hours of worktime increased 7 percent over the 1947 figure to a total of 7,660,000 man-hours. The average employee worked 1,868 hours during the year, or 40 more than in 1947.

Injuries.—There were 1 fatality and 180 nonfatal injuries in gold placer mines during the year, compared with 3 fatalities and 230 nonfatal injuries in 1947. Thus, injuries were reduced at these mines despite increased exposure-time. The rates of 0.13 fatality and 23.50 nonfatal injuries per million man-hours of work were marked improvements over the corresponding rates in 1947.

MISCELLANEOUS METAL

Employment.—The labor force of 2,900 men during the year was slightly lower than in 1947 in the mines of this group, which includes antimony, bauxite, chromite, cobalt, manganese, mercury, molybdenum, pyrite, titanium, tungsten, and vanadium-uranium operations. These mines operated an average of 279 working days during the year, virtually the same as in 1947. Total man-hours of worktime were slightly less than in the year preceding. These mines worked an average shift of 8.12 hours, compared with 8.01 hours in 1947. The average workyear per man was 2,269 hours, or 25 more than in the preceding year.

Injuries.—The injury record of miscellaneous metal mines during the year was a significant improvement over that of the preceding year, when their safety record was relatively unfavorable. The number of fatal and nonfatal injuries was reduced greatly; there were 3 fatal and 420 nonfatal injuries during the year, compared with 8 fatal and 592 nonfatal injuries in 1947. The frequency rates of 0.46 fatal and 63.83 nonfatal injuries per million man-hours were considerably lower than the corresponding rates of 1.18 and 87.63, respectively, in the year preceding.

Employment and injury experience at nonmetal mines and quarries in the United States, 1946–48, by industries

Industry and year	Men working daily	Average active mine-days	Man-days worked	Man-hours worked	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Fatal	Nonfatal
Nonmetal mines: [1]								
1946	11,312	291	3,296,626	26,876,871	26	1,369	0.97	50.94
1947	12,176	292	3,554,901	28,809,150	12	1,308	.42	45.40
1948 (preliminary)	12,200	284	3,470,000	28,350,000	15	1,165	.53	41.09
Quarries:								
Cement: [2]								
1946	25,901	311	8,063,361	64,185,021	12	834	.19	12.99
1947	28,184	315	8,883,904	70,756,640	26	820	.37	11.59
1948 (preliminary)	28,700	327	9,377,000	75,190,000	24	800	.32	10.64
Limestone:								
1946	20,850	234	4,870,876	41,864,367	26	1,878	.62	44.86
1947	21,177	246	5,218,930	44,209,247	24	1,921	.54	43.45
1948 (preliminary)	21,700	239	5,190,000	43,900,000	28	1,735	.64	39.52
Lime: [2]								
1946	8,741	296	2,591,301	20,657,787	4	1,011	.19	48.94
1947	9,254	291	2,690,488	21,669,032	6	1,022	.28	47.16
1948 (preliminary)	9,900	299	2,962,000	23,710,000	9	995	.38	41.97
Marble:								
1946	2,370	260	616,200	5,292,992		173		32.68
1947	3,165	262	830,620	6,833,627	2	200	.29	29.27
1948 (preliminary)	3,100	243	754,000	5,900,000	1	185	.17	31.36
Granite:								
1946	5,176	249	1,288,468	10,930,012	5	493	.46	45.11
1947	5,726	253	1,451,371	12,003,295	4	652	.33	54.32
1948 (preliminary)	6,300	268	1,687,000	13,810,000	6	500	.43	36.21
Traprock:								
1946	2,493	244	607,405	5,125,217	3	221	.59	43.12
1947	2,470	242	597,234	5,080,337	3	261	.59	51.37
1948 (preliminary)	2,600	232	604,000	5,090,000	1	260	.20	51.08
Slate:								
1946	1,323	274	361,855	3,330,047	2	181	.60	54.35
1947	1,740	267	465,449	4,174,220	3	243	.72	58.21
1948 (preliminary)	1,900	275	522,000	4,890,000	3	195	.61	39.88
Sandstone:								
1946	3,411	253	862,381	7,142,732	3	346	.42	48.44
1947	3,529	243	858,419	7,252,419	7	385	.97	53.09
1948 (preliminary)	4,000	239	956,000	7,950,000	1	340	.13	42.77

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

NONMETAL MINES

Employment.—The average of 12,200 men at work daily in 1948 was virtually the same as in the preceding year in this group of mines, which comprises barite, feldspar, gypsum, magnesite, mica, phosphate rock, rock salt, sulfur, and miscellaneous nonmetallic-mineral operations. Total man-hours of worktime at these mines was slightly lower than in 1947. The average workyear per man was 2,324 hours, or 42 less than in 1947.

Injuries.—The over-all safety record of nonmetal mines for the year was better than in 1947 because of improved nonfatal-injury experience. However, fatality experience was less favorable. The 15 deaths at these mines occurred at the rate of 0.53 per million man-hours, compared with 12 fatalities and a rate of 0.42 in 1947. The rate of 41.09 nonfatal injuries per million man-hours was appreciably better than the rate of 45.40 in 1947.

QUARRIES

The over-all injury experience in the quarry industries during 1948 was more favorable than in 1947. There were fewer fatal and nonfatal injuries in 1948, despite the fact that man-hours of exposure were 5 percent greater than in 1947. The fatality rate of 0.40 per million man-hours was an improvement over the comparable rate of 0.44 in 1947, and the nonfatal-injury rate of 27.77 was appreciably lower than the rate of 32.00 for the previous year. Operating activity in the quarry industries was greater than in 1947. The average of 78,200 men working was approximately 3,000 higher than in the previous year. These industries worked an average shift of 8.18 hours for 282 days, or 3 more than in 1947. The average employee had a workyear of 2,307 hours, or 21 more than in 1947.

CEMENT

Employment.—The average number of men working in cement quarries and mills increased slightly in 1948 to a total of 28,700. These men worked an average of 327 days, or 12 more than in the preceding year. Total man-hours of worktime increased to 75,190,000 man-hours, or 6 percent more than the comparable figure for 1947. The average employee worked a shift of 8.02 hours during the year and had a workyear of 2,620 hours, or 109 hours more than in the previous year.

Injuries.—Despite increased exposure time in cement quarries and mills during the year, there were fewer fatal and nonfatal injuries than in 1947. The 24 fatalities occurred at a rate of 0.32 per million man-hours, and the 800 nonfatal injuries had a rate of occurrence of 10.64. Both rates represent improvements over the corresponding frequencies in 1947.

LIMESTONE

Employment.—Employment at limestone operations in 1948 was slightly higher than in 1947, but the average number of active working days dropped to 239, or 7 less than in the preceding year. Men at these operations had a total worktime of 43,900,000 man-hours, or slightly less than in the preceding year. Each employee worked an average shift of 8.46 hours and had a total workyear of 2,023 hours, or 65 hours less than in 1947.

Injuries.—The over-all injury experience at limestone operations was favorable because of a greatly improved nonfatal-injury record. However, fatality experience for the year was less favorable than in 1947. The 28 fatalities occurred at a rate of 0.64, compared with a rate of 0.54 for the year preceding. The nonfatal injury-frequency rate of 39.52 per million man-hours was a significant improvement over the rate of 43.45 for 1947.

LIME

Employment.—Employment at lime plants and associated quarries in 1948 increased to an average of 9,900 men working daily. As this increased working force averaged 299 active days, 8 more than in 1947, aggregate man-hours of worktime increased 9 percent to a total of 23,710,000. The average employee at these operations worked a shift of 8.00 hours for the year and had a total workyear of 2,395 hours, or 53 more than in 1947.

Injuries.—Fatality experience at lime plants and associated quarries was less favorable than in 1947. The nine fatalities occurred at a rate of 0.38 per million man-hours, compared with six deaths and a frequency rate of 0.28 in 1947. On the other hand, the rate of 41.97 nonfatal injuries per million man-hours was significantly lower than comparable rate of 47.16 for the preceding year. From an over-all standpoint, the safety record of these operations was improved considerably in 1948.

MARBLE

Employment.—Activity in marble operations dropped in 1948. These operations employed 3,100 men for an average of 243 working days, or 19 less than in 1947. Total man-hours of worktime during the year declined 14 percent from the 1947 total to 5,900,000. Each employee averaged a shift of 7.82 hours during 1948 and had a total workyear of 1,903 hours, 256 less than in 1947.

Injuries.—The number of fatal and nonfatal injuries in marble operations declined in 1948. The fatality rate of 0.17 per million man-hours was lower than the comparable rate of 0.29 in 1947. However, the nonfatal rate of 31.36 per million man-hours was higher than the rate of 29.27 for the preceding year.

GRANITE

Employment.—Employment in 1948 gained 10 percent over 1947 to a total of 6,300 men, who worked an average of 268 days, or 15 more than in the preceding year. Total worktime was 15 percent higher than the comparable total for 1947. In 1948 the average granite worker had a shift of 8.19 hours and a workyear of 2,192 hours, 96 more than in 1947.

Injuries.—Fatality experience in granite operations was less favorable than in 1947. The six fatalities occurred at the rate of 0.43 per million man-hours, which was higher than the rate of 0.33 for the preceding year. However, nonfatal-injury experience improved considerably. The rate of 36.21 nonfatal injuries per million man-hours was much more favorable than the rate of 54.32 for 1947.

TRAPROCK

Employment.—The average number of men working at traprock quarries increased to 2,600 men, who averaged 232 working days during the year, 10 less than in 1947. The aggregate worktime in these operations was virtually the same in both years. The average employee worked a shift of 8.43 hours and a workyear of 1,958 hours, 99 less than in the preceding year.

Injuries.—Injury experience in these quarries during the year was more favorable than in 1947. The rates of 0.20 fatal and 51.08 nonfatal injuries per million man-hours were lower than the corresponding rates for the preceding year.

SLATE

Employment.—An average of 1,900 men worked in slate quarries in 1948, a slight gain over the preceding year. These quarries averaged 275 working days, 8 more than in 1947. The aggregate worktime of 4,890,000 man-hours was 17 percent higher than the comparable total for the preceding year. The average employee worked a shift of 9.37 hours and had a workyear of 2,574 hours, 175 hours more than in 1947.

Injuries.—The preliminary totals of 3 fatalities and 195 nonfatal injuries occured at frequencies of 0.61 and 39.88 per million man-hours of work. Both of these rates were more favorable than the comparable frequency rates for 1947.

SANDSTONE

Employment.—Employment at sandstone quarries increased to a total of 4,000 men, who worked an average of 239 days, 4 less than in 1947. The aggregate of 7,950,000 man-hours of work at these quarries was 10 percent higher than the corresponding total for 1947. The average shift was 8.32 hours, and each worker averaged a workyear of 1,988 hours, 67 hours less than in 1947.

Injuries.—Fatality experience at sandstone quarries was improved remarkably in 1948. There was one fatality during the year, compared with seven deaths chargeable to 1947. The rate of 0.13 death per million man-hours was significantly lower than the rate of 0.97 for the preceding year. Nonfatal-injury experience likewise was much better in 1948. The rate of 42.77 nonfatal injuries was appreciably better than the rate of 53.09 for 1947.

COKE PLANTS

The fatality record at coke plants during the year was slightly less favorable than in 1947, but the nonfatal experience was improved. Total employment increased to 25,000 men, who averaged 350 active working days during the year. Man-hours of worktime at coke plants increased 5 percent over that in 1947 to a total of 69,540,000. Fatality experience was slightly less favorable than in 1947; the rate of 0.24 death per million man-hours was slightly higher than in 1947. On the other hand, the nonfatal injury-frequency rate of 13.01 was an improvement over the corresponding rate in the preceding year.

Employment and injury experience at coke plants in the United States, 1946–48

Type and year	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:								
1946	18,906	354	6,693,947	53,547,047	8	648	0.15	12.10
1947	20,778	362	7,526,622	60,271,826	11	701	.18	11.63
1948 (preliminary)	21,900	363	7,958,000	63,590,000	15	680	.24	10.69
Beehive ovens:								
1946	2,504	204	510,740	4,163,075		162		38.91
1947	2,927	262	766,542	5,846,933	4	225	.68	38.48
1948 (preliminary)	3,100	256	795,000	5,950,000	2	225	.34	37.82

BYPRODUCT COKE

Employment.—The average of 21,900 men working in byproduct-coke plants was slightly higher than in 1947. These men averaged 363 active days, and their aggregate worktime totaled 63,590,000, or 6 percent higher than in the preceding year. The average shift at these plants was 7.99 hours and the average workyear per man 2,904 hours.

Injuries.—The 15 fatalities at byproduct-coke plants occurred at a rate of 0.24 per million man-hours, which was higher than the rate of 0.18 in 1947. However, nonfatal-injury experience was better than in the preceding year. The rate of 10.69 nonfatal injuries per million man-hours was an improvement over the rate of 11.63 for 1947.

BEEHIVE COKE

Employment.—Employment at beehive plants during the year increased to 3,100 men, who averaged 256 active working days, 6 less than in 1947. The aggregate worktime of 5,950,000 man-hours at these plants was slightly higher than in 1947. The average shift at these plants was 7.48 hours and the average workyear per employee was 1,919 hours, 79 less than 1947.

Injuries.—The injury record of beehive plants during the year was better than in 1947. The two fatalities occurred at the rate of 0.34 per million man-hours, which was one-half the rate of 0.68 for 1947. The nonfatal frequency of 37.82 per million man-hours was slightly lower than the comparable rate for the preceding year.

METALLURGICAL PLANTS

The safety record of metallurgical plants was much better in 1948 than in 1947. There were 13 fatal injuries compared with 21 the year before. The fatality rate of 0.10 per million man-hours was a significant improvement over the rate of 0.17 for the preceding year. Nonfatal experience was also appreciably better. Employment was virtually the same as in 1946, but active working days increased to 315. The average length of shift was 8.01 hours and the average workyear per man 2,519 hours, 21 more than in 1947.

ORE-DRESSING PLANTS

Ore-dressing includes such milling operations as crushing, screening, washing, jigging, magnetic separation, and floatation of ores (metallic).

Employment.—The average number of men working in all metal mills in 1948 increased very slightly to 16,100. Increases in employment in copper and lead-zinc mills more than offset the slight decline in the average number of workers in gold-silver, iron, and miscellaneous-metal mills. Aggregate worktime in these metal mills increased to 36,730,000 man-hours. The average employee worked 8.02 hours per shift and 2,280 hours during the year, 8 hours more than in 1947.

Injuries.—The fatality record of metal mills was less favorable than in 1947. The nine fatalities chargeable to these mills occurred at the rate of 0.25 per million man-hours, compared with a rate of 0.19 in the preceding year. On the other hand, the nonfatal rate of 22.73 injuries per million man-hours was lower than the rate of 24.05 in 1947.

Employment and injury experience at ore-dressing (metallic) plants in the United States, 1946–48, by industries [1]

Industry and year	Men-working daily	Average active mill-days	Man-days worked	Man-hours worked	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Fatal	Nonfatal
Copper:								
1946	5,579	279	1,555,028	12,435,937	1	322	0.08	25.89
1947	5,846	323	1,887,600	15,100,609	2	288	.13	19.07
1948 (preliminary)	6,300	318	2,001,000	16,020,000	4	290	.25	18.10
Iron:								
1946	3,286	190	623,715	5,096,279	1	67	.20	13.15
1947	3,343	245	820,014	6,662,689	2	86	.30	12.91
1948 (preliminary)	3,300	270	890,000	7,220,000		95		13.16
Gold-silver:								
1946	1,015	263	267,053	2,077,925	1	89	.48	42.83
1947	1,107	282	312,564	2,450,112	1	138	.41	56.32
1948 (preliminary)	900	308	277,000	2,170,000	1	120	.46	55.30
Lead-zinc:								
1946	4,388	276	1,212,603	9,720,505	6	303	.62	31.17
1947	4,384	264	1,158,113	9,291,639	2	270	.22	29.06
1948 (preliminary)	4,500	246	1,105,000	8,860,000	3	240	.34	27.09
Miscellaneous metals: [2]								
1946	1,329	259	344,264	2,750,897	1	85	.36	30.90
1947	1,257	269	338,547	2,707,720		89		32.87
1948 (preliminary)	1,100	279	307,000	2,460,000	1	90	.41	36.59
Total:								
1946	15,597	257	4,002,663	32,081,543	10	866	.31	26.99
1947	15,937	283	4,516,838	36,212,769	7	871	.19	24.05
1948 (preliminary)	16,100	284	4,580,000	36,730,000	9	835	.25	22.73

[1] Includes crushers, grinders, washers, ore concentrators, and sintering, cyaniding, leaching, and other ore-dressing plants and auxiliary works.
[2] Includes aluminum, antimony, chromium, manganese, mercury, molybdenum, tungsten, vanadium, and other metals.

NONFERROUS REDUCTION PLANTS AND REFINERIES

The reduction plants and refineries in this classification are engaged in the primary extraction of nonferrous metals from ores and concentrates and the refining of crude primary nonferrous metals. Iron and steel plants are excluded.

Employment.—Employment in each group of plants except the zinc group was higher in 1948 than in 1947. The average of 33,200 men working was slightly higher than in the preceding year. The aggregate worktime of 87,470,000 man-hours likewise was slightly higher. In 1948 the average employee worked 8 hours per shift and 2,635 hours during the year, 28 more than in 1947.

Injuries.—The safety record of these operations during the year was considerably improved over that of 1947. The number of fatal injuries was lower in each group of plants except zinc, which had one fatal in both 1947 and 1948. The number of nonfatal injuries was lower in all groups. The 4 fatal injuries occurred at a rate of 0.05 per million man-hours, compared with 14 fatalities and a rate of 0.16 for 1947. Similarly, the nonfatal injury-frequency rate of 22.58 per million man-hours was an improvement over the rate of 27.27 for the preceding year.

Employment and injury experience at primary nonferrous reduction and refinery plants in the United States, 1946–48, by industries [1]

Industry and year	Men working daily	Average active smelter-days	Man-days worked	Man-hours worked	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Fatal	Nonfatal
Copper:								
1946	10, 187	289	2, 946, 354	23, 572, 764	6	503	0. 25	21. 34
1947	12, 393	322	3, 992, 485	31, 938, 431	7	726	. 22	22. 73
1948 (preliminary)	12, 500	325	4, 068, 000	32, 610, 000	2	600	. 06	18. 40
Lead and silver-lead:								
1946	3, 848	255	980, 243	7, 844, 293		160		20. 40
1947	3, 679	331	1, 219, 309	9, 750, 024	4	197	. 41	20. 21
1948 (preliminary)	4, 000	329	1, 314, 000	10, 510, 000	1	190	. 10	18. 08
Zinc:								
1946	9, 917	338	3, 356, 262	26, 199, 631	4	915	. 15	34. 92
1947	10, 484	345	3, 616, 035	28, 667, 924	1	994	. 03	34. 67
1948 (preliminary)	9, 800	344	3, 368, 000	26, 880, 000	1	845	. 04	31. 44
Miscellaneous metals: [2]								
1946	5, 405	277	1, 496, 988	11, 974, 531		350		29. 23
1947	6, 589	305	2, 007, 873	16, 061, 153	2	440	. 12	27. 40
1948 (preliminary)	6, 900	317	2, 184, 000	17, 470, 000		340		19. 46
Total:								
1946	29, 357	299	8, 779, 847	69, 591, 219	10	1, 928	. 14	27. 70
1947	33, 145	327	10, 835, 702	86, 417, 532	14	2, 357	. 16	27. 27
1948 (preliminary)	33, 200	329	10, 934, 000	87, 470, 000	4	1, 975	. 05	22. 58

[1] Includes roasting, electrolytic, retort, and other nonferrous metal reduction and refinery plants.
[2] Includes antimony, magnesium, mercury, and tin plants.

PART II. COMMODITY REVIEWS

Abrasive Materials

By ROBERT W. METCALF

GENERAL SUMMARY

RECORD high outputs were established in 1948 for quartz, ground sand and sandstone, and pumice and pumicite. Sales of diatomite remained at an active level. Particularly noteworthy are the large increases shown for quartz (due to a large new operation) and for pumice and pumicite, the latter because of the large gain in use as aggregate in the West and Southwest. Garnet and emery each declined moderately in volume. Production of garnet, however, except for 1947 was the highest of any year since 1925, and value of emery output was the second highest since 1918. For other natural abrasives, for which figures are given in the accompanying table, large proportional decreases in tonnage were reported. Production of silicon carbide and aluminum oxide and shipments of metallic abrasives in 1948 were slightly less than in 1947, although the total realizations for silicon carbide and aluminum oxide were somewhat higher than in 1947. The value of metallic abrasives was 22 percent higher.

The value of imports of natural abrasive materials in 1948 totaled $34,184,654, an increase of 143 percent over 1947. Augmented imports of diamond bort, carbonados and ballas, and diamond dust were the chief factors in this large rise. Receipts of crude pumice and corundum ore also rose in both quantity and value, while imports of flint and Turkish emery declined. The value of exports of natural abrasive products in 1948 declined 21 percent to $2,643,608, all classes of exports showing substantial losses in quantity compared with 1947.

Salient statistics of the abrasives industries in the United States, 1947–48

	1947		1948		Percent of change in 1948	
	Short tons	Value	Short tons	Value	Short tons	Value
Natural abrasives (domestic) sold or used by producers:						
Diatomite	(1)	(1)	(1)	(1)	--------	--------
Tripoli	34,578	$751,422	26,845	$705,523	−22	−6
Quartz	[2] 101,317	[2] 424,525	161,861	750,667	+60	+77
Ground sand and sandstone	651,120	5,181,113	702,572	5,814,664	+8	+12
Grindstones	10,620	476,811	7,921	402,667	−25	−16
Pulpstones	76	4,976	33	2,100	−57	−58
Oilstones and related products	(3)	(3)	(3)	(3)	--------	--------
Millstones	(4)	23,189	(4)	17,733	--------	−24
Tube-mill liners	1,496	40,303	1,297	41,555	−13	+3
Grinding pebbles	5,860	122,883	4,026	101,583	−31	−17
Pumice and pumicite	442,552	2,021,880	607,746	2,501,906	+37	+24
Garnet	8,722	614,071	8,039	587,797	−8	−4
Emery	5,798	66,927	5,405	69,408	−7	+4
Artificial abrasives:						
Silicon carbide-production [5]	63,724	5,633,811	63,033	5,874,731	−1	+4
Aluminum oxide-production [5]	160,022	10,158,432	154,972	10,279,583	−3	+1
Metallic abrasives (steel shot and grit)—shipments	154,191	12,449,855	147,218	15,174,773	−5	+22
Foreign trade:						
Imports	(6)	14,054,978	(6)	34,184,654	--------	+143
Exports	(6)	3,351,546	(6)	2,643,608	--------	−21

[1] Average annual figure for 1945–47 was 213,588 short tons valued at $4,307,088; Bureau of Mines not at liberty to publish annual data separately.
[2] Revised figure.
[3] Bureau of Mines not at liberty to publish figure.
[4] Tonnage of millstones not recorded.
[5] Includes Canadian production.
[6] Not feasible to total weights because of incommensurable units.

This chapter includes data for many of the materials used for abrasive purposes, although certain clays, carbides, oxides, and other substances noted later under Miscellaneous Mineral Abrasive Materials are not included in the statistics shown herein. Certain of the abrasive products for which figures are given also have important nonabrasive uses.

NATURAL SILICA ABRASIVES

Diatomite.—Output of diatomite in 1948 continued at an active pace. Current production figures may not be published by the Bureau of Mines, but the average annual production of diatomite for the 3-year period 1945–47 totaled 213,588 short tons valued at $4,307,088. Average annual data for preceding periods were: 1942–44, 174,957 tons, valued at $3,298,178; and 1939–41, 120,167 tons valued at $1,915,405.

Producing States in 1948 were California, Oregon, Nevada, and Washington. The largest producer by far is California. Moderate increases in output in 1948 as compared with 1947 were reported by two States and moderate decreases by the others. Exact statistics showing uses of diatomaceous earth may not be published. It is, however, possible to indicate approximate percentages of diatomite consumed in the major uses: Filtration, somewhat over half of the total shipments; fillers, about one quarter of shipments; and insulation, about one eighth. Other uses, including abrasives, comprised the remainder.

Prices for diatomite continued firm during 1948 and the market stable, with supplies adequate for most grades. In fact, quotations on diatomite for 1946 through 1948, as reported in E&MJ Metal and Mineral Markets, remained unchanged 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 effect of continued inhaling of diatomaceous earth was described.[1] Various types of diatomite filters were described,[2] including use for swimming-pool recirculating systems [3] and Canadian army filtration apparatus.[4]

Considerable interest has been manifest in the use of diatomite in cobalt catalysts in the Fischer-Tropsch process and several studies dealing with phases of this development have been published.[5]

An investigation of Australian diatomites as filter mediums was published.[6] A good description of tests of Scottish diatomite from the Isle of Skye was given in the British trade press.[7] A diagram showing many possible applications for this material was included. Algerian diatomaceous earth deposits were described.[8] A comprehensive study of the diatomaceous earth deposits of the Union of South Africa includes information as to occurrence, mining, preparation, uses, and other phases of the industry.[9]

Tripoli.—Sales of tripoli, amorphous silica, and rottenstone in 1948 declined 22 percent in quantity and 6 percent in value to 26,845 short tons valued at $705,523. The total value, however, is 24 percent greater than that in 1920, the peak year in value except for 1947. The decrease in tonnage was due largely to discontinuance of the business of one of the two firms reporting production in Illinois for many years. Other States producing these mineral substances in 1948 were Missouri and Pennsylvania.

Tripoli is used chiefly as an abrasive in polishing and buffing compositions, and as a filler. Tripoli sold for abrasive uses in 1948 declined 26 percent and that sold as filler increased 6 percent compared with 1947. Tonnages sold for other uses, including foundry facing, decreased 10 percent.

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[2] Kominek, E. G., Industrial Applications of Diatomite Filters: Ind. Eng. Chem., Vol. 39, No. 11, November 1947, pp. 1413–1419.

[3] Engle, J. W., Application of Diatomaceous Earth Filters to Swimming-Pool Recirculation Systems: Am. Water Works Assoc. Jour., vol. 40, No. 2, February 1948, pp. 274–275 (abs.).

[4] Water and Sewage, Diatomite Filtration as Developed by the Canadian Army: vol. 87, No. 1, January 1949, pp. 20–21.

[5] Craxford, S. R., Fischer-Tropsch Synthesis with Cobalt Catalysts: Jour. Soc. Chem. Ind., vol. 66, December 1947, pp. 440–444.
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Tripoli [1] sold or used by producers in the United States, 1943–48

Year	Short tons	Value	Year	Short tons	Value
1943	14,912	$244,365	1946	28,955	$549,099
1944	18,425	301,863	1947	34,578	751,422
1945	18,247	306,829	1948	26,845	705,523

[1] Including Pennsylvania rottenstone.

Tripoli [1] sold or used by producers in the United States, 1946–48, by uses

Use	1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value
Abrasives	21,206	$406,620	29,866	$654,232	22,193	$606,402
Filler	4,450	89,721	2,573	47,640	2,723	45,000
Other uses [2]	3,299	52,758	2,139	49,550	1,929	54,121
Total	28,955	549,099	34,578	751,422	26,845	705,523

[1] Including Pennsylvania rottenstone.
[2] Foundry facing and miscellaneous uses.

As quoted in E&MJ Metal and Mineral Markets, prices on tripoli in 1948 were the same as in the preceding 4 years (per short ton, f. o. b. Missouri, in paper-lined burlap bags, minimum carlot 30 tons): Once-ground, through 40-mesh, rose or cream, $14.50; double-ground, through 110-mesh, rose or cream, $16; air-floated, through 200-mesh, $26. Dry-ground, 325-mesh amorphous silica, f. o. b. works, Illinois, at the beginning of 1948 was quoted in Oil, Paint and Drug Reporter at $24 to $40 per ton in carlots and $29 for less than carlots. These quotations were reduced in July to $20 to $30 per ton for carlots and $25 for less than carlots. No change occurred during the balance of the year. Quotations on rottenstone throughout 1948, as given by the same source, were unchanged from those reported in April 1947: Carlots, in bags, at mines, $36 per short ton; and less than carlots, $43 per ton.

Firms actively producing tripoli, amorphous silica, and rottenstone in 1948 were: Illinois (amorphous silica)—Ozark Minerals Co., Cairo; Oklahoma (mine) and Missouri (mill)—American Tripoli Corp., Seneca, Mo.; and Pennsylvania (rottenstone)—Keystone Filler & Mfg. Co., Muncy, and Penn Paint & Filler Co., Antes Fort. Ray Williams and Charles Hinz, of Cairo, Ill., who had acquired the Olive Branch Mineral Co., Olive Branch, Ill., discontinued operations early in 1948.

Quartz.—Sales of crude, crushed, and ground quartz from pegmatite veins or dikes and from quartzite in 1948 rose to 161,861 short tons, valued at $750,667, a new record in both tonnage and value. The 1948 level was 60 percent in quantity above 1947 and 6 percent greater than the former record tonnage in 1914 (153,401 tons). The value reported for 1948 was 77 percent greater than that in 1947, the former peak year in realization. These increases in 1947 and 1948 were due largely to the augmented use of crushed quartz in the manufacture of ferrosilicon in Western States and to the greater use of vein quartz from North Carolina.

Quartz (crude, crushed, and ground) [1] sold or used by producers in the United States, 1944–48

Year	Crude		Crushed		Ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
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
1947	21,940	118,231	[2] 62,169	[2] 170,254	17,208	136,040	[2] 101,317	[2] 424,525
1948	41,081	250,184	104,496	374,781	16,284	125,702	161,861	750,667

[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.
[2] Revised figure.

Quartz (crude, crushed, and ground) [1] sold or used by producers in the United States, 1946–48, by States

State	1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value
Arizona, California, Oregon, Washington	41,844	$160,266	54,137	$255,044	91,926	$493,481
Massachusetts	829	7,715	1,019	9,185	792	7,288
Other States [2]	30,506	125,871	[3] 46,161	[3] 160,296	69,143	249,898
Total	73,179	293,852	[3] 101,317	[3] 424,525	161,861	750,667

[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] Maryland, North Carolina, South Dakota, Tennessee, and Wisconsin.
[3] Revised figure.

Crude and crushed quartz outputs were substantially higher in 1948 than in 1947, and sales of ground material decreased somewhat. The average value per ton of such quartz sold in 1948 rose to $4.64 compared with $4.19 in 1947 and $4.02 in 1946. Not included in these statistics in 1948 were sales of quartzite to cement mills and certain sales of quartz or quartzite for use in the manufacture of ferrosilicon.

Combined production of Arizona, California, Oregon, and Washington in 1948 again rose sharply and probably was largely consumed in the manufacture of ferrosilicon. Output in Eastern States also increased substantially. Quotations on "hard-quartz" silica at the beginning of 1948, reported in Oil, Paint and Drug Reporter, were as follows: 325-mesh, (99½-percent grade) carlots in bags, $20 per ton, and less than carlots, $25; and 140-mesh (99½-percent grade) carlots in bags, $15 per ton, and less than carlots, $20. During the first week in July all these prices were reduced $5 per ton and remained at the lower level for the rest of 1948.

Ground Sand and Sandstone.—Ground sand and sandstone sold or used by producers in 1948 topped the previous year in both tonnage and value and reached a record high. The sales in 1948 totaled 702,572 short tons valued at $5,814,664—8 percent greater in quantity and 12 percent higher in value than in 1947, the former peak year. Average value per ton in 1948 rose to $8.28 compared with $7.96 in 1947. Sales in Illinois, the largest producing State, were 17 percent above 1947. The Ohio-Virginia-West Virginia district in 1948 rose 9 percent above 1947. Georgia and Massachusetts showed small gains in 1948 compared with 1947. Sales in New Jersey, one of the larger producing States, decreased slightly. Large producing States other than New Jersey and Illinois were Ohio, Pennsylvania, and West Virginia.

Ground sand and sandstone sold or used by producers in the United States, 1944–48

Year	Short tons	Value	Year	Short tons	Value
1944	558,606	$3,989,981	1947	651,120	$5,181,113
1945	533,656	3,709,597	1948	702,572	5,814,664
1946	575,888	4,125,398			

Ground sand and sandstone sold or used by producers in the United States, 1946–48, by States

State	1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value
California	39,401	$215,889	(1)	(1)	(1)	(1)
Washington			(1)	(1)	6,682	$33,783
Georgia	4,406	25,993	11,031	$57,820	11,708	53,570
Illinois	144,753	1,061,046	198,500	1,614,173	232,971	1,943,284
Massachusetts	2,000	10,000	1,944	11,628	2,150	14,000
New Jersey	105,985	649,828	118,446	772,213	116,832	782,644
Ohio, Virginia, and West Virginia	169,710	1,396,151	177,048	1,568,756	193,289	1,781,053
Other States [2]	109,633	766,491	144,151	1,156,523	138,940	1,206,330
Total	575,888	4,125,398	651,120	5,181,113	702,572	5,814,664

[1] Included with "Other States."
[2] 1946: Missouri, Pennsylvania, and Wisconsin; 1947: California, Missouri, Pennsylvania, Washington, and Wisconsin; 1948: California, Missouri, Pennsylvania, Texas, and Wisconsin.

The chief consumers of ground sand and sandstone in 1948 were the pottery, porcelain, and tile industries (40 percent of the tonnage for which uses were reported), makers of cleaning and scouring compounds and other abrasive products (23 percent), foundries (15 percent), glass manufactures (6 percent), and producers of enamel (5 percent). This distribution is based on reports from companies accounting for 92 percent of the total sales. Filler and miscellaneous comprise the rest of the tonnage for which data were given. The uses showing increases in 1948 over 1947 were pottery, porcelain, and tile; foundries and abrasive products.

Ground sand and sandstone sold or used by producers in the United States in 1948, by uses [1]

Use	Short tons	Value	
		Total	Average per ton
Abrasive:			
Cleansing and scouring compound	138,138	$1,003,643	$7.27
Other	9,175	37,773	4.12
Enamel	30,902	231,865	7.50
Filler	14,687	114,381	7.79
Foundry	99,502	786,517	7.90
Glass	40,425	306,302	7.58
Pottery, porcelain, and tile	256,721	2,421,240	9.43
Other uses	56,822	435,243	7.66
Total reported by uses	646,372	5,336,964	8.26

[1] Data represent 92 percent of the industry.

Abrasive Sands.—Large quantities of natural sands with a high silica content annually are sold for glass grinding, stone polishing, coating sandpaper, sandblasting, or other abrasive purposes. Sales of such abrasive sands in 1948 totaled 1,119,802 short tons valued at $2,151,095, an increase of 2 percent in quantity and 19 percent in value compared with 1947. The 1948 figures include 381,455 tons of blast sand valued at $1,189,530. Detailed data regarding tonnages produced in each State appear in the Sand and Gravel chapter of this volume.

SPECIAL SILICA-STONE PRODUCTS

Grindstones and Pulpstones.—Sales of grindstones in 1948 decreased by 25 percent compared with 1947 and were the lowest since 1939. The value declined to a point slightly above the 1945 level. Grindstones were produced in Ohio and West Virginia, and output of pulpstone was reported from Washington.

Grindstones and pulpstones sold by producers in the United States, 1944–48

Year	Grindstones		Pulpstones		
			Quantity		Value
	Short tons	Value	Pieces	Equivalent short tons	
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
1947	10,620	476,811	24	76	4,976
1948	7,921	402,667	12	33	2,100

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

Oilstones and Related Products.—Production of natural sharpening stones, including oilstones, whetstones, scythestones, and rubbing stones, continued at an active rate in 1948; the Bureau of Mines is not at liberty to publish the figures. Producing States in 1948, and the type of abrasive stones reported from each, were: Arkansas—oilstones; Indiana—scythestones, whetstones, and rubbing stones; New Hampshire—scythestones; and Ohio—scythestones, whetstones, and rubbing stones (holystones).

Millstones.—The value of sales of millstones and chasers in 1948 declined 24 percent compared with 1947, but still was higher than other years since 1929. As in 1947, marketed production in 1948 of millstones and chasers was reported in Ulster County, N. Y., Rowan County, N. C., and in Montgomery County, Va.

Value of millstones and chasers sold by producers in the United States, 1943–48 [1]

Year	Number of producers	Value	Year	Number of producers	Value
1943	4	$9,240	1946	4	$14,780
1944	3	9,700	1947	4	23,189
1945	4	15,018	1948	3	17,733

[1] Produced in Minnesota (1945 only) New York, North Carolina, and Virginia.

Grinding Pebbles and Tube-Mill Liners.—The quantity of grinding pebbles sold or used in 1948 was 31 percent less than in 1947 and the total value 17 percent less. The tonnage of tube-mill liners also decreased, although the value of sales showed a small increase. Grinding pebbles were produced in 1948 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, 1944–48

Year	Grinding pebbles		Tube-mill liners		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
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
1947	5,860	122,883	1,496	40,303	7,356	163,186
1948	4,026	101,583	1,297	41,555	5,323	143,138

The following firms produced for sale the products indicated: Crystal Silica Co., Los Angeles, Calif., grinding pebbles; Jasper Stone Co., Sioux City, Iowa, liners and grinding pebbles (quarries in Minnesota); Harris Granite Quarries Co., Salisbury, N. C., liners and grinding pebbles; Dezendorf Marble Co., Austin, Tex., grinding pebbles; Mineral Products Co., Seattle, Wash., grinding pebbles; and Baraboo Quartzite Co., Baraboo, Wis., liners and grinding pebbles.

Comparative tests of the wear rates of porcelain balls and French flint pebbles for the paint and ceramic industries showed the much greater resistance to attrition of the flint pebbles.[10]

[10] Grindings and Mixings, French Flint Pebbles Wear Slowest According to a Study Recently Made: April 1949, pp. 1-2 (Paul O. Abbe, Inc., Little Falls, N. J.).

NATURAL SILICATE ABRASIVES

Pumice and Pumicite.—Pumice or pumicite (volcanic ash) sold or used totaled 607,746 short tons valued at $2,501,906 in 1948, a new record in both quantity and value, and 37 percent greater in tonnage and 24 percent greater in value than the former high year 1947. This active market was due to the greatly augmented use of these materials as aggregate for construction, particularly in the Western States. A great deal of research and testing work has been undertaken. A very active demand continues to exist for concrete containing properly sized pumice. Addition of this material to the batch lightens the weight of the finished concrete while in most instances maintaining adequate strength.

Pumice and pumicite sold or used by producers in the United States, 1943–48

Year	Short tons	Value	Year	Short tons	Value
1943	85,150	$611,495	1946	319,883	$1,585,753
1944	88,757	704,110	1947	442,552	2,021,880
1945	157,011	1,051,037	1948	607,746	2,501,906

Pumice and pumicite sold or used by producers in the United States, 1946–48, by States

State	1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value
Alaska	-----	-----	-----	-----	(1)	(1)
California	89,181	$755,570	169,037	$1,026,275	196,934	$1,110,447
Colorado	600	1,200	(1)	(1)	-----	-----
Idaho	108,847	163,515	98,618	119,882	79,426	93,602
Kansas	35,466	105,084	(1)	(1)	(1)	(1)
Montana	-----	-----	2,035	9,476	(1)	(1)
Nebraska	4,772	45,900	4,546	43,760	4,000	34,200
New Mexico	62,623	432,890	85,639	512,176	177,630	812,545
Oklahoma	-----	-----	(1)	(1)	(1)	(1)
Oregon	3,004	12,532	33,240	111,380	106,277	307,274
Texas	805	13,054	(1)	(1)	(1)	(1)
Utah	-----	-----	7,500	30,000	7,618	30,472
Washington	14,585	56,008	26,497	74,173	26,675	47,787
Undistributed [1]	-----	-----	15,440	94,758	9,186	65,579
Total	319,883	1,585,753	442,552	2,021,880	607,746	2,501,906

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

Output in 1948 was reported from 11 States and Alaska. The largest producer in 1948 was California, whose production was 17 percent larger than in 1947. New Mexico attained second place in order of output, more than doubling the production of 1947, and Oregon was third, having 220 percent more than in 1947. Idaho, which was fourth in production, showed a substantial loss in tonnage, and Washington and Utah showed small gains. Nebraska reported a smaller output. The increases were due to the larger demands for pumice in construction. On account of the lower costs and less extensive preparation required for pumice used as aggregate as well as the smaller tonnages of pumice consumed for abrasive purposes, the average realization per ton for all pumice and pumicite has been dropping steadily. In 1946 the average value per ton was $4.96; in 1947, $4.57; and in 1948, $4.12.

Pumice and pumicite sold or used by producers in the United States, 1946–48, by uses

Use	1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value
Abrasive:						
Cleansing and scouring compounds and hand soaps	52,085	$386,593	25,266	$323,885	16,005	$245,994
Other abrasive uses	2,369	112,694	5,800	326,348	4,508	251,828
Acoustic plaster	4,342	139,871	5,427	163,360	3,612	109,498
Concrete admixture and concrete aggregate	248,247	607,695	397,223	1,083,630	559,697	1,665,727
Other uses [1]	12,840	338,900	8,836	124,657	23,924	228,859
Total	319,883	1,585,753	442,552	2,021,880	607,746	2,501,906

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

Pumice and pumicite sold for concrete admixture and concrete aggregate in 1948 reached 559,697 short tons in 1948, an increase of 41 percent over the active year 1947. Pumice used for abrasive purposes and for acoustic plaster each declined by about one third in 1948 compared with the previous year. Other uses increased by 171 percent and included sales for absorbents, insecticides, insulation, and paint filler. Trends in sales of pumice and pumicite in recent years, separated according to chief uses, are indicated in figure 1.

Quotations on domestic and imported pumice in 1948 were given in Oil, Paint and Drug Reporter as follows: Domestic—ground, coarse (sizes 0½, 1, 1½, 2, 3), in bags, ton lots, New York, 3⅝ to 4 cents per pound (Chicago, 4½ cents), smaller lots, 3⅞ to 4¼ cents; fine, in bags, ton lots, 3⅜ cents per pound, smaller lots, 3⅝ to 4 cents; imported—Italian, silk-screened, fine, in bags, ton lots, 4 cents per pound; coarse, in bags, ton lots, 5½ cents; sun dried, fine, in bags,

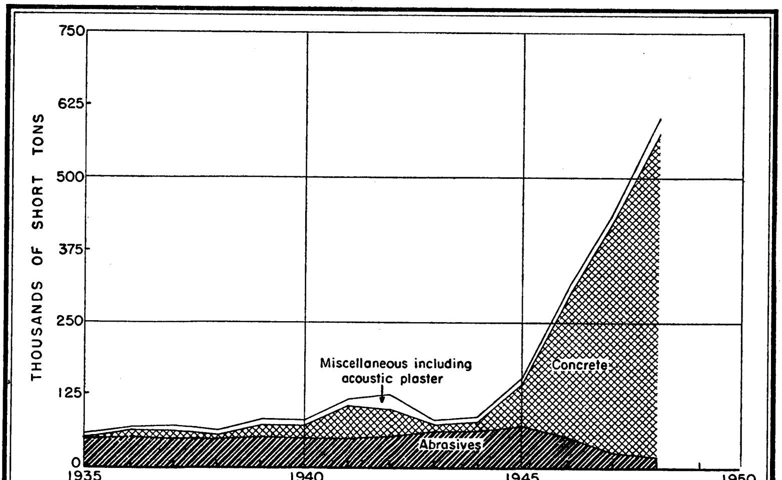

FIGURE 1.—Trends, by uses, of pumice and pumicite sold or used in the United States, 1935–48.

ton lots, 3 cents per pound; coarse, in bags, ton lots, 4½ cents. Pumice in barrels was quoted at ½ cent per pound higher.

The heavy demand for aggregates and the resultant greatly increased production of pumice and pumicite in the Western and Southwestern States led to formation of a Pumice Producers Association about the middle of 1948. The initial aims were outlined to be an organized research program, the standardization of pumice for use as concrete aggregates, and a program of national advertising. Technical sessions stressed construction operations in which pumice had been used, the lines along which future research should be directed, and the advantages to be gained by pumice construction.[11] Representatives of the pumice industry and related fields in the State of Washington also were reported to be organizing an association with similar aims.[12] California has under way a study of its pumice resources and their utilization, and a two- to five-year research program to aid in the development and wider commercial application of the Washington pumice deposits has been initiated at Washington State College, Pullman.[13]

Many new enterprises both in the mining and the processing of pumice products have arisen in the last two or three years. Specifications and methods of manufacture and new applications have been described in the literature. Among the operations described have been three plants in New Mexico.[14]

A technical discussion of pumice in various concrete mixes [15] and its application to prefabricated housing construction [16] was published. An informative series of articles entitled "The Story of Pumice" was presented in the trade journal, Concrete, beginning in the August 1948 and continuing through the December issue (vol. 56, Nos. 8–12). Subjects discussed included mining, processing and grading, precasting house panels, ready-mixed concrete, monolithic concrete hospital construction, progress of structural design, and manufacture and tests of concrete masonry units.

A study of the many types of lightweight aggregates (including pumice) in use in the Los Angeles area was published.[17] Based largely on the above study but giving much additional information was a discussion of lightweight aggregates in Architectural Record.[18] The Oklahoma Geological Survey has discovered that volcanic ash can be bloated or expanded to make satisfactory light, cellular products with good insulating and structural possibilities in the lightweight aggregate field.[19] Glazes compounded with volcanic ash have a long fusion range and are said to be suitable for a wide range of colors.[20]

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11 Concrete, Pumice Producers Form Organization to Carry Out Three-Point Program: Vol. 56, No. 7, July 1948, p. 30; Rock Products, Pumice Producers Unite: Vol. 51, No. 7, July 1948, p. 128.

12 Pit and Quarry, vol. 40, No. 8, February 1948, p. 123.

13 Engineering and Mining Journal, vol. 149, No. 6, June 1948, p. 123.

14 Lenhart, W. B., Pumice Takes Lead in the Southwest: Rock Products, vol. 51, No. 6, June 1948, pp. 186–187; Rock Products, Processing Pumice for Aggregate: Vol. 51, No. 9, September 1948, pp. 102, 104; Rock Products, Design Plant for Ready-Mixed Concrete: Vol. 51, No. 9, September 1948, pp. 131–133.

15 Wagner, Walter K., Design and Control of Pumice Concrete Mixes: Rock Products, vol. 51, No. 9, September 1948, pp. 125–127, 136.

16 Rock Products, Prefabricated Housing of Pumice Concrete: Vol. 51, No. 9, September 1948, pp. 129–130. Concrete, Pumice Concrete Houses at Muroc Air Base: Vol. 56, No. 6, June 1948, pp. 14–15, 31.

17 Ingram, Stuart H., Lightweight Aggregates in the Southwest: Am. Inst. Min. and Met. Eng., Min. Technol., vol. 11, No. 5, Tech. Pub. 2240, September 1947, 15 pp.

18 Architectual Record, Lightweight Aggregates Win New Attention: Vol. 104, No. 1, July 1948, pp. 143–145.

19 Rock Products, vol. 51, No. 6, June 1948, p. 187.

20 Carey, J. Sheldon, Glazes from Kansas Volcanic Ash: Bull. Am. Ceram. Soc., vol. 27, No. 6, June 15, 1948, pp. 225–228.

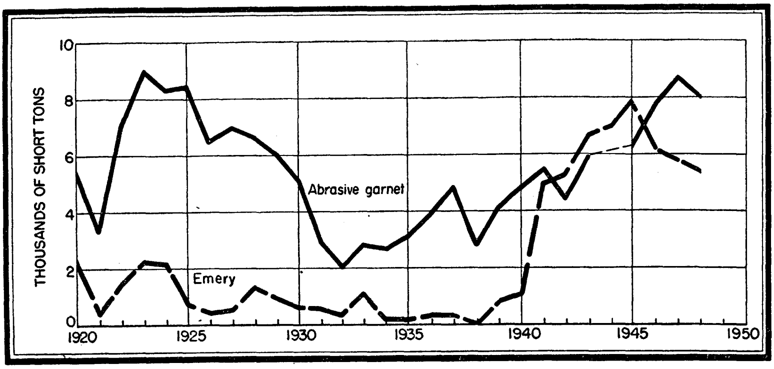

FIGURE 2.—Marketed production in the United States of abrasive garnet and domestic emery, 1920–48.

Garnet.—Output of garnet in 1948 totaled 8,039 short tons valued at $587,797, or 8 percent less in tonnage and 4 percent less in value than in 1947. Except for 1947, this production in 1948 was larger in both quantity and value than in any year since 1925. The trend in output (sales) of garnet since 1920 is shown in figure 2. The following producers reported sales in 1948: Idaho Garnet Abrasive Co., Inc., P. O. Box 1452, Spokane 6, Wash. (deposit near Fernwood, Idaho); Garnet Mines, Inc., Fernwood, Idaho; Barton Mines Corp., North Creek, N. Y.; and Northern Minerals, Inc., Essex, N. Y. Occurrence of garnet deposits in Japan was studied and output data given in a recent publication.[21]

Abrasive garnet sold or used by producers in the United States, 1943–48

Year	Short tons	Value	Year	Short tons	Value
1943	5,935	$429,120	1946	7,743	$570,186
1944	(1)	(1)	1947	8,722	614,071
1945	6,306	375,198	1948	8,039	587,797

1 Bureau of Mines not at liberty to publish figure.

The quotations on domestic garnet in 1948, as given in E&MJ Metal and Mineral Markets, remained at the same level as in immediately preceding years: New York Adirondack garnet concentrates, grain, $85 per short ton.

NATURAL ALUMINA ABRASIVES

Corundum.—The corundum consumed in the United States in recent years, aside from moderate tonnages recovered from tailing dumps in the Craigmont area, Ontario, Canada, was imported from southern Africa, particularly the Union of South Africa. Transportation difficulties and inability to increase output substantially have resulted in smaller shipments. Although a sizable demand exists for this product in the United States, imports have fallen behind the potential market. Efforts have continued to stimulate higher

21 Cobb, Edward H., Garnet Resources of Japan: General Headquarters Supreme Commander of the Allied Powers (Tokyo), Natural Resources Sect., Prelim. Study 7, 1947, 10 pp. Chem. Abs., vol. 42, No. 2, Jan. 20, 1948, p. 494.

production in the chief country of origin of this commodity. Although the imports of corundum ore from the Union of South Africa in 1948 reached 3,612 short tons, or 50 percent greater than in 1947, they nevertheless were considerably under most recent years. The recovery of corundum from tailing dumps in Canada has been discontinued, while production on a commercial scale in other possible producing areas, such as Brazil, India, and South African areas other than the Transvaal, has been small or nonexistent.

Available statistics of world production of corundum in recent years appear in the accompanying table.

World production of corundum by countries, in metric tons, 1937–48 [1]

[Compiled by Pauline Roberts]

Country [1]	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
Australia (New South Wales)	------	------	------	------	------	------	------	------	[2] 10	(3)	(3)	(3)
Belgian Congo	------	------	------	------	------	------	------	[4] 5	------	------	------	------
Brazil	------	------	------	------	------	------	------	[5] 100	(3)	(3)	(3)	(3)
Canada	------	------	------	------	------	------	------	[6] 157	[6] 1,195	[6] 1,080	------	(3)
French Equatorial Africa	------	------	------	------	------	------	------	[5] 2	142	46	3	(3)
India	------	3	1	(7)	56	135	110	349	409	97	84	(3)
Madagascar	27	35	5	------	------	------	14	70	50	21	1	4
Nyasaland	------	------	------	------	(7)	81	180	305	328	379	(3)	(3)
Portuguese East Africa	------	------	------	------	------	------	834	1,108	152	(3)	(3)	(3)
Southern Rhodesia	(3)	102	69	90	32	74	44	------	------	13	------	114
Swaziland	------	------	------	------	------	15	141	------	------	------	(3)	(3)
Tanganyika	------	------	------	------	------	------	7	------	------	------	(3)	(3)
Union of South Africa (sales)	2,237	1,397	2,381	3,820	6,119	6,724	4,270	3,531	4,379	1,854	2,313	2,537
United States (sales)	------	------	------	------	------	------	(8)	(8)	------	------	------	------
Total [9]	2,300	1,537	2,456	3,910	6,207	7,029	5,600	5,650	6,800	3,850	3,000	3,300

[1] In addition to countries listed, corundum probably is produced in U. S. S. R., but data on production are not available.
[2] Reported as corundum and emery (believed to be largely emery).
[3] Data not available.
[4] Imports into United States.
[5] Estimate.
[6] Recovered from tailing dumps.
[7] Less than 1 ton.
[8] Bureau of Mines not at liberty to publish figure.
[9] Includes estimates for entries where footnote 3 indicates data not available and includes United States production as measured by sales. Excludes estimates for U. S. S. R.

Quotations on crude corundum imported into the United States do not appear in domestic trade journals. Corundum grain in 1948 was quoted in E&MJ Metal and Mineral Markets as follows: Per pound, sizes 8 to 60, inclusive, 8¾ cents; 70–275, inclusive, 9¾ cents; 500, 30 cents; 850, 45 cents; 1,000, 45 cents; 1,200 to 1,600 inclusive, 65 cents; and 2,600, 70 cents.

Emery.—Marketed output of emery in 1948 decreased 7 percent in tonnage in 1948 compared with 1947. The total value of sales, however, increased 4 percent to the highest value (except for 1945) since 1918. The only producers of emery in 1948 were Joe DeLuca, and DiRubbo & Ellis, of Peekskill, N. Y. The crude emery is shipped to manufacturers of grinding wheels, abrasive sticks, and other abrasive products. A large part of the output also is used as a nonslip agent in concrete floors and steps. The production since 1920 is presented graphically in figure 2.

The quotation on crude domestic emery ore in E&MJ Metal and Mineral Markets up to May 1947 was $10 per short ton for first-grade ore, f. o. b. New York. Beginning May 1947 and continuing through 1948, this figure was given as $12 per ton. The same publication quoted grain emery before September 1947 as follows (per pound, in 350-pound kegs, f. o. b. Pennsylvania): Turkish and Naxos, 7 cents; American, 5 cents. After September 1947 and continuing through 1948, quotations were reported as 10 cents per pound for Turkish and Naxos and 6½ cents for American.

Emery sold or used by producers in the United States, 1943–48

Year	Short tons	Value	Year	Short tons	Value
1943	6, 666	$63, 195	1946	6, 188	$62, 099
1944	6, 940	64, 858	1947	5, 798	66, 927
1945	7, 856	75, 977	1948	5, 405	69, 408

NATURAL CARBON ABRASIVES [22]

Industrial Diamonds.—World sales of industrial diamonds in 1948 rose more than 150 percent to the highest figure on record, £11,300,000, according to Industrial Distributors (Sales), Ltd., London, the diamond-syndicate marketing organization. Chief factors in this large increase in sales were the wider and more intensive employment of abrasive diamonds in industry and in mining. Contributing largely also to the higher sales were substantial purchases by the United States Government under its stock-piling program. The much larger imports for consumption in the United States during 1948 were the direct result of these developments.

Extensive experimentation in industrial laboratories in the United States,[23] as well as in the Diamond Research Laboratory at Johannesburg, Union of South Africa,[24] are increasing the uses and applications of industrial diamonds and promoting more efficient recovery methods. Sending an electric arc through the fine steel needles used in boring minute holes in wire-drawing dies speeds up the drilling processes, according to a recently issued patent.[25] One type of unusually clear diamond, free from flaws, has been discovered to be useful to the nuclear physicist as an efficient radiation counter.[26]

The geology and occurrences of diamonds throughout the world were described.[27] Location of deposits and approximate total value of production of minerals including diamonds in the mineral belt extending from the Congo down through southern Africa were presented by means of a map and table.[28] Production and history of wartime development were published for diamond mines in Tanganyika [29] and in Sierra Leone.[30] New diamond discoveries in the

[22] See also Gem Stones chapter of this volume.
[23] South African Mining and Engineering Journal, vol. 59, No. 2902, Sept. 25, 1948, p. 101.
[24] South African Mining and Engineering Journal, vol. 59, No. 2879, Apr. 17, 1948, p. 189.
[25] Science News Letter, vol. 53, No. 16, Apr. 17, 1948, p. 249 (U. S. Patent 2,438,941, assigned to the Government by C. G. Peters, F. K. Harris, W. B. Emerson, I. L. Cooter, and K. F. Neffien).
[26] Curtiss, L. F., Diamonds Used To Detect Atomic Radiation. Nat. Bureau of Standards, Tech. Bull., vol. 31, No. 11, November 1947, pp. 121–123.
Mining Journal (London), vol. 231, No. 5913, Dec. 18, 1948, p. 946.
[27] Wilson, N. W., The World's Diamond Deposits: Mining Mag. (London), vol. 79, No. 6, December 1948, pp. 329–341.
[28] Mining and Industrial Magazine of Southern Africa, The Richest Part of the Earth's Crust: Vol. 38, No. 11, November 1948, pp. 597, 599, 601.
[29] Mining and Industrial Magazine of Southern Africa, Diamond Mines of Tanganyika: Vol. 38, No. 6, June 1948, p. 335.
[30] Mine and Quarry Engineering, Diamonds in Sierra Leone: Vol. 14, No. 5, May 1948, p. 142.

Congo [31] and in British Guiana [32] were reported. A detailed description of the diamond fields of Venezuela, including production figures and methods of recovery, was published.[33] Resources and the results of wartime investigation of the diamond deposits near Murfreesboro, Ark., were reported.[34]

ARTIFICIAL ABRASIVES

Production of silicon carbide and aluminum oxide and shipments of metallic abrasives each were only slightly smaller in 1948 than in 1947. The total realization was somewhat higher in 1948; that for metallic abrasives rose 22 percent to a new record. The tonnage of metallic abrasives was higher than in any year except 1947. The total for aluminum oxide shown in the accompanying table includes 15,706 short tons of "white high-purity or special" material valued at $1,726,093, a small decrease in both quantity and value compared with 1947. The estimated percentage of aluminum oxide used for refractory and other nonabrasive purposes in 1948 remained at 4 percent, the same as in 1947, while the similar figure for silicon carbide rose to 47 percent in 1948 compared with 42 percent in 1947.

Crude artificial abrasives produced in the United States and Canada, 1944–48

Year	Silicon carbide [1]		Aluminum oxide [1] (abrasive grade)		Metallic abrasives [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
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
1947	63,724	5,633,811	160,022	10,158,432	154,191	12,449,855	377,937	28,242,098
1948	63,033	5,874,731	154,972	10,279,583	147,218	15,174,773	365,223	31,329,087

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

Stocks of silicon carbide at the end of 1948 rose sharply, and those of aluminum oxide showed a small increase, while those of metallic abrasives decreased slightly. Capacity of plants producing silicon carbide and aluminum oxide remained at virtually the same level. The capacity of the metallic abrasives industry was reported to be 2 percent less than in 1947. Operations in 1948 were at a somewhat lower rate compared with capacity than in 1947: Silicon carbide, 86 percent in 1948 compared with 88 in 1947; aluminum oxide, 66 percent in 1948 and 69 in 1947; and metallic abrasives, 61 percent in 1948 and 64 in 1947.

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[31] Mining and Industrial Magazine of Southern Africa, Mineral Wealth of the Congo: Vol. 38, No. 9, September 1948, pp. 473, 479.
[32] Mining Journal (London), vol. 230, No. 5877, Apr. 10, 1948, p. 265; vol. 231, No. 5901, Sept. 25, 1948, pp. 701–702.
[33] Davey, John C., The Diamond Fields of Venezuela: Eng. and Min. Jour., vol. 149, No. 4, April 1948, pp. 74–78.
[34] National Jeweler, vol. 44, No. 1, January 1949, p. 130; No. 4, April 1949, p. 280.

Stocks of crude artificial abrasives and capacity of manufacturing plants, as reported by producers in the United States and Canada, 1944–48, in short tons

Year	Silicon carbide		Aluminum oxide		Metallic abrasives [1]	
	Stocks, Dec. 31	Average annual capacity	Stocks, Dec. 31	Average annual capacity	Stocks, Dec. 31	Average annual capacity
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
1947	3,524	72,350	32,977	233,500	9,987	245,479
1948	5,387	73,250	34,177	233,500	9,907	240,129

1 Figures pertain to United States plants only.

Production of aluminum oxide and silicon carbide is concentrated largely in the Niagara Falls region of Canada and the United States and in Quebec in areas of plentiful and relatively cheap water power; some aluminum oxide, however, is produced in Alabama. Neither the new plant of the Coated Products Division of Carborundum Co., nor the proposed silicon carbide plant at Vancouver, Wash., projected by the same firm, are yet in operation. The new furnace plant of Electro Refractories & Alloys, Canada, Ltd., at Cap-de-la-Madelaine, near Three Rivers, Quebec, was not placed in production until January 1949. Toward the end of 1948, the Abrasive Grain Association and five individual manufacturers of artificial abrasives in an anti-trust consent judgment by the United States District Court at Buffalo, N. Y., were enjoined from fixing prices and uniform conditions of sale of artificial abrasive grain and from exchanging price lists or quotations. Under the judgment, purchasers have the option of buying at a delivered price or at a factory price based on delivered price less actual cost of transportation.[35]

Statistics for metallic abrasives cover steel shot and grit but do not include steel wool. The figures represent operations of plants in the United States only. As in 1947, 18 companies with 19 plants reported sales in 1948. The three largest producing States were Ohio, Michigan, and Pennsylvania. Other States in which metallic abrasives were manufactured in 1948 were Illinois, Massachusetts, New Hampshire, and New York.

Two high-purity aluminum oxide powders of ultrafine, uniform particle size have proved useful in metallographic polishing and are said to be suitable for optical and gem polishing, metal finishing, as catalyst carriers, and in the manufacture of phosphors for lighting.[36] Use of type 32 aluminum oxide in vitrified bonding wheels was described and advantages reported.[37] The chemical properties, history and manufacture of boron carbide were outlined.[38]

35 Chemical and Engineering News, vol. 26, No. 49, Dec. 6, 1948, p. 3626.
36 Chemical and Engineering News, vol. 26, No. 38, Sept. 20, 1948, p. 2840; Chem. Ind., vol. 63, No. 3, September 1948, p. 424.
37 Larson, E. T., Grits and Grinds, vol. 38, No. 8, 1947, pp. 12–13; Jour. Am. Ceram. Soc., vol. 31, No. 5, May 1, 1948, p. 95.
38 Lefebre, A., Abrasives: Ind. Ceram., 1948, No. 383, 31; British Ceram. Abs., 1948, 276A; British Abs. B-I, II, III, December 1948, p. 706.

Shot-peening of nonferrous metals increased fatigue and corrosion resistance appreciably, reduced the susceptibility of brass to season-cracking, and was effective as a cure for porosity in aluminum die castings.[39]

MISCELLANEOUS MINERAL ABRASIVE MATERIALS

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

FOREIGN TRADE[40]

Imports.—The total value of imports for consumption of natural abrasive products rose 143 percent in 1948 compared with 1947. Crude or unmanufactured diamond bort, carbonado and ballas, and diamond dust were the chief contributors to this increased import trade, showing gains in 1948 of 166, 125, and 95 percent, respectively, over 1947 levels. Imports of corundum ore, crude or unmanufactured pumice, and garnet were considerably higher in 1948 than in 1947. Imports of manufactured diamond bort and emery ore registered large decreases, while receipts of unground flint, flints, and flintstones were only slightly less than in 1947.

Exports.—The value of exports of natural abrasive products in 1948 declined 21 percent compared with 1947. All classes of products shown in the accompanying table showed moderate to substantial decreases in quantity of exports. Exports of grindstones, emery and corundum wheels, and emery powder, in particular, were 37, 72, and 49 percent, respectively, less than in 1947, and the weight of "Other natural abrasives" decreased by 14 percent.

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[39] Knight, Harold A., Shot-Peening of Nonferrous Metals: Materials and Methods, vol. 26, No. 5, November 1947, pp. 83–86.

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

Abrasive materials imported for consumption in the United States, 1946–48, by kinds

[U. S. Department of Commerce]

Kind	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Burrstones: Bound up into millstones.....short tons..	13	$1,099	27	$1,848	1	$204
Grindstones, finished or unfinished.....short tons..	232	12,077	251	17,255	307	19,882
Hones, oilstones, and whetstones.....short tons..	12	26,595	20	59,315	42	73,619
Corundum (including emery):						
Corundum ore....short tons..	4,207	340,891	2,401	194,158	3,612	300,865
Emery ore.....do....	2,561	33,358	3,105	50,750	1,102	11,350
Grains, ground, pulverized, or refined.....pounds..	117,368	7,011	114,493	4,516	125,041	4,809
Paper and cloth coated with emery or corundum..reams..	873	130,660	1,356	180,584	1,509	180,743
Wheels, files, and other manufactures of emery or corundum or garnet.....pounds..	4,378	4,113	7,212	8,674	8,350	9,530
Garnet in grains, ground, etc.do....	38,874	2,373	1,264	190	3,101	578
Tripoli and rottenstone.short tons..	93	3,095	83	2,951	.....	.....
Pumice:						
Crude or unmanufactured short tons..	5,471	61,190	7,809	70,174	8,475	85,370
Wholly or partly manufactured.....short tons..	984	25,204	795	17,028	780	18,979
Manufactures, n. s. p. f.....	.....	110	.....	148	.....	.....
Diamonds:						
Bort, manufactured....carats..	2,104	63,674	1,679	95,975	613	69,024
Bort (glaziers' and engravers' diamonds, unset, and miners').....carats..	4,609,146	14,012,604	3,892,778	12,525,230	10,357,119	31,676,586
Carbonado and ballas....do....	16,136	284,932	27,234	315,636	61,197	844,915
Dust.....do....	77,732	129,272	116,391	230,139	226,430	618,265
Flint, flints, and flintstones, unground.....short tons..	6,965	182,026	11,399	280,407	11,193	269,935
Total.....	.....	15,320,284	.....	14,054,978	.....	34,184,654

Abrasive materials exported from the United States, 1944–48, by kinds

[U. S. Department of Commerce]

Kind	Grindstones		Wheels of emery and corundum		Emery powder	
	Pounds	Value	Pounds	Value	Pounds	Value
1944.....	3,393,763	$155,048	600,682	$342,215	744,076	$74,331
1945.....	4,699,860	252,293	248,118	144,589	326,758	34,003
1946.....	6,135,719	285,799	431,434	218,961	529,362	60,982
1947.....	4,591,080	217,747	450,834	256,191	547,264	66,104
1948.....	2,887,995	131,725	128,412	81,495	278,347	48,376

Kind	Diamond dust		Diamond grinding wheels		Other natural abrasives, hones, and whetstones		Total value
	Carats	Value	Pounds	Value	Pounds	Value	
1944.....	119,458	$133,270	2,897	$104,947	45,494,759	$1,281,864	$2,091,675
1945.....	92,019	95,761	3,256	83,626	54,548,442	1,475,874	2,086,146
1946.....	116,650	146,490	4,398	95,205	52,881,184	1,619,416	2,426,853
1947.....	122,925	324,572	13,217	212,074	69,989,036	2,274,858	3,351,546
1948.....	52,600	80,352	11,562	270,929	60,257,843	2,030,731	2,643,608

Aluminum

By RICHARD H. MOTE AND HORACE F. KURTZ

GENERAL SUMMARY

PRIMARY aluminum output in the United States in 1948 rose to a new peacetime record despite floods and electric-power shortages which curtailed production and forced plant closures. Even though the 1948 output exceeded all but that in the war years 1943 and 1944, the quantity was insufficient to meet heavy consumer demand for the metal in established uses and in new and substitute uses resulting from the prevailing short supply and relatively high price of many competing materials. Apparent consumption of virgin aluminum in 1948 was 27 percent greater than in the preceding year, as net imports in crude and semicrude form added approximately 40,000 tons to the total supply. Consumption of the metal for the manufacture of building products, particularly roofing and siding, continued to lead the field of uses in 1948. In addition to the expanded use of primary aluminum, large quantities of secondary aluminum were reclaimed from scrap and made available for consumption during the year.

Salient statistics of the aluminum industry, 1939–43 (average) and 1944–48

	1939–43 (average)	1944	1945	1946	1947	1948
Primary production short tons	424,035	776,446	495,060	409,630	571,750	623,456
Value	$131,408,000	$222,416,000	$140,864,000	$115,812,000	$161,626,000	$180,755,000
Quoted price per pound [1] cents	17.0	15.0	15.0	15.0	15.0	15.7
Secondary production short tons	150,318	325,645	298,387	278,073	[2] 344,837	286,777
Imports	$18,543,732	$30,322,653	$99,370,633	$12,463,960	$6,603,722	$42,202,648
Exports	$29,436,083	$89,800,122	$9,906,041	$20,284,053	$52,231,972	$43,185,781
World production short tons	1,301,000	[2] 1,844,000	[2] 958,000	[2] 873,000	[2] 1,195,000	1,394,000

[1] Ceiling price 15 cents, April 1942–August 1945.
[2] Revised figure.

The broad inflationary price trend in 1948 forced a break in the price of standard 99.0–99.5 percent aluminum ingot, which had been 15 cents a pound since the latter part of 1941. Increased costs of labor and materials precipitated two price rises of 1 cent each in June and October and established the quotation at 17 cents.

World production of aluminum advanced 17 percent from 1,084,000 metric tons in 1947 to approximately 1,265,000 tons in 1948. As in the United States, output in most foreign countries was generally hampered by power shortages.

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

PRODUCTION

Primary.—Domestic production of primary aluminum totaled 623,456 short tons in 1948, an increase of 9 percent over the 571,750 tons produced in 1947 and the highest peacetime output in the history of the industry. The accelerated growth of aluminum production in recent years is strikingly indicated by comparison with growth in over-all industrial output. The index of total production [1] increased from 170 in 1946 to 192 in 1948, a gain of 13 percent during the 2-year period. The index for aluminum production, calculated on the same base period, advanced from 328 in 1946 to 498 in 1948, an increase of 52 percent, which shows that the aluminum industry expanded during the period at a rate four times that of industrial output as a whole.

Production of primary aluminum in the United States, 1941–48, by months, in short tons [1]

Month	1941	1942	1943	1944	1945	1946	1947	1948
January	21,800	32,250	60,650	84,846	48,750	24,700	50,045	48,767
February	19,500	30,100	55,600	74,400	45,750	22,200	47,002	45,699
March	22,200	34,400	64,600	80,200	53,360	25,950	53,032	51,874
April	22,900	35,000	66,800	77,800	51,700	25,850	51,007	53,277
May	25,200	37,200	72,850	76,450	52,200	24,800	51,116	55,450
June	25,800	39,500	74,150	66,400	47,600	27,750	46,259	48,557
July	27,000	45,000	78,450	67,550	48,000	35,700	47,998	52,937
August	27,900	48,950	81,350	61,650	45,900	39,800	47,054	54,953
September	27,600	49,550	86,400	47,450	31,700	41,050	43,228	53,255
October	29,500	54,150	94,250	48,400	25,100	44,950	43,959	54,526
November	29,000	55,000	91,350	44,450	20,900	46,250	43,461	50,714
December	30,667	60,006	93,729	46,850	24,100	50,630	47,589	53,447
Total	309,067	521,106	920,179	776,446	495,060	409,630	571,750	623,456

[1] Monthly data 1941–July 1946 from producers' reports to War Production Board and its successor, Civilian Production Administration; all other data from reports to Bureau of Mines. Monthly figures have been adjusted to final annual totals.

Except in January, February, and June, the monthly production of primary aluminum in 1948 was at a rate exceeding 600,000 tons annually. Early in the year a drought in the Southeast caused a power shortage in the Tennessee Valley, which curtailed operations in that area and caused domestic primary aluminum output to drop to 45,699 tons in February, the low point of the year. Production gained steadily thereafter to reach the 1948 peak monthly output of 55,450 tons in May. Serious floods along the Columbia River from late May until early July forced the Reynolds Metals Co. plant at Troutdale, Oreg., to close for almost 2 months and curtailed operations at the Reynolds plant at Longview, Wash., and the Aluminum Co. of America plant at Vancouver, Wash. As a result, production slumped to 48,557 tons in June. The monthly output rose in the following months but fell again during the latter part of the year owing to a seasonal drop in water level in the Northwest.

[1] Federal Reserve Bank indexes of physical volume of industrial production; 1935–39 equals 100.

Although congressional approval of a program for Air Force expansion and the persistent demand for aluminum in markets formerly supplied by other metals indicated a potentially increasing need, domestic production of the light metal appeared to be limited to a level not exceeding the 1948 output by the lack of additional electric power. According to the Federal Power Commission, the total power load in December 1948 was almost equivalent to the total national installed capacity. Although increases in generator capacity are scheduled over the next few years, they are barely adequate to cover existing commitments and do not allow for any substantial increase in the number of aluminum reduction units.

Aware of the lack of surplus hydroelectric power, the Aluminum Co. of America turned to natural gas as a source of energy for producing electricity. In conjunction with the Nordberg Manufacturing Co., Alcoa developed a special type of spark-fired internal-combustion engine which will use natural gas as a fuel to generate electric energy for its new aluminum reduction plant at Point Comfort, near Port Lavaca, Tex. Construction at Point Comfort was begun in 1948, and installations will include a three-pot-line plant with a production capacity of approximately 57,000 tons of aluminum metal per year, a plant for making carbon electrodes, and a 120,000-kw. power plant, which will utilize 120 of the newly developed gas engines. Tentative plans to expand the Permanente Metals Co. alumina plant at Baton Rouge, La., to include pot lines for aluminum reduction with electric power to be generated from natural gas were reported during the year.

The industry functioned in 1948 along competitive lines established in 1946. Alcoa operated about 330,000 tons, or 51 percent of the total 649,000 tons operable rated annual reduction capacity; Reynolds, 190,000 tons or 29 percent; and Permanente, 129,000 tons or 20 percent. Nearly all wartime aluminum plants held by the War Assets Administration for which electric power was not economically available were disposed of during 1948. The Torrence, Calif., reduction plant was sold to Columbia Steel Co. for conversion into a sheet-steel mill. The rod and bar mill at Newark, Ohio, was acquired by the Permanente Metals Co., and equipment for manufacturing steel-reinforced aluminum-conductor cable was added during the year. The plant at Massena, N. Y., was sold to the Aluminum Co. of America during the latter part of the year, along with some of the carbon-producing equipment at the Burlington, N. J., plant. Alcoa announced late in 1948 that its old plant at Massena would be shut down and the power thus made available would be used for the newly purchased installation. The company also announced that its Niagara Falls plant would close in 1949 owing to lack of power.

Secondary.—Owing to virtual exhaustion of scrapped military aircraft that had been plentiful since 1942, recovery of secondary aluminum from scrap in 1948 dropped 17 percent from the record high tonnage reclaimed in 1947. In addition to the production of remelt alloy ingot at Navy air stations, output was recorded in 1948 from five Army airfields, where the last of the wartime military planes sold to private contractors was melted.

Detailed information regarding secondary aluminum in 1948 is given in the Secondary Metals—Nonferrous chapter of this volume.

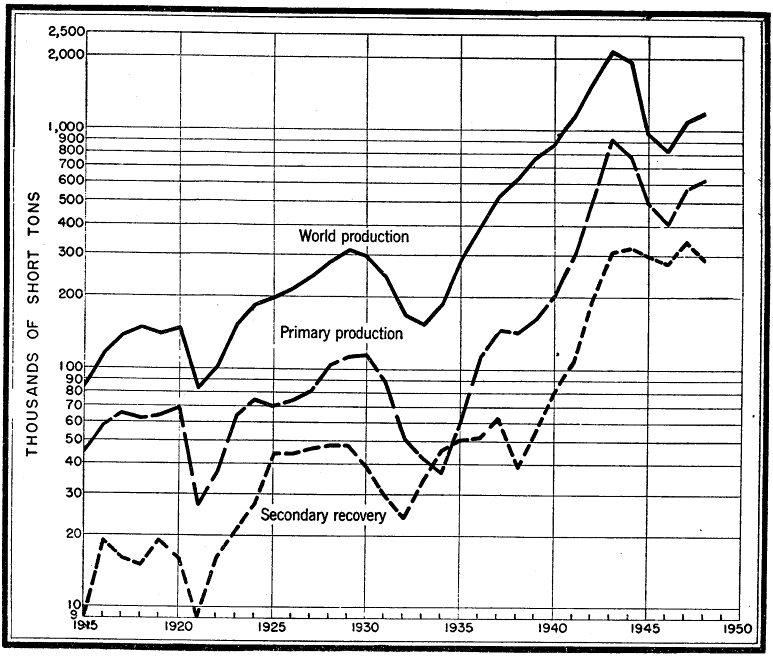

FIGURE 1.—Trends in world and domestic primary production and domestic secondary recovery of aluminum, 1915–48.

CONSUMPTION AND USES

The apparent consumption of primary aluminum totaled 665,950 tons in 1948, as computed by the usual method of adding production and net imports and adjusting for producers' stock changes. This total was 27 percent greater than the 524,200 tons used in 1947. However, as pointed out in the 1946 chapter of this series, the large importation and subsequent holding by the Office of Metals Reserve of Canadian aluminum during the war years greatly distorted the apparent consumption; and for the purpose of presenting a truer picture of domestic aluminum consumption a modified set of figures was evolved, taking into account releases of Canadian aluminum from Reconstruction Finance Corporation inventories. These stocks, which at the end of 1946 were 71,760 tons, were reduced to 18,700 tons by December 31, 1947, and completely disposed of in 1948. The adjusted apparent consumption figures for 1944 through 1948 are 671,072, 696,750, 575,687, 571,760, and 684,650 tons, respectively.

If the modified figures for apparent consumption of primary aluminum are added to the figures for secondary recovery from old scrap

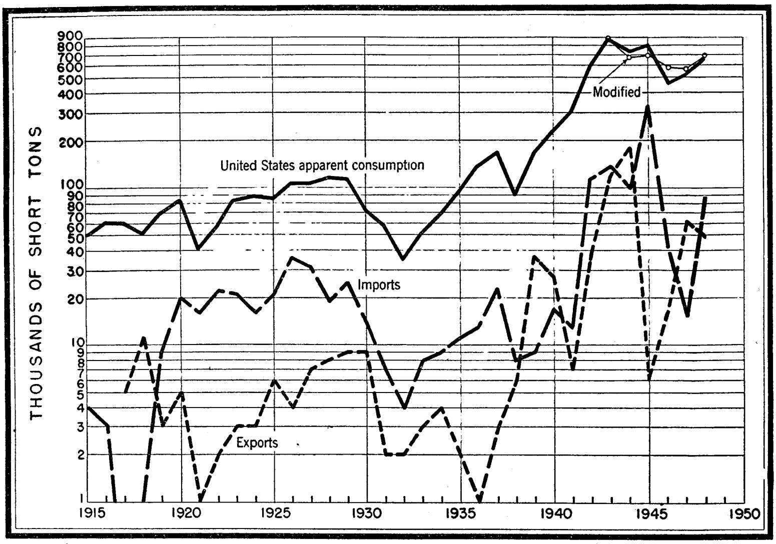

FIGURE 2.—Trends in imports, exports, and apparent consumption of aluminum, 1915–48.

only, the following total consumption figures are obtained (quantities in short tons):

Year	Apparent consumption of primary aluminum	Secondary aluminum recovered from old scrap	Total consumption
1939–43 (average)	432,753	40,282	473,035
1944	[1] 671,072	22,899	693,971
1945	[1] 696,750	27,311	724,061
1946	[1] 575,687	90,535	666,222
1947	[1] 571,760	[2] 163,847	[2] 735,607
1948	[1] 684,650	95,648	780,298

[1] Modified.
[2] Revised figure.

The building trade was the best customer of the aluminum industry for the third successive year. The largest use of the light metal was in the manufacture of roofing and siding, but substantial quantities were also consumed in the fabrication of window frames, shingles, heating and ventilating ducts, nails, gutters and down-spouts, screens, thresholds, venetian blinds, electric conduits and accessories, awnings, garage doors, and prefabricated housing panels. Use of aluminum as heating, ventilating, and air-conditioning ducts was formally approved in 1948 by the National Board of Fire Underwriters; Federal Housing Administration building specifications were revised to permit usage of aluminum in these applications. A wider acceptance of aluminum in building construction was anticipated in future with the introduction in 1948 of pattern aluminum sheet for use in wall facing. Early application of this product has been mainly on industrial and institutional buildings, but the versatility of pattern design suggests a much wider functional and decorative use.

Production, imports, exports, and apparent consumption of primary aluminum and production of secondary aluminum in the United States, 1939–43 (average) and 1944–48

Year	Primary aluminum					Secondary aluminum	
	Production		Imports (short tons)	Exports (short tons)	Apparent consumption [1] (short tons)	Production	
	Short tons	Value				Short tons	Value [2]
1939–43 (average)	424,035	$131,408,000	57,555	45,459	432,753	150,318	$46,668,155
1944	776,446	222,416,000	100,969	188,108	744,627	325,645	93,264,728
1945	495,060	140,864,000	334,117	5,901	797,052	298,387	85,297,005
1946	409,630	115,812,000	42,607	16,694	461,877	278,073	78,639,044
1947	571,750	161,626,000	15,610	62,333	524,200	[3] 344,837	[3] 97,450,936
1948	623,456	180,755,000	89,149	49,033	665,950	286,777	82,477,065

[1] Data not available on fluctuations in consumers' stocks. Withdrawals from producers' stocks totaled 55,320 tons in 1944, 26,334 in 1946, and 2,378 in 1948; additions to producers' stocks averaged 3,378 tons from 1939 through 1943, and totaled 26,224 in 1945, and 827 in 1947. Figures not adjusted for changes in Government stocks.
[2] Based upon average price of primary aluminum as reported to Bureau of Mines.
[3] Revised figure.

The advantages of aluminum continued to be demonstrated in the field of transportation. Use of the metal in commercial vehicles such as trucks, busses, and trailer units remained large, and a strong trend toward use in the passenger-car field appeared to be developing. Growing applications in railroad rolling stock, such as passenger, hopper, box, refrigerator, and tank cars, were noted during 1948.

Use of aluminum in the electrical field exhibited a rising trend during the year. More than 1,500,000 miles of ACSR (aluminum conductor, steel-reinforced) cable is now in use in high-voltage and rural distribution lines, and an announcement by the Rural Electrification Administration that it needed additional wire and cable for about 25,000 miles of poles recently erected in the South and Midwest forecast an increase in the quantity of aluminum to be consumed for this purpose.

Consumption for aircraft production, although not large in 1948 when compared with wartime rates, is expected to increase in the immediate future as a result of expansion of the Air Force.

Other growing uses for aluminum include application in household appliances, office machines, furniture, hardware, tools, instruments, and packaging in the form of foil, caps, seals, collapsible tubes, drums, barrels, and carboys.

Shipments of aluminum by the Aluminum Co. of America in 1948 were distributed as follows (comparable 1947 figures in parentheses): Building products, 18 percent (19 percent); transportation, 13 (15); cooking utensils, 9 (9); machinery, electrical and general, 4 (6); household appliances, 9 (7); power transmission, 6 (6); shipments to fabricators for further processing, 25 (24); and all other, 16 (14). Although these figures may not fully parallel the entire aluminum industry's distribution, they do show the general use pattern of the metal.

STOCKS

Stocks of primary aluminum at reduction plants at the end of 1948 were 13,171 short tons compared with 15,549 tons at the beginning of the year. Low point of the year was at the end of November, when inventories dropped to 8,075 tons. Government stocks available for allocation, which totaled 18,700 tons on January 1, 1948, were completely disposed of during the year. Data on consumers' inventories were unavailable.

PRICES

A significant factor in the increasing acceptance of aluminum for uses formerly supplied by copper has been the price advantage it has maintained since November 1946. Although increased costs of labor and materials induced aluminum producers to raise the market price twice during 1948, the quotations continued to be substantially under the copper market price. When considered on a volumetric basis, the basis on which metals are ordinarily used, rather than by weight, the price differential was even more favorable to aluminum. The base price of 15 cents a pound for 99.0–99.5 percent virgin aluminum ingot, New York, established on October 1, 1941, continued until June 28, 1948, when the quotation was advanced to 16 cents. A second price rise to 17 cents occurred on October 11. The primary aluminum pig prices were advanced at the same time in 1948 to 15 and 16 cents per pound. Readjustments in pricing of other aluminum products were also made during 1948.

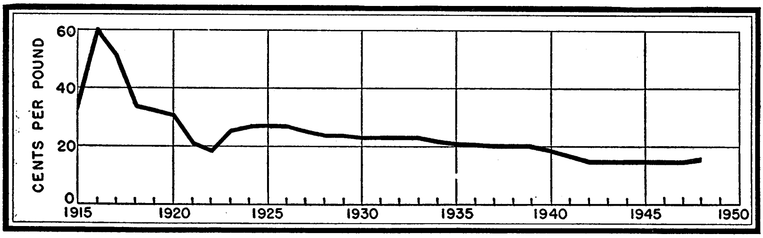

FIGURE 3.—Trend in average quoted prices of aluminum, 1915–48. Price is for No. 1 virgin metal 98–99 percent at New York through 1929; thereafter for 99-percent-plus virgin ingot, as reported by American Metal Market.

FOREIGN TRADE [2]

In contrast with 1947 foreign trade, the United States became a net importer of crude and semicrude aluminum during 1948. Imports of metal (excluding scrap and manufactures) totaled 89,149 tons in 1948, an increase of nearly six times the preceding year's total and the largest quantity since 1945. About 90 percent of the 1948 receipts came from Canada and the remainder largely from United Kingdom, Italy, Switzerland, and Norway. Imports of aluminum scrap likewise gained substantially during 1948 and reached the highest annual level ever recorded (separate reporting of scrap was begun in 1939). Although there was some controversy as to the origin of scrap designated from certain European countries, 22,012 tons were reported shipped from Canada, 15,127 tons from United Kingdom, 6,968 tons from Italy, 5,912 tons from Germany, and the remainder from 30

[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.

other countries. The actual quantity of manufactures imported was not recorded, but their total value increased 33 percent over 1947.

Aluminum imported for consumption in the United States, by classes, 1946–48

[U. S. Department of Commerce]

Class	1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value
Crude and semicrude:						
Metal and alloys, crude	41,487	$9,986,327	15,579	$3,723,514	83,164	$21,332,336
Scrap	14,493	1,766,298	15,719	2,550,627	71,728	17,459,996
Plates, sheets, bars, etc	1,120	483,474	31	25,621	5,985	3,005,929
Total	57,100	12,236,099	31,329	6,299,762	160,877	41,798,261
Manufactures:						
Bronze powder and powdered foil	5	5,289	(1)	45	(1)	550
Foil less than 0.006 inch thick	57	61,287	41	70,058	18	29,049
Folding rules			(2)	11	(2)	5
Leaf (5½ by 5½ inches)	(3)	39,504	(3)	50,608	(3)	74,485
Powder in leaf (5½ by 5½ inches)					(4)	114
Table, kitchen, hospital utensils, etc	14	47,334	38	103,607	87	157,156
Other manufactures	(5)	74,447	(5)	79,631	(5)	143,028
Total	(5)	227,861	(5)	303,960	(5)	404,387
Grand total	(5)	12,463,960	(5)	6,603,722	(5)	42,202,648

[1] Less than 1 ton.
[2] Number: 1947, 26; 1948, 1; equivalent weight not recorded.
[3] Leaves: 1946, 6,710,636; 1947, 7,566,959; 1948, 14,784,188; equivalent weight not recorded.
[4] Leaves: 30,000; equivalent weight not recorded.
[5] Quantity not recorded.

Exports of aluminum (excluding scrap and manufactures) declined from the 62,333 tons shipped in 1947 to 49,033 tons in 1948. Most of the decrease resulted from curtailed shipments of metal classified as ingots, slabs, and crude, as exports of plates, sheets, bars, and other semifinished forms were only slightly reduced. France, chief recipient among the 18 countries that purchased aluminum in ingot and slab form during 1948, received approximately 49 percent of the total. Of the plates, sheets, and bars exported, 15,421 tons went to the Republic of the Philippines, 7,499 tons to Venezuela, and the remainder to 93 other countries. Shipments of scrap dropped to 438 tons, almost all of which went to Haiti, Canada, and Germany. The value of aluminum manufactures exported in 1948 declined 26 percent.

Aluminum exported from the United States, by classes, 1946–48

[U. S. Department of Commerce]

Class	1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value
Crude and semicrude:						
Ingots, slabs, and crude	1,107	$305,072	12,098	$3,578,029	1,239	$424,676
Scrap	640	120,522	788	181,211	438	77,777
Plates, sheets, bars, etc	15,587	9,706,350	50,235	29,428,940	47,794	28,500,768
Total	17,334	10,131,944	63,121	33,188,180	49,471	29,003,221
Manufactures:						
Tubes, moldings, or other shapes	1,338	1,130,786	1,983	2,488,997	3,373	3,458,427
Table, kitchen, and hospital utensils	1,860	3,419,792	2,624	4,469,291	1,376	2,432,637
Foil and leaf	1,794	1,570,334	4,860	4,611,598	1,976	1,566,315
Powders and pastes (aluminum and aluminum bronze) (aluminum content)	435	473,770	737	709,446	474	444,967
Other manufactures	(1)	3,557,427	(1)	6,764,460	(1)	6,280,214
Total	(1)	10,152,109	(1)	19,043,792	(1)	14,182,560
Grand total	(1)	20,284,053	(1)	52,231,972	(1)	43,185,781

[1] Quantity not recorded.

TECHNOLOGY

Technologic progress reported during 1948 that broadened the field of aluminum use included an improvement in welding technique for efficiently joining thicker aluminum-alloy plates than had hitherto been successfully joined by other welding processes. The new procedure—a modification of shielded arc-welding—consists of feeding a bare or processed filler-metal wire carrying the welding current through a suitable wire holder. Joining is accomplished by a direct-current arc maintained between the end of the wire and the work. As in other shielded-arc processes, the arc is contained in an envelope of inert gas. Among the commercial applications of welded aluminum in 1948 were the first experimental field-welded aluminum pipe lines for carrying crude oil, which were laid near Magnolia, Ark., and Raceland, La.

WORLD REVIEW

World production of aluminum in 1948 totaled approximately 1,265,000 metric tons, an advance of 17 percent over 1947. A large share of this increase was due to gains in the United States and Canada, the two largest producing countries.

World production of aluminum, 1942–48, by countries, in metric tons

[Compiled by Pauline Roberts]

	1942	1943	1944	1945	1946	1947	1948
Austria	35,071	44,201	40,097	5,250	1,032	4,544	13,319
Brazil	----------	----------	----------	480	----------	----------	----------
Canada	308,982	449,734	419,176	195,691	175,449	271,302	333,007
China:							
Formosa [1]	13,498	14,498	9,201	(2)	----------	(2)	2,509
Manchuria	[1] 7,437	8,557	[3] 8,000	[3] 1,500	(2)	(2)	(2)
France	45,224	46,462	26,154	37,225	47,952	53,225	64,785
Germany	227,131	203,068	191,000	[3] 20,000	----------	----------	[4] 7,306
Hungary	5,960	9,460	[5] 13,190	2,351	1,970	5,203	5,152
India	----------	1,292	1,751	2,254	3,244	3,223	3,367
Italy	43,541	46,192	16,796	4,347	11,040	25,064	33,100
Japan	[1] 85,211	[1] 114,057	[1] 88,254	16,450	3,190	2,700	6,970
Korea	4,366	12,529	12,943	[6] 1,243	[3] 5,000	[3] 5,000	[3] 5,000
Norway	20,498	23,514	20,035	4,608	16,692	21,725	30,065
Spain	742	797	206	592	1,007	1,000	969
Sweden (includes alloys)	1,294	3,572	3,723	3,236	3,566	2,892	[3] 3,500
Switzerland	23,665	18,526	9,686	5,029	13,083	18,458	18,960
U. S. S. R.	[3] 55,000	62,340	[3] 71,000	86,310	[3] 105,000	[3] 120,000	[3] 140,000
United Kingdom	47,528	56,557	36,038	32,432	32,067	29,384	30,510
United States	472,737	834,768	704,376	449,109	371,608	518,680	565,587
Yugoslavia (estimated)	2,000	2,000	1,000	(2)	(2)	(2)	(2)
Total [7]	1,400,000	1,952,000	1,673,000	869,000	792,000	1,084,000	1,265,000

[1] Fiscal year ended March 31 of year following that stated.
[2] Data not available; estimate by author of chapter included in total.
[3] Estimated.
[4] Bizonal area.
[5] January to June, inclusive.
[6] April to June, inclusive.
[7] Preliminary; subject to revision.

Australia.—Surveys for the combined alumina and aluminum reduction plant being erected by the Australian Aluminum Production Commission at Native Point, 16 miles from Launceston, Tasmania, were virtually completed during 1948, and lay-outs for the plant building were progressing rapidly. The Production Commission expects to have the plant completed in 2 years, for an initial capacity of 13,000 tons annually.

Austria.—Although aluminum production in Austria continued to be handicapped by shortages of electric power and alumina, output in 1948 nearly tripled the 1947 figure. Of the 13,319 metric tons recovered during the year, 10,000 tons were produced in the great United Aluminum Works plant at Ranshofen and 3,319 tons in the plant at Lend. Almost half of the 1948 output was returned to foreign countries as payment for raw materials supplied. New sources of hydroelectric power were being considered during the year in order to put the aluminum industry on a year-round operating basis. Water shortages due to winter drought conditions have limited production of electric power and permitted continuous aluminum output only from March through September.

Canada.—At Arvida, Quebec, low water in the latter part of 1948, resulting in an electric power shortage, forced the Aluminum Co. of Canada to shut down one of three pot lines that had been in steady operation. Despite this handicap, production of aluminum in 1948 was 23 percent above the 1947 level. Even with the expanded production, consumer demand for the metal in both raw and fabricated form remained greater than the supply, and the company was forced to allocate its output.

The aluminum plant at Shawinigan Falls resumed operation during the year with two of the four war-installed pot lines in operation. The reduction plants at La Tuque and Beauharnois, which were closed in 1945, remained idle during 1948.

According to Aluminum, Ltd., the largest single field of consumption of its products in 1948 was in architectural and building uses, which accounted for more than 35 percent of the total. Household applications, including cooking utensils, accounted for 20 percent of the consumption; transportation, 19 percent; the electrical industry, 9 percent; food and farming, 5 percent; canning and packaging, 4 percent; the chemical industry, 1 percent; and miscellaneous uses, 5 percent.

China.—American and Canadian companies were reported investigating the possibility of restoring the plant of the Taiwan Aluminum Co. in Takao, Formosa. The plant originally comprised three units, but one was completely destroyed by bombing during World War II. During the latter part of 1948 the plant was utilizing 76 pots and producing ingot at an annual rate of 4,200 tons. Restoration of the entire plant to its designed annual capacity of 22,000 tons is estimated to require the equivalent of $2,000,000.

France.—Output of primary aluminum in France in 1948 totaled a little more than two-thirds of theoretical capacity, the producing facilities being handicapped by limited availability of power. On October 20 the French Price Directorate freed aluminum from price control.

Germany.—Early in 1948 the American Military Government announced that the German aluminum industry in the British and American zones would be permitted to resume production temporarily. Relaxation of the ban on output was based on the existence of approximately 300,000 tons of bauxite stock piled in Western Germany, which were regarded as adequate for 1 year's production of metal. The Töging plant in Bavaria began operating late in March, and produced in April the first new aluminum to be recovered in the Bizonal Area since the end of World War II. Output at this plant was curtailed later in the year, however, owing to limited power supplies. The other two smelters that were permitted to reopen—the Lünen plant near Dortmund and the Erftwerk Grevenbroich smelter—did not resume production during 1948.

Italy.—Producers of Italian aluminum sent a large part of the total domestic output abroad in 1948. Of the 33,100 metric tons produced, 13,000 tons were exported compared with 1,900 tons in 1947. Although Italy's home consumption of aluminum products is comparatively low, production had not recovered sufficiently in 1948 from wartime destruction to supply the country with the 35,000 to 40,000 tons of metal required annually. Thus, the Italian Government has been forced to authorize temporary importation of aluminum bars, wire, sheets, and tubes. It is intended to ban imports as soon as the level of home production rises to meet the nation's needs. As the price of Italian aluminum is one-third higher than the world market level, the motive in preventing free importation of metal as a protective measure to insure continuation of the home market is apparent.

Norway.—The first half of the Aardal aluminum plant, construction of which was begun during the war by the German occupation forces and completed by the Norwegians after liberation, began production of aluminum at half capacity early in 1948. Completion of the second half of the plant is scheduled for late 1949 or 1950 and will bring the total annual plant capacity to 24,000 tons. Some loss of production was experienced late in the year, when a disastrous fire on October 26 caused heavy damage and put out of action 40 of the 140 operating furnaces. Aluminum produced at the Aardal plant is recovered from alumina from Canada.

Philippines.—Plans to construct an aluminum reduction plant at Mindanao, using power from the projected Maria Christina hydroelectric development, were considered during 1948 by the Aluminum Co. of Canada. It is proposed to obtain bauxite for the plant from mines in Malaya. Aluminum produced would be shipped to the United States and Canada for processing and rolling.

Switzerland.—Exports of aluminum from Switzerland, which totaled only 979 metric tons in 1947, increased to 10,787 tons in 1948. Imports declined from 7,161 tons to 7,032.

Yugoslavia.—Five hydroelectric plants have been completed on the Drau River, and four more are now under construction, which will give a total capacity of 100,000 kw. Electricity from these plants will serve an industrial district which includes the aluminum reduction plant at Strnishche. The Strnishche plant now under construction will have a capacity of 30,000 tons of pig aluminum annually. Bauxite for the new plant will be shipped from the mines of Istria, situated in an area ceded to Yugoslavia by Italy in the peace treaty at the conclusion of World War II.

Antimony

By SAMUEL A. GUSTAVSON and MARY E. TROUGHT

GENERAL SUMMARY

DOMESTIC mine production of antimony from antimony ores increased 22 percent, and total imports of primary antimony in metal, ores, concentrates, and needle antimony increased 15 percent in 1948 over 1947, whereas consumption decreased about 7 percent. Thus supply exceeded current use, and both industrial and total Government stocks increased. Demand remained strong, however, and the price of antimony increased for the third consecutive year. The average market price during 1948, for ordinary brands of antimony metal, f. o. b. New York in carlots, was 36.67 cents per pound. The year-end quotation was 40.17 cents. These were the highest antimony prices on record except for a brief period in 1916, when a high of 45 cents per pound was reached.

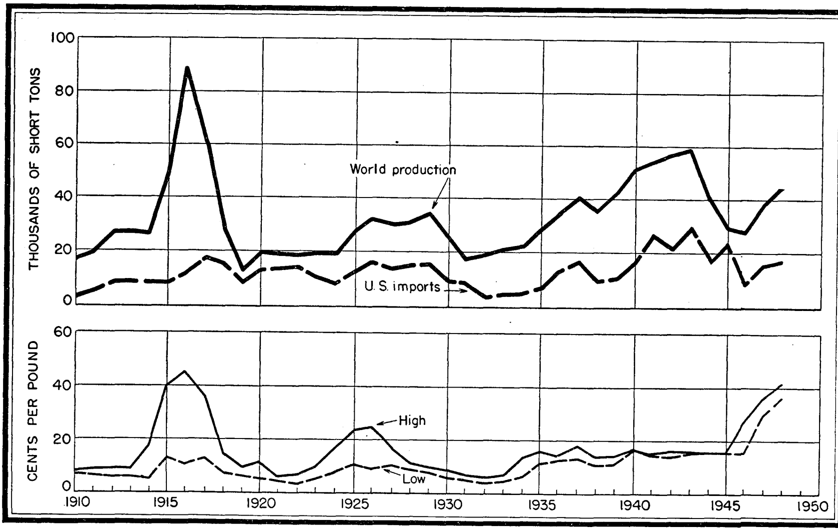

FIGURE 1.—Trends in world production, United States imports, and New York price of antimony, 1910–48.

New supply of primary antimony available for consumption during 1948, in terms of recoverable metal,[1] was 21,968 short tons. Of this total, domestic ores contributed 5,970 tons; and imports 3,176 tons as metal, 12,449 tons in ores and concentrates, and 373 tons in needle antimony. Consumption of primary antimony (including processing

[1] A factor of 92 percent of the content was used to determine quantity of metal recoverable from antimony ores and concentrates shipped to smelters.

losses) was 17,112 tons, according to the Office of Domestic Commerce, United States Department of Commerce.

Salient statistics for antimony in the United States, 1944–48

	1944	1945	1946	1947	1948
Production of primary antimony:					
Mine (antimony content) .... short tons..	4,735	1,930	2,505	5,316	6,489
Smelter (antimony content) .... do....	20,000	21,000	12,422	13,782	14,308
Production of secondary antimony .... do....	15,886	17,148	19,115	22,984	21,592
Imports for consumption:					
Antimony in ore .... do....	17,080	22,643	5,903	9,282	13,532
Needle or liquated antimony .... do....	----------	----------	----------	17	533
Metal .... do....	293	627	2,593	5,879	3,176
Exports of antimony ore and metal .... do....	745	333	462	808	327
Consumption of primary antimony .... do....	23,756	25,761	17,515	16,647	15,455
Average price of antimony at New York: [1]					
Chinese (nominal) .... cents per pound..	16.50	16.50	16.50	(2)	(2)
American .... do....	15.84	15.84	17.31	33.45	36.67
World production (estimated) .... short tons..	40,100	29,700	28,000	38,400	45,500

[1] American Metal Market.
[2] Data not available.

Secondary antimony production was 21,592 short tons in 1948 compared with 22,984 tons in 1947. High price was the major factor in maintaining a large secondary output.

Government allocation of antimony provided in War Production Board General Preference Order M–112, as amended, was continued throughout 1948.

Minor changes in export regulations were made during the year. On December 27, 1948, War Production Board General Preference Order M–112 was revised and redesignated Allocation Order M–112 by the Department of Commerce. This order was revoked March 25, 1949.

DOMESTIC PRODUCTION

MINE PRODUCTION

Shipments of antimony ores and concentrates in 1948 totaled 16,239 tons containing 6,489 tons of antimony, of which 5,970 tons are estimated as recoverable—a 22-percent increase in antimony content from 1947. The Bradley Mining Co. operation of the Yellow Pine mine supplied 93 percent of the domestic mine output in 1948 and 97 percent in 1947.

Antimony-bearing ores and concentrates produced in the United States, 1944–48, in short tons

Year	Gross weight	Antimony content		Year	Gross weight	Antimony content	
		Quantity	Average percent			Quantity	Average percent
1944	13,501	4,735	35.1	1947	20,020	5,316	26.6
1945	14,966	1,930	12.9	1948	16,239	6,489	40.0
1946	13,962	2,505	17.9				

Alaska.—Stampede Mines, Inc., operating the Stampede mine, was the Territory's only antimony producer in 1948. Production and shipments were 68 tons of 65-percent antimony concentrates.

California.—Carl Yackel shipped 5 tons of 39.7-percent antimony concentrates from the Rocket mine in Inyo County during 1948.

Idaho.—Two antimony mines were operated in Idaho during 1948; in order of output, they were the Yellow Pine mine and the Hermada mine. In 1947 the Yellow Pine mine was the only producer.

In May 1948 the Bradley Mining Co., operator of the Yellow Pine mine, began constructing a smelter to treat its antimony and gold concentrates. The company expected to complete construction in August 1949. Smelter capacity will be 9,000 tons of antimony oxide a year. Metal also can be produced, but the smelter capacity would be less. Custom ores and concentrates will probably be accepted. The company mine and mill are designed to produce antimony at the rate of 6,000 tons per year. Production in 1948 was 6,004 short tons of antimony contained in high-, medium-, and low-grade antimony concentrates. Antimony in the gold concentrates was not recovered.

The Hermada Mining Co. operated its mine in Elmore County, shipping 155 tons of ore assaying 36.6 percent antimony and 510 tons of concentrates assaying 59.4 percent antimony.

Nevada.—A total of 225 short tons of antimony ores and concentrates containing 78 tons of antimony were shipped from mines in Nevada during 1948. Shipments in 1947 totaled 1,352 tons of ore containing 55 tons of antimony. Producers in 1948 included the Big Creek Mining & Milling Co. and Phil Cox, operating mines in Lander County; N. L. Brown, operating in Nye County; and Ott F. Heizer and John M. Heizer, operating mines in Pershing County.

SMELTER PRODUCTION

Primary.—Domestic primary antimony smelters produced 14,308 short tons of antimony metal, oxide, and sulfide in 1948, a 4-percent increase over 1947. The Bureau of Mines is not at liberty to publish separate data on these three intermediate primary products. However, more than half of the output was in the form of metal and most of the remainder as oxide.

The output of antimonial lead produced as a byproduct by domestic primary lead refineries increased 17 percent. Production in 1948 was 100,764 tons of antimonial lead containing 5,760 tons of antimony compared with 86,075 tons containing 4,933 tons of antimony in 1947. A detailed discussion of antimonial lead production is contained in the Lead chapter of this volume.

Secondary.—Total production of antimony at secondary plants, including antimony recovered from scrap at primary lead refineries, was 21,592 short tons in 1948, 6 percent less than in 1947. The high antimony price has been the predominating factor in maintaining this high rate of recovery of antimony from secondary scrap material during the last 2 years. A detailed review is contained in the Secondary Metals—Nonferrous chapter of this volume.

Antimony metal, alloys, and compounds produced in the United States, 1944–48, in short tons

Year	Primary metal, oxide, and sulfide (antimony content)	Antimonial lead produced at primary lead refineries: Gross weight	Antimony content: From domestic ores [1]	From foreign ores [2]	From scrap	Total: Quantity	Total: Percent	Alloys (antimony content) produced at secondary smelters and by remelters
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	12,422	50,480	1,231	226	1,828	3,285	6.5	19,115
1947	13,782	86,075	1,460	571	2,902	4,933	5.7	22,984
1948	14,308	100,764	2,190	1,031	2,539	5,760	5.7	21,592

[1] Includes primary residues and small quantity of antimony ore.
[2] Includes foreign base bullion and small quantity of foreign antimony ore.

CONSUMPTION AND USES

Consumption of primary antimony in finished products decreased for the third consecutive year. Use in metallic and nonmetallic products totaled 15,455 tons in 1948, compared with 16,647 tons in 1947, a 7-percent decrease, according to the Department of Commerce. The over-all use pattern has not changed materially since 1946.

Industrial consumption of primary antimony, 1944–48, in short tons [1]

Product	1944	1945	1946	1947	1948
Metal products:					
Ammunition	93	107	30	24	21
Antimonial lead [2]	5,287	5,920	4,827	6,172 (Antimonial lead and battery metal)	6,024
Battery metal	2,341	1,273	1,084		1,803
Bearing metal and bearings	2,637	2,825	2,886	2,056	
Cable covering	422	275	79	61	62
Castings	115	267	233	129	81
Collapsible tubes and foil	114	203	121	77	31
Sheet and pipe	326	368	218	225	195
Solder	71	125	281	132	145
Type metal	841	1,243	1,903	1,216	1,019
Total metal products	12,247	12,606	11,662	10,092	9,381
Nonmetal products:					
Ammunition primers	43	66	15	16	6
Antimony trichloride	289	207	106	(3)	(3)
Flameproofed textiles	7,063	7,675	97	205	388
Frits and ceramic enamels	501	936	1,814	1,754	1,561
Glass and pottery	411	304	351	421	352
Matches	10	18	25	23	37
Paints and lacquers	2,490	3,062	1,662	1,324	1,288
Plastics	(3)	(3)	(3)	[4] 156	228
Rubber	(3)	(3)	(3)	39	41
Sodium antimonate	369	512	1,358	(3)	(3)
Other	333	375	425	2,617	2,173
Total nonmetal products	11,509	13,155	5,853	6,555	6,074
Grand total	23,756	25,761	17,515	16,647	15,455

[1] Compiled from monthly applications filed with Office of Materials Distribution, Department of Commerce (formerly with War Production Board and Civilian Production Administration).
[2] Includes miscellaneous metallic products.
[3] Included with "Other." Bureau of Mines not at liberty to publish separate figures.
[4] Consumption April through December 1947; January through March included with "Other."

Processing losses of primary antimony, in addition to quantities consumed as shown in the accompanying table, were reported by OMD and ODC as 1,371 tons, 2,467 tons, 646 tons, 2,049 tons and 1,657 tons, respectively, from 1944 through 1948, an average loss of 7.6 percent for the 5-year period.

STOCKS

Industrial stocks of antimony raw materials were 38 percent greater on December 31, 1948, than on December 31, 1947. The Office of Metals Reserve (OMR) purchased no antimony during the year but transferred some of its stocks to the National Strategic Stock Pile and sold some to industry. OMR stocks on December 31, 1948, of antimony contained in ores, concentrates, and as metal totaled 4,211 short tons. The Bureau of Mines is not at liberty to publish data on stocks in the National Strategic Stock Pile.

Stocks of antimony in the United States at end of year, 1947–48, in short tons of contained antimony

[Office of Materials Distribution]

Raw materials	Dec. 31, 1947				Dec. 31, 1948			
	Industry		OMR	Total	Industry		OMR	Total
	Mine	Other			Mine	Other		
Ores and concentrates	95	3,047	260	3,402	951	3,691	207	4,849
Metallic antimony	-------	1,563	6,546	8,109	-------	2,412	4,004	6,416
Antimony oxide	-------	2,015	-------	2,015	-------	2,160	-------	2,160
Antimony sulfide (needle and precipitate)	-------	127	-------	127	-------	205	-------	205
Total	95	6,752	6,806	13,653	951	8,468	4,211	13,630

Antimony ores and concentrates stocked at smelters and manufacturers' plants at end of year, 1944–48, in short tons of contained antimony

[Office of Materials Distribution]

Ore and concentrates	1944	1945	1946	1947	1948
Chemical-grade sulfide ore	794	935	373	332	351
Metallurgical-grade sulfide ore	405	907	1,147	630	953
Mixed or oxide ore	990	500	407	789	1,047
Sulfide concentrates	855	1,904	3,212	1,296	1,340
Total	3,044	4,246	5,139	3,047	3,691

PRICES

The price of antimony continued its upward trend throughout 1948. Domestic metal in bulk, f. o. b. Laredo, Tex., opened the year at 33 cents per pound, rose to 35 cents May 22, and then to 38.5 cents October 8, according to E&MJ Metal & Mineral Markets. The average price per pound for antimony metal, carlots, New York, during 1948 was 36.67 cents, according to American Metal Market. In 1947 the average was 33.45 cents.

Changes in nominal quotations according to E&MJ Metal & Mineral Markets, for antimony ore, per unit (20 pounds) of antimony contained were as follows:

	50–55 percent	*58–60 percent*	*60–65 percent*
Jan. 1	\$4. 40–\$4. 45	\$4. 50–\$4. 60	\$4. 60–\$4. 70
Mar. 18	4. 50– 4. 55	4. 55– 4. 65	4. 60– 4. 70
May 13	4. 50– 4. 55	4. 55– 4. 65	4. 70– 4. 80
May 27	4. 60– 4. 70	4. 70– 4. 80	4. 80– 5. 00
July 8	4. 70– 4. 80	4. 80– 4. 90	4. 90– 5. 10
July 29	4. 80– 4. 90	4. 90– 5. 10	5. 10– 5. 20
Aug. 12	4. 90– 5. 00	5. 00– 5. 10	5. 10– 5. 20
Aug. 26	5. 00– 5. 10	5. 10– 5. 15	5. 15– 5. 30
Oct. 7	not quoted	5. 10– 5. 20	5. 20– 5. 30

FOREIGN TRADE [2]

Imports.—Total general imports of antimony ore, metal, and needle or liquated antimony increased 15 percent in 1948 over 1947. A 42-percent decrease in imports of metal, chiefly from China, was more than offset by increases in imports of ore, principally from Mexico, Bolivia, and Peru.

The estimated antimony content of type metal and antimonial lead imported for consumption was 1,549 short tons compared with 187 tons in 1947 and 246 tons in 1946. For gross weight and value, see Lead chapter of this volume.

Antimony imported for consumption in the United States, 1944–48

[U. S. Department of Commerce]

Year	Antimony ore			Needle or liquated antimony		Antimony metal		Type metal and antimonial lead [1] (short tons)
	Short tons	Antimony content		Short tons	Value	Short tons	Value	
		Short tons	Value					
1944	41, 879	17, 080	\$2, 721, 690			293	\$105, 667	388
1945	49, 385	22, 643	4, 644, 859			627	181, 557	1, 380
1946	19, 741	5, 903	1, 323, 903			2, 593	824, 698	246
1947	28, 525	9, 282	2, 677, 454	17	\$7, 914	5, 879	3, 487, 126	187
1948	41, 683	13, 532	4, 341, 521	533	314, 809	3, 176	2, 007, 915	1, 549

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

[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.

Antimony imported into the United States, 1944–48, by countries [1]

[U. S. Department of Commerce]

Country	Antimony ore			Needle or liquated antimony		Antimony metal	
	Gross weight (short tons)	Antimony content		Short tons	Value	Short tons	Value
		Short tons	Value				
1944	41,472	16,880	$2,667,891			294	$105,667
1945	49,543	22,736	4,641,036			627	181,557
1946	19,744	5,905	1,324,117			2,593	824,698
1947							
Belgium and Luxembourg						56	35,280
Bolivia [2]	3,896	2,435	950,853			(3)	392
Canada	420	145	40,459				
Chile [2]	592	348	122,151				
China				17	$7,914	5,815	3,446,422
Mexico	23,250	6,138	1,502,226				
Peru [2]	241	156	43,680				
Siam	25	12	3,747				
Turkey	112	53	15,414				
United Kingdom						28	17,853
Total	28,536	9,287	2,678,530	17	7,914	5,899	3,499,947
1948							
Belgium and Luxembourg						210	144,301
Bolivia [2]	5,204	3,310	1,463,631				
Canada	98	31	3,833			1	387
Chile [2]	376	260	113,737				
China				533	314,809	2,986	1,875,688
Honduras	10	6	2,612				
Italy						30	19,837
Mexico	33,726	8,674	2,173,935			54	36,045
Morocco, French	171	95	45,499				
Peru [2]	1,939	1,062	497,068				
Portugal	26	17	7,318				
Siam	109	55	19,127			3	1,619
Yugoslavia	24	22	14,761			132	83,469
Total	41,683	13,532	4,341,521	533	314,809	3,416	2,161,346

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

Exports.—Domestic exports in 1948 included 69 tons (gross weight) of antimony ore and concentrates valued at $29,727 and 258 tons of antimony metal and alloys valued at $181,070. Reexports of foreign ore and concentrates were 204 short tons valued at $66,371, and of foreign metals and alloys 390 pounds valued at $105.

Foreign antimony (regulus or metal) exported from the United States, 1944–48

[U. S. Department of Commerce]

Year	Short tons	Value	Year	Short tons	Value
1944	18	$5,445	1947	40	$19,341
1945	463	141,301	1948	(1)	105
1946	139	43,197			

[1] 390 pounds.

WORLD REVIEW

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

World production of recoverable antimony, by countries, 1941–48, in metric tons[1]

[Compiled by B. B. Mitchell]

Country	1941	1942	1943	1944	1945	1946	1947	1948
North America:								
Canada	1,329	1,269	465	809	696	286	480	124
Honduras	23	103	110	65	11	8	-------	5
Mexico [2]	10,241	10,759	12,585	10,056	8,053	6,046	6,371	6,790
United States	1,013	2,457	4,638	3,952	1,611	2,091	4,437	5,416
South America:								
Argentina	123	41	100	71	13	-------	-------	-------
Bolivia (exports)	13,680	16,231	16,536	6,852	5,093	6,407	9,989	11,280
Peru	1,440	1,457	2,472	932	2,041	969	1,140	1,770
Europe:								
Austria	26	391	571	658	132	15	82	247
Czechoslovakia	1,645	[3] 3,130	(4)	(4)	1,115	2,156	1,434	1,593
France	-------	128	153	116	153	202	200	(4)
Hungary [3]	3,000	2,200	1,500	[5] [6] 1,160	(6)	-------	-------	(4)
Italy	819	667	522	403	348	330	450	430
Portugal	46	135	[3] 115	[3] 39	6	5	23	(4)
Spain	101	210	176	128	108	96	84	[7] 270
Asia:								
Burma [3]	400	843	843	843	(4)	(4)	66	(4)
China	[5] 7,989	[8] 3,510	[8] 505	[8] 203	-------	426	1,909	3,251
Indochina, French	4	1	11	25	(4)	-------	-------	-------
Iran [9]	19	(4)	18	2	-------	-------	(4)	(4)
Japan	250	350	600	450	210	49	100	124
Pakistan	(4)	(4)	(4)	(4)	(4)	(4)	(4)	-------
Siam	-------	-------	[3] 22	[3] 54	[3] 41	(4)	[3] 104	85
Turkey (Asia Minor) [10]	80	40	8	58	33	36	103	520
Africa:								
Algeria	397	304	902	170	423	-------	110	817
Morocco:								
French	184	322	409	166	353	260	390	411
Spanish	85	144	153	72	52	103	128	(11)
Southern Rhodesia	83	169	164	116	29	15	38	10
Union of South Africa	445	990	1,560	2,570	2,250	2,330	3,020	3,700
Oceania:								
Australia	1,052	1,042	532	454	172	460	162	[12] 39
New Zealand	8	-------	-------	-------	-------	-------	-------	(4)
Total (except U. S. S. R.) [13]	49,000	51,400	53,200	36,400	26,900	25,400	34,800	41,300

[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. U. S. S. R. and Yugoslavia produce antimony but data on production are not available; an estimate for Yugoslavia is included in the total.
[2] Includes antimony content of antimonial lead.
[3] Estimate.
[4] Data not available; estimate included in total.
[5] January to June inclusive.
[6] Data represent Trianon Hungary after October 1944.
[7] Includes Spanish Morocco.
[8] Data represent area designated as Free China during the period of Japanese occupation.
[9] Fiscal year ended Mar. 20 of year following that stated.
[10] Revised data; previously shipments were listed in some cases in lieu of production data.
[11] Included under Spain.
[12] Excluding New South Wales; data not available.
[13] Estimated by senior author of chapter.

Argentina.—Antimony deposits in the Cochinoca area, Jujuy Province, northwestern Argentina, were described by Federico Ahlfeld.[3]

Bolivia.—A guaranteed price for antimony by the Banco Minero in 1947 and 1948 was the chief factor in the increase in output during those years. Exports, in terms of antimony contained, were 12,260 metric tons in 1948, an increase of 13 percent over 1947 and 76 percent

[3] Ahlfeld, Federico, An Unusual Antimony Deposit in Argentina: Econ. Geol., vol. 43, No. 7, November 1948, pp. 598–602.

over 1946. A description of the antimony deposits in Bolivia, published in Mineria Boliviana in 1946, was translated by the Federal Bureau of Mines.[4]

Canada.—Antimonial lead output declined from 1,150,463 pounds in 1947 to 298,000 pounds in 1948. Imports of antimony regulus during the year totaled 1,093,835 pounds. Antimony Mines & Metals (Slocan), Ltd., has been formed to work an antimony prospect 6 miles west of Slocan City, British Columbia.

India.—Since suspension of operations in 1947 at the Chitral mine, now in Pakistan, the Star Metal Refinery in Bombay has depended chiefly on imports of antimony concentrates. Imports of concentrates totaled 571 long tons in 1948.

Japan.—A report by the Natural Resources section, SCAP, describes the antimony resources of Japan.[5] A deposit of antimony said to contain a million tons of ore has been discovered in the Santo mine, Wakayama.

Mexico.—Antimony is produced chiefly from mines in the States of San Luis Potosi, Oaxaca, Queretaro, Sonora. Production increased 7 percent in 1948 over 1947, owing largely to high prices and to the increased activities of Mexican subsidiaries of the National Lead Co.

Union of South Africa.—The 1948 output of antimony in the Union was 7,437 short tons of concentrates, 28 of which were sold locally and 7,188 exported. For some years following the organization of Consolidated Murchison (Transvaal) Goldfields & Development Co., Ltd., in 1934 to produce gold, the antimony in the ore was allowed to go to the waste dump. But with a firmer market and higher price for antimony, the company shifted its interest and now derives most of its income from antimony and only a fraction from gold.[6]

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[4] Ahlfeld, Federico, Geology of the Antimony Deposits in Bolivia: Bureau of Mines, Mineral Trade Notes, vol. 25, No. 5, Spec. Suppl. 20, November 1947, 10 pp.

[5] Hilpert, Lowell S., Antimony Resources of Japan: Natural Resources Section, GHQ, Supreme Commander for the Allied Powers (SCAP), Rept. 92, 1947, 65 pp.

[6] Symons, Ralph, Mining and Milling Antimony Ore at Consolidated Murchison Goldfields, Transvaal: Inst. Min. and Met. (London), Bull. 506, January 1949, 36 pp.

Arsenic

By JACK W. CLARK

GENERAL SUMMARY

DOMESTIC output of white arsenic in 1948 was slightly above 1947, reflecting a continued high level of activity at copper and lead smelters where arsenic is recovered as a byproduct. The price of refined white arsenic averaged 6¼ cents per pound for 1948, highest since 1924. Imports of white arsenic declined by 33 percent compared to 1947 and were the lowest since 1932. Arsenic metal imports doubled those of the previous year. Producers' inventories of white arsenic rose for the third successive year and were nearly five-fold those of 1947. Foreign output was steady, and stocks, held abroad were reported very large, especially in Sweden. The sharp rise in domestic stocks and appreciable decline in imports of white arsenic were believed related to several factors, principally the increased consumption of nonarsenical organic insecticides and the light insect infestations during 1948, particularly in the cotton-growing regions of the South. Estimated 1948 domestic production of calcium and lead arsenate declined 19 and 45 percent, respectively, below 1947 levels. Because of the variety of new organic insecticides available and generally mild weather, buyers were reluctant to place orders in advance, causing unwillingness on the part of producers to maintain high production levels. Year-end stocks of calcium and lead arsenate are thought to have been small. Exports of calcium and lead arsenate, particularly the latter, declined below 1947. Large purchases of these insecticides for the European Recovery and China Aid Programs, directed by the Economic Cooperation Administration, caused a notable shift from the normal export pattern.

Salient statistics for white arsenic in the United States, 1944–48

	1944	1945	1946	1947	1948
Production……short tons	36,094	24,349	10,211	18,755	19,367
Imports for consumption……do	9,965	13,149	13,822	13,940	9,336
Exports……do	2,401	858	(1)	(1)	(1)
Apparent consumption [2]……do	40,025	38,100	27,000	31,000	24,000
Price per pound, end of year	$0.04	$0.04	$0.06	$0.06	$0.06

[1] Data not available.
[2] Producers' shipments, imports minus exports (exports estimated at 1,000 tons annually in 1946–47; producers reported 500 tons exported in 1948). Actual consumption was 43,500 tons in 1944 (differing from apparent consumption because of reductions in consumers' stocks); actual consumption data for 1945–48 not available.

DOMESTIC PRODUCTION

Domestic white arsenic is produced principally as a byproduct in smelting complex copper and lead ores. Production of the crude grades was a little below 1947, whereas that of the refined material

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doubled the previous year's figure, presumably owing to increased demand by the glass industry, which requires the premium grade. Companies reporting output in 1948 were 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. Significant quantities of metallic arsenic were produced by the Anaconda company. Sodium arsenite solution was produced by the Shepherd Chemical Co., Cincinnati, Ohio, from imported Canadian cobalt-nickel arsenide concentrates.

White arsenic produced and shipped by producers in the United States, 1944–48

Year	Crude			Refined			Total		
	Production (short tons) [1]	Shipments		Production (short tons)	Shipments		Production (short tons)	Shipments	
		Short tons	Value [2]		Short tons	Value [2]		Short tons	Value [2]
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	10,448	557,986	1,230	1,591	97,091	10,211	12,039	655,077
1947	17,636	17,119	1,424,316	1,119	1,069	109,440	18,755	18,188	1,533,756
1948	17,302	13,749	1,141,310	2,065	1,767	126,293	19,367	15,516	1,267,603

[1] Excludes crude consumed in making refined. Includes crude white arsenic equivalent of compounds made directly from ores, flue dust, and speiss as follows: 1944, 443 tons; 1945, 112 tons; 1946, 180 tons; 1947, 97 tons; 1948, 88 tons.
[2] Partly estimated.

CONSUMPTION AND USES

During 1948 apparent consumption of white arsenic (domestic producers' sales plus imports, minus estimated exports) was nearly 24,000 short tons, a decline of 23 percent below 1947 and the lowest for any year since 1933. The reduced consumption was due largely to the warm, dry summer weather which discouraged serious insect infestations, especially in the cotton regions of the South, and to the increasing use of synthetic organic insecticides such as DDT, benzene hexachloride, chlordane, and toxaphene. Lead arsenate was reported in steady demand by fruit growers. According to industry sources, 1948 over-all insecticide needs were only 60 to 75 percent of those in the previous year, although producers were prepared to meet requirements over 1947. Competition from the organic preparations became increasingly intense; large inventories of DDT were carried over from 1947 at lowered prices. Production of benzene hexachloride doubled that of 1947, and prices were reduced. Other organics competing with the arsenicals, such as chlordane and toxaphene, were in ample supply, according to the United States Department of Agriculture.

The major portion of all arsenic produced is employed in manufacturing calcium and lead arsenate insecticides. Calcium arsenate is consumed principally by cotton growers for boll-weevil control. Lead arsenate is extensively used to suppress the codling moth in apple orchards and chewing insects in other plantings. Appreciable quantities of sodium arsenite are used in solution form as a weed killer.

Arsenic is also consumed in glass manufacture, arsenical lead alloys, sheep dip, wood preservatives,[1] poisoned baits, and acid inhibitors,[2] and is used in the Thylox process for industrial gas purification. The use of arsenic in pharmaceutical preparations for treating syphilis has declined with the advent of more effective organic preparations, such as penicillin.

A series of important interpretations of the requirements of the Insecticide, Fungicide and Rodenticide Act were issued in July 1948 by the Insecticide Division of the Department of Agriculture's Production and Marketing Administration.[3] The interpretations are for the guidance of manufacturers and distributors of commerical poisons and carry the force of law until modified.

Production of arsenical insecticides, consumption of arsenical wood preservatives, and production of arsenical drugs in the United States, 1944–48

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 aceto-arsenite)	Wolman salts (25 percent sodium arsenate)	Zinc meta-arsenite	
1944	45,352	22,175	2,265	782,256	11,503	100,190
1945	35,261	[4] 12,889	1,950	732,154	17,980	[5] 36,759
1946	28,334	17,696	(6)	1,669,889	14,650	(6)
1947	15,094	23,594	(6)	[7] 1,156,847	(6)	(6)
1948	[8] 12,300	[8] 13,000	(6)	1,286,302	(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 January to November, inclusive.
5 January to June, inclusive.
6 Data not available.
7 Revised figure.
8 Estimated.

STOCKS

Year-end producers' stocks of white arsenic for 1948 were nearly five times 1947 holdings and exceeded those of any year since 1940. Increased availability of organic insecticides curtailed demand for calcium and lead arsenates, lowering, in turn, the consumption of white arsenic. Data on stocks of calcium and lead arsenate held by producers are not available, but with output in 1948 closely geared to near-term demand, inventories are believed small. Stocks of white arsenic held by foreign producers, especially the Boliden Mining Co. in Sweden, are believed very large.

PRICES

The quotation on refined white arsenic, in Oil, Paint and Drug Reporter, which had remained unchanged at 6 cents per pound for carlots throughout 1947, was raised to 6¼ cents early in January 1948. This level was maintained until late in December, when it declined to

1 Häger, Bror O. (to Bolidens Gruvaktiebolag), Wood Impregnating Solutions Containing Heavy Metal Compounds with Arsenic and Chromic Acids: U. S. Patent 2,432,007, Dec. 2, 1947.
2 Wachter, Aaron (to Shell Development Co.), Prevention of Corrosion in Hydrogen Fluoride Catalytic Organic Reactions: U. S. Patent 2,431,715, Dec. 2, 1947.
Wachter, A., Treseder, R. S., and Weber, M. K., Arsenic as a Corrosion Inhibitor in Sulfuric Acid: Corrosion, vol. 3, No. 8, August 1947, pp. 406–414.
3 Oil, Paint and Drug Reporter, vol. 154, No. 4, July 26, 1948, p. 7.

the former price of 6 cents. Crude grades of white arsenic were sold at 4 to 6 cents per pound. Imported white arsenic was held at a substantial premium over the domestic contract price.

Calcium arsenate, in carlots, warehouse, was quoted at 9½ cents in January, increased to 9½ to 10½ in May, and in November was quoted at 10½, where it remained unchanged. Lead arsenate, carlots (in 6-pound bags), was quoted at 21¾ cents per pound early in January; successive increases in the price of lead during the year brought about a corresponding rise in lead arsenate quotations as follows: Mid-April, 23½ cents; late August, 24¾ to 25; mid-November, 30 to 31½; late November, 31½, this price remaining effective the balance of the year. The quoted price of paris green, carlots, remained steady throughout the year at 31 cents per pound. Similarly, sodium arsenate, carlots, was steady at 12 cents per pound. Gray sodium arsenite, carlots, works, was quoted at 10¾ cents per pound in January, increasing to 11¾ cents early in February, where it remained until early August, when Oil, Paint and Drug Reporter stated no further stocks were available; thereafter, sodium arsenite solution was quoted at 70 cents to $1 per gallon. Oil, Paint and Drug Reporter quoted arsenic metal in mid-July at 55 cents per pound; prices jumped to 75 to 90 cents in early November, remaining unchanged through December. No stocks of arsenic sulfide or zinc meta-arsenite were available during the year, according to Oil, Paint and Drug Reporter.

Producers and Government year-end stocks of arsenic compounds in the United States, 1944–48, in short tons

End of year	White arsenic			Calcium arsenate [1] (producers)	Lead arsenate [2] (producers)
	Producers	Government	Total		
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)
1947	1,038		1,038	(4)	(4)
1948	4,889		4,889	(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 Sept. 30; year-end data not available.
[4] Data not available.

FOREIGN TRADE [4]

Imports.—White-arsenic imports for 1948 totaled 9,336 short tons and were 33 percent below 1947 receipts and 27 percent below the 10-year average for 1939–48; 1948 imports were the lowest since 1932, when 6,882 short tons were received.

Mexico continued to be the principal supplier of white-arsenic imports, accounting for 76 percent of the total. Receipts from the U. S. S. R., the second largest supplier in 1947, dropped 69 percent; imports from Sweden were slightly below those in 1947. White arsenic was imported from Italy for the first time on record, receipts totaling 337 short tons.

Metallic arsenic imports were double those of 1947, Poland accounting for 29,979 pounds valued at $13,529 and the United Kingdom

[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.

6,608 pounds valued at $4,038. Essentially all of the arsenic sulfide reported was shipped from Belgium and was valued at $15,755. All receipts of sheep dip were from the United Kingdom and were valued at $6,692.

Arsenicals imported into and exported from the United States by classes, 1944–48, in pounds

[U. S. Department of Commerce]

Class	1944	1945	1946	1947	1948
Imports for consumption:					
White arsenic (As_2O_3 content)	19, 929, 608	26, 297, 962	27, 641, 765	27, 879, 965	18, 671, 621
Metallic arsenic	21, 395	51, 501	92, 064	18, 928	36, 587
Sulfide	---	2, 226, 560	88, 184	44, 092	88, 608
Sheep dip	159, 867	197, 000	1, 460	83, 654	38, 275
Lead arsenate	---	---	552	120, 000	---
Exports:					
White arsenic	4, 802, 932	1, 715, 855	(1)	(1)	(1)
Calcium arsenate	2, 411, 095	3, 499, 625	6, 877, 347	4, 967, 249	4, 569, 346
Lead arsenate	4, 265, 513	6, 339, 103	2, 795, 205	3, 103, 863	2, 037, 645
Paris green (cupric aceto-arsenite)	1, 138, 435	456, 811	(1)	(1)	(1)

(1) Beginning Jan. 1, 1946, not separately classified.

White arsenic (As_2O_3 content) imported for consumption in the United States, by countries, 1944–48

[U. S. Department of Commerce]

Country	1944		1945		1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Belgium and Luxembourg	---	---	---	---	---	---	---	---	5	$961
Bolivia	---	---	---	---	---	---	11	$1, 040	---	---
Canada	5	$100	1	$73	275	$24, 074	109	10, 414	83	6, 278
France	---	---	---	---	---	---	55	6, 230	---	---
Italy	---	---	---	---	---	---	---	---	337	57, 479
Mexico	7, 654	424, 911	9, 665	533, 305	10, 309	571, 483	10, 710	773, 133	7, 132	598, 989
Peru	2, 306	120, 344	3, 483	154, 595	2, 345	100, 693	150	16, 394	98	8, 860
Poland and Danzig	---	---	---	---	---	---	177	24, 922	---	---
Portugal	---	---	---	---	---	---	55	8, 207	28	4, 409
Sweden	---	---	---	---	642	57, 942	1, 228	148, 669	1, 204	157, 233
U. S. S. R.	---	---	---	---	251	18, 833	1, 445	156, 459	449	49, 320
Total	9, 965	545, 355	13, 149	687, 973	13, 822	773, 025	13, 940	1, 145, 468	9, 336	883, 529

Exports.—Calcium arsenate and lead arsenate exports for 1948 declined 8 and 34 percent, respectively, below 1947 totals. Germany and Peru each received 30 percent of the calcium arsenate shipped; France received 19 percent, and the remaining 21 percent was distributed among 11 other countries. China received 57 percent of the lead arsenate exported; 8 percent went to Japan and about 5 percent each to Brazil, Austria, and Korea. The remainder—about 30 percent—was shipped to 24 other countries. In previous years Latin-American countries have been the most important export markets for United States producers of calcium and lead arsenate. During 1948 these markets continued to be important but were overshadowed by purchases made for the European Recovery and China Aid Programs.

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, by countries, in metric tons, 1943–48 [1]

[Compiled by Bernice B. Mitchell]

Country [1]	1943	1944	1945	1946	1947	1948
Australia	2, 320	2, 341	2, 021	1, 651	1, 210	406
Austria [2]	310	(3)	(3)	(3)	(3)	(3)
Belgium-Luxembourg (exports)	15	----------	----------	(3)	(3)	70
Brazil	970	840	962	829	1, 001	984
Canada	1, 430	1, 192	928	338	357	525
France	4, 837	1, 704	1, 530	3, 140	(3)	(3)
Germany	[4] 560	[4 5] 579	(3)	(3)	(3)	(3)
Italy	461	(3)	(3)	(3)	(3)	(3)
Japan	[6] 2, 284	[6] 1, 415	(3)	767	1, 302	1, 765
Mexico	20, 301	15, 306	15, 013	9, 648	9, 685	7, 571
New Zealand	8	16	17	18	8	8
Peru	1, 195	6, 900	3, 200	753	608	1, 039
Portugal	[2 7] 446	[2 7] 263	[2] 243	[8] 304	1, 126	1, 559
Southern Rhodesia	1, 681	857	624	216	416	283
Spain	239	337	393	440	484	(3)
Sweden [2]	810	3, 044	6, 119	10, 109	15, 000	(3)
Union of South Africa	----------	----------	100	12	3	13
United Kingdom	125	141	117	147	91	(3)
United States	28, 306	32, 744	22, 089	9, 263	17, 014	17, 569
Total [9]	66, 300	68, 000	55, 600	40, 000	53, 000	53, 000

[1] Arsenic is also believed to be produced in China, Czechoslovakia, Hungary, Iran, Korea, Turkey, and U. S. S. R., but data are not available.
[2] Arsenic content of ore mined.
[3] Data not available; estimate by author of chapter included in total.
[4] Exports.
[5] January to July, inclusive.
[6] Incomplete data.
[7] Reported production appears to be too low in relation to reported exports.
[8] Exports. In addition, 173 tons of arsenic concentrates were exported.
[9] Estimated by author of chapter; excludes countries listed in footnote 1.

Argentina.—Deposits of arsenical ores containing copper, molybdenum, and bismuth occurring at Tocota, San Juan Province, were studied, and potential production was estimated.[5] The Five-Year Plan set the annual production goal for lead arsenate in 1947 at 500 metric tons.[6]

Australia.—The arsenic condensing and refining plant at Wiluna, Western Australia, owned by the Victor Leggo Mining Co. Pty., Ltd., ceased operations in April 1948. Since 1946, when the Wiluna gold mine closed down, the arsenic plant had been using previously impounded crude material. It is reported the plant will be kept intact, as there are possibilities of several of the Western Australian gold mines producing arsenical gold concentrates. The Bendigo arsenic plant, owned by the same firm, will continue to produce a few hundred tons of refined arsenic annually.[7]

Canada.—About 493 tons of refined white arsenic were produced by the Deloro Smelting & Refining Co., Ltd., Deloro, Ontario, in 1948, part being recovered in treating silver-cobalt ores from northern Ontario and part from processing of crude oxide obtained from

[5] Kittle, E. and Bellio, N., Estudio Geologico-Economico de los Yacimientos de Arsenico de Tocota, Departmento Iglesia, Provincia de San Juan: Revista Minera, vol. 17, No. 4, October–December 1946, pp. 73–144.
[6] U. S. Department of Commerce, Chemicals and Drugs: March 1947, p. 23.
[7] Bureau of Mines, Mineral Trade Notes: Vol. 27, No. 3, September 1948, p. 3.

O'Brien Gold Mines, Ltd., in northern Quebec. Some crude arsenic was exported by Beattie Consolidated Gold Mines, Ltd., northern Quebec.[8] A coal shortage was reported to have curtailed Canadian production during the year.

Colombia.—Reserves of arsenopyrite ores at El Zancudo Mine were estimated at 100,000 tons.[9]

France.—Domestic mines producing arsenical ores were listed and their locations given.[10]

Iran.—Small quantities of arsenic were produced in 1947.[11] Orpiment and realgar ores are mined at Zarah Shah. A description of Iranian arsenic ore deposits has been published.[12]

Peru.—Cerro de Pasco Copper Corp. completed construction of its new calcium arsenate plant at Oroya in 1947. Production began late in the year and had reached a rate of 100 metric tons per annum in 1948.[13]

Poland.—In March 1947 the Polish Central Chemical Board signed an agreement to export 257 tons of arsenic to the United Kingdom, 50 tons to the United States, 100 tons to South American countries, and 20 tons to Denmark.[14] By order of the Ministry of Agriculture the Azoty factory at Jaworzno is producing "Arsopol," an arsenic compound used in spraying trees from the air.[15]

Portugal.—Reports state that a new plant for production of high-grade white arsenic has been constructed at Pintor, southeast of Oporto, and began production late in 1947. Monthly output is said to be 230 tons on a three-shift day, 7-day-week basis. Raw materials comprise ore from the mine at Pintor and concentrates from Tuella Tin Mines Limitada and Minas dos Mouros, Tres-os-Montes Province; and from Beralt Tin and Wolfram Ltd., Beira Baixa Province.

Sweden.—The Boliden Mining Co., largest individual producer of white arsenic in the world, was reported to be expanding refining capacity. Crude-arsenic stocks on hand are said to be large enough to meet world demand for many years.[16] The annual report of the company for 1948 indicates concern over the encroachment of organic compounds in the insecticide field and states that research is active in seeking new uses for arsenic. An abundance of native arsenic was reported in one vein at the Linskold Copper mine, northern Sweden.[17]

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8 McLeod, H., Canadian Mining Journal: Vol. 70, No. 2, February 1949, pp. 70–71.

9 Restrepo, Gilberto Botero, Notes on the Abandoned El Zancudo Mine and its Possibilities as a Source of Supply of Arsenic and Antimony Minerals: Colombia Serv. Geol. Nacl. Estud. Geol., vol. 6, 1943, pp. 383–396.

10 Charrin, Victor, Large Nonferrous Deposits in France: Genie Civil, vol. 125, 1948, pp. 207-208.

11 Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 3, March 1948, p. 48.

12 Ladame, Georges, Metalliferous Resources of Iran: Schweizerische Mineralogische, und Petrographische Mitteilungen, vol. 25, 1945, pp. 165–303.

13 U. S. Department of Commerce, Chemicals and Drugs: October 1948, p. 20.

14 U. S. Department of Commerce, Chemicals and Drugs: May 1947, p. 23.

15 U. S. Department of Commerce, Chemicals and Drugs: March 1948, p. 24.

16 U. S. Department of Commerce, Chemicals and Drugs: March 1947, p. 23.

17 Gavelin, Sven, Arsenic-Cobalt-Silver Veins in Linsköld Copper Mine, N. Sweden: Sveriges Geologiska Undersokning, Series C, No. 469, 1945, 19 pp.

Asbestos

By G. W. JOSEPHSON AND F. M. BARSIGIAN

GENERAL SUMMARY

THE world-wide shortage of asbestos continued to be acute in 1948. After the war many asbestos-products manufacturers embarked upon expansion programs as demand increased, but it soon became apparent that the supplies of raw asbestos were inadequate to support this rapid expansion program. Consequently, growth of the industry has been inhibited, and it has not been possible to take full advantage of all the manufacturing capacity available. The shortage has stimulated the search for substitute fibers that might be available in larger quantity.

Asbestos was mined in the United States at a record rate, but the total was only a small fraction of our requirements—only 5 percent of the asbestos consumed in the United States in 1948.

The bulk of the asbestos produced in the United States is chrysotile, coming largely from Vermont and Arizona. The market for amphibole asbestos is still comparatively small but has increased recently owing to use in a new type of insulating product.

Imports of asbestos also attained a new record. Canada is our principal supplier of chrysotile; relatively small quantities are received from Southern Rhodesia and Russia.

United States amosite supplies come from South Africa, as does nearly all of the crocidolite used in this country. Interest in and development of blue asbestos deposits in other countries, such as Australia and Bolivia, have been noteworthy during the past year, but these have not yet become suppliers of large tonnages.

The general shortage of asbestos fibers has been so acute that comparatively little progress was made in their procurement for the National Strategic Stock Pile during the past year.

Prices of raw asbestos increased considerably during 1948.

Salient statistics of the asbestos industry in the United States, 1947–48

	1947		1948	
	Short tons	Value	Short tons	Value
Domestic asbestos—				
Produced:				
Chrysotile	24,462	(1)	(2)	(1)
Amphibole	677	(1)	(2)	(1)
Total produced	25,139	(1)	37,237	(1)
Sold or used by producers:				
Chrysotile	23,586	$912,340	(2)	(2)
Amphibole	449	6,218	(2)	(2)
Total sold or used by producers	24,035	918,558	37,092	$1,806,261
Imports (unmanufactured)	594,839	29,821,519	647,881	37,974,092
Exports (unmanufactured)	2,087	316,414	6,530	1,173,259
Apparent consumption [3]	616,787	30,423,663	678,443	38,607,094
Exports of asbestos products	(1)	12,823,480	(1)	10,471,059

[1] Figure not available.
[2] Bureau of Mines not at liberty to publish figure separately.
[3] Quantity sold or used by producers, plus imports, minus exports.

PRODUCTION

In 1948 production of asbestos in the United States attained a new record of 37,237 short tons—48 percent more than in 1947. Chrysotile production was reported from Vermont and Arizona and amphibole from California, Georgia, and North Carolina. During 1948 considerable exploration was carried on, but no large commercial developments were reported. However, one promising deposit of chrysotile was being investigated.

Asbestos sold or used by producers in the United States, 1944–48, by varieties

Year	Chrysotile		Amphibole		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1944	6,275	$373,112	392	$7,222	6,667	$380,334
1945	11,986	442,056	240	3,989	12,226	446,045
1946	13,645	499,260	430	5,504	14,075	504,764
1947	23,586	912,340	449	6,218	24,035	918,558
1948	(1)	(1)	(1)	(1)	37,092	1,806,261

1 Bureau of Mines not at liberty to publish figure separately.

Alaska.—Alaska has some rather inaccessible deposits of tremolite and chrysotile in the Kobuk River district, but in 1948 no output was reported from them.

Arizona.—In 1948 chrysotile production in Arizona was substantially higher than in the previous year. The following firms and individuals were active: Apache Asbestos Mines, Inc., Arizona Chrysotile Asbestos, Arthur Enders, Ted Heron, Charles Ireland, Louis Kuehne, Roger Q. Kyle, Phillips Asbestos Mines, K. Reidhead, and the Globe Asbestos Co. The Globe firm operates the largest mill in the area.

California.—In Shasta County production of tremolite was reported by Homer E. Fenn of Hazel Creek, Ray J. Sylvester of Mount Shasta, and the Powhatan Mining Co. (Woodlawn, Baltimore, Md.). H. Zimdars and J. Delume of Foresthill mined a small quantity of tremolite in Placer County but discontinued mining later in the year.

Georgia.—Powhatan Mining Co. mined anthophyllite in Rabun County near Dillard and in Barrow County near Statham.

North Carolina.—The only asbestos production in North Carolina in 1948 came from an amphibole mine in Macon County, operated by Powhatan Mining Co. of Woodlawn, Baltimore, Md.

Vermont.—Vermont was the principal asbestos-producing State in 1948. The Vermont Asbestos Mines Division of the Ruberoid Co., the only producer in Vermont, increased its production considerably. This asbestos is a high-grade chrysotile that is milled by the company, largely for use in its own asbestos products.

CONSUMPTION AND USES

A census of manufactures covering 1947 was taken by the Bureau of the Census during 1948. This is the first such census taken since 1939. The production statistics for asbestos products are shown in the following table.

Production of asbestos products in the United States, 1939 and 1947, and shipments, 1947

[U. S. Bureau of the Census]

Product	Unit of measure	1939 Production [1] Quantity	1939 Production [1] Value $1,000	1947 Production Quantity	1947 Shipments and interplant transfers Quantity	1947 Shipments and interplant transfers Value $1,000
Asbestos-cement products:						
Siding shingles and clapboard	M squares	(2)	(3)	4,928	4,889	$30,682
Roofing shingles	do	664	$4,599	900	881	6,846
Flat sheets and wallboard (1/4-inch basis)	M sq. ft.	(2)	(3)	157,238	147,516	13,419
Corrugated sheets	do	7,551	845	45,839	41,321	5,140
Other (including pipe, conduits, and ducts)			[3] 11,207			14,323
Total			(2)			70,410
Asbestos friction materials:						
Brake linings:						
Woven (containing asbestos yarn, tape, or cloth)	M lin. ft.	(2)	14,377 (woven and molded)	19,601	19,589	6,968
Molded (including all nonwoven types)	Cu. ft.	(2)		[4] 454,215	[4] 425,859	31,787
Clutch facings:						
Woven (containing asbestos yarn, tape, or cloth)	M pieces	9,084	2,446	20,732	20,004	9,851
Molded (including all nonwoven types)	do	(2)	(5)	39,513	40,296	10,000
Total			(2)			58,606
Asbestos insulation:						
Pipe insulation:						
Cellular and laminated		(2)	(2)			6,687
85 percent magnesia		(2)	(2)			6,578
Other		(2)	(2)			2,998
Block insulation (including sheet and lagging):						
Cellular and laminated	M bd. ft.	(2)	(2)	13,073	13,529	1,558
85 percent magnesia	do	(2)	(2)	31,343	31,888	4,573
Other	do	(2)	(2)	10,652	11,442	2,094
Total			11,712			24,488
Asbestos textiles:						
Carded fiber	M pounds	(2)	(6)		506	178
Roving and lap	do	4,437	1,018	23,358	4,960	1,819
Wick and rope	do	(2)	(6)	3,221	2,785	1,291
Yarn, cord, and thread	do	7,923	2,683	25,285	9,748	4,815
Cloth	do	5,263	1,813	11,940	7,998	5,624
Tape	do	2,212	1,174	6,543	3,266	2,469
Other	do	(2)	1,997	1,039	1,036	795
Total			8,685			16,991
Other asbestos products:						
Asbestos, asbestos-metallic, and asbestos-rubber gaskets		(2)	(2)			31,915
Asbestos compressed sheet	M pounds	5,448	1,205	10,779	7,639	2,795
Asbestos (except compressed sheet), asbestos-metallic, and asbestos-rubber packing	do	(2)	(2)	8,919	8,937	9,459
Asbestos millboard	Ton	9,137	867	20,218	19,355	2,812
Asbestos paper	do	42,615	4,476	97,119	96,760	10,592
Asphalt floor tile	M sq. yds.	4,933	3,633	41,479	40,981	37,825
Other			[7] 15,693			[8] 7,812

[1] Probably represents production for sale only.
[2] Figure not available.
[3] Figures for siding shingles and clapboard, flat sheets and wallboard, and asbestos flexible roofing are included with "Other asbestos-cement products."
[4] Partly estimated.
[5] Included in "Other" under "Other asbestos products."
[6] Included in "Other asbestos textiles."
[7] Represents asbestos conduits and ducts (other than cement), molded clutch facings, paper, table mats and protectors, asbestos insulating cement, 85-percent magnesia cement, and high-temperature cements.
[8] Represents asbestos drier felts, fabricated asbestos-paper products, stove mats and table pads, asbestos insulating cement, asbestos gloves, and miscellaneous asbestos products.

Apparent consumption of raw asbestos in the United States, 1944–48

Year	Short tons	Value	Year	Short tons	Value
1944	389,241	$18,864,291	1947	616,787	$30,423,663
1945	378,030	15,926,622	1948	678,443	38,607,094
1946	459,752	17,840,775			

The Census data, as well as those in the accompanying table of raw-asbestos consumption, indicate the rapid rate of expansion that has taken place in the asbestos industry. The major uses of asbestos in industry are in such products as pipe covering, packing, gaskets, brake linings, and various textiles. The building industry also consumes very large tonnages in asbestos-cement products (such as shingles, sheets, and pipes), floor tile, and other uses. The correlation between activity in construction, general industrial production, and asbestos consumption during the past 29 years is shown in figure 1.

Market Conditions.—As in 1947, the world demand for asbestos was greater than the supply. Production was being expanded, particularly in Canada, but the increase during the year was not nearly sufficient. American factories purchased the largest part of world production, but the demands of other consumers were becoming increasingly important factors in the market. Toward the latter part

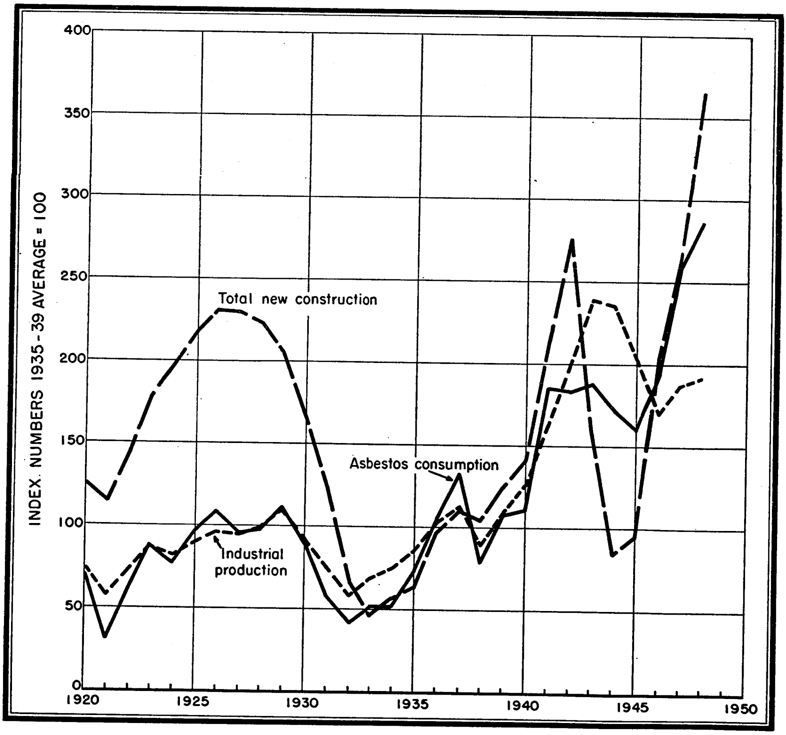

FIGURE 1.—Consumption of asbestos compared with total new construction and industrial production, 1920–48. Units are reduced to percentages of the 1935-39 average. Statistics on value of construction from Bureau of Foreign and Domestic Commerce and on industrial production from Federal Reserve Board.

of the year there was some evidence that the shortage of textile fibers was easing, but this did not reach a point that would release fiber for stock piling. There was also a slight recession in demand for shorts during part of the year, but this is said to have been largely overcome. The exploration and mine-development work that are progressing throughout the world promise some relief for the future. As indicated in the World Review section of this chapter, a number of important expansion programs are in progress. However, at the end of 1948 contracting activities indicated that more than the available supply would be required for 1949 and that any early relief from the shortage can come only from a decline in demand for asbestos products.

Asbestos varies widely in physical properties and consequently in utility. Each variety has fundamental advantages and disadvantages, and even within a single variety the properties vary so much that great care must be exercised in proper handling and processing of the product in order to attain the most efficient use of the raw materials. A brief paper discussing asbestos research and the properties that determine utilization was published in 1948.[1]

New Uses.—Some noteworthy new products were announced during 1948. An outstanding example is Quinterra paper. In making this product, chrysotile fibers are formed by a special paper-making process into a paperlike tape having a thickness of only 1.5 to 20 mills. It is used for electrical wire insulation.[2] A new plant has been built for its manufacture.[3]

Another new product that attracted attention during 1948 was phospho-asbestos, a molded asbestos material having superior properties for use in circuit breakers.[4]

Many varieties of asbestos have found commercial use, but anthophyllite generally has such a weak fiber that comparatively little has been consumed in the United States in the past. However, it appears to be the most suitable type for use in a newly developed insulating material composed principally of a plastic and anthophyllite. The product is now in commercial production, and the prospect of developing a substantial market for it is considered to be promising.

PRICES

Under current market conditions, coupled with higher material and labor costs, the prices of all grades of crude and milled asbestos fiber from both Canada and Vermont increased in 1948. 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 dollars: Group 1 (Crude No. 1), $800; group 2 (Crude No. 2, Crude Run-of-Mine, and Sundry), $302.50–$545; group 3 (Spinning or Textile Fiber), $170.50–$354.50; group 4 (Shingle Fiber) $82.50–$127; group 5 (Paper Fiber), $58–$73.50; group 6 (Waste, Stucco, or Plaster), $43–$47.50; and group 7 (Refuse or Shorts), $19.50–$44.50.

Prices of Canadian asbestos increased in February and these figures were quoted from then until December: Crude No. 1, $896–$960;

[1] Badollet, M. S., Research on Asbestos Fibers: Canadian Min. and Met. Bull., vol. 42, No. 432, April 1948, pp. 213–216.

[2] Asbestos, Quinterra, a New Type of Electrical Insulation: Vol. 30, No. 2, August 1948, pp. 12–14.

[3] Asbestos, Johns Manville's Newest Plant: Vol. 30, No. 5, November 1948, pp. 16–18.

[4] Asbestos, Phospho-Asbestos; Vol. 30, No. 5, November 1948, pp. 10–12.

Crude No. 2, Crude Run-of-Mine, and Sundry, \$350–\$545; Spinning or Textile Fiber, \$204.50–\$378; Shingle Fiber, \$84.50–\$128; Paper Fiber, \$69.50–\$78; Waste, Stucco, or Plaster, \$47–\$51.50; and Refuse or Shorts, \$24.50–\$46.

At the end of the year, another general price increase was being put in effect.

The prices of Vermont asbestos in short tons f. o. b. Hyde Park or Morrisville, Vt., quoted in January 1948, were: Shingle Fiber, \$92.50–\$102.50; Paper Fiber, \$65–\$73; Waste, Stucco, or Plaster, \$48.50; Refuse or Shorts, \$25.50–\$44.50. These prices were increased in March 1948 and remained unchanged throughout the year, as follows: Shingle Fiber, \$97–\$107; Paper Fiber, \$68.50–\$85; Waste, Stucco, or Plaster, \$51; Refuse or Shorts, \$25.50–\$46.50.

FOREIGN TRADE[5]

As the major producing countries are not large consumers, a very high proportion of the asbestos output of the world moves in foreign trade. The United States has only a negligible export trade in unmanufactured asbestos. The exported material is largely domestic chrysotile from Arizona and a modest tonnage of foreign material that is reexported, with or without blending, to higher-priced markets. On the other hand, exports of manufactured asbestos products are substantial, totaling \$10,471,059 in 1948.

Asbestos imported for consumption in the United States, and asbestos and asbestos products exported from the United States, 1944–48

[U. S. Department of Commerce]

Year	Asbestos (unmanufactured)				Manufactured asbestos products—exports (value)
	Imports		Exports		
	Short tons	Value	Short tons	Value	
1944	383,049	\$18,542,940	475	\$58,983	\$5,614,243
1945	374,354	16,317,752	8,550	837,175	7,264,288
1946	456,688	18,731,378	11,011	1,395,367	9,263,092
1947	594,839	29,821,519	2,087	316,414	12,823,480
1948	647,881	37,974,092	6,530	1,173,259	10,471,059

United States imports of unmanufactured asbestos were 9 percent higher than in 1947. Canada supplied 93 percent of the total, the Union of South Africa 3 percent, Southern Rhodesia 2 percent, and Russia 2 percent. Small quantities were received from other countries as indicated in the accompanying table.

[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, 1947–48, by countries and classes

[U. S. Department of Commerce]

Country	Crude (including blue fiber)		Mill fibers		Short fibers		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1947								
Australia	(1)	$198					(1)	$198
Canada	497	264,148	162,302	$13,936,784	396,480	$11,053,272	559,279	25,254,204
Italy	4	2,318	4	4,855			8	7,173
Southern Rhodesia [2]	8,894	1,735,167	98	15,484			8,992	1,750,651
Union of South Africa	20,031	2,144,528			3	88	20,034	2,144,616
U. S. S. R.	6,524	663,788					6,524	663,788
United Kingdom	1	705					1	705
Venezuela			1	184			1	184
	35,951	4,810,852	162,405	13,957,307	396,483	11,053,360	594,839	29,821,519
1948								
Australia	3	1,550					3	1,550
Bolivia	68	11,445					68	11,445
Canada	676	361,316	168,690	16,884,386	432,850	14,512,547	602,216	31,758,249
China			2	238			2	238
India	(1)	68					(1)	68
Italy			10	11,122			10	11,122
Southern British Africa	692	87,741					692	87,741
Southern Rhodesia [2]	10,463	2,033,398	20	6,873	30	8,546	10,513	2,048,817
Turkey					4	400	4	400
Union of South Africa	18,859	2,073,371					18,859	2,073,371
U. S. S. R.	7,327	851,656	8,187	1,129,380			15,514	1,981,036
United Kingdom	(1)	55					(1)	55
	38,088	5,420,600	176,909	18,031,999	432,884	14,521,493	647,881	37,974,092

[1] Less than 1 ton.
[2] Includes the following crude credited to Mozambique by the U. S. Department of Commerce: 1947—67 tons, $17,778; 1948—1,055 tons, $106,431.

Manufactured asbestos products exported from the United States, 1947–48, by kinds

[U. S. Department of Commerce]

Products	1947		1948	
	Quantity	Value	Quantity	Value
Brake blocks ... short tons	312	$494,165	132	$219,670
Brake lining:				
Molded and semimolded ... do	1,654	2,907,716	1,301	2,238,135
Not molded ... linear feet	949,449	552,244	681,364	404,085
Clutch facing ... number	1,636,400	794,688	1,134,146	550,937
Paper, millboard, and roll board ... short tons	1,078	272,823	1,639	308,384
Pipe covering and cement ... do	2,765	510,887	1,599	298,781
Sheets ... do	5,292	641,069	3,718	455,816
Textiles, yarn, and packing ... do	2,101	2,622,055	1,575	2,302,384
Asbestos roofing ... squares	164,114	1,152,621	210,238	1,392,071
Other asbestos manufactures, except roofing short tons	(1)	1,186,845	(1)	1,151,088
Magnesia and manufactures ... do	(1)	1,688,367	(1)	1,149,708
		12,823,480		10,471,059

[1] Quantity not recorded.

TECHNOLOGY

Iron removal received considerable attention during 1948, and a review was published on the subject.[6] The problem is of particular importance because of the use in military equipment of low-iron chrysotile that is now obtained principally from Southern Rhodesia. Development of methods of beneficiating more available grades of asbestos would improve our military supply position.

The shortage of amosite is resulting in serious efforts to find substitutes. In this case one of the most promising lines of investigation is leading toward the substitution of glass fiber in some heat-insulating products.

WORLD REVIEW

Although official statistics are not available for some producing areas, it is estimated that Canada supplied nearly two-thirds of the world asbestos output in 1948. Russia probably was in second place, Southern Rhodesia third, and the Union of South Africa fourth.

World production of asbestos, 1943–48, by countries, in metric tons [1]

[Compiled by P. Roberts]

Country [1]	1943	1944	1945	1946	1947	1948
Argentina	349	292	153	([2])	([2])	([2])
Australia:						
New South Wales	422	2,598	2,674	241	290	([2])
South Australia	11	6	7	8	40	[3] 40
Tasmania	19	105	281	—	—	—
Western Australia	247	313	1,109	380	1,069	977
Bolivia (exports)	22	13	61	—	76	147
Brazil	([2])	([2])	([2])	([2])	3	10
Canada (sales) [4]	423,831	380,349	423,559	506,371	600,391	650,239
Chile	([2])	([2])	313	280	([2])	([2])
China	[3] 20,000	([2])	([2])	([2])	([2])	([2])
Cyprus (exports)	1,189	1,983	3,125	5,993	6,369	8,108
Egypt	7	240	[5] 50	65	1,015	1,625
Finland [6]	7,466	7,733	4,197	5,781	([2])	([2])
France	78	31	400	575	475	([2])
French Morocco	182	506	480	446	790	399
India	909	592	833	312	123	([2])
Indochina, French	312	242	—	—	—	—
Italy	8,459	7,238	5,222	8,814	10,468	[3] 11,770
Japan	5,302	12,900	8,044	3,997	3,708	4,590
Kenya	321	341	389	[3] 165	582	([2])
Korea	5,310	4,779	1,303	([7])	([7])	([7])
Madagascar	([8])	3	1	1	([8])	([8])
New Zealand	190	17	2	—	—	—
Portugal	96	33	20	12	([2])	([2])
Southern Rhodesia	52,749	52,882	51,119	50,686	49,073	62,502
Spain	50	—	—	—	—	([2])
Swaziland	17,179	29,628	21,243	29,155	25,360	29,421
Switzerland	11	7	35	40	—	—
Turkey	133	234	138	55	([2])	203
Union of South Africa	32,347	31,372	25,597	18,348	27,344	41,490
United States (sold or used by producers)	5,456	6,048	11,091	12,769	21,804	33,649
Venezuela	([2])	([2])	([2])	65	293	192
Total (estimate)	633,800	601,800	632,400	725,600	866,800	989,400

[1] In addition to countries listed asbestos is produced in Algeria, Bulgaria, Czechoslovakia, Uganda, and U. S. S. R. Estimates by authors of the chapter are included in total.
[2] Data not available; estimate by authors of the chapter included in total.
[3] Estimate.
[4] Exclusive of sand, gravel, and stone (waste rock only), production of which is reported as follows: 1943, 6,272 tons; 1944, 4,101 tons; 1945–48 data not available.
[5] January to September, inclusive.
[6] Includes asbestos flour.
[7] South Korea only.
[8] Less than 1 ton.

[6] Asbestos, Removal of Iron from Asbestos Fiber: Vol. 30, No. 6, December 1948, pp. 26–32.

CANADA

In 1948 the Canadian asbestos industry reached a new output record of 716,769 short tons valued at $42,231,475, an increase of 8 percent in tonnage over 1947. The block-caving method is coming into greater use. Seven companies that are not now producers are said to have been carrying on exploration and development work. It was reported that the United Asbestos Corp. has discovered a large deposit under Black Lake, and an aggressive drilling program is in progress. Indications are that the deposit contains 50,000,000 tons averaging 4½-percent asbestos.[7]

The Potash Co. of America optioned 25,000 acres held by the Reed estate and has started an exploration program. Another firm reported to be carrying on a diamond-drilling program is the Coleraine Asbestos Co.[8]

Sales of asbestos in Canada, 1947–48, by grades

[Quebec Department of Mines]

	1947			1948		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Grade:						
Crudes	958	$503,137	$525.20	977	$594,594	$608.59
Fibers	222,196	20,221,444	91.01	241,953	25,943,710	107.23
Shorts	438,667	12,281,167	28.00	473,839	15,693,171	33.12
	661,821	33,005,748	49.87	716,769	42,231,475	58.92
Rock mined	9,837,045			10,759,016		
Rock milled	7,740,828			7,894,461		

AFRICA

Southern Rhodesia.—During 1948 preparations for the reopening of the Croft mine were being made by Mashaba Rhodesian Asbestos Co. In the Belingwe area, Vanguard Asbestos Mines, which has absorbed claims previously held by the H. M. H. Syndicate, was making arrangements to mine a large deposit.[9] In the Mashaba district the Mangwana property was investigated and found to have promise as a possible source of shingle fiber.[10]

Southern Rhodesian asbestos is distributed to many countries. In 1947 the bulk, over 40 percent, went to the United Kingdom and 20 percent to the United States. Australia, India, and France followed in that order.[11]

[7] Northern Miner, United Asbestos Big Tonnage: Vol. 34, No. 33, Nov. 4, 1948, p. 4.
[8] Northern Miner, Asbestos Industry Hits New Peaks: Vol. 34, No. 28, Sept. 30, 1948, pp. 1–3.
[9] Mining Magazine (London), vol. 79, No. 2, February 1948, p. 93.
[10] Vanderburg, W. O., Opportunity for American Capital to Acquire Asbestos Property in Southern Rhodesia: U. S. Consular Rept. 284 (Pretoria, Union of South Africa), Dec. 10, 1948, p. 4.
[11] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 1, January 1948, p. 35.

Asbestos produced in Southern Rhodesia, 1943–48

Year	Short tons	Value	Year	Short tons	Value
1943	58,146	£1,673,025	1946	55,872	£1,676,503
1944	58,293	1,674,467	1947	54,094	1,738,484
1945	56,349	1,788,386	1948	68,897	2,604,623

Swaziland.—The asbestos produced in Swaziland is chrysotile mined at the Havelock mine by Turner & Newhall, Ltd. Both open-pit and underground mining methods are used.[12] Output in 1948 totaled 29,421 metric tons—almost equal to the record of 29,628 tons produced in 1944.

Union of South Africa.—Exploratory work by the Stoltzburg Asbestos Co., in the Eastern Transvaal, has revealed reserves of over 5,000,000 tons of ore ranging from 3 to 5 percent asbestos. The deposit is being prepared for mining by ring stoping or block caving. Expansion of the mill to bring capacity up to 350–400 tons of fiber per month was in progress.[13]

It is reported that a program for expanding amosite production capacity by at least 50 percent was started in 1948.

The principal grades of crocidolite and amosite as outlined by the Department of Mines of the Union of South Africa are as follows:[14]

			Length of fiber, in.
Cape blue:			
No. 3 or S			0 to 3/8.
2 or A			3/8 to 3/4.
1 or B			3/4 to 1 1/4.
Long or C, D, E			1 1/2 plus.
Transvaal blue:			
Crude:		Fiberized:	
TX		TDX	+1 1/2.
T1		TD1	−1 1/4 to +7/8.
T2		TD2	−7/8 to +1/2.
T3		TD3	−1/2 to +1/4.
T4		TD4	−1/4.

Amosite:	
Longs	3/4 in. and over.
Shorts	3/4 in. and less.
B1	Best long grayish-white fiber.
B3 and D3	Second-grade long fiber, varying in color from yellow to dark brown.
M	Uniform mixed shorts.
MD	Shorts of all grade.

		Length of fiber, in.
White amosite fiber:		
Crudes:	Fiberized:	
AL1	D1	+1 1/2.
AL2	D2	−1 1/2 to +3/4.
AL3	D3 or DD	−3/4 to +1/2.

[12] South African Mining and Engineering Journal, Asbestos: Progress and Prosperity: Vol. 59, No. 2894, July 31, 1948, pp. 627–629.
[13] South African Mining and Engineering Journal, Progress at Stoltzburg Mine: Vol. 59, Part 1, No. 2885, May 29, 1948, p. 396.
[14] Asbestos, Asbestos Grades in South Africa: Vol. 30, No. 6, December 1948. p. 16.

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Tan or brown fiber:

Crudes:	Fiberized:	*Length of fiber, in.*
B1	DB1	$+1\frac{1}{2}$.
B2	DB2	$-1\frac{1}{2}$ to $+\frac{3}{4}$.
B3	DB3	$-\frac{3}{4}$ to $+\frac{1}{2}$.
	DDB	$-\frac{1}{2}$.
	DDDB	Shorts for consumption in Union of South Africa.

Asbestos produced in and exported from the Union of South Africa, 1943–48 [1]

Year	Production (short tons)			Exports	
	Transvaal	Cape Province	Total	Short tons	Value
1943	27,768	7,888	35,656	35,940	£880,019
1944	26,747	7,835	34,582	28,174	672,941
1945	20,016	8,200	28,216	22,005	591,124
1946	12,636	7,589	20,225	21,481	557,008
1947	21,959	8,183	30,142	33,237	927,371
1948	37,434	8,301	45,735	38,550	1,138,792

[1] Data from Union of South Africa, Department of Mines, Quarterly Report.

Asbestos produced in the Union of South Africa, 1943–48, by varieties and sources, in short tons [1]

Variety and source	1943	1944	1945	1946	1947	1948
Amosite (Transvaal)	23,189	22,848	16,737	9,838	18,780	30,372
Chrysotile (Transvaal)	2,034	2,014	1,765	1,666	2,253	4,441
Blue (Transvaal)	2,456	1,831	1,471	1,102	896	2,608
Blue (Cape)	7,888	7,835	8,200	7,589	8,183	8,301
Anthophyllite (Transvaal)	89	54	43	30	30	13
Total	35,656	34,582	28,216	20,225	30,142	45,735

[1] Data from Union of South Africa, Department of Mines, Quarterly Report.

OTHER COUNTRIES

Australia.—Blue asbestos is being mined on a modest scale in the Wittenoom Gorge of the Hammersley Range in a remote section of Western Australia. The two asbestos seams are said to total 2 to 6 inches in thickness and are mined by the room-and-pillar method. The asbestos occurs in a hard, ferruginous quartzite. First about 48 inches of the quartzite is removed from above the asbestos, and then the bottom 24-inch section containing the two seams of cross-fiber crocidolite is mined. The mine is operated by Blue Asbestos, Ltd., a subsidiary of Colonial Sugar Recovery, Ltd. The product is used almost entirely in Australia itself. Output is now comparatively small, but capacity is being increased.[15]

Bolivia.—Bolivian crocidolite output is small, as it is somewhat lacking in strength; however, some interest in the fiber has developed, as it appears to serve satisfactorily as a filtering material.

Finland.—Finska Mineral Aktiebolaget produces about 6,000 tons of anthophyllite annually from surface mines at Paakkila in Northern

[15] Mining Magazine (London), Blue Asbestos Deposits in the Hammersley Range: Vol. 78, No. 4, April 1948, pp. 205–207.

Savolax and at Maljasalmi in Northern Karelia. The company also operates an asbestos-products plant in Helsinki, where most of its own asbestos as well as chrysotile from the Urals is used.[16]

France.—During 1948 a deposit of tremolitic asbestos near Chateau-Queyras, France, received considerable attention. It had been operated on a small scale in the past. The fiber is said to be of promising quality, and an attempt is being made to bring the deposit into commercial production.[17] In 1948 the Canari mine in Corsica was being developed for a projected production rate of 15 to 20 tons per day of chrysotile slip fiber.[18] A deposit of chrysotile is being operated on a small scale in French Morocco.

Italy.—Articles on the geology of Italian asbestos deposits were published during 1948.[19]

Switzerland.—Deposits of asbestos close to Alp Quadrada, near Poschiavo (Canton Grisons), Switzerland, are mined by Studiengesellschaft für Asbestgewinnung. The mine has been worked since 1942, producing 85.2 metric tons from 1942 to 1946. The product is considered to be of good quality for use in filters.[20]

U. S. S. R.—Russia exported 500 tons of raw asbestos to Norway in 1947.[21]

16 Asbestos, Finska Mineral Aktiebolaget: Vol. 30, No. 1, July 1948, pp. 12–13.
17 Ru Keyser, W. A., Asbestos at Chateau-Queyras, France: Asbestos, vol. 29, No. 10, April 1948, pp. 8–20.
18 Asbestos, The Canari Mine—Corsica: Vol. 30, No. 3, September 1948, pp. 20–21.
19 Asbestos, Geology of Italian Deposits: Vol. 29, No. 7, January 1948, pp. 16–24. Asbestos Deposit at San Vittore (Balangero), Italy: Vol. 29, No. 12, June 1948, pp. 16–24.
20 Bureau of Mines, Mineral Trade Notes: Vol. 27, No. 1, July 1948, p. 26.
21 Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 5, May 1948, p. 28.

Asphalt and Related Bitumens

By A. H. REDFIELD AND SARAH J. SPENCER

GENERAL SUMMARY

DOMESTIC demand [1] for petroleum asphalt was 6 percent higher in 1948 than in 1947, but export demand was 51 percent lower. However, export demand was only 3 percent of the total demand, domestic and foreign, so that the total demand increased 2 percent from 1947 to 1948. In numerical terms, an increase of 482,517 tons in domestic demand—offset in part by a decrease of 285,991 tons in export demand—was met by an increase of 478,517 tons in refinery production and by greater imports of petroleum and lake asphalt totaling 77,078 tons. As a result, stocks held at the refineries increased 342,912 tons during 1948 compared with a decrease of 16,364 tons (revised figure) during 1947.

NATIVE ASPHALT AND BITUMENS

Bituminous Rock.—Sales of bituminous rock by producers in the United States increased from 1,004,740 short tons valued at $3,756,074 in 1947 to 1,084,004 tons valued at $3,634,917 in 1948. Bituminous limestone totaled 747,934 tons valued at $1,947,038 in 1947 and 904,183 tons valued at $2,292,873 in 1948. Bituminous sandstone amounted to 256,806 tons valued at $1,809,036 in 1947 and 179,821 tons valued at $1,342,044 in 1948. Two companies in Texas and one in Alabama were responsible for the general gain in 1948 over 1947; in Kentucky, Missouri, Oklahoma, and Utah less rock asphalt was sold in 1948 than in 1947. Sales values per ton were generally larger in 1948 than in 1947; in Alabama, however, they were lower, and in Oklahoma they remained at the same level as in 1947.

Gilsonite.—Sales of gilsonite by producers in northeastern Utah decreased from 67,165 short tons valued at $1,746,228 in 1947 to 52,122 tons valued at $1,390,713 in 1948. However, the average sales value per ton at the mine or railhead increased from $26 in 1947 to $26.68 in 1948.

MANUFACTURED OR PETROLEUM ASPHALT

Production.—Petroleum refineries in the United States produced 9,439,800 short tons of asphalt in 1948, an increase of 5 percent over the 8,961,100 tons produced in 1947. The increase was greatest in the

[1] The term "domestic demand" as used in this chapter means apparent consumption, that is, production, plus net imports, and changes in refiners' stocks.

Indiana–Illinois–Kentucky, etc., district and in the East Coast district. California was the conspicuous exception to the general increase. Less asphalt was produced in the Appalachian and Louisiana Gulf Coast districts.

Stocks.—Stocks of asphalt held at refineries increased 50 percent—from 685,700 short tons (revised figure) on December 31, 1947, to 1,028,600 tons on December 31, 1948. The increase was general, but was greatest in the Indiana–Illinois–Kentucky, etc., district and the Oklahoma–Kansas–Missouri district.

Production, receipts, stocks, consumption, transfers, losses, exports, and domestic sales of asphalt (exclusive of road oil) at petroleum refineries in the United States in 1948, by districts, in short tons

District	Production	Receipts [1]	Stocks		Consumption by producers, transfers, losses, and exports	Sales to domestic consumers
			Jan. 1	Dec. 31		
East Coast	2,683,100	524,000	130,000	140,500	361,800	2,834,800
Appalachian	304,700	30,000	40,200	61,400	10,700	302,800
Indiana, Illinois, Kentucky, etc	1,811,300	251,600	112,700	220,200	312,200	1,643,200
Oklahoma, Kansas, and Missouri	943,500	25,900	102,000	193,300	132,900	745,200
Texas:						
Gulf Coast	532,700		19,700	52,400	141,100	358,900
Inland	458,400	6,000	33,300	48,400	62,100	387,200
Total Texas	991,100	6,000	53,000	100,800	203,200	746,100
Louisiana-Arkansas:						
Louisiana Gulf Coast	576,500		53,100	71,300	82,600	475,700
Arkansas and Inland Louisiana	541,800	99,500	57,600	68,000	55,700	575,200
Total Louisiana-Arkansas	1,118,300	99,500	110,700	139,300	138,300	1,050,900
Rocky Mountain	376,900	90,900	59,300	78,200	39,300	409,600
California	1,210,900	373,400	77,800	94,900	121,700	1,445,500
Total: 1948	9,439,800	1,401,300	685,700	1,028,600	1,320,100	9,178,100
1947	8,961,100	486,600	702,000	[2] 685,700	[2] 728,500	8,735,500

[1] Receipts from interindustry refinery transfers, addition of other petroleum products blended to make cut-back asphalts, imports, and transfers from stocks formerly not classified as asphalt.
[2] Revised figure.

Sales.—Sales of petroleum asphalt to domestic consumers increased 5 percent in quantity from 1947 to 1948 and, because of higher prices, 40 percent in value. The average sales value per short ton increased from $14.64 in 1947 to $19.48 in 1948.

Of the total sold, 26 percent was manufactured from foreign petroleum (imported chiefly from Venezuela, Colombia, and Mexico) in 1948, compared with 22 percent in 1947. Although runs of foreign crude to stills increased 28 percent from 1947 to 1948, sales of petroleum asphalt from this source increased only 25 percent. Of the foreign crude processed, 9 percent was converted into asphalt in 1947 and 10 percent in 1948. Ninety-nine percent of the asphalt made from foreign crude was manufactured in east coast refineries.

Highway and street construction and airport-runway surfacing (in the form of paving asphalt, paving flux, cut-back asphalts, and asphalt emulsions) used 62 percent of the total asphalt sold to domestic consumers by petroleum refineries in 1947 and 67 percent in 1948. Sales of all grades of asphalt devoted wholly or principally to street and road construction increased 14 percent in 1948 over 1947.

Sales of asphalt (exclusive of road oil) at petroleum refineries to domestic consumers in the United States, 1947–48, by districts

District	1947		1948	
	Short tons	Value	Short tons	Value
East Coast	2,437,172	$40,820,790	2,834,825	$60,541,034
Appalachian	406,410	6,610,856	302,791	5,809,936
Indiana, Illinois, Kentucky, etc	1,633,575	24,069,882	1,643,166	31,147,409
Oklahoma, Kansas, and Missouri	744,017	9,755,176	745,147	13,483,617
Texas:				
Gulf Coast	396,784	5,441,016	358,945	7,990,127
Inland	418,653	5,920,205	387,232	7,417,835
Total Texas	815,437	11,361,221	746,177	15,407,962
Louisiana-Arkansas:				
Louisiana Gulf Coast	520,111	7,446,403	475,697	9,375,389
Arkansas and Inland Louisiana	464,912	5,943,179	575,183	11,061,445
Total Louisiana-Arkansas	985,023	13,389,582	1,050,880	20,436,834
Rocky Mountain	367,761	4,805,649	409,638	7,458,092
California	1,346,091	17,056,300	1,445,497	24,503,430
Total United States	8,735,486	127,869,456	9,178,121	178,788,314

Asphalt and asphalt material (exclusive of road oil) sold at petroleum refineries to domestic consumers in the United States in 1948, by form and use

[Value f. o. b. refinery]

Form and use	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	1,988,477	$37,914,483	872,063	$18,419,705	2,860,540	$56,334,188
Roofing	1,051,833	20,103,125	593,538	12,103,382	1,645,371	32,206,507
Waterproofing	112,054	2,777,378	38,800	850,887	150,854	3,628,265
Blending with rubber	8,844	166,579	10,853	256,733	19,697	423,312
Briquetting	162,329	2,930,050	29,750	622,822	192,079	3,552,872
Mastic and mastic cake	4,321	100,435	1,085	24,106	5,406	124,541
Pipe coatings	35,160	825,494	2,895	72,380	38,055	897,874
Molding compounds	45,308	803,445	7,044	165,080	52,352	968,525
Miscellaneous uses	221,819	4,281,434	64,472	1,311,921	286,291	5,593,355
Total	3,630,145	69,902,423	1,620,500	33,827,016	5,250,645	103,729,439
Semisolid and liquid products of more than 200 penetration:						
Flux for—						
Paving	378,013	6,621,805	32,600	743,236	410,613	7,365,041
Roofing	918,556	13,501,514	47,165	900,783	965,721	14,402,297
Waterproofing	177	4,808	2,916	55,258	3,093	60,066
Mastic	5,179	101,725			5,179	101,725
Cut-back asphalts:						
Rapid-curing	759,679	16,130,310	398,672	8,854,470	1,158,351	24,984,780
Medium-curing	978,532	19,227,638	160,497	3,572,770	1,139,029	22,800,408
Emulsified asphalt and fluxes	43,699	836,906	81,061	2,139,210	124,760	2,976,116
Paints, enamels, japans, and lacquers	29,620	840,563	13,305	281,094	42,925	1,121,657
Other liquid products	77,805	1,246,785			77,805	1,246,785
Total	3,191,260	58,512,054	736,216	16,546,821	3,927,476	75,058,875
Grand total: 1948	6,821,405	128,414,477	2,356,716	50,373,837	9,178,121	178,788,314
1947	6,855,391	96,731,464	1,880,095	31,137,992	8,735,486	127,869,456

Sales of emulsified asphalt were higher in 1948 than in 1947. Petroleum refineries sold 55,408 short tons (13,055,205 gallons) valued at $876,070 in 1947 and 124,760 tons (29,395,889 gallons) valued at $2,976,116 in 1948. In addition, 86,242,707 gallons valued at $7,634,291 in 1947 and 102,815,746 gallons valued at $11,009,785 in 1948 were sold by major industrial companies that purchased asphalt from petrolum refineries and manufactured it into emulsions. Accordingly, total known sales of emulsified asphalts and fluxes increased 33 percent in quantity—from 99,297,912 gallons (421,433 tons) in 1947 to 132,211,635 gallons (561,137 tons) in 1948—and 64 percent in value—from $8,510,361 in 1947 to $13,985,901 in 1948.

Roofing manufacture made the second-largest demand for asphalt, absorbing 32 percent of the total sales of asphalt to domestic consumers in 1947 and 28 percent in 1948. Although sales of prepared roofing and asphalt siding reported to the Bureau of the Census decreased 15 percent—from 74,240,000 squares in 1947 to 63,219,000 squares in 1948—domestic sales of roofing asphalt and roofing flux combined decreased 8 percent—from 2,835,114 short tons in 1947 to 2,611,092 tons in 1948. These figures do not include roofing asphalt and flux consumed by the refining companies in factories making prepared roofing and siding, owned by themselves or by affiliated companies.

APPARENT CONSUMPTION

The period of high demand that had characterized 1940–47 continued into 1948. The apparent average monthly domestic consumption of petroleum asphalt (including small quantities of imported lake asphalt and grahamite) was increased 6 percent—from 719,432 short tons (revised figure) in 1947 to 759,667 tons in 1948. Total apparent consumption was 8,633,181 tons (revised figure) in 1947 and 9,115,698 tons in 1948.

DISTRIBUTION BY RAIL

Although the apparent domestic consumption of petroleum asphalt increased 6 percent from 1947 to 1948 and refinery sales to domestic consumers 5 percent, the tonnage of asphalt (natural, byproduct, and petroleum) terminated by class I railroads in the United States decreased 4 percent—from 7,063,978 short tons in 1947 to 6,764,934 tons in 1948, according to the Interstate Commerce Commission. It may be noted, however, that railroad terminations of asphalt were equivalent to only 82 percent of the total apparent consumption of asphalt in the United States in 1947 and 74 percent in 1948 and that considerable quantities of asphalt were delivered to consumers by water, minor railroads, and motor trucks. Accordingly, the figures in the accompanying table do not present a complete picture of the consumption of asphalt by States.

Of the total deliveries by rail, 54 percent in 1947 and 56 percent in 1948 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 were 2 percent lower in 1948 than in 1947. In the States lying south of the Potomac and Ohio, deliveries of asphalt were slightly less in 1948 than in 1947. Between the Mis-

Asphalt (natural, byproduct, and petroleum) terminated by class I railroads in the United States, 1947–48, by States, in short tons

[Interstate Commerce Commission, Freight Commodity Statistics]

Region and State	1947	1948	Region and State	1947	1948
New England	191,106	158,518	East South Central:		
Middle Atlantic:			Kentucky	128,606	114,345
New York	282,966	267,246	Tennessee	161,601	226,837
New Jersey	85,977	69,820	Alabama	109,068	72,378
Pennsylvania	765,607	804,884	Mississippi	58,373	45,044
Total	1,134,550	1,141,950	Total	457,648	458,604
East North Central:			West South Central:		
Ohio	1,067,766	1,055,879	Arkansas	88,461	74,505
Indiana	257,758	254,247	Louisiana	289,166	175,980
Illinois	643,710	613,008	Oklahoma	19,722	21,046
Michigan	248,239	237,597	Texas	187,621	152,351
Wisconsin	249,423	273,392	Total	584,970	423,882
Total	2,466,896	2,434,123	Mountain:		
West North Central:			Montana	16,981	29,819
Minnesota	213,669	194,411	Idaho	24,173	19,955
Iowa	76,739	83,647	Wyoming	10,122	10,585
Missouri	157,321	159,552	Colorado	82,359	81,211
North Dakota	32,491	42,754	New Mexico	44,460	58,443
South Dakota	50,603	61,744	Arizona	36,902	38,068
Nebraska	82,310	99,091	Utah	27,542	25,607
Kansas	92,698	90,988	Nevada	30,335	20,020
Total	705,831	732,187	Total	272,874	283,708
South Atlantic:			Pacific:		
Delaware	12,426	10,007	Washington	108,890	81,507
Maryland	19,710	18,842	Oregon	76,352	71,028
District of Columbia	519	1,069	California	395,739	322,063
Virginia	128,155	124,178			
West Virginia	101,602	114,448	Total	580,981	474,598
North Carolina	126,838	146,111			
South Carolina	76,060	86,875			
Georgia	88,534	85,798	Total United States	7,063,978	6,764,934
Florida	115,278	70,036	Canada	8,423	11,477
Total	669,122	657,364	Grand total	7,072,401	6,776,411

sissippi River and the Rocky Mountains, railroad terminations of asphalt were 10 percent less in 1948 than in 1947; declines in Texas and Louisiana were partly offset by increases in Iowa, Missouri, the Dakotas, and Nebraska. In the Rocky Mountain States receipts of asphalt by rail were 4 percent larger in 1948 than in 1947. In the three Pacific States rail deliveries of asphalt were 18 percent lower in 1948 than in 1947.

FOREIGN TRADE [2]

Imports.—Imports of natural asphalt and bitumen into the United States totaled 5,802 short tons valued at $242,526 in 1947 and 6,690 tons valued at $181,018 in 1948. Imports of lake asphalt from Trinidad increased from 3,291 tons valued at $73,017 in 1947 to 4,667 tons valued at $97,444 in 1948. Imports of grahamite from Cuba decreased from 466 tons valued at $11,364 in 1947 to 76 tons valued at $2,297 in 1948. Imports of 1,754 tons valued at $8,071 in 1947 and 1,833 tons valued at $13,754 in 1948 were ascribed to the Netherlands West Indies.

Imports of solid petroleum asphalt increased from 183,365 tons

[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

valued at $1,444,545 in 1947 to 247,176 tons valued at $1,898,767 in 1948. Virtually all of the 1947 and 1948 imports came from the Netherlands West Indies.

In addition, the United States received from the Netherlands West Indies 123,795 barrels (22,508 short tons) of liquid petroleum asphalt valued at $247,847 in 1947 and 191,880 barrels (34,887 tons) valued at $506,930 in 1948.

Exports.—The tonnage of natural asphalt, unmanufactured, exported from the United States decreased from 23,902 short tons valued at $1,065,386 in 1947 to 13,682 tons valued at $559,462 in 1948. Of the 1948 exports, 42 percent went to Europe, notably to the United Kingdom, Sweden, Belgium, and the Netherlands. Canada received 18 percent of the total and Mexico 23 percent.

Exports of petroleum asphalt from the United States dropped from 555,949 short tons valued at $14,207,963 in 1947 to 269,958 tons valued at $8,984,509 in 1948. The principal decreases were in exports to Europe and to Australasia. On the other hand, more asphalt was exported to Far Eastern countries of Asia, except Malaya and China.

Petroleum asphalt exported from the United States, 1946–48, by countries

[U. S. Department of Commerce]

Country	1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value
North America:						
British Honduras	580	$15,679	548	$21,525	866	$35,529
Canada	6,260	322,259	8,207	433,039	10,768	462,199
Canal Zone	151	3,086	290	7,635	364	11,599
Cuba	122	4,824	345	16,375	97	6,029
Dominican Republic	12	344	1,195	4,118	735	19,316
Guatemala	650	14,139	2,422	50,862	1,560	37,903
Honduras	56	1,137	217	7,373	681	30,910
Mexico	4,538	67,163	13,058	215,476	10,278	170,871
Newfoundland and Labrador	2,040	48,052	18	940	17	1,230
Nicaragua	158	4,595	206	5,786	614	36,107
Panama, Republic of	18	536	501	12,588	120	5,171
Other North America	586	11,894	622	16,780	319	11,382
Total North America	15,171	493,708	27,629	792,497	26,419	828,246
South America:						
Argentina	328	22,695	182	16,622	90	9,923
Bolivia			245	6,029	383	12,310
Brazil	4,419	113,598	23,119	687,875	5,741	200,922
Chile	5,267	144,421	4,534	135,622	588	18,821
Uruguay	3,610	109,220	2,592	79,472	5,697	193,222
Venezuela	146	4,472	141	4,361	894	38,748
Other South America	136	4,546	512	15,964	76	3,453
Total South America	13,906	398,952	31,325	945,945	13,469	477,399
Europe:						
Belgium and Luxembourg	12,726	355,402	18,326	455,191	5,545	203,122
Denmark	5,235	122,016	30	1,202	106	6,011
France	126,919	3,298,179	177,138	4,213,682	1,072	78,783
Finland	4,276	108,335	1,361	39,395	55	2,970
Greece	10	357	1	54	53,106	2,508,199
Italy	44,743	1,012,745	83,448	2,309,958	167	14,115
Netherlands	5,493	136,868	231	25,662	649	35,026
Norway	5,645	147,935	14,452	408,970	7,756	173,969
Portugal	5,790	162,782	28,387	866,803	12,084	377,141
Spain	24,660	602,738	25,160	550,762	2,474	96,201
Sweden	15,671	407,235	10,637	276,670	561	16,377
Switzerland	10,366	267,447	10,939	302,923	6,004	182,286
Other Europe	1,605	43,189	907	27,814	340	15,744
Total Europe	263,139	6,665,228	371,017	9,479,086	89,919	3,709,944

Petroleum asphalt exported from the United States, 1946–48, by countries—Con.

Country	1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value
Asia:						
Malaya, Federation of	204	$2,839	8,416	$206,996	5,135	$155,922
Ceylon	1,110	22,772	407	8,820	933	24,779
China	24,923	458,841	11,591	207,588	3,889	110,080
French Indochina	8,764	131,957	1,859	40,442	12,737	363,082
Hong Kong	2,709	49,011	672	18,470	3,529	115,310
India and Pakistan	671	19,512	12,627	292,188	2,718	92,853
Indonesia	2,381	58,562	15,838	424,138	29,910	831,716
Japan					1,645	56,192
Korea			5,704	148,400	18,959	554,675
Philippines, Republic of	18,621	446,779	10,649	226,211	24,976	594,975
Saudi Arabia	272	8,157	2,953	90,525	2,819	72,709
Thailand	841	11,937	519	11,232	1,604	58,343
Other Asia	341	9,868	276	8,667	265	10,765
Total Asia	60,837	1,220,235	71,511	1,683,677	109,119	3,041,401
Africa:						
Algeria	3,128	81,834	2,513	79,125		
Belgian Congo	224	6,464	110	6,335	256	12,421
French Morocco	209	12,723			959	76,208
French West Africa	2,268	68,420	1,260	47,272	4,419	189,737
Mozambique	1,278	20,938	2,389	47,591	5,460	125,926
Tunisia	4,470	107,886				
Union of South Africa	10,693	212,363	17,715	409,136	15,438	406,728
Other Africa	1,843	51,143	974	26,335	80	4,337
Total Africa	24,113	561,771	24,961	615,794	26,612	815,357
Oceania:						
Australia	7,869	167,785	14,014	359,985	2,011	59,546
New Zealand	10,885	200,175	15,372	327,938	2,409	52,616
Other Oceania			120	3,041		
Total Oceania	18,754	367,960	29,506	690,964	4,420	112,162
Grand total	395,920	9,707,854	555,949	14,207,963	269,958	8,984,509

ROAD OIL

Sales of road oil by petroleum refineries in the United States decreased 12 percent in quantity—from 6,958,000 barrels in 1947 to

Production, receipts, stocks, consumption, transfers, losses, exports, and domestic sales of road oil in the United States in 1948, by districts, in thousands of barrels

District	Production	Receipts [1]	Stocks		Consumption by producers, transfers, losses, and exports	Sales to domestic consumers
			Jan. 1	Dec. 31		
East Coast	174	130	26	32	105	193
Appalachian	7				7	
Indiana, Illinois, Kentucky, etc	1,913	187	21	72	149	1,900
Oklahoma, Kansas, and Missouri	511	428	13	7	26	919
Texas	76	48	6	3	21	106
Louisiana and Arkansas	17	8	3	6	14	8
Rocky Mountain	1,686	256	139	128	606	1,347
California	3,531		405	253	2,041	1,642
Total: 1948	7,915	1,057	613	501	2,969	6,115
1947	7,074	855	606	613	964	6,958

[1] Receipts from interindustry refinery transfers, imports, and transfers from stocks formerly not classed as road oil.

6,115,000 barrels in 1948—but increased 4 percent in value—from $17,235,000 in 1947 to $17,870,000 in 1948. The principal decrease was in California; it more than offset increases in the Indiana-Illinois-Kentucky, etc. district, and in the Rocky Mountain district. Four refining districts—Indiana-Illinois-Kentucky, etc., Oklahoma-Kansas-Missouri, Rocky Mountain, and California—together made 95 percent of all road-oil sales in 1948, compared with 96 percent in 1947.

Of the total sales of road oil to domestic consumers, 87,594 barrels valued at $243,545 in 1947 and 186,489 barrels valued at $698,172 in 1948 were made from foreign petroleum, imported chiefly from Venezuela, Colombia, and Mexico.

Road oil sold by petroleum refineries to domestic consumers in the United States, 1947–48, by districts

District	1947		1948	
	Thousand barrels	Thousand dollars	Thousand barrels	Thousand dollars
East Coast	56	167	193	725
Appalachian	7	21		
Indiana, Illinois, Kentucky, etc	1,519	6,480	1,900	5,670
Oklahoma, Kansas, and Missouri	952	1,916	919	2,459
Texas	176	409	106	363
Louisiana and Arkansas	6	15	8	25
Rocky Mountain	989	1,937	1,347	3,836
California	3,253	6,290	1,642	4,792
Total	6,958	17,235	6,115	17,870

Barite

By JOSEPH C. ARUNDALE AND F. M. BARSIGIAN

GENERAL SUMMARY

DOMESTIC mine production of 777,841 short tons of barite during 1948 was short of the record established in 1947, although well in excess of any other year on record, and the United States remained the world's leading producer of barite. Consumption of 894,309 short tons of barite was greater than during any previous year. Approximately 71 percent of the 799,848 short tons of primary barite [1] sold or used by producers was consumed by the well-drilling industry. Sales to all other major consuming industries declined, with the exception of a small increase in sales for rubber filler. Total imports of 53,204 short tons of barite represented no appreciable change from the level of 1947.

Salient statistics of the barite and barium-chemical industries in the United States, 1944–48

	1944	1945	1946	1947	1948
Barite:					
Primary:					
Produced..................short tons..	515, 136	692, 330	725, 223	884, 219	777, 841
Sold or used by producers:					
Short tons..........................	518, 617	696, 062	724, 362	834, 082	799, 848
Value................................	$3, 558, 489	$5, 348, 652	$5, 242, 755	$6, 171, 342	$6, 693, 413
Imports for consumption:					
Short tons..........................	67, 888	56, 894	44, 662	53, 222	53, 204
Value................................	$459, 664	$382, 611	$274, 267	$378, 294	$443, 515
Consumption.............short tons..	595, 563	720, 903	722, 073	835, 818	894, 309
Ground and crushed sold by producers: [1]					
Short tons..........................	344, 757	468, 939	455, 240	549, 965	631, 424
Value................................	$5, 455, 835	$7, 519, 759	$7, 208, 193	$8, 979, 400	$11, 195, 365
Barium chemicals sold by producers:					
Short tons..........................	73, 591	68, 084	80, 871	72, 919	71, 717
Value................................	$7, 740, 686	$6, 493, 448	$7, 003, 756	$7, 035, 104	$7, 028, 058
Lithopone sold or used by producers:					
Short tons..........................	142, 905	136, 161	147, 001	165, 024	140, 033
Value................................	$11, 208, 891	$10, 645, 316	$11, 840, 596	$17, 382, 592	$16, 135, 976

[1] Although all barite is crushed before use in chemicals, barite used in chemicals is not included in the 1945–48 totals for ground. In 1944 small quantities of crushed barite used by chemical producers are included.

Arkansas remained the principal producing State, with Missouri a close second. Georgia and Tennessee continued to feel the effects of competition from crude barite imported from Nova Scotia.

A sluggish demand for lithopone was reported during the latter part of the year.

[1] The term "primary barite," as used in this chapter, applies to barite as first offered to the trade, whether lump, crushed, or ground. 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.

On April 5, 1948, the Interstate Commerce Commission decided that the maintenance of lower rates on unground barite, not precipitated or refined by chemical process, than on the same commodity in ground form was not justified by transportation conditions. The Commission also found that the rates on ground barite from Malvern, Ark., and on ground and unground barite from Mineral Point, Mo., and Cartersville, Ga., to certain destination areas were unreasonable. New maximum reasonable rates on ground and unground barite were prescribed.[2]

DOMESTIC PRODUCTION

The reduced demand for barite from the lithopone, glass, and chemicals industries during the latter part of the year was a particular depressant to the Georgia and Tennessee producers, who for some time have experienced strong competition in these markets in the East from imports of barite from Nova Scotia. Georgia producers reported that operations at the end of the year had been greatly curtailed, and Tennessee production continued a rapid decline.

Barite production in the United States was reviewed.[3]

Ground (and crushed) barite produced and sold by producers in the United States, 1944–48 [1]

Year	Plants	Production (short tons)	Sales	
			Short tons	Value
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
1947	23	552, 227	549, 965	8, 979, 400
1948	23	630, 808	631, 424	11, 195, 365

[1] Barite used in chemicals, although crushed before use, is not included in 1945–48 totals. In 1944 small quantities of crushed barite used by chemical producers are included.

Arizona.—The Arizona Barite Co., which operates a mine and mill east of Mesa, Ariz., acquired a second property about 20 miles southwest of Aguila. Results of considerable development work at this new location are said to indicate that the deposit will prove large enough to justify installation of another mill. Present open-pit operations are producing approximately 50 tons of ore daily.[4]

Arkansas.—The Bureau of Mines issued a report describing 10 barite deposits in Arkansas.[5]

California.—Baroid Sales Division of National Lead Co. dismantled its Los Angeles grinding plant late in 1947 and transferred it to Merced, Calif., where crude barite from its various mines was ground during 1948 for use in drilling mud.

Idaho.—The Simplot Fertilizer Co. of Pocatello, Idaho, reported purchase of the Sun Valley Barite Co. Its barite deposit is near

[2] Report 270 I. C. C. 177, embracing No. 29224, Magnet Cove Barium Corp. v. Aberdeen & Rockfish Railroad Co. et al. and No. 29248, Thompson, Weinman & Co., Inc., v. Louisville & Nashville Railroad Co. et al. and No. 29250, Eversole-Maclay & Co. v. Aberdeen & Rockfish Railroad Co. et al.

[3] Harding, Albert C., Barite Production in the United States; Am. Inst. Min. and Met. Eng., Mining Technol., vol. 12, No. 4, July 1948, Tech. Pub. 2414, 6 pp.

[4] Mining World, vol. 10, No. 11, October 1948, p. 70.

[5] Jones, Thomas A., Barite Deposits in the Ouachita Mountains, Montgomery, Polk, and Pike Counties, Ark.: Bureau of Mines Rept. of Investigations 4348, 1948, 15 pp.

Domestic barite sold or used by producers in the United States, 1946–48, by States

State	1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value
Arkansas [1]	288, 286	$1, 844, 982	376, 017	$2, 390, 643	362, 470	$2, 899, 760
Georgia	69, 274	686, 583	61, 202	639, 865	62, 781	654, 959
Missouri	270, 850	2, 168, 067	291, 619	2, 405, 249	278, 071	2, 413, 802
Nevada	(2)	(2)	37, 388	261, 168	(2)	(2)
Tennessee	33, 595	272, 169	31, 476	285, 853	25, 818	275, 242
Other States [3]	62, 357	270, 954	36, 380	188, 564	70, 708	449, 650
Total	724, 362	5, 242, 755	834, 082	6, 171, 342	799, 848	6, 693, 413

[1] Value estimated.
[2] Included with "Other States."
[3] 1946 and 1948: Arizona, California, and Nevada; 1947: Arizona and California.

Hailey, Idaho, and the occurrence is such that the property is amenable to strip mining by benching. The barite as mined and shipped has a specific gravity of 4.05 to 4.15 and contains 84 to 88 percent barium sulfate. Although there was no production from this operation during 1948, a small tonnage produced during 1946–47 was in stock. (This previously unreported tonnage has been included with the 1948 production statistics.)

Missouri.—Barite deposits of central Missouri were described.[6] A new producer in Missouri, R. E. Wood, recovered barite from tailings from the lead-ore mill of the Fredericktown Lead Co. at Valles Mines. The Potosi Mining Co. discontinued operations at its mine near Potosi, Mo., during the latter part of 1947 and was idle during 1948.

Nevada.—Edwin L. Beck and partner mined and shipped barite from a deposit 25 miles south of Beowawe, Nev. The ore is trucked to Beowawe, from where it goes by train to the Yuba Milling Corp., Berkeley, Calif. Production was from an open-pit operation. Preparations are being made for mining two more deposits in the vicinity.[7] Baroid Sales Division of National Lead Co. reported the shut-down of its Sanders mine in Humboldt County, Nev.

New Mexico.—The Royal Flush Mining Co. prepared to develop by tunnel a barite-galena-fluorite ore deposit in the Hansonberg mining district of the Oscura Mountains in New Mexico. Owners are considering the possibilities of trucking the ore to the Blanchard Hanson mill at Hot Springs.[8] Mudrite Chemical Corp. reports that it is developing a barite property near Hatch, N. Mex., and expects to be in production during the first quarter of 1949.

North and South Carolina.—North Carolina and South Carolina State geologic departments are cooperating with the Tennessee Valley Authority in surveying the barite deposits in the vicinity of Kings Mountain, S. C.[9]

Tennessee.—The Tennessee Mining Co. discontinued operations at its mine near Del Rio, Tenn.

[6] Mather, W. B., Barite Deposits of Central Missouri: Am. Inst. Min. and Met. Eng., Mining Technol., vol. 11, No. 5, September 1947, Tech. Pub. 2246, 15 pp.
[7] Rock Products, vol. 51, No. 5, May 1948, p. 66.
[8] Engineering and Mining Journal, vol. 149, No. 6, June 1948, p. 132.
[9] Rock Products, vol. 51, No. 3, March 1948, p. 72.

Principal producers of barite in the United States in 1948

Name and address	Mine or mill location (nearest town)
ARIZONA	
Arizona Barite Co., Box 926, Mesa	Mesa.
ARKANSAS	
Baroid Sales Division, National Lead Co., 830 Ducommun St., Los Angeles 12, Calif.	Malvern.
Magnet Cove Barium Corp., Box 6504, Houston 5, Tex.	Do.
GEORGIA	
B. R. Cain Mining Co., Emerson	Cartersville.
New Riverside Ochre Co., Cartersville	Do.
Paga Mining Co., Cartersville	Do.
MISSOURI	
Apex Mining Co., Inc., Potosi	Mineral Point.
Baroid Sales Division, National Lead Co., 830 Ducommun St., Los Angeles 12, Calif.	Potosi.
Do	Richwoods.
Barite Mining Co., J. S. Detchemendy, Potosi	Potosi.
Barytes Mining Co., Potosi	Do.
Cadet Mining Co., Cadet	Mineral Point.
J. E. Carter Mining Co., Potosi	Do.
Wm. Craig Mining Co., Box 152, Cole Camp	Cole Camp.
Degonia & Cole Mining Co., Potosi	Cadet.
J. R. Dellinger, Potosi	Potosi.
De Soto Mining Co., De Soto	Richwoods.
H. & P. Mining Co., Potosi	Old Mines.
Fred Hornsey & Co., Potosi	Potosi.
A. H. Long, Cadet	Cadet.
Midwest Mining Co., 2001 Lynch Ave., East St. Louis, Ill.	Richwoods.
Reynolds & Dickey Mining Co., Potosi	Blackwell.
Lloyd Sestak, Henley	Henley.
Star Mining Co., Potosi	Old Mines.
Superior Mineral Co., Cadet	Cadet.
Do	Richwoods.
Terrace Mining Co., 450 Laurel St., St. Louis 12	Potosi.
Whaley & Scott Mining Co., Mineral Point	Old Mines.
R. E. Wood, Potosi	De Soto.
NEVADA	
California-Nevada Barytes Mines, Division of the Glidden Co., 766 50th Ave., Oakland, Calif.	Argenta.
Do	Tonopah.
Baroid Sales Division, National Lead Co., 830 Ducommun St., Los Angeles 12, Calif.	Dunphy.
Yuba Milling Co., 300 Montgomery St., San Francisco, Calif.	Beowawe.
TENNESSEE	
Clinchfield Sand & Feldspar Corp., 618 Mercantile Trust Bldg., Baltimore 2, Md.	Del Rio.
Dellinger & Duckett, Athens	Athens.
Sweetwater Mining Co., Sweetwater	Philadelphia.
B. C. Wood, Sweetwater	Sweetwater.
L. A. Wood, Sweetwater	Do.

CONSUMPTION, USES, AND STOCKS

The distribution of consumption of barite in the United States in 1948 was reported as follows (1947 in parentheses): For well drilling, 565,249 short tons (467,350); for lithopone, 153,987 (167,321); for chemicals, 100,038 (107,267); for glass, 23,580 (33,641); for paint filler, 22,000 (29,000); for rubber filler, 18,000 (17,000); and for other purposes, including grinding losses, 11,455 (14,239); total, 894,309 (835,818). These figures include both foreign and domestic barite. Consumption of barite during 1948 was the greatest on record. Since both sales by producers and consumption were greater than production, it is evident that a considerable tonnage was withdrawn from both producers' and consumers' stocks. Most of the increase in consumption was occasioned by increased activity in well drilling in which barite is used as a weighting agent in drilling muds. More and more wells are being drilled to increasingly greater depths. This use of barite was about 21 percent greater than in any previous year. Consumption of barite in lithopone was sharply reduced during the latter part of the year as the supply situation in titanium dioxide was eased [10] and that material was substituted more widely for lithopone as a pigment in paints.

Crude barite (domestic and imported) used in the manufacture of ground barite and barium chemicals in the United States, 1944–48, in short tons

Year	In manufacture of—			Total	Year	In manufacture of—			Total
	Ground barite [1]	Lithopone	Barium chemicals			Ground barite [1]	Lithopone	Barium chemicals	
1944	360,045	134,597	100,921	595,563	1947	561,230	167,321	107,267	835,818
1945	482,442	139,288	99,173	720,903	1948	640,284	153,987	100,038	894,309
1946	465,468	154,166	102,439	722,073					

[1] Includes some crushed barite.

Ground (and crushed) barite sold by producers, 1946–48, by consuming industries

Industry	1946		1947		1948	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Well drilling	372,610	82	467,350	85	565,249	90
Glass	29,181	6	33,641	6	23,580	4
Paint	26,000	6	29,000	5	22,000	3
Rubber	20,000	4	17,000	3	18,000	3
Undistributed	7,449	2	2,974	1	2,595	(1)
Total	455,240	100	549,965	100	631,424	100

[1] Less than 0.5 percent.

Lithopone sold or used by producers in the United States, 1944–48

	1944	1945	1946	1947	1948
Plants	8	8	8	8	8
Short tons	142,905	136,161	147,001	165,024	140,033
Value	$11,208,891	$10,645,316	$11,840,596	$17,382,592	$16,135,976

Lithopone sold or used by producers, 1946–48, by consuming industries

Industry	1946		1947		1948	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Paints, enamels, and lacquers	123,279	84	134,830	82	104,441	75
Floor coverings and textiles	15,167	10	17,469	10	20,859	15
Rubber	1,607	1	3,085	2	4,192	3
Other	6,948	5	9,640	6	10,541	7
Total	147,001	100	165,024	100	140,033	100

[10] Oil, Paint and Drug Reporter, vol. 154, No. 15, Oct. 11, 1948, p. 75.

Barium chemicals produced and used or sold by producers in the United States, 1944–48, 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]					
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
1947	15	173,385	172,987	248	15,888
1948	16	152,383	151,509	459	31,442
Carbonate (synthetic):					
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
1947	5	46,761	20,767	25,985	1,739,144
1948	5	43,227	16,588	27,482	1,927,599
Chloride (100 percent basis):					
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
1947	4	14,133	3,984	9,867	986,958
1948	4	14,244	4,432	8,998	964,311
Hydroxide:					
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
1947	4	5,774	568	4,910	787,711
1948	4	5,030	92	4,849	809,589
Nitrate:					
1944	3	11,160		11,333	2,066,976
1945	2	(5)		(5)	(5)
1946	1	(5)		(5)	(5)
1947	1	(5)		(5)	(5)
1948	2	(5)		(5)	(5)
Oxide:					
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
1947	3	7,318	6,865	378	74,320
1948	3	7,247	6,449	577	127,716
Sulfate (synthetic):					
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
1947	8	27,353	10,980	16,086	1,302,869
1948	7	22,733	(5)	(5)	(5)
Other barium chemicals: [6]					
1944	(7)	30,111	2,904	27,275	3,180,939
1945	(7)	36,428	4,405	27,727	3,529,401
1946	(7)	28,880	4,395	26,176	3,024,845
1947	(7)	21,107	4,092	15,445	2,128,214
1948	(7)	13,469	[8] 15,443	[8] 29,352	[8] 3,167,401
Total: [9]					
1944	22			73,591	7,740,686
1945	19			68,084	6,493,448
1946	19			80,871	7,003,756
1947	20			72,919	7,035,104
1948	20			71,717	7,028,058

[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 with "Other barium chemicals."
[6] Consists mostly of titanium dioxide-barium sulfate pigments, with small quantities of barium acetate, chromate, nitrate, perchlorate, peroxide, and sulfide. Specific chemicals may not be revealed by specific years.
[7] Plants included in above figures.
[8] Also includes barium sulfate (synthetic).
[9] A plant producing more than 1 product is counted but once in arriving at grand totals.

PRICES

Prices of crude barite, witherite, and most barium chemicals in 1948 remained practically unchanged from the previous year. Ground barite was moderately increased in value.

883326—50——12

Crude.—The December 30, 1948, issue of E&MJ Metal and Mineral Markets quoted the following prices for crude barite, f. o. b. mines: Georgia, crude, $11.50–$12.00 per long ton; Missouri, crude, minimum 94 percent $BaSO_4$, less than 1 percent iron, $9.50; 93 percent $BaSO_4$, $9.00–$9.25, f. o. b. mines.

Ground.—In December the price of water-ground barite in paper bags, carlots, St. Louis, was advanced to $35.05 a ton (an advance of $1.75 a ton), according to Oil, Paint and Drug Reporter. Well-drilling grades of ground barite averaged $16.80 a short ton, bulk, f. o. b. mine, according to reports of grinders to the Bureau of Mines.

Witherite.—Witherite (barium carbonate) showed no price increase and was quoted in 1948 at $65 per ton, air-floated, carlots; $73 on less than a carload.

Range of quotations on barium chemicals, 1946–48

[Oil, Paint and Drug Reporter]

	1946	1947	1948
Lithophone:			
Ordinary, bags, at New York ... pound	$0.04¼–$0.05	$0.05 –$0.06	$0.06 –$0.06⅜
Ordinary, barrels, at New York ... do	.04½– .05¼	.05¼– .06¼	(1)
Titanated, bags ... do	.056 – .06¾	.06¾– .07¾	.07¾– .08¼
Titanated, barrels ... do	.0585– .07¼	.07¼– .08	(1)
Barium carbonate, precipitated, bags, carlots, works ... short ton	60.00 –70.00	60.00 –75.00	67.50 –80.00
Barium chlorate, 112-pound kegs, works ... pound	.27½– .31	.25½– .31	.25½– .31
Barium chloride, technical, crystals, bags, carlots, works ... short ton	[2] 75.00	80.00 –85.00	85.00 –90.00
Barium peroxide, drums, carlots, works ... pound	.10	.10 – .11½	.11½– .12
Barium hydrate, crystals, bags, works ... do	[2] .06 – .07½	.08 – .09½	.09 – .09½
Barium nitrate, barrels, carlots, works ... do	.09½– .11½	.09½– .11½	.11½
Blanc fixe (dry):			
Direct process, bags, carlots, works ... short ton	70.00	70.00 –85.00	85.00
Byproduct, bags, carlots, works ... do	60.00	60.00 –72.50	72.50 –77.50

[1] Not quoted for entire year.
[2] For material in barrels.

FOREIGN TRADE[11]

Barite.—Imports of crude barite were at about the same rate in 1948 as the previous year. Canada continued to lead as a source of imports—principally to eastern lithopone and chemicals producers. Increased imports from Mexico went mostly to western and southwestern well drilling. For the first time since before World War II, Italy shipped a sizable tonnage to the United States.

A reduced import duty of $3.50 per ton of crude barite became effective January 1, 1948, as a result of the General Agreement on Tariffs and Trade, signed at Geneva October 30, 1947.

The Office of International Trade announced December 2 that, in view of the increased domestic supply of lithopone, no fixed export quotas were established for the fourth quarter of 1948. Accordingly, applications for licenses to export these commodities could be submitted to the OIT at any time during a calendar quarter.[12]

Following the announced intentions of the Government to negotiate trade agreements with 11 additional countries at Geneva in April 1949, hearings were held concurrently before the Tariff Commission

[11] Figures on imports and exports complied by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.
[12] Oil, Paint and Drug Reporter, vol. 154, No. 23, Dec. 6, 1948, p. 3.

and the Committee for Reciprocity Information. The hearings before the Tariff Commission were intended to develop the "peril point" below which tariffs cannot be reduced in the new agreements if injury to domestic industry is to be avoided. The CRI hearings were held to gather the views of industry on the possible effect of further cuts in duties on domestic industry.

Protests against any further reductions in tariffs on barite ore and barium products were heard from a number of industry representatives, They said that the present duty of $7.50 a ton on ground, white barite is not adequate to protect the domestic industry, and any further reduction would virtually turn the eastern market for this material over to the importers. The domestic product, they said, is undersold on the world market by as much as $20 a ton. Italy, it was stated, recently offered a small shipment in the United States at a price $7.54 under the domestic price; and, while it was of a lower grade than the domestic product, it could be used for paint pigments, inks, and certain other purposes for which the domestic product is sold.[13]

Barite imported for consumption in the United States, by countries, 1944–48

[U. S. Department of Commerce]

	1944		1945		1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Crude barite:										
Brazil	2	$25								
Canada	67,126	456,088	49,487	$327,242	44,109	$268,839	48,364	$355,349	39,877	$359,161
Cuba			2,307	29,417						
Italy							2	40	5,601	51,257
Mexico	760	3,551	5,100	25,952	553	5,428	4,856	22,905	7,726	33,097
Total crude barite	67,888	459,664	56,894	382,611	44,662	274,267	53,222	378,294	53,204	443,515
Ground barite:										
Canada	6,660	176,287	1	15						
Cuba	5,304	67,630								
Greece									(1)	11
Total ground barite	11,964	243,917	1	15					(1)	11

1 Less than 1 ton.

Witherite.—All imports of witherite came from Great Britain.

Witherite, crude, unground, imported for consumption in the United States, 1944–48 [1]

[U. S. Department of Commerce]

Year	Short tons	Value [2]	Year	Short tons	Value [2]
1945	896	$26,736	1947	739	$25,757
1946	1,107	31,599	1948	2,470	94,809

1 No transactions during 1944.
2 Valued at port of shipment.

13 Oil, Paint and Drug Reporter, vol. 154, No. 24, Dec. 13, 1948, p. 61.

Barium Chemicals.—Exports of lithopone were only slightly less than in the record year of 1941.

Lithopone exported from the United States, 1944–48

[U. S. Department of Commerce]

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1944	11,551	$1,107,430	$95.87	1947	13,652	$1,784,414	$130.71
1945	11,576	1,049,961	90.70	1948	21,015	2,972,912	141.47
1946	9,651	888,555	92.07				

Barium chemicals imported for consumption in the United States, 1944–48

[U. S. Department of Commerce]

Year	Lithopone		Barium nitrate		Barium hydroxide		Other barium compounds	
	Pounds	Value	Short tons	Value	Short tons	Value	Short tons	Value
1944					95	$7,382		
1945	75	$7			35	3,091		
1946	1,000	58						
1947	112	21	66	$9,511			6	$1,916
1948			141	17,492			11	3,771

TECHNOLOGY

The Bureau of Mines published a report on dressing barite ores from New Mexico, Missouri, and Arkansas.[14]

The Clinchfield Sand & Feldspar Co., Baltimore, Md., is making laboratory tests to develop processing methods for economical recovery of barite from low-grade deposits in the area of Kings Mountain, S. C., which previously yielded barite only by hand picking.[15] The company has a processing plant at Kings Creek, S. C., where ore from Tennessee is treated.

An article was published describing conversion of barite to barium carbonate by a process involving the solution of barite in fused sodium chloride, separation of insoluble impurities by settling and decantation, addition of sodium carbonate to the melt followed by slow cooling, and separation of the barium carbonate by leaching out the other salts. It is claimed that this procedure has the advantage over the preparation of barium carbonate from barium sulfide of yielding a barium carbonate free from objectionable sulfur compounds.[16]

An article was published describing the production of blanc fixe from barite by a process involving solution of barite in molten salt; separation of impurities by settling; decolorizing the traces of impuri-

[14] Fine, M. M., and Kennedy, J. S., Investigation of Ore-Dressing Methods for Barite Ores From New Mexico, Missouri, and Arkansas: Bureau of Mines Rept. of Investigations 4280, 1948, 31 pp.
[15] Rock Products, vol. 51, No. 3, March 1948, p. 73.
[16] Booth, Harold Simmons, and Pollard, Elisha Frederick, Reactions in Inert Fused Substances, Conversion of Barytes to Barium Carbonate: Ind. Eng. Chem., vol. 40, No. 10, October 1948, pp. 1983–1986.

ties left; quenching the melt in water; and washing, filtering, and drying the product.[17]

A report was published on German practice in the manufacture of barium compounds.[18]

WORLD REVIEW

Australia.—The treatment of barite from South Australian deposits is being undertaken by the Adelaide Chemical Co., Ltd., which is constructing a new plant at Port Adelaide for manufacture of barium sulfate, chloride, and carbonate.[19]

World production of barite, 1943–48, by countries, in metric tons [1]

[Compiled by Helen L. Hunt]

Country [1]	1943	1944	1945	1946	1947	1948
Algeria	2,988	1,340	2,880	14,240	23,692	16,681
Argentina	11,009	14,405	8,585	10,000	[2] 35,000	(3)
Australia	4,610	4,487	3,502	7,708	5,500	(3)
Austria	(3)	(3)	(3)	808	2,007	3,842
Belgium	170	300	----	(3)	----	(3)
Brazil	(3)	282	617	10,326	13,971	[2] 10,000
Canada	22,202	107,700	126,632	109,242	116,731	86,608
Chile	1,500	1,606	3,097	3,752	2,546	(3)
Colombia	(3)	(3)	(3)	(3)	[2] 2,800	120
Cuba (exports)	3,158	8,219	2,094	----	----	----
Egypt	76	59	54	----	167	----
France	18,290	9,575	13,795	34,570	50,275	(3)
Germany	373,672	[2] 330,000	(3)	[4] 45,736	[5] 35,000	[5] 41,000
Greece	----	----	----	----	[2] 20,000	18,706
India	9,002	15,545	25,051	29,558	24,700	[6] 15,425
Ireland	5,485	10,519	16,714	13,557	12,904	(3)
Italy	31,271	24,163	11,935	24,861	65,798	[2] 56,000
Japan	[7] 15,642	[7] 12,049	[7] 7,540	581	907	3,334
Korea	10,099	5,640	----	[8] 100	[2] 1,000	(3)
Palestine	----	----	23	3	(3)	(3)
Peru	----	2,352	4,240	(3)	[2] 7,000	(3)
Portugal	1	70	----	294	1,211	(3)
Southern Rhodesia	1,256	14	----	173	18	51
Spain	6,309	7,491	9,877	12,245	21,028	15,968
Swaziland	----	----	79	224	172	98
Sweden	----	----	1,250	505	1,319	(3)
Switzerland	268	233	----	----	----	----
Tunisia	72	76	68	408	470	230
Union of South Africa	2,740	3,201	2,222	2,326	2,672	1,734
United Kingdom [9]	102,736	100,422	94,711	112,705	96,267	(3)
United States	389,451	467,321	628,068	657,908	802,146	705,642
Total [10]	1,014,000	1,129,000	1,266,000	1,094,000	1,346,000	1,207,000

[1] In addition to countries listed, barite is produced in China, Czechoslovakia, Mexico, Norway, U. S. S. R., and Yugoslavia, but data on production are not available. (No production in French Indochina, 1943–48.)
[2] Estimate.
[3] Data not available; estimate by author of chapter included in total.
[4] Excludes British zone.
[5] Excludes British, French, and Soviet zones.
[6] Exports.
[7] Preliminary data for the fiscal year ended March 31 of year following that stated.
[8] South Korea only.
[9] Includes witherite.
[10] Estimated by author of chapter; excludes estimates for countries listed in footnotes 1, 4, and 5.

[17] Booth, Harold Simmons, Pollard, Elisha Frederick, and Rentschler, Mahlon Jacob, Reactions in Inert Fused Substances; Production of Blanc Fixe from Barytes: Ind. Eng. Chem., vol. 40, No. 10, October 1948, pp. 1981–1982.
[18] Nobis, Alfred, Manufacture of Barium Compounds: British Intelligence Objectives Subcommittee Rept. 1766, item 22, 1948, 4 pp.
[19] Echo des Mines et de la Métallurgie, No. 3397, June 1948, p. 123.

Canada.—Shipments of crude barite to the Cleveland area of the United States were expected to be started by Woodhall Mines, Ltd., in early 1948. The material will be produced from the company's 560-acre property in Langmuir Township of the Porcupine district. The company planned to erect a modern processing plant at Whitby, Ontario, during 1948 to process the ore being shipped out by rail from Connaught Station. The underground workings at the Langmuir property were being reopened, and development work at the two "open" ends of the 60-foot level was to be continued from where the operators left off. The No. 1 vein was exposed for 2,500 feet on the surface; an adit tunnel has already been driven 200 feet along that vein. In the summer of 1947, 1,200 tons of high-grade barite was stockpiled, but none was shipped out or exported. A successful financing program provided funds on hand considered enough to cover plans for development work and construction of the initial processing unit.[20]

Output of barite at the quarry at Walton, Nova Scotia, owned by Canadian Industrial Minerals, Ltd., totaling 131,190 short tons in 1947, was the largest in the history of the company. During 1947 a crosscut was driven at the 270-foot level of the shaft, and a raise was carried up to the quarry floor. Output by this method approximates 2,200 tons per week in addition to the regular open-cut production.

Investigations of the barite deposits on the east side of Lake Ainslie were discontinued temporarily in 1947 by the Provincial Department of Mines and were to have been resumed later, possibly in the fall of 1948. It is understood that the Department was concentrating on investigation of the fluorspar deposits and that therefore the equipment necessary to continue the barite investigation was not available.[21]

Diamond drilling was begun on what may be Nova Scotia's second replacement deposit of barite ore. The first is the Walton ore body brought into production several years ago by the Springer, Sturgeon subsidiary, Canadian Industrial Minerals, Ltd. With the exception of these two, all the other known occurrences of barite in Nova Scotia consist of irregular veinlets and fissure fillings.

Maritime Barytes, Ltd., holds property 7 miles east of the village of Brookfield. A geophysical survey was successful in tracing the favorable contact. The drilling is being done under the usual arrangement whereby the Nova Scotia Department of Mines provides the drills, the company paying the operating expense. The company controls a second barite deposit at Upper Brookfield in an outlier off the main contact. Diamond drilling here has indicated 50,000 tons of barite ore that can be mined cheaply by open-cut quarry methods. Plans are being considered to install a process of mechanical separation to bring this deposit into production as soon as possible.[22]

Germany.—It was reported that Sachtleben A.-G., Germany, has been granted permission to double production of lithopone in 1949 at its Homberg works. The plant will then be operating at more than 50 percent of capacity.[23]

[20] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 4, April 1948, p. 25.
[21] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 4, April 1948, p. 25.
[22] Northern Miner (Toronto), vol. 34, No. 14, June 24, 1948, pp. 17, 21.
[23] Oil, Paint and Drug Reporter, vol. 154, No. 15, Oct. 11, 1948, p. 75.

India.—A process for manufacturing barium chloride from barite and magnesium chloride has been developed at the university department of chemical technology, Bombay. The method involves roasting barite with wood charcoal, powdering the resulting mass, and heating the pulverized material with 46 to 47 percent magnesium chloride solution. The process, it is stated, yields a low-cost barium chloride suitable for the removal of sulfate impurities in brine. Sulfur is obtained as a byproduct. The commercial possibilities are being investigated.[24]

Large deposits of barite occur in Dhone taluk (Kurnool district), Pulidendla taluk (Cuddapah district), and Tadpatri taluk (Anatapur district). The mining methods are primitive. A Bombay firm recently erected pulverizers for powdering barite (300-mesh). Annual production is estimated at 20,000 to 30,000 tons.[25]

Indonesia.—Three occurrences of barite are known; however, the two in Java are so small that they are not considered to have value. A third deposit, in southwest Borneo, has not yet been fully explored but may be workable on a small scale.[26]

Union of South Africa.—Barite is mined by two producers in the Barberton district, Transvaal, and ground material in gray, midwhite, and superwhite can be supplied.[27]

United Kingdom.—Laporte Chemicals, Ltd., of Luton, announced that they expected to begin production of barium chloride near the end of 1948 in its plant being erected at the Barnsley works of its subsidiary, John Nicholson & Sons, Ltd. It was expected that this plant will be large enough to meet the home trade requirements, with perhaps a supply available for export. The closing down at the beginning of 1948 of this department of the Athole G. Allen Co. created a scarcity of barium chloride and increased dependence on continental supplies. Domestic barite is considered adequate to supply all foreseeable needs.[28]

The Bridford mine of the Devonshire Baryta Co. is producing barite, using jigs and tables for concentration. Elsewhere in the country. a number of small mines are also producing barite.[29]

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24 Chemical and Engineering News, vol. 26, No. 30, July 26, 1948, pp. 2220–2222.
25 Bureau of Mines, Mineral Trade Notes: Vol. 27, No. 2, August 1948, p. 22.
26 Bureau of Mines, Mineral Trade Notes: Vol. 27, No. 1, July 1948, p. 26.
27 Bureau of Mines, Mineral Trade Notes: Vol. 27, No. 3, September 1948, pp. 29–30.
28 Chemical Age (London), vol. 59, No. 1529, Oct. 30, 1948, p. 592.
29 Mining World, vol. 10, No. 11, October 1948, p. 49.

Bauxite

By RICHARD H. MOTE AND HORACE F. KURTZ

GENERAL SUMMARY

DOMESTIC mine production of crude bauxite increased for the third consecutive year in 1948 and totaled 1,724,437 long tons (1,457,148 tons, dried equivalent), a gain of nearly 21 percent over the 1947 output. Mines in Arkansas supplied 96 percent of the 1948 total.

Imports of bauxite in 1948 surpassed the previous record established in 1947, increasing 37 percent to 2,488,915 tons. Receipts from Surinam constituted 82 percent of the total in 1948, compared with 91 percent the preceding year. Exports of bauxite and concentrates, chiefly to Canada, decreased for the fifth successive year and totaled 54,113 tons.

Bauxite consumption in the United States totaled 2,725,140 tons (dried equivalent), 6 percent higher than the 2,564,442 tons used in 1947. Of the total for 1948, about 84 percent was consumed at alumina plants.

Salient statistics of the bauxite industry in the United States, 1939–43 (average), and 1944–48

	1939–43 (average)	1944	1945	1946	1947	1948
Crude ore production (dried equivalent) long tons	2,117,296	2,823,724	981,009	1,104,054	1,202,055	1,457,148
Value of production	\$10,447,407	\$14,402,497	\$5,591,084	\$6,892,864	\$6,884,666	\$8,696,708
Imports (as shipped) long tons	939,670	560,461	739,581	852,005	1,821,580	2,488,915
Exports (as shipped) do	189,216	146,638	126,077	97,788	94,369	54,113
World production (as shipped) long tons	7,348,000	7,028,000	3,525,000	4,493,000	6,385,000	8,116,000

Stocks of bauxite at mines and processing plants were 568,075 tons (dried equivalent) on December 31, 1948, an increase of 15 percent over inventories at the close of 1947; consumers' stocks totaled 669,698 tons, compared with 446,434 tons at the end of 1947. The War Assets Administration stock pile in Arkansas remained unchanged at 2,785,527 tons throughout 1948. Bauxite stocks in the National Strategic Stock Pile were not disclosed.

World production of bauxite in 1948 was estimated at 8,116,000 long tons, or 27 percent above the 1947 output. The United States and the Guianas, collectively, mined two-thirds of the world total.

Aluminum metal is discussed in the Aluminum chapter of this volume.

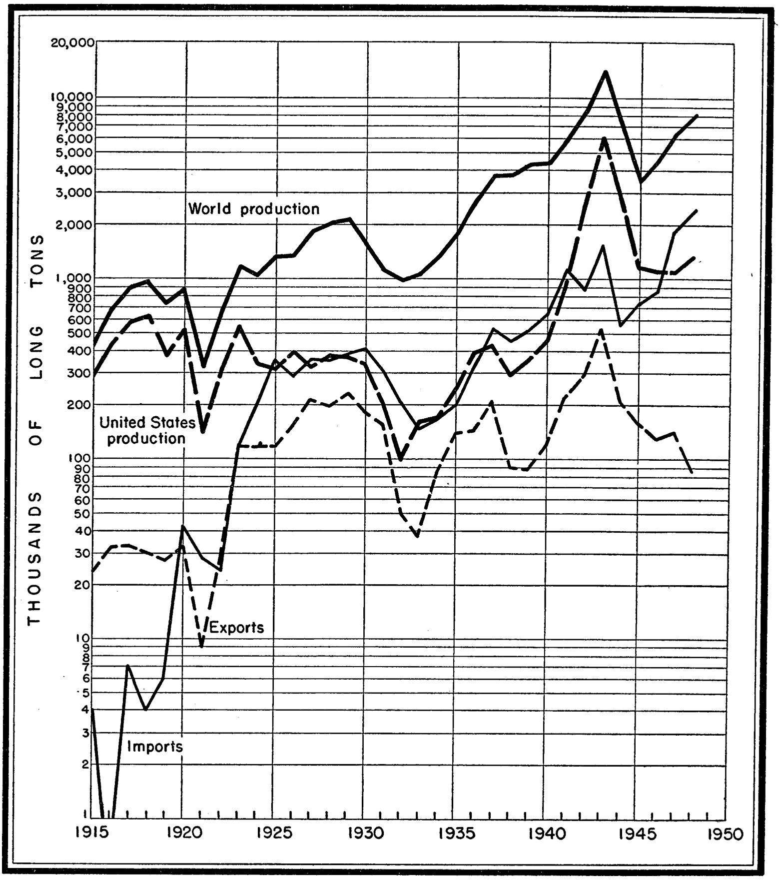

FIGURE 1.—Trends in domestic production, imports, exports, and world production of bauxite, 1915–48.

RESERVES

In 1944 the Bureau of Mines and the Geological Survey estimated [1] reserves of domestic bauxite at 36,341,000 long tons. This figure included all deposits (measured or indicated) 8 feet or more in thickness in which the material did not exceed 15 percent SiO_2 or 6 percent FeO but did contain at least 40 percent Al_2O_3 recoverable bauxite on a mined and dried basis. These limits of analysis were the theoretical extremes for bauxite to be used in the production of alumina by wartime modifications of the Bayer process. Although no revisions of the original estimate have been made, deduction of the quantity mined during the past 4 years reduced the total domestic reserves to about 31,600,000 tons.

Construction of improved alumina plants did not appear forthcoming at the end of 1948; however, the existing plant at Hurricane

[1] Investigation of National Resources, Hearings before a Subcommittee of the Committee on Public Lands, United States Senate, 80th Cong., 1st sess., 1947, pp. 217–224.

Creek, Ark., is capable of processing bauxite of greater than 6 percent FeO content, and this fact may permit a considerable increase in the reserve figure. Larger tonnages of low-grade ore await the development of improved methods of concentration and purification, but it seems unlikely that extensive additional deposits of high-grade bauxite, economically recoverable by existing mining methods, remain in the United States. A deposit[2] of high-silica bauxite was discovered in Clackamas County, Oreg., in 1948 and shows possibilities of being usable for purposes other than alumina.

PRODUCTION

Domestic mine production of crude bauxite in 1948 increased for the third successive year of the postwar period, despite greater imports of foreign ore. The gain of 21 percent over 1947 to 1,724,437 long tons (1,457,148 tons, dried equivalent) was due largely to the rising peacetime demand for aluminum. The output of bauxite from mines in Alabama, Arkansas, and Georgia increased 21, 21, and 34 percent, respectively. Virginia mines remained idle throughout 1948.

Alabama.—The Alcoa Mining Co. and the D. M. Wilson Bauxite Co. operated mines in the Eufaula district, Barbour and Henry Counties, and produced Alabama's entire output. The Alcoa Mining Co. also operated a drying plant nearby, from which dried bauxite was shipped chiefly to the chemical and refractory industries. Alabama bauxite ore processed in the activating plant of the Floridin Co., Quincy, Fla., was shipped to petroleum-refining industries.

Production and shipments of crude bauxite from mines in the United States, 1944–48, by States, in long tons

State and year	Production			Shipments to processing plants, consumers, and Government stock piles		
	Crude	Dried bauxite equivalent	Value [1]	Crude	Dried bauxite equivalent	Value
Alabama, Georgia, and Virginia:						
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
1947	58, 418	48, 492	301, 128	58, 418	48, 492	301, 128
1948	74, 511	61, 807	397, 222	74, 511	61, 807	397, 222
Arkansas:						
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, 288, 764	1, 050, 347	6, 578, 270	1, 282, 099	1, 044, 939	6, 546, 469
1947	1, 368, 693	1, 153, 563	6, 583, 538	1, 340, 988	1, 032, 035	6, 438, 697
1948	1, 649, 926	1, 395, 341	8, 299. 486	1, 532, 697	1, 295, 693	7, 761, 679
Total United States:						
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, 353, 135	1, 104, 054	6, 892, 864	1, 347, 125	1, 099, 145	6, 864, 985
1947	1, 427, 111	1, 202, 055	6, 884, 666	1, 399, 406	1, 080, 527	6, 739, 825
1948	1, 724, 437	1, 457, 148	8, 696, 708	1, 607, 208	1, 357, 500	8, 158, 901

[1] Computed from the selling price of bauxite shippedf rom the mines.

[2] Mining and Industrial News, New Bauxite Discovery: Vol. 16, No. 10, October 1948, pp. 15, 21.

Bauxite shipped from mines and processing plants in the United States, 1944–48, 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
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
1947	50,024	51,291	1,186,726	1,108,932	1,236,750	1,160,223
1948	59,520	59,474	1,430,688	1,314,069	1,490,208	1,373,543

[1] Includes crude, dried, calcined, activated, and sintered.

Arkansas.—The Alcoa Mining Co. continued operations at its mines in the vicinity of Bauxite, Saline County, and at the Drury mines near Sweet Home, Pulaski County, increasing production slightly over 1947 in both localities. Bauxite from the mines in Saline County was processed at the drying and calcining plant near Bauxite and shipped mostly to alumina plants, although smaller tonnages went to chemical, abrasive, and other industries. On June 1, 1948, the Alcoa Mining Co. began operating the Drury calcining plant of its affiliate, the Aluminim Ore Co. This plant, which serves the Drury mines, shipped dried and calcined bauxite to chemical, abrasive, and alumina plants during the year.

The American Cyanamid Co. worked two mines in the Berger district, Pulaski County, in 1948. Output from the Rauch Leased mine was reduced from the previous year, but the Berry-Mayhan mine was put into operation, so that total production for this company increased about 30 percent. Ore from these two mines and a portion of the inventory at the idle Heckler mine went to the company drying plant near Berger. Total shipments of dried bauxite, all destined for the chemical and oil-refining industries, were less than in 1947.

Consolidated Chemical Industries, Inc., resumed mining low-silica bauxite at its Bierman Tract operation, Pulaski County, in 1948. All of the mine shipments were treated at the Peiser Spur concentrating plant in Little Rock and later consumed in the alumina industry.

Although output totaled less than in the preceding year, the Crouch Mining Co. continued to produce high-grade ore from its Young mine, Saline County, throughout 1948. The company calcining plant, in the vicinity of Bauxite, served the mine, and the calcined ore was sold entirely for use in the abrasive industry.

In 1948, the Dulin Bauxite Co. produced considerably more ore from its mines in Pulaski County than in 1947. After extraction, the bauxite is either shipped directly to consumers or other processors or sent to the company calcining plant near Sweet Home. The ore is calcined mainly for abrasive manufacture.

The Norton Co. did not operate the Norton mine, Saline County, during 1948, but purchased ore from another company for calcining at its plant near Bauxite. The entire plant output, used for the production of abrasives, was less than half the 1947 total.

The Porocel Corp. operated its milling, activating, and purifying plant at Berger, Pulaski County, during 1948, treating a slightly smaller quantity of bauxite than in 1947. The Porocel plant for impregnating activated bauxite with chemicals remained idle. Crude ore was purchased from local producers; the finished product was shipped to oil-refining and chemical plants.

Operations ceased at the Rummel mine of the Pulaski Mining Co., in Pulaski County, during the second quarter of 1948. Output for the year was about one-tenth of the 1947 total. Since closing, the Rummel property has been sold to the Reynolds Mining Corp.

The Reynolds Mining Corp. continued to operate its underground and open-pit mines in Saline and Pulaski Counties during 1948. The company increased output by about one-third of the 1947 total and remained the largest producer of domestic bauxite. All of the ore was sold to the parent Reynolds Metals Co. for use at the Hurricane Creek alumina plant.

A description of the activities and results of bauxite investigations by the Bureau of Mines at its project in Saline and Pulaski Counties, together with data and maps showing the location of holes drilled and the deposits developed, has been published in a series of reports.[3]

Georgia.—The American Cyanamid Co. mined high-silica bauxite from its Hatton and Thigpen mines in the Andersonville district, Sumpter County, increasing production over 1947. All the ore was dried in the adjacent oil-fired standard-rotary-drying plant and shipped to the chemical industry. The Alcoa Mining Co. did not operate any of its Georgia mines in 1948.

Virginia.—The mines near Spottswood, Augusta County, owned by the Alcoa Mining Co., remained idle throughout 1948.

Recovery of processed bauxite in the United States, 1944–48, in long tons

Year	Crude ore treated	Processed bauxite recovered			
		Dried	Activated, calcined, or sintered	Total	Dried bauxite equivalent
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
1947	655,702	410,727	102,320	513,047	564,829
1948	688,898	476,921	68,800	545,721	584,856

3 Malamphy, M. C., Dale, G. K., Romslo, T. M., Reed Jr., A. H., and Ollar, A., Investigation of Arkansas Bauxite: Bureau of Mines Rept. of Investigations 4251–4268, 1948, 18 vols.

Bauxite shipped from mines and processing plants in the United States, 1945–48, by consuming industries, in long tons

Industry	1945		1946		1947		1948	
	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]	816,776	760,782	872,311	732,972	1,032,161	907,852	1,297,617	1,149,070
Chemical	98,664	97,029	109,496	109,153	91,728	91,343	102,943	102,943
Abrasive[3]	117,493	174,338	98,670	146,868	86,265	129,126	54,187	82,677
Petroleum refining, refractory,[3] and other	33,078	39,645	21,153	29,781	26,596	31,902	35,461	38,853
Total:								
Long tons	1,066,011	1,071,794	1,101,630	1,018,774	1,236,750	1,160,223	1,490,208	1,373,543
Value	$7,386,337		$7,725,939		$8,473,704		$9,963,032	

[1] Includes crude, dried, calcined, activated, and sintered.
[2] Includes shipments to Office of Metals Reserve stock piles as follows: 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 with "Abrasive."

CONSUMPTION AND USES

Bauxite consumption totaled 2,725,140 long tons (dried equivalent) in 1948, a gain of more than 6 percent over 1947. 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 use. Consumption of bauxite on an as-shipped basis totaled 2,743,053 tons, consisting of 748,906 tons of crude ore, 1,835,569 tons of dried ore, 151,319 tons of calcined ore, and 7,259 tons of activated ore. Of that consumed (dried-equivalent basis) in 1948, 45 percent was domestic ore and 55 percent foreign. The alumina industry used 78 percent of the domestic ore and 88 percent of the foreign ore consumed during 1948.

Bauxite consumed in the United States, 1947–48, by industries, in long tons

[Dried-bauxite equivalent]

Industry	1947			1948		
	Domestic	Foreign	Total	Domestic	Foreign	Total
Alumina[1]	869,796	1,258,135	2,127,931	965,081	1,314,042	2,279,123
Chemical	104,038	41,094	145,132	115,264	42,613	157,877
Abrasive and refractory	[2] 204,781	[2] 54,478	[2] 259,259	125,030	122,277	247,307
Other	[2] 22,576	[2] 9,544	[2] 32,120	26,334	14,499	40,833
Total	1,201,191	1,363,251	2,564,442	1,231,709	1,493,431	2,725,140

[1] Includes some bauxite used in making chemicals and other products.
[2] Revised figure.

Alumina.—The alumina industry used domestic and foreign crude and dried bauxite, principally from Arkansas, Surinam, Indonesia, and British Guiana. Of the total bauxite consumed in the United States in 1948, alumina plants used 84 percent compared with 83 percent in 1947. Although most of the bauxite consumed by the alumina industry is destined to emerge finally as aluminum metal, some of the alumina is used by the chemical, abrasive, and refractory industries, and some is processed into special products, such as activated and tabular aluminas, for use in the oil-refining and ceramic industries.

Chemical.—Producers of aluminum salts increased their consumption of bauxite by 9 percent in 1948. Of the other aluminum-bearing materials used in the manufacture of aluminum salts, producers reported consuming 13,923 short tons of aluminum trihydrate, 4,324 tons of secondary aluminum, 79,871 tons of clay, and a small quantity of bichromate residues. Consumption of bauxite for the production of nonmetallurgical alumina is included with the figures for alumina in the preceding paragraph and table.

Gains in production and shipments of aluminum sulfate were sufficiently large in 1948 to effect substantial increases in the totals for aluminum salts. Although the same number of companies shipped aluminum salts in 1948, the value of shipments was 13 percent greater. Output of alumina for purposes other than aluminum production gained slightly, but shipments to consumers were 24 percent less.

Aluminum salts and alumina produced and shipped in the United States, 1947–48

	1947				1948			
	Production (short tons)	Shipments			Production (short tons)	Shipments		
		Shippers	Short tons	Value		Shippers	Short tons	Value
Aluminum salts:								
Alum:								
Ammonia	5,007	5	5,299	$393,839	5,768	4	5,931	$417,992
Potash	3,782	4	3,633	304,098	2,744	3	3,334	250,436
Aluminum chloride:								
Liquid	6,862	4	6,643	263,384	9,553	5	9,439	425,234
Crystal	18,268	2	18,079	3,045,440	17,403	1	17,528	2,923,057
Anhydrous		6				5		
Aluminum sulfate:								
Commercial:								
General	595,612	17	582,222	13,469,279	648,480	14	646,022	15,521,015
Municipal	10,755	8	10,671	162,595	14,829	8	14,891	318,055
Iron-free	24,371	8	24,419	985,489	25,193	6	24,404	1,081,452
Sodium aluminum sulfate	25,538	2	24,103	1,829,971	26,154	2	25,972	2,210,050
Sodium aluminate		8				10		
Total aluminum salts	690,195	[1] 37	675,069	20,454,095	750,124	[1] 37	747,521	23,147,291
Alumina [2]	78,238	7	79,292	6,774,282	82,512	7	60,080	5,605,013

[1] A company shipping more than 1 kind of salt is counted but once in arriving at total.
[2] Excludes alumina produced for use in making aluminum; includes activated, calcined, and crude alumina and light and heavy hydrate, converted to a calcined-alumina equivalent.

Abrasive and Refractory.—Consumption of bauxite by the manufacturers of abrasive pigs in Canada and the United States and the manufacturers of refractories in the United States declined 5 percent in 1948. The most notable change in the consumption pattern of these industries was the increased use of foreign bauxite.

Other.—Bauxite consumption in the cement, steel, ferro-alloy, and petroleum-refining industries increased 27 percent during 1948.

STOCKS

Total stocks of bauxite on hand December 31, 1948, increased 8 percent over inventories at the beginning of the year. Stocks at mines and processing plants totaled 568,075 long tons (dried equivalent) compared with 492,798 tons at the end of 1947. Consumers' plants had 669,698 tons on hand December 31, 1948, a gain of 50 percent during the year. The large Government-owned (War Assets Administration) stock pile of medium-grade bauxite in Arkansas, on which the Reynolds Metals Co., as operators of the Hurricane Creek plant, held option to purchase if needed, remained unchanged at 2,785,527 tons throughout 1948. All stock figures mentioned in this chapter exclude bauxite held by the Bureau of Federal Supply for the National Strategic Stock Pile.

Stocks of bauxite on hand December 31, 1944–48, in long tons

Year	Producers, crude	Processors		Consumers		Government, crude	Total	
		Crude	Processed [1]	Crude	Processed [1]		Crude and processed	Dried bauxite equivalent
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	350, 565	196, 599	9, 853	62, 442	181, 708	[2] 3, 277, 090	[2] 4, 078, 257	[2] 3, 516, 901
1947	378, 068	182, 899	11, 497	35, 983	[3] 399, 224	[2] 3, 277, 090	[2,3] 4, 284, 761	[2] 3, 724, 759
1948	495, 297	159, 304	7, 441	57, 191	590, 124	[2] 3, 277, 090	[2] 4, 586, 447	[2] 4, 023, 300

[1] Dried, calcined, activated, and sintered.
[2] Excludes stocks in the National Strategic Stock Pile.
[3] Revised figure.

PRICES

In 1948 the average selling price, f. o. b. mines and processing plants, was \$5.08 a long ton for crude (undried) bauxite, \$7.50 for crushed dried bauxite, \$14.90 for calcined bauxite, and \$57.93 for activated bauxite. Corresponding prices in 1947 were as follows: \$4.82 for crude, \$7.67 for dried, \$15.99 for calcined, and \$55.30 for activated. The weighted average price for all grades of domestic ore as shipped to consumers was \$6.69 a long ton in 1948 (\$6.85 in 1947). The following nominal market quotations were changed during 1948: Domestic ore, chemical, crushed and dried, 55 to 58 percent Al_2O_3, 1.5 to 2.5 percent Fe_2O_3, \$7.50 to \$8.50 a long ton f. o. b. Alabama and Arkansas mines; other grades, 56 to 59 percent Al_2O_3, 5 to 8 percent SiO_2, \$7.50 to \$8.50 f. o. b. Arkansas mines; and abrasive grade, crushed and calcined, 80 to 84 percent Al_2O_3, \$16 f. o. b. Arkansas mines. Prices quoted at the close of the year were \$8 to \$8.50 for chemical, crushed and dried, \$8 to \$8.50 for other grades, and \$17 for abrasive grade, crushed and calcined. Quotations on foreign bauxite have not been published in domestic trade journals since February 1941.

FOREIGN TRADE [4]

Imports of bauxite in 1948 established an all-time record. The gain of 37 percent over 1947 receipts marked the fourth year of uninterrupted increase. Of the ore imported in 1948, 2,051,265 long tons came from Surinam, 302,079 tons from Indonesia, 114,764 tons from British Guiana, 16,178 tons from Brazil, 4,623 tons from Trinidad and Tobago, and 6 tons from three other countries. By customs districts, 1,390,388 tons were received at Mobile, 1,018,730 at New Orleans, 25,139 at Philadelphia, 18,135 at Maryland, 12,340 at Massachusetts, 10,903 at New York, 5,582 at Georgia, 4,205 at San Francisco, 3,487 at Sabine, and 6 at two other districts. The duty on bauxite remained unchanged at 50 cents a long ton throughout the year.

Bauxite and aluminum compounds imported into the United States, 1944–48

[U. S. Department of Commerce]

Year	Bauxite			Alumina		Aluminum compounds	
	As imported (long tons)	Dried bauxite equivalent [1] (long tons)	Value	Long tons	Value	Short tons	Value
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
1947	1,821,580	1,842,176	11,869,631			80	2,348
1948	2,488,915	2,558,037	15,820,743	6	3,547	5,559	124,167

[1] Calculated by Bureau of Mines. [2] Less than 1 ton.

Exports of bauxite and bauxite concentrates declined for the fifth successive year, totaling 43 percent less than in 1947. Of the 1948 exports, 46,220 tons were classified as bauxite and other aluminous ores and 7,893 tons as bauxite concentrates (including alumina). Virtually all the bauxite shipments went to Canada to be used in the production of crude abrasives, which are returned to the United States for final manufacture and consumption. Canada also received about 90 percent of the bauxite concentrates exported.

Bauxite and aluminum compounds exported from the United States, 1944–48

[U. S. Department of Commerce]

Year	Bauxite (including bauxite concentrates), long tons			Aluminum sulfate		Other aluminum compounds	
	As exported	Dried bauxite equivalent [1]	Value	Short tons	Value	Short tons	Value
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
1947	94,369	141,235	1,888,040	23,389	706,572	3,753	738,374
1948	54,113	86,284	1,202,036	14,342	467,622	3,539	599,210

[1] Calculated by Bureau of Mines.

[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.

WORLD REVIEW

The total world output of bauxite in 1948 was estimated to have increased 27 percent over 1947. Expanded production in British Guiana, Indonesia, Surinam, and the United States contributed most to the over-all gain. Two regions in the Western Hemisphere, comprising three Southern States in the United States and two of the Guianas, mined 67 percent of the 1947 and 1948 totals.

World production of bauxite, by countries, in metric tons, 1941–48 [1]

[Compiled by Pauline Roberts]

Country [1]	1941	1942	1943	1944	1945	1946	1947	1948
Australia:								
New South Wales	2,671	1,832	734	2,025	1,700	1,438	2,401	(2)
Victoria	2,793	1,655	1,855	1,842	1,792	2,351	2,555	1,969
Austria	879	554	24	18,812	8,756	------	(2)	5,324
Brazil	14,365	29,890	[3] 93,000	[3] 19,000	[3] 23,000	[3] 17,000	[3] 17,000	[3] 17,000
British Guiana	1,060,979	1,215,744	1,919,060	928,178	678,482	[4] 1,137,991	[4] 1,318,190	1,903,230
France	587,420	639,560	916,350	665,630	308,127	449,125	677,372	790,000
Germany	12,478	13,752	12,276	(2)	(2)	(2)	(2)	(2)
Gold Coast	14,886	44,767	162,685	107,854	148,547	116,846	[4] 97,437	[4] 132,190
Greece	18,000	23,000	25,000	10,000	------	1,315	23,500	40,183
Haiti	------	------	------	------	300	300	------	------
Hungary	823,410	988,550	1,001,370	758,299	35,402	101,140	340,260	[3] 300,000
India	13,170	18,551	24,548	12,330	14,116	10,108	12,862	(2)
Indochina, French	10,200	12,800	------	360	------	------	(2)	------
Indonesia	171,821	[5] 297,700	[5] 649,760	[5] 275,017	(2)	------	(2)	437,822
Italy	540,881	509,430	291,862	41,120	25,093	65,447	167,719	[3] 160,000
Jamaica	------	------	2,642	------	------	------	------	------
Japan	------	------	------	2,000	------	------	------	------
Malaya, Federation of	[5] 26,140	[5] 54,700	[5] 168,336	[5] 72,343	------	------	------	------
Palau Island [6]	59,297	135,669	104,223	1,000	------	------	------	(2)
Portuguese East Africa	1,352	1,860	3,272	6,177	4,369	1,469	2,784	2,960
Rumania	9,762	15,041	12,633	(2)	(2)	663	[3] 600	(2)
Spain	1,393	2,214	23,947	2,921	5,119	4,926	5,822	8,916
Surinam	1,198,900	1,227,512	1,655,147	625,804	[4] 683,990	[4] 857,843	[4] 1,809,837	2,149,906
U. S. S. R. (estimate)	325,000	198,000	313,000	355,000	[3] 400,000	[3] 425,000	[3] 475,000	[3] 500,000
United Kingdom:								
Northern Ireland	13,090	95,724	107,924	44,502	36,981	------	------	------
United States (dried equivalent of crude ore)	952,090	2,643,797	6,332,921	2,869,045	996,754	1,121,774	1,221,348	1,480,535
Yugoslavia	[7] 203,000	[7] 86,000	(2)	(2)	(2)	(2)	(2)	(2)
Total [1]	6,114,000	8,358,000	14,123,000	7,141,000	3,582,000	4,565,000	6,488,000	8,246,000

[1] Bauxite is also produced in French West Africa, but production data are not available and no estimate is included in total.
[2] Data not available; estimate by junior author of chapter included in total.
[3] Estimate.
[4] Exports.
[5] Imports into Japan, Formosa, and Korea in fiscal year ended Mar. 31 of year following that stated; preliminary figures.
[6] Imports into Japan and Formosa in fiscal year ended Mar. 31 of year following that stated; preliminary figures.
[7] Croatia only; estimate for rest of Yugoslavia included in total.

British Guiana.—The Demerara Bauxite Co., the largest producer in British Guiana, shipped most of its ore to Arvida, Quebec, to be reduced to aluminum by its affiliate, the Aluminum Co. of Canada. A new company, named the Plantation Bauxite Co., has been formed recently in Georgetown to develop extensive bauxite deposits on the west bank of the Demerara River. It is associated with the Demerara Bauxite Co. and, therefore, also affiliated with the Aluminum Co. of Canada.

A royalty of 2 cents a long ton is levied on all ore mined and processed within the colony, whereas 25 cents a ton is collected in royalties and taxes on bauxite exported in the raw state. Some long-established companies, such as the Demerara Bauxite Co., however, may continue to export crude ore under old leases which provide for a royalty and tax of only 10 cents a ton.

France.—Output of bauxite in France during 1948 increased 17 percent over the 1947 total and reached a level higher than the prewar average. As the largest producer in the Eastern Hemisphere, France continued to dominate the European aluminum industry. French ore, essentially a monohydrate, was not desirable for alumina production by the process used in America. Both domestic consumption and exports of bauxite were greater in 1948 than in the preceding year.

Gold Coast.—Shipments of bauxite from Gold Coast increased 36 percent in 1948. The only large producing mine, situated near Awaso, Sefwi-Bekwai, Western Province, was operated by the British Aluminum Co. on behalf of the United Kingdom Ministry of Supply. Plans have been made for construction of a dam on the Volta River eventually to supply electric power for a reduction plant. Reserves exceeding 200,000,000 tons, much of which is high-grade ore, have been indicated by recent surveys.[5]

Hungary.—Before the close of World War II, Hungary exported most of its bauxite to Germany for aluminum production. As the German market has largely disappeared, an attempt has been made to increase domestic consumption for production of the metal. The U. S. S. R. received about half of the 1948 exports, and the remainder was shipped to other nations in continental Europe.

In February 1948, the anticipated bill for nationalization of the bauxite and aluminum industries was enacted by the Government. Following this action, a new company, entitled the Hungarian Bauxite-Aluminum Co., Ltd., wholly owned by the Hungarian State, was established.

Indonesia.[6]—Mining operations of major proportions were resumed in 1948 on Bintan Island, site of the largest known bauxite deposits in the Far East. Open-pit methods are employed, and since the arrival of new equipment to replace that destroyed or confiscated by the Japanese, production has been highly mechanized. Part of the output was shipped to the aluminum industry in Formosa, but the bulk of it was exported to the United States. It was reported that the Netherlands Indies Bauxite Exploration Co., Inc., a subsidiary of the N. V. Billiton Maatschappij and the sole bauxite operator on Bintan Island, planned to build an alumina plant at Palembang, southern Sumatra, utilizing Bintan bauxite.

Italy.—Postwar treaties, having deprived Italy of the Istrian Peninsula, formerly the source of nearly 70 percent of the Italian bauxite production, have caused that nation to rely on imports and the development of new ore deposits. Most of the domestic output in 1948 was mined in the Foggia and Bari areas, with lesser tonnages coming from the Puglia and Abruzzi areas. The Ministry of Industry and Commerce had issued plans for increasing production 100 percent within the next 5 years. Imports, which came almost exclusively from France and Yugoslavia, increased considerably during 1948.

[5] Report of the Geological Survey Department for the Financial Years 1940–41 to 1945–46; Govt. Printing Dept., Accra, Gold Coast, 1947, pp. 4–5.

[6] Bureau of Mines, Mineral Trade Notes, Sources of Bauxite in Asia: Vol. 26, Spec. Suppl. 27, June 1948, pp. 9–13.

Malaya, Federation of.—During 1948, Canadian, Australian, and British companies expressed interest in Malayan bauxite deposits, which have been unproductive since cessation of the Japanese occupation. Tentative plans would use Malayan ore in proposed southwest Pacific aluminum-reduction plants. It was believed that prospecting would reveal new deposits to supplement the abundant known reserves.

Surinam.—Production of bauxite in Surinam, the world's largest producer in 1948, exceeded 2,000,000 long tons and established a new record for the colony. The Surinaamsche Bauxiet Maatschappij remained the largest producing company, supplying bauxite for its affiliate, the Aluminum Co. of America, and for the Baton Rouge, La., alumina plant of the Permanente Metals Corp. The other large company, the N. V. Billiton Maatschappij, continued to mine throughout 1948 while working on expansion of its excavating, washing, drying, and transportation operations.

Bismuth

By JACK W. CLARK

GENERAL SUMMARY

AT THE CLOSE of 1948 the supply of bismuth metal was able to meet domestic consumptive demand. The purchase program for the National Strategic Stock Pile, however, injected a note of uncertainty as to the over-all adequacy of supplies of refined metal. Domestic production was up 24 percent over 1947, the increase being due, apparently, to appreciably larger imports of bismuth-rich lead bullion from Mexico and Peru shipped to the United States for refining. Total 1948 imports of refined bismuth were slightly below those for 1947; all imported metal originated in Peru. Exports of bismuth metal were up almost half again as large as in the year preceding; over 95 percent of the shipments were destined for the United Kingdom. Late in 1948, the Economic Cooperation Administration authorized $50,000 to France, under the European Recovery Program, for purchase of bismuth metal in the United States. Stocks of metal and compounds held by producers, consumers, and distributors at the year end in 1948 are thought to have been small. No quantitative information is made public regarding the strategic stock pile. Foreign stocks are not believed to be large. Peru continued in 1948 to be the largest foreign producer of refined metal. A Canadian producer suspended production near the end of the year.

Domestic consumption of metal was believed somewhat lower than in 1947; manufacturers of pharmaceutical chemicals and low-melting alloys were the major users. Trade in finished products, particularly pharmaceuticals, was fairly strong during the first half of 1948, weakening thereafter.

The price of refined bismuth metal held at $2 per pound, ton lots, throughout the year; this level, reached in February 1947, was the highest since 1928. Prices of compounds increased generally in the last 6 months of 1948, owing to higher production costs.

Bismuth appears to show promise in the field of nuclear energy because of its extremely low absorption of neutrons, combined with other desirable characteristics, such as chemical stability and a favorable range between melting and boiling points.

DOMESTIC PRODUCTION

Virtually all the refined bismuth produced in the United States is recovered as a byproduct in refining domestic and imported lead and copper ores and imported lead bullion. Domestic production figures cannot be divulged, but 1948 output increased 24 percent over the previous year; this rise was believed due to sharply increased imports of lead bullion during the year, principally from Mexico and Peru.

Refined primary bismuth metal is produced by the American Smelting & Refining Co. at Omaha, Nebr. and Perth Amboy, N. J.; the Eagle-Picher Co. at East Chicago, Ind.; and the U. S. S. Lead Refinery, Inc. (subsidiary of United States Smelting, Refining & Mining Co.), at East Chicago, Ind. The Eagle-Picher plant—reported to custom-refine bismuth concentrates—was purchased September 25, 1946, from International Smelting & Refining Co. (subsidiary of Anaconda Copper Mining Co.) The Anaconda firm continues to market bismuth from its ores; the metal is refined on a toll basis by the American Smelting & Refining Co. Many small companies that refine nonferrous metal scrap are believed to produce small quantities of bismuth.

Results of the exploration and metallurgical testing of bismuth-bearing base metal ores at Alta, Utah, were published by the Bureau of Mines.[1] A small deposit of high-grade bismuth ore was reported near Dixon, N. Mex.

CONSUMPTION AND USES

Although data on quantities of bismuth consumed domestically are not available, trade journals indicated that usage in 1948 was down somewhat from 1947. Demand was firm early in 1948, slackening in midyear, with slow trading and low sales volume thereafter. Consumption of bismuth metal in 1948, based upon producers' sales, was divided about equally between manufacturers of pharmaceuticals and low-melting alloys, being little changed from the year previous. The Bureau of Federal Supply was in the market throughout 1948, purchasing refined metal for the National Strategic Stock Pile; in the fall, producers and importers of bismuth met with United States Department of Commerce and Munitions Board representatives to discuss methods for facilitating procurement for the stock pile.

Bismuth compounds are used principally in indigestion remedies, cosmetics, and antisyphilitic drugs. The thioglycolate was reported effective in weakening the virus of rabies and its use recommended as an adjunct to the Pasteur treatment.[2] In the catalytic oxidation of ammonia to nitrous oxide a manganese oxide-bismuth oxide catalyst was shown to be very effective, giving a maximum yield of 71 percent.[3]

Alloys of bismuth have been extensively studied,[4] those of most importance commercially being characterized by low melting points and virtual constancy of volume upon solidification. Bismuth content of most of these alloys is 50–60 percent, the balance being tin, lead, cadmium, indium, and zinc in variable percentages. In years before World War II the fusible alloys were used almost wholly for

[1] Kasteler, John I., and Hild, John H., Lead, Zinc, Silver, Copper, Bismuth Deposits, South Hecla Mine, Alta, Salt Lake County, Utah: Bureau of Mines Rept. of Investigations 4170, 1948, 8 pp.

[2] Crivellari, C., and Calabrese, A., Prophylactic Rabies Treatment with Bismuth Salts: Semana Med., vol. 2, 1948, pp. 60–69.

[3] Kobe, Kenneth A., and Hosman, Paul H., Catalytic Oxidation of Ammonia to Nitrous Oxide: Ind. Eng. Chem., vol. 40, No. 3, March 1948, pp. 397–399.

[4] Henry, Otto H., and Badwick, Edward L., Constitution of Bismuth-Indium System: Am. Inst. Min. and Met. Eng., Metals Technol., vol. 14, No. 3, April 1947, Tech. Pub. 2159, 5 pp.

Cullity, B. D., Thermo-Electric Properties and Electrical Conductivity of Bismuth-Selenium Alloys: Am. Inst. Min. and Met. Eng., Metals Technol., vol. 15, No. 1, January 1948, Tech. Pub. 2313, 8 pp.

fire alarms, sprinklers, and other safety devices; thereafter, bismuth alloys found extensive applications in the aircraft industries as an aid in bending thin-walled metal tubing and in pattern making. These uses have continued to be of considerable importance during the post-war reconversion period.[5] Bismuth metal also finds use in solders and selenium rectifiers and as a minor alloying constituent of aluminum and other metals, imparting improved machinability. A novel heating element for use in high-temperature furnaces was described. Taking advantage of the high electrical resistance, low vapor pressure, and other favorable properties of bismuth, an element was constructed consisting of a spiral vitreous silica tube filled with a 25-percent bismuth alloy. A nichrome preheater winding around the silica tube was used to heat the bismuth alloy to its melting point before use. Temperatures up to 1,350° C. were attained.[6] Bismuth metal has been considered as a possible coolant for a nuclear energy power-producing pile; its absorption cross section for thermal neutrons is exceedingly low, being excelled only by beryllium, among the metals. An estimated 5 tons of metal would be required for an enriched reactor of 100,000 kw. output.[7] Methods of recovering bismuth [8] and of beneficiating bismuth ores [9] were described.

Bismuth consumed in the United States, 1946–48, by uses

Uses	1946 [1]		1947 [2]	1948 [2]
	Pounds	Percent of total	Percent of total	Percent of total
Pharmaceuticals	831,882	63	52	49
Fabricating alloys	306,891	23	34	47
Ammunition solders	68,860	5	(3)	(3)
Fuse alloys	38,900	3	(3)	(3)
Aluminum alloys	33,514	2	3	(3)
Other	50,221	4	11	4
Total consumption	1,330,268	100	100	100

[1] Figures compiled by Civilian Production Administration and U. S. Department of Commerce.
[2] Estimated by producing companies.
[3] Included in "Other."

STOCKS

Year-end bismuth metal inventories for 1948 of primary producers declined about 20 percent below those reported on hand as of December 31, 1947. Stocks of refined metal are held in the National Strategic Stock Pile, but quantities cannot be revealed. Supplies of alloys and compounds in the hands of producers, distributors, and consumers at the end of the year are believed to have been small.

[5] Paterson, Donald, A New Technique in the Construction of Major Assembly Jigs: Sheet Metal Industries, vol. 24, October 1947, pp. 2035–2046.
Rose, Kenneth, Soft Alloys Used to Make Short-Run Sheet Metal Dies: Materials and Methods, vol. 27, No. 3, March 1948, pp. 83–85.
Dickinson, T. A., Flexible Molds for Low-Melt Alloys: Foundry, vol. 76, October 1948, pp. 218–20.
Patton, Walter G., Economical Short-Run Stamping Dies Made of Low-Melting Alloys Chilled to −320° F. in Liquid Nitrogen: Iron Age, vol. 161, No. 8, Feb. 19, 1948, pp. 84–86.
[6] Chaleur et Industrie, (Furnace and Pyrometer for High Temperatures): Vol. 28, No. 3, 1947, pp. 312–318.
[7] Goodman, Clark (ed.), The Science and Engineering of Nuclear Power: Addison-Wesley Press, Inc., Cambridge, Mass., vol. 2, 1949, pp. 15 and 286.
[8] Downie, C. C., Bismuth in Works Byproducts: Min. Jour. (London), vol. 229, No. 5837, July 5, 1947. pp. 403–404.
[9] Hart, J. G., Separation of Molybdenite and Bismuthinite by Flotation: Chem. and Eng. Min. Rev., vol. 37, 1945, p. 390.

PRICES

Bismuth metal was quoted by E&MJ Metal & Mineral Markets at $2.00 per pound, ton lots, throughout 1948. London quotations for metal as given in the Metal Bulletin at the beginning of the year were 11s. per pound, 5-cwt. lots; this price declined to 10s. 9d. early in October and remained unchanged thereafter. Metal Bulletin average quotations on bismuth ores containing 50, 40, and 30 percent bismuth, respectively, were 6s. 9d., 6s. 2d., 5s. 5d. from January to May 1948, then declined to 6s. 6d., 6s., and 5s. 2d. until October, when prices dropped further to 6s., 5s., and 4s. 3d., remaining unchanged thereafter through December.

Prices of bismuth chemicals remained firm for the first 6 months of 1948; but, in general, scattered increases, due mainly to higher manufacturing costs, were noted thereafter. Prices per pound at the beginning of 1948 and at year end, as quoted by the Oil, Paint and Drug Reporter, were as follows:

	January 1948	*December 1948*
Chloride	$4. 50	$3. 95
Citrate	3. 12	3. 27
Hydroxide	4. 00	4. 18
Nitrate	1. 60	1. 85
Oxychloride	3. 80	3. 97
Oxide	4. 20	4. 60
Phenolsulfonate	--------	4. 70
Subcarbonate	2. 60	2. 80
Subgallate	2. 45	2. 75
Subiodide	4. 13	4. 90
Subnitrate	2. 15	2. 30
Subsalicylate	3. 05	3. 20
Sulfocarbolate	4. 05	4. 20
Ammonium citrate	3. 70	3. 80

FOREIGN TRADE [10]

Imports.—Refined bismuth-metal imports in 1948 decreased for the second successive year; however, the decline was only 3 percent under 1947 receipts. All refined-metal imports originated in Peru. Lead bullion containing bismuth is imported from Peru and Mexico for refining in the United States. In 1948 quantities received exceeded shipments in 1947 by nearly five times. The bismuth content of this bullion is not included in the import totals given below. No import trade in bismuth compounds or mixtures was reported.

Exports.—Shipments of bismuth metal and alloys in 1948 increased for the fourth consecutive year and were 46 percent above exports for 1947. The United Kingdom was the largest recipient, accounting for 336,390 pounds valued at $680,078. Late in 1948 the Economic Cooperation Administration allocated $50,000 to France for purchase of bismuth metal in the United States as a part of the European Recovery Program. Of the amount allocated, $45,000 was expended in 1948 and $5,000 carried over into the first quarter of 1949. Exports of bismuth compounds are included in a group classification with other chemicals and are not separately available.

[10] 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, 1944–48

[U. S. Department of Commerce]

Year	Bismuth ore [1]			Refined metallic bismuth		Bismuth compounds and mixtures	
	Pounds		Value	Pounds	Value	Pounds	Value
	Gross weight	Bi content					
1944	118,739	51,349	$60,878	363,980	$345,796	40	$352
1945				333,231	316,135		
1946	(2)	(2)	(2)	422,336	464,922		
1947	(2)	(2)	(2)	310,561	480,808		
1948	(2)	(2)	(2)	299,824	464,733		

[1] Figures compiled by Foreign Economic Administration.
[2] Data not available. About 600,000 pounds of high-grade bismuth concentrates from Korea believed imported in 1948.

Bismuth exported from the United States, 1946–48, by classes

[U. S. Department of Commerce]

Class	1946		1947		1948	
	Pounds	Value	Pounds	Value	Pounds	Value
Matte	93,960	$8,629				
Metal and alloys	153,058	173,463	240,833	$452,147	352,027	$711,354

WORLD REVIEW

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

World production of bismuth, 1942–48, by countries, in kilograms [1]

[Compiled by B. B. Mitchell]

Country [1]	1942	1943	1944	1945	1946	1947	1948
Argentina: Metal	13,101	18,000	14,000	20,120	22,000	22,000	(2)
In ore [3]	17,000	25,000	24,500	31,000	12,000	20,000	(2)
Australia (in ore) [4]	762	5,741	3,556	3,251	1,270	3,201	4,000
Bolivia (in ore and bullion exported) [5]	8,896	12,419	605	15,337	27,867	88,964	35,142
Canada: Metal [6]	157,648	184,882	56,188	86,098	109,090	128,988	108,971
China (in ore) [3]	11,000	(2)	(2)		1,380	(2)	(2)
France (metal)	11,000	5,000	3,000				[3] 30,000
Germany: In bismuth ore	17,500	(2)	(2)	(2)	(2)	(2)	(2)
In other ores	14,700	(2)	(2)	(2)	(2)	(2)	(2)
Japan (metal)	[7] 71,000	[7] 66,000	[7] 54,000	(2)	(2)	22,862	23,300
Mexico (in impure bars)	128,041	175,055	165,379	161,368	76,000	256,000	161,000
Peru: Metal	373,942	482,920	416,159	307,446	221,778	233,794	205,861
In lead-bismuth alloy	16,913			1,500	89,665	3,043	47,225
Spain (metal)	15,880	15,198	4,910	10,071	13,756	21,172	38,000
Sweden					12,441	10,998	(2)
Union of South Africa (in ore)	167	1,890	818	610	711		437
United States	(8)	(8)	(8)	(8)	(8)	(8)	(8)
World production (estimate)	1,700,000	1,400,000	1,200,000	1,100,000	900,000	1,400,000	1,400,000

[1] Bismuth is believed to be produced also in Brazil, Burma, Norway, Rumania, 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] Refined metal plus bismuth content of bullion exported.
[7] Incomplete data for year ended March 31 of year following that stated.
[8] Production included in total; Bureau of Mines not at liberty to publish separately.

Australia.—Bismuth ores are smelted and refined by Bismuth Products Pty., Ltd., Sydney.

Brazil.—Deposits of bismuth ore in the Borborema Plateau in the States of Rio Grande do Norte and Paraiba were described. Production of bismuth in 1943 was estimated at 6½ metric tons.[11]

Canada.—The Consolidated Mining & Smelting Co. of Canada, Ltd., Trail, B. C., continued during 1948 in its position as Canada's largest bismuth producer. Production has been intermittent since 1928. Annual capacity is 60 tons. Some shipments of metal were made by the Molybdenite Corp. of Canada, Ltd., before operations ceased at its mine at La Corne, Quebec, in November 1948. During the year the Deloro Refining & Smelting Co. of Canada, Ltd., Deloro, Ontario, exported speiss containing bismuth.[12] For the period 1937–46, production of bismuth (metal content) in all forms was about 900 short tons. For the same period production of bismuth metal was 865 tons, and domestic consumption, exports, and imports totaled 296, 702, and 5 tons, respectively.[13]

China.—Bismuth is found as the mineral bismutite, a carbonate, associated with tungsten ores at Pangkushan, Anyuanhsien, southern Kiangsi Province. Reserves of bismutite are estimated at 3,000 metric tons.[14]

Korea.—Bismuth is reported to occur as the mineral bismuthinite in the tungsten ores of the Sang Dong mine, southeast of Seoul in the American-occupied zone. Before and during World War II, this mine was a large producer of bismuthinite concentrates. About 300 tons of high-grade concentrates are believed to have been exported to the United States in 1948.

Peru.—Large quantities of refined bismuth metal are produced by the Cerro de Pasco Copper Corp. as byproducts of its copper and lead smelting operations at Oroya. Peruvian customs figures give the content of metallic bismuth in all products exported since 1940, in metric tons, as follows: 1940, 383 tons; 1941, 520; 1942, 346; 1943, 484; 1944, 446; 1945, 272; 1946, 311; 1947, 219; 1948, 250 (estimated for first 11 months).

Sweden.—Small quantities of bismuth are produced by the Boliden Mining Co.[15]

Uganda.—Several hundred pounds of bismuth ore have been produced from deposits where it is found in association with tungsten and tin ores.[16]

United Kingdom.—Bismuth ores and residues are smelted and refined by Capper Pass, Bristol, and Mining & Chemical Products, Ltd., London.

U. S. S. R.—Bismuth is produced as a byproduct in the treatment of zinc and lead concentrates at the electrolytic zinc plant in the North Caucasus.[17]

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[11] Rolff, P. A. M. de Almeida, Bismuto, Cobre e Ouro na Borborema: Ministerio da Agricultura-Dep't. Nacional de Producão Mineral-Avulso No. 75, 1946, 26 pp.

[12] McLeod, H., La Corne Mine: Canadian Min. Jour., vol. 70, No. 2, February 1949, p. 71.

[13] Dominion Bureau of Statistics, Mineral Production of Canada, 1946: 1949, pp. 198–199.

[14] Nan, Y. T. Tungsten-Bismuth Ore of Pangkushan, Anyuanhsien: Bull. Geol. Surv. Kiangsi, vol. 7, 1942, pp. 15–17.

[15] Smith, Geoffrey, Mineral Position of ECA Nations, No. 12—Sweden: Eng. and Min. Jour., vol. 150, No. 3, March 1948, p. 81.

[16] Davies, K. A., and Bissett, C. B., The Geology and Mineral Deposits of Uganda: Bull. Imperial Inst. vol. 45, No. 2, April-June 1947, p. 170.

[17] Borovik, S. A., and Prokopenko, N. M., (Rare and Disseminated Elements in the Raw Materials Products and Refuse of the "Electrozinc" Plant): Compt. rend. acad. sci. U. R. S. S., vol. 51, 1946, pp. 523–6.

Cadmium

By RICHARD H. MOTE

GENERAL SUMMARY

CADMIUM was relatively plentiful during the first part of 1948, but the supply became less abundant as the year progressed. Whereas domestic consumption continued at a slightly greater rate than in 1947, production of primary metallic cadmium declined 5 percent, and output of primary cadmium compounds dropped sharply. Imports of cadmium-bearing flue dust and metallic cadmium fell off 22 percent and 52 percent, respectively, thus further limiting the availability of the metal during the year. At the end of 1948 the continuing high level of consumption in face of reduced production and imports had caused a 62-percent reduction in total industry stocks. Prices advanced during the year from $1.75 a pound for commercial sticks and $1.80 for patented shapes to $2 and $2.05, respectively.

Salient statistics of the cadmium industry in the United States, 1944–48, in pounds of contained cadmium

	1944	1945	1946	1947	1948
Production (primary)	8,779,856	8,383,629	6,471,187	8,508,146	7,775,657
Imports (metal)	66,627	28,724	17,415	20,292	9,809
Exports (metal)	548,015	102,199	140,385	303,401	955,701
Consumption, apparent	[1] 8,865,000	8,642,799	6,983,610	[2] 7,726,753	7,818,485

[1] Actual consumption.
[2] Revised figure.

DOMESTIC PRODUCTION

The most important ore mineral of cadmium is greenockite (CdS, 77.8 percent cadmium), which occurs in minor quantities associated with virtually all zinc ores and to a smaller extent with lead and copper ores containing zinc mineralization. No ore is beneficiated for the cadmium alone, as cadmium contents are always too small to support profitable mining. For the same reason the quantity of cadmium contained in ores is rarely determined. In zinc concentrates the cadmium content seldom exceeds 1 percent, which itself is exceptional. Zinc concentrates from the Tri-State region average 0.35 percent cadmium, and concentrates from mines in the Rocky Mountain region and far West rarely carry more than 0.2 percent cadmium.

The entire domestic supply of primary cadmium is recovered concurrently with the treatment of ores of other metals as a byproduct from the flue dusts of zinc-blende roasting furnaces and lead blast furnaces, from zinc dust collected in the early stages of distillation in zinc retorts, and from the sludges of electrolytic zinc plants. A small quantity of secondary metal is recovered from old bearings and other alloys but constitutes no great proportion of the total supply. As most reduction plants participating in the recovery of cadmium treat both domestic and foreign cadmium-bearing materials without determining the cadmium content of either, the origin of the metal produced from domestic sources 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 of this volume for metals like copper, lead, and zinc.

Cadmium produced and shipped in the United States, 1944–48, in pounds of contained cadmium

	1944	1945	1946	1947	1948
Production:					
Primary:					
Metallic cadmium	8,453,470	7,932,579	6,200,398	8,007,287	7,582,961
Cadmium compounds [1]	326,386	451,050	270,789	500,859	192,696
Total primary production	8,779,856	8,383,629	6,471,187	8,508,146	7,775,657
Secondary (metal and compounds) [1] [2]	106,850	72,473	355,104	104,764	121,159
Shipments by producers:					
Primary:					
Metallic cadmium	8,551,424	7,938,658	6,180,265	7,852,907	7,639,113
Cadmium compounds [1]	285,203	451,050	270,789	500,859	192,696
Total primary shipments	8,836,627	8,389,708	6,451,054	8,353,766	7,831,809
Secondary (metal and compounds) [1] [2]	106,850	67,513	360,924	134,793	121,159
Value of primary shipments:					
Metallic cadmium	$6,435,124	$6,106,992	$6,094,572	$12,358,526	$12,679,571
Cadmium compounds [3]	213,902	347,308	267,033	788,352	319,875
Total value	6,649,026	6,454,300	6,361,605	13,146,878	12,999,446

[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).

The domestic output of primary metallic cadmium decreased 5 percent in 1948 owing largely to a work stoppage beginning in August at the Fairmont City zinc smelter of the American Zinc Co. of Illinois. The production of cadmium contained in primary compounds dropped sharply, but the recovery of cadmium in secondary metal and compounds increased.

A list of plants producing cadmium metal in the United States in 1948 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.
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 cadmium content of the cadmium oxide and sulfide produced in 1948 decreased 18 percent from the 1947 output. Data for the production of other cadmium compounds are not available for 1948.

Cadmium oxide and cadmium sulfide produced in the United States, 1944–48, 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
1944	571,366	499,507	1,312,263	466,794	1947	449,847	392,556	3,501,508	1,308,385
1945	439,415	383,553	1,731,510	637,667	1948	334,859	291,847	3,137,035	1,096,775
1946	364,285	317,767	3,637,177	1,225,680					

[1] Includes cadmium lithopone and cadmium sulfoselenide.

CONSUMPTION AND USES

The apparent consumption of cadmium in all forms in 1948 totaled 7,818,486 pounds, a 1-percent increase over 1947. By far the largest single use of cadmium is for electroplating iron, steel, and, to a much smaller extent, copper alloys. The metal is desired for this use because (1) a thin coating is adequate to provide the necessary protection against corrosion; (2) cadmium has a high rate of deposition; (3) the metal has a high throwing power (the property of depositing uniformly in recesses); (4) cadmium is capable of imparting an enduring metallic luster to the electroplated item; and (5) cadmium has high resistivity to atmospheric corrosion. A disadvantage of cadmium plating is its low resistance to acids.

Another large use of cadmium metal is in the manufacture of bearing metals. Cadmium-base bearing metals containing 98.3 to 98.5 percent cadmium and varying quantities of nickel, silver, or copper, depending upon the type of bearing desired, are used successfully in internal-combustion engines that operate at high speeds and temperatures.

Small quantities of cadmium metal are consumed for the manufacture of solders and other alloys.

Compounds of cadmium have a wide variety of uses. Cadmium oxide, hydrate, and chloride are used in making electroplating solutions, while cadmium sulfide and cadmium sulfoselenide are employed as standard agents for producing yellow and red colors, respectively, in paint, soap, rubber, ceramics, paper, printing ink, leather, and other products. Cadmium bromide, chloride, and iodide are used in photographic films, process engraving, and lithographing.

Advantages of the nickel-cadmium storage battery, a new domestic use of cadmium, gained publicity in 1948. This type of battery—used for many years in Europe—consists of negative and positive plates composed of perforated-steel tapes within which are clamped the active battery materials. In the negative plates these materials are cadmium oxide and iron; positive plates contain nickel hydroxide and graphite. The individual plates, held apart by polystyrene separators, are assembled into plate units and suspended in an alkaline electrolyte of potassium hydroxide. The entire battery unit, consisting of positive and negative plates and electrolyte, is housed in an all-steel case. The standard European nickel-cadmium automobile battery contains approximately 7 pounds of cadmium. An American manufacturer, using techniques developed in Germany during World War II, plans to produce an automobile battery containing only 1.4 pounds per battery. This reduction in use of cadmium is accomplished by utilizing sintered battery plates molded from powdered nickel. The use of these thin, extremely porous plates, which are impregnated with cadmium and other active battery materials, permits construction of a lighter, smaller battery capable of delivering a high voltage per pound of weight. Among the reported [1] virtues of the nickel-cadmium battery are its normal life of 15 to 20 years; its ability to hold a charge when idle for long periods of time; its resistance to freezing; its ability to withstand physical abuse without case breakage; long periods of use without addition of distilled water; and the noncorrosive nature of the alkaline electrolyte, which eliminates deterioration of the battery case, insulation, and plate separators.

A recent article [2] presents the results of research on the comparative behavior of the nickel-cadmium and lead-acid storage batteries based upon data from tests and actual experience. With respect to the life of the battery, the report concludes that the nickel-cadmium product will remain serviceable longer under normal conditions. Comparative tests on self-discharge indicated that, under normal service conditions, where the battery is not left idle for more than a month, the lead battery is far superior. During this initial period the cadmium battery loses capacity rapidly. Only when the battery is idle for a long time does the cadmium battery show better residual capacity. Freezing of the electrolyte is an important factor in operating a battery at low temperatures. Lead-acid batteries will freeze in subzero temperatures while discharged. Dr. Willihnganz points out that, despite the claim that the cadmium battery cannot freeze, the normal alkaline electrolyte, such as is used in the cadmium battery, freezes at —25° C. (—13° F.). A German manufacturer of cadmium batteries recommends that, for exceptionally severe temperatures, the electrolyte gravity be increased to 1.24 with a lower freezing point and that this electrolyte be used only in emergency because it seriously reduces the life of the battery. Water consumption of a battery depends almost entirely on the amount of overcharge. Tests on water consumption indicated that, on a simple cycle service, the cadmium battery required more water than the corresponding lead battery.

STOCKS

Total domestic stocks of cadmium metal and compounds, excluding consumers' stocks for which data are not available, decreased 61 percent in 1948. Details are given in the following table.

Cadmium stocks at end of year, 1947–48, in pounds of contained cadmium

	1947 [1]			1948		
	Metallic cadmium	Cadmium compounds	Total cadmium	Metallic cadmium	Cadmium compounds	Total cadmium
Producers	443,870		443,870	388,950		388,950
Compound manufacturers	26,620	214,960	241,580	10,610	93,872	104,482
Distributors [2]	319,351	48,720	368,071	70,741	33,810	104,551
Government [3]	484,462		484,462			
Total stocks [4]	1,274,303	263,680	1,537,983	470,301	127,682	597,983

[1] Figures partly revised.
[2] Comprises principally 6 largest dealers.
[3] Excludes cadmium in national strategic stock pile.
[4] Excludes consumers' stocks, which were about 1,000,000 pounds at the end of 1944 (latest date for which figures were compiled).

[1] Manchester, Harland, Nickel-Cadmium Battery Lasts as Long as the Car: Popular Science Monthly, vol. 153, No. 2, August 1948, pp. 113–118. Reprinted in condensed form in the Reader's Digest, vol. 53, No. 317, September 1948, pp. 79–82.
[2] Willihnganz, Eugene, Is There a Lifetime Battery?: Paper presented at the Convention of the Association of American Battery Manufacturers, Inc., Chicago, Ill., Nov. 11–13, 1948.

PRICES

The quoted New York price was $1.75 a pound for commercial sticks and $1.80 a pound for patented shapes until August 2, when it advanced to $1.90 and $1.95, respectively. It was further advanced November 15 to $2 for sticks and $2.05 for patented shapes. The average price for domestic metal, as reported to the Bureau of Mines by primary producers, was $1.66 a pound in 1948, compared with $1.57 in 1947, 99 cents in 1946, 77 cents in 1945, 75 cents in 1944, and 79 cents in 1943 and 1942.

FOREIGN TRADE [3]

In 1948 total imports for consumption of metallic cadmium and of cadmium contained in flue dust decreased 23 percent in weight and 14 percent in value. Exports of cadmium increased 151 percent in value.

Imports.—Imports of cadmium-bearing flue dust, virtually all from Mexico, decreased 22 percent from the 1947 rate. Metallic cadmium imports dropped 52 percent from 1947, to the lowest level since 1932. Of the 9,809 pounds of metal imported in 1948, Canada supplied 64 percent and Peru 36 percent.

Cadmium metal and flue dust imported for consumption in the United States, 1946–48, by countries

[U. S. Department of Commerce]

Country	1946		1947		1948	
	Pounds	Value	Pounds	Value	Pounds	Value
Metallic cadmium						
Belgian Congo	6,700	$5,444				
Belgium and Luxembourg	2,240	5,366	2,000	$7,073		
Canada	3,568	5,459	14,612	20,551	6,300	$14,491
Peru	4,907	7,629	3,658	4,508	3,509	7,018
Switzerland			2	150		
United Kingdom			20	63		
Total metallic cadmium	17,415	23,898	20,292	32,345	9,809	21,509
Flue dust (Cd content)						
Australia					621	303
Mexico	1,609,366	598,494	2,355,588	1,673,153	1,827,518	1,437,833
Netherlands	43,539	19,397				
Total flue dust	1,652,905	617,891	2,355,588	1,673,153	1,828,139	1,438,136
Grand total	1,670,320	641,789	2,375,880	1,705,498	1,837,948	1,459,645

Exports.—Owing to a sharp rise in exports of metallic cadmium to countries included in the Organization for European Economic Cooperation, the total value of cadmium exported in 1948 was over two and one-half times greater than in the previous year. Of the 955,701 pounds of cadmium metal exported, Germany received 28 percent, France 24, United Kingdom 12, Switzerland 9, Belgium and Netherlands each 8; the remaining 11 percent went to 16 other countries.

[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.

Cadmium exported from the United States, 1946–48, gross weight, by kinds

[U. S. Department of Commerce]

Kind	1946		1947		1948	
	Pounds	Value	Pounds	Value	Pounds	Value
Dross, flue dust, residues, and scrap	459,775	$45,587	18,251	$21,838	92,847	$55,247
Metal	140,385	163,879	303,401	746,804	955,701	1,872,467
Alloys	75	99	----------	----------	1,506	2,657
Total	----------	209,565	----------	768,642	----------	1,930,371

Tariff.—Action taken at the the Geneva Trade Conference of 1947 reduced as of January 1, 1948, the import duty on cadmium metal from 7½ cents per pound as established in the Canadian Trade Agreement of 1939 to 3¾ cents per pound. Cadmium contained in flue dust remained duty free in 1948.

WORLD PRODUCTION

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

World production of cadmium, by countries, in 1940–48, in kilograms

[Compiled by B. B. Mitchell]

Country	1940	1941	1942	1943	1944	1945	1946	1947	1948
Australia (Tasmania)	175,232	194,975	165,821	160,100	253,972	223,784	224,128	191,369	223,936
Belgian Congo	---------	3,086	27,344	23,094	21,544	18,233	16,571	26,040	18,000
Belgium	[1] 530,800	[1] 23,178	[1] 40,188	[1] 31,797	[1] 1,089	(2)	[3] 88,900	[3] 86,300	[3] 157,900
Canada	411,917	567,573	521,158	356,804	239,032	293,048	364,073	325,874	346,089
France	100,000	20,000	10,000	10,000	5,250	7,000	47,000	43,000	50,067
Germany	296,194	371,944	243,124	275,783	209,105	(2)	[4] 1,000	[4] 1,206	[4] 3,500
Italy	214,871	184,016	122,785	71,606	38,855	28,800	25,000	38,400	49,700
Japan	(2)	(2)	[5] 102,000	[5] 112,000	[5] 85,000	[6] 22,000	[7] 900	8,710	18,874
Mexico [8]	815,734	906,577	854,264	801,992	682,295	1,052,766	717,000	778,000	906,000
Norway	28,600	25,048	13,482	11,355	10,600	13,000	28,000	50,314	69,000
Peru	---------	---------	2,131	3,653	2,174	9,320	850	1,407	2,400
Poland	234,960	235,867	231,784	219,991	195,044	49,150	115,000	[9] 71,000	(2)
South-West Africa [8]	39,634	225,450	---------	---------	---------	---------	---------	---------	431,000
U. S. S. R.	[10] 50,000	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
United Kingdom	182,797	148,324	152,406	167,828	197,312	178,714	121,926	106,441	115,769
United States:									
Metallic cadmium	2,791,484	3,146,976	3,321,797	3,808,474	3,834,409	3,598,139	2,812,439	3,632,025	3,439,555
Cadmium compounds (Cd content)	95,000	134,000	21,600	32,100	148,045	204,592	122,827	227,185	87,405
Total	5,222,000	5,220,000	5,026,000	5,336,000	5,291,000	4,698,000	4,019,000	4,859,000	4,772,000

[1] Exports; 1939 exports inserted in 1940 in lieu of any other data.
[2] Data not available; estimate by author of chapter included in total.
[3] Incomplete data.
[4] Bizonal area.
[5] Preliminary data for fiscal year ended March 31 of year following that stated.
[6] April to September, inclusive.
[7] November to December, inclusive.
[8] 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.
[9] January to July, inclusive.
[10] Estimated average for 1936–38.

Carbon Black

By F. S. LOTT, D. S. COLBY, AND H. BACKUS

GENERAL SUMMARY

PRODUCTION and consumption of carbon black in the United States declined in 1948 for the first time since 1942. Production of all types dropped nearly 2 percent below the 1947 level to 1,297,729,000 pounds. The decrease took place in the furnace types of black, while production of contact types was almost 4 percent above that of last year.

Total sales were 5 percent below 1947. Sales for domestic use totaled 932,433,000 pounds, a decline of 7 percent, but exports increased 1 percent to 321,915,000 pounds. Stocks in producers' storage of furnace and contact types increased during the year by 43,131,000 pounds. The stock of contact blacks rose from 8,619,000 pounds to 27,646,000 and that of furnace types from 66,493,000 pounds to 90,597,000. Stocks on December 31, 1948, equaled a 54-day supply of furnace black and a 16-day supply of contact black, at year's end sales rates.

The carbon-black industry consumed 480,646,000 thousand cubic feet of natural gas and 44,600,000 gallons of liquid hydrocarbons in 1948. Contact plants yielded an average of 1.61 pounds and furnace plants an average of 8.07 pounds of black per thousand cubic feet of natural gas used. The value of all blacks produced averaged 5.88 cents per pound compared with 5.36 cents in 1947.

Salient statistics of carbon black produced from natural gas and liquid hydrocarbons in the United States, 1944–48

	1944	1945	1946	1947	1948
THOUSAND POUNDS					
Production:					
Contact process (chiefly channel)	414,676	538,539	619,109	653,966	677,133
Furnace processes	387,184	514,259	625,312	664,999	620,596
Total	801,860	1,052,798	1,244,421	1,318,965	1,297,729
Sales:					
Domestic deliveries	780,439	846,262	998,655	1,000,684	932,433
Exports	156,991	173,773	271,085	319,076	321,915
Total	937,430	1,020,035	1,269,740	1,319,760	1,254,348
Losses	402	1	458	321	250
Stocks of producers Dec. 31	69,243	102,005	76,228	75,112	118,243
VALUE					
Production ... thousand dollars	29,411	42,323	59,988	70,639	76,295
Average per pound ... cents	3.67	4.02	4.82	5.36	5.88

The consumption of carbon black by the rubber industry in 1948 declined 7 percent to 870,564,000 pounds. The industry also reversed the trend toward furnace blacks and used a larger percentage of contact black in 1948 than in 1947, influenced by the increasing percentage of natural rubber being used and a better supply situation with respect to contact blacks.

Sales to ink companies remained high and substantially unchanged, but paint companies bought only 6,799,000 pounds, 16 percent less than in 1947. Miscellaneous uses increased 36 percent.

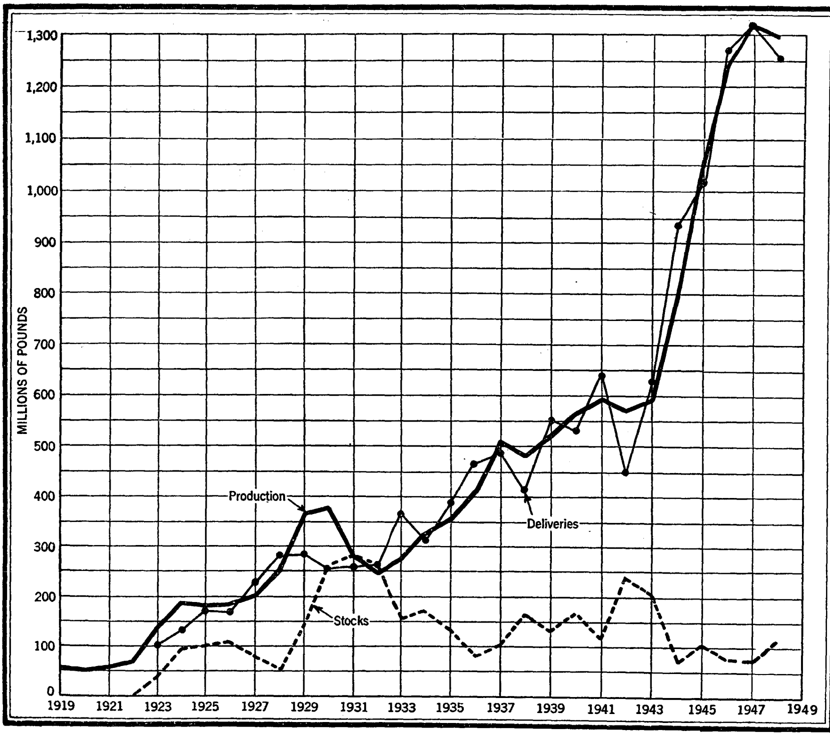

FIGURE 1.—Production, stocks, and deliveries of carbon black, 1919–48.

PRODUCTION

By States.—The first decline in production since 1942 had its severest effect on operations in Louisiana. The production of Texas continued to increase. Texas thus regained a small part of the supremacy in carbon-black manufacture that it lost during the wartime expansion program. Louisiana production in 1948 decreased by 13 percent to 165,032,000 pounds, 13 percent of the country's total manufacture. Texas Panhandle production rose 3 percent over 1947 to 653,480,000 pounds, but the production rate of the rest of the State declined 5 percent, resulting in a net increase of 1 percent for the entire

State. Texas accounted for 70 percent of the Nation's total production. The small producing States, Oklahoma and New Mexico, had large percentage changes in their production rates, a decrease of 17 percent and an increase of 29 percent, respectively. The declines in Louisiana and Oklahoma doubtless reflect the active demand in those States for natural gas for fuel uses.

Carbon black produced from natural gas and liquid hydrocarbons in the United States, 1944–48, by States and districts, in thousands of pounds

State and district	1944	1945	1946	1947	1948
Louisiana	160,019	168,229	191,857	190,252	165,032
Texas:					
Panhandle district	401,556	541,464	596,678	633,250	653,480
Rest of State	99,606	179,974	234,172	262,523	249,904
Total Texas	501,162	721,438	830,850	895,773	903,384
Other States	140,679	163,131	221,714	232,940	229,313
Grand total	801,860	1,052,798	1,244,421	1,318,965	1,297,729

Carbon black produced from natural gas and liquid hydrocarbons in the United States, by States and districts, and natural gas used, in 1948

State and district	Producers reporting [1]	Number of plants	Production: Thousands of pounds	Production: Value at plant: Total (thousands of dollars)	Production: Value at plant: Average (cents)	Natural gas used: Millions of cubic feet	Natural gas used: Average yield per M cubic feet of gas (pounds)	Natural gas used: Value: Total (thousands of dollars)	Natural gas used: Value: Average per M cubic feet (cents)
California	1	1	} [2] 115,725	5,230	4.52	19,050	5.80	1,001	5.25
Kansas	3	4							
Louisiana	7	7	165,032	6,338	3.84	21,672	7.61	1,002	4.72
New Mexico	4	4	63,271	4,046	6.39	42,616	1.48	1,566	3.67
Oklahoma	2	3	50,317	2,660	5.29	15,857	3.17	1,144	7.21
Texas:									
Panhandle district	14	31	[2] 653,480	42,505	6.50	288,855	1.80	14,243	4.93
Rest of State	7	13	[2] 249,904	15,516	6.21	92,596	2.69	3,747	4.05
Total Texas	[1] 17	44	[2] 903,384	58,021	6.42	381,451	2.02	17,990	4.72
Total United States	[1] 24	63	[2] 1,297,729	76,295	5.88	480,646	2.41	22,723	4.73

[1] In counting the total number of producers reporting, a producer operating in more than 1 State, district, or county is counted but once.
[2] Includes carbon black made from liquid hydrocarbons.

By Months.—The production of all types of carbon black in 1948 was 1,297,729,000 pounds, a decrease of 2 percent from the record high of 1947, due to the 7-percent decline in furnace-black production. Contact blacks were produced in new record quantities, 677,133,000 pounds for the year, 4 percent greater than in 1947.

Manufacture of carbon black slumped in the middle of 1948 but by December had risen again to within 1 percent of the January 1948 production rate. The major production decline took place in the manufacture of furnace blacks. In the third quarter of the year furnace-black production dropped 5 million pounds per month below the first quarter average but rose to within 6 percent of the January rate by the end of 1948. The slump in contact-black production was less-pronounced. Third-quarter production of this type was less than 1 million pounds per month below the first-quarter average and by the end of the year had risen to 3 percent above the January rate.

Production, shipments, and exports of carbon black in the United States in 1948, by months, in thousands of pounds

Month	Production [1]				Shipments [1]			Exports [2]
	Contact	Furnace	Total	Daily average	Contact	Furnace	Total	Contact and furnace
January	58,096	56,470	114,566	3,696	57,136	51,089	108,225	20,117
February	54,465	50,927	105,392	3,634	54,302	47,898	102,200	31,264
March	56,412	53,279	109,691	3,538	58,569	51,368	109,937	28,984
April	54,556	53,613	108,169	3,606	50,730	47,102	97,832	21,668
May	57,653	55,569	113,222	3,652	57,566	49,998	107,564	32,354
June	54,681	51,915	106,596	3,553	53,148	48,966	102,114	28,288
July	55,973	48,211	104,184	3,361	53,247	47,561	100,808	24,376
August	55,402	48,194	103,596	3,342	57,105	49,738	106,843	21,809
September	55,189	49,347	104,536	3,485	54,093	46,736	100,829	25,843
October	58,754	50,034	108,788	3,509	53,769	52,604	106,373	26,781
November	56,031	49,884	105,915	3,531	54,659	50,969	105,628	37,306
December	59,921	53,153	113,074	3,648	54,172	51,823	105,995	23,125
Total	677,133	620,596	1,297,729	3,546	658,496	595,852	1,254,348	321,915

[1] Compiled from reports of the National Gas Products Association and of producing companies not included in the association figures.
[2] U. S. Department of Commerce.

Methods and Yields.—The average yield of carbon black from natural gas in 1948 dropped to 2.41 pounds per thousand cubic feet. This is the first time that the yield had dropped since the expansion of the furnace process. It was caused by a reduction in the percentage of furnace-type black produced and by a decrease in the average yield of black obtained from the furnace process. In 1948, 48 percent of all carbon black was produced by furnace processes compared to 50 percent in 1947. The over-all yield from these processes dropped from 8.27 pounds per thousand cubic feet of gas in 1947 to 8.07 pounds in 1948. Lower yields resulted from increased production of the new types of highly reinforcing furnace blacks.

Contact processes accounted for 52 percent of the carbon black produced in 1948, and the yield was again improved slightly to 1.61 pounds per thousand cubic feet of gas processed. The contact plants used 420,939 million cubic feet of natural gas and furnace plants 59,707 million cubic feet.

A better understanding of the yields can be had by examining the percentage of recovery by the different processes. Natural gas contains about 35 pounds of carbon per thousand cubic feet, varying slightly with the composition of the gas. The yield of 1.61 pounds per thousand cubic feet for contact plants represents a recovery of 4.6 percent of the total carbon fed to the plant. A yield of 8.07 pounds per thousand cubic feet for furnace plants is a recovery of 23 percent of the carbon. A process using all liquid hydrocarbons achieves a 50-percent carbon recovery, according to trade information.

The production of carbon black from liquid hydrocarbons increased in 1948 by over 50 percent to nearly 139 million pounds, consuming 44,600,000 gallons of feedstock. The yields from processes using liquid feeds are not available in all cases because both liquid and gas may be fed simultaneously. However, 3 pounds of black per gallon of liquid is thought to be an average yield.

Yield of carbon black, quantity and value of natural gas used, and number of producers of carbon black in the United States, 1944–48

	1944	1945	1946	1947	1948
Estimated quantity of natural gas used..million cubic feet..	355,770	431,830	478,349	484,882	480,646
Average yield of carbon black per million cubic feet pounds..	2.20	2.32	2.44	2.51	2.41
Average value of natural gas used per million cubic feet........cents..	1.62	2.28	3.02	3.57	4.73
Number of producers reporting	22	21	22	21	24
Number of plants	54	59	60	63	63

Number and Capacity of Plants.—The total number of operating plants remained unchanged at 63 in 1948—44 contact-type and 19 furnace-type. Two plants began operation: one, the small channel type plant of Carbon Blacks, Inc., which was moved from Texas to Richland Parish, La.; the other, a new contact-type plant of 30,000 pounds per day capacity in Reagan County, Tex., operated by a new producer Witco Hydrocarbon Corp.

Two plants were removed from operation—the Pontotoc County, Okla., plant of Charles Eneu Johnson Co. was dismantled, and the Columbian-Phillips plant in Moore County, Tex., was dismantled and is to be merged with the Seminole 66 plant of Columbian Carbon Corp. in Gaines County, Tex.

Total operating capacity decreased slightly to 4,031,800 pounds per day. Furnace-plant capacity is rated at 2,140,200 pounds per day, and 1948 production averaged 79 percent of this figure. Contact-plant capacity is 1,891,600 pounds per day, and production was 98 percent of the rating.

It is notable that the rated capacity to produce furnace types of carbon black is greater than that for the older contact types. Furnace grades are produced in 19 plants with an average capacity of 113,000 pounds per day, while the average contact plant has a capacity of 43,000 pounds per day. The capacity of a furnace plant varies with the type of black produced, being materially less when producing the newer-type, highly reinforcing black than when producing a coarser black. It is assumed that the capacity reported for each plant is consistent with grades of black usually produced by that plant.

Producers.—The number of producers increased from 21 in 1947 to 24 in 1948. Moore County Carbon Co. sold its plant to United Carbon Co. Carbon Blacks, Inc., resumed operations, having been out of production in 1947 while moving its plant from Texas to Louisiana. Witco Carbon Co., Witco Hydrocarbon Corp., and Sid Richardson Carbon Co. entered the industry as producers in 1948.

Number and capacity of carbon-black plants operated in the United States, 1947–48

State or district	County or parish	Number of plants 1947 Contact	Number of plants 1947 Furnace	Number of plants 1948 Contact	Number of plants 1948 Furnace	Total daily capacity (pounds) 1947	Total daily capacity (pounds) 1948
California	Contra Costa		1		1	429,400	421,800
Kansas	Grant	2	2	2	2		
Louisiana	Avoyelles		1		1	660,800	638,200
	Evangeline		1		1		
	Ouachita	2	2	2	2		
	Richland			1			
Total Louisiana		2	4	3	4	660,800	638,200
New Mexico	Lea	4		4		176,600	187,200
Oklahoma	Pontotoc	1				212,000	205,000
	Texas	1	2	1	2		
Total Oklahoma		2	2	1	2	212,000	205,000
Texas:							
Panhandle district	Carson	[1] 1		[1] 1		1,877,300	1,862,800
	Gray	6	1	6	1		
	Hutchinson	[1] 13	3	[1] 13	3		
	Moore	7	1	6	1		
Total Panhandle district		27	5	26	5	1,877,300	1,862,800
Rest of State	Aransas	1	1	1	1	715,200	716,800
	Brazoria	1	1	1	1		
	Ector	1		1			
	Gaines	1		1			
	Harris		1		1		
	Montgomery		1		1		
	Nueces	1		1			
	Reagan			1			
	Stephens						
	Terry		1		1		
	Ward	1		1			
	Winkler	1		1			
Total rest of State		7	5	8	5	715,200	716,800
Total Texas		34	10	34	10	2,592,500	2,579,600
Total United States		44	19	44	19	4,071,300	4,031,800

[1] 1 plant in both Carson and Hutchinson Counties tabulated under Hutchinson County.

DEMAND—SALES

Domestic consumption as indicated by manufacturers' sales decreased 7 percent in 1948 to 932,433,000 pounds. Export sales increased 1 percent to 321,915,000 pounds to make the year's total demand 1,254,348,000 pounds, compared with 1,319,760,000 pounds in 1947. The trend toward increasing consumption of furnace black was reversed in 1948, as demand fell 9 percent. Contact-black sales declined only 1 percent.

The month-to-month trend in sales of contact blacks showed a gradual decline throughout 1948. Sales of furnace blacks declined through September, after which there was a sharp increase.

The rubber industry consumed 93 percent of all carbon blacks sold domestically in 1948. This is a slight decrease from the 94-percent consumption of 1947. Consumption of virgin rubber in the United

States decreased 5 percent in 1948, while carbon-black consumption by the rubber industry at the same time decreased 8 percent. If 95,000,000 pounds of carbon black are allowed for use in reclaimed rubber during 1948, the over-all domestic use of carbon black in virgin rubber dropped from 752 pounds to 706 pounds per long ton of virgin rubber used. This decline reflects the increasing use of natural rubber, which requires a lighter carbon-black loading than do synthetics. Of the total virgin rubber processed in this country during 1948, natural rubber comprised 58 percent compared with 50 percent in 1947. This swing to natural rubber is also responsible for the increasing amount of channel blacks being used.

Carbon-black usage by the ink-manufacturing industry remained essentially unchanged in 1948, increasing by 176,000 pounds to 32,436,000 pounds. This maintains the record high established in 1947 but does not continue the correlation established with newsprint

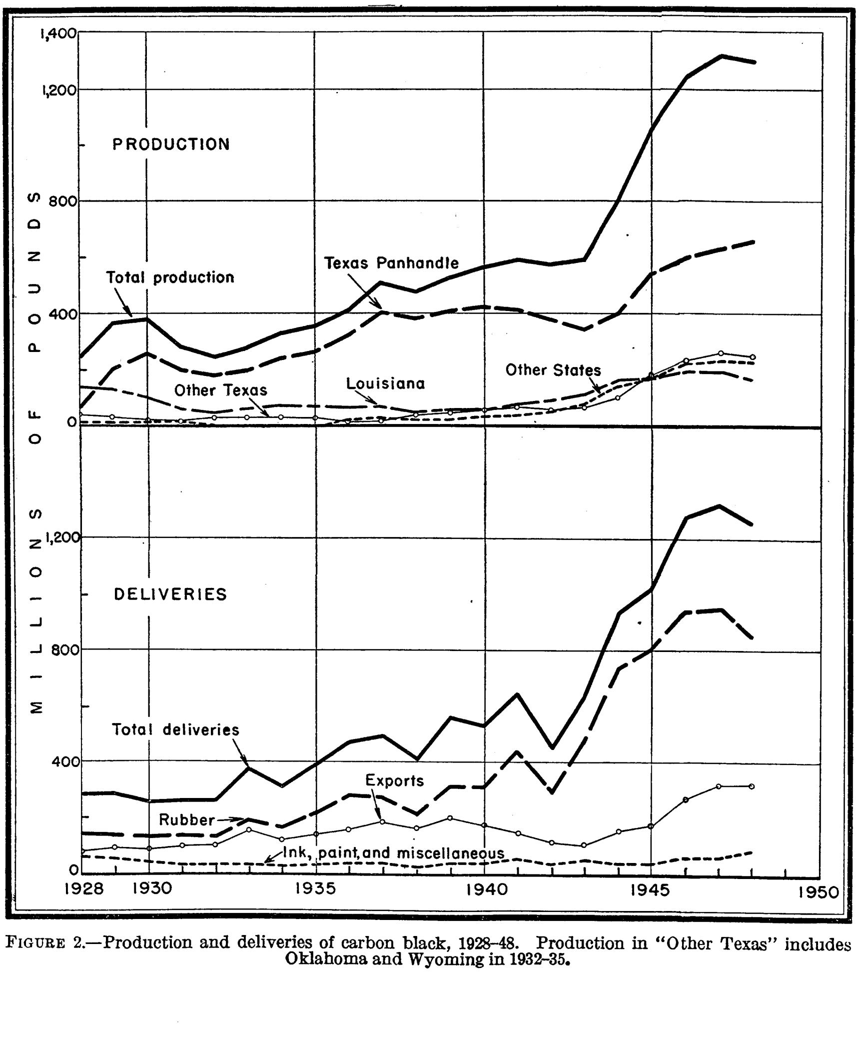

FIGURE 2.—Production and deliveries of carbon black, 1928–48. Production in "Other Texas" includes Oklahoma and Wyoming in 1932–35.

consumption. The American Newspaper Publishers Association reports that newsprint consumption in this country increased 8 percent to 5,141,000 short tons in 1948.

The greatest proportionate decline in consumption took place in the paint industry, which used 6,799,000 pounds of carbon black in 1948, 16 percent less than in 1947. Sales of paint products as a whole, after correction for change in price index, increased 5 percent in 1948. The decline in carbon-black consumption by this industry is a continuation of last year's trend, when consumption was 13 percent below that of 1946. This brings usage almost back to the prewar level of approximately 6 million pounds per year.

Sales of carbon black for domestic consumption in the United States, by uses, 1944–48, in thousands of pounds

Use	1944	1945	1946	1947	1948
Rubber	738, 029	804, 386	941, 464	943, 580	870, 564
Ink	24, 479	22, 824	29, 561	32, 260	32, 436
Paint	5, 315	7, 421	9, 312	8, 137	6, 799
Miscellaneous	12, 616	11, 631	18, 318	16, 707	22, 634
Total	780, 439	846, 262	998, 655	1, 000, 684	932, 433

STOCKS

Producers' stocks of carbon black increased from 75,112,000 pounds on January 1, 1948, to 118,243,000 on December 31. Contact-black stocks increased throughout the year from an inadequate minimum on January 1 to a 16-day supply of 27,646,000 pounds at the end of the year. The stock of furnace blacks, which was satisfactory at the end of 1947, increased 25 million pounds during the first half of 1948 and leveled off for the remainder of the year close to 90 million pounds. This stock is equivalent to a 54-day supply based on December shipments.

Producers' stocks of carbon black, although not well-balanced by principal grades, were not abnormally high in 1948, being approximately the size of stocks held in the late 1930's when demand was less than half as great as at present. Stocks of contact and furnace type held by producers as of December 31, 1944–48, were as follows, in pounds:

Year	*Contact types*	*Furnace types*	*Total*
1944	58, 036, 000	11, 207, 000	69, 243, 000
1945	64, 956, 000	37, 049, 000	102, 005, 000
1946	17, 006, 000	59, 222, 000	76, 228, 000
1947	8, 619, 000	66, 493, 000	75, 112, 000
1948	27, 646, 000	90, 597, 000	118, 243, 000

PRICES

The average value of all carbon blacks produced in the United States in 1948 was 5.88 cents per pound f. o. b. producing plants. This is a rise of 0.52 cent per pound from the 1947 average. Contact blacks advanced 0.94 cent per pound to 7.28 cents, while the average value of furnace types declined 0.04 cent to 4.35 cents per pound. The rise in natural-gas average cost from 3.57 to 4.73 cents per thousand cubic feet accounts for 0.68 cent per pound of the rise in value of contact types, but furnace-black value declined despite rising gas costs. Furnace-black prices are less influenced by gas costs because of the higher yields obtained. The spread between the average unit value of contact and furnace blacks has now widened to 2.93 cents per pound.

The published market prices of ordinary rubber grades of channel blacks increased 1 cent per pound in 1948, according to Oil, Paint and Drug Reporter, and the prices of the common furnace blacks (that is, semireinforcing and high-modulus) remained unchanged throughout the year. The rubber grades of channel black increased 0.5 cent per pound on January 1, 1948, and a like amount on April 1 to a price of 7.32 cents per pound for carloads in bags f. o. b. plant. Fine-furnace-black prices increased on the same dates by 0.50 and 0.82 cent per pound, respectively, to make its price equal to that of the rubber channel blacks.

Prices of carbon black in carlots, f. o. b. plant, 1940–48, in cents per pound

[Oil, Paint and Drug Reporter]

Date of change	Channel blacks		Furnace blacks		
	Ordinary rubber grades [1]		Semireinforcing grades (SRF)	High-modulus grades (HMF)	Fine grades (FF)
	Bags	Bulk	Bags	Bags	Bags
Jan. 1, 1940	2.425	2.30	3.00		
Apr. 1, 1940	2.65	2.50	3.00		
July 1, 1940	2.925	2.75	3.00		
Apr. 1, 1941	3.175	3.00	3.00		
July 1, 1941	3.35	3.15	3.00		
Jan. 1, 1942 [2]	3.55	3.30	3.50		
Apr. 1, 1944 [2]	3.55	3.30	3.50	5.00	
Jan. 1, 1946 [2]	5.25	5.00	3.50	5.00	
Oct. 1, 1946 [2]	5.75	5.50	3.50	5.00	
Jan. 1, 1947	6.32	6.00	3.50	5.00	6.00
Oct. 1, 1947	6.32	6.00	3.50	5.00	6.00
Jan. 1, 1948	6.82	6.50	3.50	5.00	6.50
Apr. 1, 1948	7.32	7.00	3.50	5.00	7.32

[1] Chiefly easy-processing (EPC) and medium-processing (MPC) but also includes hard-processing (HPC) and conductive (CC) channel blacks.
[2] Office of Price Administration ceiling prices. Average realization on sales to the Rubber Reserve Company was generally higher.

FOREIGN TRADE [1]

Imports.—Imports of carbon black in 1948, except for 40 pounds from Germany, came exclusively from Canada. The quantity of "gas black and carbon black" imported from Canada in 1948 was 74,100 pounds compared with only 25 pounds in 1947. The declared value of this material was 12.2 cents per pound. Acetylene-black imports reached a record high of 10,145,681 pounds, valued at $1,284,539, an average value of 12.7 cents per pound compared with a 1947 value of 10.9 cents per pound when imports were 7,639,716 pounds.

[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.

Exports.—Exports of carbon black in 1948 gained 1 percent to 321,915,000 pounds. The unit value of the exported blacks was 8.86 cents per pound compared with 8.41 cents per pound in 1947. Shipments to Russia and Poland were cut off entirely in 1948, and Germany received carbon black from the United States this year for the first time since the war. Japan's imports have increased sharply since it began receiving shipments in 1947.

Carbon-black exports to individual countries fluctuate so widely from year to year that it is difficult to generalize concerning their usage trends. However, among those countries whose purchases from the United States are still increasing are Austria, Chile, Indonesia, Mexico, Peru, and Switzerland. The United Kingdom is still the largest export customer, and its purchases increased by 10.5 million pounds to 102 million pounds. Those countries with a decreasing purchasing trend are China, Czechoslovakia, Portugal, and Yugoslavia.

Carbon black exported from the United States, by months, 1947–48

[U. S. Department of Commerce]

Month	1947		1948	
	Pounds	Value	Pounds	Value
January	33, 422, 951	$2, 564, 080	20, 117, 312	$1, 754, 225
February	18, 423, 618	1, 531, 901	31, 263, 868	3, 085, 142
March	30, 245, 343	2, 141, 713	28, 983, 583	2, 560, 895
April	23, 396, 473	1, 744, 171	21, 668, 011	1, 850, 377
May	24, 888, 440	2, 185, 826	32, 353, 774	2, 812, 230
June	28, 176, 534	2, 222, 187	28, 288, 695	2, 363, 583
July	28, 553, 326	2, 590, 793	24, 375, 687	2, 190, 098
August	40, 477, 557	3, 895, 659	21, 809, 145	1, 855, 858
September	32, 469, 648	2, 874, 979	25, 842, 784	2, 302, 249
October	20, 625, 140	1, 812, 924	26, 780, 634	2, 394, 549
November	16, 145, 286	1, 325, 857	37, 305, 711	3, 331, 813
December	22, 251, 389	1, 958, 546	23, 125, 375	2, 022, 496
Total	319, 075, 705	26, 848, 636	321, 914, 579	28, 523, 515

Carbon black exported from the United States, by countries, 1946–48

[U. S. Department of Commerce]

Country	1946		1947		1948	
	Pounds	Value	Pounds	Value	Pounds	Value
Argentina	6, 988, 074	$602, 767	10, 112, 153	$905, 655	5, 764, 671	$551, 665
Australia	12, 523, 962	1, 015, 150	15, 159, 188	1, 412, 446	15, 155, 026	1, 396, 873
Austria	141, 050	6, 212	493, 650	33, 585	1, 910, 300	162, 663
Belgium-Luxembourg	3, 731, 625	265, 362	11, 928, 375	1, 082, 997	6, 718, 745	697, 691
Brazil	6, 403, 875	466, 474	11, 341, 072	929, 282	8, 810, 209	816, 433
Canada	42, 087, 414	2, 036, 554	56, 382, 871	3, 050, 370	51, 620, 189	3, 094, 028
Chile	965, 885	63, 808	1, 129, 875	100, 488	1, 434, 215	124, 624
China	4, 521, 187	425, 975	1, 544, 745	149, 277	825, 659	88, 428
Colombia	565, 139	54, 862	1, 673, 236	138, 953	1, 043, 288	98, 623
Cuba	1, 028, 072	72, 066	1, 198, 260	81, 238	272, 240	24, 225
Czechoslovakia	2, 974, 425	165, 960	2, 217, 088	157, 982	436, 250	42, 319
Denmark	1, 766, 495	126, 013	1, 736, 500	167, 765	2, 925, 915	293, 939
France	46, 698, 747	2, 954, 845	37, 541, 122	2, 934, 075	46, 481, 544	4, 219, 264
Finland	2, 029, 210	148, 825	615, 875	59, 184	1, 098, 350	104, 155
Germany	----------	----------	----------	----------	1, 416, 100	135, 742
Hungary	----------	----------	425, 950	37, 159	367, 250	35, 911
India and Pakistan	8, 126, 276	576, 511	7, 625, 445	606, 891	13, 033, 382	1, 218, 818
Indonesia	117, 675	10, 955	975, 600	75, 358	1, 982, 276	187, 290
Ireland	1, 375, 550	110, 626	1, 386, 313	142, 895	1, 125, 675	121, 617
Italy	10, 119, 318	608, 382	19, 078, 369	1, 451, 272	10, 580, 964	990, 559
Japan	----------	----------	50, 000	6, 000	3, 570, 100	281, 752
Malaya, Federation of	462, 300	39, 573	728, 050	55, 695	144, 250	13, 982

Carbon black exported from the United States, by countries, 1946-48—Con.

Country	1946		1947		1948	
	Pounds	Value	Pounds	Value	Pounds	Value
Mexico	6, 224, 266	$328, 486	6, 364, 681	$381, 824	8, 949, 796	$624, 814
Netherlands	4, 031, 610	297, 173	4, 414, 944	452, 962	3, 955, 110	361, 290
New Zealand	840, 326	83, 423	2, 293, 591	187, 447	1, 654, 652	162, 251
Norway	1, 787, 925	113, 523	1, 384, 170	125, 924	1, 386, 950	129, 174
Peru	490, 956	38, 867	770, 410	66, 315	863, 813	76, 527
Poland and Danzig	339, 200	13, 528	448, 000	36, 065		
Portugal	746, 752	53, 761	714, 742	65, 591	394, 650	41, 618
Spain	5, 971, 900	399, 665	3, 199, 225	266, 665	4, 314, 850	412, 207
Sweden	6, 949, 230	478, 407	7, 150, 399	636, 061	5, 019, 042	464, 227
Switzerland	2, 461, 045	204, 023	1, 666, 840	145, 326	2, 789, 369	270, 445
Union of South Africa	8, 598, 967	649, 627	11, 625, 340	1, 284, 300	11, 208, 660	1, 013, 913
Uruguay	710, 900	47, 049	875, 550	74, 040	172, 525	16, 197
U. S. S. R.	555, 000	50, 227	500, 000	25, 000		
United Kingdom	75, 824, 863	5, 367, 506	91, 891, 486	9, 320, 271	102, 379, 289	10, 057, 257
Venezuela	389, 250	25, 855	359, 920	28, 501	403, 820	31, 953
Yugoslavia	568, 300	26, 459	550, 500	22, 085	110, 230	17, 136
Other countries	1, 968, 011	159, 933	1, 522, 170	151, 692	1, 595, 225	143, 905
Total	271, 084, 780	18, 088, 432	319, 075, 705	26, 848, 636	321, 914, 579	28, 523, 515

TECHNOLOGY

The return of natural rubber to the domestic rubber market permitted an increase in the percentage used relative to the synthetic product. This reversion to natural rubber was accompanied in 1948 by a growing consumption of contact blacks in preference to the furnace blacks which became so important in synthetic compounding. With compounding following this pattern, a major factor in the future course of the carbon-black industry will be the ability of synthetic rubber to compete, on its own merits, with the natural product.

Regardless of merit, a certain quantity of synthetic material must be incorporated in rubber products to maintain our rubber self-sufficiency; but beyond this, synthetic rubber production will depend upon the price and service competition it can offer.

The brightest hope of synthetic rubber standing on its own has been the excellent properties shown by so-called "cold rubber." This is a synthetic rubber manufactured under refrigerated temperature conditions. Tire tread compounded from this material apparently wears longer than that made of natural rubber. The other properties of "cold rubber" fall between those of ordinary synthetic and natural rubber. The Reconstruction Finance Corporation has authorized that half of the operating synthetic rubber capacity be converted to this process, which will give a "cold-rubber" capacity of nearly 200,000 tons per year by the middle of 1949.

Paralleling the development of "cold rubber" has been an improvement in the reinforcing properties of furnace blacks. The particle size of these new blacks has been reduced to that of easy-processing channel black, and their surface characteristics are such that they are more highly reinforcing than channel black of the same fineness. These highly reinforcing blacks, called "very fine furnace," "reinforcing furnace," and "high-abrasion furnace," increase the abrasion resistance of both natural and synthetic rubber above that obtainable with easy processing channel. Channel blacks give so excellent a product with natural rubber that their use in natural should not be materially affected by the new furnace types. However, both standard and low-temperature GR–S have given their best performance when compounded with the new types of furnace blacks, and demand for synthetics and these blacks should be closely related.

The coarser type of furnace black, semireinforcing furnace, now enjoys an economic advantage over channel black because of the high yield of this furnace process. The yield from natural gas of the fine furnace blacks, however, is less than one-third that obtained when semireinforcing grades are produced. Because of the low yield of the fine grades of furnace black and the reduced rate at which they can be produced, the cost advantage over channel black tends to disappear. At the end of 1948, rubber grades of channel black and fine furnace black were quoted at the same price.

Two methods have developed for producing these highly reinforcing furnace blacks. One, just discussed, uses natural gas as feedstock. To realize a reasonable yield from this method, additional equipment must be installed at the furnace plant to preheat the gas, and the process is difficult to control. The other procedure is to use an oil feed or a combination of gas and oil. This method has been gaining in favor, and higher yields and throughputs have been obtained than with gas alone. Gas is still a cheaper source of carbon than oil. The growth of this process will depend in large measure upon the relative price of natural gas and petroleum fractions in the future.

The practicability of producing carbon blacks from liquid-petroleum fractions will have a decentralizing effect on the industry because transportation and storage is a lesser problem for oil in many areas than for gas. One plant is operating in Wales and two are now scheduled for construction in England, our largest export customer for blacks. Both of these will be furnace-type plants and will use a liquid feedstock. One, to be operated by Philblack, Ltd., under a licensing agreement with Phillips Petroleum Corp., will be financed privately and produce 20 million pounds per year of carbon black. The other plant, the first to be approved under the guaranteed investment plan of the Economic Cooperation Administration, will be operated by Cabot Carbon, Ltd., a subsidiary of Godfrey L. Cabot, Inc. This plant is scheduled to produce 10 million pounds of black per year and to be in full operation by the end of 1950.

Cement

By D. G. RUNNER AND ESTHER V. BALSER

GENERAL SUMMARY

PRODUCTION and apparent consumption, as indicated by mill shipments of cement in 1948, increased sharply over the preceding year's totals. The efforts of the industry to pace demands resulted in the greatest output of cement in history. Total production of 208,888,511 barrels of hydraulic cements was 10 percent greater than in 1947. The gains were reflected in all types (portland cement and other hydraulic cements—natural, masonry, puzzolan, and hydraulic lime). The portland-cement industry operated at 81 percent and the remainder of the hydraulic cement industry at 99 percent of productive capacity during 1948. Mill shipments of portland cement, which totaled 204,304,662 barrels, represented an increase of 9 percent over the 1947 figures—an all-time record. Shipments of other hydraulic cements increased 15 percent. Stocks of all hydraulic cements at mills on December 31, 1948, amounted to 11,365,729 barrels, 12 percent greater than at the end of 1947.

The average net mill realization per barrel of portland cement reached $2.18—an increase of 28 cents over the 1947 price. Other hydraulic cements, as a group, reported a gain of 32 cents a barrel to $2.29.

The long-term trend, as indicated by the moving 12-month total of production of finished portland cement in the Bureau of Mines Monthly Cement Reports, continued the climb started in 1945 and reached a record high in December 1948.

Monthly production during 1948 totaled 14.5 million barrels in January, declined slightly in February, increased gradually through August, declined again slightly in the following month, and reached a high for the year of 19.3 million barrels in October. From this point production gradually declined to a year-end output of 17.4 million barrels. The monthly average for the year exceeded 17 million barrels.

Salient statistics of the cement industry in the United States, 1944–48 [1]

	1944	1945	1946	1947	1948
Production of finished cement:					
Portland ... barrels	90,905,696	102,804,884	164,064,188	186,519,347	205,448,263
Masonry, natural, and puzzolan (slag-lime) ... barrels	1,246,703	1,483,763	2,474,674	2,951,098	3,440,248
Total production ... do	92,152,399	104,288,647	166,538,862	189,470,445	208,888,511
Capacity used at portland-cement mills ... percent	37.8	42.5	67.9	74.9	80.8
Production of portland-cement clinker [2] ... barrels	90,508,803	102,702,976	165,126,403	187,602,420	207,544,072
Active plants:					
Portland	151	145	153	150	150
Masonry, natural, and puzzolan (slag-lime)	9	9	9	9	9
Shipments from mills:					
Portland ... barrels	94,271,881	106,353,595	169,567,593	187,491,869	204,304,662
Value [3]	$150,357,754	$173,337,010	$292,396,343	$356,213,976	$445,678,073
Per barrel	$1.59	$1.63	$1.72	$1.90	$2.18
Masonry, natural, and puzzolan (slag-lime) ... barrels	1,320,274	1,479,513	2,533,106	2,927,885	3,375,135
Value [3]	$1,638,892	$2,093,848	$4,155,171	$5,764,398	$7,734,289
Per barrel	$1.24	$1.42	$1.64	$1.97	$2.29
Total shipments ... barrels	95,592,155	107,833,108	172,100,699	190,419,754	207,679,797
Value	$151,996,646	$175,430,858	$296,551,514	$361,978,374	$453,412,362
Stocks at mills, Dec. 31:					
Portland:					
Finished cement ... barrels	19,952,711	16,454,775	10,969,755	[4] 10,011,607	[5] 11,155,208
Clinker [2] ... do	5,328,986	4,462,633	3,886,443	[4] 3,605,299	[5] 3,781,254
Masonry, natural, and puzzolan (slag-lime) ... barrels	166,889	170,324	112,031	[4] 145,408	[5] 210,521
Imports ... do	169	323	3,734	4,606	282,852
Exports ... do	4,040,405	6,474,721	5,163,362	[6] 6,771,250	5,922,163
Apparent consumption [7] ... do	91,551,919	101,358,710	166,941,071	[6] 183,454,387	202,040,486

[1] Figures include Puerto Rico and 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.
[6] 198,723 barrels, valued at $839,916, shipped under the U. S. Army Civilian Supply Program, is excluded from exports shown but is deducted from apparent consumption.
[7] Shipments from domestic mills plus net imports.

Monthly shipments from mills in 1948 followed the prewar seasonal pattern, but at a much higher level. With the exception of 2 months, February and October, monthly shipments were higher in 1948 than in the preceding year. Mill shipments amounted to 9.2 million barrels in January, declined in February, increased gradually to 21.4 million barrels in June, and declined again in the following 3 months until another peak of 20.3 million barrels was reached. Shipments then declined to 12.7 million barrels in December.

Consumption trends of portland cement in 1948, as indicated in figure 1, are about the same as in the previous year. The Middle States [1] were the leading consuming region.

The improvement and expansion program of the cement industry continued in 1948, as three new wet-process plants were put into operation. The Ideal Cement Co., of Denver, Colo., started operation during the year of its "twin" plants at two locations where it also operates two dry-process plants—the Colorado Portland Cement Division, Portland, Colo., which began operating in June, and the Union Portland Cement Division, Devils Slide, Utah, which started producing in October. The Carolina Giant Cement Co., Philadelphia, Pa., started production in December from its new plant at

[1] The States comprising each region are found in Minerals Yearbook, 1945, p. 1222.

Harleyville, S. C. Other developments include the proposal of the Lehigh Portland Cement Co., Allentown, Pa., to build a new plant on a 9,500-acre site near Flagler Beach, Fla. The raw material will be coquina limestone found near the site. Although final details have not been concluded, a new 10-million-dollar wet-process plant is proposed for construction near Banning and Palm Springs, Calif. Action is delayed, however, by a zoning ordinance which would bar construction of the plant. Existing installations were improved by numerous cement companies during the year. The Portland Point, N. Y., plant of the Pennsylvania-Dixie Cement Corp. remained inactive during 1948, and the dry-process Northampton, Pa., plant of the Universal-Atlas Cement Co., after being kept in a stand-by condition for a number of years, was dismantled during the year.

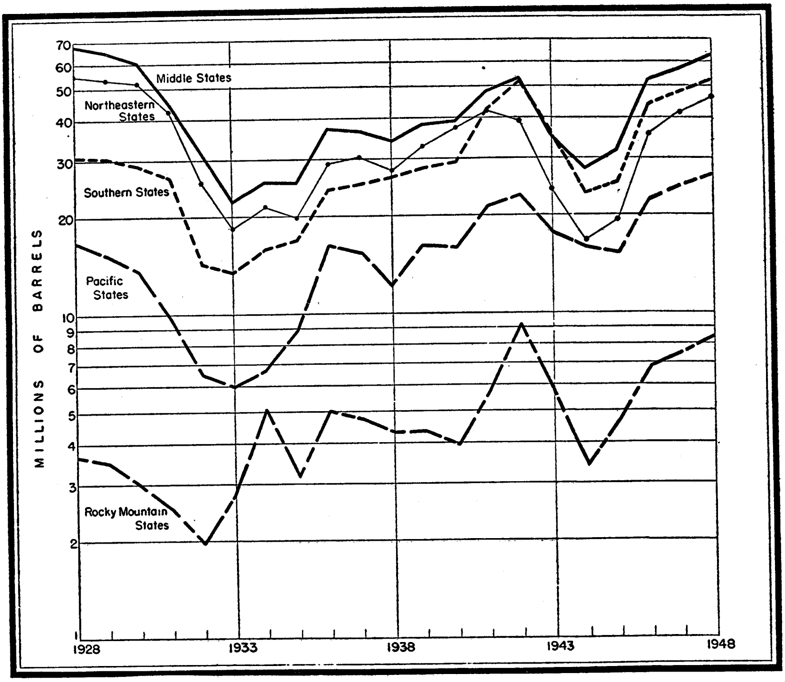

FIGURE 1.—Trends of indicated consumption of portland cement in continental United States, 1928–48, by regions.

The United States Supreme Court decision of April 26, 1948, on the basing-point price system has apparently left much confusion and many interpretations in its wake. The cement companies, in general, have abandoned the multiple-basing-point delivered price and are selling their product at prices f. o. b. the shipping point or, if the purchaser desires, at a delivered price reflecting full freight charges from shipping point to destination. At least one company, it is reported, is adhering to the competitive sales policy in effect before the multiple-basing-point system was outlawed. The United States Senate named a special committee to study the effect of the Supreme Court's decision.

PRODUCTION, SHIPMENTS, AND STOCKS

PORTLAND CEMENT

In 1948 the output of portland cement constituted 98 percent of the total output of hydraulic cements. This production came from 150 active plants located in 35 States and Puerto Rico. One new plant began operating in December 1948, but no shipments were made from it during the year.

Production in 1948 was greater in all districts, as grouped by the Bureau of Mines, than in 1947. In continental United States the increases ranged from 4 percent in the Alabama district to 19 percent in the Colorado-Wyoming-Montana-Utah-Idaho district. The Puerto Rico district production increased 30 percent over the preceding year. Quantitywise, the Eastern Pennsylvania-Maryland district led with an output of 33,589,877 barrels, followed by California with a 24,601,-892-barrel production. The following districts produced more than 10 million barrels in 1948: Texas, New York-Maine, Indiana-Kentucky-Wisconsin, Michigan, and Ohio. These seven districts supplied 58 percent of the total output.

Shipments of finished portland cement were also greater in all districts in 1948 than in 1947. The increases ranged from 4 percent in the Indiana-Kentucky-Wisconsin district to 17 percent in the Oregon-Washington district, while a gain of 28 percent was registered in the Puerto Rico district.

Stocks of finished cement were 11 percent greater on December 31, 1948, than on the same date of the preceding year. Seven districts (including Puerto Rico) show decreases in stocks from the 1947 total, and 12 reported increases ranging from 1 percent in the Eastern Missouri-Minnesota-South Dakota and Kansas districts to 116 percent in the Colorado-Wyoming-Montana-Utah-Idaho district. The trend of month-end stocks of clinker in 1948 varied slightly from the preceding year's pattern. The peak was reached in March instead of May, as in the previous year. The decreases continued gradually to the low for the year in November.

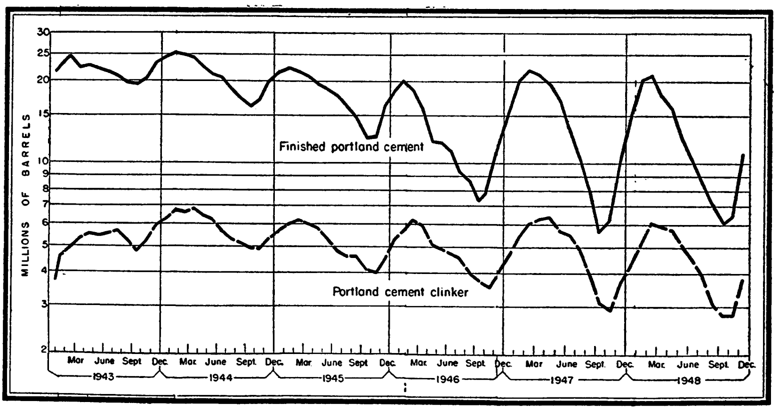

FIGURE 2.—Trends in end-of-month stocks of finished portland cement and portland-cement clinker 1943–48.

Finished portland cement produced, shipped, and in stock in the United States, 1947–48, by districts

District	Active plants		Production			Shipments from mills								Stocks at mills on Dec. 31		
			Barrels			1947			1948					Barrels		
	1947	1948	1947	1948	Percent change from 1947	Barrels	Value: Total	Value: Average	Barrels	Value: Total	Value: Average	Percent change from 1947 in— Barrels	Percent change from 1947 in— Average value	1947	1948 [1]	Percent change from 1947
Eastern Pennsylvania and Maryland	21	21	29,602,680	33,589,877	+13.5	29,903,222	$53,741,512	$1.80	33,518,779	$71,150,988	$2.12	+12.1	+17.8	[2] 1,661,398	1,732,496	+4.3
New York and Maine	12	11	12,132,952	13,504,096	+11.3	12,548,319	23,031,143	1.84	13,475,277	28,825,985	2.14	+7.4	+16.3	[2] 1,014,711	1,043,530	+2.8
Ohio	9	9	9,382,564	10,035,211	+7.0	9,296,311	16,611,421	1.79	10,020,198	20,496,930	2.05	+7.8	+14.5	[2] 606,345	621,358	+2.5
Western Pennsylvania and West Virginia	8	8	8,168,412	8,940,151	+9.4	8,250,695	14,616,077	1.77	8,931,245	18,518,280	2.07	+8.2	+16.9	[2] 611,907	620,813	+1.5
Michigan	9	7	10,211,809	11,410,085	+11.7	10,470,766	18,868,187	1.80	11,116,911	23,533,001	2.12	+6.2	+17.8	891,584	1,184,758	+32.9
Illinois	4	4	7,227,748	7,570,536	+4.7	7,155,280	13,219,260	1.85	7,573,404	15,200,723	2.01	+5.8	+8.6	[2] 483,450	480,582	−0.6
Indiana, Kentucky, and Wisconsin	6	6	11,636,308	12,333,325	+6.0	11,696,651	21,377,465	1.83	12,153,061	24,479,875	2.01	+3.9	+9.8	[2] 568,094	748,358	+31.7
Alabama	7	7	9,514,190	9,908,219	+4.1	9,509,697	16,663,543	1.75	9,948,600	20,140,177	2.02	+4.6	+15.4	314,542	274,161	−12.8
Tennessee	6	6	5,900,618	6,727,160	+14.0	6,101,108	11,017,225	1.81	6,774,926	13,667,060	2.02	+11.0	+11.6	259,464	211,698	−18.4
Virginia, Georgia, Florida, Louisiana and South Carolina [3]	6	7	6,118,256	7,134,091	+16.6	6,147,130	12,190,232	1.98	7,058,877	16,201,937	2.30	+14.8	+16.2	[2] 209,017	284,231	+36.0
Iowa	5	5	6,335,666	6,807,214	+7.4	6,155,670	12,054,420	1.96	6,835,578	14,424,526	2.11	+11.0	+7.7	[2] 502,082	473,718	−5.6
Eastern Missouri, Minnesota, and South Dakota	6	6	9,134,368	9,654,828	+5.7	9,127,591	17,360,892	1.90	9,649,881	20,740,674	2.15	+5.7	+13.2	[2] 472,532	477,479	+1.0
Kansas	6	6	7,131,802	7,933,899	+11.2	7,208,147	13,017,277	1.81	7,930,965	16,188,379	2.04	+10.0	+12.7	268,864	271,798	+1.1
Western Missouri, Nebraska, Oklahoma, and Arkansas	6	6	6,392,194	6,960,336	+8.9	6,378,721	11,779,421	1.85	6,860,520	14,528,697	2.12	+7.6	+14.6	280,804	380,620	+35.5
Texas	10	10	12,462,925	13,700,633	+9.9	12,349,219	24,111,833	1.95	13,786,846	30,352,972	2.20	+11.6	+12.8	[2] 516,610	430,397	−16.7
Colorado, Wyoming, Montana, Utah, and Idaho	7	9	4,586,069	5,456,272	+19.0	4,631,303	10,737,902	2.32	5,250,131	14,314,150	2.73	+13.4	+17.7	[2] 177,409	383,550	+116.2
California	11	11	22,788,173	24,601,892	+8.0	22,846,458	46,539,749	2.04	24,162,926	57,742,226	2.39	+5.8	+17.2	[2] 586,438	1,025,404	+74.9
Oregon and Washington	9	9	5,917,445	6,740,050	+13.9	5,811,456	13,937,036	2.40	6,816,082	18,224,466	2.67	+17.3	+11.3	563,845	487,813	−13.5
Puerto Rico	2	2	1,875,168	2,440,388	+30.1	1,904,125	5,339,381	2.80	2,440,455	6,947,027	2.85	+28.2	+1.8	22,511	22,444	−0.3
Total	150	150	186,519,347	205,448,263	+10.1	187,491,869	356,213,976	1.90	204,304,662	445,678,073	2.18	+9.0	+14.7	[2] 10,011,607	11,155,208	+11.4
Pennsylvania	24	24	33,349,859	38,310,627	+14.9	33,655,687	60,998,207	1.81	38,255,543	81,638,484	2.13	+13.7	+17.7	[2] 2,005,479	2,060,563	+2.7
Missouri	5	5	8,013,550	8,503,012	+6.1	8,030,939	15,066,390	1.88	8,428,343	17,911,257	2.13	+4.9	+13.3	[2] 383,800	458,469	+19.5

[1] Subject to revision.
[2] Revised figure.
[3] South Carolina began producing in December 1948; no shipments made.

Production, shipments from mills, and stocks at mills of finished portland cement in the United States in 1948, 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	2,438	2,264	2,429	2,653	2,971	2,840	2,955	2,984	3,053	3,118	3,014	2,849
New York and Maine	831	792	837	1,049	1,175	1,170	1,364	1,288	1,297	1,340	1,194	1,177
Ohio	716	483	705	743	912	887	1,030	970	841	974	931	843
Western Pennsylvania and West Virginia	692	544	698	653	795	741	777	816	745	893	820	765
Michigan	826	367	437	546	980	1,219	1,298	1,324	1,204	1,135	1,115	960
Illinois	620	468	387	612	663	618	739	669	688	714	657	736
Indiana, Kentucky, and Wisconsin	803	776	903	1,045	921	1,060	1,169	1,232	1,141	1,166	1,155	964
Alabama	726	620	804	825	851	819	863	914	892	899	855	844
Tennessee	494	455	507	542	584	575	590	631	564	616	592	578
Virginia, Georgia, Florida, Louisiana, and South Carolina [1]	510	550	551	558	597	578	623	605	624	634	621	662
Iowa	473	465	424	506	676	625	573	625	672	685	575	509
Eastern Missouri, Minnesota, and South Dakota	550	636	735	722	949	913	873	869	851	883	849	813
Kansas	531	606	501	589	736	717	726	704	718	745	706	657
Western Missouri, Nebraska, Oklahoma, and Arkansas	426	513	482	508	635	652	539	645	594	610	707	649
Texas	935	1,088	1,044	1,181	1,095	1,142	1,208	1,158	1,196	1,178	1,167	1,307
Colorado, Wyoming, Montana, Utah, and Idaho	408	315	301	404	415	394	487	540	486	591	610	507
California	1,936	1,824	2,013	2,140	2,019	2,022	2,077	2,133	2,152	2,320	2,078	1,890
Oregon and Washington	422	414	515	570	559	586	638	639	676	639	591	500
Puerto Rico	204	167	229	195	207	199	192	215	211	209	198	215
United States: 1948	14,541	13,347	14,502	16,041	17,740	17,757	18,721	18,961	18,605	19,349	18,435	17,425
1947	13,406	12,618	14,205	14,566	13,389	15,971	16,342	17,480	17,319	18,300	16,814	16,123
SHIPMENTS												
Eastern Pennsylvania and Maryland	1,324	1,161	2,494	3,090	2,963	3,445	3,672	3,403	3,402	3,384	3,150	2,030
New York and Maine	476	433	769	1,171	1,310	1,487	1,501	1,488	1,469	1,444	1,209	717
Ohio	302	290	674	907	1,014	1,160	1,106	1,114	942	1,077	930	504
Western Pennsylvania and West Virginia	261	221	487	657	825	1,148	1,136	1,004	903	1,012	845	432
Michigan	266	296	460	976	970	1,324	1,334	1,455	1,384	1,297	911	445
Illinois	159	198	355	749	885	1,015	807	832	761	746	717	351
Indiana, Kentucky, and Wisconsin	389	413	743	1,170	1,371	1,418	1,292	1,206	1,152	1,245	1,158	596
Alabama	625	568	812	869	910	912	906	906	882	919	842	799
Tennessee	328	333	565	660	637	654	600	626	615	620	578	559
Virginia, Georgia, Florida, and Louisiana	424	414	583	621	612	644	653	636	614	642	620	595
Iowa	127	138	308	792	915	888	756	758	738	672	566	186
Eastern Missouri, Minnesota, and South Dakota	284	244	544	921	1,091	1,254	1,080	932	902	945	891	561
Kansas	330	183	421	950	888	797	742	747	749	778	753	593

See footnote at end of table.

Production, shipments from mills, and stocks at mills of finished portland cement in the United States in 1948, by months and districts, in thousands of barrels—Continued

District	January	February	March	April	May	June	July	August	September	October	November	December
SHIPMENTS—continued												
Western Missouri, Nebraska, Oklahoma, and Arkansas	296	164	394	768	660	685	597	690	684	720	644	558
Texas	909	678	1,220	1,288	1,182	1,231	1,279	1,198	1,194	1,221	1,142	1,247
Colorado, Wyoming, Montana, Utah, and Idaho	253	193	314	531	492	450	497	548	509	596	512	353
California	1,909	1,880	2,049	2,105	2,003	2,087	2,128	2,176	2,085	2,121	1,941	1,679
Oregon and Washington	353	354	545	619	621	609	726	767	736	670	512	317
Puerto Rico	190	177	220	203	195	218	182	219	217	215	189	219
United States: 1948	9,205	8,338	13,957	19,047	19,544	21,426	20,994	20,705	19,938	20,324	18,110	12,741
1947	8,395	8,434	12,133	15,414	15,328	18,179	20,099	20,365	19,840	20,562	16,267	12,379
STOCKS (END OF MONTH)												
Eastern Pennsylvania and Maryland	2,778	3,880	3,816	3,378	3,386	2,781	2,065	1,648	1,298	1,031	895	1,713
New York and Maine	1,366	1,725	1,793	1,671	1,536	1,219	1,082	872	701	597	583	1,043
Ohio	1,028	1,220	1,252	1,088	987	714	638	492	393	301	283	621
Western Pennsylvania and West Virginia	990	1,313	1,525	1,522	1,492	1,085	725	536	379	262	237	570
Michigan	1,452	1,523	1,500	1,070	1,080	976	939	768	628	465	669	1,185
Illinois	949	1,219	1,251	1,113	891	493	425	262	188	156	95	481
Indiana, Kentucky, and Wisconsin	980	1,343	1,503	1,379	929	571	451	478	466	384	380	748
Alabama	411	463	455	411	352	260	217	226	235	216	229	274
Tennessee	424	546	488	370	317	238	227	233	181	178	192	212
Virginia, Georgia, Florida, Louisiana, and South Carolina [1]	315	451	418	354	340	274	244	214	224	216	217	284
Iowa	856	1,182	1,298	1,013	773	511	328	194	129	143	151	474
Eastern Missouri, Minnesota, and South Dakota	744	1,136	1,327	1,129	991	654	447	384	328	268	226	477
Kansas	471	890	971	609	458	377	361	317	287	254	207	272
Western Missouri, Nebraska, Oklahoma, and Arkansas	411	760	848	587	563	529	471	425	336	226	290	381
Texas	543	953	778	670	583	495	424	385	387	344	370	430
Colorado, Wyoming, Montana, Utah, and Idaho	332	454	440	314	236	181	169	162	140	131	229	383
California	612	557	521	556	571	506	456	412	479	678	815	1,026
Oregon and Washington	637	698	667	618	556	533	445	316	257	226	304	487
Puerto Rico	37	27	35	28	45	25	35	31	25	18	27	22
United States: 1948	15,336	20,340	20,886	17,880	16,086	12,422	10,149	8,355	7,061	6,094	6,399	[2] 11,083
1947	15,931	20,112	22,178	21,331	19,388	17,095	13,337	10,452	7,921	5,668	6,209	[3] 9,975

[1] South Carolina began producing in December 1948; no shipments made.
[2] Subject to revision.
[3] Revised figure.

Stocks of finished portland cement and portland-cement clinker at mills in the United States [1] on Dec. 31, and yearly range in end-of-month stocks, 1944–48

		Dec. 31 (barrels)	Range			
			Low		High	
			Month	Barrels	Month	Barrels
1944	Cement	19,952,711	October	16,049,000	February	25,073,000
	Clinker	5,329,000	November	4,856,000	April	6,687,000
1945	Cement	16,454,775	October	12,385,000	February	22,171,000
	Clinker	4,462,633	November	4,022,000	March	6,185,000
1946	Cement	10,969,755	October	7,298,000	February	20,034,000
	Clinker	3,886,443	November	3,512,000	March	6,281,000
1947	Cement	[2] 10,011,607	October	5,668,000	do	22,178,000
	Clinker	[2] 3,605,299	November	2,929,000	May	6,353,000
1948	Cement	[3] 11,155,208	October	6,094,000	March	20,886,000
	Clinker	[3] 3,781,254	November	2,781,000	do	6,072,000

[1] Includes Hawaii and Puerto Rico.
[2] Revised figure.
[3] Subject to revision.

NATURAL, MASONRY (NATURAL), AND PUZZOLAN CEMENTS

In 1948, as in the previous year, nine cement plants produced hydraulic cements other than portland. Output, shipments, and stocks in 1948 were, respectively, 17, 15, and 45 percent greater than in the previous year. Producers reported the consumption of 47,609 short tons of coal and of gas equivalent to approximately 3,927 short tons of coal. Statistics for the 5-year period 1944–48 are shown in the following table.

Natural, masonry (natural), and puzzolan (slag-lime) cements produced, shipped, and in stock at mills in the United States, 1944–48

Year	Production		Shipments		Stocks on Dec. 31
	Active plants	Barrels (376 pounds)	Barrels (376 pounds)	Value	Barrels (376 pounds)
1944	9	1,246,703	1,320,274	$1,638,892	166,889
1945	9	1,483,763	1,479,513	2,093,848	170,324
1946	9	2,474,674	2,533,106	4,155,171	112,031
1947	9	2,951,098	2,927,885	5,764,398	[1] 145,408
1948	9	3,440,248	3,375,135	7,734,289	[2] 210,521

[1] Revised figure.
[2] Subject to revision.

TYPES OF CEMENT

A break-down of the total production of portland cement by various types for the 1944–48 period is shown in the accompanying table. With the exception of high-early-strength cement, the output of all types increased in 1948 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, showed substantial gains over the previous year's figures. Increases in sales of sulfate-resisting, type V, and white cements are noteworthy.

Prepared Masonry Mortars.—Production of these mixed materials in 1948 was reported by 86 plants and totaled 10,523,545 barrels.

Shipments reached 10,321,781 barrels valued at $26,226,385—an average of $2.54 per barrel. These data are not included in the statistical tabulations in this chapter, but the portland cement used in manufacturing these mixtures is included.

Portland cement produced and shipped in the United States,[1] 1944–48, by types

Type and year	Active plants	Production (barrels)	Shipments		
			Barrels	Value	
				Total	Average
General use and moderate heat (types I and II):					
1944 [2]	151	83, 576, 685	86, 933, 387	$135, 564, 313	$1. 56
1945	145	89, 922, 894	93, 379, 480	148, 653, 647	1. 59
1946	153	139, 173, 936	144, 038, 503	244, 051, 517	1. 69
1947	150	157, 525, 464	158, 637, 287	297, 619, 024	1. 88
1948	150	174, 909, 904	173, 365, 414	374, 584, 386	2. 16
High-early-strength (type III):					
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
1947	92	6, 015, 985	5, 899, 830	13, 284, 390	2. 25
1948	92	5, 513, 312	5, 615, 894	14, 224, 177	2. 53
Low-heat (type IV):					
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
1947	5	125, 113	137, 469	252, 721	1. 84
1948	3	135, 871	153, 994	306, 962	1. 99
Sulfate-resisting (type V):					
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
1947	5	64, 126	94, 455	231, 523	2. 45
1948	6	204, 862	163, 127	505, 710	3. 10
Oil-well:					
1944	15	938, 872	931, 371	1, 802, 361	1. 94
1945	16	1, 231, 756	1, 305, 493	2, 499, 739	1. 91
1946	17	1, 510, 843	1, 568, 881	3, 110, 351	1. 98
1947	18	1, 701, 305	1, 708, 719	3, 592, 577	2. 10
1948	14	1, 817, 746	1, 966, 854	4, 972, 499	2. 53
White:					
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, 200	4. 14
1947	4	855, 323	837, 489	3, 762, 417	4. 49
1948	4	1, 034, 500	1, 005, 356	4, 510, 169	4. 49
Portland-puzzolan:					
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, 870	1. 55
1947	5	1, 519, 961	1, 529, 551	2, 970, 919	1. 94
1948	6	1, 545, 584	1, 693, 207	3, 733, 436	2. 20
Air-entrained:					
1945 [3]	52	5, 075, 332	4, 903, 355	7, 773, 719	1. 59
1946	69	13, 765, 384	13, 850, 983	23, 173, 284	1. 67
1947	73	17, 850, 165	17, 768, 010	32, 359, 835	1. 82
1948	73	19, 421, 610	19, 453, 359	40, 322, 716	2. 07
Miscellaneous: [4]					
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
1947	20	861, 905	879, 059	2, 140, 570	2. 44
1948	20	864, 874	887, 457	2, 518, 018	2. 84

[1] Including Puerto Rico and Hawaii.
[2] Includes air-entrained and Vinsol resin cements classed as modified cements by producers.
[3] Figures reported separately for the first time in 1945.
[4] Includes hydroplastic, plastic, and waterproofed cements.

CAPACITY OF PLANTS

The aggregate annual capacity of all portland-cement plants in 1948, as reported to the Bureau of Mines, increased 2 percent over that reported in 1947.

The over-all rate of operation in 1948 was at 81 percent of total capacity. As indicated in the following table, the percentage of capacity utilized gained in all but two operating districts—Virginia-Georgia-Florida-Louisiana-South Carolina and Colorado-Wyoming-Montana-Utah-Idaho. In the continental United States the increases in percentage points ranged from 1 in the Iowa district to 17 in the Eastern Pennsylvania-Maryland district. An increase of 21 percent was recorded in the Puerto Rico district. The percentage of capacity used in each month of 1948 was higher than in the corresponding months of 1947 and—with the exception of a slight decrease in February from January figures—followed the seasonal pattern of low rates in the first quarter and a steady increase to a peak in September and October, with a decline at year end.

Portland-cement-manufacturing capacity of the United States, 1947–48, by districts

District	Estimated capacity (barrels)		Percent of capacity utilized	
	1947	1948	1947	1948
Eastern Pennsylvania and Maryland	42, 819, 325	38, 943, 325	69. 1	86. 3
New York and Maine	17, 391, 715	17, 561, 640	69. 8	76. 9
Ohio	12, 483, 515	12, 952, 515	75. 2	77. 5
Western Pennsylvania and West Virginia	13, 961, 300	13, 961, 300	58. 5	64. 0
Michigan	12, 974, 046	14, 200, 000	78. 7	80. 4
Illinois	9, 864, 510	9, 864, 510	73. 3	76. 7
Indiana, Kentucky, and Wisconsin	17, 908, 000	17, 989, 163	65. 0	68. 6
Alabama	10, 980, 810	11, 177, 660	86. 6	88. 6
Tennessee	7, 417, 000	7, 357, 000	79. 6	91. 4
Virginia, Georgia, Florida, Louisiana, and South Carolina [1]	7, 580, 000	9, 980, 000	80. 7	71. 5
Iowa	7, 930, 000	8, 430, 000	79. 9	80. 7
Eastern Missouri, Minnesota, and South Dakota	11, 322, 295	11, 387, 265	80. 7	84. 8
Kansas	9, 440, 000	9, 497, 000	75. 5	83. 5
Western Missouri, Nebraska, Oklahoma, and Arkansas	7, 670, 000	7, 850, 000	83. 3	88. 7
Texas	14, 936, 000	16, 006, 000	83. 4	85. 6
Colorado, Wyoming, Montana, Utah, and Idaho	4, 890, 000	7, 625, 000	93. 8	71. 6
California	29, 438, 702	29, 170, 000	77. 4	84. 3
Oregon and Washington	7, 600, 000	7, 780, 000	77. 9	86. 6
Puerto Rico	2, 500, 000	2, 540, 000	75. 0	96. 1
Total	249, 107, 218	254, 272, 378	74. 9	80. 8

[1] South Carolina began producing in December 1948; no shipments made.

Percentage of capacity used in the finished portland-cement industry in the United States, 1947–48

Month	Monthly		12 months ended—		Month	Monthly		12 months ended—	
	1947	1948	1947	1948		1947	1948	1947	1948
January	66	71	70	78	July	80	90	75	81
February	68	70	71	79	August	86	91	75	82
March	69	71	72	79	September	88	93	76	83
April	74	80	73	78	October	90	93	77	83
May	66	86	74	80	November	85	92	77	84
June	81	89	74	80	December	79	84	78	84

Total capacity of wet-process plants, as indicated in the accompanying table, increased slightly in 1948, in contrast to dry-process plants, whose capacity declined. The percentage of cement produced by wet-process plants in 1948, however, was maintained at about the same level as in 1947.

A grouping of the cement plants based on their estimated annual capacity is shown in the following table. Gains were registered in the 1,000,000- to 2,000,000-, and 2,000,000- to 3,000,000-barrel-capacity groups, whereas the number of plants in the less-than-1,000,000-barrel class declined.

Number of portland-cement plants in the United States (including Puerto Rico), by size groups, in 1948

Estimated annual capacity, barrels:	*Number of plants*
Less than 1,000,000	26
1,000,000 to 2,000,000	96
2,000,000 to 3,000,000	18
3,000,000 to 10,000,000	11
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Capacity of portland-cement plants in the United States,[1] 1946–48, by processes

Process	Capacity						Percent of capacity utilized			Percent of total finished cement produced		
	Thousands of barrels			Percent of total								
	1946	1947	1948	1946	1947	1948	1946	1947	1948	1946	1947	1948
Wet	125,227	129,116	136,588	51.8	51.8	53.7	70.2	78.0	81.4	53.6	54.0	54.1
Dry	116,395	119,991	117,684	48.2	48.2	46.3	65.4	71.5	80.1	46.4	46.0	45.9
Total	241,622	249,107	254,272	100.0	100.0	100.0	67.9	74.9	80.8	100.0	100.0	100.0

[1] Includes Puerto Rico and Hawaii.

CLINKER PRODUCTION

The output of clinker, the intermediate product of the industry, was 11 percent greater in 1948 than in 1947. Peak production was reached in October, while stocks reached their greatest accumulation in March. Stocks of clinker on December 31, 1948, were 5 percent greater than those reported for the year-end 1947.

Production and stocks of portland-cement clinker at mills in the United States in 1948, 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	2,561	2,390	2,467	2,674	2,935	2,867	2,968	3,030	3,039	3,149	2,974	2,943
New York and Maine	974	815	934	1,002	1,093	1,161	1,275	1,264	1,242	1,315	1,216	1,226
Ohio	795	572	742	764	902	914	951	891	796	983	942	867
Western Pennsylvania and West Virginia	687	632	733	712	762	736	797	772	705	857	820	859
Michigan	872	576	690	781	884	1,073	1,107	1,190	1,155	1,216	1,103	1,115
Illinois	618	580	523	598	624	571	663	654	627	684	673	725
Indiana, Kentucky, and Wisconsin	862	898	979	985	1,088	1,069	1,146	1,148	1,117	1,205	1,153	1,186
Alabama	712	680	826	871	861	849	884	910	864	884	830	867
Tennessee	521	492	537	557	588	558	570	614	559	578	580	585
Virginia, Georgia, Florida, Louisiana, and South Carolina [1]	562	570	594	569	613	601	604	620	625	639	648	724
Iowa	550	512	492	505	594	466	606	622	605	658	598	611
Eastern Missouri, Minnesota, and South Dakota	669	680	779	663	855	808	829	838	810	878	859	873
Kansas	588	579	547	557	741	715	714	676	713	768	685	689
Western Missouri, Nebraska, Oklahoma, and Arkansas	491	536	480	498	628	598	597	607	545	612	714	618
Texas	956	1,134	1,105	1,144	1,100	1,130	1,244	1,179	1,146	1,214	1,175	1,216
Colorado, Wyoming, Montana, Utah, and Idaho	398	333	353	363	429	393	506	517	511	583	577	592
California	1,943	1,848	1,973	2,070	2,094	2,015	2,130	2,190	2,116	2,237	2,139	2,112
Oregon and Washington	473	426	517	547	609	619	573	567	607	646	592	609
Puerto Rico	223	191	168	190	217	193	183	198	179	209	192	207
United States: 1948	15,455	14,444	15,439	16,050	17,617	17,336	18,347	18,487	17,961	19,315	18,470	18,624
1947	14,274	13,496	14,903	15,052	13,451	15,494	16,231	16,881	16,466	17,597	16,734	17,023
STOCKS (END OF MONTH)												
Eastern Pennsylvania and Maryland	745	857	875	858	790	772	726	689	561	530	475	532
New York and Maine	376	409	504	473	418	417	348	326	289	276	316	368
Ohio	338	417	446	436	411	412	332	237	181	181	170	183
Western Pennsylvania and West Virginia	176	265	318	349	306	281	288	250	195	138	137	227
Michigan	265	411	623	839	717	550	338	176	78	114	82	180
Illinois	131	236	369	335	274	216	134	109	43	12	22	7
Indiana, Kentucky, and Wisconsin	293	371	430	362	516	504	463	378	339	349	340	524
Alabama	88	133	145	182	173	187	193	175	135	104	78	94
Tennessee	214	239	248	250	237	203	171	151	134	77	62	59

See footnote at end of table.

Production and stocks of portland-cement clinker at mills in the United States in 1948, by months and districts, in thousands of barrels—Continued

District	January	February	March	April	May	June	July	August	September	October	November	December
STOCKS (END OF MONTH)—continued												
Virginia, Georgia, Florida, Louisiana, and South Carolina [1]	49	55	79	74	72	82	49	51	43	34	47	94
Iowa	265	312	381	368	276	106	133	137	74	52	76	166
Eastern Missouri, Minnesota, and South Dakota	237	286	349	308	244	146	129	115	89	99	111	172
Kansas	117	90	141	102	103	93	73	41	36	57	37	60
Western Missouri, Nebraska, Oklahoma, and Arkansas	112	137	159	141	125	76	130	106	59	50	59	29
Texas	87	128	183	135	132	114	144	172	119	144	148	61
Colorado, Wyoming, Montana, Utah, and Idaho	94	110	150	105	112	110	132	102	125	113	73	152
California	425	410	389	347	405	385	413	456	410	318	362	568
Oregon and Washington	218	230	235	216	271	307	249	184	121	131	140	258
Puerto Rico	69	100	48	50	68	71	69	61	37	45	46	47
United States: 1948	4,299	5,196	6,072	5,930	5,650	5,032	4,514	3,916	3,068	2,824	2,781	[2] 3,781
1947	4,593	5,354	5,996	6,338	6,353	5,746	5,514	4,855	3,889	3,114	2,929	[3] 3,605

[1] South Carolina began producing in December 1948; no shipments made.
[2] Subject to revision.
[3] Revised figure.

Portland-cement clinker produced and in stock at mills in the United States,[1] 1947–48, by processes, in barrels of 376 pounds [2]

Process	Plants		Production		Stocks on Dec. 31–	
	1947	1948	1947	1948	1947 [3]	1948 [4]
Wet	88	88	101,663,716	112,034,399	1,730,515	1,682,172
Dry	61	60	85,938,704	95,509,673	1,874,784	2,099,082
Total	149	148	187,602,420	207,544,072	3,605,299	3,781,254

[1] Including Puerto Rico.
[2] Compiled from monthly estimates of producers.
[3] Revised figures.
[4] Subject to revision.

RAW MATERIALS

For a great many years the principal raw materials for the manufacture of portland cement in the United States have been limestone and clay or shale. In 1948, 71 percent of the output was made from this combination compared with 69 percent in 1947. Cement rock and pure limestone furnished 23 percent in 1948, while the combination of blast-furnace slag and limestone in 1948 supplied 5 percent of the output. As in the past several years, marl and clay supplied a minor part of the raw materials utilized by the cement industry in 1948, accounting for only 1 percent of the total quantity used.

Production and percentage of total output of portland cement in the United States,[1] 1900–14, 1926, 1929, 1933, 1935, and 1941–48, according to raw materials

Year	Cement rock and pure limestone		Limestone and clay or shale [2]		Marl and clay		Blast-furnace slag and limestone	
	Barrels	Percent	Barrels	Percent	Barrels	Percent	Barrels	Percent
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	68.3	2,720,500	1.7	10,130,891	6.2
1947	43,428,201	23.3	129,338,247	69.3	2,408,845	1.3	11,344,054	6.1
1948	47,559,783	23.1	144,855,487	70.5	2,620,060	1.3	10,412,933	5.1

[1] Includes Puerto Rico and Hawaii, 1941–48.
[2] 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 1946–48.

The tonnages of raw materials (exclusive of fuels and explosives) required for the production of portland cement in 1946–48 are given in the following table. Limestone, cement rock, and clay and shale constitute 94 percent of the total materials consumed. Except for sand and sandstone and miscellaneous items, which show decreases, all types of raw materials consumed in 1948 show gains over the preceding year's figures.

Raw materials used in producing portland cement in the United States,[1] 1946–48

Raw material	1946	1947	1948
	Short tons	*Short tons*	*Short tons*
Cement rock	10,781,078	11,728,062	13,046,856
Limestone (including oystershells)	34,579,673	40,034,322	43,489,837
Marl	860,798	563,148	601,716
Clay and shale [2]	4,845,224	5,373,591	6,440,584
Blast-furnace slag	706,986	864,617	896,474
Gypsum	1,157,324	1,445,622	1,507,876
Sand and sandstone (including quartz)	460,910	821,017	723,769
Iron materials [3]	218,634	257,048	318,106
Miscellaneous [4]	144,139	147,056	133,716
Total	53,754,766	61,234,483	67,158,934
	Pounds	*Pounds*	*Pounds*
Average total weight required per barrel (376 pounds) of finished cement	655	657	654

[1] Including Puerto Rico and Hawaii.
[2] Includes bentonite, diatomaceous shale, and fuller's earth.
[3] Includes iron ore, pyrite cinders and ore, and mill scale.
[4] Includes diatomite, fluorspar, pumicite, flue dust, pitch, red mud and rock, hydrated lime, tufa, cinders, calcium chloride, sludge, grinding aids, and air-entraining compounds.

FUEL AND POWER

As a result of the increased output of cement in 1948, all types of fuel consumed by the portland-cement industry increased over the report for 1947, except byproduct gas. The percentage changes in consumption are: Coal, 8 percent; fuel oil, 1 percent; natural gas, 16 percent; and byproduct gas, a decrease of 56 percent. Average monthly consumption of these fuels in 1948 compared to that reported in 1947 (1947 averages in parentheses) was: Coal, 712,804 (661,465) short tons; fuel oil, 388,196 (385,344) barrels; natural gas, 6,109,433 (5,264,974) thousand cubic feet; and byproduct gas, 97,865 (223,457) thousand cubic feet.

The number of plants using electric energy, the kilowatt-hours generated and purchased, and the average electric energy used per barrel of cement compared with 1947 figures are shown in an accompanying table. The percentage of electricity generated declined, and the quantity purchased increased.

Finished portland cement produced and fuel consumed by the portland-cement industry in the United States,[1] 1947–48, by processes

Process	Finished cement produced			Fuel consumed [2]		
	Plants	Barrels of 376 pounds	Percent of total	Coal (short tons)	Oil (barrels of 42 gallons)	Natural gas (M cubic feet)
1947						
Wet	88	100,696,955	54.0	3,980,760	2,852,511	41,054,656
Dry	62	85,822,392	46.0	3,956,814	1,771,613	[3] 22,125,029
Total	150	186,519,347	100.0	[4] 7,937,574	4,624,124	63,179,685
1948						
Wet	89	111,152,861	54.1	4,182,633	2,828,993	50,868,082
Dry	61	94,295,402	45.9	4,371,017	1,829,363	[3] 22,445,110
Total	150	205,448,263	100.0	[5] 8,553,650	4,658,356	73,313,192

[1] Including Puerto Rico.
[2] Figures compiled from monthly estimates of producers.
[3] Includes byproduct gas: 1947—2,681,487 M cubic feet; 1948—1,174,377 M cubic feet.
[4] Includes 18,564 tons of anthracite and 7,919,010 tons of bituminous coal.
[5] Includes 8,162 tons of anthracite and 8,545,488 tons of bituminous coal.

Portland cement produced in the United States,[1] 1947–48, by kind of fuel

Fuel	Finished cement produced			Fuel consumed [2]		
	Number of plants	Barrels of 376 pounds	Percent of total	Coal (short tons)	Oil (barrels of 42 gallons)	Natural gas (M cubic feet)
1947						
Coal	89	[3] 105,011,561	56.3	6,440,596		
Oil	12	[3] 14,601,599	7.8		3,032,878	
Natural gas	11	[3] 13,702,618	7.3			19,946,198
Coal and oil	10	14,474,204	7.8	920,289	555,908	
Coal and natural gas	13	15,072,126	8.1	467,362		[4] 15,020,189
Oil and natural gas	5	12,968,637	7.0		784,396	14,228,314
Coal, oil, and natural gas	10	10,688,602	5.7	109,327	250,942	13,984,984
Total	150	186,519,347	100.0	[5] 7,937,574	4,624,124	63,179,685
1948						
Coal	86	[3] 111,639,361	54.3	6,828,396		
Oil	11	[3] 16,134,873	7.8		3,228,053	
Natural gas	13	[3] 17,428,962	8.5			26,178,518
Coal and oil	10	16,404,113	8.0	910,801	546,288	
Coal and natural gas	14	16,952,731	8.3	574,555		[6] 14,057,923
Oil and natural gas	7	15,134,254	7.4		757,296	19,182,357
Coal, oil, and natural gas	9	11,753,969	5.7	239,898	126,719	13,894,394
Total	150	205,448,263	100.0	[7] 8,553,650	4,658,356	73,313,192

[1] Including Puerto Rico.
[2] Figures compiled from monthly estimates of producers.
[3] Average consumption of fuel per barrel of cement produced was as follows: 1947—coal, 122.7 pounds; oil, 0.2077 barrel; natural gas, 1,456 cubic feet. 1948—coal, 122.3 pounds; oil, 0.2001 barrel; natural gas, 1,502 cubic feet.
[4] Includes 2,681,487 M cubic feet of byproduct gas.
[5] Includes 18,564 tons of anthracite and 7,919,010 tons of bituminous coal.
[6] Includes 1,174,377 M cubic feet of byproduct gas.
[7] Includes 8,162 tons of anthracite and 8,545,488 tons of bituminous coal.

Electric energy used at portland-cement-producing plants in the United States,[1] 1947–48, 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		
1947								
Wet	31	710, 978, 300	75	1, 506, 086, 691	2, 217, 064, 991	52. 9	100, 696, 955	22. 0
Dry	34	1, 182, 877, 720	48	793, 962, 560	1, 976, 840, 280	47. 1	85, 822, 392	23. 0
Total	65	1, 893, 856, 020	123	2, 300, 049, 251	4, 193, 905, 271	100. 0	186, 519, 347	22. 5
Percent of total electric energy used		45. 2		54. 8	100. 0			
1948								
Wet	33	768, 380, 279	80	1, 654, 086, 208	2, 422, 466, 487	53. 1	111, 152, 861	21. 8
Dry	32	1, 212, 270, 475	51	923, 903, 358	2, 136, 173, 833	46. 9	94, 295, 402	22. 7
Total	65	1, 980, 650, 754	131	2, 577, 989, 566	4, 558, 640, 320	100. 0	205, 448, 263	22. 2
Percent of total electric energy used		43. 4		56. 6	100. 0			

[1] Including Puerto Rico.

TRANSPORTATION

The quantity and proportion of cement shipped by each of the major methods of transportation for the 1946–48 period are given in the following table. The proportions shipped by railroad, truck, and boat in 1948 varied little from the previous year. In 1948 railroads carried most of the shipments—81 percent of the total tonnage. The trend during the past few years is toward bulk shipments, as indicated by the 5-percent increase in this mode of shipment for 1948.

Shipments of portland cement from mills in the United States,[1] 1946–48, 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 [2]	Total		
			Paper	Cloth				
	Barrels	*Percent*	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Percent*
1946								
Truck	[3] 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
Total	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	(4)	70.2	100.0	
1947								
Truck	[3] 13,343,705	19.3	14,635,937	2,006,759		16,642,696	29,986,401	16.0
Railroad	54,198,948	78.5	82,457,113	17,044,651	13,617	99,515,381	153,714,329	82.0
Boat	1,525,322	2.2	2,139,597	126,220		2,265,817	3,791,139	2.0
Total	69,067,975	100.0	99,232,647	19,177,630	13,617	118,423,894	187,491,869	100.0
Percent of total	36.8		53.0	10.2	(4)	63.2	100.0	
1948								
Truck	[3] 18,526,570	21.7	16,242,337	1,329,250		17,571,587	34,538,532	16.9
Railroad	65,210,300	76.6	82,889,312	16,513,115	15,850	99,418,277	166,188,202	81.3
Boat	1,440,323	1.7	2,103,000	34,605		2,137,605	3,577,928	1.8
Total	85,177,193	100.0	101,234,649	17,876,970	15,850	119,127,469	204,304,662	100.0
Percent of total	41.7		49.5	8.8	(4)	58.3	100.0	

[1] Includes Puerto Rico and Hawaii.
[2] Includes steel drums and iron and wood barrels.
[3] Includes cement used at mills by producers as follows—1946: 584,224 barrels; 1947: 813,830 barrels; 1948: 645,420 barrels.
[4] Less than 0.05 percent.

CONSUMPTION

The following table shows that the indicated consumption of portland cement in 1948 increased in all but seven States—Kentucky, Nevada, New Hampshire, Tennessee, Vermont, Virginia, and West Virginia. Variation of percentages for the various States compared with 1947 ranges from a decrease of 10 for West Virginia to an increase of 51 for Wyoming. California, New York, Texas, Pennsylvania, Illinois, Ohio, and Michigan, in that order, were the largest consumers of cement in 1948. These seven States accounted for 44 percent of the total consumption, while the 14 non-cement-producing States, including the District of Columbia, accounted for 13 percent of the total consumption.

Destination of shipments of finished portland cement from mills in the United States, 1946–48, by States

Destination	1946 (barrels)	1947 (barrels)	1948	
			Barrels	Percentage of change from 1947
Continental:				
Alabama	2,744,143	2,930,108	3,178,143	+8.5
Arizona [1]	1,171,168	1,491,197	1,766,820	+18.5
Arkansas	1,331,500	1,349,460	1,729,254	+28.1
California	17,341,128	19,301,504	20,567,994	+6.6
Colorado	1,726,667	1,837,330	1,972,316	+7.3
Connecticut [1]	2,120,160	2,156,811	2,364,453	+9.6
Delaware [1]	484,159	431,850	502,794	+16.4
District of Columbia [1]	1,011,075	1,130,816	1,191,379	+5.4
Florida	3,731,283	4,221,661	4,493,013	+6.4
Georgia	3,049,291	3,051,785	3,100,808	+1.6
Idaho	707,091	838,121	870,172	+3.8
Illinois	8,766,933	9,331,506	10,580,915	+13.4
Indiana	5,256,194	5,216,917	5,596,464	+7.2
Iowa	3,758,932	4,262,177	4,272,285	+.3
Kansas	2,954,100	3,724,882	4,213,812	+13.1
Kentucky	2,319,754	2,903,057	2,780,706	−4.2
Louisiana	2,563,968	3,134,441	3,820,931	+21.9
Maine	657,951	787,507	843,560	+7.1
Maryland	2,751,643	3,145,913	3,470,828	+10.3
Massachusetts [1]	2,526,515	2,941,870	3,328,225	+13.1
Michigan	7,570,738	8,048,093	8,942,493	+11.1
Minnesota	3,716,917	3,914,258	4,195,552	+7.2
Mississippi [1]	1,686,806	1,537,801	1,746,788	+13.6
Missouri	4,885,365	4,893,203	5,299,347	+8.3
Montana	553,373	556,765	674,642	+21.2
Nebraska	1,813,766	1,817,942	2,094,185	+15.2
Nevada [1]	400,329	268,823	262,543	−2.3
New Hampshire [1]	517,126	519,317	505,735	−2.6
New Jersey [1]	5,122,199	5,272,019	6,103,555	+15.8
New Mexico [1]	1,073,385	1,108,513	1,204,872	+8.7
New York	10,231,890	12,730,701	14,272,508	+12.1
North Carolina [1]	3,506,313	3,170,599	3,434,257	+8.3
North Dakota [1]	672,182	753,385	901,701	+19.7
Ohio	9,027,415	9,684,692	10,249,103	+5.8
Oklahoma	3,025,839	3,295,015	3,830,317	+16.2
Oregon	1,477,665	1,835,962	2,159,785	+17.6
Pennsylvania	9,702,251	10,974,095	12,480,244	+13.7
Rhode Island [1]	495,436	546,547	739,570	+35.3
South Carolina [2]	1,347,237	1,335,828	1,429,335	+7.0
South Dakota	727,561	924,729	1,050,780	+13.6
Tennessee	3,665,692	4,102,443	4,081,837	−.5
Texas	9,904,082	11,520,189	12,893,560	+11.9
Utah	932,799	954,883	1,039,132	+8.8
Vermont [1]	378,325	497,077	458,626	−7.7
Virginia	3,492,109	3,571,849	3,550,455	−.6
Washington	3,364,011	3,512,855	4,096,601	+16.6
West Virginia	2,006,952	2,400,206	2,155,276	−10.2
Wisconsin	4,443,029	4,585,162	5,060,929	+10.4
Wyoming	342,817	397,814	599,926	+50.8
Unspecified	36,397	333,666	35,141	−89.5
Total continental United States	163,093,661	179,253,344	196,193,667	+9.5
Outside continental United States [3]	6,473,932	8,238,525	8,110,995	−1.5
Total shipped from cement plants	169,567,593	187,491,869	204,304,662	+9.0

[1] Non-cement-producing State.
[2] South Carolina began producing in December 1948; no shipments made.
[3] Direct shipments by producers to foreign countries and to noncontiguous Territories (Alaska, Hawaii, Puerto Rico, etc.), including distribution from Puerto Rican mills (1946–48) and Hawaiian mill (1946 only).

Destination of shipments of finished portland cement from mills in the United States in 1948, by months, in barrels

Destination	January	February	March	April	May	June	July	August	September	October	November	December
Alabama	207, 609	171, 331	268, 430	264, 220	283, 353	263, 503	272, 529	298, 786	294, 008	313, 393	279, 983	261, 477
Arizona	150, 651	175, 018	187, 412	164, 647	154, 241	124, 609	141, 195	145, 806	153, 984	146, 303	120, 649	102, 629
Arkansas	66, 280	35, 093	95, 098	145, 706	143, 969	163, 269	133, 958	157, 817	170, 321	178, 075	205, 947	221, 902
California	1, 571, 791	1, 550, 689	1, 687, 304	1, 725, 650	1, 744, 573	1, 818, 209	1, 884, 930	1, 870, 885	1, 772, 784	1, 860, 905	1, 672, 600	1, 406, 255
Colorado	114, 781	78, 835	118, 961	190, 958	153, 534	188, 660	211, 195	213, 460	187, 275	211, 840	169, 064	133, 602
Connecticut	45, 809	48, 063	112, 508	208, 998	211, 595	236, 017	303, 752	289, 431	290, 649	282, 394	219, 216	115, 748
Delaware	20, 224	13, 512	31, 623	47, 408	49, 483	52, 251	71, 058	50, 317	51, 357	47, 248	46, 896	27, 501
District of Columbia	58, 581	61, 423	112, 481	128, 678	106, 887	125, 645	120, 983	101, 917	89, 914	95, 167	110, 469	71, 692
Florida	338, 475	381, 656	379, 952	412, 131	377, 299	361, 639	365, 988	339, 191	326, 568	352, 720	394, 886	462, 161
Georgia	200, 190	177, 558	263, 744	281, 895	275, 486	275, 233	245, 123	277, 147	294, 566	303, 556	276, 907	229, 117
Idaho	56, 201	43, 835	66, 963	83, 831	78, 347	83, 566	75, 462	93, 492	93, 980	89, 038	93, 214	48, 045
Illinois	280, 651	302, 221	515, 677	1, 007, 437	1, 018, 909	1, 309, 356	1, 123, 884	1, 135, 906	1, 053, 593	1, 141, 811	1, 105, 647	585, 094
Indiana	150, 819	172, 221	336, 298	556, 883	578, 930	616, 669	619, 146	573, 178	542, 722	629, 869	567, 123	248, 763
Iowa	77, 000	85, 721	178, 012	473, 543	479, 782	662, 295	504, 401	468, 139	440, 363	428, 237	365, 860	109, 545
Kansas	156, 475	89, 819	200, 684	518, 331	477, 818	455, 299	370, 511	391, 179	399, 936	426, 635	395, 099	331, 560
Kentucky	92, 917	88, 938	269, 870	244, 749	301, 234	307, 362	290, 488	279, 748	260, 475	248, 813	277, 272	143, 203
Louisiana	219, 069	201, 942	287, 916	324, 712	358, 896	318, 337	329, 683	343, 948	359, 250	349, 664	324, 844	358, 041
Maine	17, 798	21, 323	28, 833	78, 593	76, 521	112, 657	121, 526	102, 103	115, 068	82, 105	60, 051	26, 780
Maryland	128, 947	96, 543	239, 725	334, 260	325, 863	330, 811	340, 086	334, 504	369, 976	398, 889	401, 655	169, 236
Massachusetts	72, 602	86, 268	187, 889	291, 781	293, 660	355, 413	386, 155	362, 386	355, 976	380, 747	327, 190	227, 814
Michigan	217, 942	246, 364	373, 403	843, 274	938, 298	1, 140, 177	1, 043, 929	1, 085, 158	984, 399	970, 329	721, 417	377, 025
Minnesota	82, 928	96, 761	181, 556	423, 483	600, 752	624, 035	504, 624	432, 081	392, 189	369, 540	270, 370	135, 459
Mississippi	95, 499	54, 452	116, 154	180, 996	174, 095	167, 709	220, 812	176, 762	168, 752	165, 522	212, 406	118, 982
Missouri	210, 564	144, 051	315, 117	513, 354	500, 093	509, 578	520, 314	571, 756	573, 568	584, 735	499, 609	327, 009
Montana	23, 066	15, 741	44, 328	79, 906	75, 594	43, 772	75, 925	77, 810	75, 011	86, 915	52, 694	26, 840
Nebraska	58, 386	40, 300	88, 171	230, 060	250, 308	265, 654	221, 917	205, 445	208, 980	225, 552	203, 844	95, 225
Nevada	20, 968	18, 891	23, 356	21, 584	26, 411	27, 489	18, 927	25, 154	24, 545	25, 256	18, 936	10, 987
New Hampshire	14, 824	13, 182	26, 667	48, 182	43, 824	53, 713	49, 799	59, 168	63, 238	55, 051	52, 555	25, 375
New Jersey	163, 893	165, 413	429, 526	563, 072	537, 401	626, 187	671, 252	599, 613	681, 200	732, 165	596, 514	336, 819
New Mexico	90, 742	79, 361	96, 545	95, 056	104, 297	122, 228	103, 016	95, 084	98, 996	112, 717	110, 177	113, 106
New York	301, 846	366, 007	822, 951	1, 271, 300	1, 333, 159	1, 635, 474	1, 727, 312	1, 736, 249	1, 576, 219	1, 535, 729	1, 348, 298	632, 576
North Carolina	139, 135	93, 144	275, 028	305, 508	297, 653	362, 712	352, 347	306, 106	274, 029	281, 714	337, 419	283, 549
North Dakota	6, 462	12, 356	29, 997	73, 089	137, 217	125, 372	100, 071	92, 485	137, 725	113, 533	46, 819	24, 231
Ohio	338, 936	311, 955	637, 088	901, 633	971, 602	1, 164, 063	1, 089, 997	1, 132, 505	1, 025, 261	1, 225, 305	932, 728	496, 773

Destination of shipments of finished portland cement from mills in the United States in 1948, by months, in barrels—Continued

Destination	January	February	March	April	May	June	July	August	September	October	November	December
Oklahoma	200,831	108,745	228,633	449,163	330,272	368,565	328,076	352,095	348,726	392,719	361,602	402,756
Oregon	124,977	125,273	164,813	186,823	188,470	198,674	220,022	230,474	234,096	192,502	159,071	111,402
Pennsylvania	348,097	313,750	735,681	1,024,053	1,142,956	1,346,158	1,478,079	1,488,734	1,457,182	1,449,089	1,127,154	568,487
Rhode Island	7,897	14,124	39,320	80,124	84,278	78,052	78,856	89,658	89,325	81,895	60,912	34,945
South Carolina	95,115	75,209	123,723	134,653	135,711	134,095	130,173	140,389	130,671	132,692	151,704	173,482
South Dakota	13,285	20,795	55,085	132,487	139,187	135,836	151,460	97,399	103,201	103,025	79,306	20,895
Tennessee	140,930	126,132	299,271	373,380	431,675	425,179	398,851	412,674	406,192	422,447	359,056	286,032
Texas	803,752	564,525	1,109,509	1,256,730	1,154,391	1,176,820	1,231,191	1,124,693	1,114,132	1,125,048	1,055,203	1,162,085
Utah	39,460	37,616	63,396	115,354	117,610	100,625	101,778	117,338	107,434	119,696	87,800	29,635
Vermont	6,367	5,143	12,772	64,212	45,202	66,934	73,131	55,903	52,055	49,103	38,150	5,979
Virginia	148,383	118,507	324,619	321,895	330,065	394,825	376,699	336,925	299,519	269,505	375,063	238,161
Washington	205,791	182,405	328,638	385,042	385,907	365,601	435,408	477,362	452,052	409,440	307,415	177,921
West Virginia	86,229	76,613	173,933	176,907	189,014	232,239	237,326	225,040	203,315	211,887	240,171	101,878
Wisconsin	91,347	110,513	191,464	453,453	686,527	684,289	597,728	595,848	567,719	488,584	415,252	176,984
Wyoming	15,845	11,920	24,686	53,067	59,600	48,118	71,933	70,915	67,118	70,237	69,343	41,503
Unspecified	367	5,226	1,614	9,833	6,642	------------	8,873	4,289	602	5,638	4,076	1,477
Continental United States	8,120,734	7,436,483	12,906,424	18,252,084	18,908,591	20,784,973	20,531,879	20,244,452	19,540,216	19,974,979	17,709,636	11,817,743
Outside continental United States [1]	1,084,266	901,517	1,050,576	794,916	635,409	641,027	462,121	460,548	397,784	349,021	400,364	923,257
Total	9,205,000	8,338,000	13,957,000	19,047,000	19,544,000	21,426,000	20,994,000	20,705,000	19,938,000	20,324,000	18,110,000	12,741,000

[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 mills.

LOCAL SUPPLY

The surplus or deficiency in the quantity of cement locally available is indicated in the following table. The comparison is based on shipments from mills and on consumption as shown by State receipts of mill shipments. The 1948 deficiencies occurred in two States and four districts.

The total surplus of producing States in 1948 was distributed as follows: 26,479,265 barrels to non-cement-producing States, Alaska, and Hawaii; 5,670,838 barrels to destinations outside continental United States (excluding local consumption of Puerto Rican production); and 35,141 barrels to unspecified destinations.

Estimated surplus or deficiency in local supply of portland cement in cement-producing States, 1947–48, in barrels

State or division	1947			1948		
	Shipments from mills	Estimated consumption	Surplus or deficiency	Shipments from mills	Estimated consumption	Surplus or deficiency
Alabama	9,509,697	2,930,108	+6,579,589	9,948,600	3,178,143	+6,770,457
California	22,846,458	19,301,504	+3,544,954	24,162,926	20,567,994	+3,594,932
Illinois	7,155,280	9,331,506	−2,176,226	7,573,404	10,580,915	−3,007,511
Iowa	6,155,670	4,262,177	+1,893,493	6,835,578	4,272,285	+2,563,293
Kansas	7,208,147	3,724,882	+3,483,265	7,930,965	4,213,812	+3,717,153
Michigan	10,470,766	8,048,093	+2,422,673	11,116,911	8,942,493	+2,174,418
Missouri	8,030,939	4,893,203	+3,137,736	8,428,343	5,299,347	+3,128,996
Ohio	9,296,311	9,684,692	−388,381	10,020,198	10,249,103	−228,905
Pennsylvania	33,655,687	10,974,095	+22,681,592	38,255,543	12,480,244	+25,775,299
Puerto Rico	1,904,125	1,601,869	+302,256	2,440,455	1,901,545	+538,910
Tennessee	6,101,108	4,102,443	+1,998,665	6,774,926	4,081,837	+2,693,089
Texas	12,349,219	11,520,189	+829,030	13,786,846	12,893,560	+893,286
Colorado, Montana, Utah, Wyoming, and Idaho	4,631,303	4,584,913	+46,390	5,250,131	5,156,188	+93,943
Oregon and Washington	5,811,456	5,348,817	+462,639	6,816,082	6,256,386	+559,696
Georgia, Kentucky, Virginia, Florida, and Louisiana	7,516,763	16,882,793	−9,366,030	8,404,890	17,745,913	−9,341,023
Indiana, Wisconsin, Minnesota, Nebraska, Oklahoma, South Dakota, and Arkansas	17,802,391	21,103,483	−3,301,092	18,889,106	23,557,481	−4,668,375
Maryland and West Virginia	4,498,230	5,546,119	−1,047,889	4,194,481	5,626,104	−1,431,623
New York and Maine	12,548,319	13,518,208	−969,889	13,475,277	15,116,068	−1,640,791
Total	187,491,869	157,359,094	+30,132,775	204,304,662	172,119,418	+32,185,244

PRICES

The average net mill realization of all portland cement shipped from mills in 1948 advanced to $2.18 per barrel from $1.90 per barrel in 1947. The average net mill realization in each quarter of 1948 was: First, $2.12; second, $2.11; third, $2.21; and fourth, $2.28.

The composite wholesale price of portland cement, f. o. b. destination, according to the Bureau of Labor Statistics index (1926=100) was 130.4 in 1948, whereas in 1947 it was 115.7.

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Average mill value per barrel, in bulk, of portland cement in the United States,[1] 1944–48

Year	Value	Year	Value
1944	$1.59	1947	$1.90
1945	1.63	1948	2.18
1946	1.72		

[1] Includes Puerto Rico and Hawaii.

FOREIGN TRADE [2]

Imports.—Imports of hydraulic cement increased greatly in 1948, amounting to 282,852 barrels compared with 4,606 barrels in the previous year, and for the most part represent purchases from Belgium and Luxembourg, Mexico, and the United Kingdom. Imports of all hydraulic cement, except white nonstaining portland cement for the years 1946–48, are listed by country of origin in the second following table. Imports of white nonstaining cement in 1948 totaled 223 barrels valued at $718.

Hydraulic cement imported for consumption in the United States, 1944–48

[U. S. Department of Commerce]

Year	Barrels	Value	Year	Barrels	Value
1944	169	$418	1947	4,606	$28,668
1945	323	700	1948	282,852	785,120
1946	3,734	15,531			

Roman, portland, and other hydraulic cements imported for consumption in the United States, by countries, 1946–48 [1]

[U. S. Department of Commerce]

Country	1946		1947		1948	
	Barrels	Value	Barrels	Value	Barrels	Value
Belgium and Luxembourg	2	$4			104,937	$261,927
Bulgaria					17	56
Canada	2,498	8,124	334	$1,078	3,030	14,109
Mexico					149,990	397,705
United Kingdom	1,091	6,922	4,272	27,590	24,655	110,605
Total	3,591	15,050	4,606	28,668	282,629	784,402

[1] Excludes "white nonstaining, and other special cement."

Exports.—Exports of cement in 1948 totaled 5,922,163 barrels valued at $20,917,176. As indicated in the following table, shipments were divided about equally between countries in North America and South America. The largest purchasers were Canada, Cuba, Dominican Republic, Brazil, and Venezuela.

Shipments of hydraulic cement to noncontiguous Territories of the United States for the 1946–48 period are shown in an accompanying table. Shipments to Guam, Samoa, and the Virgin Islands increased over the previous year's figures, while shipments to Puerto Rico declined.

[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.

Hydraulic cement exported from the United States, 1944–48

[U. S. Department of Commerce]

Year	Barrels	Value	Percent of total shipments from mills
1944	4,040,405	$10,044,838	4.2
1945	6,474,721	15,567,490	6.0
1946	5,163,362	13,484,933	3.0
1947	[1] 6,771,250	[1] 21,826,718	[1] 3.6
1948	5,922,163	20,917,176	2.9

[1] Exclusive of 198,723 barrels, valued at $839,916, exported under the Army Civilian Supply Program.

Hydraulic cement exported from the United States, by countries, 1946–48

[U. S. Department of Commerce]

Country	1946		1947		1948	
	Barrels	Value	Barrels	Value	Barrels	Value
North America:						
Bermuda	10,972	$25,055	12,712	$37,443	634	$2,998
Canada	295,101	979,906	1,100,559	3,558,874	907,400	3,416,965
Central America:						
British Honduras	1,621	3,882	3,425	16,594	250	950
Canal Zone	75,646	178,671	332,509	883,943	108,045	333,431
Costa Rica	60,897	168,958	120,716	362,731	72,599	235,924
El Salvador	82,585	197,794	138,911	481,106	47,441	169,578
Guatemala	37,546	103,915	27,623	87,893	26,224	93,942
Honduras	40,150	90,048	97,365	329,996	62,752	210,099
Nicaragua	24,649	56,314	12,696	41,414	9,452	40,225
Panama, Republic of	151,196	383,248	253,512	822,452	82,379	299,747
Mexico	1,033,474	2,811,361	481,961	1,681,811	158,623	577,995
Newfoundland and Labrador	3,636	8,499	53,406	143,773	1,145	4,107
West Indies:						
British:						
Bahamas	14,197	42,449	20,185	73,357	10,085	40,396
Barbados			7,642	16,573	108	324
Jamaica	6,105	13,540	12,907	42,376	3,508	14,180
Leeward and Windward Islands	463	1,018			4,783	16,481
Trinidad and Tobago			68,300	198,187	20,375	63,510
Cuba	284,389	717,738	518,339	1,682,314	398,529	1,421,288
Dominican Republic	323,072	730,119	352,458	1,066,324	215,462	752,212
French West Indies	58,412	125,588	60,238	175,129	3,232	10,480
Haiti	37,025	88,366	32,277	98,639	15,757	57,193
Netherlands Antilles	49,037	128,232	36,516	115,191	137,746	470,736
Other North America			[1] 1,000	[1] 4,600	250	719
Total North America	[1] 2,590,173	[1] 6,854,701	[1] 3,745,257	[1] 11,920,720	2,286,779	8,233,480
South America:						
Argentina	14,045	81,786	14,287	77,095	4,455	40,141
Bolivia	878	5,449	1,880	12,907	1,546	14,393
Brazil	735,094	1,853,186	403,333	1,462,542	493,622	1,890,808
Chile	7,509	32,558	3,192	24,955	8,910	59,120
Colombia	286,660	796,790	337,544	1,382,666	113,195	478,302
Ecuador	35,652	85,329	85,361	255,399	9,888	34,730
Paraguay	7,804	21,200	3,960	14,125	332	2,532
Peru	70,732	188,398	91,699	257,239	21,629	74,924
Surinam	3,250	6,975	6,181	17,363	3,328	10,698
Uruguay	3,024	21,176	2,711	17,561	1,327	9,348
Venezuela	1,066,317	2,590,675	1,600,581	4,908,461	2,020,617	6,822,478
Other South America	4,701	10,974	5,419	17,859	68	301
Total South America	2,235,666	5,694,496	2,556,148	8,448,172	2,678,917	9,437,775
Europe:						
France					465	5,763
Norway	121	12,255				

See footnote at end of table.

Hydraulic cement exported from the United States, by countries, 1946-48—Con.

Country	1946		1947		1948	
	Barrels	Value	Barrels	Value	Barrels	Value
Europe—Continued						
Portugal	434	$2,552	461	$2,737		
U. S. S. R.			751	7,242		
United Kingdom	3	345	554	3,802	190	$1,476
Other Europe	[1] 661	[1] 5,590	[1] 387	[1] 2,531	1,253	12,609
Total Europe	[1] 1,219	[1] 20,742	[1] 2,153	[1] 16,312	1,908	19,848
Asia:						
Bahrein, State of	301	2,895	1,639	5,679	1,900	15,284
Ceylon			78,170	227,971	21,649	70,111
China	156,252	424,987	3,981	19,938	125	323
French Indochina			380	1,024	689	15,848
Hong Kong	18,073	39,559	5,901	19,168	1,750	5,198
India	703	4,371	13,287	57,812		
Indonesia	1,000	2,325	17,087	43,760	71,381	226,380
Korea			(2)	(2)	162,503	527,291
Kuwait			37,922	112,421	36,895	134,577
Philippines, Republic of	93,819	261,954	152,117	470,590	400,397	1,321,795
Saudi Arabia	31,977	76,169	77,308	237,107	117,417	454,729
Syria			1,461	6,352		
Turkey	8	25	901	7,571		
Other Asia	5,385	21,690	802	2,455	4,501	16,301
Total Asia	307,518	833,975	[2] 390,956	[2] 1,211,848	819,207	2,787,837
Africa:						
Egypt	250	785	167	1,550	400	3,144
Ethiopia			1,750	4,908		
French West Africa	145	312	1,297	3,320	1,678	5,318
Liberia	5,014	11,197	11,575	30,940	4,231	14,694
Madagascar					65,349	189,369
Mozambique	300	957	7,064	25,807	12,238	43,446
Nigeria			1,786	4,536	1,440	4,714
Portuguese Guinea and Angola	13,813	38,549	20,036	55,135	4,987	20,032
Southern Rhodesia	500	1,130	1,325	8,200		
Tangier	3,247	7,077				
Union of South Africa	5,031	19,758	17,849	55,524	19,600	71,762
Other Africa	423	1,084	1,292	3,756	5,897	20,266
Total Africa	28,723	80,849	64,141	193,676	115,820	372,745
Oceania:						
French Pacific Islands	63	170	1,796	5,804	14,825	49,746
New Zealand			10,783	30,095	3,782	12,746
Other Oceania			16	91	925	2,999
Total Oceania	63	170	12,595	35,990	19,532	65,491
Grand total	5,163,362	13,484,933	[2] 6,771,250	[2] 21,826,718	5,922,163	20,917,176

[1] Revised figure.
[2] Exclusive of 198,723 barrels, valued at $839,916, exported to Korea under the Army Civilian Supply Program.

Hydraulic cement shipped to noncontiguous Territories of the United States, 1946-48

[U. S. Department of Commerce]

Territory	1946		1947		1948	
	Barrels	Value	Barrels	Value	Barrels	Value
Alaska	43,929	$124,259	53,424	$140,051	(1)	(1)
American Samoa	304	919	25	90	495	$1,621
Guam			2,937	8,798	4,467	18,330
Hawaii	469,565	865,444	547,184	1,106,942	(1)	(1)
Puerto Rico	41,762	109,682	16,005	78,184	14,964	91,313
Virgin Islands	25,964	66,088	17,360	56,196	28,071	103,647
Wake Island					630	2,757

[1] Data not available.

TECHNOLOGY

The portland cement industry in 1948 expanded its use of improved raw grinding by closed-circuits, uniform kiln feed with new grinding system, and efficient dust collection by electrical precipitators.[3 4] A review and discussion of the control of portland cement raw mixtures has been released,[5] as well as a report on the results obtained in a study of fineness of cements made to determine gain or loss of cementing value in concrete from extreme fines.[6]

During the year new developments in the use of slag in cement were noted. A report recommended separate grinding of lime and slag in the manufacture of lime-slag cements. Formulas are given for obtaining cement strength after 7, 28, and 68 days.[7] According to another report, lime has been replaced by barium oxide in the manufacture of portland cement. Proportions corresponding to monobarium, dibarium, and tribarium silicate produced cements unstable in plain water but were resistant to a 1-percent solution of magnesium sulfate. The investigations are being continued.[8]

Recognizing that concrete walls and floors are possible sources of certain types of germ activity, an antiseptic cement has been developed. Tests have indicated that sections containing antiseptic cement remained free of germs. This process is covered by United States Patent 2,439,440.[9]

Two patents relating to waterproofing agents for cement have been released. One, United States Patent 2,428,785, granted October 14, 1947, provides for a mixture of CrO_3 and pumicite to be heated together until it turns black. Proper proportions of this product are then ground while hot and mixed with a suitable quantity of finely powdered aluminum. After being properly ignited, this second mixture is mixed with portland cement to provide the final product, suitable for making concrete surfaces impervious to water.[10] United States Patent 2,434,695, granted January 20, 1948, provides for addition of a suitable proportion of $CaCl_2$, glucose, and water to portland cement to seal cracks in old concrete, and as a bonding mortar for cement blocks. By adjusting the proportion of sand to cement, greater consistency is attained, and waterproofing properties are increased.[11]

During 1948 the American Society for Testing Materials revised some of its specifications for cement—one for air-entraining portland cement (C175–48T) and one for portland blast-furnace-slag cement (C205–48T). Tentative methods of chemical analysis of portland cement (C114–48T) were revised in June 1948. The following tentative definition of the term "addition", as applied to hydraulic cements (C219–48T), was adopted by the society during 1948:

> In the manufacture of portland cement, any material, other than water and/or untreated calcium sulfate, which is interground with the clinker.

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3 Pit and Quarry, vol. 41, No. 6, December 1948, pp. 60–64.
4 Rock Products, vol. 51, No. 10, October 1948, pp. 96–99; No. 11, November 1948, pp. 82–87.
5 Rock Products, vol. 51, No. 8, August 1948, pp. 160–162, 186.
6 Rock Products, vol. 51, No. 1, January 1948, pp. 130–134.
7 British Abstracts, November 1948, p. 618.
8 Journal of the American Ceramic Society, vol. 31, No. 4, April 1, 1948, p. 67.
9 Science News Letter, vol. 53, No. 17, April 24, 1948, p. 264.
10 Chemical Abstracts, vol. 42, No. 4, February 20, 1948, col. 1407–1408.
11 British Abstracts, November 1948, p. 625.

WORLD REVIEW[12]

Available statistics on world production of cement in 1943–48 are given in the following table.

World production of hydraulic cement, by countries, in metric tons, 1943–48

[Compiled by Pauline Roberts]

Country[1]	1943	1944	1945	1946	1947	1948
North America:						
Canada	1,159,286	1,141,594	1,344,934	1,835,302	1,894,956	2,240,300
Cuba	169,609	173,750	180,753	240,406	276,369	284,954
Guatemala	[2] 21,000	[2] 23,000	[2] 29,000	[2] 29,000	27,600	31,200
Mexico	578,253	608,400	740,400	736,800	707,800	833,444
Nicaragua	12,030	10,034	[2] 16,000	9,975	15,959	16,220
United States	23,067,914	15,716,820	17,786,688	28,403,616	32,314,655	35,626,454
South America:						
Argentina	957,076	1,081,809	1,087,578	1,140,529	1,363,400	1,251,770
Bolivia	23,006	28,154	27,174	30,742	38,828	39,130
Brazil	[3] 747,409	809,908	774,378	826,382	913,525	1,111,503
Chile	374,747	362,877	411,088	579,906	602,299	539,789
Colombia	258,578	281,626	302,598	332,265	346,227	363,749
Ecuador	27,860	34,691	37,504	38,497	33,231	40,369
Peru	206,792	248,522	264,892	260,617	255,644	282,373
Uruguay	131,544	189,314	216,592	272,490	279,353	278,203
Venezuela	111,721	119,670	124,447	128,329	153,120	214,513
Europe:						
Austria	773,000	(4)	(4)	387,680	281,271	721,379
Belgium	[5] 459,520	600,000	646,898	1,889,777	2,609,174	3,336,000
Bulgaria	(4)	126,044	245,100	(4)	(4)	(4)
Czechoslovakia	[6] 350,000	(4)	(4)	920,000	1,404,000	1,656,000
Denmark	639,038	646,837	219,996	501,835	669,500	809,923
Finland	238,279	180,221	277,679	329,792	(4)	556,000
France	2,926,250	1,485,560	1,512,000	3,372,000	3,856,000	5,379,000
Germany	[7] 9,073,000	(4)	(4)	[8] 2,520,000	[8] 2,897,000	[9] 5,113,200
Greece	(4)	(4)	(4)	[2] 110,000	(4)	(4)
Hungary	701,290	[10] [11] 153,290	[10] [12] 38,280	163,590	209,060	(4)
Ireland	251,980	222,515	(4)	(4)	(4)	(4)
Italy	1,712,187	1,349,953	1,143,069	(4)	2,790,000	(4)
Luxembourg	(4)	(4)	(4)	(4)	89,272	102,000
Netherlands	358,000	214,000	231,000	402,654	519,262	588,997
Norway	311,152	(4)	141,800	425,000	460,000	510,000
Poland	(4)	(4)	[13] 300,906	1,398,915	1,521,822	1,823,857
Portugal	246,799	244,974	262,980	330,100	427,734	496,800
Rumania	455,030	326,262	249,420	314,892	421,398	452,000
Spain	1,701,520	1,843,037	1,926,052	2,145,140	2,186,338	[2] 1,872,000
Sweden	922,734	1,061,140	1,213,513	1,461,726	1,550,000	1,489,200
Switzerland	367,000	430,000	415,000	694,000	994,790	[2] 1,000,000
U. S. S. R.[2]	(4)	(4)	1,800,000	3,400,000	4,800,000	(4)
United Kingdom	7,081,869	4,633,188	4,116,019	6,681,545	7,071,708	8,658,314
Yugoslavia	[2] 750,000	(4)	(4)	586,092	1,233,180	1,188,000
Asia:						
China	[14] 1,538,247	[14] 1,177,890	42,500	208,057	608,692	(4)
Formosa	309,394	245,000	(4)	(4)	(4)	235,000
India[15]	2,145,898	2,076,806	2,180,443	1,969,387	1,464,128	1,540,332
Indochina, French	127,000	------------	4,910	36,430	39,871	97,259
Indonesia	------------	------------	(4)	(4)	10,000	37,751
Iran	35,000	38,000	[16] [17] 25,000	[17] 42,700	[16] [17] 42,714	(4)
Japan	3,767,666	2,959,686	1,172,273	929,000	1,236,000	1,842,726
Korea	1,400,000	1,003,002	139,049	160,696	168,191	[18] 18,200
Palestine and Israel	166,804	176,499	147,237	265,935	328,300	(4)
Philippines, Republic of	(4)	(4)	[12] 27,231	56,261	133,918	120,384
Syria and Lebanon	151,900	171,326	178,471	201,500	205,600	258,000
Thailand	64,800	26,400	(4)	(4)	58,800	82,800
Turkey[19]	168,939	286,521	288,455	321,462	350,456	344,924
Africa:						
Algeria	80,900	96,445	104,400	116,400	127,200	130,800
Belgian Congo	69,221	84,776	76,264	81,514	115,441	[2] 126,942
Egypt	322,859	423,902	432,088	587,577	648,353	768,283
Eritrea	27,500	38,000	(4)	(4)	------------	(4)
Ethiopia[2]	25,000	(4)	(4)	(4)	(4)	(4)
Morocco, French	[2] 140,000	109,020	76,835	175,180	218,877	262,232
Mozambique	30,647	27,932	33,919	26,275	35,858	35,858
Tunisia	23,000	58,500	59,600	83,540	115,100	162,000
Union of South Africa	915,600	1,113,600	1,053,600	1,180,200	1,379,818	1,308,000

See footnotes at end of table.

[12] Some of the data in this portion of the chapter were prepared by G. Richards Gwinn.

World production of hydraulic cement, by countries, in metric tons, 1943–48—Continued

Country [1]	1943	1944	1945	1946	1947	1948
Oceania:						
Australia:						
New South Wales	351,887	313,976	312,185	373,794	439,271	(4)
Tasmania	43,530	(4)	42,782	(4)	(4)	(4)
Victoria	(4)	127,971	133,407	152,763	194,777	(4)
New Zealand	226,800	229,200	237,600	229,900	219,409	247,205
Total [20]	71,188,000	53,875,000	48,812,000	73,533,000	84,565,000	97,130,000

[1] In addition to countries listed, hydraulic cement is produced in Albania, Hong Kong, Queensland, and South Australia, but data are not available.
[2] Estimate.
[3] Beginning in 1943, white cement is included.
[4] Data not available; estimate by senior author of chapter included in total.
[5] Excludes portland-cement data, which are not yet available.
[6] Slovakia only.
[7] Includes Sudetenland.
[8] Excludes Russian Zone.
[9] Bizonal area.
[10] Data represent Trianon Hungary after October 1944.
[11] January to June, inclusive.
[12] June to December, inclusive.
[13] April to December, inclusive.
[14] Data represent area designated as Free China during the period of Japanese occupation, and Manchuria.
[15] Beginning September 1947, excludes Pakistan.
[16] Production in Government-operated mines.
[17] Fiscal year ended Mar. 20 of year following that stated.
[18] South Korea only.
[19] Data revised in some instances to cover production rather than shipments.
[20] Estimated by senior author of chapter; excludes estimates for countries listed in footnote 1.

NORTH AMERICA

Canada.—Shipments of cement from the eight producing plants reached 11,936,245 barrels (valued at $21,968,909) in 1947 and totaled 14,127,123 barrels (valued at $28,264,987) in 1948. These plants—6 of which are owned by the Canada Cement Co., Ltd., and 1 each by the St. Mary's Cement Co. and the British Columbia Cement Co.—have 19 kilns. The capacity used in 1947 was 38,000 and in 1948 40,300 barrels per day. Imports of cement in 1948 amounted to 1,120,671 barrels valued at $3,995,173 compared with 1,248,625 barrels—valued at $3,843,652—in the preceding year. Atlantic Chemicals Co., Ltd., has developed plans for a plant to manufacture portland cement and sulfur dioxide. The plant will be on the Petitcodiac River, New Brunswick, and will have a single kiln with a capacity of about 1,200 barrels per day. Local anhydrite and shale will be used in the process.[13]

Mexico.—The cement market declined during part of 1947 and 1948. Shortage of funds has forestalled the active start of such public construction as dams, irrigation, and highway projects. According to one report, these factors have caused the cement prices to vary somewhat. The outlook for most of 1948 was that production and requirements would be in balance. In 1947 the distributor's price at the five plants that had been in operation a year and at the four new plants under construction was raised to 120 pesos per ton. The industry has agreed to furnish the Federal Government with up to 30 percent of its capacity output when called upon.

[13] Cement Manufacturing Industry, 1948, Department of Trade and Commerce, Dominion Bureau of Statistics, Ottawa, Canada, April 21, 1949, 5 pp.

Negotiations have been undertaken to increase the capacity of various plants, notably Cementos Hidalgo, S. C. L. (increase of 300 tons per day); Cementos Del Pacifico, S. A. (increase of 150 tons per day); Cementos Del Bajio, S. A. (increase of 100 tons per day); Cementos La Cruz Azul, S. C. L., the Lagunas unit (increase of 400 tons per day); and Cemento Mexicano Portland (increase of 300 tons per day). A new 80-ton-per-day unit of Cemento Portland Blanco de Mexico, S. A., for the manufacture of white cement has also been placed in operation.

Central America.—New plants are being planned for El Salvador, Honduras, and Guatemala. The shortage of cement supply in the latter country has occasioned the freeing of gray, white, and industrial cements from customs duties, allotted revenues tax, consular fees, and the custom-house reconstruction tax.

SOUTH AMERICA

Argentina.—The backlog of construction accumulated during the recent war has stimulated the building of a new plant and the planned extension of four other plants. The industry has returned to the use of fuel oil at cement plants. During the recent war, asphaltites, wood charcoal, petroleum coke, wood gas, and linseed oil were burned. To step up industrial expansion, imports of portland cement have been freed from customs duties and a number of handling charges. The Argentine National Economic Council has agreed to authorize the importation of 500,000 tons of cement for building up a stock against the requirements of the Five Year Plan.

Bolivia.—The local cement plant, which produced 185,000 barrels in 1946, increased production in the first half of 1947 to 103,000 barrels. The average monthly production was 17,250 barrels.

Brazil.—Two new cement plants, Belo Horizonte of the Cia de Cemento Portland and Esteio plant of Cia Brasihera di Cement Portland, started operations in 1947. The Lone Star Cement Corp., a United States firm, is planning to add a third kiln to its plant at Guaxandiba. It was expected that the new kiln will be in operation by middle of 1948.[13a]

Chile.—The Juan Soldado cement plant at La Serena has made some improvements in plant equipment designed to increase the output. The construction of the Polpaico plant of the Sociedad Minera e Industrial Polpaico, Ltda., which has an ultimate capacity of 200,000 metric tons, has gone forward. A United States firm has offered the Chilean Government a modern cement plant for $1,800,000. If accepted, the plant will be erected near lime deposits at San Jose de Maipo.

EUROPE

The backlog of essential construction work in Europe has created a great demand for cement. The lack of coal, manpower, and suitable equipment has been partly responsible for the continuing demand for this commodity. Among the chief types of cement manufactured in Europe are ordinary portland, high-early-strength, low-heat cement, and in some instances sulfate-resisting cement. Blended cements, in which blast-furnace slag is used, are also produced.

[13a] Pit and Quarry, vol. 40, No. 1, July 1947, pp. 106–107.

Belgium.—The cement industry has overcome the coal shortage to some extent by utilizing slag cements, which require less clinker and thus smaller quantities of coal for domestic consumption; portland cement is exported to obtain more foreign exchange. In 1947 the firm of Cimenteries et Briquiteries, Reunies, Belgium, was constructing a cement plant of 1,000 metric tons capacity per day, which has two 11½- by 475-foot rotary kilns. Raw grinding by open circuit and clinker grinding by closed circuit were included.

Finland.—The demand for cement in Finland is growing. The firm of Pargas Kalkbergs Aktiebolag—the largest cement-manufacturing company in Finland—has an output of about half the country's total. This company operates three kilns and is planning to install a fourth as soon as available. Coal for operating is obtained from the United Kingdom and Poland and gypsum from Cyprus and French North Africa.

Germany.—The cement industry in Germany is hampered by lack of coal of the necessary quality and of iron ore for use in the cement batch. The Hanover portland-cement plant, Teutonia A. G., has obtained premission to manufacture cement for export. The plant in 1947 was running at about 40 percent of prewar capacity, about 10,000 metric tons monthly. The output will go chiefly to Latin America.

Poland.—The total production of Polish cement plants in the first 7 months of 1948 amounted to 1,078,000 tons. Exports to Brazil, Argentina, Malaya, and the U. S. S. R. amounted to about 151,000 tons.

Spain.—Thirty-one plants produced portland cement in Spain in 1947 from 51 rotary kilns and 25 vertical kilns. The wet process is used in 26 plants. A plant with an annual capacity of 50,000 metric tons of portland cement was to be built in 1948 at Villaneuva del Rio, Seville Province. The production, distribution, and price of cement are controlled by the Government. The price in the first quarter of 1947 was 183 pesetas per metric ton, f. o. b. plant.

Sweden.—A second long kiln which increases the annual capacity 1 million barrels, has been installed at the Koping plant of the Shanke Cement Co. The total annual capacity is now 2 million barrels. The kilns were designed to burn coal but have been using oil because of the continued shortage of coal. At the present rated capacity of 2,600 barrels per day per kiln, clinker is being produced using oil with a heat utilization of 1,300 calories or 880,000 B. t. u. per barrel. The Skansa Cement Co., Malmo, Sweden, produced 936,000 tons of cement in 1947, considerably over that of the preceding year.

Switzerland.—Fifteen cement companies in Switzerland have a total maximum annual output of approximately 1,200,000 metric tons of portland cement. Coal is used as fuel, and because of the shortages of this material, efforts have been made to develop a kiln fired by electricity. The largest plant in Switzerland is the Jura-Cement-Fabriken, in Wildegg, with an annual capacity of 150,000 metric tons.

United Kingdom.—Shortages of coal and of paper bags for packaging cement have seriously retarded the cement industry in England. In turn, the cement shortage is hampering the building industry and causing unemployment. The Associated Portland Cement Manufacturers state that the industry is at liberty to export large quantities and that a target of 1½ million tons has been fixed.

According to a recent report, the combined capacity of the four plants in Scotland represents less than one-third of the normal demand. The balance of the needed cement is shipped in from England. Blast-furnace-slag cements are produced at all four plants.

ASIA

China.—The three cement plants in Formosa—(1) Suo, (2) Takao, and (3) Chikuto—are now producing 200,000 tons a year. With American technical assistance and new equipment the output is expected to reach 360,000 tons in 1949.

India.—Before August 1947 there were 24 cement plants in undivided India, with an approximate capacity of 2 million tons. In view of the present requirement of about 3 million tons per year, the Indian Government has sanctioned establishment of five new plants. Four, with an annual capacity of 150,000 tons each, will be built in Baroda, Bombay, Rewa, and Jaipur. The fifth, with an annual production of 400,000 tons, will be located in the United Provinces. Additional expansion is also projected for other plants in Bihar. Cement production in India amounted to 1.5 million long tons in the fiscal year ended March 31, 1939. For the same period ending in 1946, the output was 2 million tons, and by 1952 plans call for a cement-manufacturing capacity of 5.6 million tons.

Indonesia.—The plant of the Netherlands Indies Portland Cement Co. near Padang, Sumatra, has been found to be nearly intact, with some semiprocessed cement on hand. It is reported that one kiln, nearly 400 feet long, is capable of operating now. Other kilns will soon be operating, and the company hopes to produce 6,000 tons per month.

Iraq.—The Iraq Cement Co. is planning to build a complete cement plant on the banks of the Tigris River a few miles from Baghdad. The production capacity, using local limestone and clay and the wet process, will be about 87,000 tons per year.

Japan.—The productive capacity of the Japanese cement industry for the 1931–47 period exceeded home consumption and export demands. The designed annual capacity of the entire industry is approximately 8,000,000 metric tons. In 1947 the industry operated at about 20 to 25 percent of capacity because of shortages of coal of the required quality and lack of new parts for worn-out equipment. The major equipment items, such as kilns and raw and finish grinding mills, have been replaced, but small necessary parts, such as motors, haulageway equipment, and motor parts, were not yet available. Five types of cement are normally made—ordinary, high-early-strength, silica, slag, and nonconstructive (low-grade for floors and plastering).

The production, consumption, stocks, prices, and exports of cement in Japan and occupied areas before and during World War II were described.[14]

[14] Gwinn, G. Richards, What Has Happened to the Cement Industry in Japan?: Rock Products, vol. 51, No. 1, January 1948, pp. 108–112.

Republic of Philippines.—Cebu Portland Cement Co. is again operating at the rate of about 3,500 barrels per day. Present plans call for the addition of two kilns during 1948 to supplement the two already in use.

Turkey.—The plant at Sivas will be doubled in capacity to meet the rising demand for cement. Two new plants are planned, one at Izmir and the second at Zonguldak. The present production of 400,000 tons is insufficient to meet the 600,000 tons annual requirement.

AFRICA

Mozambique.—A new cement plant, equipped with American machinery, is planned by the Companhia de Cimentos de Mozambique. Operations are scheduled to begin this year, and the cement is intended to supply Portuguese Africa territory.

Union of South Africa.—The Union, like most other areas throughout the world, experienced a cement shortage in 1948. This condition has resulted in slowing the housing boom, and to alleviate the situation a voluntary allocation plan was worked out. There are nine plants already in the Union, but four more are under construction at Lichtenburg, Klerksdorp, Kimberley, and Port Shepstone. According to one report, cement was imported from Yugoslavia, Belgium, Poland, and Denmark to help relieve the shortage.

OCEANIA

Australia.—The Metropolitan Cement Party, Ltd., Sydney, Australia, plans to reassemble the 1,000,000-barrel-capacity River Rouge cement plant of the Ford Motor Co. in the Sydney area. The Great Barrier Reef supplies the Queensland Cement & Lime Co. with enough material to manufacture 15,000 bags of cement per day. Other raw materials used in the production of coral cement and supplied locally are aluminous clay, siliceous clays, and ironstone.

Chromium

By ROLAND D. PARKS [1]

GENERAL SUMMARY

CHROMITE imports into the United States during 1948 were at the record level of over 1.5 million short tons and exceeded consumption in all grades—chemical, refractory, and particularly metallurgical. Industry stocks improved in each group. Domestic production, though higher than in 1947, totaled only 3,619 short tons with operating mines confined to Oregon and California.

The bulk of United States chromite imports in 1948 came from the U. S. S. R., Union of South Africa, Turkey, Republic of the Philippines, Cuba, and Southern Rhodesia, listed in order of importance—unchanged from 1947.

Imports from Turkey, largely metallurgical-grade, increased markedly from 1947, as did shipments of this grade from New Caledonia, a minor source. Supplies of chemical-grade ore from the Union of South Africa—main source of this grade—continued steady. Although total imports of refractory-grade ore dropped slightly from the previous year, supplies continued steady from the principal sources—Republic of the Philippines and Cuba.

The U. S. S. R., leading world producer, again supplied one-quarter of the total expanded United States imports, largely in metallurgical-grade ore.

Among the smaller suppliers, Brazil, Cyprus, and Guatemala resumed shipments during the year, whereas none was reported from India.

Metallurgical and refractory grades of chromite remained, during the year, on the list of strategic and critical materials for which stockpiling was considered necessary. Purchases for the National Strategic Stock Pile are made by the Bureau of Federal Supply, as outlined in the 1947 chapter of this series.

Salient statistics of chromite in the United States, 1944–48, in short tons

	1944	1945	1946	1947	1948
Total supply	894,019	928,738	761,498	1,107,128	1,545,744
Imports for consumption	848,390	914,765	757,391	1,106,180	1,542,125
Domestic production	45,629	13,973	4,107	948	3,619
Consumption by industry	848,449	808,120	734,759	833,357	875,033
Exports	1,019	12,366	2,158	3,435	2,894

Total new supply of chromite available in 1948 for industry and stock piling increased 40 percent over 1947 to an all-time record with the supply of metallurgical-grade ore up over 90 percent. Supply of

[1] Consulting Mining Engineer, U. S. Bureau of Mines. Chapter prepared under supervision of Norwood B. Melcher.

chemical-grade increased 18 percent, whereas 5 percent less refractory ore was available. Total supply was 77 percent over industrial consumption for the year, with metallurgical-grade showing an excess of 129 percent, refractory, 37 percent, and chemical, 27 percent.

Consumers' stocks totaled 602,491 short tons of all grades at the end of the year; 256,770 tons were metallurgical-grade; 108,997 tons were chemical; and 236,724 tons were refractory. These industry stocks represented net gains of 34, 44, and 64 percent, respectively, from the previous year.

DOMESTIC PRODUCTION

Domestic production revived slightly in 1948 after declining uninterruptedly from the all-time peak of 160,120 short tons in 1943 to less than a thousand tons in 1947.

All of the 1948 output of 3,619 short tons was believed to have been used for metallurgical purposes. Over 80 percent of the 1948 production was made during the first half of the year but with an uptrend noted again in the fourth quarter.

William S. Robertson, operating the Oregon Chrome Mines, Inc., Selma, Josephine County, Oreg., was the largest producer. A new 700-foot haulage crosscut is reported to have been driven into the ore body at this property, some 500 feet below the surface.[2] Other producers included Lockhart & Messinger and Sam J. Wilson from their operations in Del Norte County, Calif.; Eugene Brown, O'Brien, Oreg.; and Tyrrell Transportation Co., Stockton, Calif.

Of the domestic shipments, 1,744 short tons were known to contain over 45 percent Cr_2O_3 and 1,684 tons contained between 35 and 45 percent Cr_2O_3; analysis of the balance was not reported.

Chromium Mining and Smelting Corp., Ltd., leased a War Assets Administration electric furnace plant at Mead, Wash., for production of exothermic (self-melting) chromium alloying metals, development and production of which were interrupted during the war when facilities at Sault Ste. Marie were converted to making ferrosilicon.[3] For raw material the company is drawing on domestic chromite from California and Oregon, as well as on foreign ores.

Chromite production (shipments) in the United States, 1944–48, by States in short tons, and number of producers in 1948

State	1944	1945	1946	1947	1948	
					Number of producers	Short tons
Alaska	1,845					
California	34,715	9,607	[1] 4,107	948	3	274
Montana	1,251					
Oregon	7,818	4,366	(1)		2	3,345
Total	45,629	13,973	4,107	948	5	3,619

[1] California and Oregon production combined. Bureau of Mines not at liberty to publish separate State totals for 1946.

[2] Mining and Industrial News, vol. 16, No. 3, March 1948, p. 10.
[3] Northern Miner, vol. 34, No. 30, Oct. 14, 1948, pp. 1 and 16.

Chromite shipped from mines in the United States, 1880–1948 [1]

Year	Short tons	Year	Short tons	Year	Short tons	Year	Short tons
Before 1880	224,000	1897–99	------	1917	48,972	1935	577
1880	2,563	1900	157	1918	92,322	1936	301
1881	2,240	1901	412	1919	5,688	1937	2,600
1882	2,800	1902	353	1920	2,802	1938	909
1883	3,360	1903	168	1921	316	1939	4,048
1884	2,240	1904	138	1922	398	1940	2,982
1885	3,024	1905	25	1923	254	1941	14,259
1886	2,240	1906	120	1924	323	1942	112,876
1887	3,360	1907	325	1925	121	1943	160,120
1888	1,680	1908	402	1926	158	1944	45,629
1889	2,240	1909	670	1927	225	1945	13,973
1890	4,031	1910	230	1928	739	1946	4,107
1891	1,537	1911	134	1929	301	1947	948
1892	1,680	1912	225	1930	90	1948	3,619
1893	1,624	1913	286	1931	300		
1894	4,122	1914	662	1932	174	Total	847,719
1895	1,949	1915	3,675	1933	944		
1896	880	1916	52,679	1934	413		

[1] Production of chromite before 1880 was "about 200,000 long tons" (224,000 short tons), all from Maryland and Pennsylvania, according to Mineral Resources, 1908, pt. 1, p. 760. Most of the figures for 1880–95 represent conversion to short tons from rounded long tons.

CONSUMPTION AND USES

Consumption of chromite during 1948 increased 5 percent in total tonnage over 1947. By industries, metallurgical consumption was up 2 percent, refractory 5 percent, and chemical 11 percent for the year. Both refractory and chemical consumption was at new highs again in 1948. Metallurgical consumption, although showing steady increase since 1946, remained below the figures for 1941–45 and 29 percent below the peak war year 1943.

For 1940–48, inclusive, data for which are given in an accompanying table, the metallurgical industry has used one-half of the total tonnage consumed, refractory uses have taken one-third, and chemicals have consumed one-sixth of the total. This distribution is on a tonnage basis, without regard to the chromic oxide content of the several grades. Chemical consumption was steadier than either refractory or metallurgical during this period. Ores used for refractory purposes in 1948 averaged lower in chromic oxide content than in any recent year.

Consumption of chromite and tenor of ore used by primary consumer groups in the United States, 1940–48 in short tons

Year	Metallurgical		Refractory		Chemical		Total	
	Gross weight (short tons)	Average tenor (percent Cr_2O_3)	Gross weight (short tons)	Average tenor (percent Cr_2O_3)	Gross weight (short tons)	Average tenor (percent Cr_2O_3)	Gross weight (short tons)	Average tenor (percent Cr_2O_3)
1940	259,113	50.5	186,386	35.8	117,416	47.2	562,915	45.0
1941	402,208	50.1	270,947	34.8	127,135	46.3	800,290	44.3
1942	479,615	48.5	294,092	34.0	118,245	44.8	891,952	43.2
1943	555,259	48.5	282,178	34.0	127,163	44.7	964,600	43.8
1944	456,171	49.4	264,053	34.2	128,225	45.7	848,449	44.1
1945	429,644	49.1	252,407	34.2	126,069	45.0	808,120	43.8
1946	376,848	48.3	228,641	33.9	129,270	44.9	734,759	43.2
1947	385,983	47.4	311,018	35.2	136,356	44.7	833,357	41.1
1948	395,417	48.2	327,795	33.8	151,821	45.5	875,033	42.7

Consumption of ferrochromium in the United States in 1948 was 122,753 short tons, up 8 percent from the 1947 figure of 113,491 short tons. Companies canvassed by the Bureau of Mines use about 85 percent of the total.

Uses of chromite divide rather sharply into three main groups—metallurgical, refractory, and chemical. Each class of use calls for certain qualities in the raw material.

Specifications.—The mineral chromite does not have a fixed chemical composition. It is usually spoken of as $Cr_2O_3 \cdot FeO$ but also contains varying proportions of iron, alumina, magnesia, lime, and silica. These additional elements, while lowering the grade of the material in terms of chromium content, are essential to certain applications as may be seen from the usual trade specifications outlined below.

For metallurgical use, such as the manufacture of ferrochrome, chromite generally must contain a minimum of 48 percent Cr_2O_3, with a chromium : iron ratio of not less than 3 : 1. Further, the ore must be of hard, lumpy structure. Usual specifications call for 6-inch maximum size of piece, with not more than 10 to 15 percent through a ½-inch screen. Silica is undesirable, and combined alumina and magnesia of over 25 percent may be objectionable.

Refractory-grade chromite usually contains about 63 percent combined Cr_2O_3 and Al_2O_3, with 57 percent a common minimum. Iron and silica should be low, usually around 10 and 5 percent, respectively. Hard lump ore is desirable for making bricks, and ground material is suitable for cement. Magnesia content ranges around 15 percent.

Chemical-grade chromite should contain a minimum of 45 percent Cr_2O_3. High iron is not harmful within reasonable limits; a common chrome : iron ratio is 1.6 : 1. Silica must be less than 8 percent and sulfur low. Fines and concentrates are often preferred because they disintegrate readily in processing.

Metallurgical Uses.—The principal metallurgical use of chromite is for production of ferrochromium, the usual form in which chromium is added to the bath to make chrome alloy steels. Ferrochromium usually contains 66 to 72 percent chromium. Two grades are standard—high-carbon ferrochrome of 4 to 7 percent carbon content and low-carbon ferrochrome of less than 2 percent carbon content. Chromite is used also in the metallurgical industry to make exothermic chromium alloys, such as chrom-X, as well as chromium briquets. Chrom-X is made in both high- and low-carbon grades. Briquets are used largely in ferrous foundries. Each briquet contains 2 pounds of chromium.

Chrome alloy steel may be made in the electric furnace directly from scrap and chromite.

Chromium, when alloyed with steel, even in small proportions, improves hardness and tensile strength without serious loss of ductility. Its use permits greater depth of hardness—an advantage, for instance, in armor plate. The added strength of chrome steels favors use of lighter shapes and gages wherever reduction in weight is desirable. Stainless steel, with its corrosion resistance, is the most important of the chromium-alloy steels.

Chemical Uses.—Sodium bichromate is the primary chrome chemical from which other compounds are made. The largest consumption of chrome chemicals is in pigments; tanning and electroplating also require important quantities. Minor uses include dyeing, bleaching, alloys, and prevention of corrosion. During World War II, plating requirements expanded so rapidly that restriction of other less essential uses was needed to keep within industry capacity. Approximately 1.5 tons of chemical-grade chromite is consumed per ton of chemicals produced. High-temperature alloys are of especial interest at this time for jet engines and other applications. These alloys have a low iron content and hence are not true steels. Chromium, one of the major constituents, is introduced as pure metal in making the alloy. Any substantial increase in production of high-temperature alloys would need to be accompanied by corresponding output of chromium metal, which, in turn, uses chemical-grade chromite as the raw material.

Refractory Uses.—As a neutral refractory, resistant to different types of slag, chrome bricks and patching cement are used in lining and repairing furnaces for both ferrous and nonferrous metals.

A new refractory concrete of high strength was reported [4] to have been developed in 1948. Withstanding temperatures up to 3,100° F. with volume stability, this new chrome-base concrete may be poured in the usual manner or applied under pressure. The material is reported to be especially adaptable to construction or repair of vertical walls and arches.

PRICES

Prices of imported chromite are quoted on the long-ton basis, f. o. b. cars at eastern or southern ports with freight differentials for delivery to the west coast. Domestic shipments are sold f. o. b. nearest railroad point. Quoted prices, as shown in the accompanying table from the magazine Steel, remained steady during 1948.

Ferrochromium and chromium-metal prices rose during 1948. High-carbon ferrochromium advanced in price during the year from 18.6 to 20.5 cents per pound of contained Cr for packed lump alloy, contract. Low-carbon ferrochromium (0.06 percent carbon), on the same basis, was quoted at 26.5 cents in January 1948 and 28.75 cents a year later. Chromium metal (97 percent Cr minimum, 0.50 percent C maximum) advanced in price during the year from 93 cents to $1.03 per pound of contained Cr.

Prices of basic chrome brick, according to the magazine Steel, increased during 1948 from $59 to $69 per short ton, f. o. b. works, Baltimore, Md., or Chester, Pa.

[4] Mining Journal (London), vol. 231, No. 5894, Aug. 7, 1948, p. 584.

Price quotations for various grades of chromite in 1948

[Steel]

Source	Cr_2O_3 (percent)	Cr : Fe ratio	Prices per long ton [1]	
			Beginning of year	End of year
Indian and African	48	3:1	$39.00	$39.00
Do	48	2.8:1	37.50	37.50
Do	48	----------	31.00	31.00
South African (Transvaal)	50	----------	29.50	29.50–30.50
Do	48	----------	28.50	29.00–30.00
Do	45	----------	26.50	26.50
Do	44	----------	25.50–26.00	25.50–26.00
Rhodesian	48	[2] 3:1	39.00	39.00
Do	48	----------	30.00	30.00
Do	45	----------	27.00–27.50	27.00–27.50
Brazilian—nominal	48	[2] 3:1	43.50	----------
Do	44	[2] 2.5:1	33.65	33.65
Domestic (sellers nearest rail)	48	3:1	39.00	39.00

[1] Gross ton f. o. b. cars, New York, Philadelphia, Baltimore, Charleston, S. C., plus ocean freight differential for delivery to Portland, Oreg., and/or Tacoma, Wash.
[2] Lump

FOREIGN TRADE [5]

Imports of chromite in 1948 increased 39 percent over 1947 to a total of 1,542,125 short tons containing 680,723 tons of Cr_2O_3; the value was $33,050,888, up 75 percent. Shipments from the Soviet Union, largest supplier, increased 49 percent from the previous year and were almost entirely of metallurgical grade. The Union of South Africa, second source, increased shipments of all grades 12 percent and provided more than four-fifths of the chemical-grade ore. Shipments from Turkey, largely metallurgical grade, increased nearly 300 percent to place Turkey third among total suppliers and second among metallurgical. The Republic of the Philippines, fourth in tonnage, was again the leading supplier of refractory ore. Cuba, fifth in total, was second in refractory grade. Imports from Cuba declined 1 percent for the year. Southern Rhodesia increased shipments (mainly metallurgical grade) 78 percent.

Imports of ferrochromium in 1948 (all from Canada) totaled 9,019 short tons, containing 4,714 tons of Cr, and were valued at $1,470,653. Exports of this product were 6,754 short tons valued at $2,371,367. Exports of chrome ore and concentrates were 2,894 short tons valued at $81,671; chromic acid exports totaled 1,580,792 pounds valued at $529,077.

[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.

Chromite imported for consumption in the United States, 1947–48, by countries and by grades

[U. S. Department of Commerce]

Country	Chemical grade			Metallurgical grade			Refractory grade			Total		
	Short tons		Value	Short tons		Value	Short tons		Value	Short tons		Value
	Gross weight	Cr_2O_3 content		Gross weight	Cr_2O_3 content		Gross weight	Cr_2O_3 content		Gross weight	Cr_2O_3 content	
1947												
Canada				68	34	$2,316				68	34	$2,316
Cuba				18,130	7,010	327,508	146,861	52,389	$1,701,059	164,991	59,399	2,028,567
India	3,548	1,739	$68,691	6,162	3,326	59,945				9,710	5,065	128,636
New Caledonia [1]	8,049	3,809	110,171	12,555	6,376	290,197				20,604	10,185	400,368
Philippines, Republic of				8,691	3,853	120,250	197,964	67,940	1,524,675	206,655	71,793	1,644,925
Sierra Leone [2]				7,762	3,648	152,460	10,640	5,320	180,500	18,402	8,968	332,960
Southern Rhodesia	[3] 4,519	[3] 1,988	[3] 29,217	59,529	29,271	835,033	7,053	3,236	105,683	[3] 71,101	[3] 34,495	[3] 969,933
Turkey	1,120	538	28,000	59,042	27,196	1,681,454	2,240	1,120	80,000	62,402	28,854	1,789,454
Union of South Africa	[3] 145,748	[3] 66,973	[3] 1,027,665	53,775	24,696	551,301	62,990	28,684	476,440	[3] 262,513	[3] 120,353	[3] 2,055,406
U. S. S. R.	6,720	3,226	224,390	215,945	110,546	7,660,888	42,438	22,249	1,070,733	265,103	136,021	8,956,011
Yugoslavia				24,631	10,824	558,319				24,631	10,824	558,319
Total	169,704	78,273	1,488,134	466,290	226,780	12,239,671	470,186	180,938	5,139,090	1,106,180	485,991	18,866,895
1948												
Brazil	1,792	860	35,275							1,792	860	35,275
Canada				145	56	5,526	49	26	1,964	194	82	7,490
Cuba	3,903	1,874	49,661	24,806	8,428	378,154	134,792	47,511	1,574,895	163,501	57,813	2,002,710
Guatemala				1,416	680	53,088				1,416	680	53,088
Malta, Gozo, and Cyprus	5,455	2,509	126,420							5,455	2,509	126,420
New Caledonia [1]				46,452	24,884	1,168,960				46,452	24,884	1,168,960
Philippines, Republic of	3,369	1,483	28,353	21,624	9,438	306,312	210,591	70,748	1,877,249	235,584	81,669	2,211,914
Sierra Leone [2]				8,288	3,481	140,900				8,288	3,481	140,900
Southern Rhodesia	1,117	525	16,674	108,345	51,224	1,992,107	16,918	7,871	311,578	126,380	59,620	2,320,359
Turkey				232,954	109,875	7,177,814	20,532	9,771	728,748	253,486	119,646	7,906,562
Union of South Africa	159,230	73,174	1,268,659	67,437	31,072	902,334	66,077	29,252	520,299	292,744	133,498	2,691,292
U. S. S. R.	17,668	8,481	602,663	376,298	181,637	13,421,492				393,966	190,118	14,024,155
Yugoslavia				12,867	5,863	361,763				12,867	5,863	361,763
Total	192,534	88,906	2,127,705	900,632	426,638	25,908,450	448,959	165,179	5,014,733	1,542,125	680,723	33,050,888

[1] Classified as French Pacific Islands.
[2] Classified as British West Africa.
[3] Revised figure.

WORLD REVIEW

Australia.—The Australian Council for Scientific and Industrial Research is said to have developed a new process for extracting chromic oxide for which either low-grade chromite or the usual standard ores will serve as raw material.[6]

World production of chromite, 1941–48, by countries, in metric tons

[Compiled by B. B. Mitchell]

Country	1941	1942	1943	1944	1945	1946	1947	1948
North America:								
Canada	2,152	10,393	26,848	24,543	5,221	2,821	1,961	1,497
Cuba	163,175	286,470	354,152	192,131	172,626	174,350	159,209	116,624
Guatemala	697	529	374	97	443	47	625	474
Mexico	12	17	----	----	101	----	----	----
United States	12,935	102,400	145,259	41,394	12,676	3,726	860	3,283
South America:								
Argentina	60	210	250	181	3,000	----	----	----
Brazil (exports)	5,944	5,776	7,813	4,721	1,490	----	----	1,626
Europe:								
Albania	[1] 20,000	[1] 5,000	----	----	----	----	----	[2] 16,500
Bulgaria	([3])	[1] 6,500	[1] 7,000	([3])	([3])	([3])	([3])	([3])
Greece	16,240	24,300	15,500	18,295	2,413	9,062	[1] 8,000	1,500
Portugal	----	----	1,267	1,500	1,669	1,530	533	([3])
Sweden	----	80	224	127	----	----	----	----
United Kingdom	848	520	294	116	----	----	----	([3])
Yugoslavia	([3])	[1] 100,000	[1] 65,000	([3])	([3])	([3])	([3])	([3])
Asia:								
Cyprus (exports)	4,816	2,936	7,986	469	1,070	1,158	5,283	6,899
India	50,940	50,380	33,789	40,190	31,642	45,511	35,274	([3])
Indochina, French	----	3,570	6,510	2,300	----	----	----	----
Iran [4]	----	435	1,267	12	----	----	([3])	([3])
Japan	54,510	67,540	58,520	71,135	28,539	7,079	2,347	9,340
Philippines, Republic of	[5] 329,243	[1] 50,000	[1] 60,000	[1] 70,000	([3])	57,000	195,185	256,854
Turkey [6]	135,714	116,342	154,512	182,108	146,716	103,167	102,875	285,353
U. S. S. R	([3])	[2] 400,000	[1] 325,000	([3])	([3])	([3])	([3])	([3])
Africa:								
Egypt	----	312	910	150	150	----	266	191
Sierra Leone	13,907	10,726	16,306	9,851	578	10,301	16,769	7,886
Southern Rhodesia	322,123	348,314	287,453	277,051	186,318	151,433	155,149	230,703
Union of South Africa	141,884	337,620	163,232	88,909	99,090	212,253	373,094	412,783
Oceania:								
Australia:								
Queensland	----	----	----	1,125	----	----	([3])	([3])
New South Wales	356	365	412	246	287	([3])	([3])	([3])
New Caledonia	64,509	67,610	46,952	55,229	40,826	24,946	50,530	75,021
Total (estimate)	1,752,000	1,999,000	1,787,000	1,397,000	1,100,000	1,120,000	1,658,000	2,113,000

[1] Estimate.
[2] Planned production as reported.
[3] Data not available; estimates by author of chapter included in total.
[4] Fiscal year ended March 20 of year following that stated.
[5] January to October, inclusive.
[6] Data revised in some instances to cover production rather than shipments.

Cuba.—Development work was in progress early in 1948 at the Cayoguan, Delta No. 2, and Narciso mines to aid in meeting production schedules.[7]

Cyprus.—Cyprus Chrome Co., Ltd., at present sending hand-sorted lump ore to Sweden, is installing a gravity concentrator.[8] Sorted grade as shipped is reported to run 46–48 percent Cr_2O_3 with a Cr : Fe ratio of 2.8. Ore is trucked some 14 miles from the concentrator at Kakapetria to the railroad leading to the port of Farmagustis. Annual shipments of 10,000 tons are hoped for.

[6] Mining Journal (London), vol. 230, No. 5883, May 22, 1948, p. 393.
[7] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 4, April 1948, p. 3.
[8] Engineering and Mining Journal, vol. 149, No. 1, January 1948, p. 127.

India.—Mineral policy planning in India, reportedly, is looking toward the use of chromite for domestic extraction of chromium metal and manufacture of alloys rather than for export, as heretofore.[9] Reserves of high-grade chromite are thought to be limited. The bulk of the production to date has been for refractory bricks.

Chromite reserves in Baluchistan and Kalat are reported under investigation by Pakistan authorities.[10] These deposits currently produce some 2,000 tons annually. Exchange of this chromite for iron from India is reported under consideration.

New Caledonia.—Most of the chromite produced in New Caledonia is of metallurgical grade. Output of all grades was up 48 percent from 1947, but United States imports of metallurgical in 1948, which constituted total receipts, were nearly four times the previous year's receipts of this grade. The Cr_2O_3 content of metallurgical ore received in 1948 was 53.6 percent compared with 50.8 percent in 1947.

It was reported in mid-1948 that two mines—Claudette I and Claudette II—near Coulee, were to be worked.[11]

Republic of the Philippines.—The Acoje Mining Co. began producing in June 1948 from its metallurgical chromite mine east of Santa Cruz, Zamboles.[12] Ore is being stocked for grading. The Misamis Chromite Co., Inc., began producing in July. Reserves were estimated as of January 1948 at 26,000 metric tons of positive ore with large indicated tonnage.[13] As of mid-1948, no rehabilitation work was reported in progress at Zambales Chrome Mining Co., near the Acoje mine, or at the Filipinas Mining Co. property, Zambales.

Rhodesia.—Some 300,000 tons of chromite were reported early in 1948 in stock waiting rail movement, one-half at Selukave.[14] Rhodesian deposits were described in the 1947 chapter of this series.

Rumania.—Reserves of chromite in the Turnu-Severin area, southwest Rumania, are reported at 2 to 10 million metric tons of 30 to 50 percent Cr_2O_3 content.[15]

Sierra Leone.—Sierra Leone Chrome Mines Co., Ltd., is reported to have exclusive prospecting rights to a belt extending some 70 miles northeast from Pujehun to the Gori Hills.[16] All known occurrences in Sierra Leone are stated to be in this area. Mining to date has been from a deposit some 6 miles north of Hangsha, where the grade is stated to be 43–44 percent Cr_2O_3. The ore can be beneficiated to about 50 percent Cr_2O_3, still retaining a suitable chrome : iron ratio. Inadequate rail facilities are reported to have held back shipments.

Southern Rhodesia.—Inadequate rail facilities to the port of Beira were reported early in 1948 to be the main factor preventing increase of export of chromite from Southern Rhodesia to an estimated capacity level of around 800,000 tons per year.[17]

The possibility of domestic manufacture of ferrochrome was reported under study.

9 Mining Journal (London), vol. 230, No. 5871, Feb. 28, 1948, p. 149.
10 Engineering and Mining Journal, vol. 149, No. 5, May 1948, p. 152.
11 Bureau of Mines, Mineral Trade Notes: Vol. 27, No. 1, July 1948, p. 5.
12 Bureau of Mines, Mineral Trade Notes: Vol. 27, No. 1, July 1948, pp. 5–6.
13 See footnote 12.
14 Mining Journal (London), vol. 230, No. 5873, Mar. 13, 1948, p. 180.
15 Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 6, June 1948, p. 4.
16 Mining Journal (London), vol. 230, No. 5863, Jan. 3, 1948, p. 4.
17 Mining Journal (London), vol. 230, No. 5866, Jan. 24, 1948, p. 61.

Turkey.—Chromite mining in Turkey expanded rapidly in 1948. Recent changes in mining regulations are reported [18] to have encouraged private business to mine chromite. During World War II all Turkish chromite was purchased and exported by the Eti Bank, still the largest producer, and stated [19] to control two-thirds of the deposits. Exploration licenses are understood now to be convertible into concessions without the former limits on production, with the result that many chromite properties are being exploited on the basis of export contracts.

Output of the Eti Bank mines was being expanded in 1948 by installation of equipment from the United States to aid in filling reported contracts with United States importers for over 100,000 tons for delivery by mid-1949.

The port of Antalya (Adalia) was used for the first time in July to ship chromite from the Tefenni mine, Burdur. It is reported that a jig and table concentrator are being planned for beneficiating the Guleman ore. Spiral concentrators are stated to be in use at the Kavak mine to beneficiate the low-grade ore. The product is exported through the port of Izmit, mainly to Norway and Sweden.

Private chromite mines in the Islahiye district near the Syrian border are in production, at a rate estimated at 25,000 tons per year. Private production during the first quarter of 1948 was 21,762 short tons with an additional 11,347 tons from the Guleman district.[20]

Union of South Africa.—Chrome Mines of South Africa, Ltd., is reported [21] as a newly formed company combining the chromite mining activities of the Union Corp., Ltd., and the African Mining and Trust Co. (Pfy.), Ltd. This consolidation includes the Zwartkop and Tweelaagte mines, Rustenburg district and the Groothoek mine, Lydenburg district. These deposits, which are in the Transvaal, were described in the 1945 chapter of this series. A recent estimate [22] places reserves of all grades at 200,000,000 tons down to a depth of 500 feet along the dip.

Beneficiation of chromite is under investigation in South Africa. Laboratory tests as reported [23] improved the Cr_2O_3 content substantially in two of ten instances. Tests by a new method for reducing iron in chromite are said [24] to have concentrated Transvaal ore up to 58 percent Cr_2O_3 content with 3 : 1 chrome : iron ratio at low treatment cost.

[18] Ergunalp, F., Turkish Chromite Production Up: Min. World, vol. 10, No. 12, November 1948, p. 43.
[19] Mining Journal (London), Feb. 14, 1948, vol. 230, No. 5869, p. 119.
[20] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 5, May 1948, p. 6.
[21] Engineering and Mining Journal, August 1948, p. 144.
[22] Mining and Industrial Magazine, vol. 38, No. 1, January 1948, pp. 27–29.
[23] South African Mining and Engineering Journal, vol. 59, pt. 1, No. 2892, July 17, 1948, p. 583.
[24] Mining Journal (London), vol. 231, No. 5911, Dec. 4, 1948, p. 907.

Clays

By R. W. METCALF AND A. LINN[1]

GENERAL SUMMARY

GREATLY increased private and public building programs and a higher level of general business activity, particularly in steel operations, resulted in a 12-percent increase in the volume of all clay produced in 1948 and large increases in shipments of the principal types of structural clay products. Record years were achieved in five of the six chief classifications of clay discussed herein—kaolin or china clay, ball clay, fire clay, bentonite, and fuller's earth; also there was a substantial increase in the output of miscellaneous clays.

The building boom in 1948 was chiefly responsible for the 14-percent increase in output of common clays and shales (miscellaneous clays) used in heavy clay products and in cement. Common clay and shale comprised 84 percent of the clay used for heavy clay products and virtually all of that consumed in portland and other hydraulic cements.

Augmented pottery output in 1948 stimulated the ball- and china-clay industries to record heights. Major factors in the expansion of kaolin volume were sizable increases in shipments for paper coating and rubber.

Salient statistics of the clay industry in the United States, 1947–48

	1947		1948	
	Short tons	Value	Short tons	Value
Domestic clay sold or used by producers:				
Kaolin or china clay	1,425,106	$17,107,963	1,568,848	$19,756,738
Ball clay	269,050	2,923,760	298,979	3,342,647
Fire clay, including stoneware clay	9,038,680	26,208,602	9,849,914	29,424,034
Bentonite	763,889	5,949,586	921,560	7,136,308
Fuller's earth	329,068	4,660,614	342,081	5,273,851
Miscellaneous clays	21,773,680	17,422,962	24,746,599	20,414,694
Total sold or used by producers	33,599,473	74,273,487	37,727,981	85,348,272
Imports:				
Kaolin or china clay	82,628	1,330,001	99,930	1,650,102
Common blue and Gross Almerode	25,849	342,711	32,195	460,422
Fuller's earth	155	3,001	129	2,092
Other clay	3,768	43,450	3,687	29,454
Total imports	112,400	1,719,163	135,941	2,142,070
Exports:				
Kaolin or china clay	18,686	234,707	19,074	319,294
Fire clay	110,193	780,993	102,482	935,232
Other clay (including fuller's earth)	138,244	3,587,489	145,292	3,883,050
Total exports	267,123	4,603,189	266,848	5,137,576

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

Especially large sales of bentonite for use in rotary drilling mud and substantial gains in consumption as a foundry sand bond and as a filtering and decolorizing medium gave bentonite its tenth year of record-shattering production.

An increasing demand for fuller's earth as oil or grease absorbent and other uses, such as insecticides, fungicides, and rotary drilling muds, contributed to a new high in fuller's earth output, surpassing the former record established in 1930.

Stimulated by activity in the metallurgical and other high-temperature industries, and also by the demand for heavy clay products, the output of fire clay in 1948 rose to a new high for the second year in succession.

Price quotations of clay and clay products in 1948 followed the general upward trend.

Imports of kaolin or china clay and blue clay, including Gross Almerode, increased 21 and 25 percent, respectively, in 1948 compared with 1947. By far the greater part of the tonnage of both classes of clay originated in the United Kingdom (99 percent of the kaolin or china clay and 90 percent of the common blue and Gross Almerode clays). Total exports of clay remained at approximately the same level in 1948 as in 1947. Exports of kaolin or china in 1948 were slightly larger, whereas exports of fire clay decreased compared with 1947. Average export unit values rose somewhat.

CONSUMPTION AND USES

The clay-consumption data shown in the accompanying table are comparable with similar information published in Minerals Yearbooks covering the period 1944 to date. Figures relating to kaolin, ball clay, bentonite, and fuller's earth are comparable for previous years also. The fire clay and miscellaneous clay data beginning with 1944 include captive tonnage, which was not requested from the producers in earlier years. A more detailed explanation of these differences appeared in the Clays chapter of Minerals Yearbook 1944.

Clay consumed in the manufacture of heavy clay products was 10 percent greater than in 1947 and comprised 56 percent of the total tonnage. Clays used in refractories and in portland and other hydraulic cements each consumed 17 percent of the total; paper filler and coating, 2 percent; rotary drilling mud, filtering and decolorizing oils, and pottery, 1 percent each. The remainder was used for a variety of other purposes.

Many uses showed large gains in 1948 over figures reported in 1947. The proportional increases for some of the more important classifications were as follows: Rotary drilling mud, 24 percent; cement, 19 percent; paper filler and coating, 12 percent; refractories, 11 percent; filtering and decolorizing oils, 9 percent; pottery, 7 percent; and high-grade tile, 6 percent.

Clay sold or used by producers in the United States in 1948, 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	141,969	242,333	38				384,340
Stoneware, including chemical stoneware		1,212	40,911				42,123
Art pottery and flower pots	3,509	7,484	18,073			23,351	52,417
Slip for glazing	319	200				1,850	2,369
Total	145,797	251,229	59,022			25,201	481,249
Tile, high-grade	29,292	23,842	125,546			5,268	183,948
Kiln furniture, etc.:							
Saggers, pins, stilts	6,617		25,038				31,655
Wads			2,237				2,237
Total	6,617		27,275				33,892
Architectural terra cotta			16,264				16,264
Paper:							
Filler	472,360	400					472,760
Coating	399,768						399,768
Total	872,128	400					872,528
Rubber	176,965		15,480			1,848	194,293
Linoleum	28,285	808	4,758				33,851
Paints:							
Filler or extender	14,471	2,757				270	17,498
Calcimine	1,158						1,158
Total	15,629	2,757				270	18,656
Portland and other hydraulic cements	56,157		6,289			6,361,518	6,423,964
Refractories:							
Fire brick and block	83,670	11,958	4,765,194				4,860,822
Bauxite, high-alumina brick			52,150				52,150
Fire-clay mortar, including clay processed for laying fire brick	50,902	300	266,562				317,764
Clay crucibles	955	100	537				1,592
Glass refractories	875	50	3,414				4,339
Zinc retorts and condensers			39,975				39,975
Foundries and steel works	4,571	228	808,610	228,799	162	37,738	1,080,108
Other refractories	4,943		101,497			613	107,053
Total	145,916	12,636	6,037,939	228,799	162	38,351	6,463,803
Heavy clay products: Common brick, face brick, paving brick, drain tile, sewer pipe, and kindred products	5,810		3,471,820			17,620,376	21,098,006
Miscellaneous:							
Rotary drilling mud			2,310	330,395	22,608	188,154	543,467
Filtering and decolorizing oils (raw and activated earths)				290,319	[1]217,691		508,010
Other filtering and clarifying				3,638	5,758		9,396
Artificial abrasives	12,531		224				12,755
Absorbent uses (oily floors, etc.)	5,360				74,095		79,455
Asbestos products	3,217						3,217
Chemicals	18,160		76,489	1,683	73		96,405
Enameling	2,397	1,244					3,641
Fertilizers	18,976					43	19,019
Filler (other than paper or paint)	1,800	1,784	2,812	5,809		5,177	17,382
Insecticides and fungicides	15,950			3,084	18,749	1,047	38,830
Plaster and plaster products	4,005		1,026				5,031
Concrete admixture, sealing dams, etc				1,911			1,911
Other uses	3,856	4,279	2,660	55,922	2,945	499,346	569,008
Total	86,252	7,307	85,521	692,761	341,919	693,767	1,907,527
Grand total:							
1948	1,568,848	298,979	9,849,914	921,560	342,081	24,746,599	37,727,981
1947	1,425,106	269,050	9,038,680	763,889	329,068	21,773,680	33,599,473

[1] Comprises the following: Mineral oils, 194,225 tons; vegetable oils, 23,466 tons.

CHINA CLAY OR KAOLIN

In 1948 the output of china clay or kaolin for the third successive year established a new peak for the industry, reaching 1,568,848 short tons valued at $19,756,738, or 10 percent greater than in 1947, the next highest year. The accompanying chart shows the growth of kaolin output, highlighting the increasing demands of the major consuming industries.

The chief uses of kaolin in 1948 were for the manufacture of paper, 872,128 short tons (56 percent of the total sales); rubber, 176,965 tons (11 percent); refractories, 145,916 tons (9 percent); and pottery, 145,797 tons (9 percent). The remainder (15 percent) was consumed for a wide variety of purposes, including cement, high-grade tile, fertilizers, chemicals, insecticides, paint filler or extender, calcimine and linoleum. Large relative increases in consumption over 1947 were reported for pottery, 21 percent; high-grade tile, 29 percent; paper filler and coating combined, 12 percent; and cement, 36 percent. Newer uses attracting attention were fertilizers and insecticides.

Kaolin sold or used by producers in the United States, 1947–48, by States

State	Sold by producer		Used by producer		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1947						
Alabama, Florida, and North Carolina	63,283	$1,077,006			63,283	$1,077,006
California	16,359	278,489			16,359	278,489
Georgia	922,861	12,132,303	109,152	$623,738	1,032,013	12,756,041
Pennsylvania	(1)	(1)	(1)	(1)	33,491	122,653
South Carolina	(1)	(1)	(1)	(1)	271,054	2,774,545
Other States [2]	290,795	2,932,959	22,656	63,468	8,906	99,229
Total	1,293,298	16,420,757	131,808	687,206	1,425,106	17,107,963
1948						
Alabama, Florida, and North Carolina	64,614	1,106,387			64,614	1,106,387
California	(1)	(1)	(1)	(1)	25,562	352,538
Georgia	1,018,427	13,941,390	117,013	701,308	1,135,440	14,642,698
Pennsylvania	(1)	(1)	(1)	(1)	50,021	190,998
South Carolina	(1)	(1)	(1)	(1)	283,485	3,347,078
Other States [2]	334,671	3,905,887	34,123	101,766	9,726	117,039
Total	1,417,712	18,953,664	151,136	803,074	1,568,848	19,756,738

[1] Included with "Other States."
[2] Includes States indicated by footnote 1 and Illinois, Utah, and Virginia.

Georgia produced more kaolin than any other State, again furnishing 72 percent of the total output. South Carolina was second in rank and Alabama, Florida, and North Carolina combined, third. Other States producing kaolin in 1948 were California, Illinois, Pennsylvania, Utah, and Virginia. No production was reported for Maryland in 1948. All States or groups of States for which statistics are published in the accompanying table showed small to substantial gains in output in 1948 compared with 1947.

Imports of kaolin in 1948 rose 21 percent to 99,930 short tons and were the highest since 1940. Of the 1948 total, 98,469 tons came from

United Kingdom and small tonnages each from Canada, France, and Czechoslovakia.

Exports of kaolin in 1948 rose 2 percent compared with 1947. Canada was the principal country of destination, accounting for 86 percent of the total. Small tonnages also were shipped to Mexico, several South American countries, Europe, Africa, and Asia.

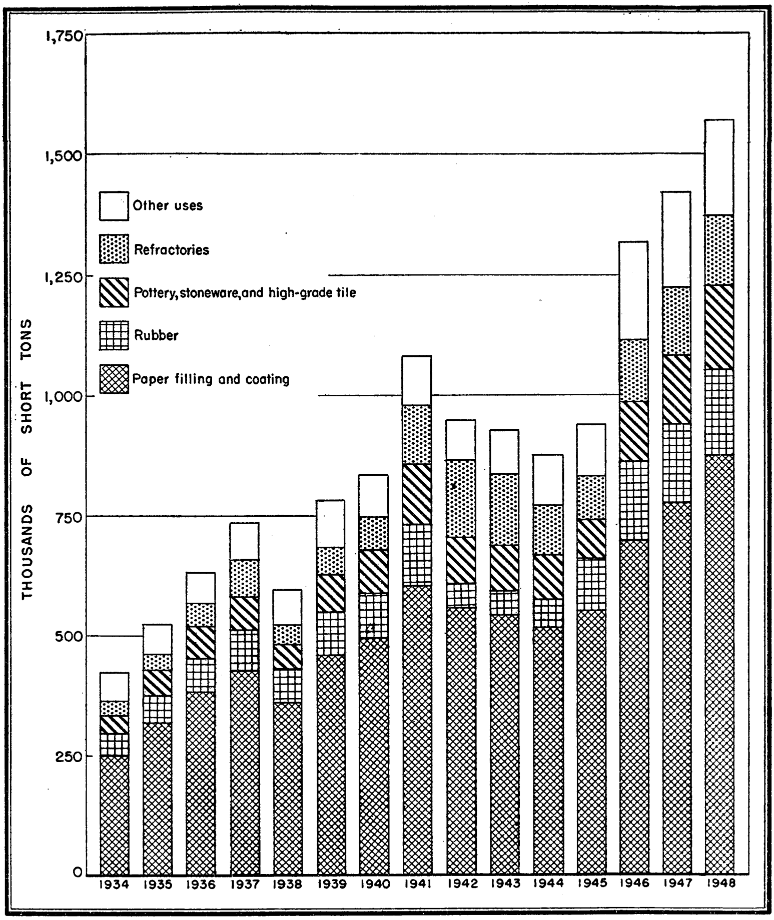

FIGURE 1.—Kaolin sold or used by domestic producers for specified uses, 1934–48.

Quotations on Georgia, South Carolina, Virginia, and North Carolina kaolins, as reported in E&MJ Metal and Mineral Markets, at the beginning of 1948 ranged from $2.50 to $3.50 per short ton for sagger clays up to $20 or $30 per ton for certain prepared grades. Beginning in July, these quotations rose to $3.50 to $4.50 for sagger clays, with increases generally of 75 cents to $1 per ton for the various other grades quoted. The higher levels remained in effect during the balance of the year. In early 1948 Florida kaolins were quoted as follows: Washed and crushed in bulk, $16.75 per ton; washed and

Georgia kaolin sold or used by producers, 1944–48, 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 tons		Total	Average per tons
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
1947	902,554	12,034,383	13.33	129,459	721,658	5.57	1,032,013	12,756,041	12.36
1948	1,006,325	13,866,799	13.78	129,115	775,899	6.01	1,135,440	14,642,698	12.90

air-floated, $20.75; and air-floated enamel clay, $30 to $35. The latter grade was raised to $35 per ton in March 1948. According to Oil, Paint and Drug Reporter, imported china clay ex dock at the end of 1948 was quoted at $16 to $35 for white lump in bulk and $45 for powdered material in carlots. Powdered kaolin, ex warehouse, l. c. l., was quoted by the same source at $50 to $55 per ton. The average value per ton of domestic kaolin as reported to the Bureau of Mines by the producers in 1948 was $12.59, compared with $12 in 1947 and $10.25 in 1946.

BALL CLAY

Sales of ball clay in 1948 rose 11 percent to a new high, reaching nearly 300,000 tons (298,979 short tons). This is an increase of over 100,000 tons in 7 years. As in all of the last 5 years, Tennessee supplied the larger part of the output—173,797 tons (58 percent of the total); Kentucky furnished 103,426 tons (35 percent), or a combined total of 93 percent in 1948 for these two States compared with 91 percent in 1947. The remainder was mined in Maryland, Mississippi, and New Jersey.

Whiteware and stoneware mixtures consumed 251,229 short tons (84 percent of the total); high-grade tile, 23,842 tons (8 percent); refractories, 12,636 tons (4 percent); and paint filler, enamel, linoleum, paper filler, and other uses, the remaining 4 percent. Increases in 1948 over 1947 for whiteware mixtures and refractories were 13 and 17 percent, respectively; ball clay used in high-grade tile declined 7 percent.

Quotations on ball clay in 1948, from E&MJ Metal & Mineral Markets, were as follows: Kentucky and Tennessee crude ball clay, which ranged from $5 to $12 per short ton at the beginning of the year, were raised to $7 to $12 in February, and changed to $10 in September; air-floated and pulverized material, which ranged from $11 to $21 at the start of the year, was raised to $15.50 to $20.50 in February and changed to $19.50 to $20.50 in September and again to $19.50 in October for Tennessee clays only. Maryland ball clay, shredded, in bulk was quoted at $7 to $9 per ton throughout 1948; air-floated material, in bags, which was quoted at $17 to $21 at the beginning of the year, had a range of $14 to $17.50 after September. The average realization reported by producers to Bureau of Mines in 1948 rose to $11.18, compared with $10.87 in 1947 and $9.85 in 1946.

Imports of common blue and Gross Almerode clays in 1948 rose 25 percent in quantity and 34 percent in value compared with 1947. By far the greater portion of these receipts was unmanufactured common blue clay. The United Kingdom supplied 90 percent of the imports in this classification, Canada about 7 percent, Germany almost 3 percent, and Brazil less than half of 1 percent. Imports of Gross Almerode clays comprised about 1 percent of the combined common blue and Gross Almerode clays. Exports, if any, are not separately shown in official foreign trade returns.

Ball clay sold by producers in the United States, 1946–48, by States

State	1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value
Kentucky	98,918	$990,301	99,951	$1,072,203	103,426	$1,155,530
Maryland, Mississippi, and New Jersey	12,538	106,208	22,931	262,947	21,756	284,588
Tennessee	131,689	1,299,393	146,168	1,588,610	173,797	1,902,529
Total	243,145	2,395,902	269,050	2,923,760	298,979	3,342,647

FIRE CLAY

A continued heavy demand for refractories, particularly in the steel industry, and the exceptional market for new building construction again resulted in a record year in production of fire clay, which rose 9 percent over 1947 and nearly reached 1 million tons in 1948.

As above indicated, the two major uses of fire clay were in refractories and heavy clay products. They consumed 61 and 35 percent, respectively, of the total fire clay in 1948. About 1 percent each was used in high-grade tile and in chemicals, and the remainder in a wide variety of other uses. The increases in four principal classifications over 1947 were refractories, 11 percent (over 600,000 tons); heavy clay products, 7 percent (over 200,000 tons); high-grade tile, 25 percent; and chemicals, 6 percent.

Both quality and proximity to market influence the location of fire-clay operations. Thus, in 1948, Ohio was first in order of output of fire clay and supplied 28 percent of the total tonnage, followed by Pennsylvania, 19 percent of the total; Missouri, 15 percent; California, 6 percent; and Kentucky, 5 percent. The remainder (27 percent) was produced in 30 States and Alaska, which for the first time reported output of fire clay. Of the 17 principal fire-clay-producing States, 14 had a larger output in 1948 than in 1947, and 3 reported decreases.

Quotations on fire clay are not given in trade journals. However, reports from producers to the Bureau of Mines indicated that the average sales value of fire clay sold in 1948 rose to $2.90, compared with $2.77 in 1947 and $2.64 in 1946. The average value of all fire clay, including both sales and captive tonnage, was $2.99 in 1948, compared with $2.90 in 1947 and $2.63 in 1946.

Official foreign trade statistics do not show imports of fire clay separately. Exports, however, are listed and in 1948 totaled 102,482 short tons valued at $935,232, a small decrease in tonnage (7 percent) but a substantial gain in value (20 percent) compared with 1947.

The chief country of destination was Canada, which took 86 percent of the total exports. Mexico received 7 percent, and the remaining 7 percent represented small shipments to 57 destinations in North and South America, Europe, Africa, Asia, and Oceania.

Fire clay, including stoneware clay [1] sold or used by producers in the United States, 1947–48 by States

State	Sold by producer		Used by producer		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1947						
Alabama	104,432	$166,652	39,912	$108,886	144,344	$275,538
Arkansas	(2)	(2)	(2)	(2)	230,241	731,324
California	225,701	614,487	261,380	454,530	487,081	1,069,017
Colorado	56,704	113,200	60,037	137,619	116,741	250,819
Illinois	200,872	690,343	190,469	398,024	391,341	1,088,367
Indiana	293,366	430,756	145,662	351,519	439,028	782,275
Kentucky	95,143	494,972	405,575	1,594,379	500,718	2,089,351
Maryland	19,992	151,452	118,386	325,218	138,378	476,670
Missouri [3]	324,774	814,811	881,197	2,900,001	1,205,971	3,714,812
New Jersey	86,672	669,136	185,705	442,268	272,377	1,111,404
Ohio	795,233	1,856,067	1,828,229	4,345,489	2,623,462	6,201,556
Pennsylvania	321,801	1,038,595	1,417,991	5,468,737	1,739,792	6,507,332
Tennessee	(2)	(2)	(2)	(2)	23,481	133,223
Texas	(2)	(2)	(2)	(2)	221,925	507,639
Utah	(2)	(2)	(2)	(2)	27,294	73,868
Washington	13,394	16,794	42,822	86,612	56,216	103,406
West Virginia	(2)	(2)	(2)	(2)	302,602	898,629
Other States [4]	139,951	353,948	783,280	2,184,107	117,688	193,372
Total	2,678,035	7,411,213	6,360,645	18,797,389	9,038,680	26,208,602
1948						
Alabama	130,023	235,418	40,766	111,108	170,789	346,526
Arkansas	(2)	(2)	(2)	(2)	273,540	909,376
California	135,068	378,729	412,262	933,701	547,330	1,312,430
Colorado	114,036	234,150	52,453	134,776	166,489	368,926
Illinois	198,732	701,890	200,474	486,488	399,206	1,188,378
Indiana	206,249	347,515	111,848	239,198	318,097	586,713
Kentucky	95,778	486,288	420,391	1,724,054	516,169	2,210,342
Maryland	15,557	107,633	119,247	440,367	134,804	548,000
Missouri [3]	370,064	947,030	1,126,699	3,876,852	1,496,763	4,823,882
New Jersey	86,032	700,047	246,733	610,656	332,765	1,310,703
Ohio	794,732	1,979,751	1,991,777	4,578,905	2,786,509	6,558,656
Pennsylvania	338,096	1,106,561	1,533,591	6,196,592	1,871,687	7,303,153
Tennessee	(2)	(2)	(2)	(2)	30,148	174,695
Texas	(2)	(2)	(2)	(2)	259,128	590,420
Utah	(2)	(2)	(2)	(2)	26,363	76,279
Washington	22,955	32,464	59,145	109,668	82,100	142,132
West Virginia	(2)	(2)	(2)	(2)	314,084	756,627
Other States [4]	128,394	377,473	898,812	2,346,720	123,943	216,796
Total	2,635,716	7,634,949	7,214,198	21,789,085	9,849,914	29,424,034

[1] Includes stoneware clay as follows: 1947—138,349 tons, $289,831; 1948—143,701 tons, $321,062.
[2] Included with "Other States."
[3] Includes diaspore and burley clay as follows: 1947—diaspore, 40,504 tons, $349,937; burley, 51,330 tons, $251,449; 1948—diaspore, 52,255 tons, $565,163; burley, 38,393 tons, $225,003.
[4] Includes Alaska (1948), Delaware, Idaho, Iowa, Kansas, Massachusetts, Michigan (1947), Minnesota, Mississippi, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oregon, South Carolina, Virginia, and States indicated by footnote 2 above.

The active market for fire-clay products was reflected in the quotations for fire-clay brick during 1948. Quotations on Missouri, Kentucky, and Pennsylvania fire-clay brick, which started the year at $87 per thousand for first quality and $70 for second quality, rose in March to $92 for first quality and $73 for second quality and again in September to $100 for first-quality and $80 for second-quality brick. In the same journal, E&MJ Metal and Mineral Markets, Ohio fire brick—which at the beginning of 1948 were quoted at $64 per thousand for first quality, $56 for intermediate grade and $51 for second grade—rose in March to $67 per thousand for intermediate grade and $59 for second grade, and again in September to $74 per thousand for intermediate-grade and $66 for second-grade brick (quotations on first quality Ohio fire brick were not reported in March and subsequent months).

BENTONITE

Production of bentonite in 1948 totaled 921,560 short tons valued at $7,136,308, higher by 21 percent in tonnage and 20 percent in value than in the previous record year 1947. This industry has experienced rapid expansion. As recently as 1938, annual sales were less than 200,000 tons. Production was reported in nine States in 1948 compared with eight States in 1947.

The most important markets for bentonite in 1948, as for many years, were the foundry and petroleum industries, as a foundry-sand bond, as rotary drilling mud, and in filtering and decolorizing. These three uses combined employed 92 percent of the total bentonite sold in 1948, compared with 90 percent in 1947. The remainder was consumed for a wide variety of purposes. Compared with 1947, increases in tonnage in 1948 for filtering and decolorizing oils, foundry-sand bond, and rotary drilling mud were 17, 11, and 39 percent, respectively.

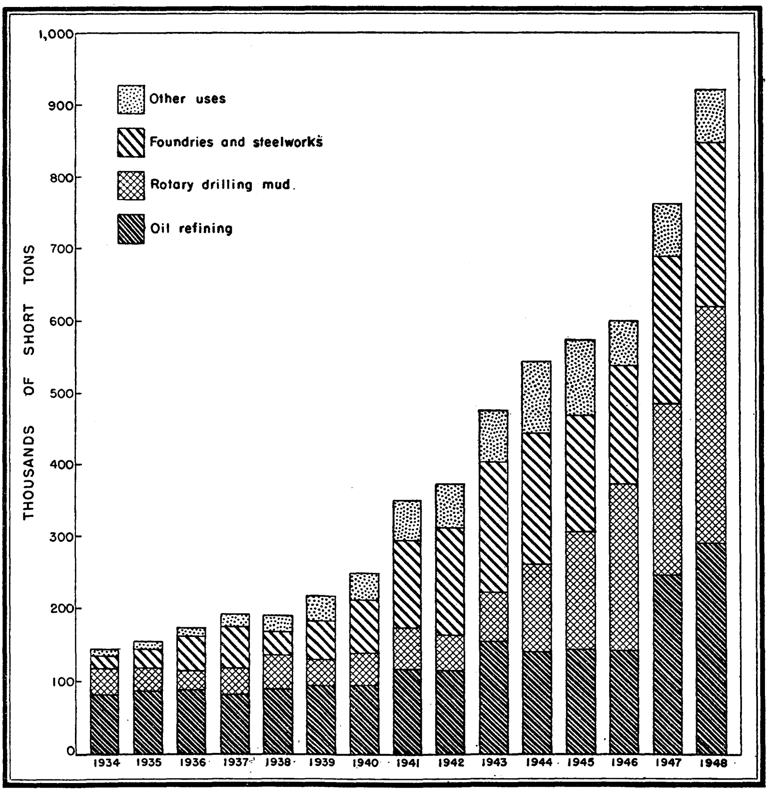

FIGURE 2.—Bentonite sold or used by domestic producers for specified uses, 1934–48.

Bentonite sold or used by producers in the United States, 1946–48, by States

State	1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value
California	(1)	(1)	5,328	$55,500	18,676	$101,450
South Dakota	186,707	$1,394,378	186,450	2,070,659	156,701	1,702,430
Texas	21,576	192,891	18,628	146,187	29,926	282,036
Wyoming	212,530	1,988,918	259,084	2,583,255	383,815	3,682,734
Other States [2]	180,615	785,227	294,399	1,093,985	332,442	1,367,658
Total	601,428	4,361,414	763,889	5,949,586	921,560	7,136,308

[1] Included with "Other States."
[2] Includes Arizona, California (1946), Colorado (1946 and 1948), Mississippi, Montana, Nevada (1946 and 1948), Oklahoma (1946), and Utah.

The Wyoming-South Dakota area furnished 59 percent of the total tonnage in 1948—42 percent from Wyoming and 17 percent from South Dakota. Texas supplied 3 percent and California 2 percent of the total, and the remainder was produced in Mississippi, Arizona, Utah, and Colorado.

Quotations on Wyoming bentonite throughout 1948, as given in E&MJ Metal and Mineral Markets, remained at the same levels as in the last half of 1947—dried, crushed in bulk, $8 per ton; and 200-mesh, pulverized, in 100-pound bags, $11. The average value per ton as reported by the producers to the Bureau of Mines in 1948 declined slightly to $7.74 from the $7.79 reported in 1947, which compares with $7.25 in 1946.

Imports of bentonite in 1948 were small and originated almost wholly in Mexico. Exports of bentonite are not separately shown in foreign trade statistics but are included under the blanket classification of "other clays or earths, n. s. p. f." However, various bentonite producers reported to the Bureau of Mines that in 1948 they exported 41,400 short tons, compared with about 41,000 tons in 1947. Sales were distributed widely throughout the world. They included shipments destined for Canada, Mexico, Arabia, Australia, New Zealand, South Africa, Philippines, and most of the countries in Europe and South and Central America.

The operations of a large bentonite mining and processing firm in Wyoming were described.[2] Origin, occurrence, and uses were mentioned briefly. Utilization of the blue-gray subsurface Wyoming bentonite, heretofore rejected in mining, may become possible by allowing it to oxidize, thus changing it into the form now marketed.[3] Wyoming is studying the natural resources of the State, including location of deposits and quantities available.[4]

The use of bentonite in the filtration of molten sulfur to remove impurities was described.[5] A dehydrating agent prepared from montmorillonite was reported.[6] The preparation of an expanded light-weight bentonite suitable for use as a filter medium, an insulating material, or an oil absorbent was patented.[7] Properties of ben-

[2] Canadian Mining Journal, Bentonite Deposits: Vol. 69, No. 6, June 1948, p. 91.
[3] Rock Products, vol. 51, No. 11, November 1948, p. 63.
[4] Mining Congress Journal, vol. 34, No. 12, December 1948, p. 73.
[5] Lee, James A., Filtration Solves Sulphur Difficulties: Chem. Eng., vol. 55, No. 4, April 1948, pp. 119–121.
[6] Chemical Industries, vol. 63, No. 3, September 1948, p. 446.
[7] Bechtner, Paul (assigned to American Colloid Co.), Expanded Bentonite: U. S. Patent 2,433,193, Dec. 23, 1947 (May 1, 1944); Am. Ceram. Soc. Jour., vol. 31, No. 4, Apr .1, 1948, p. 93 (abs.).

tonite suitable for use in Bureau of Reclamation projects and satisfactory test procedures were determined.[8] The results of using montmorillonite as a catalyst in cracking and X-ray diffraction studies were reported.[9] The occurrence and utilization of swelling and nonswelling bentonites in Australia were described.[10]

FULLER'S EARTH

The output of fuller's earth in 1948 totaled 342,081 short tons valued at $5,273,851, an increase of 4 percent in quantity and 13 percent in value over 1947. The 1948 production was a new high and surpassed the previous record year, 1930 (335,644 tons), by 2 percent. The accompanying chart (fig. 3) shows a considerable expansion in output since 1940. Sales for filtering and decolorizing minerals, the principal use, in recent years have scarcely been holding their own, while more recently developed markets such as absorbents for oily floors and insecticides have resulted in larger over-all shipments.

Consumption of fuller's earth in mineral-oil refining in 1948 comprised 57 percent of the total production. Absorbent uses consumed 22 percent of the total output; vegetable oils and rotary drilling mud, each 7 percent; insecticides and fungicides, 5 percent; other filtering and clarifying, 2 percent; and binders, chemicals, foundries, and various other uses, less than 1 percent.

Increases in output were reported from all producing States except Texas. Texas, however, supplied 27 percent of the total output. The Georgia-Florida area produced 55 percent of the total tonnage, and Illinois 11 percent.

Fuller's earth sold or used by producers in the United States, 1946–48, by States

State	1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value
Florida and Georgia	144,214	$2,100,652	168,557	$2,699,660	188,014	$3,224,169
Illinois	33,134	296,637	37,740	388,955	37,942	410,678
Texas	110,693	1,157,892	102,901	1,199,726	92,310	1,162,336
Other States [1]	10,711	147,812	19,870	372,273	23,815	476,668
Total	298,752	3,702,993	329,068	4,660,614	342,081	5,273,851

[1] Includes California, Mississippi (1947–48), Nevada, Tennessee, and Utah.

Quotations on Georgia and Florida fuller's earth in 1948, according to E&MJ Metal and Mineral Markets, were as follows: 30- to 60-mesh, $14.50 per short ton; 15- to 30-mesh, $14; 200-mesh up, $10; and 100-mesh up, $7. Average realization as reported to the Bureau of Mines by producers rose in 1948 to $15.42, compared with $14.16 in 1947 and $12.39 in 1946.

[8] McConnell, D., Testing and Properties of Bentonites: U. S. Bureau of Reclamation, Petrographic Lab. Rept. 44C, April 1947, 9 pp.; Bldg. Sci. Abs., vol. 21, 1948, p. 66; British Abs., November 1948, p. 610.

[9] Grenall, Alexander, Montmorillonite Cracking Catalyst—X-Ray Diffraction: Ind. Eng. Chem., vol. 40, No. 11, November 1948, pp. 2148–2149.

[10] Lynch, Charles, Bentonite in Australia: Mining Mag. (London), vol. 79, No. 5, November 1948, pp. 280–281.

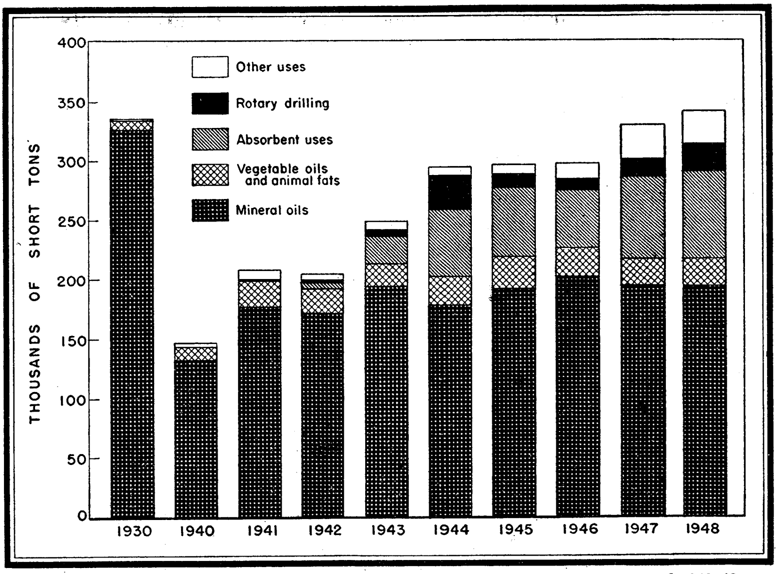

FIGURE 3.—Fuller's earth sold or used by producers for specified uses, 1930 and 1940–48

Imports of fuller's earth are small, totaling only 129 short tons in 1948. Exports are not separately reported in official foreign trade statistics. As compiled from reports by the producers to the Bureau of Mines, however, exports of fuller's earth in 1948 approximated 10,600 short tons, compared with 9,500 tons in 1947. Among the destinations reported were Canada, Venezuela, Peru, other South American countries, three or four European nations, Bahrein Island, and Saudi Arabia.

MISCELLANEOUS CLAYS

This section includes statistics for clays and shales (large tonnages of which are used in the manufacture of heavy clay products and portland cement) other than those treated in the foregoing pages. With these also are grouped comparatively minor tonnages of slip clay, oil-well drilling mud, pottery clay, and others that cannot be clearly identified as belonging to one of the types discussed separately in this chapter.

The construction boom in 1948 resulted in an increase of nearly 3,000,000 tons in output of miscellaneous clays, up 14 percent compared with 1947. The manufacture of heavy clay products consumed 71 percent of the total and cement 26 percent. Tonnages used in heavy clay products and in cement in 1948 were 11 and 19 percent, respectively, greater than in 1947.

Most of this clay or shale (96 percent in 1947 and 1948) was captive tonnage, which was mined by the manufacturing companies near their processing plants and was first marketed in the form of brick, cement, tile, or other finished products. The average value of the miscellaneous clay sold as raw or prepared clay in 1948 declined slightly to $1.89 from the $1.99 reported in 1947 and compares with $1.79 in

1946. Some of the special types of clay included under this classification, however, sold for much higher values. The value of the captive clay, largely mined by mechanized methods, was computed from individual estimates that generally are $1 or less per ton.

Miscellaneous clays, including shale and slip clay, sold or used by producers in the United States, 1947–48, by States

State	Sold by producers [1]		Used by producers [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1947						
Alabama	(3)	(3)	(3)	(3)	976,992	$680,022
Arkansas			172,896	$155,788	172,896	155,788
California	224,374	$751,223	1,216,934	811,131	1,441,308	1,562,354
Colorado	42,475	73,134	217,820	154,294	260,295	227,428
Connecticut			184,751	134,802	184,751	134,802
Georgia			886,533	680,276	886,533	680,276
Illinois	31,409	36,556	1,773,494	1,422,727	1,804,903	1,459,283
Indiana	99,552	84,915	643,298	487,718	742,850	572,633
Iowa	13,862	73,736	882,703	714,928	896,565	788,664
Kansas	(3)	(3)	(3)	(3)	532,777	372,461
Kentucky			187,126	144,682	187,126	144,682
Louisiana			215,199	153,236	215,199	153,236
Maine			20,865	18,865	20,865	18,865
Maryland	(3)	(3)	(3)	(3)	455,180	345,004
Massachusetts	(3)	(3)	(3)	(3)	124,717	99,348
Michigan	(3)	(3)	(3)	(3)	1,161,024	842,605
Minnesota	(3)	(3)	(3)	(3)	130,207	111,662
Missouri			538,440	336,345	538,440	336,345
Montana			38,891	39,039	38,891	39,039
Nebraska	(3)	(3)	(3)	(3)	98,011	86,844
New Hampshire			28,605	21,456	28,605	21,456
New Jersey			296,402	264,049	296,402	264,049
New Mexico	(3)	(3)	(3)	(3)	54,255	41,484
New York	(3)	(3)	(3)	(3)	1,174,134	855,385
North Carolina	(3)	(3)	(3)	(3)	1,044,515	863,537
Ohio	35,903	25,217	1,903,620	1,487,556	1,939,523	1,512,773
Oklahoma			522,704	349,000	522,704	349,000
Oregon	(3)	(3)	(3)	(3)	135,120	78,867
Pennsylvania	28,216	37,920	1,529,113	1,189,542	1,557,329	1,227,462
Tennessee			761,692	534,663	761,692	534,663
Texas	(3)	(3)	(3)	(3)	1,145,325	1,085,315
Utah			151,802	201,459	151,802	201,459
Washington	(3)	(3)	(3)	(3)	185,958	137,922
West Virginia	(3)	(3)	(3)	(3)	288,078	218,526
Wisconsin	(3)	(3)	(3)	(3)	111,450	81,200
Wyoming			15,414	10,527	15,414	10,527
Undistributed [4]	424,231	704,695	8,685,356	6,323,483	1,491,844	1,127,996
Total	900,022	1,787,396	20,873,658	15,635,566	21,773,680	17,422,962
1948						
Alabama	48,156	44,011	1,027,634	738,384	1,075,790	782,395
Arkansas			193,913	186,984	193,913	186,984
California	240,950	765,691	1,841,359	1,281,220	2,082,309	2,046,911
Colorado			292,287	238,392	292,287	238,392
Connecticut			314,569	230,026	314,569	230,026
Georgia			1,081,225	829,412	1,081,225	829,412
Illinois	43,990	49,542	2,043,436	1,809,605	2,087,426	1,859,147
Indiana	98,129	82,071	793,799	617,267	891,928	699,338
Iowa	9,680	88,483	860,170	683,413	869,850	771,896
Kansas			583,338	438,672	583,338	438,672
Kentucky			182,493	143,590	182,493	143,590
Louisiana			248,870	194,956	248,870	194,956
Maine			26,906	24,552	26,906	24,552
Maryland			447,247	324,389	447,247	324,389
Massachusetts	(3)	(3)	(3)	(3)	131,609	103,783
Michigan	300,224	283,422	1,007,946	702,318	1,308,170	985,740
Minnesota	(3)	(3)	(3)	(3)	112,672	97,187
Missouri	(3)	(3)	(3)	(3)	638,784	485,246
Montana			29,603	28,309	29,603	28,309
Nebraska	(3)	(3)	(3)	(3)	158,079	127,766
New Hampshire			25,262	18,960	25,262	18,960
New Jersey			265,318	235,028	265,318	235,028
New Mexico	(3)	(3)	(3)	(3)	46,983	50,604
New York	(3)	(3)	(3)	(3)	1,465,305	1,129,484
North Carolina	(3)	(3)	(3)	(3)	1,179,437	961,221

See footnotes at end of table.

Miscellaneous clays, including shale and slip clay, sold or used by producers in the United States, 1947–48, by States—Continued

State	Sold by producers [1]		Used by producers [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1948—Continued						
Ohio	(3)	(3)	(3)	(3)	2,177,072	$1,699,165
Oklahoma			510,316	$389,903	510,316	389,903
Oregon	(3)	(3)	(3)	(3)	165,931	117,740
Pennsylvania	13,589	$21,036	1,673,730	1,339,961	1,687,319	1,360,997
South Carolina			426,039	364,549	426,039	364,549
Tennessee	(3)	(3)	(3)	(3)	790,752	625,342
Texas	38,665	321,466	1,262,525	987,082	1,301,190	1,308,548
Utah			138,311	169,580	138,311	169,580
Washington	(3)	(3)	(3)	(3)	209,266	152,420
West Virginia			276,395	220,049	276,395	220,049
Wisconsin	(3)	(3)	(3)	(3)	155,062	113,803
Wyoming			16,821	9,640	16,821	9,640
Undistributed [5]	172,251	164,865	8,211,453	6,387,866	1,152,752	888,970
Total	965,634	1,820,587	23,780,965	18,594,107	24,746,599	20,414,694

[1] Includes slip clay as follows—1947: Michigan, New York, and Pennsylvania, 3,051 tons, $35,122; 1948: Michigan and New York, figures cannot be shown. Purchases by cement companies of common clay and shale—1947: 431,498 tons, estimated at $365,676; 1948: 472,556 tons, estimated at $362,853.
[2] Includes the following: Common clay and shale used by producers in portland-cement manufacture—1947: 4,913,997 tons, estimated at $2,476,998; 1948: 5,888,962 tons, estimated at $3,761,284.
[3] Included with "Undistributed."
[4] Figures include Arizona, Delaware, District of Columbia, Florida, Idaho, Mississippi, Nevada, North Dakota, Puerto Rico, South Carolina, South Dakota, Vermont, Virginia, and States indicated by footnote 3.
[5] Figures include Alaska, Arizona, Delaware, District of Columbia, Florida, Idaho, Mississippi, North Dakota, Puerto Rico, South Dakota, Vermont, Virginia, and States indicated by footnote 3.

Miscellaneous clays, including the so-called common or surface clays, are of widespread occurrence, and virtually all States contribute to the national total. In 1948; States reporting a production of over 1 million tons were, in order of output: Ohio, Illinois, California, Pennsylvania, New York, Michigan, Texas, North Carolina, Georgia, and Alabama.

HEAVY CLAY PRODUCTS

With construction moving at an accelerated pace, shipments of clay products in 1948 continued to expand; the total value of the principal classes of structural products rose 22 percent to $268,000,000, compared to $219,000,000 in 1947, according to the Bureau of the Census. The active market for private houses particularly was reflected in the 16-percent increase in shipments of both common brick and floor and wall tile over 1947 levels. Shipments of vitrified clay sewer pipe and drain tile and structural and hollow facing tile all were higher in 1948 than in 1947, percentages of increase in quantity ranging from 2 percent for unglazed structural tile to 8 percent for vitrified-clay sewer pipe.

A record output of refractories during World War II years resulted from the urgent demands for military equipment and civilian goods, leading to industrial expansion, particularly in metalworking and glass industries. After the war the demand for refractories declined as industry reconverted to peacetime production and studied its future capacity requirements. As the postwar boom developed, expansion and high production became general, and demand for refractories for both maintenance and new construction increased again.

Shipments of principal structural clay products in the United States, 1946–48 [1]

Product and unit of quantity	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Unglazed brick____M stand. brick__	4,643,787	$91,926,000	4,930,717	$106,079,000	5,706,838	$134,445,000
Unglazed hollow facing tile M brick equiv__	100,966	2,711,000	301,208	13,789,000	321,841	16,029,000
Glazed hollow facing tile_____do____	171,866	8,052,000				
Vitrified paving brick____M brick__	25,376	833,000	(2)	(2)	(2)	(2)
Unglazed structural tile short tons__	1,243,661	11,490,000	1,229,885	12,427,000	1,250,904	13,364,000
Vitrified-clay sewer pipe______do____	1,077,584	30,288,000	1,324,793	40,302,000	1,432,512	46,731,000
Drain tile____________________do____	(2)	(2)	714,632	9,626,000	734,331	10,866,000
Glazed and unglazed floor and wall tile and accessories, including quarry tile________M square feet__	(2)	(2)	88,047	36,781,000	102,251	46,646,000

[1] Compiled from information furnished by the Bureau of the Census, U. S. Department of Commerce.
[2] Figures not available for glazed brick and products indicated by footnote 2.

Production statistics of refractories for 1941–46 were published in the Clays chapter of Minerals Yearbook, 1946 (pp. 260–262). Figures for 1947 are shown in the accompanying table.

Production and shipments of refractories in the United States, by kind, in 1947

[Bureau of the Census]

Product	Unit of quantity	Production (quantity)	Shipments	
			Quantity	Value (in thousands of dollars)
Clay refractories:				
Fire-clay brick, standards and special shapes, except superduty.	1,000 9-in. equiv___	719,603	696,364	56,000
Superduty fire-clay brick, standards and special shapes.	_____do___________	71,704	65,653	6,777
Insulating fire brick, standards and special shapes_	_____do___________	44,805	42,147	6,027
High-alumina brick, standards and special shapes (50 percent Al_2O_3 and over, except fused alumina and mullite).	_____do___________	25,184	24,504	5,347
Ladle brick_________________________	_____do___________	151,619	152,393	6,775
Glass-house pots, tank blocks, upper structure, and floaters.	Short tons_________	30,963	31,829	3,689
Hot-top refractories_________________	1,000 9-in. equiv___	48,104	47,466	4,044
Sleeves, nozzles, runner brick, and tuyères_______	_____do___________	48,223	48,347	4,498
High-temperature bonding mortars__________	Short tons_________	75,644	73,720	4,615
Plastic refractories (including wet and dry ramming mixtures).	_____do___________	80,451	79,447	3,384
Cast and castables (hydraulic setting)___________	_____do___________	48,870	47,794	2,987
Ground crude fire-clay and high-alumina material_	_____do___________	406,695	404,355	3,319
Other clay refractories_______________________				3,435
Total clay refractories_______________________				110,897
Nonclay refractories:				
Silica brick and shapes_______________________	1,000 9-in. equiv___	313,001	311,136	29,407
Magnesite and magnesite-chrome (magnesite predominating) brick and shapes.	_____do___________	22,461	21,992	9,507
Chrome and chrome-magnesite (chrome predominating) brick and shapes.	_____do___________	38,762	38,838	13,822
Graphite and other carbon crucibles and retorts__	Short tons_________	10,449	10,466	4,653
Other graphite and carbon refractories__________	_____do___________	2,874	2,793	1,116
High temperature bonding mortars______________	_____do___________	48,415	47,584	4,011
Plastic refractories (including wet and dry ramming mixtures).	_____do___________	61,181	60,671	3,848

Production and shipments of refractories in the United States, by kind, in 1947—Continued

Product	Unit of quantity	Production (quantity)	Shipments	
			Quantity	Value (in thousands of dollars)
Nonclay refractories—Continued				
Dead-burned magnesia and magnesite	Short tons	293,535	294,741	9,134
Other nonclay brick and shapes (including silicon carbide, fused alumina, fused magnesia, mullite, kyanite, sillimanite, zirconia, forsterite, etc.).				12,802
Other nonclay refractory materials sold in lump or ground form (including ground silica and nonclay cast and castables).				5,015
Total nonclay refractories				93,315
Grand total refractories				204,212

TECHNOLOGY

Lightweight clay products received a great deal of attention during the last year or two. The results of studies of the bloating characteristics of clays, shales, slates, and other materials undertaken at three experiment stations of the Bureau of Mines were published.[11] The compounds necessary to the bloating reaction (carbonates, sulfides, sulfates, and carbonaceous materials) need be present in only small percentages to be effective and may be added to a nonbloating material to produce an expanded product. A series of lightweight clay products has been developed at the University of North Carolina from combinations of clay with coal silt, sawdust, or peat.[12] Methods of testing clays for use in lightweight aggregate were reported.[13] An article on expanded clay and shale aggregate, including discussions of economics and methods of production, appeared toward the end of 1948.[14]

Interest in clay and shale deposits and their utilization is continuing, and many States and research organizations are planning investigations of their clay resources or actually have embarked upon such projects. The ceramic possibilities of Washington, Oregon, and Idaho clays were studied.[15] The clay deposits in central and northwestern Kansas [16] and in southwestern Oklahoma [17] were investigated, and

[11] Conley, J. E., Wilson, Hewitt, Klinefelter, T. A., and others, Production of Lightweight Concrete Aggregates From Clays, Shales, Slates, and Other Materials: Bureau of Mines Rept. of Investigations 4401, 1948, 121 pp.

[12] Bell, W. C., Development of Lightweight Structural Clay Products: Am. Ceram. Soc. Bull., vol. 27, No. 3, Mar. 15, 1949, p. 128.

[13] Cox, Paul E., Testing Clays for Light-Weight Aggregate Manufacture: Ceram. Age, vol. 52, No. 6, December 1948, p. 318.

[14] Bauer, Wolf G., Mechanics, Techniques and Economics of Expanded Clay-Shale Aggregate Production: Pit and Quarry, vol. 41, No. 6, December 1948, pp. 91–95.

[15] Skinner, Kenneth G., and Kelly, Hal J., Preliminary Ceramic Tests of Clays From Seven Pacific Northwest Deposits: Bureau of Mines Rept. of Investigations 4449, 1949, 59 pp.

[16] McMillan, W. D., and Wilson, Arthur O., Central Kansas Clay Deposits: Bureau of Mines Rept. of Investigations 4379, 1948, 38 pp.

Brick and Clay Record, Seeks Uses of Kansas Clays: Vol. 113, No. 3, September 1948, p. 62.

[17] Funnell, John E., Ceramic Materials in Southwest Oklahoma: Am. Ceram. Soc. Bull., vol. 27, No. 3, Mar. 15, 1949, p. 126 (abs.).

uses for clays in Texas [18] and Louisiana [19] and shales in South Carolina [20] were reported.

The large-scale research program into all phases of the clay-products industries, sponsored by the Structural Clay Products Institute, is to concentrate its activities under three main phases—end-use research, product development, and production research. Two projects under this comprehensive program have been completed and the results published—one, a study of lightweight aggregates at the University of North Carolina (mentioned elsewhere in this section) and a study of soft-mud brick manufacture at the New York State College of Ceramics.[21]

A detailed summary of recent progress in most branches of the ceramic industry was published.[22] The following ceramic fields were covered: Porcelain enamel, electrical porcelain, china tableware, glass, chemical ware, structural clay products, refractories, and sanitary ware.

[18] Pence, F. K., Texas Ceramic Industry Growing: Manufacturers Record, vol. 117, No. 8, August 1948, p. 38.

[19] Brick and Clay Record, Research on Louisiana Clays Furthers State Industry: Vol. 112, No. 4, April 1948, p. 53.

[20] Brick and Clay Record, South Carolina Studying State's Shale Deposits: Vol. 113, No. 2, August 1948, p. 45.

[21] American Ceramic Society Bulletin, Soft-Mud Brick Study Completed: Vol. 27, No. 11, Nov. 15, 1948, p. 449.

[22] Chemical Engineering, Recent Trends in the Ceramic Industry: Vol. 55, No. 7, July 1948, pp. 127–134.

Coal—Bituminous and Lignite [1]

By W. H. YOUNG, R. L. ANDERSON, and E. M. HALL

SURVEY OF THE BITUMINOUS-COAL AND LIGNITE INDUSTRY IN 1948

THE production of soft coal in 1948—an estimated output of 594,000,000 tons [2]—decreased 6 percent from the all-time record of 630,623,722 tons produced in 1947. Decreased production was due to a work stoppage in March and April and to reduced exports and domestic demand during the latter half of the year. The estimated loss of production due to strikes in 1948 was 47,000,000 tons, compared to only 19,000,000 tons in 1947, computed at the going rate of production immediately before the strikes. According to the Bureau of Labor Statistics, there were 562 strikes in soft-coal mines in 1948, with 584,000 workers involved and 9,580,000 man-days lost (an average of 16 days per man on strike).

Production.—Production was very high during the first 6 months of 1948, generally exceeding 13,000,000 tons per week, except during strikes. During the last 6 months output remained close to the 12,000,000-ton-per-week level.

Consumption.—Electric power utilities, coke ovens, and cement mills used more coal in 1948 than in 1947. The total consumption in 1948 was approximately 26,000,000 tons less than in 1947. Table 5 shows trends in consumption for the major classes of consumers.

[1] Data for 1948 are preliminary; detailed statistics with final revisions will be released later. Data for 1947 are final.

[2] Throughout this chapter, "tons" refers to net tons of 2,000 pounds, unless otherwise indicated.

Changes in Stocks.—The reserve supply of bituminous coal and lignite in the hands of industrial consumers and retail coal yards increased from 52,161,000 tons at the beginning of 1948 to 69,373,000 tons at the close. The days' supply of stocks increased from 33 to 46. Stocks on the upper Lake docks increased 1,662,758 tons from January 1 to December 31, 1948.

Mechanization.—The quantity of coal loaded mechanically at underground mines in the United States was less in 1948 than in 1947. However, the percentage mechanically loaded increased from 61 percent of the total underground output in 1947 to 63 percent in 1948. Sales of underground loading equipment, in terms of capacity, were 55 percent more in 1948 than in 1947.

Mechanical Cleaning.—The total capacity of mechanical-cleaning equipment sold for use at bituminous-coal mines in 1948 was estimated at 17,700 tons of cleaned coal per hour, an increase of 2 percent over the previous year.

Trend of Employment.—The average number of men working daily at bituminous-coal and lignite mines in 1948 increased to 435,000 men from 419,182 in 1947.

Index to Capacity.—As it is not possible for all mines to operate every working day in the year, a conservative figure of 280 days for calculating potential capacity 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 1947 was 2,694,973 tons, which (if applied to 280 days) gives an annual potential output of 755,000,000 tons compared with the actual total production of 630,623,722 tons.

Trend of Fuel Efficiency.—Since 1942 there has been no definite trend in fuel efficiency for the various consuming industries. During 1948 railroads and electric public-utility power plants attained increased fuel efficiency, while coke ovens used more coal per net ton of pig iron.

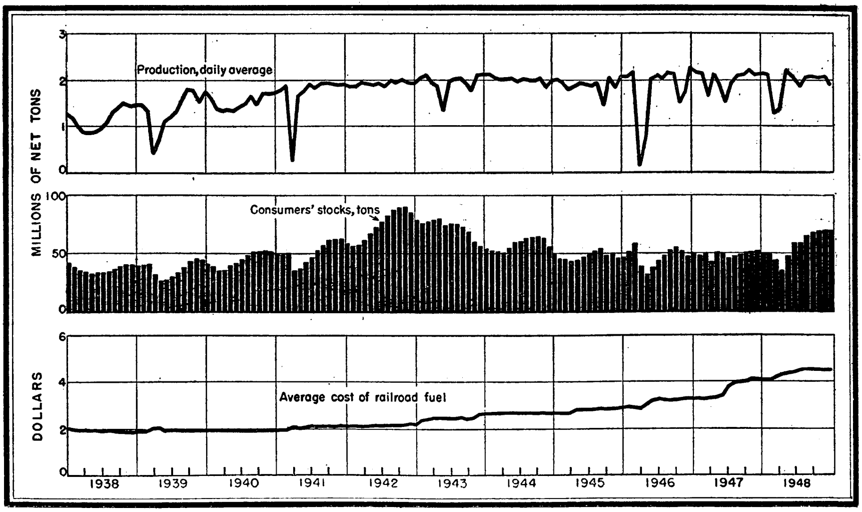

FIGURE 1.—Trends of production, stocks, and prices of bituminous coal and lignite in the United States, 1938–48.

Competition with Oil and Gas.—Soon after the close of the war, increased competition among the fuels developed, with numerous reports of conversion from coal to fuel oil and gas.

Electric power utilities consumed 11 percent more bituminous coal, 6 percent less fuel oil, and 28 percent more gas in 1948 than in 1947.

Class I railroads decreased their consumption of coal 13 percent in 1948 and their purchases of fuel oil 7 percent from 1947 purchases.

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 53,372 in 1947 to 61,359 in 1948. Shipments of domestic oil burners, boiler-burner units, and furnace-burner units decreased from 1,078,576 (revised figure) in 1947 to 392,864 in 1948.

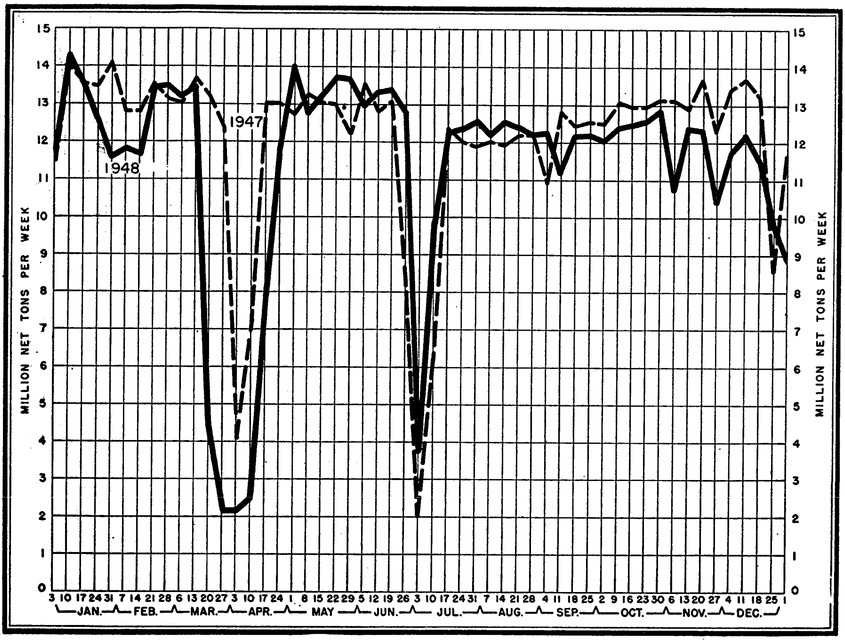

FIGURE 2.—Production of bituminous coal and lignite in the United States, by weeks, 1947–48.

SOURCES OF DATA

Bituminous-coal- and lignite-production statistics for 1948 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 1948, allowance has been made for commercial truck shipments, local sales and colliery fuel, and small trucking or wagon mines producing 1,000 tons a year or more.

Data for 1947 are final and 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.

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 many small mines producing less than 1,000 tons a year.

These data include, for convenience and historical comparison, the small output of anthracite and semianthracite produced outside Pennsylvania and the production of lignite.

SALIENT STATISTICS

TABLE 1.—Salient statistics of the bituminous-coal and lignite industry in the United States, 1947–48

[All tonnage figures represent net tons]

	1947	1948 (preliminary)	Change in 1948
			Percent
Production	630,623,722	594,000,000	−5.8
Consumption in the United States [1]	557,243,000	531,161,000	−4.7
Stocks at end of year:			
Industrial consumers and retail yards	52,161,000	69,373,000	+33.0
Stocks on upper Lake docks	5,626,219	7,288,977	+29.6
Imports and exports: [2]			
Imports	290,141	291,337	+.4
Exports	68,666,963	45,925,325	−33.1
Price indicators (average per net ton):			*Dollars*
Average cost of railroad fuel purchased, f. o. b. mines [3]	$3.64	$4.34	+.70
Average cost of coking coal at merchant coke ovens [4]	$7.43	$8.74	+1.31
Average retail price	$12.99	$15.40	+2.41
Average railroad freight charge per net ton [5]	$2.49	$2.71	+.22
Average value, f. o. b. mines [6]	$4.16	$4.95	+.79
Underground loading machinery sold: [7]			*Percent*
Mobile loading machines (number)	485	723	+49.1
Scrapers (number)	12	17	+41.7
Conveyors, including those equipped with duckbills (units)	846	1,025	+21.2
"Mother" conveyors (units)	200	230	+15.0
Surface stripping	139,395,011	138,000,000	−1.0
Mechanically loaded underground	298,157,281	286,000,000	−4.1
Mechanically cleaned	174,435,937	175,000,000	+.3
Number of mines [8]	8,700	8,000	−8.0
Average number of days worked [8]	234	210	−10.3
Average number of men working daily [8]	419,182	435,000	+3.8
Production per man per day [8]	6.42	6.50	+1.2
Fuel-efficiency indicators:			
Pounds of coal per kilowatt-hour at electric power plants [9]	1.31	1.30	−.8
Pounds per 1,000 gross ton-miles—railroads [10]	114	111	−2.6

[1] Represents certain classes of consumers only.
[2] U. S. Department of Commerce.
[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] Average receipts per net ton of revenue bituminous coal and lignite originated, as reported by the Interstate Commerce Commission.
[6] Average gross realization, selling cost not deducted.
[7] Young, W. H., and Anderson, R. L., Sales of Mechanical Loading and Cleaning Equipment: Coal Age, February 1949, pp. 94–96; Min. Cong. Jour., February 1949, pp. 63–65; Mechanization, February 1949, pp. 73–76.
[8] Based upon reports of mine operators producing 1,000 tons and over.
[9] Federal Power Commission.
[10] Interstate Commerce Commission; includes coal equivalent of fuel oil consumed.

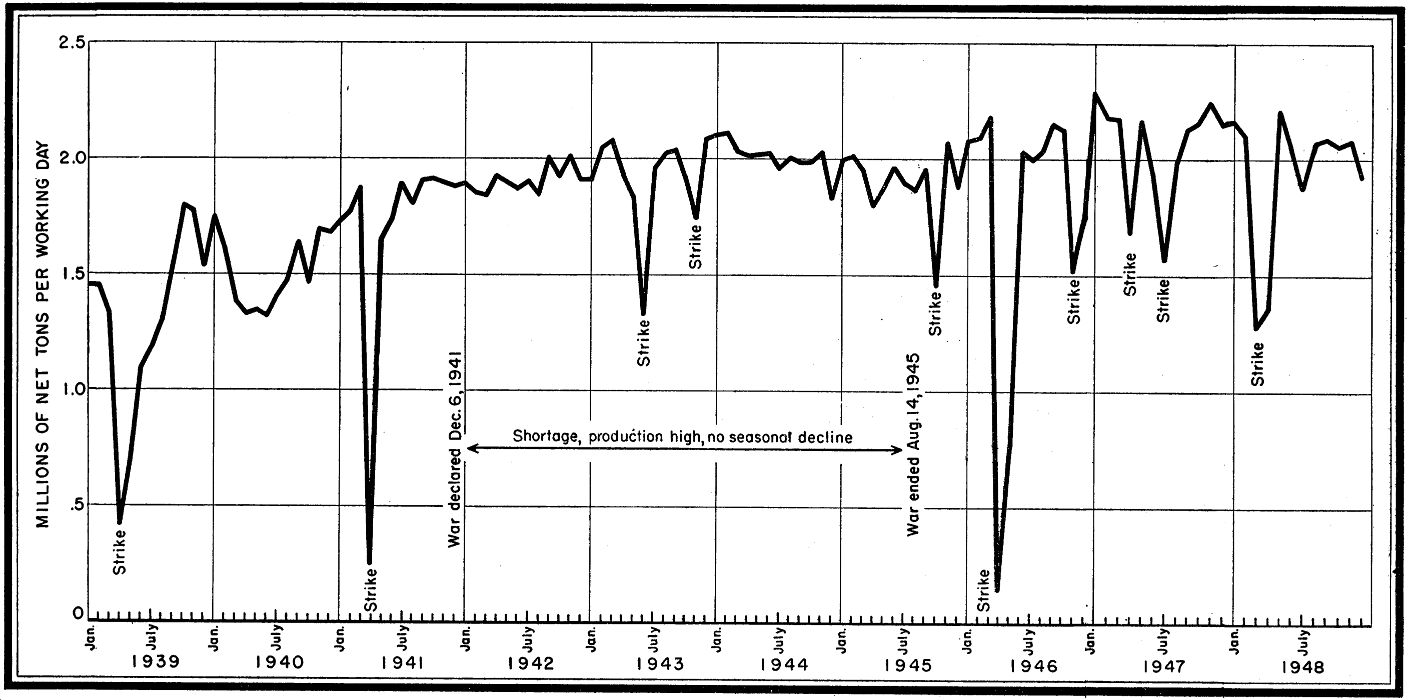

Figure 3.—Average production of bituminous coal and lignite in the United States per working day in each month, 1939–48.

PRODUCTION BY WEEKS AND MONTHS

The following tables summarize the preliminary statistics of weekly and monthly production of bituminous coal and lignite in 1948. 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 (p. 631).

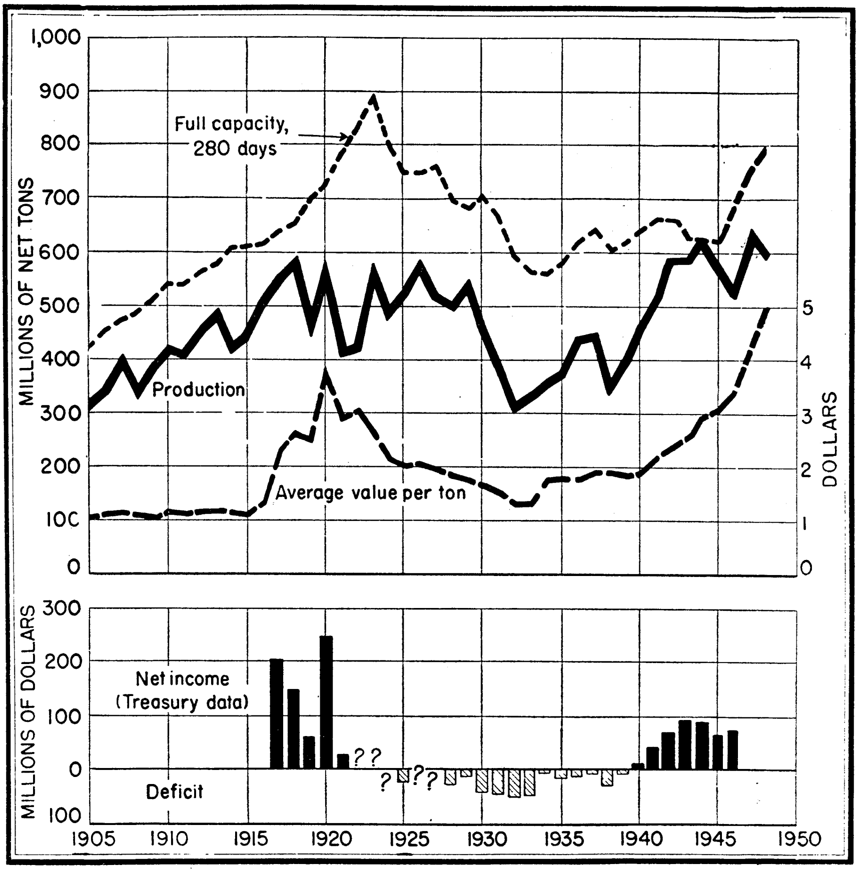

FIGURE 4.—Trends of bituminous-coal and lignite production, realization, mine capacity, and net income or deficit in the United States, 1905–48.

TABLE 2.—Estimated weekly production of bituminous coal and lignite in the United States in 1948

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. 3	[1] 4,693,000	[1] 2.2	[2] 2,248,000	July 17	12,274,000	6	2,046,000
Jan. 10	14,270,000	6	2,378,000	July 24	12,335,000	6	2,056,000
Jan. 17	13,528,000	6	2,255,000	July 31	12,561,000	6	2,094,000
Jan. 24	12,596,000	6	2,099,000	Aug. 7	12,175,000	6	2,029,000
Jan. 31	11,544,000	6	1,924,000	Aug. 14	12,561,000	6	2,094,000
Feb. 7	11,780,000	6	1,963,000	Aug. 21	12,387,000	6	2,065,000
Feb. 14	11,651,000	6	1,942,000	Aug. 28	12,218,000	6	2,036,000
Feb. 21	13,461,000	6	2,244,000	Sept. 4	12,253,000	6	2,042,000
Feb. 28	13,503,000	6	2,251,000	Sept. 11	11,180,000	5	2,236,000
Mar. 6	13,179,000	6	2,197,000	Sept. 18	12,205,000	6	2,034,000
Mar. 13	13,454,000	6	2,242,000	Sept. 25	12,218,000	6	2,036,000
Mar. 20	4,413,000	6	736,000	Oct. 2	12,055,000	6	2,009,000
Mar. 27	2,169,000	6	362,000	Oct. 9	12,336,000	6	2,056,000
Apr. 3	2,131,000	6	355,000	Oct. 16	12,463,000	6	2,077,000
Apr. 10	2,475,000	6	413,000	Oct. 23	12,528,000	6	2,088,000
Apr. 17	7,836,000	6	1,306,000	Oct. 30	12,805,000	6	2,134,000
Apr. 24	11,714,000	6	1,952,000	Nov. 6	10,704,000	5.3	2,020,000
May 1	14,007,000	6	2,335,000	Nov. 13	12,370,000	5.7	2,170,000
May 8	12,732,000	6	2,122,000	Nov. 20	12,357,000	6	2,060,000
May 15	13,248,000	6	2,208,000	Nov. 27	10,394,000	5	2,079,000
May 22	13,712,000	6	2,285,000	Dec. 4	11,707,000	6	1,951,000
May 29	13,669,000	6	2,278,000	Dec. 11	12,140,000	6	2,023,000
June 5	12,985,000	5.5	2,361,000	Dec. 18	11,490,000	6	1,915,000
June 12	13,321,000	6	2,220,000	Dec. 25	9,692,000	5	1,938,000
June 19	13,371,000	6	2,229,000	Jan. 1, 1949	[1] 8,874,000	[1] 5	[2] 1,755,000
June 26	12,757,000	6	2,126,000				
July 3	3,678,000	6	613,000	Total	594,000,000	307.7	1,930,000
July 10	9,841,000	5	1,968,000				

[1] Figures represent output and number of working days in that part of the week included in calendar year shown. Total production for the week ended January 3, 1948, 11,689,000; week ended January 1, 1949, 8,949,000 net tons.

[2] Average daily output for the entire week and not for working days in calendar year shown.

TABLE 3.—Estimated monthly production of bituminous coal and lignite, by States, in thousands of net tons, in 1948

[Figures are based principally upon the records of railroad carloadings and river shipments of coal and beehive coke, supplemented by direct reports from certain local sources. Allowance is made for total production of all mines producing 1,000 tons and over per year]

State	January	February	March	April	May	June	July	August	September	October	November	December	Total
Alabama	1,884	1,611	964	964	1,911	1,722	1,394	1,338	1,544	1,574	1,479	1,655	18,040
Alaska	42	43	47	30	24	24	17	19	32	43	43	46	410
Arkansas	193	156	104	74	122	131	131	138	140	162	153	156	1,660
Colorado	719	647	396	296	421	382	245	398	469	491	584	579	5,627
Illinois	6,381	5,991	4,137	4,206	5,802	5,482	5,241	5,801	5,477	6,169	5,806	6,007	66,500
Indiana	2,204	2,158	1,162	1,166	2,142	1,961	1,700	1,956	1,928	2,036	1,949	2,138	22,500
Iowa	153	128	135	140	131	100	118	131	130	196	188	200	1,750
Kansas	260	229	183	166	210	195	174	212	220	245	250	271	2,615
Kentucky:													
Eastern	5,632	5,177	3,152	3,403	6,118	5,721	5,030	5,745	5,078	4,810	4,323	3,911	58,100
Western	2,295	2,020	1,881	2,096	2,118	2,174	2,250	2,036	1,834	1,811	1,638	1,747	23,900
Maryland	159	129	114	153	176	158	163	114	128	104	85	113	1,596
Michigan	1	1	2	1	1	1	1	1	1	2	1	1	14
Missouri	456	402	319	291	369	227	304	372	385	430	439	476	4,470
Montana (bituminous and lignite)	270	253	272	193	208	191	220	223	237	242	248	243	2,800
New Mexico	149	133	77	78	143	126	105	140	130	106	108	125	1,420
North and South Dakota (lignite)	309	280	249	178	129	131	148	161	260	383	366	396	2,990
Ohio	3,450	2,854	2,272	2,252	3,476	3,553	2,550	3,285	3,208	3,244	3,125	2,835	36,104
Oklahoma	318	257	218	228	236	217	220	223	230	269	252	257	2,925
Pennsylvania (bituminous)	12,257	10,835	8,025	7,531	12,819	12,481	10,532	12,390	11,960	11,959	10,464	11,297	132,550
Tennessee	572	535	316	263	574	518	533	595	536	542	465	461	5,910
Texas (bituminous and lignite)	6	6	6	5	5	3	3	3	4	5	5	5	56
Utah	781	671	326	249	711	568	508	542	547	534	613	666	6,716
Virginia	1,789	1,495	1,077	1,346	2,106	1,918	1,947	1,866	1,608	1,560	1,495	1,413	19,620
Washington	125	119	68	79	110	102	78	101	106	106	115	101	1,210
West Virginia:													
Southern [1]	10,460	9,166	5,583	6,028	10,763	9,790	9,855	10,432	10,400	10,640	10,027	9,500	112,644
Northern [2]	5,135	4,459	2,970	3,353	5,234	4,761	4,795	5,073	5,053	5,174	4,926	4,623	55,556
Wyoming	629	638	343	381	523	480	348	483	512	608	642	713	6,300
Other States [3]	2	2	1	1	1	1	1	1	1	2	2	2	17
Total, 1948	56,631	50,395	34,399	35,151	56,583	53,118	48,611	53,779	52,158	53,447	49,791	49,937	594,000
Days and average production:													
Number of working days	26.2	24.0	27.0	26.0	25.5	26.0	26.0	26.0	25.0	26.0	24.0	26.0	307.7
Average production per working day	2,161	2,100	1,274	1,352	2,219	2,043	1,870	2,068	2,086	2,056	2,075	1,921	1,930

[1] Includes operations on the N. & W., C. & O., Virginian, T. & O. C., B. C. & G., and the B. & O. in Kanawha, Mason, and Clay Counties.
[2] Rest of State, including the Panhandle district and Grant, Mineral, and Tucker Counties.
[3] Includes Arizona and Georgia.

AVERAGE VALUE

TABLE 4.—Average value per ton, f. o. b. mines, of bituminous coal and lignite in the United States, by States, 1947–48 [1]

State	1947			1948 (preliminary)
	Strip mines	Underground mines	Total all mines	
Alabama	$5.53	$5.47	$5.48	$6.09
Alaska	5.36	7.46	7.07	(2)
Arizona	----------	4.61	4.61	(2)
Arkansas	4.96	7.82	6.67	7.73
Colorado	4.30	4.53	4.53	4.99
Georgia	5.40	5.40	5.40	(2)
Illinois	3.13	3.16	3.15	3.66
Indiana	3.15	3.32	3.22	3.98
Iowa	3.23	4.28	3.82	(2)
Kansas	3.20	4.57	3.34	3.85
Kentucky	3.38	4.57	4.42	5.42
Maryland	3.83	5.19	4.80	(2)
Michigan	----------	7.68	7.68	(2)
Missouri	3.20	4.54	3.33	3.53
Montana (bituminous and lignite)	1.16	3.60	2.05	1.96
New Mexico	----------	4.52	4.52	5.05
North and South Dakota (lignite)	1.93	1.92	1.93	2.26
Ohio	3.08	3.86	3.50	3.96
Oklahoma	4.09	5.08	4.41	4.47
Pennsylvania	3.70	4.42	4.23	4.96
Tennessee	4.82	4.76	4.77	5.62
Texas (lignite)	.98	----------	.98	(2)
Utah	----------	3.93	3.93	4.51
Virginia	5.02	4.82	4.83	6.03
Washington	5.12	6.17	5.99	6.39
West Virginia	3.98	4.55	4.48	5.48
Wyoming	2.67	3.50	3.37	3.79
Total	3.47	4.35	4.16	4.95

[1] Average gross realization, selling cost not deducted.
[2] Included in total.

CONSUMPTION

TABLE 5.—Consumption of bituminous coal and lignite, by consumer class, with retail deliveries in the United States, 1939–48, in thousands of net tons

Year	Colliery fuel	Electric power utilities [1]	Bunker foreign trade [2]	Railroads [3] (class I)	Coke plants		Steel and rolling mills	Cement mills [4]	Other industrials [5]	Retail dealer deliveries [5]	Total of classes shown
					Beehive	Oven					
1939	2,565	43,979	1,477	79,072	2,298	61,216	9,808	5,274	100,514	71,570	377,773
1940	2,443	50,973	1,426	85,130	4,803	76,583	10,040	5,633	108,026	87,700	432,757
1941	2,489	61,861	1,643	97,384	10,529	82,609	10,902	6,832	122,379	97,460	494,088
1942	2,708	65,636	1,585	115,410	12,876	87,974	10,434	7,570	133,271	104,750	542,214
1943	2,702	76,403	1,647	130,283	12,441	90,019	11,238	5,851	142,816	122,764	596,164
1944	2,712	78,887	1,559	132,049	10,858	94,438	10,734	3,789	131,898	124,906	591,830
1945	2,442	71,603	1,785	125,120	8,135	87,214	10,084	4,215	127,164	121,805	559,567
1946	1,951	68,743	1,381	110,166	7,167	76,121	8,603	7,009	118,659	100,586	500,386
1947	(6)	86,009	1,689	109,296	10,475	94,325	10,048	7,938	138,300	99,163	557,243
1948 [7]	(6)	95,686	1,057	94,838	9,973	97,326	10,046	8,464	124,024	89,747	531,161

[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] Bureau of Census, U. S. Department of Commerce.
[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 1947 consumption for all uses by class I line-haul railways, plus purchases for class II and class III railways, plus purchases by all switching terminal companies combined was 112,819,388 tons of bituminous coal and lignite.
[4] Includes a small amount of anthracite.
[5] Estimates based upon reports collected from a selected list of representative manufacturing plants and retail dealers.
[6] Included in "Other industrials."
[7] Subject to revision.

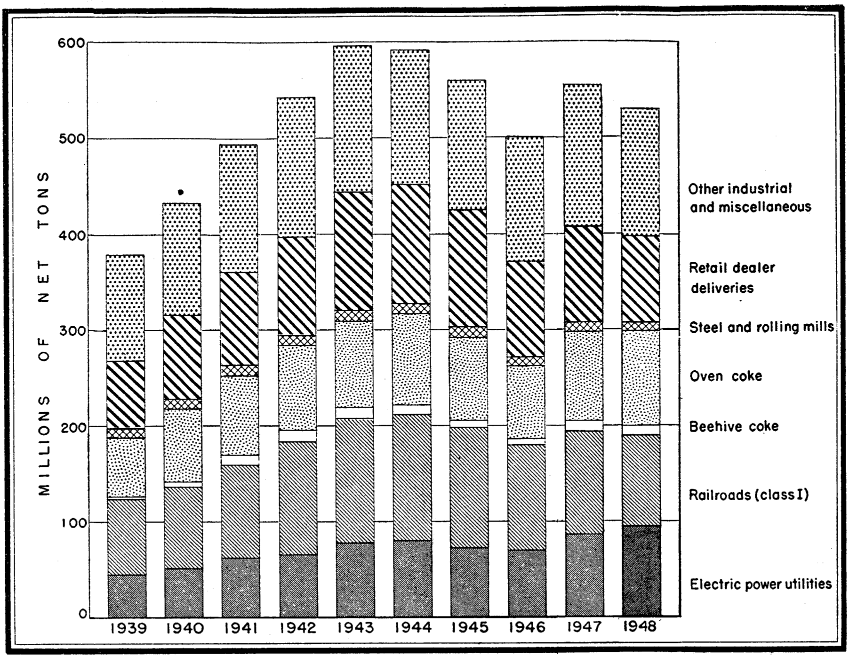

FIGURE 5.—Consumption of bituminous coal and lignite, by consumer class, with retail deliveries in the United States, 1939–48

FUEL EFFICIENCY

TABLE 6.—Indicators of effect of fuel economy on consumption of coal in the United States per unit of performance since the World War of 1914–18

	Pounds	Reduction from base period (percent)
Steam railroads:		
Pounds per 1,000 gross ton-miles freight service:		
Average:		
1919–20	170	
1947	114	32.9
1948	111	34.7
Pounds per passenger-train car-mile:		
Average:		
1919–20	18.5	
1947	15.9	14.1
1948	15.7	15.1
Electric public-utility power plants:		
Pounds per kilowatt-hour:		
1919	3.20	
1947	1.31	59.1
1948	1.30	59.4
Iron and Steel Plants:		
Pounds coking coal per net ton of pig: [1]		
1918	3,194	
1947	2,755	13.7
1948	2,783	12.9
Coke manufacture: Savings of heat values through recovery of gas, tar, light oils, and breeze by extension of oven coke in place of beehive, 1913–14, expressed as percent of coal used for all coke in 1948 [2]		18.7

[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 coal-chemical materials which are covered in next item.

[2] These coal-chemical materials 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.

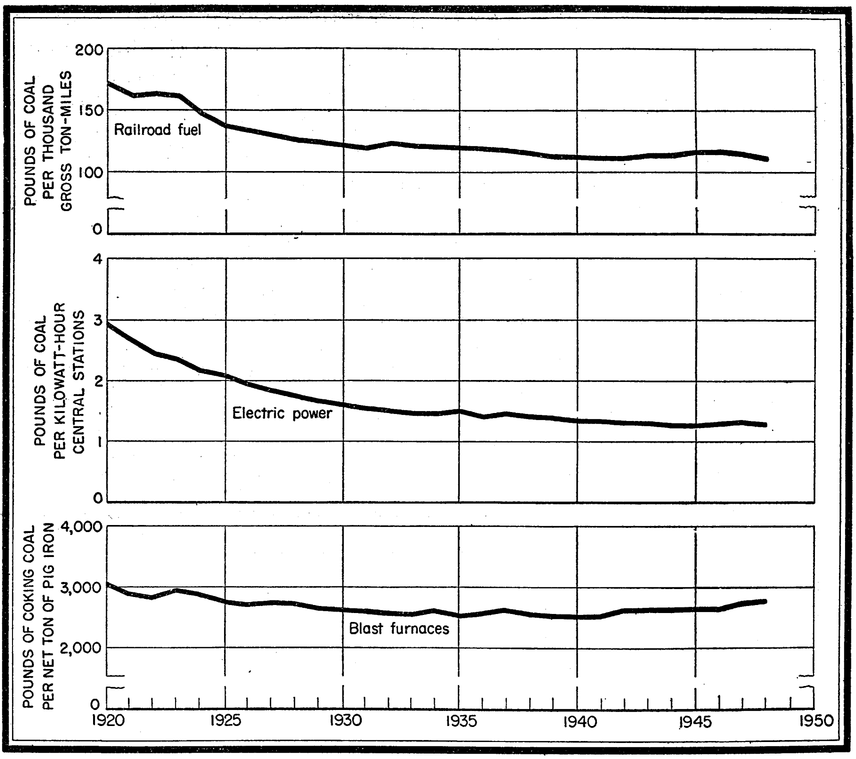

FIGURE 6.—Trends in fuel efficiency in the United States, 1920–48

RELATIVE RATE OF GROWTH OF COAL, OIL, AND WATER POWER, 1889–1948

The total supply of available energy in the form of coal, oil, natural gas, and water power in 1948 was 36,703 trillion B. t. u.—a 1.9-percent increase over 1947.

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 1889 and 1899 to 1948.

In converting water power to its equivalent of fuel required to perform the same work, the *prevailing* or average performance of all fuel-burning central electric stations for each year in question has been used. This average has declined from about 7.05 pounds of coal per kilowatt-hour in 1899 to 1.3 in 1948, which shows the influence of improving fuel efficiency. The *prevailing* fuel equivalent closely approximates the quantity of fuel that would have been needed in any one year to generate the same power in a steam-electric station. It should be noted, however, that the ultimate use of the water power generated often displaces 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 1948 than do the central stations.

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. 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 transportation 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 of 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,

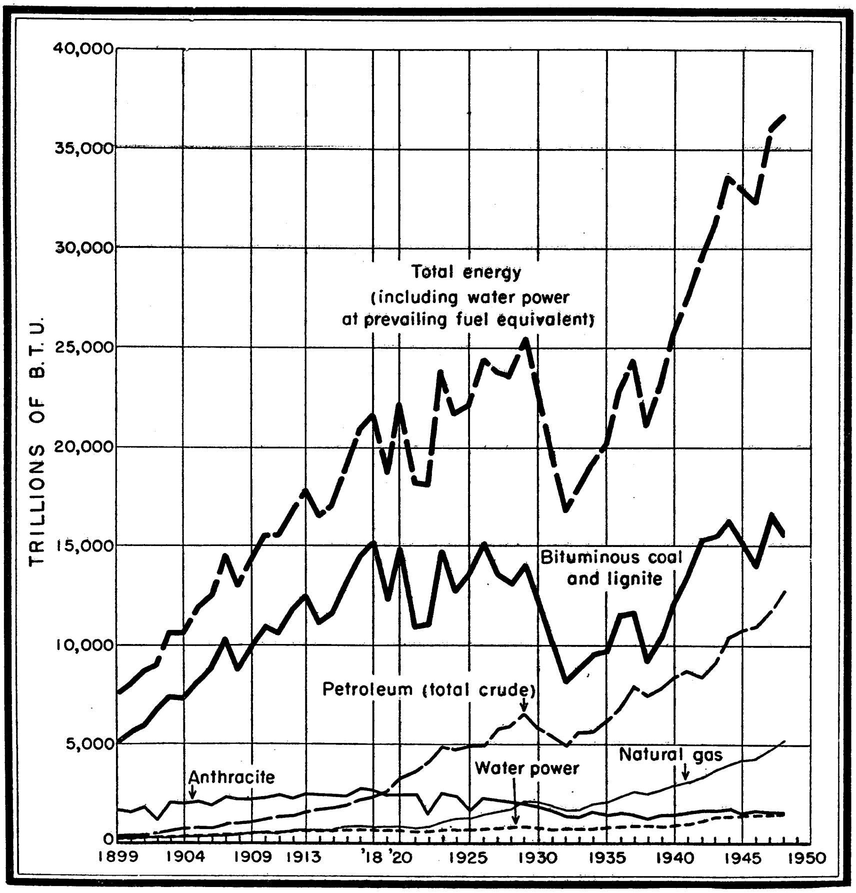

FIGURE 7.—Annual supply of energy from mineral fuels and water power in the United States, 1899–1948.

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.

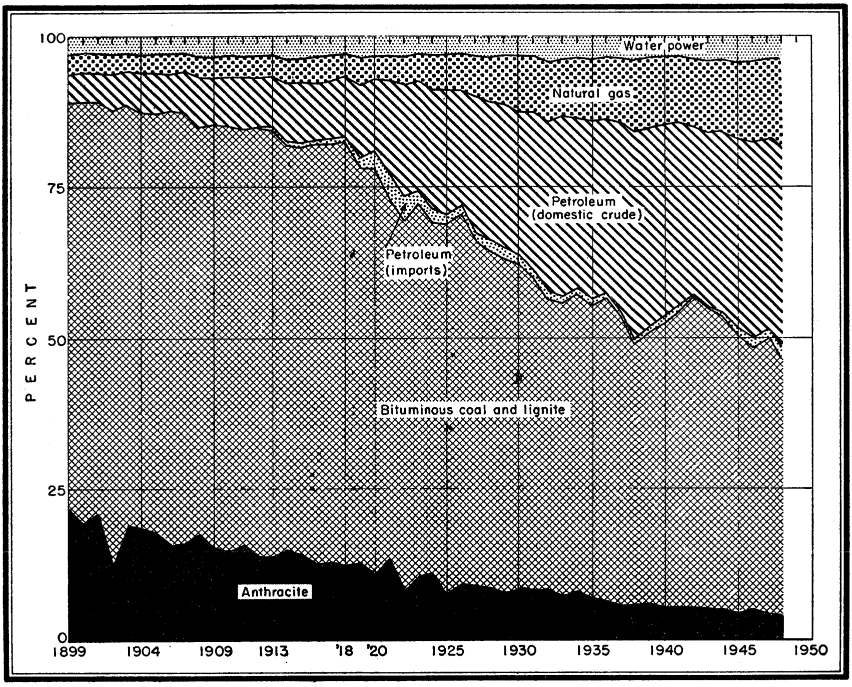

FIGURE 8.—Percentage of total British thermal units equivalent contributed by the several sources of energy in the United States, counting water power at the prevailing fuel equivalent of central stations in each year, 1899–1948.

TABLE 7.—Annual supply of energy from mineral fuels and water power in the United States, 1889 and 1899–1948, in trillions of British thermal units [1]

Year	Pennsylvania anthracite	Bituminous coal and lignite	Total coal	Petroleum (total crude) Domestic production	Petroleum (total crude) Imports	Natural gas (marketed production)	Total petroleum and natural gas	Total mineral fuels	Water power [2]	Grand total
1889	1,239	2,507	3,746	211	--------	268	479	4,225	(3)	(3)
1899	1,643	5,065	6,708	342	--------	240	582	7,291	238	7,529
1900	1,560	5,563	7,123	382	--------	254	636	7,759	250	8,009
1901	1,835	5,917	7,752	416	--------	283	699	8,451	264	8,715
1902	1,125	6,818	7,943	533	--------	301	834	8,777	289	9,066
1903	2,029	7,408	9,437	603	--------	319	922	10,359	321	10,680
1904	1,990	7,301	9,291	702	--------	333	1,035	10,326	354	10,680
1905	2,112	8,255	10,367	808	--------	377	1,185	11,552	386	11,938
1906	1,939	8,983	10,922	759	--------	418	1,177	12,099	414	12,513
1907	2,328	10,343	12,671	997	--------	437	1,434	14,105	441	14,546
1908	2,265	8,713	10,978	1,071	--------	432	1,503	12,481	476	12,957
1909	2,205	9,949	12,155	1,099	--------	517	1,616	13,771	513	14,284
1910	2,298	10,928	13,226	1,257	3	547	1,807	15,033	539	15,572
1911	2,461	10,635	13,096	1,323	9	551	1,883	14,979	565	15,544
1912	2,295	11,793	14,088	1,338	41	604	1,983	16,071	585	16,656
1913	2,490	12,535	15,025	1,491	102	626	2,219	17,243	609	17,852
1914	2,470	11,075	13,545	1,595	101	636	2,332	15,877	636	16,513
1915	2,421	11,597	14,018	1,687	109	676	2,472	16,490	659	17,149
1916	2,382	13,166	15,548	1,805	125	810	2,740	18,288	681	18,969
1917	2,709	14,457	17,166	2,012	181	855	3,048	20,214	700	20,914
1918	2,688	15,180	17,868	2,136	226	775	3,137	21,005	701	21,706
1919	2,396	12,206	14,602	2,270	317	802	3,389	17,991	718	18,709
1920	2,437	14,899	17,336	2,658	637	858	4,153	21,489	738	22,227
1921	2,461	10,897	13,358	2,833	752	712	4,297	17,655	620	18,275
1922	1,487	11,063	12,551	3,345	764	820	4,929	17,480	643	18,123
1923	2,539	14,792	17,331	4,394	492	1,083	5,969	23,300	685	23,985
1924	2,392	12,672	15,064	4,284	467	1,228	5,978	21,042	648	21,690
1925	1,681	13,625	15,306	4,582	371	1,278	6,231	21,537	668	22,205
1926	2,297	15,022	17,319	4,625	362	1,411	6,398	23,717	728	24,445
1927	2,179	13,565	15,744	5,407	350	1,553	7,310	23,054	776	23,830
1928	2,049	13,120	15,169	5,409	479	1,686	7,574	22,743	854	23,597
1929	2,008	14,017	16,025	6,044	474	2,062	8,580	24,605	816	25,421
1930	1,887	12,249	14,136	5,388	373	2,089	7,850	21,986	752	22,738
1931	1,622	10,011	11,633	5,106	284	1,813	7,203	18,836	668	19,504
1932	1,356	8,114	9,470	4,711	268	1,673	6,652	16,122	713	16,835
1933	1,348	8,741	10,089	5,434	191	1,672	7,297	17,386	711	18,097
1934	1,555	9,415	10,970	5,448	213	1,904	7,565	18,535	698	19,233
1935	1,419	9,756	11,175	5,980	193	2,060	8,233	19,408	806	20,214
1936	1,485	11,504	12,989	6,598	194	2,330	9,122	22,111	812	22,923
1937	1,410	11,673	13,083	7,675	165	2,588	10,428	23,511	871	24,382
1938	1,255	9,132	10,387	7,286	158	2,468	9,912	20,299	866	21,165
1939	1,400	10,345	11,745	7,590	199	2,663	10,452	22,197	838	23,035
1940	1,400	12,072	13,472	8,119	256	2,860	11,235	24,707	880	25,587
1941	1,533	13,471	15,004	8,413	304	3,024	11,741	26,745	934	27,679
1942	1,641	15,267	16,908	8,320	74	3,282	11,676	28,584	1,136	29,720
1943	1,650	15,463	17,113	9,034	83	3,671	12,788	29,901	1,304	31,205
1944	1,733	16,233	17,966	10,067	269	3,989	14,325	32,291	1,344	33,635
1945	1,494	15,134	16,628	10,282	444	4,213	14,939	31,567	1,442	33,009
1946 [4]	1,646	13,989	15,635	10,404	535	4,333	15,272	30,907	1,406	32,313
1947 [4]	1,556	16,522	18,078	11,142	596	4,778	16,516	34,594	1,427	36,021
1948 [4]	1,552	15,563	17,115	12,098	776	5,235	18,109	35,224	1,479	36,703

[1] 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 it 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 and of 40 percent for public utilities.

[2] Fuel equivalent calculated by assuming the average central-station practice for each of the years for which data are available.

[3] Data not available.

[4] Subject to revision.

TABLE 8.—Index numbers for relative rate of growth of coal, oil, and water power in the United States, 1889 and 1899–1948

[Figures are expressed as percentage of 1918 rate]

Year	Pennsylvania anthracite	Bituminous coal and lignite	Total coal	Petroleum (total crude) Domestic production	Petroleum (total crude) Imports	Natural gas (marketed production)	Total petroleum and natural gas	Total mineral fuels	Water power[1]	Grand total
1889	46	17	21	10	--------	35	15	20	(2)	(2)
1899	61	33	38	16	--------	31	19	35	34	35
1900	58	37	40	18	--------	33	20	37	36	37
1901	68	39	43	19	--------	37	22	40	38	40
1902	42	45	44	25	--------	39	27	42	41	42
1903	75	49	53	28	--------	41	29	49	46	49
1904	74	48	52	33	--------	43	33	49	50	49
1905	79	54	58	38	--------	49	38	55	55	55
1906	72	59	61	36	--------	54	38	58	59	58
1907	87	68	71	47	--------	56	46	67	63	67
1908	84	57	61	50	--------	56	48	59	68	60
1909	82	66	68	51	--------	67	52	66	73	66
1910	85	72	74	59	1	71	58	72	77	72
1911	92	70	73	62	4	71	60	71	81	72
1912	85	78	79	63	18	78	63	77	83	77
1913	93	83	84	70	45	81	71	82	87	82
1914	92	73	76	75	45	82	74	76	91	76
1915	90	76	78	79	48	87	79	79	94	79
1916	89	87	87	85	55	105	87	87	97	87
1917	101	95	96	94	80	110	97	96	100	96
1918	100	100	100	100	100	100	100	100	100	100
1919	89	80	81	106	140	103	108	86	102	86
1920	91	98	97	124	282	111	132	102	105	102
1921	92	72	74	132	333	92	137	84	88	84
1922	55	73	70	156	338	106	157	83	92	83
1923	94	97	97	206	218	140	191	111	98	110
1924	89	83	84	201	207	158	191	100	92	100
1925	63	90	86	215	164	165	199	103	95	102
1926	85	99	97	217	160	182	204	113	104	113
1927	81	89	88	253	155	201	233	110	111	110
1928	76	86	85	253	212	218	241	108	122	109
1929	75	92	90	283	210	266	274	117	116	117
1930	70	81	79	252	165	270	250	105	107	105
1931	60	66	65	239	126	234	230	90	95	90
1932	50	53	53	221	119	216	212	77	102	78
1933	50	57	56	252	90	205	229	82	101	83
1934	58	62	61	255	94	246	241	88	100	89
1935	53	64	63	280	85	266	262	92	115	93
1936	55	76	73	309	86	301	291	105	116	106
1937	52	77	73	359	73	334	332	112	124	112
1938	47	60	58	341	70	318	316	97	124	98
1939	52	68	66	355	88	344	333	106	120	106
1940	52	80	75	380	113	369	358	118	126	118
1941	57	89	84	394	135	390	374	127	133	128
1942	61	101	95	390	33	423	372	136	162	137
1943	61	102	96	423	37	474	408	142	186	144
1944	64	107	101	471	119	515	457	154	192	155
1945	56	100	93	481	196	544	476	150	206	152
1946[3]	61	92	88	487	237	559	487	147	201	149
1947[3]	58	109	101	522	264	617	526	165	204	166
1948[3]	58	103	96	566	343	675	577	168	211	169

[1] At prevailing central-station equivalent.
[2] Data not available.
[3] Subject to revision.

TABLE 9.—Percentage of total British thermal unit equivalent contributed by the several mineral fuels and water power in the United States, 1899–1948 [1]

Year	Pennsylvania anthracite	Bituminous coal and lignite	Total coal	Petroleum (total crude)		Natural gas (marketed production)	Total petroleum and natural gas	Total mineral fuels	Water power, fuel equivalent	Grand total
				Domestic production	Imports					
1899	21.8	67.3	89.1	4.5	--------	3.2	7.7	96.8	3.2	100.0
1900	19.5	69.4	88.9	4.8	--------	3.2	8.0	96.9	3.1	100.0
1901	21.1	67.9	89.0	4.8	--------	3.2	8.0	97.0	3.0	100.0
1902	12.4	75.2	87.6	5.9	--------	3.3	9.2	96.8	3.2	100.0
1903	19.0	69.4	88.4	5.6	--------	3.0	8.6	97.0	3.0	100.0
1904	18.6	68.4	87.0	6.6	--------	3.1	9.7	96.7	3.3	100.0
1905	17.7	69.2	86.9	6.8	--------	3.1	9.9	96.8	3.2	100.0
1906	15.5	71.8	87.3	6.1	--------	3.3	9.4	96.7	3.3	100.0
1907	16.0	71.1	87.1	6.9	--------	3.0	9.9	97.0	3.0	100.0
1908	17.5	67.2	84.7	8.3	--------	3.3	11.6	96.3	3.7	100.0
1909	15.4	69.7	85.1	7.7	--------	3.6	11.3	96.4	3.6	100.0
1910	14.7	70.2	84.9	8.1	--------	3.5	11.6	96.5	3.5	100.0
1911	15.9	68.4	84.3	8.5	--------	3.6	12.1	96.4	3.6	100.0
1912	13.8	70.8	84.6	8.0	0.3	3.6	11.9	96.5	3.5	100.0
1913	14.0	70.2	84.2	8.3	.6	3.5	12.4	96.6	3.4	100.0
1914	14.9	67.1	82.0	9.7	.6	3.8	14.1	96.1	3.9	100.0
1915	14.1	67.7	81.8	9.8	.6	4.0	14.4	96.2	3.8	100.0
1916	12.6	69.4	82.0	9.5	.6	4.3	14.4	96.4	3.6	100.0
1917	13.0	69.1	82.1	9.6	.9	4.1	14.6	96.7	3.3	100.0
1918	12.4	69.9	82.3	9.8	1.1	3.6	14.5	96.8	3.2	100.0
1919	12.8	65.3	78.1	12.1	1.7	4.3	18.1	96.2	3.8	100.0
1920	11.0	67.0	78.0	12.0	2.9	3.8	18.7	96.7	3.3	100.0
1921	13.5	59.6	73.1	15.5	4.1	3.9	23.5	96.6	3.4	100.0
1922	8.2	61.1	69.3	18.5	4.2	4.5	27.2	96.5	3.5	100.0
1923	10.6	61.6	72.2	18.3	2.1	4.5	24.9	97.1	2.9	100.0
1924	11.0	58.4	69.4	19.8	2.1	5.7	27.6	97.0	3.0	100.0
1925	7.6	61.3	68.9	20.6	1.7	5.8	28.1	97.0	3.0	100.0
1926	9.4	61.4	70.8	18.9	1.5	5.8	26.2	97.0	3.0	100.0
1927	9.1	56.9	66.0	22.7	1.5	6.5	30.7	96.7	3.3	100.0
1928	8.7	55.6	64.3	22.9	2.0	7.2	32.1	96.4	3.6	100.0
1929	7.9	55.1	63.0	23.8	1.9	8.1	33.8	96.8	3.2	100.0
1930	8.3	53.9	62.2	23.7	1.6	9.2	34.5	96.7	3.3	100.0
1931	8.3	51.3	59.6	26.2	1.5	9.3	37.0	96.6	3.4	100.0
1932	8.1	48.2	56.3	28.0	1.6	9.9	39.5	95.8	4.2	100.0
1933	7.4	48.4	55.8	30.0	1.1	9.2	40.3	96.1	3.9	100.0
1934	8.1	49.0	57.1	28.3	1.1	9.9	39.3	96.4	3.6	100.0
1935	7.0	48.3	55.3	29.5	1.0	10.2	40.7	96.0	4.0	100.0
1936	6.5	50.2	56.7	28.8	.8	10.2	39.8	96.5	3.5	100.0
1937	5.8	47.8	53.6	31.5	.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	5.1	48.3	53.4	29.9	.8	11.9	42.6	96.0	4.0	100.0
1945	4.5	45.9	50.4	31.1	1.3	12.8	45.2	95.6	4.4	100.0
1946 [2]	5.1	43.3	48.4	32.2	1.7	13.4	47.3	95.7	4.3	100.0
1947 [2]	4.3	45.9	50.2	30.9	1.6	13.3	45.8	96.0	4.0	100.0
1948 [2]	4.2	42.4	46.6	33.0	2.1	14.3	49.4	96.0	4.0	100.0

[1] Percentages based upon figures in table 7.
[2] Subject to revision.

STOCKS HELD BY CONSUMERS

TABLE 10.—Stocks of bituminous coal and lignite in hands of commercial consumers and in retail dealers' yards in the United States, 1947–48

Date	Total stocks (net tons)	Days' supply at current rate of consumption on date of stock taking							
		Coke ovens	Steel plants	Other indus-trials	Electric utilities	Retail yards	Rail-roads	Cement mills	Total
1947									
Jan. 1	47,157,000	24	28	45	60	10	23	41	32
Feb. 1	49,688,000	23	30	45	57	8	24	41	29
Mar. 1	47,867,000	26	31	39	57	5	23	41	27
Apr. 1	49,033,000	29	38	42	63	6	25	44	31
May 1	42,419,000	21	37	33	62	10	25	42	30
June 1	50,218,000	25	45	51	73	15	28	59	38
July 1	49,778,000	28	50	39	77	16	30	52	37
Aug. 1	45,366,000	19	47	47	71	19	26	46	36
Sept. 1	47,157,000	21	48	55	65	12	24	41	37
Oct. 1	48,370,000	24	44	44	64	9	22	41	33
Nov. 1	50,276,000	27	40	39	64	9	22	46	32
Dec. 1	50,455,000	30	34	44	65	8	20	45	33
Dec. 31	52,161,000	34	32	52	62	6	22	46	33
1948									
Jan. 1	52,161,000	34	32	52	62	6	22	46	33
Feb. 1	49,576,000	32	26	38	56	3	22	46	28
Mar. 1	48,613,000	32	28	51	55	3	22	45	30
Apr. 1	43,585,000	28	27	52	54	3	21	44	30
May 1	34,418,000	20	28	46	51	6	21	36	30
June 1	47,032,000	29	41	54	64	7	29	45	37
July 1	58,010,000	39	48	67	68	9	35	59	45
Aug. 1	58,139,000	34	53	67	75	13	35	59	47
Sept. 1	64,057,000	38	51	58	80	15	36	57	47
Oct. 1	67,592,000	40	50	58	83	14	36	60	48
Nov. 1	68,696,000	41	48	53	85	12	36	56	46
Dec. 1	69,579,000	42	39	50	90	15	36	54	47
Dec. 31	69,373,000	43	38	53	90	9	38	52	46

FINAL BITUMINOUS-COAL AND LIGNITE STATISTICS FOR 1947

Tables 11 to 50 give the final detailed statistics of bituminous-coal- and lignite-mine operations in 1947. The subjects covered include production, number and size of mines, employment, value, mechanization, exports, and world production.

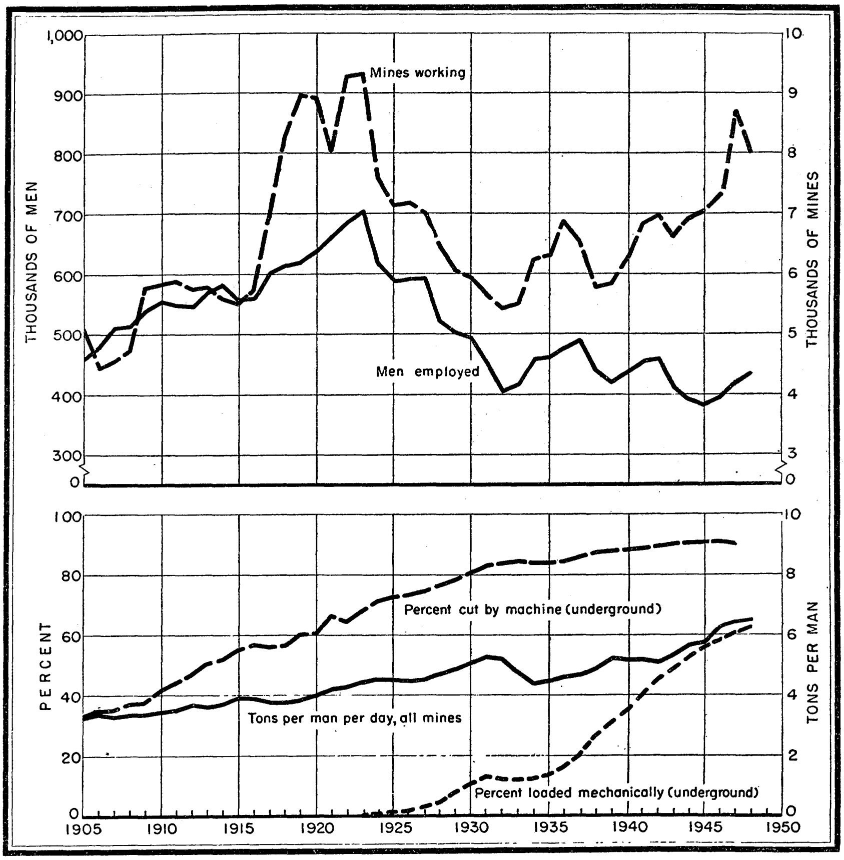

FIGURE 9.—Trends of employment, mechanization, and output per man at bituminous-coal and lignite mines in the United States, 1905–48.

TABLE 11.—Salient trends in bituminous-coal and lignite-mining industry in the United States, 1940–47

	1940	1941	1942	1943	1944	1945	1946	1947
Production:								
Loaded at mine for shipment by rail.....net tons..	380, 387, 674	425, 184, 319	482, 814, 042	495, 863, 581	527, 135, 489	490, 471, 988	450, 615, 524	527, 281, 632
Loaded at mine for shipment by water.....do....	29, 493, 058	30, 240, 489	34, 018, 025	30, 188, 093	31, 518, 334	27, 547, 679	24, 641, 533	29, 802, 779
Shipped by truck or wagon.....do....	35, 540, 476	40, 055, 638	45, 154, 432	42, 432, 667	40, 123, 023	41, 477, 428	42, 730, 884	55, 859, 262
Taken by locomotive tenders at tipple.....do....	939, 058	1, 099, 582	920, 213	779, 154	807, 679	694, 555	731, 748	
Shipped by conveyor or tram to point of consumption.do....	5, 887, 994	6, 067, 697	7, 121, 116	7, 476, 717	7, 206, 392	6, 416, 327	5, 700, 870	
Used by mine employees.....do....	2, 035, 201	1, 872, 026	2, 180, 077	2, 549, 775	2, 545, 343	2, 660, 039	2, 464, 300	17, 680, 049
Used at mines for power and heat.....do....	2, 442, 989	2, 488, 950	2, 708, 312	2, 701, 828	2, 713, 073	2, 442, 398	1, 950, 645	
Made into beehive coke at mines.....do....	4, 045, 050	7, 140, 544	7, 776, 720	8, 185, 254	7, 526, 907	5, 906, 913	5, 086, 564	
Total production.....do....	460, 771, 500	514, 149, 245	582, 692, 937	590, 177, 069	619, 576, 240	577, 617, 327	533, 922, 068	630, 623, 722
Number of active mines of commercial size:								
Class 1 (200,000 tons or more).....number..	636	730	811	855	828	753	706	801
Class 2 (100,000 to 200,000 tons).....do....	432	437	484	464	559	591	560	618
Class 3 (50,000 to 100,000 tons).....do....	371	402	445	481	540	629	637	704
Class 4 (10,000 to 50,000 tons).....do....	1, 157	1, 305	1, 492	1, 544	1, 776	1, 920	2, 016	2, 665
Class 5 (1,000 to 10,000 tons).....do....	3, 728	3, 948	3, 740	3, 276	3, 225	3, 140	3, 414	3, 912
Total number 1,000 tons and over.....do....	6, 324	6, 822	6, 972	6, 620	6, 928	7, 033	7, 333	8, 700
Average number of men employed at mines active:								
Underground.....men...	365, 013	376, 765	374, 654	326, 763	301, 461	290, 001	[1] 296, 030	[1] 311, 369
Surface:								
In strip pits.....do....	8, 983	10, 861	12, 893	16, 643	21, 035	23, 261	[1] 25, 408	[1] 29, 783
All others.....do....	65, 079	69, 355	74, 444	72, 601	70, 851	69, 838	[1] 74, 996	[1] 78, 030
Total.....do....	439, 075	456, 981	461, 991	416, 007	393, 347	383, 100	[1] 396, 434	[1] 419, 182
Average number of days mines operated.....	202	216	246	264	278	261	214	234
Capacity of active mines with existing labor force:								
Per year of 308 days.....net tons..	703, 000, 000	733, 000, 000	730, 000, 000	689, 000, 000	686, 000, 000	682, 000, 000	768, 000, 000	830, 000, 000
Per year of 280 days.....do....	639, 000, 000	666, 000, 000	663, 000, 000	626, 000, 000	624, 000, 000	620, 000, 000	699, 000, 000	755, 000, 000
Per year of 261 days.....do....	595, 000, 000	621, 000, 000	618, 000, 000	583, 000, 000	582, 000, 000	578, 000, 000	651, 000, 000	703, 000, 000
Output per man per day.....do....	5. 19	5. 20	5. 12	5. 38	5. 67	5. 78	6. 30	6. 42
Output per man per year.....do....	1, 049	1, 125	1, 261	1, 419	1, 575	1, 508	1, 347	1, 504
Underground output cut by machine.....do....	369, 227, 277	408, 510, 296	462, 344, 719	461, 051, 743	469, 458, 349	424, 726, 432	382, 133, 540	442, 101, 535
Percent of underground output cut by machine.....	88. 4	89. 0	89. 7	90. 3	90. 5	90. 8	90. 8	90. 0
Underground output mechanically loaded.....net tons..	147, 870, 252	186, 667, 250	232, 902, 920	249, 805, 214	274, 189, 132	262, 512, 729	245, 340, 768	298, 157, 281
Percent of underground output mechanically loaded.....	35. 4	40. 7	45. 2	48. 9	52. 9	56. 1	58. 4	60. 7
Quantity mined by stripping.....net tons..	43, 167, 336	55, 071, 609	67, 202, 663	79, 685, 175	100, 898, 376	109, 986, 865	112, 963, 717	139, 395, 011
Percent mined by stripping.....	9. 4	10. 7	11. 5	13. 5	16. 3	19. 0	21. 1	22. 1
Quantity cleaned by wet or pneumatic process [2].....net tons..	102, 269, 753	117, 539, 522	142, 187, 346	145, 575, 849	158, 727, 129	147, 885, 936	138, 669, 837	174, 435, 937
Percent cleaned by wet or pneumatic process [2].....	22. 2	22. 9	24. 4	24. 7	25. 6	25. 6	26. 0	27. 7

[1] Average number of men working daily.

[2] Includes central washeries operated by consumers.

TABLE 12.—Coal produced in the United States, by States, 1937–47 with production of maximum year and cumulative production from earliest record to end of 1947, in thousands of net tons

State	Maximum production		Production by years											Total production from earliest record to end of 1947
	Year	Quantity	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	
Alabama	1926	21,001	12,440	11,062	12,047	15,324	15,464	19,301	17,160	18,752	18,236	16,183	19,048	790,543
Arkansas	1907	2,670	1,511	1,197	1,152	1,454	1,574	1,985	1,718	1,972	1,854	1,631	1,871	88,752
Colorado	1917	12,483	7,187	5,663	5,923	6,589	6,949	8,086	8,324	8,168	7,621	5,914	6,358	460,854
Georgia	1903	416	(1)	(1)	(1)	(1)	(1)	31	14	24	43	114	7	(1)
Illinois	1918	89,291	51,602	41,912	46,783	50,610	54,703	65,071	72,631	76,792	73,011	63,469	67,860	3,018,733
Indiana	1918	30,679	17,765	14,759	16,943	18,869	22,484	25,388	25,065	27,962	25,183	21,697	25,449	944,889
Iowa	1917	8,966	3,637	3,103	2,948	3,231	2,939	2,948	2,771	2,141	2,046	1,788	1,684	334,338
Kansas	1918	7,562	2,893	2,654	2,675	3,579	4,008	4,230	3,437	3,369	3,228	2,493	2,745	261,482
Kentucky	1947	84,241	47,086	38,545	42,557	49,141	53,710	62,231	63,211	71,356	69,593	66,553	84,241	1,811,107
Maryland	1907	5,533	1,549	1,281	1,443	1,503	1,701	2,001	1,933	1,870	1,763	2,003	2,051	257,496
Michigan	1907	2,036	562	494	457	410	311	231	169	140	126	80	14	46,348
Missouri	1917	5,671	4,091	3,436	3,273	3,097	3,145	3,520	4,310	4,779	3,983	3,733	4,236	249,798
Montana (bituminous and lignite)	1944	4,844	2,965	2,732	2,804	2,867	3,254	3,829	4,833	4,844	4,467	3,723	3,178	151,599
New Mexico	1918	4,023	1,715	1,239	1,230	1,111	1,251	1,669	1,851	1,744	1,484	1,280	1,443	119,072
North Carolina	1922	79	------	------	------	------	------	------	------	------	------	------	------	(1)
North Dakota (lignite)	1947	2,760	2,251	2,050	2,072	2,218	2,309	2,537	2,500	2,366	2,522	2,555	2,760	61,712
Ohio	1920	45,878	25,178	18,591	20,289	22,772	29,319	32,764	32,255	33,877	32,737	32,314	37,548	1,628,013
Oklahoma	1920	4,849	1,600	1,245	1,188	1,646	1,771	2,387	2,838	3,209	2,909	2,647	3,421	152,291
Pennsylvania (bituminous)	1918	178,551	111,002	77,705	92,584	116,603	130,240	144,073	141,050	146,052	132,965	125,497	147,079	7,142,034
Tennessee	1942	8,158	5,213	4,472	5,185	6,008	7,045	8,158	7,179	7,266	6,271	5,618	6,258	313,657
Texas (bituminous and lignite)	1913	2,429	910	879	826	621	353	304	153	[2] 109	[2] 80	[2] 56	[2] 61	60,805
Utah	1947	7,429	3,810	2,947	3,285	3,576	4,077	5,517	6,666	7,119	6,679	5,994	7,429	184,893
Virginia	1943	20,280	13,795	12,283	13,531	15,348	18,441	20,136	20,280	19,514	17,235	15,527	20,171	521,540
Washington	1918	4,082	2,002	1,567	1,690	1,650	1,841	1,953	1,528	1,524	1,357	991	1,118	140,330
West Virginia	1947	176,157	118,646	93,288	108,362	126,438	140,250	155,882	158,804	164,704	152,035	144,020	176,157	4,670,271
Wyoming	1945	9,847	5,918	5,204	5,373	5,808	6,646	8,133	9,155	9,540	9,847	7,635	8,051	351,048
Other States	------	------	203	237	235	299	364	328	342	383	342	407	386	65,014
Total bituminous and lignite	1947	630,624	445,531	348,545	394,855	460,772	514,149	582,693	590,177	619,576	577,617	533,922	630,624	23,826,619
Pennsylvania anthracite	1917	99,612	51,856	46,099	51,487	51,485	56,368	60,328	60,644	63,701	54,934	60,507	57,190	4,799,101
Grand total	------	------	497,387	394,644	446,342	512,257	570,517	643,021	650,821	683,277	632,551	594,429	687,814	28,625,720

[1] Included with "Other States."
[2] Lignite only.

TABLE 13.—Growth of bituminous-coal and lignite-mining industry in the United States, 1890–1947

Year	Production (net tons)	Value		Men employed	Number of mines	Capacity at 280 days (millions of tons)
		Total [1]	Average per ton [1]			
1890	111,302,322	$110,420,801	$0.99	192,204	(2)	137
1891	117,901,238	117,188,400	.99	205,803	(2)	148
1892	126,856,567	125,124,381	.99	212,893	(2)	162
1893	128,385,231	122,751,618	.96	230,365	(2)	174
1894	118,820,405	107,653,501	.91	244,603	(2)	196
1895	135,118,193	115,779,771	.86	239,962	2,555	196
1896	137,640,276	114,891,515	.83	244,171	2,599	202
1897	147,617,519	119,595,224	.81	247,817	2,454	213
1898	166,593,623	132,608,713	.80	255,717	2,862	221
1899	193,323,187	167,952,104	.87	271,027	3,245	230
1900	212,316,112	220,930,313	1.04	304,375	(2)	255
1901	225,828,149	236,422,049	1.05	340,235	(2)	281
1902	260,216,844	290,858,483	1.12	370,056	(2)	316
1903	282,749,348	351,687,933	1.24	415,777	(2)	350
1904	278,659,689	305,397,001	1.10	437,832	4,650	386
1905	315,062,785	334,658,294	1.06	460,629	5,060	417
1906	342,874,867	381,162,115	1.11	478,425	4,430	451
1907	394,759,112	451,214,842	1.14	513,258	4,550	473
1908	332,573,944	374,135,268	1.12	516,264	4,730	482
1909	379,744,257	405,486,777	1.07	543,152	5,775	510
1910	417,111,142	469,281,719	1.12	555,533	5,818	538
1911	405,907,059	451,375,819	1.11	549,775	5,887	538
1912	450,104,982	517,983,445	1.15	548,632	5,747	566
1913	478,435,297	565,234,952	1.18	571,882	5,776	577
1914	422,703,970	493,309,244	1.17	583,506	5,592	608
1915	442,624,426	502,037,688	1.13	557,456	5,502	610
1916	502,519,682	665,116,077	1.32	561,102	5,726	613
1917	551,790,563	1,249,272,837	2.26	603,143	6,939	636
1918	579,385,820	1,491,809,940	2.58	615,305	8,319	650
1919	465,860,058	1,160,616,013	2.49	621,998	8,994	669
1920	568,666,683	2,129,933,000	3.75	639,547	8,921	725
1921	415,921,950	1,199,983,600	2.89	663,754	8,038	781
1922	422,268,099	1,274,820,000	3.02	687,958	9,299	832
1923	564,564,662	1,514,621,000	2.68	704,793	9,331	885
1924	483,686,538	1,062,626,000	2.20	619,604	7,586	792
1925	520,052,741	1,060,402,000	2.04	588,493	7,144	748
1926	573,366,985	1,183,412,000	2.06	593,647	7,177	747
1927	517,763,352	1,029,657,000	1.99	593,918	7,011	759
1928	500,744,970	933,774,000	1.86	522,150	6,450	691
1929	534,988,593	952,781,000	1.78	502,993	6,057	679
1930	467,526,299	795,483,000	1.70	493,202	5,891	700
1931	382,089,396	588,895,000	1.54	450,213	5,642	669
1932	309,709,872	406,677,000	1.31	406,380	5,427	594
1933	333,630,533	445,788,000	1.34	418,703	5,555	559
1934	359,368,022	628,383,000	1.75	458,011	6,258	565
1935	372,373,122	658,063,000	1.77	462,403	6,315	582
1936	439,087,903	770,955,000	1.76	477,204	6,875	618
1937	445,531,449	864,042,000	1.94	491,864	6,548	646
1938	348,544,764	678,653,000	1.95	441,333	5,777	602
1939	394,855,325	728,348,366	1.84	421,788	5,820	621
1940	460,771,500	879,327,227	1.91	439,075	6,324	639
1941	514,149,245	1,125,362,836	2.19	456,981	6,822	666
1942	582,692,937	1,373,990,608	2.36	461,991	6,972	663
1943	590,177,069	1,584,644,477	2.69	416,007	6,620	626
1944	619,576,240	1,810,900,542	2.92	393,347	6,928	624
1945	577,617,327	1,768,204,320	3.06	383,100	7,033	620
1946	533,922,068	1,835,539,476	3.44	[3] 396,434	7,333	699
1947	630,623,722	2,622,634,946	4.16	[3] 419,182	8,700	755

[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.
[3] Average number of men working daily.

TABLE 13.—Growth of bituminous-coal and lignite-mining industry in the United States, 1890–1947—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 [4]	Mechanically loaded	Mechanically cleaned [5]	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	(6)	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
1946	214	(2)	(2)	6.30	1,347	90.8	58.4	26.0	21.1
1947	234	(3)	(2)	6.42	1,504	90.0	60.7	27.7	22.1

[2] Data not available.
[4] Percentages for 1890 to 1913, inclusive, are of total production, as a separation of strip-mine and underground production is not available for those years.
[5] For 1906 to 1926, inclusive, these 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, the percentages include the total tons cleaned at the mines and at consumer-operated washeries.
[6] One-half day or less.

TABLE 14.—Growth of strip mining at bituminous-coal and lignite-mines in the United States, 1914–47

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.			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
1946	112,964	420,958	533,922	21.1	15.73	5.43	6.30	2.87	3.59	3.44	1,445	2,744
1947	139,395	491,229	630,624	22.1	15.93	5.49	6.42	3.47	4.35	4.16	1,750	3,254

[1] Includes power strip pits proper and excludes horse stripping operations and mines combining stripping and underground in the same operation for the years 1914–42, inclusive. The years 1943–47, inclusive, 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 15.—Growth of mechanical loading at underground bituminous-coal and lignite mines in the United States, 1923–47

[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	Total	Pit-car loaders	Hand loaded conveyors	Total				Mobile loading machines	Scrapers	Conveyors equipped with duckbills or other self-loading heads	Pit-car loaders	Hand loaded conveyors	Total all types
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
1946	186,975	917	19,678	207,570	623	37,148	37,771	245,341	420,958	58.3	3,200	75	1,521	93	3,470	8,359
1947	229,836	854	21,921	252,611	353	45,193	45,546	298,157	491,229	60.9	3,569	67	1,531	71	3,979	9,217

[1] Data not available.

[2] Exclusive of tonnage "Handled by conveyors."

SUMMARY BY STATES

TABLE 16.—Number of mines, production, value, employment, days active, man-days, and output per day at bituminous-coal and lignite mines in the United States, by States, in 1947

[Exclusive of mines producing less than 1,000 tons]

State	Number of active mines	Disposition of coal produced (net tons)					Average value per ton [2]	Average number of men working daily				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	Shipped by truck	Used at mines [1]	Total quantity		Underground	Surface		Total			
									In strip pits	All others				
Alabama	406	15,437,298	1,410,536	1,490,049	710,342	19,048,225	$5.48	16,368	652	3,398	20,418	245	5,004,744	3.81
Alaska	4	322,306	----	36,558	2,356	361,220	7.07	161	25	75	261	313	81,712	4.42
Arizona	4	----	----	10,060	----	10,060	4.61	26	----	7	33	123	4,049	2.48
Arkansas	63	1,517,197	225,728	122,804	5,220	1,870,949	6.67	1,668	342	412	2,422	185	448,330	4.17
Colorado	178	4,339,754	420,120	1,429,065	169,165	6,358,104	4.53	4,703	55	1,227	5,985	208	1,244,746	5.11
Georgia	2	7,119	----	----	164	7,283	5.40	39	8	10	57	37	2,121	3.43
Illinois	260	58,247,416	1,668,862	6,786,040	1,157,693	67,860,011	3.15	21,581	1,866	7,974	31,421	236	7,425,236	9.14
Indiana	108	22,509,109	352,280	2,049,429	538,279	25,449,097	3.22	5,158	2,084	2,500	9,742	236	2,297,530	11.08
Iowa	120	492,163	302,074	883,446	6,372	1,684,055	3.82	1,378	219	315	1,912	180	344,977	4.88
Kansas	59	2,366,063	120,655	205,392	52,424	2,744,534	3.34	600	454	407	1,461	216	315,249	8.71
Kentucky	2,610	60,883,190	11,411,972	11,341,494	604,026	84,240,682	4.42	51,908	1,938	10,905	64,751	215	13,899,490	6.06
Maryland	118	1,259,975	262,870	519,231	9,206	2,051,282	4.80	1,459	359	395	2,213	191	423,124	4.85
Michigan	1	----	----	12,583	1,430	14,013	7.68	27	----	6	33	204	6,732	2.08
Missouri	82	3,419,953	50,385	761,688	4,401	4,236,427	3.33	787	555	561	1,903	203	387,157	10.94
Montana:														
Bituminous	20	3,019,292	41,416	66,825	11,688	3,139,221	2.04	545	90	265	900	214	192,687	16.29
Lignite	8	----	----	38,469	200	38,669	2.90	28	2	7	37	185	6,859	5.64
Total, Montana	28	3,019,292	41,416	105,294	11,888	3,177,890	2.05	573	92	272	937	213	199,546	15.93
New Mexico	24	1,301,904	27,880	72,479	40,947	1,443,210	4.52	917	----	247	1,164	231	268,468	5.38
North Dakota (lignite)	46	2,228,163	----	458,278	73,421	2,759,862	1.92	154	279	247	680	255	173,735	15.89
Ohio	586	27,861,436	2,725,644	6,764,753	196,371	37,548,204	3.50	13,243	3,280	4,064	20,587	220	4,532,135	8.28
Oklahoma	70	2,979,890	286,500	143,707	10,466	3,420,563	4.41	1,257	528	547	2,332	208	484,553	7.06
Pennsylvania	2,171	104,704,436	16,556,526	16,316,208	9,502,126	147,079,296	4.23	76,219	10,512	16,909	103,640	239	24,720,918	5.95
South Dakota (lignite)	4	----	420	14,158	40	14,618	2.44	2	11	2	15	176	2,634	5.55

See footnotes at end of table.

TABLE 16.—Number of mines, production, value, employment, days active, man-days, and output per day at bituminous-coal and lignite mines in the United States, by States, in 1947—Continued

[Exclusive of mines producing less than 1,000 tons]

State	Number of active mines	Disposition of coal produced (net tons)					Average value per ton [2]	Average number of men working daily				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	Shipped by truck	Used at mines [1]	Total quantity		Underground	Surface		Total			
									In strip pits	All others				
Tennessee	131	5,343,200	392,142	469,485	53,656	6,258,483	$4.77	5,245	144	996	6,385	209	1,333,810	4.69
Texas (lignite)	1	60,504	----------	----------	----------	60,504	.98	----------	15	----------	15	240	3,600	16.81
Utah	44	6,860,245	129,499	277,178	161,777	7,428,699	3.93	3,101	----------	1,101	4,202	253	1,061,384	7.00
Virginia	267	16,636,728	2,787,054	260,691	486,326	20,170,799	4.83	13,409	326	2,397	16,132	251	4,054,885	4.97
Washington	39	779,680	71,381	241,998	24,867	1,117,926	5.99	840	97	342	1,279	238	303,967	3.68
West Virginia	1,227	157,982,038	9,504,957	4,948,147	3,721,437	176,156,579	4.48	87,404	5,745	21,785	114,934	246	28,255,515	6.23
Wyoming	47	7,747,845	28,606	139,047	135,649	8,051,147	3.37	3,142	197	929	4,268	238	1,017,077	7.92
Grand total	8,700	508,306,904	48,777,507	55,859,262	17,680,049	630,623,722	4.16	311,369	29,783	78,030	419,182	234	98,297,424	6.42

[1] Includes coal used by mine employees, taken by locomotive tenders at tipple, used at mine for power and heat, coal transported from mine to point of use by conveyor or tram, coal made into beehive coke at mine and all other uses at mine.

[2] 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.)

PRODUCTION BY WEEKS AND MONTHS

TABLE 17.—Bituminous-coal and lignite production (final figures) in the United States in 1947, 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. 4	[1] 6, 959, 000	[1] 3. 1	[2] 2, 286, 000	July 19	12, 391, 000	6	2, 065, 000
Jan. 11	14, 046, 000	6	2, 341, 000	July 26	12, 016, 000	6	2, 003, 000
Jan. 18	13, 547, 000	6	2, 258, 000	Aug. 2	11, 911, 000	6	1, 985, 000
Jan. 25	13, 477, 000	6	2, 246, 000	Aug. 9	12, 017, 000	6	2, 003, 000
Feb. 1	14, 099, 000	6	2, 350, 000	Aug. 16	11, 944, 000	6	1, 991, 000
Feb. 8	12, 778, 000	6	2, 130, 000	Aug. 23	12, 212, 000	6	2, 035, 000
Feb. 15	12, 802, 000	6	2, 134, 000	Aug. 30	12, 243, 000	6	2, 041, 000
Feb. 22	13, 557, 000	6	2, 260, 000	Sept. 6	10, 942, 000	5	2, 188, 000
Mar. 1	13, 122, 000	6	2, 187, 000	Sept. 13	12, 841, 000	6	2, 140, 000
Mar. 8	13, 039, 000	6	2, 173, 000	Sept. 20	12, 466, 000	6	2, 078, 000
Mar. 15	13, 648, 000	6	2, 275, 000	Sept. 27	12, 530, 000	6	2, 088, 000
Mar. 22	13, 159, 000	6	2, 193, 000	Oct. 4	12, 473, 000	6	2, 079, 000
Mar. 29	12, 411, 000	6	2, 069, 000	Oct. 11	13, 080, 000	6	2, 180, 000
Apr. 5	4, 093, 000	5	819, 000	Oct. 18	12, 972, 000	6	2, 162, 000
Apr. 12	7, 309, 000	6	1, 218, 000	Oct. 25	12, 965, 000	6	2, 161, 000
Apr. 19	13, 077, 000	6	2, 180, 000	Nov. 1	13, 178, 000	6	2, 196, 000
Apr. 26	13, 063, 000	6	2, 177, 000	Nov. 8	13, 132, 000	6	2, 189, 000
May 3	12, 744, 000	6	2, 124, 000	Nov. 15	12, 925, 000	5. 8	2, 228, 000
May 10	13, 295, 000	6	2, 216, 000	Nov. 22	13, 636, 000	6	2, 273, 000
May 17	13, 093, 000	6	2, 182, 000	Nov. 29	12, 287, 000	5	2, 457, 000
May 24	13, 005, 000	6	2, 168, 000	Dec. 6	13, 377, 000	6	2, 230, 000
May 31	12, 230, 000	5. 5	2, 224, 000	Dec. 13	13, 652, 000	6	2, 275, 000
June 7	13, 593, 000	6	2, 266, 000	Dec. 20	13, 262, 000	6	2, 210, 000
June 14	12, 825, 000	6	2, 138, 000	Dec. 27	8, 565, 000	5	1, 713, 000
June 21	13, 082, 000	6	2, 180, 000	Jan. 3, 1948	[1] 6, 996, 000	[1] 3	[2] 2, 248, 000
June 28	8, 284, 000	6	1, 381, 000				
July 5	2, 012, 000	5	402, 000	Total	630, 624, 000	306. 4	2, 058, 000
July 12	6, 262, 000	6	1, 044, 000				

[1] Figures represent output and number of working days in that part of week included in the calendar year shown. Total production for the week ended Jan. 4, 1947, was 11,661,000 net tons; week ended Jan. 3, 1948, 11,689,000 net tons.
[2] Average daily production for entire week and not for working days in calendar year shown.

TABLE 18.—Bituminous-coal and lignite production (final figures) in the United States in 1947, with estimates by months

Month	1947			Month	1947		
	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	60, 113, 000	26. 1	2, 303, 000	August	51, 822, 000	26	1, 993, 000
February	52, 420, 000	24	2, 184, 000	September	53, 369, 000	25	2, 135, 000
March	56, 499, 000	26	2, 173, 000	October	58, 366, 000	27	2, 162, 000
April	42, 015, 000	25	1, 681, 000	November	53, 692, 000	23. 8	2, 256, 000
May	57, 506, 000	26. 5	2, 170, 000	December	55, 852, 000	26	2, 148, 000
June	48, 323, 000	25	1, 933, 000				
July	40, 647, 000	26	1, 563, 000	Total	630, 624, 000	306. 4	2, 058, 000

TABLE 19.—Coal production in the United States, in 1947, 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 1,000 tons and over per 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	1,730	1,637	1,721	1,231	1,861	1,406	1,007	1,596	1,592	1,872	1,645	1,750	19,048
Alaska	33	22	32	27	23	18	20	24	31	41	42	48	361
Arkansas	204	155	132	63	92	171	108	174	182	205	201	184	1,871
Colorado	826	682	641	339	362	412	221	391	517	590	616	761	6,358
Illinois	6,974	6,128	6,611	4,389	5,949	4,640	4,265	5,362	5,777	6,042	5,685	6,038	67,860
Indiana	2,563	2,366	2,563	1,619	2,302	1,623	1,624	2,004	2,176	2,272	2,186	2,151	25,449
Iowa	174	167	166	124	130	79	124	97	126	136	167	194	1,684
Kansas	268	253	250	168	209	208	154	222	222	262	249	280	2,745
Kentucky:													
Eastern	5,885	4,861	5,414	3,656	5,872	4,720	3,713	5,207	5,586	6,132	5,473	5,540	62,059
Western	1,965	1,657	2,182	1,734	1,864	1,748	1,648	1,676	1,723	1,855	1,928	2,202	22,182
Total Kentucky	7,850	6,518	7,596	5,390	7,736	6,468	5,361	6,883	7,309	7,987	7,401	7,742	84,241
Maryland	243	213	185	136	173	170	137	175	160	145	158	156	2,051
Missouri	413	390	385	259	322	320	237	344	344	405	385	432	4,236
Montana:													
Bituminous	404	287	275	189	233	144	175	246	264	306	298	318	3,139
Lignite	5	4	3	2	3	2	2	3	3	4	4	4	39
Total Montana	409	291	278	191	236	146	177	249	267	310	302	322	3,178
New Mexico	155	136	137	98	128	115	81	106	118	119	115	135	1,443
North Dakota (lignite)	304	252	230	158	136	134	142	126	227	363	342	346	2,760
Ohio	3,257	2,830	3,241	2,826	3,377	3,016	2,530	2,983	3,131	3,561	3,246	3,550	37,548
Oklahoma	346	265	287	239	239	217	258	292	290	324	315	349	3,421
Pennsylvania (bituminous)	13,827	12,606	12,836	9,803	13,399	11,778	10,216	12,270	12,380	13,769	11,968	12,227	147,079
South Dakota (lignite)	2	1	1	1	1	1	1	1	1	2	2	1	15
Tennessee	629	541	575	374	569	475	329	510	502	568	557	629	6,258
Texas (lignite)	6	6	7	6	4	4	3	4	4	5	6	6	61
Utah	786	780	763	521	662	589	414	530	539	531	589	725	7,429
Virginia	1,867	1,523	1,691	1,207	1,848	1,590	1,214	1,796	1,790	2,041	1,783	1,821	20,171
Washington	116	108	110	81	74	88	51	79	84	110	102	115	1,118
West Virginia	16,211	13,791	15,324	12,270	17,102	14,044	11,629	15,072	14,944	15,901	14,830	15,039	176,157
Wyoming	915	756	734	494	570	610	343	530	653	802	797	847	8,051
Other States [1]	5	3	3	1	2	1	1	2	3	3	3	4	31
Total bituminous coal and lignite	60,113	52,420	56,499	42,015	57,506	48,323	40,647	51,822	53,369	58,366	53,692	55,852	630,624
Pennsylvania anthracite [2]	5,172	4,254	4,984	4,293	4,564	4,624	4,098	5,011	5,158	5,524	4,629	4,879	57,190
Grand total 1947	65,285	56,674	61,483	46,308	62,070	52,947	44,745	56,833	58.527	63,890	58,321	60,731	687,814

[1] Includes Arizona, Georgia, and Michigan.

[2] Includes Sullivan County.

TABLE 20.—Number and production of bituminous-coal and lignite mines in the United States, classified by size of output in each State, in 1947

[Exclusive of mines producing less than 1,000 tons]

State	Class 1A—500,000 tons and over					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	2.0	5,247,323	655,915	27.6	19	4.7	6,062,144	319,060	31.8	25	6.1	3,475,026	139,001	18.2
Alaska	----	----	----	----	----	----	----	----	----	----	2	50.0	294,758	147,379	81.6
Arizona	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Arkansas	----	----	----	----	----	----	----	----	----	----	2	3.2	299,226	149,613	16.0
Colorado	1	.6	613,347	613,347	9.6	4	2.2	963,933	240,983	15.2	16	9.0	2,069,609	129,351	32.6
Georgia	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Illinois	53	20.4	52,192,319	984,761	76.9	21	8.1	7,043,203	335,391	10.4	31	11.9	4,063,908	131,094	6.0
Indiana	22	20.4	18,043,747	820,170	70.9	11	10.2	3,897,793	354,345	15.3	15	13.9	2,033,017	135,534	8.0
Iowa	----	----	----	----	----	1	.8	202,228	202,228	12.0	1	.8	159,372	159,372	9.5
Kansas	1	1.7	526,868	526,868	19.2	3	5.1	1,182,929	394,310	43.1	4	6.8	584,658	146,165	21.3
Kentucky	24	.9	18,759,335	781,639	22.3	74	2.9	22,305,964	301,432	26.5	105	4.0	15,425,006	146,905	18.3
Maryland	----	----	----	----	----	2	1.7	481,592	240,796	23.5	1	.8	125,214	125,214	6.1
Michigan	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Missouri	3	3.7	1,931,589	643,863	45.6	4	4.9	1,373,061	343,265	32.4	2	2.4	256,917	128,459	6.1
Montana (bituminous)	1	5.0	1,982,185	1,982,185	63.1	2	10.0	683,359	341,680	21.8	1	5.0	180,397	180,397	5.7
Montana, North Dakota, South Dakota, and Texas (lignite)	----	----	----	----	----	7	11.8	2,338,488	334,070	81.4	----	----	----	----	----
New Mexico	----	----	----	----	----	3	12.5	1,076,387	358,796	74.6	1	4.2	133,801	133,801	9.3
Ohio	18	3.1	15,772,801	876,267	42.0	22	3.8	7,241,039	329,138	19.3	44	7.5	6,176,183	140,368	16.4
Oklahoma	----	----	----	----	----	6	8.6	1,514,036	252,339	44.2	6	8.6	885,894	147,649	25.9
Pennsylvania	61	2.8	59,309,898	972,293	40.3	91	4.2	28,528,344	313,498	19.4	152	7.0	21,160,095	139,211	14.4
Tennessee	----	----	----	----	----	8	6.1	2,027,851	253,481	32.4	19	14.5	2,708,633	142,560	43.3
Utah	5	11.4	4,252,502	850,500	57.3	6	13.6	2,016,230	336,038	27.1	5	11.4	611,221	122,244	8.2
Virginia	9	3.4	7,400,285	822,254	36.7	17	6.4	5,626,452	330,968	27.9	18	6.7	2,695,323	149,740	13.4
Washington	----	----	----	----	----	----	----	----	----	----	3	7.7	510,501	170,167	45.7
West Virginia	90	7.3	70,688,235	785,425	40.1	192	15.7	59,174,086	308,198	33.6	158	12.9	23,240,146	147,090	13.2
Wyoming	7	14.9	5,053,092	721,870	62.8	5	10.6	1,565,871	313,174	19.4	7	14.9	1,012,443	144,635	12.6
Total 1947	303	3.5	261,773,526	863,939	41.5	498	5.7	155,304,990	311,857	24.6	618	7.1	88,101,348	142,559	14.0

TABLE 20.—Number and production of bituminous-coal and lignite mines in the United States, classified by size of output in each State, in 1947—Continued

[Exclusive of mines producing less than 1,000 tons]

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	21	5.2	1,383,712	65,891	7.3	87	21.4	2,007,641	23,076	10.5	246	60.6	872,379	3,546	4.6	406	19,048,225	46,917
Alaska	----	----	----	----	----	2	50.0	66,462	33,231	18.4	----	----	----	----	----	4	361,220	90,305
Arizona	----	----	----	----	----	----	----	----	----	----	4	100.0	10,060	2,515	100.0	4	10,060	2,515
Arkansas	10	15.9	770,356	77,036	41.2	23	36.5	714,054	31,046	38.1	28	44.4	87,313	3,118	4.7	63	1,870,949	29,698
Colorado	18	10.1	1,343,130	74,618	21.1	37	20.8	979,297	26,467	15.4	102	57.3	388,788	3,812	6.1	178	6,358,104	35,720
Georgia	----	----	----	----	----	----	----	----	----	----	2	100.0	7,283	3,642	100.0	2	7,283	3,642
Illinois	34	13.1	2,321,165	68,270	3.4	70	26.9	1,970,637	28,152	2.9	51	19.6	268,779	5,270	.4	260	67,860,011	261,000
Indiana	9	8.3	638,244	70,916	2.5	34	31.5	770,297	22,656	3.0	17	15.7	65,999	3,882	.3	108	25,449,097	235,640
Iowa	2	1.7	139,465	69,733	8.3	42	35.0	850,551	20,251	50.5	74	61.7	332,439	4,492	19.7	120	1,684,055	14,034
Kansas	----	----	----	----	----	16	27.1	311,726	19,483	11.4	35	59.3	138,353	3,953	5.0	59	2,744,534	46,518
Kentucky	113	4.3	8,183,572	72,421	9.7	746	28.6	14,011,936	18,783	16.6	1,548	59.3	5,554,869	3,588	6.6	2,610	84,240,682	32,276
Maryland	8	6.8	523,573	65,447	25.5	32	27.1	643,515	20,110	31.4	75	63.6	277,388	3,699	13.5	118	2,051,282	17,384
Michigan	----	----	----	----	----	1	100.0	14,013	14,013	100.0	----	----	----	----	----	1	14,013	14,013
Missouri	2	2.4	133,303	66,652	3.1	14	17.1	317,552	22,682	7.5	57	69.5	224,005	3,930	5.3	82	4,236,427	51,664
Montana (bituminous)	1	5.0	79,626	79,626	2.5	5	25.0	171,000	34,200	5.5	10	50.0	42,654	4,265	1.4	20	3,139,221	156,961
Montana, North Dakota, South Dakota, and Texas (lignite)	4	6.8	262,177	65,544	9.1	6	10.2	111,249	18,542	3.9	42	71.2	161,739	3,851	5.6	59	2,873,653	48,706
New Mexico	1	4.2	82,395	82,395	5.7	5	20.8	100,074	20,015	6.9	14	58.3	50,553	3,611	3.5	24	1,443,210	60,134
Ohio	50	8.5	3,458,313	69,166	9.2	159	27.1	3,778,383	23,763	10.1	293	50.0	1,121,485	3,828	3.0	586	37,548,204	64,075
Oklahoma	5	7.1	420,233	84,047	12.3	17	24.3	454,231	26,719	13.3	36	51.4	146,169	4,060	4.3	70	3,420,563	48,865
Pennsylvania	226	10.4	16,029,361	70,926	10.9	782	36.0	18,081,422	23,122	12.3	859	39.6	3,970,176	4,622	2.7	2,171	147,079,296	67,747
Tennessee	7	5.3	512,178	73,168	8.2	34	26.0	754,154	22,181	12.0	63	48.1	255,667	4,058	4.1	131	6,258,483	47,775
Utah	2	4.5	173,354	86,677	2.3	14	31.8	331,096	23,650	4.5	12	27.3	44,296	3,691	.6	44	7,428,699	168,834
Virginia	20	7.5	1,482,886	74,144	7.3	128	47.9	2,647,139	20,681	13.1	75	28.1	318,714	4,250	1.6	267	20,170,799	75,546
Washington	2	5.1	144,493	72,247	12.9	17	43.6	388,313	22,842	34.7	17	43.6	74,619	4,389	6.7	39	1,117,926	28,665
West Virginia	166	13.5	11,940,160	71,929	6.8	388	31.6	9,968,739	25,693	5.7	233	19.0	1,145,213	4,915	.6	1,227	176,156,579	143,567
Wyoming	3	6.4	213,728	71,243	2.7	6	12.8	124,586	20,764	1.5	19	40.4	81,427	4,286	1.0	47	8,051,147	171,301
Total 1947	704	8.1	50,235,424	71,357	8.0	2,665	30.6	59,568,067	22,352	9.4	3,912	45.0	15,640,367	3,998	2.5	8,700	630,623,722	72,485

BITUMINOUS COAL AND LIGNITE LOADED FOR SHIPMENT BY INDIVIDUAL RAILROADS AND WATERWAYS

TABLE 21.—Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, as reported by mine operators, in net tons, in 1947 [1]

Route	State	Net tons: By State	Net tons: Total for route
RAILROADS			
Alabama Central	Alabama	145,371	145,371
Alabama Great Southern	do	105,050	105,050
Alaska	Alaska	322,306	322,306
Algiers, Winslow & Western	Indiana	2,718,938	2,718,938
Alton	Illinois	310,005	310,005
Artemus-Jellico	Kentucky	362,353	362,353
Atchison, Topeka & Santa Fe	Colorado	286,063	2,368,874
	Illinois	822,159	
	Kansas	331,400	
	New Mexico	929,252	
Baltimore & Ohio	Illinois	339,314	50,423,007
	Indiana	691,727	
	Maryland	141,495	
	Ohio	4,832,447	
	Pennsylvania	12,322,568	
	West Virginia	32,095,456	
Bessemer & Lake Erie	Pennsylvania	4,671,745	4,671,745
Bevier & Southern	Missouri	210,728	210,728
Brimstone	Tennessee	95,398	95,398
Buffalo Creek & Gauley	West Virginia	595,892	595,892
Cambria & Indiana	Pennsylvania	3,701,411	3,701,411
Campbell's Creek	West Virginia	935,154	935,154
Carbon County	Utah	1,735,807	1,735,807
Central of Georgia	Alabama	822,397	829,516
	Georgia	7,119	
Chesapeake & Ohio	Kentucky	15,704,427	73,652,365
	Ohio	1,636,614	
	West Virginia	56,311,324	
Cheswick & Harmar	Pennsylvania	995,089	995,089
Chicago, Burlington & Quincy	Colorado	114,598	14,906,913
	Illinois	12,222,111	
	Iowa	183,669	
	Missouri	314,934	
	Wyoming	2,071,601	
Chicago & Eastern Illinois	Illinois	1,240,826	3,103,685
	Indiana	1,862,859	
Chicago & Illinois Midland	Illinois	6,376,878	6,376,878
Chicago, Indianapolis & Louisville	Indiana	777,588	777,588
Chicago, Milwaukee, St. Paul & Pacific	do	5,737,714	6,699,582
	Iowa	125,982	
	Missouri	2,426	
	Montana (bituminous)	792,242	
	North Dakota (lignite)	40,798	
	South Dakota (lignite)	420	
Chicago & North Western	Illinois	2,979,546	2,979,546
Chicago, Rock Island & Pacific	Arkansas	70,170	1,525,177
	Illinois	685,243	
	Iowa	220,512	
	Missouri	210,173	
	Oklahoma	339,079	
Cleveland, Cincinnati, Chicago & St. Louis	Illinois	4,754,601	8,027,968
	Indiana	3,273,367	
Clinchfield	Kentucky	79,050	4,929,963
	Virginia	4,850,913	
Colorado & Southeastern	Colorado	105,806	105,806
Colorado & Southern	do	359,814	359,814
Colorado & Wyoming	do	611,840	611,840
Conemaugh & Black Lick	Pennsylvania	72,681	72,681
Cumberland & Pennsylvania	Maryland	444,674	444,674
Dardanelle & Russellville Ry. Co.	Arkansas	48,125	48,125
Denver & Intermountain	Colorado	100,085	100,085
Denver & Rio Grande Western	do	2,367,047	5,564,274
	New Mexico	18,730	
	Utah	3,178,497	
Detroit, Toledo & Ironton	Ohio	700	700
East Broad Top Railroad & Coal Co.	Pennsylvania	556,520	556,520

See footnotes at end of table.

TABLE 21.—Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, as reported by mine operators, in net tons, in 1947 [1]—Continued

Route	State	Net tons: By State	Net tons: Total for route
RAILROADS—continued			
Erie	Ohio	97,704	980,066
	Pennsylvania	882,362	
Evansville Suburban & Newburgh	Indiana	10,641	10,641
Fort Dodge, Des Moines & Southern	Iowa	39,821	39,821
Fort Smith & Van Buren	Oklahoma	77,815	77,815
Galesburg & Great Eastern	Illinois	656,089	656,089
Great Northern	Montana (bituminous)	38,693	688,608
	North Dakota (lignite)	514,520	
	Washington	135,395	
Gulf, Mobile & Ohio	Alabama	276,176	2,248,468
	Illinois	1,972,292	
Harriman & Northeastern	Tennessee	2,961	2,961
Huntingdon & Broad Top Mountain Railroad & Coal Co.	Pennsylvania	954,336	954,336
Illinois Central	Alabama	223,677	23,529,108
	Illinois	12,122,960	
	Indiana	329,561	
	Kentucky	10,852,910	
Illinois Terminal	Illinois	316,697	316,697
Interstate	Kentucky	194,650	2,738,924
	Virginia	2,544,274	
Iowa Southern Utilities Co.	Iowa	23,024	23,024
Johnstown & Stony Creek	Pennsylvania	341,441	341,441
Joplin-Pittsburg	Kansas	266,280	266,280
Kanawha Central	West Virginia	125,242	125,242
Kansas City Southern	Arkansas	86,430	1,298,103
	Missouri	976,761	
	Oklahoma	234,912	
Kansas, Oklahoma & Gulf	Oklahoma	11,533	11,533
Kelley's Creek & Northwestern	West Virginia	706,420	706,420
Kentucky & Tennessee	Kentucky	732,154	732,154
Lake Erie, Franklin & Clarion	Pennsylvania	358,529	358,529
Laramie, North Park & Western	Colorado	28,910	28,910
Ligonier Valley	Pennsylvania	163,755	163,755
Litchfield & Madison	Illinois	781,729	781,729
Louisville & Nashville	Alabama	3,870,347	40,206,272
	Illinois	139,026	
	Kentucky	34,939,464	
	Tennessee	1,026,574	
	Virginia	230,861	
Mary Lee	Alabama	752,756	752,756
Midland Valley	Arkansas	287,357	705,954
	Oklahoma	418,597	
Minneapolis & St. Louis	Illinois	2,044,776	2,069,819
	Iowa	25,043	
Minneapolis, St. Paul & Sault Ste. Marie	North Dakota (lignite)	620,106	620,106
Missouri-Illinois	Illinois	131,487	131,487
Missouri-Kansas-Texas	Kansas	286,589	749,336
	Missouri	320,210	
	Oklahoma	142,537	
Missouri Pacific	Arkansas	813,248	9,188,018
	Illinois	6,911,054	
	Kansas	763,027	
	Missouri	400,950	
	Oklahoma	299,739	
Monongahela	Pennsylvania	4,060,451	16,159,583
	West Virginia	12,099,132	
Montana, Wyoming & Southern	Montana (bituminous)	249,862	249,862
Montour	Pennsylvania	6,176,344	6,176,344
Nashville, Chattanooga & St. Louis	Alabama	2,753	794,700
	Tennessee	791,947	
New York Central (includes coal shipped over Kanawha & Michigan, Kelley's Creek, Toledo & Ohio Central, and Zanesville & Western).	Ohio	7,168,030	16,612,579
	Pennsylvania	7,113,434	
	West Virginia	2,331,115	
Nicholas, Fayette & Greenbrier	do	2,212,991	2,212,991
Norfolk & Western	Kentucky	7,208,845	51,550,988
	Virginia	10,718,931	
	West Virginia	33,623,212	
North East Oklahoma	Kansas	22,670	22,670
Northern Pacific	Montana (bituminous)	1,979,911	3,656,498
	North Dakota (lignite)	1,052,739	
	Washington	623,848	

See footnotes at end of table.

TABLE 21.—Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, as reported by mine operators, in net tons, in 1947 [1]—Continued

Route	State	Net tons: By State	Net tons: Total for route
RAILROADS—continued			
Oklahoma City-Ada-Atoka	Oklahoma	198,084	198,084
Oneida & Western	Tennessee	22,593	22,593
Pacific Coast	Washington	47,572	47,572
Pennsylvania (includes Pittsburgh, Cincinnati, Chicago & St. Louis).	Illinois	98,991	60,827,892
	Indiana	5,244,088	
	Ohio	8,525,091	
	Pennsylvania	45,900,640	
	West Virginia	1,059,082	
Peoria Terminal	Illinois	369,335	369,335
Pittsburg & Lake Erie	Pennsylvania	1,704,557	1,704,557
Pittsburg & Shawmut	do	3,161,844	3,161,844
Pittsburg, Shawmut & Northern	do	83,703	83,703
Pittsburgh, Chartiers & Youghiogheny	do	317,966	317,966
Pittsburgh & West Virginia	Ohio	497,859	1,881,087
	Pennsylvania	1,224,079	
	West Virginia	159,149	
Preston	do	76,897	76,897
Rio Grande Southern	Colorado	7,370	7,370
Rockdale, Sandow & Southern	Texas (lignite)	60,504	60,504
St. Louis & O'Fallon	Illinois	378,240	378,240
St. Louis-San Francisco	Alabama	2,459,093	5,876,980
	Arkansas	437,595	
	Kansas	816,752	
	Missouri	619,446	
	Oklahoma	1,544,094	
Southern	Alabama	3,228,294	10,464,888
	Illinois	130,202	
	Indiana	2,214,906	
	Kentucky	1,898,474	
	Tennessee	2,060,534	
	Virginia	932,478	
Southern Pacific	New Mexico	381,802	381,802
Springfield Terminal	Illinois	732,127	732,127
Tennessee	Tennessee	1,156,581	1,156,581
Tennessee Central	do	392,208	392,208
Tennessee Coal, Iron & Railroad Co	Alabama	3,472,602	3,472,602
Thomas & Sayreton	do	472,976	472,976
Union	Pennsylvania	256,433	256,433
Union Pacific	Colorado	778,341	6,535,132
	Utah	7,695	
	Washington	44,246	
	Wyoming	5,704,850	
Unity	Pennsylvania	682,186	682,186
Utah	Utah	2,067,745	2,067,745
Virginian	Virginia	146,325	15,199,487
	West Virginia	15,053,162	
Wabash	Illinois	2,577,784	3,168,680
	Iowa	176,186	
	Missouri	414,710	
West Virginia Northern	West Virginia	779,527	779,527
Western Allegheny	Pennsylvania	861,396	861,396
Western Maryland	Maryland	936,676	6,482,890
	Pennsylvania	531,098	
	West Virginia	5,015,116	
Wheeling & Lake Erie	Ohio	7,595,578	7,595,578
Winifrede	West Virginia	235,088	235,088
Woodward Iron Co	Alabama	978,330	978,330
Youngstown & Suburban	Ohio	39,907	39,907
Total, railroad shipments		527,281,632	527,281,632
WATERWAYS			
Allegheny River	Pennsylvania	930,636	930,636
Black Warrior River	Alabama	38,012	38,012
Emory River	Tennessee	134,050	134,050
Illinois River	Illinois	822,806	822,806
Kanawha River	West Virginia	2,209,315	2,209,315

See footnotes at end of table.

TABLE 21.—Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, as reported by mine operators, in net tons, in 1947 [1]—Continued

Route	State	Net tons	
		By State	Total for route
WATERWAYS—continued			
Monongahela River	Pennsylvania	23,215,118	24,717,214
	West Virginia	1,502,096	
Ohio River	Kentucky	322,835	877,610
	Ohio	193,150	
	West Virginia	361,625	
Tennessee River	Tennessee	52,496	52,496
Youghiogheny River	Pennsylvania	20,640	20,640
Total waterway shipments		29,802,779	29,802,779
Total loaded at mines for shipment by railroads and waterways.		557,084,411	557,084,411
Shipped by truck		55,859,262	55,859,262
Used at mine [2]		17,680,049	17,680,049
Total production, 1947		630,623,722	630,623,722

[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 the quantity of bituminous 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 the parent railroad system.

[2] Includes coal used by mine employees, taken by locomotive tenders at tipple, used at mine for power and heat, transported from mine to point of use by conveyor or tram, made into beehive coke at mine, and all other uses at mine.

METHODS OF RECOVERY

TABLE 22.—Bituminous coal and lignite mined by different methods in the United States, by States, in 1947

State	From underground workings							From strip pits		Grand total production (net tons)
	Mined by hand		Shot from 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	374,586	2.2	3,426,223	20.0	13,298,593	77.8	17,099,402	1,948,823	10.2	19,048,225
Alaska			294,758	100.0			294,758	66,462	18.4	361,220
Arizona			10,060	100.0			10,060			10,060
Arkansas	42,498	3.8	101,478	9.1	975,845	87.1	1,119,821	751,128	40.1	1,870,949
Colorado	1,098,878	18.0	154,350	2.5	4,857,603	79.5	6,110,831	247,273	3.9	6,358,104
Georgia			3,295	100.0			3,295	3,988	54.8	7,283
Illinois	167,099	.4	2,072,473	4.1	47,903,247	95.5	50,142,819	17,717,192	26.1	67,860,011
Indiana	62,411	.5	188,234	1.7	11,003,265	97.8	11,253,910	14,195,187	55.8	25,449,097
Iowa	54,063	5.7	424,617	45.1	463,779	49.2	942,459	741,596	44.0	1,684,055
Kansas	35,004	12.9	80,831	29.8	155,261	57.3	271,096	2,473,438	90.1	2,744,534
Kentucky	396,502	.5	16,317,339	22.2	56,955,158	77.3	73,668,999	10,571,683	12.5	84,240,682
Maryland	721,415	49.7			731,444	50.3	1,452,859	598,423	29.2	2,051,282
Michigan					14,013	100.0	14,013			14,013
Missouri	40,738	10.4	29,429	7.5	322,332	82.1	392,499	3,843,928	90.7	4,236,427
Montana (bituminous)			5,596	.5	1,116,396	99.5	1,121,992	2,017,229	64.3	3,139,221
Montana (lignite)			37,098	98.5	550	1.5	37,648	1,021	2.6	38,669
New Mexico	63,220	4.4	160,739	11.1	1,219,251	84.5	1,443,210			1,443,210
North Dakota (lignite)			27,872	5.9	444,318	94.1	472,190	2,287,672	82.9	2,759,862
Ohio	112,416	.6	51,610	.2	20,023,985	99.2	20,188,011	17,360,193	46.2	37,548,204
Oklahoma	10,685	1.0	58,105	5.2	1,045,649	93.8	1,114,439	2,306,124	67.4	3,420,563
Pennsylvania	9,954,769	9.0	3,407,913	3.1	96,641,469	87.9	110,004,151	37,075,145	25.2	147,079,296
South Dakota (lignite)			1,100	100.0			1,100	13,518	92.5	14,618
Tennessee	311,615	5.4	616,396	10.7	4,813,951	83.9	5,741,962	516,521	8.3	6,258,483
Texas (lignite)								60,504	100.0	60,504
Utah	6,565	.1	278,052	3.7	7,144,082	96.2	7,428,699			7,428,699
Virginia	53,914	.3	1,341,220	7.0	17,636,924	92.7	19,032,058	1,138,741	5.6	20,170,799
Washington	125,690	13.6	363,348	39.5	432,035	46.9	921,073	196,853	17.6	1,117,926
West Virginia	2,572,843	1.7	3,325,059	2.1	148,265,135	96.2	154,163,037	21,993,542	12.5	176,156,579
Wyoming	132,957	1.9	12,113	.2	6,637,250	97.9	6,782,320	1,268,827	15.8	8,051,147
Total 1947	16,337,868	3.3	32,789,308	6.7	442,101,535	90.0	491,228,711	139,395,011	22.1	630,623,722

TABLE 23.—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, in 1946 and 1947

State	1946			1947		
	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
Alabama	624	17, 593	76. 4	605	21, 981	77. 8
Arkansas	76	12, 533	89. 2	83	11, 757	87. 1
Colorado	517	9, 270	83. 2	495	9, 813	79. 5
Illinois	823	56, 157	95. 7	749	63, 956	95. 5
Indiana	216	44, 770	98. 0	213	51, 659	97. 8
Iowa	56	10, 281	49. 7	62	7, 480	49. 2
Kansas	19	6, 632	59. 8	20	7, 763	57. 3
Kentucky	1, 851	26, 987	84. 4	1, 859	30, 638	77. 3
Maryland	49	12, 641	42. 9	52	14, 066	50. 3
Michigan	19	4, 210	100. 0	3	4, 671	100. 0
Missouri	60	5, 659	86. 6	50	6, 447	82. 1
Montana (bituminous and lignite)	57	21, 401	99. 2	38	29, 393	96. 3
New Mexico	64	15, 958	79. 8	64	19, 051	84. 5
North Dakota (lignite)	7	56, 176	92. 1	10	44, 432	94. 1
Ohio	794	22, 658	99. 3	822	24, 360	99. 2
Oklahoma	85	10, 677	93. 1	75	13, 942	93. 8
Oregon	2	7, 945	92. 6	----	----	----
Pennsylvania	3, 404	24, 183	87. 7	3, 322	29, 091	87. 9
Tennessee	271	16, 882	84. 4	253	19, 027	83. 8
Utah	231	24, 797	95. 6	231	30, 927	96. 2
Virginia	380	36, 123	92. 3	438	40, 267	92. 7
Washington	57	7, 282	46. 5	53	8, 152	46. 9
West Virginia	3, 617	34, 039	95. 4	3, 999	37, 076	96. 2
Wyoming	346	18, 499	96. 4	369	17, 987	97. 9
Total	13, 625	28, 046	90. 8	13, 865	31, 886	90. 0

STRIPPING OPERATIONS

TABLE 24.—Stripping operations of all types in the bituminous-coal and lignite fields of the United States, by States and counties, in 1947 [1]

State and county	Number of strip pits	Number of power shovels and dragline excavators				Mined by stripping (net tons)	Average number of men working daily			Average number of days mines were active	Number of man-days worked	Average tons per man per day
		Steam	Electric	Diesel	Gasoline		In strip pits	All others	Total			
Alabama:												
Bibb and Blount	7	4		2	3	139,215	71	17	88	261	22,966	6.06
Jefferson	8			11	1	292,230	102	50	152	245	37,284	7.84
St. Clair	4			2	4	138,281	60	21	81	245	19,856	6.96
Tuscaloosa	7			11		386,232	100	33	133	252	33,468	11.54
Walker	20	1	3	32	2	992,865	319	121	440	198	87,250	11.38
Total Alabama	46	5	3	58	10	1,948,823	652	242	894	225	200,824	9.70
Alaska	2			2		66,462	25	12	37	168	6,202	10.72
Arkansas:												
Franklin	1	1			1	31,277	27	6	33	197	6,493	4.82
Johnson	4			6	1	244,973	57	27	84	194	16,326	15.01
Scott	1			1		86,430	22	8	30	185	5,550	15.57
Sebastian	11	5		15	8	388,448	236	70	306	157	48,120	8.07
Total Arkansas	17	6		22	10	751,128	342	111	453	169	76,489	9.82
Colorado:												
Fremont	2				1	7,223	8	2	10	52	515	14.03
Huerfano	1					1,051	3		3	40	120	8.76
Jackson	2				2	42,755	16	3	19	235	4,470	9.56
Routt	2		1	2	1	196,244	28	45	73	172	12,534	15.66
Total Colorado	7		1	2	4	247,273	55	50	105	168	17,639	14.02
Georgia: Walker	1			1		3,988	8	4	12	53	636	6.27
Illinois:												
Bureau	2		4	2		683,371	54	117	171	285	48,788	14.01
Fulton	9		23	5	2	6,795,762	536	588	1,124	277	311,202	21.84
Grundy	3		16	2	3	1,676,989	254	267	521	301	157,074	10.68
Hancock	1			1	1	17,358	11	5	16	114	1,831	9.48
Jackson	1		3			449,356	61	44	105	262	27,523	16.33
Knox, LaSalle and Saline	6		9	7		1,377,607	230	213	443	227	100,490	13.71
Livingston	1				1	6,453	3		3	162	486	13.28
Perry	3		12	2	1	2,657,818	249	382	631	257	161,914	16.41
Randolph	1		2	1		1,061,714	63	68	131	299	39,124	27.14
St. Clair	3		5	3	3	1,147,172	105	84	189	280	52,913	21.68
Schuyler	1			2		107,900	20	23	43	144	6,190	17.43

See footnote at end of table.

TABLE 24.—Stripping operations of all types in the bituminous-coal and lignite fields of the United States, by States and counties, in 1947 [1]—Continued

State and county	Number of strip pits	Number of power shovels and dragline excavators				Mined by stripping (net tons)	Average number of men working daily			Average number of days mines were active	Number of man-days worked	Average tons per man per day
		Steam	Electric	Diesel	Gasoline		In strip pits	All others	Total			
Illinois—Continued												
Vermilion	2	1	-------	2	1	89,312	24	7	31	222	6,895	12.95
Will	1	-------	2	1	-------	242,833	27	24	51	248	12,648	19.20
Williamson	9	-------	2	15	2	1,403,547	229	118	347	196	68,164	20.59
Total Illinois	43	1	78	43	14	17,717,192	1,866	1,940	3,806	261	995,242	17.80
Indiana:												
Clay	12	1	9	18	14	2,070,049	381	216	597	237	141,753	14.60
Daviess and Knox	3	-------	4	2	2	788,892	108	110	218	218	47,476	16.62
Fountain	1	-------	-------	1	1	78,215	26	5	31	293	9,083	8.61
Greene	3	1	3	2	2	778,048	85	56	141	235	33,110	23.50
Owen	1	-------	-------	-------	2	8,741	5	1	6	162	970	9.01
Parke	1	-------	-------	3	1	51,580	22	5	27	241	6,519	7.91
Pike	7	1	15	8	2	4,044,615	530	388	918	255	234,233	17.27
Spencer	2	-------	-------	2	2	188,636	44	26	70	209	14,607	12.91
Sullivan	6	-------	11	5	1	1,963,078	289	244	533	245	130,520	15.04
Vermillion and Vigo	5	-------	6	2	2	978,177	194	88	282	192	54,132	18.07
Warrick	6	-------	12	16	3	3,245,156	400	312	712	250	177,990	18.23
Total Indiana	47	3	60	59	32	14,195,187	2,084	1,451	3,535	241	850,393	16.69
Iowa:												
Mahaska	9	-------	1	9	9	305,406	98	42	140	278	38,882	7.85
Marion	12	-------	1	4	10	342,345	75	31	106	235	24,960	13.72
Monroe	2	-------	-------	-------	-------	9,784	10	-------	10	191	1,914	5.11
Van Buren	3	-------	-------	1	3	24,351	16	5	21	171	3,584	6.79
Wapello	3	-------	-------	4	3	59,710	20	14	34	162	5,520	10.82
Total Iowa	29	-------	2	18	25	741,596	219	92	311	241	74,860	9.91
Kansas:												
Bourbon	5	1	2	-------	1	195,405	43	23	66	210	13,876	14.08
Cherokee	10	2	4	2	5	868,068	136	84	220	242	53,206	16.32
Coffey	1	-------	-------	-------	-------	1,150	5	2	7	59	415	2.77
Crawford	9	5	15	-------	4	1,390,514	243	180	423	255	107,716	12.91
Labette	2	-------	-------	-------	1	6,364	7	3	10	200	2,004	3.18
Linn	1	-------	-------	1	1	5,021	7	2	9	179	1,611	3.12
Osage	3	-------	-------	-------	2	6,916	13	3	16	125	2,005	3.45
Total Kansas	31	8	21	3	14	2,473,438	454	297	751	241	180,833	13.68

Kentucky:												
Boyd	5			10	1	450,804	99	25	124	217	26,919	16.75
Butler	3			3		88,500	25	9	34	240	8,155	10.85
Carter	1			3		111,295	49	13	62	179	11,114	10.01
Clay	1			1		7,775	11	3	14	85	1,190	6.53
Daviess	1				3	50,000	35	10	45	104	4,700	10.64
Elliott	1	1				2,100	4	1	5	200	1,000	2.10
Hancock	1			4		171,443	27	10	37	265	9,788	17.52
Hopkins	26	1	13	48	5	6,055,577	737	513	1,250	206	257,587	23.51
Knott	1					3,200	8	2	10	34	340	9.41
Knox	2			4		43,360	23	11	34	256	8,720	4.97
Laurel	4	1		8		259,460	78	26	104	245	25,478	10.18
Leslie	1			1		6,235	16	9	25	25	625	9.98
Letcher	9			20		679,114	185	46	231	220	50,910	13.34
Magoffin	1			1		1,115	5	1	6	20	120	9.29
McCreary	1			1		10,080	4	2	6	223	1,338	7.53
Muhlenberg	8	2	4	15	4	1,481,381	299	87	386	189	73,075	20.27
Ohio	11		2	19	2	664,181	209	112	321	125	40,049	16.58
Perry	1		1	2		206,705	40	5	45	258	11,630	17.77
Pike	3			3		66,518	21	13	34	123	4,167	15.96
Pulaski	2			2		7,400	7	3	10	122	1,220	6.07
Rockcastle	1			2		7,000	4	2	6	140	840	8.33
Webster	1			2	1	150,190	22	6	28	213	5,964	25.18
Whitley	4	2		1		48,250	30	12	42	158	6,635	7.27
Total Kentucky	89	7	20	150	16	10,571,683	1,938	921	2,859	193	551,564	19.17
Maryland:												
Allegany	17			10	13	274,019	181	61	242	113	27,290	10.04
Garrett	15	1		10	9	324,404	178	56	234	123	28,883	11.23
Total Maryland	32	1		20	22	598,423	359	117	476	118	56,173	10.65
Missouri:												
Barton	5		3	4	3	463,688	123	58	181	176	31,946	14.51
Bates	3		4		2	989,011	70	98	168	271	45,550	21.71
Boone	2			2		58,414	15	1	16	257	4,107	14.22
Callaway	3			4	3	165,888	52	21	73	236	17,201	9.64
Dade	3				1	8,078	6	3	9	277	2,490	3.24
Henry	6		8	3	1	727,256	113	55	168	230	38,636	18.82
Jasper	1	1				5,504	3	1	4	310	1,240	4.44
Macon	2		5			541,647	45	79	124	293	36,353	14.90
Monroe	2	1			1	7,219	11	3	14	220	3,076	2.35
Randolph	1		2			413,254	29	56	85	269	22,895	18.05
St. Clair	1			1		24,597	10	5	15	270	4,050	6.07
Vernon	6	3	5	1	1	439,372	78	38	116	240	27,858	15.77
Total Missouri	35	5	27	15	12	3,843,928	555	418	973	242	235,402	16.33

See footnote at end of table.

TABLE 24.—Stripping operations of all types in the bituminous-coal and lignite fields of the United States, by States and counties, in 1947 [1]—Continued

State and county	Number of strip pits	Number of power shovels and dragline excavators				Mined by stripping (net tons)	Average number of men working daily			Average number of days mines were active	Number of man-days worked	Average tons per man per day
		Steam	Electric	Diesel	Gasoline		In strip pits	All others	Total			
Montana:												
Bituminous coal:												
Carbon	1		1	1		35,044	17	7	24	131	3,142	11.15
Rosebud	1		6	1		1,982,185	73	17	90	278	25,011	79.25
Total bituminous coal	2		7	2		2,017,229	90	24	114	247	28,153	71.65
Lignite	1					1,021	2		2	121	242	4.22
Total Montana	3		7	2		2,018,250	92	24	116	245	28,395	71.08
North Dakota: Lignite	30	2	15	10	19	2,287,672	279	197	476	249	118,536	19.30
Ohio:												
Athens	7			14	5	534,762	122	64	186	200	37,233	14.36
Belmont	18		2	24	8	1,590,173	232	130	362	233	84,198	18.89
Carroll	5			10	4	202,307	74	23	97	192	18,633	10.86
Columbiana	17			29	5	699,376	169	49	218	231	50,460	13.86
Coshocton	10			13	8	307,702	91	32	123	209	25,746	11.95
Gallia	1					1,344	3		3	67	201	6.69
Guernsey	4			7	1	219,375	73	20	93	173	16,122	13.61
Harrison	18		16	31	5	5,095,837	762	363	1,125	239	269,305	18.92
Hocking	6			9	3	160,368	72	31	103	123	12,677	12.65
Holmes	1			4		43,568	16	14	30	151	4,530	9.62
Jackson	12			5	3	103,165	53	15	68	186	12,671	8.14
Jefferson	28	2	5	43	10	2,757,813	498	230	728	208	151,764	18.17
Lawrence	2	1		2		24,583	7	2	9	169	1,518	16.19
Mahoning	6			9		176,533	48	8	56	198	11,089	15.92
Meigs	2			1	2	51,971	13	5	18	231	4,166	12.48
Morgan	4			2	2	37,719	32	14	46	67	3,088	12.21
Muskingum	8	1	2	5	7	1,153,881	131	43	174	222	38,566	29.92
Noble	7		2	13		717,537	118	80	198	139	27,607	25.99
Perry	21		3	35	11	1,527,657	323	242	565	200	113,214	13.49
Portage	1			2		94,131	18	6	24	316	7,584	12.41
Stark	7			11	11	386,398	96	28	124	256	31,734	12.18
Tuscarawas	16	2		17	19	1,030,273	198	96	294	283	83,327	12.36
Vinton	10			9	5	354,564	114	59	173	236	40,893	8.67
Wayne	1			2		89,156	17	4	21	289	6,069	14.69
Total Ohio	212	6	30	297	109	17,360,193	3,280	1,558	4,838	218	1,052,395	16.50

Oklahoma:												
Coal	4		1	4		208,140	44	30	74	273	20,231	10.29
Craig	2			2		7,839	9	5	14	129	1,802	4.35
Haskell	1	1		1		86,128	22	2	24	264	6,342	13.58
Latimer	1		2			314,163	30	28	58	280	16,242	19.34
Le Flore	4			4	5	312,626	86	47	133	170	22,605	13.83
Muskogee	2	3		1		203,930	53	15	68	321	21,844	9.34
Okmulgee and Tulsa	4		3	2	1	473,448	121	86	207	195	40,366	11.73
Rogers	4	5	3	1	2	610,044	124	69	193	287	55,305	11.03
Wagoner	2		1			89,806	39	36	75	76	5,709	15.73
Total Oklahoma	24	9	10	15	8	2,306,124	528	318	846	225	190,446	12.11
Pennsylvania:												
Allegheny	65			109	25	4,992,337	980	389	1,369	202	276,497	18.06
Armstrong	23		1	45	4	1,667,681	472	157	629	221	138,944	12.00
Beaver	12			18	3	401,331	116	32	148	218	32,242	12.45
Bedford	6			11	8	497,093	160	42	202	248	50,172	9.91
Blair	1			2		93,263	12	4	16	240	3,840	24.29
Bradford	1				1	5,255	5	1	6	97	582	9.03
Butler	27	3		37	16	1,731,136	406	124	530	215	113,911	15.20
Cambria	47			61	5	1,938,862	595	193	788	154	121,644	15.94
Centre	15	1		19	10	702,624	220	67	287	208	59,675	11.77
Clarion	31			56	8	2,546,938	614	218	832	231	192,207	13.25
Clearfield	120	6		165	32	5,047,948	1,803	498	2,301	192	442,325	11.41
Clinton	7	1		7	2	462,682	125	30	155	219	33,943	13.63
Elk	16			21	1	583,090	256	49	305	159	48,497	12.02
Fayette	71	3	2	61	20	1,812,219	745	190	935	131	122,705	14.77
Fulton	1			4		130,529	19	7	26	234	6,084	21.45
Greene	10			18	3	546,166	141	40	181	217	39,296	13.90
Huntingdon	6			11	6	292,659	116	23	139	240	33,353	8.77
Indiana	48		2	61	6	1,853,676	607	187	794	164	130,369	14.22
Jefferson	39	2	1	49	5	1,441,040	451	117	568	187	106,034	13.59
Lawrence	6			6	4	151,467	41	14	55	211	11,584	13.08
Lycoming	1			1	1	6,672	5	1	6	133	795	8.39
McKean	1					1,404	4		4	100	400	3.51
Mercer	6			10		299,400	83	28	111	215	23,850	12.55
Somerset	50		3	59	14	1,982,976	628	196	824	171	140,876	14.08
Tioga	3			3	1	35,650	21	6	27	118	3,182	11.20
Venango	3			7	3	217,079	36	10	46	290	13,322	16.29
Washington	43	6	2	83	13	5,700,465	1,118	462	1,580	193	304,357	18.73
Westmoreland	81	2		65	35	1,933,503	733	186	919	139	128,010	15.10
Total Pennsylvania	740	24	11	989	226	37,075,145	10,512	3,271	13,783	187	2,578,696	14.38
South Dakota: Lignite	3			1	2	13,518	11	1	12	194	2,331	5.80
Tennessee:												
Anderson	1				1	3,650	2	1	3	170	510	7.16
Bledsoe	1			3		35,991	17	3	20	175	3,500	10.28
Campbell	1		2			162,336	32	23	55	231	12,683	12.80
Grundy	1		1	2		80,838	29	4	33	232	7,656	10.56

See footnote at end of table.

TABLE 24.—Stripping operations of all types in the bituminous-coal and lignite fields of the United States, by States and counties, in 1947 [1]—Continued

State and county	Number of strip pits	Number of power shovels and dragline excavators				Mined by stripping (net tons)	Average number of men working daily			Average number of days mines were active	Number of man-days worked	Average tons per man per day
		Steam	Electric	Diesel	Gasoline		In strip pits	All others	Total			
Tennessee—Continued												
Hamilton	1			3		153,709	39	16	55	279	15,362	10.01
Morgan and Scott	3			5		79,997	25	13	38	168	6,388	12.52
Total Tennessee	8		3	13	1	516,521	144	60	204	226	46,099	11.20
Texas: Lignite	1	1			1	60,504	15		15	240	3,600	16.81
Virginia:												
Buchanan and Tazewell	5			14	1	437,391	146	29	175	156	27,233	16.06
Dickenson and Russell	3		8	7	1	422,021	105	36	141	176	24,814	17.01
Wise	7			4	3	279,329	75	19	94	191	17,931	15.58
Total Virginia	15		8	25	5	1,138,741	326	84	410	171	69,978	16.27
Washington:												
King	4			2	3	115,466	44	20	64	184	11,747	9.83
Kittitas	2		2	1	1	60,589	33	8	41	214	8,758	6.92
Thurston	2				3	20,798	20	4	24	152	3,645	5.71
Total Washington	8		2	3	7	196,853	97	32	129	187	24,150	8.15
West Virginia:												
Barbour	21			35	3	1,736,346	491	317	808	141	114,172	15.21
Boone	3			4	2	54,739	37	8	45	117	5,253	10.42
Braxton	2			1		53,977	24	11	35	90	3,152	17.12
Brooke	13			19	1	1,033,933	271	86	357	174	62,144	16.64
Fayette	22			45	5	2,268,569	566	157	723	204	147,150	15.42
Gilmer	2			3		50,007	35	14	49	86	4,190	11.93
Grant	2			3		46,575	67	9	76	55	4,201	11.09
Greenbrier	11	1		14	8	788,140	233	49	282	192	54,084	14.57
Hancock	3			4	2	116,164	38	11	49	182	8,898	13.06
Harrison	88			192	7	8,520,920	1,676	727	2,403	173	415,261	20.52
Kanawha	9			7	2	93,525	69	19	88	81	7,104	13.17
Lewis	2			4		217,644	44	7	51	280	14,280	15.24
Logan	3			6		145,904	58	12	70	143	9,999	14.59
Marion	15			11		301,035	141	53	194	100	19,321	15.58
Marshall	1	1				32,607	16	5	21	65	1,365	23.89
McDowell	4			4		62,987	42	12	54	85	4,578	13.76
Mineral	6			2	4	81,831	53	12	65	82	5,342	15.32
Mingo	8			21		935,488	223	95	318	207	65,785	14.22

Monongalia	13			24	1	1,096,731	253	71	324	211	68,356	16.04
Nicholas	15			15	1	454,716	170	53	223	162	36,171	12.57
Pocahontas	1			1		13,953	6	3	9	120	1,080	12.92
Preston	13	2		14	1	611,907	163	145	308	188	57,815	10.58
Putnam	1			2		38,372	14	6	20	109	2,180	17.60
Raleigh	14			19	2	530,664	251	54	305	126	38,327	13.85
Randolph	14			21	5	651,614	218	96	314	135	42,513	15.33
Taylor	19			28	1	979,256	238	81	319	155	49,425	19.81
Tucker	5		1	12	6	686,276	185	54	239	180	43,051	15.94
Upshur	5			8	2	300,471	95	36	131	135	17,656	17.02
Webster	3			3		64,513	44	11	55	73	4,035	15.99
Wyoming	2			2		24,678	24	11	35	55	1,940	12.72
Total West Virginia	320	4	1	524	53	21,993,542	5,745	2,225	7,970	164	1,308,828	16.80
Wyoming:												
Campbell and Converse	3		2	1		219,654	20	33	53	285	15,083	14.56
Carbon	3	1		3	1	497,744	65	37	102	235	23,946	20.79
Sheridan	1			3		551,429	112	60	172	244	41,893	13.16
Total Wyoming	7	1	2	7	1	1,268,827	197	130	327	247	80,922	15.68
Total United States 1947	1,750	83	301	2,279	591	139,395,011	29,783	13,555	43,338	202	8,750,633	15.93

[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 25.—Summary of underground bituminous-coal and lignite mines where shot holes were power-drilled in the United States, by States, in 1947

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	Electric drills	Compressed air drills	Total	
Alabama	73	746	111	12,985,848	248,021	13,233,869	14,868,354
Alaska	2	12	12	122,959	171,799	294,758	294,758
Arkansas	18	20	34	150,274	91,991	242,265	891,760
Colorado	91	443	57	4,038,003	25,103	4,063,106	5,439,632
Illinois	152	1,178	11	47,449,154		47,449,154	47,917,012
Indiana	31	257	1	10,653,129		10,653,129	10,666,060
Iowa	13	34	2	221,180	22,506	243,686	284,425
Kansas	1	1		17,371		17,371	17,371
Kentucky	962	2,710	110	59,294,691	9,000	59,303,691	64,468,949
Maryland	5	38	5	452,250		452,250	685,782
Michigan	1	2		14,013		14,013	14,013
Missouri	8	9	2	160,985		160,985	180,680
Montana:							
Bituminous	11	42	3	1,060,961		1,060,961	1,060,961
Lignite	5	13		24,162		24,162	32,484
New Mexico	6	38	6	1,163,562		1,163,562	1,163,562
North and South Dakota (lignite)	8	16		443,035		443,035	450,768
Ohio	83	505	3	15,637,750		15,637,750	16,743,163
Oklahoma	6	39		664,642		664,642	697,066
Pennsylvania	308	2,264	524	65,479,089	858,805	66,337,894	88,134,977
Tennessee	33	212	33	3,768,478	12,150	3,780,628	4,368,299
Utah	39	270	16	7,396,498		7,396,498	7,402,680
Virginia	181	373	57	10,787,980	297,613	11,085,593	14,352,259
Washington	22	78	153	243,863	600,060	843,923	848,626
West Virginia	475	3,168	308	100,130,823	415,860	100,546,683	127,677,577
Wyoming	28	472	1	6,752,315		6,752,315	6,752,315
Total 1947	2,562	12,940	1,449	349,113,015	2,752,908	351,865,923	415,413,533

MINING METHODS

Figure 10 shows the percentage of total production of bituminous coal and lignite, by methods of mining and underground loading in the United States, 1938–47. Data are based on total production of mines and are not comparable with the percentage of underground production mechanically loaded, as given in table 13.

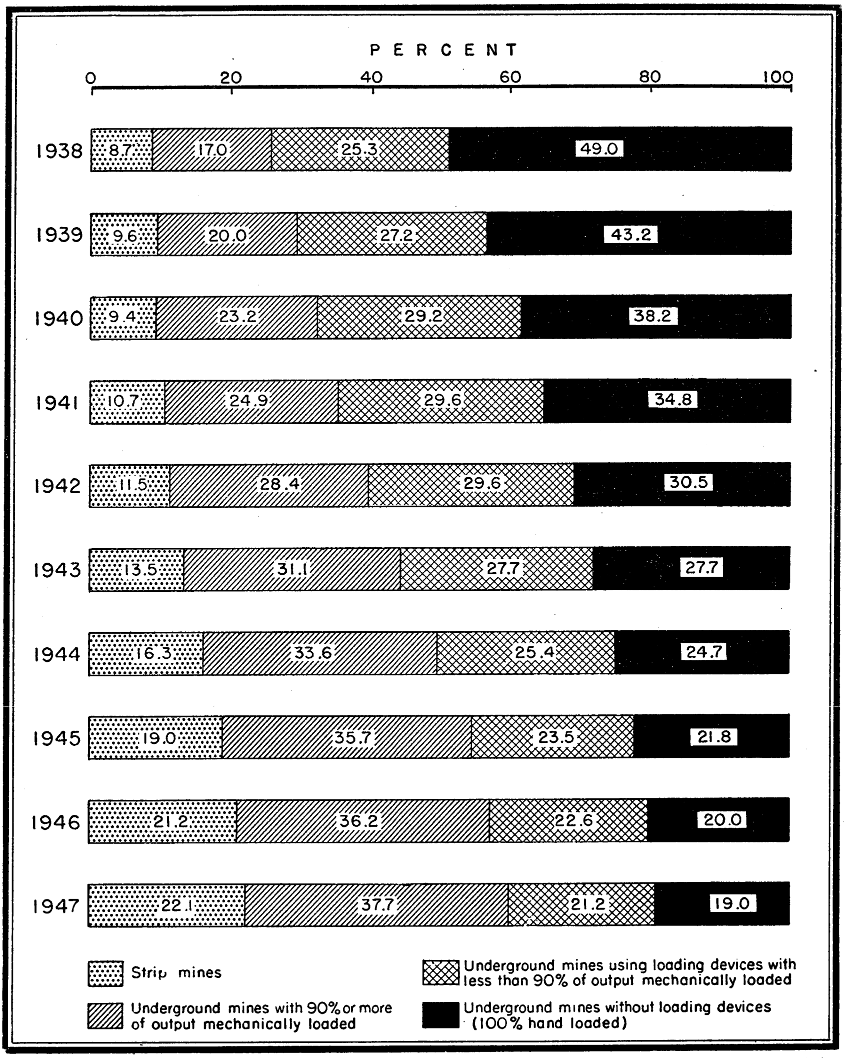

FIGURE 10.—Percentage of bituminous coal and lignite produced in the United States, by methods of mining and underground loading, 1938–47

MECHANICAL LOADING

Bituminous coal and lignite mechanically loaded in underground mines amounted to 298,157,281 tons in 1947, or 61 percent of the total underground output.

Mechanical loading equipment used in underground bituminous-coal and lignite mines is divided into two types: Devices that virtually eliminate hand shoveling (known as mobile loaders, scrapers, and self-loading conveyors) 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 1948.—The estimated capacity of mechanical loading equipment sold for underground use in all coal mines was 55 percent greater in 1948 than in 1947. Table 26 shows the sales reported to bituminous-coal and lignite operators, by type of equipment, and the number of manufacturers reporting for 1941–48.

Sales of conveyors to bituminous-coal and lignite mines in 1948 totaled 1,025 units. The figures for 1942–48 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 various States in 1948 and the number of units in actual use in 1947 are shown in table 28.

Statistics on Mechanical Loading in Bituminous-Coal and Lignite Mines.—More than three-fourths of the underground, mechanically loaded tonnage was handled by mobile loaders in 1947. Table 29 shows the tonnage and percentage handled by each type of equipment in 1946 and 1947.

During 1947, in underground bituminous-coal and lignite mines, 3,569 mobile loaders handled 229,836,006 tons, an average of 64,398 tons per mobile loader per year; self-loading conveyors averaged 14,318; scrapers, 12,748; hand-loaded face conveyors, 11,358; and pit-car loaders, 4,966 per year per unit for the same period.

Mechanical Loading by States.—West Virginia has been the leading producer of mechanically loaded coal since 1939. During 1947 West Virginia produced 99,749,277 tons of mechanically loaded coal, followed by Pennsylvania with 55,387,355, Illinois with 44,402,843, Kentucky with 30,325,756, and Ohio with 14,469,873. These five States produced 82 percent of the total output of underground, mechanically loaded bituminous coal in the United States in 1947.

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 30. Comparative changes in underground mechanical loading in 1946–47, by States, are shown in table 31.

Table 32 shows bituminous-coal and lignite tonnage mined by stripping compared with underground hand-loaded and machine-loaded tonnage, as well as productivity at strip and underground mines, by States, for 1947.

TABLE 26.—Units of mechanical loading equipment sold to bituminous-coal and lignite mines for underground use in the United States, as reported by manufacturers, 1941–48

	1941	1942	1943	1944	1945	1946	1947	1948	Change 1948 from 1947 (percent)
Type of equipment:									
Mobile loaders	367	352	234	282	349	490	485	723	+49.1
Scrapers [1]	8	15	13	20	6	3	12	17	+41.7
Conveyors [2]	1,800	1,167	798	580	738	838	846	1,025	+21.2
Pit-car loaders	10	2	1	--------	(3)	(3)	(3)	(3)	--------
Total, all types	2,185	1,536	1,046	882	1,093	1,331	1,343	1,765	+31.4
Number of manufacturers reporting	32	28	24	22	25	24	23	22	--------

[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 conveyors were counted for 1941, but the figures for 1942–48, inclusive, do not include loading heads separately.
[3] Canvass of sales of pit-car loaders discontinued in 1945.

TABLE 27.—Units of mechanical loading equipment in use in underground bituminous-coal and lignite mines in the United States, 1942–47

Type of equipment	1942	1943	1944	1945	1946	1947	Change 1947 from 1946 (percent)
Mobile loaders	2,301	2,525	2,737	2,950	3,200	3,569	+11.5
Scrapers	93	83	87	87	75	67	−10.7
Pit-car loaders	481	321	241	142	93	71	−23.7
Conveyors equipped with duckbills or other self-loading heads	1,062	1,226	1,331	1,383	1,521	1,531	+.7
Hand-loaded conveyors	3,041	3,191	3,236	3,385	3,470	3,979	+14.7
Total all types	6,978	7,346	7,632	7,947	8,359	9,217	+10.3

TABLE 28.—Comparison of mechanical loading equipment and "mother" conveyors in actual use in bituminous-coal and lignite mines in the United States in 1947 with sales reported in 1948, by States

State	Mechanical loading equipment						"Mother" conveyors [2]
	Mobile loaders		Scrapers		Conveyors [1]		
	In use in 1947	Sales in 1948	In use in 1947	Sales in 1948	In use in 1947	Sales in 1948	Sales in 1948
Alabama	135	8	31		358	66	6
Arizona							1
Arkansas		1			73	18	
Colorado	28	4	1		307	8	
Idaho						4	
Illinois	554	44			27	6	14
Indiana	142	14				2	
Iowa	5				12		
Kentucky	351	124	1	1	709	145	41
Maryland	3				35	1	
Michigan					1		
Montana	41				8	1	
New Mexico	18	3	6		1		
North Carolina				1		2	
North Dakota	7						
Ohio	179	36			178	44	5
Oklahoma	4				83	18	5
Pennsylvania	800	169	14	2	1,024	215	25
Tennessee	15	19			171	20	3
Utah	87	15			132	6	
Virginia	98	20			188	35	4
Washington	1		6	2	97		
West Virginia	1,071	265		8	1,797	425	124
Wyoming	30	1	8	3	309	9	2
Total	3,569	723	67	17	5,510	1,025	230

[1] Includes hand-loaded conveyors and conveyors equipped with duckbills or other self-loading heads.
[2] Includes all haulage conveyors with capacity over 500 feet except main slope conveyors. Data on number in use in 1947 are not available.

TABLE 29.—Bituminous coal and lignite mechanically loaded underground in the United States, by types of loading equipment, 1946–47

Type of equipment	1946		1947	
	Net tons	Percent of total	Net tons	Percent of total
Mobile loaders:				
Loading direct into mine cars	132,662,797	54.1	155,352,706	52.1
Loading onto conveyors	8,379,074	3.4	10,025,273	3.4
Loading into rubber-tired trucks	45,932,942	18.7	64,458,027	21.6
Scrapers	916,759	.4	854,113	.3
Pit-car loaders	622,363	.3	352,573	.1
Conveyors equipped with duckbills or other self-loading heads	19,678,478	8.0	21,921,484	7.3
Hand-loaded conveyors	37,148,355	15.1	45,193,105	15.2
Grand total loaded mechanically	245,340,768	100.0	298,157,281	100.0

TABLE 30.—Mechanical loading underground in bituminous-coal and lignite mines in the United States, by States, in 1947

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 (number of units)	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	20	17	14	51	135	31	35	------	323	7,282,480	3,306,910	10,589,390	4,885,663	2,986,866	5,751,818	13,624,347
Arkansas	--------	19	--------	19	--------	-------	--------	------	73	-----------	895,347	895,347	-----------	948,318	-----------	948,318
Colorado	41	18	4	63	28	1	214	1	93	3,274,355	402,370	3,676,725	3,969,480	385,177	296,118	4,650,775
Illinois	75	1	6	82	554	-------	27	70	-------	44,059,377	343,466	44,402,843	41,327,560	117,594	3,573,130	45,018,284
Indiana	17	--------	--------	17	142	-------	--------	------	-------	10,246,786	-----------	10,246,786	10,246,786	-----------	-----------	10,246,786
Iowa	3	--------	1	4	5	-------	11	------	1	222,843	3,522	226,365	225,225	-----------	7,522	232,747
Kentucky	116	42	24	182	351	1	216	------	493	25,168,853	5,156,903	30,325,756	28,434,652	5,288,691	8,612,689	42,336,032
Maryland	--------	4	1	5	3	-------	3	------	32	192,666	255,611	448,277	-----------	386,971	275,498	662,469
Michigan	--------	1	--------	1	--------	-------	--------	------	1	-----------	2,803	2,803	-----------	14,013	-----------	14,013
Montana (bituminous and lignite)	9	1	--------	10	41	-------	6	------	2	1,046,095	10,000	1,056,095	1,046,095	47,500	-----------	1,093,595
New Mexico	5	--------	--------	5	18	6	1	------	-------	1,067,882	-----------	1,067,882	1,213,832	-----------	-----------	1,213,832
North Dakota (lignite)	2	--------	--------	2	7	-------	--------	------	-------	423,887	-----------	423,887	432,507	-----------	-----------	432,507
Ohio	35	8	2	45	179	-------	154	------	24	14,265,963	203,910	14,469,873	15,253,806	194,270	285,102	15,733,178
Oklahoma	--------	8	1	9	4	-------	--------	------	83	130,000	602,686	732,686	-----------	602,777	172,448	775,225
Pennsylvania	108	80	36	224	800	14	82	------	942	47,453,321	7,934,034	55,387,355	55,678,713	9,309,923	10,576,806	75,565,442
Tennessee	9	10	10	29	15	-------	42	------	129	1,210,494	1,638,992	2,849,486	1,235,647	1,678,400	1,184,405	4,098,452
Utah	22	4	3	29	87	-------	118	------	14	6,966,048	93,137	7,059,185	6,848,939	84,875	367,698	7,301,512
Virginia	21	11	10	42	98	-------	51	------	137	5,599,650	1,746,345	7,345,995	6,308,153	1,878,835	4,190,635	12,377,623
Washington	5	2	2	9	1	6	8	------	89	101,777	421,303	523,080	48,629	46,644	449,481	544,754
West Virginia	199	108	105	412	1,071	-------	290	------	1,507	77,530,206	22,219,071	99,749,277	74,777,760	19,401,457	33,675,373	127,854,590
Wyoming	20	1	2	23	30	8	273	------	36	6,368,920	309,268	6,678,188	6,268,832	108,522	317,902	6,695,256
Total: 1947	707	335	221	1,263	3,569	67	1,531	71	3,979	252,611,603	45,545,678	298,157,281	258,202,279	43,480,833	69,736,625	371,419,737
1946	654	313	195	1,162	3,200	75	1,521	93	3,470	207,570,050	37,770,718	245,340,768	221,173,263	38,769,218	54,025,233	313,967,714
Percent change, 1947 from 1946	+8.1	+7.0	+13.3	+8.7	+11.5	−10.7	+0.7	−23.7	+14.7	+21.7	+20.6	+21.5	+16.7	+12.2	+29.1	+18.3

[1] Includes mobile loaders, scrapers, and conveyors equipped with duckbills or other self-loading heads; some mines in this class 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.

TABLE 31.—Comparative changes in underground mechanical loading of bituminous coal and lignite by principal types of loading devices in the United States, by States, 1946–47

State	Net tons						Handled by each class (percent)				Underground output mechanically loaded (percent)	
	1946			1947			1946		1947			
	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]	1946	1947
Alabama	5,255,066	2,885,063	8,140,129	7,282,480	3,306,910	10,589,390	64.6	35.4	68.8	31.2	56.7	61.9
Arkansas	----------	715,818	715,818	----------	895,347	895,347	----------	100.0	----------	100.0	67.0	80.0
Colorado	2,990,267	398,002	3,388,269	3,274,355	402,370	3,676,725	88.3	11.7	89.1	10.9	58.8	60.2
Illinois	41,875,095	477,959	42,353,054	44,059,377	343,466	44,402,843	98.9	1.1	99.2	.8	87.7	88.6
Indiana	8,889,172	25,000	8,914,172	10,246,786	----------	10,246,786	99.7	.3	100.0	----------	90.3	91.1
Iowa	253,809	1,850	255,659	222,843	3,522	226,365	99.3	.7	98.4	1.6	22.1	24.0
Kentucky	20,086,034	4,283,432	24,369,466	25,168,853	5,156,903	30,325,756	82.4	17.6	83.0	17.0	41.2	41.2
Maryland	27,703	283,643	311,346	192,666	255,611	448,277	8.9	91.1	43.0	57.0	21.5	30.9
Michigan	----------	34,411	34,411	----------	2,803	2,803	----------	100.0	----------	100.0	43.0	20.0
Montana (bituminous and lignite)	1,142,015	15,244	1,157,259	1,046,095	10,000	1,056,095	98.7	1.3	99.1	.9	91.2	91.1
New Mexico	809,933	----------	809,933	1,067,882	----------	1,067,882	100.0	----------	100.0	----------	63.3	74.0
North Dakota (lignite)	354,379	----------	354,379	423,887	----------	423,887	100.0	----------	100.0	----------	83.0	89.8
Ohio	12,356,640	221,585	12,578,225	14,265,963	203,910	14,469,873	98.2	1.8	98.6	1.4	69.5	71.7
Oklahoma	130,000	440,602	570,602	130,000	602,686	732,686	22.8	77.2	17.7	82.3	58.5	65.7
Oregon	----------	16,089	16,089	----------	----------	----------	----------	100.0	----------	----------	93.8	----------
Pennsylvania	36,369,029	6,467,136	42,836,165	47,453,321	7,934,034	55,387,355	84.9	15.1	85.7	14.3	45.7	50.4
Tennessee	824,988	1,534,400	2,359,388	1,210,494	1,638,992	2,849,486	35.0	65.0	42.5	57.5	43.5	49.6
Utah	5,432,296	98,460	5,530,756	6,966,048	93,137	7,059,185	98.2	1.8	98.7	1.3	92.3	95.0
Virginia	4,295,140	1,638,479	5,933,619	5,599,650	1,746,345	7,345,995	72.4	27.6	76.2	23.8	39.9	38.6
Washington	59,415	413,582	472,997	101,777	421,303	523,080	12.6	87.4	19.5	80.5	52.9	56.8
West Virginia	60,288,895	17,410,975	77,699,870	77,530,206	22,219,071	99,749,277	77.6	22.4	77.7	22.3	60.2	64.7
Wyoming	6,130,174	408,988	6,539,162	6,368,920	309,268	6,678,188	93.7	6.3	95.4	4.6	98.5	98.5
Total	207,570,050	37,770,718	245,340,768	252,611,603	45,545,678	298,157,281	84.6	15.4	84.7	15.3	58.4	60.7

[1] Includes mobile loaders, scrapers, and conveyors equipped with duckbills or other self-loading heads.
[2] Includes hand-loaded conveyors and pit-car loaders.

TABLE 32.—Bituminous-coal and lignite production by methods of mining and loading and average output per man per day, in the United States, by States, in 1947

State	Mined by stripping		Mined underground				Total	
	Net tons	Average tons per man per day	Hand-loaded (net tons)	Mechanically loaded (net tons)	Total (net tons)	Average tons per man per day	Net tons	Average tons per man per day
Alabama	1,948,823	9.70	6,510,012	10,589,390	17,099,402	3.56	19,048,225	3.81
Alaska	66,462	10.72	294,758		294,758	3.90	361,220	4.42
Arizona			10,060		10,060	2.48	10,060	2.48
Arkansas	751,128	9.82	224,474	895,347	1,119,821	3.01	1,870,949	4.17
Colorado	247,273	14.02	2,434,106	3,676,725	6,110,831	4.98	6,358,104	5.11
Georgia	3,988	6.27	3,295		3,295	2.22	7,283	3.43
Illinois	17,717,192	17.80	5,739,976	44,402,843	50,142,819	7.80	67,860,011	9.14
Indiana	14,195,187	16.69	1,007,124	10,246,786	11,253,910	7.78	25,449,097	11.08
Iowa	741,596	9.91	716,094	226,365	942,459	3.49	1,684,055	4.88
Kansas	2,473,438	13.68	271,096		271,096	2.02	2,744,534	8.71
Kentucky	10,571,683	19.17	43,343,243	30,325,756	73,668,999	5.52	84,240,682	6.06
Maryland	598,423	10.65	1,004,582	448,277	1,452,859	3.96	2,051,282	4.85
Michigan			11,210	2,803	14,013	2.08	14,013	2.08
Missouri	3,843,928	16.33	392,499		392,499	2.59	4,236,427	10.94
Montana (bituminous)	2,017,229	71.65	74,254	1,047,738	1,121,992	6.82	3,139,221	16.29
Montana (lignite)	1,021	4.22	29,291	8,357	37,648	5.69	38,669	5.64
New Mexico			375,328	1,067,882	1,443,210	5.38	1,443,210	5.38
North Dakota (lignite)	2,287,672	19.30	48,303	423,887	472,190	8.55	2,759,862	15.89
Ohio	17,360,193	16.50	5,718,138	14,469,873	20,188,011	5.80	37,548,204	8.28
Oklahoma	2,306,124	12.11	381,753	732,686	1,114,439	3.79	3,420,563	7.06
Pennsylvania	37,075,145	14.38	54,616,796	55,387,355	110,004,151	4.97	147,079,296	5.95
South Dakota (lignite)	13,518	5.80	1,100		1,100	3.63	14,618	5.55
Tennessee	516,521	11.20	2,892,476	2,849,486	5,741,962	4.46	6,258,483	4.69
Texas (lignite)	60,504	16.81					60,504	16.81
Utah			369,514	7,059,185	7,428,699	7.00	7,428,699	7.00
Virginia	1,138,741	16.27	11,686,063	7,345,995	19,032,058	4.78	20,170,799	4.97
Washington	196,853	8.15	397,993	523,080	921,073	3.29	1,117,926	3.68
West Virginia	21,993,542	16.80	54,413,760	99,749,277	154,163,037	5.72	176,156,579	6.23
Wyoming	1,268,827	15.68	104,132	6,678,188	6,782,320	7.24	8,051,147	7.92
Total 1947	139,395,011	15.93	193,071,430	298,157,281	491,228,711	5.49	630,623,722	6.42

MECHANICAL CLEANING

Bituminous coal mechanically cleaned in 1947 amounted to 174,435,-937 tons, or 28 percent of the total output.

Mechanical cleaning by wet methods include jigs, concentrating tables, classifiers, launders, dense-medium processes, and any combinations of these five methods.

Pneumatic methods of coal cleaning include air tables, air flow, air sand, and any combination of these three methods.

Tables 33, 34, 37, and 38 include mechanical cleaning data on all coal mined in the United States except Pennsylvania anthracite. Tables 35 and 36 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 33 compares bituminous coal cleaned in 1944–47 by method of cleaning. Both wet and pneumatic methods increased in 1947 over 1946.

Mechanical Cleaning, by Types of Equipment.—The tonnage of bituminous coal cleaned by wet methods was 156,083,452 tons in 1947—an increase of 28 percent over 1946. The quantity cleaned by pneumatic methods was 18,352,485 tons—an increase of more than 10 percent.

Table 34 compares the number of cleaning plants and the tons of cleaned coal, by types of equipment, for 1946 and 1947. During 1947, 440 wet-washing and 84 pneumatic cleaning plants were in operation. Sixty-three tipples used both wet and dry methods at the same plant; deducting these duplications gives a net total of 461 plants that cleaned coal in 1947, an increase of 16 plants over 1946.

Mines served by cleaning plants, exclusive of those that ship to washeries operated by steel companies, produced 244,511,541 tons or 39 percent of the total bituminous output in 1947. In this same group of mines, 164,310,898 tons were mechanically cleaned; therefore 67 percent of the coal produced at mines with cleaning plants in 1947 was cleaned at the mine. The remainder of the output from these mines (33 percent) presumably represents the larger sizes commonly picked by hand. (See tables 36 and 38.)

Relation Between Raw Coal, Clean Coal, and Refuse.—For every 100 tons of raw coal cleaned during 1947 at the mines, 84 tons of clean, merchantable coal, on an average, were obtained and 16 tons of refuse discarded. Table 38 shows the total production of mines with cleaning plants and results of cleaning operations, by States.

Methods of Mining at Mines Served by Cleaning Plants.—Underground mechanical loading appears to be closely related to mechanical cleaning. Underground coal loaded mechanically in 1947 totaled 298,157,281 tons, of which 158,507,079 tons (53 percent) passed through tipples equipped with mechanical cleaning devices. Production of coal from strip mines in 1947 was 139,395,011 tons, of which 42,016,524 tons (30 percent) came from strip mines having mechanical cleaning tipples. Hand-loaded underground coal production in 1947 totaled 193,071,430 tons of which 23 percent passed through tipples equipped with cleaning plants. (See tables 32 and 36.)

TABLE 33.—Bituminous coal mechanically cleaned by wet and pneumatic methods, in the United States, in net tons of clean coal, 1944–47

Method of cleaning	1944	1945	1946	1947	Change 1947 from 1946 (percent)
By wet methods:					
At mines	128,390,547	121,418,585	115,120,292	145,958,413	+26.8
At consumer-operated cleaning plants	10,272,142	9,051,154	6,938,347	10,125,039	+45.9
Total wet methods	138,662,689	130,469,739	122,058,639	156,083,452	+27.9
By pneumatic methods	20,064,440	17,416,197	16,611,198	18,352,485	+10.5
Grand total	158,727,129	147,885,936	138,669,837	174,435,937	+25.8

TABLE 34.—Bituminous coal cleaned in the United States, by types of equipment in actual operation, 1946–47

[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)	
	1946	1947	1946	1947	1946	1947
Wet methods:						
Jigs	226	234	64,702,238	85,931,353	46.7	49.3
Concentrating tables	10	9	1,447,200	2,980,368	1.0	1.7
Classifiers	68	67	13,883,088	14,647,771	10.0	8.4
Launders	18	19	16,020,328	17,902,394	11.6	10.3
Dense-Media	59	70	14,172,428	17,702,322	10.2	10.1
Jigs and concentrating tables	14	14	3,776,190	4,302,422	2.7	2.5
Other combinations of methods 1, 2, 3, 4, and 5	21	27	8,057,167	12,616,822	5.8	7.2
Total wet methods	416	440	122,058,639	156,083,452	88.0	89.5
Pneumatic methods	88	84	16,611,198	18,352,485	12.0	10.5
Grand total	[1] 504	[1] 524	138,669,837	174,435,937	100.0	100.0

[1] Number of plants using both wet and pneumatic methods was 59 in 1946 and 63 in 1947.

TABLE 35.—Total production of all coal at bituminous mines in the United States having cleaning plants, in net tons, 1946–47

[Does not include any estimate for mines that may ship to consumer-operated plants]

Type of equipment	1946	1947	Change 1947 from 1946 (percent)
Wet methods:			
Jigs	98, 228, 966	123, 267, 688	+25. 5
Concentrating tables	884, 813	945, 919	+6. 9
Classifiers	29, 727, 885	33, 176, 301	+11. 6
Launders	14, 978, 052	19, 721, 354	+31. 7
Dense-Media	29, 329, 451	34, 901, 017	+19. 0
Jigs and concentrating tables	4, 137, 840	4, 697, 185	+13. 5
Other combinations of methods 1, 2, 3, 4, and 5	12, 566, 806	17, 953, 150	+42. 9
Total wet methods	189, 853, 813	234, 662, 614	+23. 6
Pneumatic methods	52, 939, 443	59, 917, 199	+13. 2
Grand total	242, 793, 256	294, 579, 813	+21. 3
Less duplications [1]	42, 519, 334	50, 068, 272	+17. 8
Net total	200, 273, 922	244, 511, 541	+22. 1
United States, total production [2]	533, 922, 068	630, 623, 722	+18. 1
Percent produced at mines having cleaning plants	37. 5	38. 8	

[1] Mines using both wet and pneumatic methods.
[2] For purposes of historical comparison and statistical convenience, the figures include the output of lignite and of anthracite and semianthracite outside of Pennsylvania. There are no mechanical cleaning plants at lignite mines.

TABLE 36.—Method of mining at bituminous-coal mines in the United States served by cleaning plants, 1944–47

[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 1947 from 1946 (percent)
	1944	1945	1946	1947	
Mined from strip pits	32, 444, 227	35, 910, 050	33, 221, 819	42, 016, 524	+26. 5
Mechanically loaded underground	137, 926, 900	129, 733, 226	125, 521, 189	158, 507, 079	+26. 3
Hand-loaded underground	62, 564, 653	48, 614, 794	41, 530, 914	43, 987, 938	+5. 9
Total	232, 935, 780	214, 258, 070	200, 273, 922	244, 511, 541	+22. 1

TABLE 37.—Bituminous coal mechanically cleaned by wet and pneumatic methods in the United States, by States, 1946–47

[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)	
	1946	1947	1946	1947	1946	1947
Alabama	51	52	11,608,231	13,923,152	71.7	73.1
Alaska	2	1	164,623	171,799	44.9	47.6
Arkansas	3	4	98,177	250,060	6.0	13.4
Colorado	10	8	901,069	1,373,708	15.2	21.6
Illinois	57	53	28,164,779	33,363,568	44.4	49.2
Indiana	19	22	10,669,696	13,865,723	49.2	54.5
Kansas	5	4	1,273,764	1,349,393	51.1	49.2
Kentucky	23	30	8,270,196	12,195,014	12.4	14.5
Maryland	(1)	2	(1)	318,498	(1)	15.5
Michigan	1		7,554		9.4	
Missouri	10	9	2,991,932	3,071,263	80.2	72.5
Montana	2	3	171,882	170,522	4.6	5.4
New Mexico	3	3	395,347	477,873	30.9	33.1
Ohio	11	15	6,467,864	9,366,478	20.0	24.9
Oklahoma	1	2	90,000	385,442	3.4	11.3
Oregon	1		14,961		87.2	
Pennsylvania [2]	[1] 61	62	[1] 29,807,425	36,728,026	23.8	25.0
Tennessee	3	3	125,276	188,572	2.2	3.0
Utah	3	3	1,636,201	1,679,577	27.3	22.6
Virginia	18	18	3,401,629	3,375,524	21.9	16.7
Washington	21	19	816,465	954,734	82.4	85.4
West Virginia [3]	140	148	31,592,766	41,227,011	21.9	23.4
Total	[4] 445	[5] 461	138,669,837	174,435,937	26.0	27.7

[1] For purpose of concealment 1 plant in Maryland is included with Pennsylvania.
[2] 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.
[3] Includes some coal mined in West Virginia and cleaned in Ohio and Pennsylvania.
[4] Represents 59 plants using both wet and pneumatic methods of cleaning and 386 plants using only 1 cleaning method.
[5] Represents 63 plants using both wet and pneumatic methods of cleaning and 398 plants using only 1 cleaning method.

TABLE 38.—Result of operations at bituminous-coal-cleaning plants in the United States, by States, in net tons, in 1947

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	18,705,128	13,923,152	4,781,976	25.6	14,939,390
Alaska	246,799	171,799	75,000	30.4	171,799
Arkansas	284,507	250,060	34,447	12.1	455,079
Colorado	128,338	115,199	13,139	10.2	616,060
Illinois	39,519,166	33,363,568	6,155,598	15.6	47,252,222
Indiana	16,426,695	13,865,723	2,560,972	15.6	18,409,719
Kansas	1,661,515	1,349,393	312,122	18.8	1,357,393
Kentucky	15,076,545	12,195,014	2,881,531	19.1	16,302,575
Maryland	348,598	318,498	30,100	8.6	485,998
Missouri	3,718,036	3,071,263	646,773	17.4	3,193,952
Montana	178,522	170,522	8,000	4.5	265,735
New Mexico	581,678	477,873	103,805	17.8	1,076,387
Ohio	11,848,324	9,366,478	2,481,846	20.9	13,714,844
Oklahoma	435,703	385,442	50,261	11.5	536,546
Pennsylvania [2]	32,596,065	27,861,496	4,734,569	14.5	40,915,170
Tennessee	203,515	188,572	14,943	7.3	654,502
Utah	1,760,385	1,679,577	80,808	4.6	2,283,364
Virginia	3,690,564	3,375,524	315,040	8.5	9,414,365
Washington	1,209,200	954,734	254,466	21.0	1,015,285
West Virginia [3]	46,723,648	41,227,011	5,496,637	11.8	71,451,156
Total at mines only [4]	195,342,931	164,310,898	31,032,033	15.9	244,511,541
Consumer plants [5]	11,277,037	10,125,039	1,151,998	10.2	----------
Grand total 1947	206,619,968	174,435,937	32,184,031	15.6	----------

[1] In Alabama (for example) for every 100 tons of raw coal cleaned in 1947, an average of 25.6 tons of refuse was discarded and 74.4 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 39 for each coal-producing county in the United States from which three or more operators submitted reports for 1947. 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 the operators have granted permission to publish them separately. 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.

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, beginning with 1946, statistics of average production per man per day are not precisely comparable with those for other years. The figures since 1946 were based on the average number of men working daily, while the figures for previous years were based on the average number of men on the rolls per pay period.

TABLE 39.—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 1947

[Exclusive of mines producing less than 1,000 tons]

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
ALABAMA												
Bibb	718,892	61,422	15,132	795,446	$6.25	714	13	248	975	261	254,641	3.12
Blount	180,617	199,446	333	380,396	5.31	360	58	93	511	256	130,675	2.91
Cullman	------------	40,213	72	40,285	5.05	71	--------	15	86	228	19,599	2.06
Jackson	2,753	13,933	134	16,820	5.38	21	--------	8	29	230	6,659	2.53
Jefferson	9,368,663	237,966	106,032	9,712,661	5.48	9,271	102	1,726	11,099	252	2,794,637	3.48
Marion	201,965	140,337	2,841	345,143	6.89	458	--------	88	546	241	131,651	2.62
St. Clair	822,397	75,651	7,483	905,531	5.42	489	60	141	690	244	168,092	5.39
Shelby	392,515	93,236	2,371	488,122	6.17	599	--------	107	706	232	163,719	2.98
Tuscaloosa	710,903	61,866	1,622	774,391	4.85	405	100	148	653	232	151,502	5.11
Walker	4,449,129	560,770	574,322	5,584,221	5.33	3,976	319	823	5,118	231	1,182,224	4.72
Winston	------------	5,209	------------	5,209	5.38	4	--------	1	5	269	1,345	3.87
Total Alabama	16,847,834	1,490,049	710,342	19,048,225	5.48	16,368	652	3,398	20,418	245	5,004,744	3.81
ALASKA												
Total Alaska	322,306	36,558	2,356	361,220	$7.07	161	25	75	261	313	81,712	4.42
ARIZONA												
Total Arizona	------------	10,060	------------	10,060	$4.61	26	--------	7	33	123	4,049	2.48

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ARKANSAS

Franklin	116,887	117	1,257	118,261	$6.42	238	27	42	307	147	45,235	2.61
Johnson	370,883	72,948	755	444,586	6.88	230	57	89	376	194	72,897	6.10
Logan	280,040	5,400	1,831	287,271	8.46	539		88	627	171	107,360	2.68
Pope	48,125		255	48,380	7.62	67		20	87	245	21,315	2.27
Scott	86,430			86,430	5.58		22	8	30	185	5,550	15.57
Sebastian	840,560	44,339	1,122	886,021	6.07	594	236	165	995	197	195,973	4.52
Total Arkansas	1,742,925	122,804	5,220	1,870,949	6.67	1,668	342	412	2,422	185	448,330	4.17

COLORADO

Boulder	132,222	190,238	3,738	326,198	$4.65	327		52	379	181	68,491	4.76
Delta	79,333	18,599	4,483	102,415	4.40	84		35	119	197	23,442	4.37
Elbert		995	137	1,132	3.80	2		1	3	162	487	2.32
El Paso	66,092	136,453	11,949	214,494	3.95	173		38	211	235	49,564	4.33
Fremont	135,821	291,998	1,781	429,600	4.97	326	8	93	427	199	84,946	5.06
Garfield	10,588	41,347	21	51,956	4.58	35		8	43	258	11,106	4.68
Gunnison	562,674	31,317	29,119	623,110	4.46	381		120	501	211	105,691	5.90
Huerfano	525,074	55,667	4,440	585,181	4.82	561	3	126	690	201	138,768	4.22
Jackson	28,910	13,845		42,755	4.26		16	3	19	235	4,470	9.56
Jefferson	100,085	19,326	1,931	121,342	4.25	105		22	127	231	29,388	4.13
La Plata	28,796	20,137	44	48,977	3.14	45		8	53	196	10,395	4.71
Las Animas	1,169,986	70,385	49,211	1,289,582	4.73	1,233		230	1,463	228	333,420	3.87
Mesa	82,307	20,633	850	103,790	4.13	69		14	83	218	18,073	5.74
Moffat	114,838	24,795	6,861	146,494	4.78	63		19	82	190	15,604	9.39
Montrose		8,949		8,949	3.43	9		2	11	182	2,003	4.47
Rio Blanco		14,572	51	14,623	4.11	20		3	23	207	4,766	3.07
Routt	944,807	38,705	33,311	1,016,823	4.87	623	28	327	978	185	181,248	5.61
Weld	778,341	431,104	21,238	1,230,683	3.95	647		126	773	211	162,884	7.56
Total Colorado	4,759,874	1,429,065	169,165	6,358,104	4.53	4,703	55	1,227	5,985	208	1,244,746	5.11

GEORGIA

Total Georgia	7,119		164	7,283	$5.40	39	8	10	57	37	2,121	3.43

See footnotes at end of table.

TABLE 39.—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 1947—Continued

[Exclusive of mines producing less than 1,000 tons]

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
ILLINOIS												
Bureau	564,361	125,016	377	689,754	$3.57	37	54	128	219	238	52,100	13.24
Christian	7,215,850	107,906	51,755	7,375,511	2.45	1,914	----	596	2,510	274	688,749	10.71
Clinton	207,367	105,625	19,975	332,967	3.66	211	----	55	266	248	65,934	5.05
Douglas	50,354	----	----	50,354	3.59	26	----	5	31	251	7,781	6.47
Edgar	----	26,655	1,499	28,154	3.59	46	----	5	51	132	6,732	4.18
Franklin	13,714,642	367,201	361,654	14,443,497	3.38	5,755	----	1,921	7,676	235	1,802,850	8.01
Fulton	6,699,606	262,791	16,111	6,978,508	3.05	136	536	609	1,281	269	344,101	20.28
Gallatin	56,945	24,410	2,100	83,455	3.17	61		10	71	277	19,636	4.25
Grundy	1,351,745	315,753	9,491	1,676,989	3.79	----	254	267	521	301	157,074	10.68
Hancock	----	17,200	158	17,358	4.80	----	11	5	16	114	1,831	9.48
Henry	59,180	55,755	1,128	116,063	3.65	48	----	13	61	256	15,619	7.43
Jackson	1,178,555	139,234	9,180	1,326,969	3.16	263	61	131	455	260	118,191	11.23
Jefferson	467,140	42,735	23,690	533,565	3.36	239	----	82	321	221	70,901	7.53
Knox	674,280	111,213	2,903	788,396	2.60	114	57	79	250	224	56,089	14.06
La Salle	37,356	122,671	12,035	172,062	5.00	181	20	40	241	139	33,466	5.14
Livingston	----	6,453	----	6,453	4.87	----	3	----	3	162	486	13.28
Logan	----	52,778	----	52,778	3.80	48	----	6	54	160	8,613	6.13
Macoupin	4,718,524	150,348	168,332	5,037,204	2.93	2,212	----	539	2,751	258	708,839	7.11
Madison	1,102,708	966,234	84,093	2,153,035	3.30	978	----	269	1,247	254	317,062	6.79
Marion	199,457	29,381	8,085	236,923	3.31	110	----	45	155	265	41,075	5.77
Menard	----	27,527	2,147	29,674	4.30	46	----	9	55	242	13,302	2.23
Montgomery	788,970	31,870	56,782	877,622	2.89	241	----	78	319	284	90,596	9.69
Peoria	369,335	230,860	4,355	604,550	3.09	319	----	51	370	237	87,789	6.89
Perry	4,897,710	67,532	56,520	5,021,762	3.07	900	249	671	1,820	249	453,024	11.08
Randolph	2,457,929	109,620	31,221	2,598,770	3.17	625	63	296	984	238	233,991	11.11
St. Clair	1,654,604	1,623,582	74,065	3,352,251	2.82	1,194	105	320	1,619	225	364,777	9.19
Saline	4,181,983	79,218	76,298	4,337,499	3.56	1,927	153	723	2,803	217	606,874	7.15
Sangamon	1,497,775	729,058	30,901	2,257,734	3.11	1,186	----	215	1,401	244	342,247	6.60
Schuyler	85,928	29,022	600	115,550	3.21	6	20	25	51	165	8,390	13.77
Tazewell	----	88,170	4,193	92,363	4.43	89	----	7	96	240	23,001	4.02
Vermilion	405,510	218,958	9,763	634,231	3.01	730	24	104	858	112	95,690	6.63
Warren	----	2,319	20	2,339	3.63	2	----	1	3	326	978	2.39
Washington	282,452	55,953	13,243	351,648	3.56	247	----	69	316	198	62,434	5.63
Will	100,584	141,674	575	242,833	3.61	----	27	24	51	248	12,648	19.20

Williamson	4,895,428	320,057	24,444	5,239,929	3.42	1,654	229	565	2,448	209	511,426	10.25
Woodford	--------	1,261	--------	1,261	6.22	36	--------	11	47	20	940	1.34
Total Illinois	59,916,278	6,786,040	1,157,693	67,860,011	3.15	21,581	1,866	7,974	31,421	236	7,425,236	[4] 9.14
INDIANA												
Clay	1,947,560	122,135	7,717	2,077,412	$3.48	21	381	220	622	232	144,439	14.38
Daviess	34,001	27,121		61,122	3.96	34	46	26	106	111	11,771	5.19
Dubois	--------	24,789	--------	24,789	3.09	14	--------	3	17	247	4,205	5.90
Fountain	--------	78,215	--------	78,215	4.31	--------	26	5	31	293	9,083	8.61
Gibson	780,256	149,197	21,689	951,142	3.63	471	--------	81	552	211	116,718	8.15
Greene	1,282,682	67,823	7,093	1,357,598	3.37	202	85	87	374	239	89,420	15.18
Knox	3,210,290	451,989	37,464	3,699,743	3.01	1,232	62	435	1,729	267	462,437	8.00
Owen	--------	8,741	--------	8,741	4.27	--------	5	1	6	162	970	9.01
Parke	1,081	94,653	96	95,830	4.55	67	22	16	105	179	18,780	5.10
Perry	--------	1,200	--------	1,200	3.00	2	--------	--------	2	200	400	3.00
Pike	3,967,751	62,160	20,704	4,050,615	3.04	5	530	389	924	255	235,313	17.21
Spencer	108,521	113,093	--------	221,614	3.48	25	44	30	99	195	19,287	11.49
Sullivan	3,645,876	146,682	10,292	3,802,850	3.27	867	289	378	1,534	235	359,983	10.56
Vermillion	378,680	65,829	5,794	450,303	3.40	81	80	54	215	170	36,518	12.33
Vigo	3,606,197	290,458	418,441	4,315,096	3.25	1,779	114	352	2,245	226	506,390	8.52
Warrick	3,898,494	345,344	8,989	4,252,827	3.15	358	400	423	1,181	239	281,816	15.09
Total Indiana	22,861,389	2,049,429	538,279	25,449,097	3.22	5,158	2,084	2,500	9,742	236	2,297,530	[4] 11.08
IOWA												
Appanoose	43,363	119,417	2,248	165,028	$4.74	333	--------	44	377	181	68,058	2.42
Boone	39,821	19,336	1,425	60,582	4.98	66	--------	10	76	196	14,891	4.07
Davis	772	7,718	--------	8,490	3.92	17	--------	3	20	94	1,887	4.50
Guthrie	--------	3,190	30	3,220	5.87	12	--------	2	14	117	1,638	1.97
Jasper	153	29,134	80	29,367	4.12	50	--------	10	60	243	14,560	2.02
Lucas	23,187	15,072	--------	38,259	4.73	113	--------	13	126	86	10,804	3.54
Mahaska	186,672	146,761	847	334,280	3.35	28	98	47	173	260	45,022	7.42
Marion	310,097	243,819	493	554,409	3.41	273	75	78	426	185	79,006	7.02
Monroe	45,407	106,747	574	152,728	4.00	194	10	27	231	167	38,519	3.97
Page	--------	9,723	--------	9,723	6.00	12	--------	2	14	240	3,360	2.89
Polk	--------	21,774	--------	21,774	4.24	60	--------	10	70	75	5,250	4.15
Van Buren	--------	40,598	10	40,608	3.92	27	16	13	56	185	10,381	3.91
Wapello	16,850	62,908	--------	79,758	3.09	29	20	21	70	142	9,947	8.02
Warren	--------	8,969	--------	8,969	3.91	10	--------	2	12	227	2,718	3.30
Wayne	--------	2,338	10	2,348	4.76	10	--------	2	12	105	1,260	1.86
Other counties: Dallas and Greene	127,915	45,942	655	174,512	4.40	144	--------	31	175	215	37,676	4.63
Total Iowa	794,237	883,446	6,372	1,684,055	3.82	1,378	219	315	1,912	180	344,977	4.88

See footnotes at end of table.

TABLE 39.—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 1947—Continued

[Exclusive of mines producing less than 1,000 tons]

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
KANSAS												
Bourbon	174,290	20,941	174	195,405	$3.35	----	43	23	66	210	13,876	14.08
Cherokee	836,568	47,472	9,598	893,638	3.21	49	136	93	278	221	61,549	14.52
Coffey	----	1,150	----	1,150	3.22	----	5	2	7	59	415	2.77
Crawford	1,474,689	81,602	7,538	1,563,829	3.30	245	243	221	709	231	163,949	9.54
Franklin	----	2,532	----	2,532	5.92	5	----	1	6	160	959	2.64
Labette	----	6,364	----	6,364	4.23	----	7	3	10	200	2,004	3.18
Leavenworth	----	----	35,004	35,004	6.00	186	----	45	231	204	47,124	.74
Linn	1,171	9,731	----	10,902	3.98	12	7	4	23	190	4,376	2.49
Osage	----	35,600	110	35,710	5.24	103	13	15	131	160	20,997	1.70
Total Kansas	2,486,718	205,392	52,424	2,744,534	3.34	600	454	407	1,461	216	315,249	[5] 8.71
KENTUCKY												
Eastern Kentucky:												
Bell	2,921,765	427,469	26,807	3,376,041	$5.22	3,192	----	542	3,734	206	770,016	4.38
Boyd	485,862	287,216	9,339	782,417	4.17	326	99	73	498	237	118,251	6.62
Breathitt	69,458	181,933	----	251,391	4.66	222	----	55	277	164	45,545	5.52
Carter	240,736	341,378	514	582,628	4.50	406	49	92	547	233	127,405	4.57
Clay	368,600	116,170	75	484,845	4.94	674	11	111	796	221	175,760	2.76
Clinton	----	2,300	----	2,300	4.23	7	----	1	8	90	720	3.19
Elliott	----	47,804	----	47,804	3.72	45	4	9	58	233	13,493	3.54
Floyd	6,974,236	897,261	15,128	7,886,625	5.10	5,671	----	1,007	6,678	226	1,507,810	5.23
Greenup	----	110,192	----	110,192	3.98	115	----	19	134	220	29,433	3.74
Harlan	11,700,343	238,130	115,655	12,054,128	5.08	10,540	----	1,772	12,312	205	2,525,580	4.77
Jackson	----	126,372	2,717	129,089	4.49	144	----	32	176	233	40,996	3.15
Johnson	658,126	863,958	5,660	1,527,744	5.28	1,223	----	220	1,443	211	304,002	5.03
Knott	1,224,544	113,706	2,621	1,340,871	4.70	842	8	171	1,021	205	208,897	6.42
Knox	545,775	341,125	3,455	890,355	4.95	676	23	146	845	203	171,706	5.19
Laurel	464,801	352,855	3,531	821,187	4.45	347	78	91	516	257	132,559	6.19

Lawrence	7,358	83,461		90,819	3.90	99		17	116	232	26,944	3.37
Lee	36,142	32,707		68,849	3.87	84		11	95	227	21,588	3.19
Leslie	605,770	156,646		762,416	5.04	490	16	89	595	201	119,749	6.37
Letcher	6,790,933	1,262,817	55,992	8,109,742	5.00	5,203	185	1,084	6,472	208	1,344,354	6.03
Lewis		6,452		6,452	4.69	10		2	12	100	1,200	5.38
Magoffin	287,184	403,803		690,987	4.33	522	5	89	616	192	118,332	5.84
Martin	403,409	47,479		450,888	4.34	250		57	307	225	69,193	6.52
McCreary	1,076,307	49,740	23,695	1,149,742	4.95	888	4	125	1,017	234	237,664	4.84
Menifee		30,753		30,753	4.20	34		7	41	259	10,639	2.89
Montgomery		7,667		7,667	4.69	6		1	7	269	1,883	4.07
Morgan		123,367		123,367	4.67	114		23	137	234	32,110	3.84
Perry	6,289,162	239,983	95,728	6,624,873	4.80	4,840	40	919	5,799	201	1,163,730	5.69
Pike	11,101,919	1,131,824	206,226	12,439,969	4.56	7,870	21	1,719	9,610	237	2,273,045	5.47
Pulaski	133,070	174,835		307,905	4.18	161	7	30	198	272	53,860	5.72
Rockcastle	164,242	40,740		204,982	3.87	106	4	20	130	274	35,560	5.76
Wayne	300	1,900		2,200	3.62	8		2	10	161	1,608	1.37
Whitney	511,827	151,235	200	663,262	4.81	462	30	101	593	234	138,689	4.78
Wolfe		35,810		35,810	4.69	30		8	38	188	7,148	5.01
Total Eastern Kentucky	53,061,869	8,429,088	567,343	62,058,300	4.88	45,607	584	8,645	54,836	216	11,829,469	5.25
Western Kentucky:												
Butler		264,304		264,304	$3.35	96	25	24	145	228	32,995	8.01
Christian		13,900		13,900	3.69	9		2	11	220	2,420	5.74
Daviess	50,000	408,772	8	458,780	3.49	211	35	58	304	211	64,135	7.15
Edmonson		15,800		15,800	3.41	13		2	15	164	2,460	6.42
Hancock	115,697	94,986		210,683	3.20	26	27	16	69	235	16,198	13.01
Henderson	9,000	244,450		253,450	2.88	163		35	198	207	41,002	6.18
Hopkins	11,039,781	652,807	5,742	11,698,330	3.20	2,324	737	1,198	4,259	214	910,465	12.85
McLean	31,243	120,850		152,093	3.63	142		23	165	210	34,602	4.40
Muhlenberg	6,179,687	526,688	29,277	6,735,652	2.95	2,496	299	614	3,409	210	716,346	9.40
Ohio	817,054	345,157	1,656	1,163,867	3.30	333	209	184	726	156	113,462	10.26
Union	558,748	98,278		657,026	3.07	218		54	272	258	70,243	9.35
Webster	432,083	126,414		558,497	3.24	270	22	50	342	192	65,693	8.50
Total Western Kentucky	19,233,293	2,912,406	36,683	22,182,382	3.14	6,301	1,354	2,260	9,915	209	2,070,021	[4] 10.72
Total Kentucky	72,295,162	11,341,494	604,026	84,240,682	4.42	51,908	1,938	10,905	64,751	215	13,899,490	6.06

MARYLAND

Allegany	616,077	292,789	2,518	911,384	$4.66	762	181	208	1,151	184	211,572	4.31
Garrett	906,768	226,442	6,688	1,139,898	4.91	697	178	187	1,062	199	211,552	5.39
Total Maryland	1,522,845	519,231	9,206	2,051,282	4.80	1,459	359	395	2,213	191	423,124	4.85

See footnotes at end of table.

TABLE 39.—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 1947—Continued

[Exclusive of mines producing less than 1,000 tons]

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
MICHIGAN												
Total Michigan	-----	12,583	1,430	14,013	$7.68	27	-----	6	33	204	6,732	2.08
MISSOURI												
Adair	11,523	98,477	358	110,358	$3.82	145	-----	30	175	202	35,403	3.12
Barton	457,758	14,747	893	473,398	3.15	11	123	64	198	182	36,111	13.11
Bates	977,881	13,370	50	991,301	3.10	4	70	99	173	270	46,655	21.25
Boone	-----	58,414	-----	58,414	3.08	-----	15	1	16	257	4,107	14.22
Callaway	-----	165,888	-----	165,888	3.44	-----	52	21	73	236	17,201	9.64
Clay	-----	11,302	529	11,831	6.41	87	-----	14	101	60	6,055	1.95
Dade	-----	8,078	-----	8,078	3.83	-----	6	3	9	277	2,490	3.24
Daviess	-----	7,566	-----	7,566	5.81	21	-----	4	25	148	3,700	2.04
Harrison	-----	9,807	670	10,477	5.83	16	-----	3	19	179	3,410	3.07
Henry	640,515	86,741	-----	727,256	3.21	-----	113	55	168	230	38,636	18.82
Jasper	-----	4,988	516	5,504	3.55	-----	3	1	4	310	1,240	4.44
Lafayette	-----	46,080	482	46,562	5.70	119	-----	20	139	159	22,047	2.11
Linn	-----	6,956	-----	6,956	6.00	32	-----	4	36	125	4,500	1.55
Macon	514,139	61,999	229	576,367	3.24	51	45	88	184	275	50,598	11.39
Monroe	-----	7,066	153	7,219	4.26	-----	11	3	14	220	3,076	2.35
Putnam	-----	20,139	-----	20,139	4.50	50	-----	9	59	143	8,422	2.39
Ralls	-----	2,356	-----	2,356	5.57	5	-----	2	7	186	1,300	1.81
Randolph	443,313	73,487	-----	516,800	3.43	126	29	79	234	231	54,018	9.57
Ray	2,714	21,065	80	23,859	6.52	116	-----	18	134	117	15,700	1.52
St. Clair	16,040	9,562	-----	25,602	3.27	2	10	5	17	249	4,230	6.05
Vernon	406,455	33,600	441	440,496	3.34	2	78	38	118	239	28,258	15.59
Total Missouri	3,470,338	761,688	4,401	4,236,427	3.33	787	555	561	1,903	203	387,157	[5] 10.94

MONTANA

Bituminous coal:												
Blaine	----------	7,810	----------	7,810	$6.37	8	--------	1	9	240	2,160	3.62
Carbon	249,862	16,188	768	266,818	4.05	111	17	61	189	191	36,101	7.39
Cascade	38,693	11,804	60	50,557	2.81	52	--------	9	61	90	5,505	9.18
Chouteau	----------	1,016	10	1,026	6.12	2	--------	1	3	195	585	1.75
Fergus	----------	1,490	12	1,502	4.61	2	--------	--------	2	192	384	3.91
Musselshell	793,538	28,517	7,268	829,323	3.52	370	--------	176	546	225	122,941	6.75
Rosebud	1,978,615	----------	3,570	1,982,185	1.11	--------	73	17	90	278	25,011	79.25
Total bituminous coal	3,060,708	66,825	11,688	3,139,221	2.04	545	90	265	900	214	192,687	[4] 16.29
Lignite	----------	38,469	200	38,669	2.90	28	2	7	37	185	6,859	5.64
Total Montana	3,060,708	105,294	11,888	3,177,890	2.05	573	92	272	937	213	199,546	[4] 15.93

NEW MEXICO

Bernalillo	----------	2,000	14	2,014	$5.03	4	--------	1	5	133	665	3.03
Colfax	1,195,078	5,782	9,328	1,210,188	4.37	560	--------	151	711	264	187,734	6.45
McKinley	106,826	33,075	29,669	169,570	5.53	267	--------	68	335	157	52,573	3.23
Rio Arriba	18,730	3,210	75	22,015	3.93	19	--------	6	25	219	5,479	4.02
San Juan	----------	13,963	----------	13,963	3.79	33	--------	7	40	250	10,012	1.39
Santa Fe	9,150	10,427	1,703	21,280	5.99	23	--------	10	33	256	8,448	2.52
Socorro	----------	4,022	158	4,180	5.37	11	--------	4	15	237	3,557	1.18
Total New Mexico	1,329,784	72,479	40,947	1,443,210	4.52	917	--------	247	1,164	231	268,468	5.38

NORTH DAKOTA (LIGNITE)

Total North Dakota	2,228,163	458,278	73,421	2,759,862	$1.92	154	279	247	680	255	173,735	[4] 15.89

See footnotes at end of table.

TABLE 39.—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 1947—Continued

[Exclusive of mines producing less than 1,000 tons]

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
OHIO												
Athens	1,938,717	133,279	9,928	2,081,924	$4.22	1,238	122	357	1,717	201	345,698	6.02
Belmont	8,831,729	277,735	21,058	9,130,522	3.65	4,339	232	932	5,503	232	1,277,505	7.15
Carroll	208,827	261,842	5,808	476,477	3.70	195	74	58	327	253	82,822	5.75
Columbiana	143,769	706,577	161	850,507	3.28	149	169	71	389	217	84,409	10.08
Coshocton	318,517	292,990	1,115	612,622	3.48	213	91	72	376	227	85,474	7.17
Gallia	97,424	102,738	----------	200,162	4.24	214	3	31	248	227	56,343	3.55
Guernsey	409,440	68,767	1,182	479,389	3.76	196	73	43	312	214	66,862	7.17
Harrison	6,781,207	45,593	21,777	6,848,577	3.32	827	762	566	2,155	248	534,046	12.82
Hocking	465,544	166,097	306	631,947	4.17	463	72	109	644	187	120,472	5.25
Holmes	----------	47,293	4,757	52,050	3.00	7	16	15	38	168	6,389	8.15
Jackson	97,734	93,893	30,947	222,574	3.89	159	53	45	257	195	49,998	4.45
Jefferson	5,066,702	1,105,653	24,485	6,196,840	3.43	1,705	498	729	2,932	234	686,063	9.03
Lawrence	133	45,787	8,097	54,017	3.23	46	7	8	61	205	12,505	4.32
Mahoning	3,667	178,263	----------	181,930	4.06	7	48	10	65	208	13,501	13.48
Meigs	292,437	56,605	60	349,102	3.93	312	13	64	389	204	79,514	4.39
Morgan	278,482	45,383	----------	323,865	3.88	233	32	59	324	179	57,973	5.59
Muskingum	1,310,786	260,860	1,900	1,573,546	2.69	425	131	102	658	208	136,700	11.51
Noble	674,157	66,908	7	741,072	2.36	22	118	82	222	149	33,032	22.43
Perry	3,154,619	340,326	1,583	3,496,528	3.60	1,801	323	418	2,542	174	443,261	7.89
Portage	----------	89,768	4,363	94,131	3.19	----------	18	6	24	316	7,584	12.41
Stark	81,478	312,821	451	394,750	3.15	17	96	31	144	252	36,228	10.90
Tuscarawas	139,050	1,839,025	58,361	2,036,436	3.22	601	198	179	978	257	251,408	8.10
Vinton	285,241	144,814	25	430,080	4.20	74	114	73	261	223	58,279	7.38
Wayne	7,420	81,736	----------	89,156	3.16	----------	17	4	21	289	6,069	14.69
Total Ohio	30,587,080	6,764,753	196,371	37,548,204	3.50	13,243	3,280	4,064	20,587	220	4,532,135	[4] 8.28
OKLAHOMA												
Coal	198,084	15,618	----------	213,702	$5.08	20	44	34	98	240	23,483	9.10
Craig	----------	7,839	----------	7,839	3.99	----------	9	5	14	129	1,802	4.35
Haskell	88,658	1,021	1,853	91,532	3.29	11	22	5	38	233	8,847	10.35

Latimer	326,671	2,563	--------	329,234	4.13	24	30	33	87	241	20,939	15.72
Le Flore	444,369	51,520	75	495,964	5.55	377	86	147	610	133	81,182	6.11
Muskogee	202,445	1,485	--------	203,930	3.78	--------	53	15	68	321	21,844	9.34
Okmulgee	1,160,151	3,988	483	1,164,622	4.39	594	101	141	836	234	195,959	5.94
Pittsburg	154,945	10,644	559	166,148	5.75	207	--------	46	253	228	57,729	2.88
Rogers	564,267	38,331	7,446	610,044	3.75	--------	124	69	193	287	55,305	11.03
Tulsa	43,244	4,448	50	47,742	3.54	24	20	16	60	196	11,754	4.06
Wagoner	83,556	6,250	--------	89,806	3.05	--------	39	36	75	76	5,709	15.73
Total Oklahoma	3,266,390	143,707	10,466	3,420,563	4.41	1,257	528	547	2,332	208	484,553	[4] 7.06

PENNSYLVANIA (BITUMINOUS COAL)

Allegheny	13,690,586	3,260,481	1,609,720	18,560,787	$3.94	8,283	980	1,809	11,072	247	2,731,468	6.80
Armstrong	5,701,610	400,349	13,775	6,115,734	3.93	3,154	472	691	4,317	231	995,371	6.14
Beaver	168,761	356,486	2,691	527,938	3.98	140	116	56	312	221	68,875	7.67
Bedford	947,234	100,161	5,300	1,052,695	4.98	621	160	156	937	223	209,292	5.03
Blair	61,854	142,770	295	204,919	4.03	128	12	25	165	233	38,412	5.33
Bradford	--------	5,255	--------	5,255	3.97	--------	5	1	6	97	582	9.03
Butler	1,884,426	602,466	10,867	2,497,759	3.81	773	406	245	1,424	233	332,159	7.52
Cambria	14,843,800	1,140,535	1,609,577	17,593,912	4.90	13,068	595	2,690	16,353	233	3,806,827	4.62
Cameron	--------	4,798	500	5,298	3.56	4	--------	1	5	200	1,000	5.30
Centre	1,172,472	216,581	2,609	1,391,662	4.08	671	220	163	1,054	221	233,122	5.97
Clarion	3,045,907	536,921	1,531	3,584,359	3.78	800	614	329	1,743	247	430,525	8.33
Clearfield	7,741,546	752,899	38,641	8,533,086	4.25	3,062	1,803	1,111	5,976	216	1,291,265	6.61
Clinton	144,453	387,502	--------	531,955	3.32	75	125	42	242	215	52,120	10.21
Elk	439,616	546,184	1,165	986,965	3.88	351	256	119	726	194	140,827	7.01
Fayette	12,685,894	2,194,946	3,759,122	18,639,962	4.19	9,980	745	1,584	12,309	249	3,064,182	6.08
Forest	--------	2,373	--------	2,373	4.22	4	--------	2	6	300	1,800	1.32
Fulton	130,529	5,000	--------	135,529	3.99	7	19	8	34	207	7,044	19.24
Greene	12,841,032	119,262	48,624	13,008,918	4.11	7,006	141	1,357	8,504	266	2,262,989	5.75
Huntingdon	433,093	165,204	3,057	601,354	4.94	428	116	82	626	234	146,360	4.11
Indiana	8,275,438	399,004	658,510	9,332,952	4.33	5,020	607	1,174	6,801	226	1,536,096	6.08
Jefferson	2,613,640	260,255	52,751	2,926,646	3.98	1,261	451	325	2,037	225	458,167	6.39
Lawrence	--------	169,872	15	169,887	3.28	24	41	17	82	214	17,541	9.69
Lycoming	--------	32,411	150	32,561	3.71	27	5	7	39	224	8,736	3.73
McKean	--------	2,344	180	2,524	3.34	2	4	--------	6	150	900	2.80
Mercer	74,493	283,978	505	358,976	3.99	84	83	43	210	196	41,063	8.74
Somerset	7,000,245	735,143	38,830	7,774,218	4.51	4,486	628	1,045	6,159	227	1,400,904	5.55
Tioga	96,764	77,056	1,235	175,055	4.71	107	21	26	154	230	35,484	4.93
Venango	84,134	155,110	151	239,395	3.66	19	36	13	68	293	19,922	12.02
Washington	20,309,716	1,394,258	303,712	22,007,686	4.26	11,316	1,118	2,604	15,038	249	3,743,177	5.88
Westmoreland	6,873,719	1,866,604	1,338,613	10,078,936	4.04	5,318	733	1,184	7,235	227	1,644,708	6.13
Total Pennsylvania	121,260,962	16,316,208	9,502,126	147,079,296	4.23	76,219	10,512	16,909	103,640	239	24,720,918	5.95

See footnotes at end of table.

TABLE 39.—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 1947—Continued

[Exclusive of mines producing less than 1,000 tons]

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
SOUTH DAKOTA (LIGNITE)												
Total South Dakota	420	14,158	40	14,618	$2.44	2	11	2	15	176	2,634	5.55
TENNESSEE												
Anderson	1,422,589	25,925	11,497	1,460,011	$4.51	975	2	185	1,162	217	251,745	5.80
Bledsoe	39,203		8	39,211	4.43	13	17	5	35	122	4,286	9.15
Campbell	1,463,594	40,000	15,400	1,518,994	5.40	1,450	32	309	1,791	199	356,070	4.27
Claiborne	996,659	20,884	9,689	1,027,232	4.77	918		158	1,076	211	226,991	4.53
Fentress	242,543	32,291	2,343	277,177	4.37	201		42	243	236	57,255	4.84
Grundy	452,598		9,179	461,777	4.93	420	29	56	505	203	102,292	4.51
Hamilton	22,291	172,906		195,197	4.69	52	39	25	116	238	27,596	7.07
Marion	330,607	46,073	3,030	379,710	4.05	406		52	458	193	88,544	4.29
Morgan	219,061	5,754	1,250	226,065	5.16	326	7	63	396	237	93,956	2.41
Overton	22,888	6,904	306	30,098	4.10	38		7	45	183	8,248	3.65
Rhea	9,500	500		10,000	4.00	14		2	16	228	3,640	2.75
Scott	337,492		944	338,436	4.13	151	18	61	230	218	50,198	6.74
Sequatchie	21,047	15,691	10	36,748	4.23	63		6	69	165	11,404	3.22
Van Buren	1,000			1,000	4.11	2		1	3	100	300	3.33
White	1,200	8,365		9,565	3.23	12		3	15	191	2,859	3.35
Other counties: Cumberland and Putnam	153,070	94,192		247,262	4.56	204		21	225	215	48,426	5.11
Total Tennessee	5,735,342	469,485	53,656	6,258,483	4.77	5,245	144	996	6,385	209	1,333,810	4.69

TEXAS (LIGNITE)

Total Texas	60,504			60,504	$0.98		15		15	240	3,600	[5] 16.81

UTAH

Carbon	4,565,866	177,209	145,676	4,888,751	$4.01	2,079		766	2,845	250	710,418	6.88
Emery	2,396,233	68,586	16,101	2,480,920	3.80	982		325	1,307	258	337,489	7.35
Grand	19,950	2,084		22,034	3.93	16		4	20	269	5,380	4.10
Iron		6,565		6,565	3.00	6		1	7	273	1,910	3.44
Kane		2,854		2,854	3.50	3		1	4	288	1,152	2.48
Summit	7,695	19,880		27,575	2.56	15		4	19	265	5,035	5.48
Total Utah	6,989,744	277,178	161,777	7,428,699	3.93	3,101		1,101	4,202	253	1,061,384	[6] 7.00

VIRGINIA

Buchanan	5,348,352	16,424	32,900	5,397,676	$4.85	3,018	132	482	3,632	250	907,036	5.95
Dickenson	2,573,383	1,710	2,989	2,578,082	5.11	1,487	54	320	1,861	256	475,782	5.42
Lee	702,812	58,352	9,040	770,204	4.89	765		95	860	227	195,061	3.95
Montgomery	146,325	10,477	2,502	159,304	4.61	173		45	218	211	46,072	3.46
Russell	1,934,955	65,854	1,097	2,001,906	5.01	897	51	224	1,172	265	310,471	6.45
Scott	73,439	10,750	1,861	86,050	4.14	85		14	99	260	25,720	3.35
Tazewell	4,286,396	52,176	42,148	4,380,720	4.94	3,473	14	650	4,137	273	1,129,835	3.88
Wise	4,358,120	44,948	393,789	4,796,857	4.49	3,511	75	567	4,153	232	964,908	4.97
Total Virginia	19,423,782	260,691	486,326	20,170,799	4.83	13,409	326	2,397	16,132	251	4,054,885	4.97

WASHINGTON

King	185,376	151,420	1,162	337,958	$5.88	259	44	115	418	216	90,379	3.74
Kittitas	460,331	22,850	19,089	502,270	6.12	382	33	166	581	257	149,339	3.36
Lewis	11,538	33,554	213	45,305	4.65	33		9	42	203	8,511	5.32
Pierce	14,175	5,235	58	19,468	6.46	19		6	25	212	5,298	3.67
Thurston	44,246	12,230	449	56,925	3.95	29	20	13	62	172	10,680	5.33
Whatcom	135,395	16,709	3,896	156,000	6.85	118		33	151	263	39,760	3.92
Total Washington	851,061	241,998	24,867	1,117,926	5.99	840	97	342	1,279	238	303,967	3.68

See footnotes at end of table.

TABLE 39.—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 1947—Continued

[Exclusive of mines producing less than 1,000 tons]

County	Production (net tons)				Average value per ton [3]	Average number of men working daily				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Shipped by rail or water [1]	Shipped by truck	Used at mine [2]	Total		Underground	Surface		Total			
							In strip pits	All others				
WEST VIRGINIA												
Barbour	3,752,324	483,666	2,861	4,238,851	$3.85	1,393	491	775	2,659	166	440,708	9.62
Boone	6,361,579	5,606	26,446	6,393,631	4.64	3,366	37	867	4,270	258	1,102,626	5.80
Braxton	3,800	55,192	----	58,992	3.90	7	24	13	44	97	4,282	13.78
Brooke	953,806	400,885	965,282	2,319,973	3.45	697	271	185	1,153	238	274,469	8.45
Clay	872,722	39,419	35,686	947,827	4.50	645	----	225	870	186	161,827	5.86
Fayette	14,632,177	126,345	645,504	15,404,026	4.96	9,106	566	1,914	11,586	265	3,068,543	5.02
Gilmer	72,069	----	----	72,069	3.05	17	35	17	69	109	7,510	9.60
Grant	60,155	9,713	----	69,868	3.82	29	67	17	113	97	10,931	6.39
Greenbrier	3,221,162	35,206	31,893	3,288,261	5.43	1,652	233	366	2,251	255	572,929	5.74
Hancock	28,091	85,389	4,937	118,417	3.55	3	38	11	52	182	9,483	12.49
Harrison	14,217,981	873,962	6,650	15,098,593	3.50	3,342	1,676	1,496	6,514	180	1,174,796	12.85
Kanawha	9,937,005	314,091	52,722	10,303,818	4.51	6,216	69	1,092	7,377	258	1,906,233	5.41
Lewis	212,576	34,295	1,500	248,371	3.71	21	44	11	76	270	20,520	12.10
Lincoln	21,168	----	----	21,168	4.60	27	----	4	31	152	4,702	4.50
Logan	23,800,481	40,963	186,855	24,028,299	4.54	10,160	58	2,782	13,000	271	3,520,116	6.83
Marion	8,402,214	275,487	528,418	9,206,119	3.71	4,273	141	1,008	5,422	219	1,185,578	7.77
Marshall	608,804	74,922	189,133	872,859	3.97	624	16	98	738	247	182,014	4.80
Mason	145,409	57,155	473	203,037	4.23	203	----	48	251	166	41,589	4.88
McDowell	24,021,141	86,455	350,010	24,457,606	4.85	14,099	42	3,438	17,579	265	4,657,551	5.25
Mercer	2,994,190	17,840	34,589	3,046,619	5.26	2,050	----	508	2,558	277	709,190	4.30
Mineral	171,593	4,310	101	176,004	4.92	87	53	36	176	148	26,111	6.74
Mingo	6,770,779	33,843	41,037	6,845,659	4.82	3,599	223	932	4,754	242	1,151,475	5.95
Monongalia	11,699,954	683,821	12,035	12,395,810	3.71	4,806	253	1,086	6,145	222	1,365,264	9.08
Nicholas	2,308,735	218,713	9,539	2,536,987	5.33	1,359	170	284	1,813	218	394,789	6.43
Ohio	1,511,626	157,116	15,027	1,683,769	3.94	1,212	----	198	1,410	246	346,189	4.86
Pocahontas	----	13,953	----	13,953	5.55	----	6	3	9	120	1,080	12.92
Preston	2,495,664	349,731	345,015	3,190,410	4.35	1,875	163	498	2,536	258	655,369	4.87
Putnam	38,372	----	----	38,372	4.46	----	14	6	20	109	2,180	17.60
Raleigh	14,975,777	51,196	157,683	15,184,656	5.01	9,423	251	2,071	11,745	263	3,089,187	4.92
Randolph	1,786,596	198,477	9,375	1,994,448	4.26	1,048	218	306	1,572	192	301,676	6.61

Taylor	1,194,859	84,726	57	1,279,642	3.69	282	238	127	647	164	105,919	12.08
Tucker	1,061,134	3,246	1,732	1,066,112	4.76	309	185	103	597	209	124,544	8.56
Upshur	665,707	92,256	4,273	762,236	3.54	411	95	119	625	156	97,263	7.84
Wayne	376,949	11,174	----------	388,123	4.06	288	----------	68	356	200	71,246	5.45
Webster	1,786,455	17,940	13,608	1,818,003	4.79	1,198	44	309	1,551	205	318,272	5.71
Wyoming	6,323,941	11,054	48,996	6,383,991	4.89	3,577	24	764	4,365	263	1,149,354	5.55
Total West Virginia	167,486,995	4,948,147	3,721,437	176,156,579	4.48	87,404	5,745	21,785	114,934	246	28,255,515	6.23
WYOMING												
Carbon	1,197,645	8,638	30,951	1,237,234	$3.43	255	65	138	458	255	116,916	10.58
Converse	----------	12,448	----------	12,448	3.09	2	5	1	8	262	2,094	5.94
Fremont	----------	8,457	96	8,553	4.30	11	----------	5	16	225	3,603	2.37
Hot Springs	49,880	19,560	62	69,502	5.38	74	----------	31	105	149	15,617	4.45
Lincoln	410,149	8,909	610	419,668	3.70	217	----------	50	267	218	58,294	7.20
Sheridan	1,142,464	35,181	2,561	1,180,206	2.45	198	112	121	431	211	90,823	12.99
Sweetwater	4,804,393	14,319	88,933	4,907,645	3.61	2,380	----------	550	2,930	244	714,657	6.87
Other counties: Campbell, Johnson, and Uinta	171,920	31,535	12,436	215,891	1.37	5	15	33	53	284	15,073	14.32
Total Wyoming	7,776,451	139,047	135,649	8,051,147	3.37	3,142	197	929	4,268	238	1,017,077	[4] 7.92
UNITED STATES												
Total United States	557,084,411	55,859,262	17,680,049	630,623,722	$4.16	311,369	29,783	78,030	419,182	234	98,297,424	6.42

[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 used by mine employees, taken by locomotive tenders at tipple, used at mine for power and heat, coal transported from mine to point of use by conveyor or tram, coal made into beehive coke at mine and all other uses at mine.

[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] Output obtained chiefly from strip pits and by use of mechanical loading devices in which type of operation production per man per day is large.

[5] Output obtained chiefly from strip pits in which the production per man per day is large.

[6] Output obtained chiefly by use of mechanical loading devices in which type of operation production per man per day is large.

STATISTICS ON LIGNITE IN 1947[3]

PRODUCTION

The production of lignite in 1947 totaled 2,873,653 net tons, an increase of 8 percent over the 2,667,619 tons produced in 1946. These figures do not include tonnage from small mines producing less than 1,000 tons. The average value per ton in 1947 was $1.92, compared with $1.68 per ton in 1946. The average number of men working daily in 1947 totaled 747, a slight decrease from the 752 men employed in 1946. The output per man per day, based upon calculated man-days, was 15.38 tons. The industry worked an average of 250 days in 1947 compared with 236 in the previous year. North Dakota produced 96 percent of the total United States output of lignite; Montana, South Dakota, and Texas together produced the remaining 4 percent.

All data are submitted on a voluntary basis by producers of lignite, and the Bureau of Mines appreciates their cooperation in supplying the information without which this report would not have been possible.

TABLE 40.—Summary of production, value, employment, days operated, man-days of labor, and output per man per day at lignite mines in the United States in 1947, by States [1]

	Montana [2]	North Dakota	South Dakota	Texas	Total
Production (net tons):					
Loaded at mines for shipment		2,228,163	420	60,504	2,289,087
Commercial sales by truck or wagon	38,469	458,278	14,158		510,905
Used by employees, taken by locomotives at tipple, and other uses	180	[3] 56,120	40		56,340
Used at mine for power and heat	20	17,301			17,321
Total production: 1947	38,669	2,759,862	14,618	60,504	2,873,653
1946	40,013	2,554,682	16,946	55,978	2,667,619
Value:					
Total: 1947	$112,198	$5,312,084	$35,727	$59,293	$5,519,302
1946	$105,331	$4,301,603	$36,362	$46,454	$4,489,750
Average per ton: 1947	$2.90	$1.92	$2.44	$0.98	$1.92
1946	$2.63	$1.68	$2.15	$0.83	$1.68
Number of men working daily:					
Underground	28	154	2		184
Surface (including strip pits)	9	526	13	15	563
Total: 1947	37	680	15	15	747
1946	39	674	14	25	752
Average number of days mines operated:					
1947	185	255	176	240	250
1946	175	241	169	248	236
Man-days of labor: 1947	6,859	173,735	2,634	3,600	186,828
Average tons per man per day: 1947	5.64	15.89	5.55	16.81	15.38

[1] Exclusive of small mines producing less than 1,000 tons.
[2] Including output from Custer, Dawson, McCone, Richland, Roosevelt, and Sheridan Counties.
[3] Includes some lignite made into briquets.

[3] Compiled by J. A. Corgan and M. I. Cooke.

TABLE 41.—Production, value, employment, days operated, man-days of labor, and output per man per day at lignite mines in the United States in 1947, by States and counties

County	Total production (net tons)	Value: Total	Value: Average per ton	Average number of men working daily	Man-days of labor	Average number of days mine operated	Average tons per man per day
MONTANA							
Custer	13,204	$40,659	$3.08	11	1,880	171	7.02
Dawson	2,704	7,597	2.81	4	720	180	3.76
McCone	1,021	2,961	2.90	2	242	121	4.22
Richland	8,357	25,232	3.02	5	1,250	250	6.69
Roosevelt	2,460	8,610	3.50	5	950	190	2.59
Sheridan	10,923	27,139	2.48	10	1,817	182	6.01
Total Montana	38,669	112,198	2.90	37	6,859	185	5.64
NORTH DAKOTA							
Adams, Bowman, and Burleigh	77,977	$177,088	$2.27	36	6,158	171	[1] 12.66
Burke	336,722	667,238	1.98	55	13,988	254	[1] 24.07
Divide	222,777	481,113	2.16	47	11,645	248	[1] 19.13
Dunn	5,200	12,750	2.45	3	640	213	8.13
Golden Valley	2,280	5,700	2.50	4	560	140	4.07
Grant	16,996	47,379	2.79	13	1,436	110	[1] 11.84
Hettinger	16,397	47,187	2.88	8	1,238	155	[1] 13.24
McLean	216,505	415,484	1.92	79	21,016	266	[1] 10.30
Mercer	1,162,075	2,054,973	1.77	234	66,830	286	[1] 17.39
Morton	34,376	80,583	2.34	28	4,978	178	6.91
Mountrail	8,000	17,500	2.19	4	624	156	[1] 12.82
Oliver	6,000	14,000	2.33	3	690	230	8.70
Stark	87,885	198,413	2.26	41	13,007	317	6.76
Ward	554,512	1,063,309	1.92	110	29,103	265	[1] 19.05
Williams	12,160	29,367	2.42	15	1,822	121	6.67
Total North Dakota	2,759,862	5,312,084	1.92	680	173,735	255	15.89
SOUTH DAKOTA							
Dewey	10,427	$29,263	$2.81	9	1,740	193	5.99
Perkins	4,191	6,464	1.54	6	894	149	4.69
Total South Dakota	14,618	35,727	2.44	15	2,634	176	5.55
TEXAS							
Total Texas, Milam	60,504	$59,293	$0.98	15	3,600	240	[1] 16.81
UNITED STATES							
Total United States	2,873,653	$5,519,302	$1.92	747	186,828	250	15.38

[1] Output is obtained chiefly from strip pits in which the production per man per day is large.

NUMBER AND SIZE OF LIGNITE MINES

For 1947 the Bureau of Mines received reports from 59 mines producing 1,000 tons or more annually. Seven mines produced 81 percent of the total lignite mined; 4 mines accounted for 9 percent; and 48 mines, 10 percent.

TABLE 42.—Number and production of lignite mines in the United States, in 1947, classified by size of output

Class	Mines		Production		
			Net tons		Percent of total
	Number	Percent	Total	Average per mine	
100,000 tons and over	7	12	2,338,488	334,070	81
50,000 and under 100,000	4	7	262,177	65,544	9
10,000 and under 50,000	6	10	111,249	18,542	4
Under 10,000 tons	42	71	161,739	3,851	6
Total	59	100	2,873,653	48,706	100

METHODS OF RECOVERY

TABLE 43.—Lignite mined by different methods in the United States in 1947, by States, in net tons

	Montana	North Dakota	South Dakota	Texas	Total
From underground workings:					
Shot off the solid	37,098	27,872	1,100		66,070
Cut by machines [1]	550	444,318			444,868
Total underground	37,648	472,190	1,100		510,938
From strip pits	1,021	2,287,672	13,518	60,504	2,362,715
Grand total production	38,669	2,759,862	14,618	60,504	2,873,653

[1] A total of 11 machines was used—6 "permissible" and 5 other types.

STRIPPING OPERATIONS

Strip-pit operations were the source of 82 percent of the total production of lignite in 1947. Of the 2,362,715 tons of lignite produced by this method of mining, 97 percent came from pits in North Dakota. The output from stripping operations in Montana, South Dakota, and Texas totaled only 75,043 tons.

TABLE 44.—Summary of stripping operations that produced lignite in the United States in 1947, by States

	Montana	North Dakota	South Dakota	Texas	Total
Number of strip pits [1]	1	30	3	1	35
Number of shovels, dragline excavators, and coal-loading machines [2]		46	3	2	51
Coal produced by stripping	1,021	2,287,672	13,518	60,504	2,362,715
Total value at mines	$2,961	$4,405,241	$33,127	$59,293	$4,500,622
Average value per ton	$2.90	$1.93	$2.45	$0.98	$1.90
Average number of men working daily:					
In strip pits	2	279	11	15	307
All others		197	1		198
Total	2	476	12	15	505
Average number of days mines operated	121	249	194	240	247
Man-days of labor	242	118,536	2,331	3,600	124,709
Average tons per man per day	4.22	19.30	5.80	16.81	18.95

[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.

CONSUMPTION

According to the Federal Power Commission, 975,566 tons of lignite were consumed in generating electric energy in 1947; this amounts to 34 percent of the total lignite mined in the United States in that year. The consumption in the West North Central States was 951,821 tons; the West South Central States and the Mountain States consumed 2,466 and 21,279 tons, respectively.

FOREIGN TRADE [4]

TABLE 45.—Bituminous coal [1] imported for consumption in the United States, 1946–48, by countries and customs districts, in net tons

[U. S. Department of Commerce]

COUNTRY	1946	1947	1948
North America:			
Canada	434, 130	288, 394	289, 839
Mexico	-------	114	1, 148
South America: Colombia	-------	6	-------
Europe:			
Netherlands	-------	130	-------
Poland and Danzig	538	1, 120	-------
United Kingdom	-------	349	350
Africa: Union of South Africa	12	28	-------
Total	434, 680	290, 141	291, 337

CUSTOMS DISTRICT	1946	1947	1948
Alaska	2, 929	7, 372	5, 755
Chicago	-------	6	-------
Dakota	548	758	868
Duluth and Superior	135	-------	42
Florida	-------	60	-------
Galveston	-------	-------	1, 193
Hawaii	-------	64	-------
Laredo	-------	114	-------
Maine and New Hampshire	133, 039	45, 418	112, 269
Massachusetts	-------	-------	193
Michigan	44	864	148
Montana and Idaho	242, 668	213, 313	153, 777
New Orleans	-------	-------	200
New York	550	1, 927	-------
Rochester	-------	-------	55
St. Lawrence	925	77	(2)
Vermont	1, 528	2, 099	1, 403
Washington	52, 164	18, 069	15, 434
Wisconsin	150	-------	-------
Total	434, 680	290, 141	291, 337

1 Includes slack, culm, and lignite.
2 Less than 1 ton.

TABLE 46.—Exports of bituminous coal, by country groups, 1944–48, in thousands of net tons

[U. S. Department of Commerce]

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"	
1944	24, 369	356	157	580	218	(2)	352	----------	1, 307	26, 032
1945	21, 589	295	191	1, 080	3, 924	(2)	873	4	6, 072	27, 956
1946	21, 882	253	160	1, 723	16, 065	201	878	37	19, 064	41, 199
1947	25, 849	369	404	2, 866	[3] 36, 703	311	2, 057	108	[3] 42, 449	[3] 68, 667
1948	25, 845	214	159	1, 867	16, 088	765	961	26	19, 866	45, 925

1 Includes Bahamas and Panama.
2 Less than 1,000 net tons.
3 Excludes 102,179 tons ($1,010,820) exported to Austria as a part of the Army Civilian Supply Program.

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.

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TABLE 47.—Bituminous coal exported from the United States, 1946–48, by countries, in net tons [1]

[U. S. Department of Commerce]

Country	1946	1947	1948
North America:			
Bermuda	2,555	14,567	3,508
Canada	21,879,705	25,848,117	25,842,797
Central America:			
British Honduras	76	30	4
Canal Zone	9,554	34,342	22,207
Costa Rica	62	50	3,177
El Salvador	77	128	86
Guatemala	253	257	230
Honduras	262	302	293
Nicaragua	10	8	
Panama, Republic of	50	35	45
Greenland	4,110	4,493	
Iceland		57,627	
Mexico	1,688	694	1,593
Miquelon and St. Pierre		4,864	500
Newfoundland and Labrador	153,212	321,553	154,932
West Indies:			
British:			
Barbados	1,269	2,574	1,225
Jamaica	65,604	89,339	48,890
Leeward and Windward		14,800	
Trinidad and Tobago	68,038	100,797	57,675
Other British	24	491	5
Cuba	99,798	98,277	76,471
Curaçao (N. W. I.)	63	374	2,004
Dominican Republic	3,175	7,309	625
French	5,504	20,448	1,910
Haiti		2	15
Total	22,295,089	26,621,478	26,218,192
South America:			
Argentina	486,809	1,113,734	826,750
Bolivia	28,211	329	511
Brazil	1,083,379	1,468,312	959,323
Chile	17,372	163,693	27,634
Surinam	577	2,570	3,875
Uruguay	105,458	117,135	48,705
Other South America	787	500	276
Total	1,722,593	2,866,273	1,867,074
Europe:			
Austria		[2] 122,391	58,447
Azores	1,608	6,966	
Belgium and Luxembourg	887,957	3,363,800	630,604
Denmark	1,059,596	2,377,583	52,098
Finland	250,171	637,271	6,273
France	5,092,481	12,466,388	8,454,460
Germany		42,630	70,777
Gibraltar	9,330	156,872	
Greece	91,676	34,056	62,830
Ireland		1,005,584	8
Italy	4,687,950	8,780,259	4,696,415
Netherlands	1,607,383	2,691,248	770,761
Norway	744,277	738,735	
Portugal	455,024	846,901	257,230
Sweden	860,854	2,074,092	587,322
Switzerland	307,586	683,400	420,621
United Kingdom		675,043	
Other Europe	18,310		20,117
Total	16,074,203	[2] 36,703,219	16,087,963
Asia:			
British Malaya	58,940	99,519	
China	88,321	4,234	40,078
French Indochina	14,494	2,520	
Hong Kong	39,696	92,203	
India		10	32,376
Japan			688,776
Netherlands Indies		95,417	
Palestine and Trans-Jordan		3,436	
Syria		13,667	
Other Asia	11	23	3,934
Total	201,462	311,029	765,164

See footnotes at end of table.

TABLE 47.—Bituminous coal exported from the United States, 1946–48, by countries, in net tons [1]—Continued

Country	1946	1947	1948
Africa:			
Algeria	551,350	1,052,370	556,686
Belgian Congo		14,151	
British West Africa		36,425	
Canary Islands		51,822	2,082
Cape Verde Islands	25,685	89,354	
Egypt	85,399	298,135	27,596
French West Africa	40,505	244,643	132,668
Libya		27,083	
Madeira Islands	27,838	21,491	
Morocco, French	47,031	92,020	169,551
Spanish Africa		114,311	22,481
Tunisia	99,931	14,531	
Other Africa	5	1,075	49,676
Total	877,744	2,057,411	960,740
Oceania	37,487	107,553	26,192
Grand total	41,208,578	[2] 68,666,963	45,925,325

[1] Amounts stated do not include fuel or bunker coal loaded on vessels engaged in foreign trade, which aggregated 1,380,514 tons in 1946, 1,689,328 tons in 1947, and 1,057,118 tons in 1948.
[2] Excludes 102,179 tons ($1,010,820) exported to Austria as a part of the Army Civilian Supply program.

TABLE 48.—Bituminous coal exported from the United States, 1946–48, by customs districts, in net tons

[U. S. Department of Commerce]

Customs district	1946	1947	1948
North Atlantic:			
Maine and New Hampshire	33,495	57,408	5,586
Massachusetts	1,691	61	
New York	701,602	1,382,037	23,788
Philadelphia	2,492,021	2,740,855	453,540
Rhode Island	73		
South Atlantic:			
Georgia		10,708	
Maryland	6,450,702	10,871,709	3,471,674
North Carolina	4,501		
South Carolina	1,369,553	1,825,197	768,520
Virginia	4,437,316	20,146,083	13,822,963
Gulf Coast:			
Florida	1,363,403	2,015,102	330,455
Galveston	633,911	463,494	
Mobile	809,566	1,427,881	617,042
New Orleans	20,129	315,944	7,968
Sabine	531,302	731,418	
Mexican border:			
Arizona	264	272	273
El Paso	58	45	1,138
Laredo	27	27	
Pacific Coast:			
Los Angeles	334,727	142,522	100
Oregon	138,019	379,239	10,982
San Diego	92	83	125
San Francisco	15	20	69
Washington	92,037	301,035	134,461
Northern border:			
Buffalo	1,580,304	1,548,629	1,103,124
Chicago	1,199,033	1,505,335	1,633,134
Dakota	30,360	23,392	36,373
Duluth and Superior	300,414	385,036	340,995
Michigan	2,369,744	3,046,644	3,127,640
Montana and Idaho	48	4,431	723
Ohio	10,433,093	11,619,905	13,314,027
Rochester	2,899,833	3,829,918	3,465,712
St. Lawrence	2,876,940	3,677,266	2,815,519
Vermont	2,517	4,106	5,041
Wisconsin	538	193	

TABLE 48.—Bituminous coal exported from the United States, 1946–48, by customs districts, in net tons—Continued

Customs district	1946	1947	1948
Miscellaneous:			
Alaska	413	204	283
Colorado		3,037	
Hawaii	70,346	3,282	
Indiana		5	
Minnesota	5,984		
Pittsburgh	3,381	11,210	
Puerto Rico	4	325	
St. Louis	12,298		
Total	[1] 41,208,578	[2] 68,666,963	[2] 45,925,325

[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.
[2] Includes 192,905 tons in 1947 and 434,070 tons in 1948, representing shipments on vessels operated by the United States Army or Navy. Excludes 102,179 tons exported to Austria in 1947 as a part of the Army Civilian Supply Program.

TABLE 49.—Shipments of bituminous coal to noncontiguous Territories, 1946–48

[U. S. Department of Commerce]

Territory	1946		1947		1948	
	Net tons	Value	Net tons	Value	Net tons	Value
Alaska [1]	7,865	$111,451	6,860	$112,272	(2)	(2)
Hawaii	259	7,174	365	10,135	(2)	(2)
Puerto Rico	11,526	73,121	9,148	78,593	1,500	$15,607
Virgin Islands	53,771	361,170	44,514	334,149	25,799	264,564

[1] Includes shipments of anthracite.
[2] Beginning Apr. 1, 1948, no data available.

WORLD PRODUCTION

TABLE 50.—World production of coal and lignite, 1941–48, by countries, in thousands of metric tons [1]

[Compiled by B. B. Mitchell and P. Roberts]

Country [1]	1941	1942	1943	1944	1945	1946	1947	1948
North America:								
Canada:								
Coal	[2] 15,333	[2] 15,932	[2] 14,689	14,201	13,584	14,776	12,971	15,283
Lignite	[2] 1,201	[2] 1,181	[2] 1,512	1,245	1,391	1,382	1,425	1,441
Greenland	7	5	7	8	7	8	7	8
Mexico	856	914	1,025	904	915	977	1,055	(3)
United States:								
Anthracite (Pennsylvania)	51,136	54,728	55,015	57,789	49,835	54,891	51,882	51,836
Bituminous	463,908	525,948	532,903	559,750	521,582	481,943	569,482	536,071
Lignite	2,518	2,659	2,494	2,317	2,421	2,420	2,607	2,794
South America:								
Argentina [4]	(5)	5	8	9	7	3	14	(3)
Brazil:								
Coal	1,110	1,354	1,537	1,415	1,492	1,274	1,980	2,013
Lignite	2	17	23	16	9	(3)	(3)	(3)
Chile	1,717	1,782	2,032	2,047	1,827	1,740	1,850	2,239
Colombia	403	415	476	499	[6] 525	[6] 550	[6] 850	(3)
Peru	117	150	187	173	201	230	215	187
Venezuela	6	9	11	12	7	4	15	21

See footnotes at end of table.

TABLE 50.—World production of coal and lignite, 1941–48, by countries, in thousands of metric tons[1]—Continued

Country[1]	1941	1942	1943	1944	1945	1946	1947	1948
Europe:								
Albania: Lignite[6]	20	20	10	5	5	12	20	(3)
Austria:								
Coal	226	225	214	195	72	108	178	181
Lignite	3,537	3,523	3,646	3,674	2,066	2,407	2,839	3,338
Belgium	26,722	25,055	23,737	13,529	15,833	22,779	24,390	26,679
Bulgaria:								
Coal	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Lignite	2,784	3,444	3,816	2,892	3,432	3,420	4,011	(3)
Czechoslovakia:								
Coal	20,930	22,635	24,500	23,159	11,716	14,167	16,216	17,746
Lignite	21,623	23,316	26,750	26,112	15,356	19,475	22,362	23,589
Denmark: Lignite	1,000	1,800	2,600	2,200	2,320	2,300	2,800	(3)
France:								
Coal	41,849	41,869	40,531	25,241	33,313	47,185	45,229	43,291
Lignite	2,008	1,958	1,896	1,336	1,704	2,104	2,094	1,838
Germany:								
Coal	243,607	251,970	158,616	135,336	41,208	65,688	85,773	91,246
Lignite	234,996	244,643	254,604	230,808	107,772	159,876	160,518	175,736
Greece: Lignite	180	365	370	190	70	125	140	125
Hungary:								
Coal	1,301	1,250	1,376	[7, 8] 1,050	[7] 710	722	1,059	1,238
Lignite	11,298	11,720	11,296	[7, 8] 8,400	[7] 3,580	5,630	7,750	9,360
Ireland	155	167	186	206	216	216	222	180
Italy:								
Coal	2,393	2,512	1,358	613	758	1,178	1,358	[6] 1,055
Lignite	2,030	2,306	1,934	496	767	1,521	1,851	[6] 909
Netherlands:								
Coal	13,356	12,330	12,497	8,313	5,097	8,314	10,104	11,032
Lignite	199	281	383	243	130	499	474	279
Poland:								
Coal	[9] 76,343	[9] 83,972	[9] 91,362	[9] 87,389	27,366	47,288	59,130	70,260
Lignite	(3)	(3)	(3)	(3)	(3)	857	4,766	5,018
Portugal:								
Coal	435	438	403	426	436	380	377	387
Lignite	84	108	106	127	163	141	108	103
Rumania:								
Coal	264	285	306	202	211	167	163	2,631
Lignite	2,195	2,367	2,604	2,069	1,820	1,784	2,105	
Saar	(3)	(3)	(3)	(3)	(3)	7,887	10,485	12,567
Spain:								
Coal	8,763	9,257	9,591	10,485	10,732	10,759	10,606	10,277
Lignite	793	1,106	1,112	1,202	1,351	1,336	1,263	1,342
Svalbard (Spitsbergen)	330	------	------	------	6	92	345	431
Sweden	557	582	557	570	615	488	416	[6] 400
Switzerland:								
Coal	72	184	157	71	311	178	20	(3)
Lignite	8	27	75	74			15	(3)
U. S. S. R.:								
Coal	146,800	[6] 90,000	[6] 131,400	[6] 118,000	[6] 146,000	[6] 161,000	[6] 175,000	[6] 201,000
Lignite			(3)	(3)	(3)			
United Kingdom:								
Great Britain[10]	209,656	208,234	202,112	195,839	185,706	194,869	200,615	211,772
Northern Ireland:								
Coal	(5)	3	(5)	(5)	(5)	(5)	1	1
Lignite	(5)	1	1	2	3	(5)	(5)	(5)
Yugoslavia:								
Coal / Lignite	7,310	[11, 12] 1,160	1,390	(3)	(3)	10,207	13,943	11,500
Asia:								
China:								
China (except Formosa):								
Coal	58,426	65,267	[6] 62,713	[6] 62,465	[6] 16,200	[6] 15,000	[6] 20,000	[6] 8,720
Lignite	397	419			(3)	(3)	(3)	(3)
Formosa	2,885	[6] 2,360	[6] 2,500	[6] 2,500	795	1,058	1,289	[6] 2,500
India	29,937	29,906	25,921	26,546	29,635	30,186	29,438	30,786
Indochina, French:								
Coal	2,308	1,218	996	533	231	262	248	359
Lignite	21	24	25	4	------	------	------	------
Indonesia	[6] 2,029	872	1,038	753	(3)	77	[13] 288	(3)
Iran[14]	90	82	69	100	[6] 150	[6] 150	188	(3)
Japan:								
Coal	[15] 55,602	[15] 54,179	[15] 55,539	[15] 49,335	[15] 22,371	19,823	26,331	32,700
Lignite	[15] 408	[15] 1,607	[15] 2,876	[15] 2,304	[15] 1,643	2,356	2,820	2,550

See footnotes at end of table.

TABLE 50.—World production of coal and lignite, 1941–48, by countries, in thousands of metric tons [1]—Continued

Country [1]	1941	1942	1943	1944	1945	1946	1947	1948
Asia—Continued								
Korea:								
Coal	3,519	3,898	4,157	4,530	674	1,072	[6] 1,815	[16] 699
Lignite	2,638	2,958	2,430	2,519	18	458	[6] 1,653	[16] 68
Malaya, Federation of	[17] 523	249	497	416	230	228	230	381
Philippines, Republic of	[6] 60	([3])	([3])	([3])	([3])	48	74	88
Syria and Lebanon: Lignite	8	7	1	2	2	([5])	([3])	([5])
Turkey:								
Coal	3,020	2,510	2,071	2,383	2,150	2,312	2,623	2,618
Lignite	264	409	414	533	571	484	628	829
U. S. S. R.: Coal, Lignite	([18])	([18])	([18])	([18])	([18])	([18])	([18])	([18])
Africa:								
Algeria:								
Coal	80	148	117	120	162	215	205	225
Lignite	3	7	1	1	([3])	([3])	([3])	([3])
Belgian Congo	30	43	69	49	50	102	109	[17] 75
Madagascar	1	2	1	2	3	([5])	([3])	([3])
Morocco, French	139	119	102	134	179	222	268	290
Nigeria	[15] 409	[15] 471	([3])	651	679	648	591	[6] 600
Portuguese East Africa	17	7	13	16	12	16	16	([3])
Southern Rhodesia	1,412	1,561	1,779	1,808	1,669	1,613	1,508	1,695
Tunisia: Lignite	102	141	41	66	69	95	76	71
Union of South Africa	18,337	20,408	20,561	22,595	23,102	23,255	23,818	[20] 23,558
Oceania:								
Afghanistan	4	5	---------	---------	5	3	5	[19] 15
Australia:								
New South Wales	11,955	12,433	11,714	11,280	10,402	11,397	11,871	[6] 12,193
Queensland	1,477	1,663	1,727	1,686	1,661	1,593	1,914	1,775
South Australia	---------	2	---------	35	42	138	196	253
Tasmania	111	137	148	146	151	161	170	182
Victoria:								
Coal	332	318	292	262	251	194	176	[17] 129
Lignite	4,639	5,013	5,173	5,097	5,533	5,799	6,239	[17] 5,144
Western Australia	566	591	540	567	552	653	742	745
New Zealand:								
Coal	1,199	1,194	1,157	1,085	980	974	951	2,827 (Coal and Lignite)
Lignite	1,483	1,529	1,676	1,766	1,899	1,865	1,845	
Total, all grades	1,827,000	1,867,000	1,831,000	1,756,000	1,349,000	1,478,000	1,652,000	1,689,000
Lignite (total of items shown above)	297,000	313,000	328,000	308,000	166,000	216,000	230,000	241,000
Bituminous coal and anthracite (by subtraction)	1,530,000	1,554,000	1,503,000	1,448,000	1,183,000	1,262,000	1,422,000	1,448,000

[1] Coal is also mined in British Borneo, Faroe Islands, and formerly Italian East Africa, but production figures are not available and no estimate is included in the total.
[2] A change from previous years has been made in the classification adopted by the American Society for Testing Materials. (Alberta is the only Province affected.)
[3] Data not available; estimate included in total.
[4] In addition, the following quantities (metric tons) of asphaltite were produced and used as solid fuels: 1941, 16,646; 1942, 56,387; 1943, 105,625; 1944, 106,300; 1945, 135,300; 1946, 83,800; 1947, 80,900.
[5] Production less than 1,000 tons.
[6] Estimate.
[7] Data represent Trianon Hungary subsequent to October 1944.
[8] January to October, inclusive.
[9] Includes that part of Germany which is under Polish administration (east of the Oder and Neisse Rivers).
[10] Includes open-cast coal as follows, in thousands of tons: 1942, 1,332; 1943, 4,498; 1944, 8,786; 1945, 8,245; 1946, 9,053; 1947, 10,407; 1948, 11,916.
[11] Estimated production of Croatia.
[12] January to June, inclusive.
[13] Excludes production of Ombilin mines in Sumatra.
[14] Fiscal year ended March 20 of year following that stated.
[15] Fiscal year ended March 31 of year following that stated.
[16] South Korea only.
[17] January to September, inclusive.
[18] Output from U. S. S. R. in Asia included with U. S. S. R. in Europe.
[19] Planned production.
[20] Local sales and exports.

Coal—Pennsylvania Anthracite

By J. A. CORGAN AND MARIAN I. COOKE

GENERAL SUMMARY

THE PRODUCTION of Pennsylvania anthracite in 1948 totaled 57,139,948 net tons compared with 57,190,009 tons in 1947. A sharp decline in exports of anthracite to European countries and strong competition from other fuels will contribute to a decline in production and demand for anthracite in 1949.

According to the United States Weather Bureau, the 1948–49 winter season in the primary anthracite market area was one of the warmest on record. For example, the number of degree-days reported for New York City, a large consumer of anthracite (6,296,000 tons in 1948), was 15 percent less for the period September 1 to December 26, 1948, than for the similar period in 1947 and 19 percent less than normal. Inasmuch as about 80 percent of the anthracite shipments is normally consumed for space-heating purposes, the over-all consumption is affected directly by the intensity of the weather. The full impact of the warm weather in the 1948–49 winter season will be reflected in decreased production for the calendar year 1949 due to stocks probably accrued by consumers in 1948.

Although exports of anthracite to Canada increased about 10 percent over 1947, European shipments declined about 57 percent, reresulting in an over-all decline in exports of about 22 percent, or 1,834,000 tons.

Deep mines increased production slightly in 1948, accounting for 65 percent of the total output. Strip pits contributed 23 percent, a 6-percent increase over 1947, whereas culm banks accounted for only 10 percent of the production, a 12-percent decline from the 1947 output and 41 percent less than the wartime high in 1944. The remaining 2 percent was recovered from the rivers draining the anthracite fields.

The mines worked 265 days in 1948; the average number of employees totaled 76,215 men, producing an average of 2.81 tons per man per day.

Although anthracite was distributed widely during the 1948–49 coal year, the New England and Middle Atlantic States, Maryland, Delaware, and the District of Columbia received 83 percent of the total shipments; other States received 4 percent; and shipments to Canada and other foreign countries accounted for 13 percent.

Statistical Trends.—Tables 1 and 2 present pertinent statistical data on the Pennsylvania anthracite industry.

TABLE 1.—Salient statistics of Pennsylvania anthracite industry, 1944–48

	1944	1945	1946	1947	1948
Production:					
Loaded at mines for shipment:					
Breakers net tons	53,067,227	[1] 45,249,706	50,115,427	[1] 48,073,153	47,816,627
Washeries do	3,492,187	[1] 2,551,426	3,106,521	[1] 2,009,233	1,725,124
Dredges do	1,081,156	741,319	886,639	970,027	941,441
Sold to local trade and used by employees net tons	3,765,641	4,273,864	4,435,536	4,232,871	4,795,721
Used at collieries for power and heat net tons	2,295,152	2,117,594	1,962,750	1,904,725	1,861,035
Total production do	63,701,363	54,933,909	60,506,873	57,190,009	57,139,948
Value at breaker, washery, or dredge	$354,582,884	$323,944,435	$413,417,070	$413,019,486	$467,051,800
Average sales realization per net ton on breaker shipments:					
Domestic:					
Lump and Broken	$7.47	$8.02	$9.23	$10.07	$11.19
Egg	$7.56	$8.13	$9.38	$10.08	$11.22
Stove	$7.57	$8.10	$9.40	$10.03	$11.29
Chestnut	$7.58	$8.12	$9.42	$10.05	$11.29
Pea	$6.11	$6.62	$7.79	$8.23	$9.35
Total domestic	$7.38	$7.93	$9.21	$9.82	$11.05
Steam:					
Buckwheat No. 1	$4.52	$4.79	$5.53	$5.82	$6.46
Buckwheat No. 2 (Rice)	$3.59	$3.91	$4.52	$4.83	$5.45
Buckwheat No. 3 (Barley)	$2.53	$2.65	$3.11	$3.56	$4.09
Buckwheat No. 4	$1.82	$1.85	$2.09	[2] $2.46	$2.89
Other (including silt)	$1.39	$1.58	$1.90	[2] $2.06	$2.50
Total steam	$3.42	$3.56	$4.08	$4.32	$4.90
Total all sizes	$5.91	$6.26	$7.25	$7.65	$8.67
Percent by sizes in total breaker shipments:					
Domestic:					
Lump and Broken	0.3	0.3	0.3	0.5	0.5
Egg	7.1	6.5	6.3	5.8	6.0
Stove	21.9	21.7	22.0	21.7	22.5
Chestnut	25.2	25.5	25.8	25.1	24.9
Pea	8.3	7.8	7.4	7.3	7.4
Total domestic	62.8	61.8	61.8	60.4	61.3
Steam:					
Buckwheat No. 1	14.2	14.1	13.9	13.5	13.3
Buckwheat No. 2 (Rice)	8.5	8.1	7.8	7.7	7.8
Buckwheat No. 3 (Barley)	9.7	9.9	9.8	10.2	9.9
Buckwheat No. 4	3.1	3.6	4.0	[2] 5.1	4.3
Other (including silt)	1.7	2.5	2.7	[2] 3.1	3.4
Total steam	37.2	38.2	38.2	39.6	38.7
Producers' stocks [3] net tons	445,000	130,000	251,168	702,109	963,839
Exports [4] do	4,186,000	3,691,000	6,497,245	8,509,995	6,675,914
Imports [4] do	12,000	149	9,556	10,350	945
Consumption (apparent) do	59,400,000	51,600,000	53,900,000	48,200,000	50,200,000
Average number of days worked	292	269	271	259	265
Average number of men employed	77,591	72,842	78,145	78,600	76,215
Output per man per day net tons	2.79	2.79	2.84	2.78	2.81
Output per man per year do	815	751	770	720	745
Quantity cut by machines do	1,336,082	1,210,171	1,232,828	1,209,983	1,016,757
Quantity mined by stripping do	10,953,030	10,056,325	12,858,930	12,603,545	13,352,874
Quantity loaded by machines underground net tons	14,975,146	13,927,955	15,619,162	16,054,011	15,742,368
Distribution:					
Total receipts in New England [5] net tons	6,222,000	5,081,000	5,643,076	4,737,946	4,862,834
Exports to Canada [4] do	4,144,000	3,393,000	4,513,637	4,470,034	4,931,918
Loaded into vessels at Lake Erie [6] net tons	1,066,000	1,234,000	1,112,996	936,040	1,125,050
Receipts at Duluth-Superior [7] do	580,000	766,000	639,900	446,605	538,992

[1] Small quantity of washery coal included with "Breakers."
[2] Revised figure.
[3] Anthracite Committee.
[4] U. S. Department of Commerce.
[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, Duluth, Minn.

TABLE 2.—Statistical summary of monthly developments in the Pennsylvania anthracite industry in 1948

[All tonnage figures represent net tons]

	1948														1947 (total)
	January	February	March	April	May	June	July	August	September	October	November	December	Total	Change from 1947 (percent)	
Production (including mine fuel, local sales, and dredge coal)	4,929,000	4,682,000	4,935,000	4,445,000	4,874,000	4,597,000	4,372,000	5,129,000	5,015,000	4,969,000	4,687,000	4,506,000	57,140,000	−0.1	57,190,000
Shipments (breakers and washeries only, all sizes):															
By rail [1]	3,671,816	3,555,870	4,093,330	4,066,541	4,252,758	4,098,482	3,662,721	4,474,886	4,240,908	4,162,354	3,601,596	3,417,119	47,298,381	−2.0	48,239,899
By truck [2]	791,656	803,077	724,253	577,890	585,467	556,038	526,464	482,944	545,118	699,617	562,657	755,014	7,610,195	+9.3	6,961,684
Carloadings [3]	71,706	69,147	80,766	78,572	82,021	78,308	73,638	86,768	81,064	78,775	70,343	66,577	917,685	−.9	925,973
Distribution:															
Lake Erie loadings [4]	--------	--------	--------	142,948	167,089	199,428	159,011	114,202	100,106	137,328	104,938	--------	1,125,050	+20.2	936,040
Lake Ontario loadings [5]	--------	--------	--------	13,865	29,227	35,840	11,272	29,634	49,089	9,490	18,835	--------	197,252	−14.9	231,768
Receipts at Duluth-Superior [6]	--------	--------	--------	18,950	80,069	97,453	62,707	71,906	59,561	85,012	63,334	--------	538,992	+20.7	446,605
Upper Lake dock trade: [7]															
Receipts:															
Lake Superior	--------	--------	--------	26,687	80,062	102,026	62,823	85,743	59,548	92,841	63,342	--------	573,072	+21.8	470,323
Lake Michigan	1,601	1,823	1,634	80,646	58,279	85,133	76,674	52,360	44,843	29,500	47,721	4,577	484,791	+27.3	380,697
Deliveries (reloadings):															
Lake Superior	71,257	45,920	9,046	5,619	26,910	51,185	39,854	46,533	45,418	63,306	57,819	45,136	508,003	−1.6	516,021
Lake Michigan	46,008	50,955	36,754	30,770	38,408	54,362	41,714	39,319	41,408	35,881	19,581	28,460	463,620	+35.3	342,585
New England receipts:															
By tide [8]	17,049	11,459	15,720	27,694	20,954	19,408	14,081	24,711	17,070	15,269	22,179	11,334	216,928	−9.5	239,779
By rail [8]	316,147	362,499	474,545	329,338	392,811	425,015	273,990	464,508	410,408	402,149	418,847	375,649	4,645,906	+3.3	4,498,167
Exports [9]	395,984	412,423	604,367	670,771	628,255	611,908	449,364	690,531	692,169	642,129	469,640	408,373	6,675,914	−21.6	8,509,995
Imports [9]	--------	--------	1	800	144	--------	--------	--------	--------	--------	--------	--------	945	−90.9	10,350
Industrial consumption and stocks by:															
Railroads (class 1 only): [8]															
Consumption	104,408	103,153	95,263	103,740	73,625	63,720	53,971	46,438	48,120	60,667	68,940	83,018	905,063	−3.8	940,613
Stocks	95,094	86,338	83,580	76,977	75,181	87,768	81,809	86,348	99,368	101,226	103,847	96,792	96,792	−15.5	114,515
Electric-power utilities: [10]															
Consumption	339,057	318,136	333,526	328,310	314,190	308,061	331,501	349,376	339,770	352,055	325,355	326,628	3,965,965	+12.6	3,522,042
Stocks	2,086,553	2,021,135	2,025,925	2,013,304	2,112,374	2,247,587	2,276,923	2,382,864	2,474,822	2,544,504	2,545,109	2,483,372	2,483,372	+12.4	2,208,583
Stocks on Upper Lake Docks: [7]															
Lake Superior	89,840	33,732	6,927	27,995	80,871	131,841	154,809	194,019	208,147	237,682	243,202	198,065	198,065	+23.1	160,933
Lake Michigan	113,478	64,346	29,207	77,122	96,948	127,719	167,607	180,648	184,083	177,702	205,842	181,959	181,959	+15.2	157,915
Producers' stocks [11]	510,610	320,405	256,098	152,803	95,847	63,467	51,043	135,408	412,682	703,383	971,123	963,839	963,839	+37.3	702,109

See footnotes at end of table.

TABLE 2.—Statistical summary of monthly developments in the Pennsylvania anthracite industry in 1948—Continued

[All tonnage figures represent net tons]

	1948														1947 (total)
	January	February	March	April	May	June	July	August	September	October	November	December	Total	Change from 1947 (percent)	
Sales of mechanical stokers:[9]															
Class 1 (capacity under 61 lb. of coal per hour)	328	717	412	566	765	890	1,076	1,202	1,407	978	696	487	9,524	+183.1	3,364
Class 2 (capacity 61 to 100 lb. of coal per hour)	39	55	34	21	39	58	73	66	128	145	59	44	761	+94.6	391
Wholesale price indices (1926=100):[12]															
On tracks, destination:															
Chestnut	121.2	121.3	121.5	121.5	122.4	124.0	128.1	132.5	132.5	132.6	132.6	132.5	126.9	+10.5	114.8
Pea	137.4	137.6	137.8	137.8	139.0	140.9	146.1	151.7	152.2	152.0	152.0	152.1	144.7	+11.2	130.1
Labor conditions:[12]															
Average weekly earnings	$68.79	$65.78	$71.59	$55.05	$69.89	$68.91	$55.11	$72.77	$69.35	$73.74	$60.90	$63.39	$66.27	+5.7	$62.69
Average hourly earnings	$1.764	$1.817	$1.776	$1.708	$1.774	$1.749	$1.736	$1.901	$1.897	$1.904	$1.824	$1.862	$1.811	+8.6	$1.668
Average hours worked per week	39.0	36.2	40.3	32.1	39.4	39.4	31.7	38.3	36.6	38.7	33.4	34.0	36.6	−2.7	37.6
Index of employment (1939 average=100)	91.1	91.6	92.6	91.9	91.4	92.6	91.1	92.9	92.7	91.7	92.1	92.0	92.0	+.5	91.5
Index of pay-roll totals (1939 average=100)	242.4	232.8	255.9	195.4	246.2	246.0	193.3	260.3	247.3	260.4	216.0	224.6	235.1	+5.5	222.8

[1] Furnished by Anthracite Institute.
[2] Pennsylvania Department of Mines.
[3] Association of American Railroads.
[4] Ore and Coal Exchange, Cleveland, Ohio.
[5] Buffalo Branch, Ore and Coal Exchange, Cleveland, Ohio.
[6] U. S. Engineer Office, Duluth, Minn.
[7] 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.
[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 nearest available date to the end of the month.
[12] Bureau of Labor Statistics.

Anthracite Committee.—The Anthracite Committee, supported by producers representing a large percentage of the total anthracite output, in addition to its regular activities which include the compilation of current data on production, employment, requirements, and other important phases of the industry, kept the operators informed on "bootleg" mining operations. Since the passage of the Anthracite Standards Law, P. L. 168, by the 1947 Legislature of the Commonwealth of Pennsylvania, the Anthracite Committee's activity on coal inspections has broadened to include all producers in the anthracite industry. This law applies to the sizes of anthracite commonly known as Broken, Egg, Stove, Chestnut, Pea, Buckwheat, and Rice. The act fixes standards for these sizes of anthracite, including the maximum amount of undersize permitted in any of these sizes and the maximum amount of the ash content or, in the case of Broken, Egg, Stove, Chestnut, and Pea sizes, the maximum percentage of slate and bone. The committee is making every effort to encourage preparation of anthracite which meets the specifications set forth in the act. Standard anthracite specifications approved and adopted by the Anthracite Committee, effective July 28, 1947, are shown in Minerals Yearbook, 1947, p. 342.

Anthracite Institute.—The Anthracite Institute, through its information services, continued to keep anthracite producers apprised of the many facts relating to competitive fuels, as well as matters relating to freight rates, State legislation, and many other subjects of interest to the industry. Representatives of the institute appeared before various Government agencies to oppose extension of natural-gas pipe lines into the anthracite markets and increased freight rates on anthracite shipments. A large advertising and promotion campaign, to stimulate buying of anthracite and anthracite-burning equipment, was begun by the institute in 1948. Consumer advertisements appeared in leading newspapers of the anthracite-marketing area throughout the year, and these were supplemented by advertising in magazines and trade journals. This advertising campaign was largely responsible for anthracite consumers filling their coal bins during the spring and summer months of 1948. Dealer training, a program of the institute concerned chiefly with retail merchandizing, including thermostats, anthracite stokers, heater conditioning, etc., was continued and expanded in 1948. Extensive research on various phases of the utilization of anthracite was carried on in the institute's large laboratory at Wilkes-Barre, Pa. For details on research by the institute see the Research and Technology section of this chapter.

Labor Relations.—There was no major labor disturbance in the anthracite fields in 1948. The wage agreement between the anthracite operators and the United Mine Workers of America dated June 7, 1946, which was amended July 10, 1947, was amended further, effective July 16, 1948, to provide for a wage increase of $1 a day (doubling to 20 cents the royalty on each ton of anthracite produced for use or for sale) and to provide for a pension program under the Anthracite Health and Welfare Fund. The contract stated that the 1949 vacation period shall commence at the beginning of the morning shift on Saturday, June 25, 1949, and end at the beginning of the morning shift on Tuesday, July 5, 1949. The payment of $100 for the vacation was continued in 1949.

The first payment of the $100-a-month pension was made September 17, 1948, in a ceremony at Hazelton, Pa., when three anthracite miners, one each from United Mine Worker districts 1, 7, and 9, received their $100-a-month pension checks from John L. Lewis, president of the United Mine Workers.

Research and Technology.—The fluidized bed process for producing fuel and synthesis gas from anthracite silt and the pelletization or the upgrading of fine sizes of anthracite by extrusion under great pressure were two research projects receiving considerable attention by the Anthracite Institute. Pilot plants for this work have been designed and constructed. The Anthracite Institute estimates that there is well over 100,000,000 tons of silt above ground in the anthracite region that can be used for producing fuel and synthesis gas and that over 6,000,000 tons are produced annually. Work on the control of mine dust was continued by the industry, a modern dust laboratory being installed in the institute building to assist in this work.

The Joint Technical Committee of the Anthracite, Bituminous Coal, and Coke Industries continued its research work on common objectives and through the University of Illinois prepared and disseminated to home builders designs showing approved architectural methods of adapting homes to the use of coal or coke.

The Anthracite Institute, in cooperation with the Commonwealth of Pennsylvania, continued its sponsorship of research on new and improved uses for anthracite at the Mineral Industries Experiment Station of Pennsylvania State College. Problems associated with the recovery, upgrading, and utilization of fine sizes and fundamental investigations in long-range problems on utilization of the larger sizes have been stressed in the experimental work. Field studies on proposed and established processes for the recovery and cleaning of fines are being made, the primary objective being evaluation and comparison of various performances with respect to recovery and size limitations for effective cleaning and over-all efficiency.

Studies have been continued on the blending of anthrafines in coke manufacture to determine the strength and size degradation of commercial cokes made with anthrafines; the work includes also studies on methods of reducing pressures developed during carbonization and investigation of the blending compatibility of anthrafines. Investigations on the use of anthracite as cupola fuel were extended to obtain new information on the best conditions for the use of the larger sizes in high-speed melting operations.

The Bureau of Mines continued investigative work begun in 1944 in the anthracite fields on increasing the underground output per man per day of anthracite through new and improved methods of mining anthracite mechanically. In 1948, 42 percent of the total underground production was loaded mechanically. The coal beds in the Wyoming region are relatively flat and are more adaptable to present mechanical mining methods than the pitching seams in the Lehigh and Schuylkill regions; accordingly, 59 percent of the underground output of the Wyoming region was mechanically loaded in 1948, whereas only 15 percent of the combined output of the last two regions was so loaded. The first and second progress reports on anthracite mechanical mining investigations were released in August

1949.[1] These reports contain many illustrations and describe in some detail preliminary underground tests of the Bureau of Mines scraper-shaker loading machine for driving gangways and the Eickhoff shearing machine, model DEK.

The Bureau of Mines began research on underground water pools in the anthracite region in 1945 as part of its technologic investigations of the anthracite mine-water problem; the Bureau's work in this field has expanded greatly since that time. For many years a number of companies did considerable independent work on the control of mine water and flood prevention. To be successful generally, however, a program of this type should have the cooperation of the Federal Government, the Commonwealth of Pennsylvania, and the producers, as conservation of coal reserves and other benefits derived concern all three parties. The ultimate aim of the Bureau's anthracite-mine flood-prevention projects is to prevent as much water as possible from entering the mines to improve safety conditions, preserve valuable reserves of coal, and reduce operating costs by cutting the cost of pumping water to the surface. Investigations are also being conducted on the unwatering of flooded mines—a costly, difficult, and hazardous procedure requiring considerable knowledge of formations and skill in surveying, drilling, pumping, and protecting operations against rapid infiltration or inrushes of water or gas. Bureau of Mines Technical Paper 727,[2] released in 1949, contains detailed information on the water problem in the anthracite mines. The report includes maps, plans, cross sections of the underground water pools, the number of water pools in each field, the altitude of the surface of the water, the volume of the water in each pool, and many other pertinent data on the anthracite-mine water problem.

The Bureau of Mines research program for the anthracite industry is expected to be facilitated considerably upon completion of the Bureau's anthracite research laboratory at Schuylkill Haven, Pa., during the latter part of 1949. Investigations and research to be conducted through facilities thus afforded will relate particularly to the mining, preparation, and utilization of anthracite and to safety, health, and sanitation in mining operations.

Many fine papers on various matters pertaining to research in the anthracite industry are contained in Transactions of the Seventh Annual Anthracite Conference at Lehigh University, Bethlehem, Pa., May 1949.

Imports and Exports.—Despite the sharp decline in exports of anthracite from the record 8,509,995 net tons established in 1947, the 1948 total (6,675,914 tons) exceeded that for any year before 1947. The decrease in exports was due almost entirely to a drop in European shipments from 3,918,463 tons in 1947 to 1,692,967 tons in 1948. Shipments to Canada totaled 4,931,918 net tons, a 10 percent increase over 1947. The decline in shipments to European countries may be attributed largely to increased output of coal in Great Britain, Germany, Poland, and France, which enabled these countries to sus-

[1] Buch, John W., and Allan, Andrew, Jr., Anthracite Mechanical Mining Investigations, U. S. Bureau of Mines, Progress Report 1: Bureau of Mines Rept. of Investigations 4500, 1949, 9 pp.; Progress Report 2: Rept. of Investigations 4501, 1949, 14 pp.

[2] Ash, S. H., Eaton, W. L., Hughes, Karl, Romischer, W. M., and Westfield, J., Water Pools in Pennsylvania Anthracite Mines: Bureau of Mines Tech. Paper 727, 1949, 78 pp.

tain their needs more adequately and, in some instances, to export coal to other European countries. Sweden and Norway, which together received 779,134 tons of anthracite in 1947, received none in 1948. Most of the anthracite shipped to those two countries in 1947 was Egg size, which was used principally for metallurgical purposes. Belgium and Luxembourg together received 1,367,636 tons of anthracite in 1947 but took only 209,400 tons in 1948. France continued to be the largest consumer of Pennsylvania anthracite in Europe, receiving approximately 1,400,000 net tons in each of the 2 years. About 80 percent of the European tonnage consisted of Buckwheat No. 1 and smaller sizes, which were not in great demand in this country in 1948. The embargo placed on shipments of Pea and larger sizes of anthracite to Europe by the Office of International Trade on October 1, 1947, was lifted on April 1, 1948, when supplies of domestic coal again became plentiful. Canada normally consumes about 9 percent of the anthracite shipped and is, therefore, rightly considered the anthracite industry's secondary market. One of the principal reasons for greatly increased exports to Canada in recent years has been the inability of Great Britain to export anthracite to the Dominion in amounts approaching prewar levels. In 1948, Canada received 175,754 net tons of anthracite from Great Britain, compared with average annual shipments of about 1,200,000 tons before the war. The inordinately warm weather in Canada during the 1948–49 heating season had a direct bearing on the consumption of anthracite in that country. Decreased consumption during the winter of 1948–49 resulted in some coal being stock-piled and will be reflected also in a decrease in our exports to Canada in 1949.

Imports of anthracite into the United States are negligible and constitute an insignificant part of our total consumption. Details of imports and exports are given in tables 38 and 39.

SOURCES AND ACKNOWLEDGMENTS

Statistics on the Pennsylvania anthracite-mining industry as published in this chapter are based on reports furnished voluntarily by the producers and shippers of anthracite in answer to the regular annual canvass conducted by the Bureau of Mines by mail. About 99 percent of the tonnage is reported direct, and the remainder is collected by personal visits or from reliable collateral evidence. The data on individual operations are held in strict confidence.

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. The Bureau of Mines wishes to acknowledge gratefully the cordial and continued cooperation of these agencies and of the producers and shippers who reported so promptly and so fully on their 1948 operations.

PRODUCTION

Production of Pennsylvania anthracite in 1948 totaled 57,139,948 net tons compared with 57,190,009 tons in 1947. 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 (62,324 tons in 1948) produced in Sullivan County. See tables 3 to 8 for production and shipments by fields, regions, and counties. Tables 9 and 10 show percentages, by regions, of various sizes in relation to total breaker product.

TABLE 3.—Pennsylvania anthracite produced, 1944–48, by fields, in net tons

[The figures of breaker product include a certain quantity of culm-bank coal, which amounted to 3,989,580 tons in 1948]

Field	1944	1945	1946	1947	1948
Eastern Middle:					
Breakers	5,905,623	[1] 5,005,245	5,057,619	4,270,240	4,467,628
Washeries	403,688	[1] 342,116	282,481	315,014	298,601
Total Eastern Middle	6,309,311	5,347,361	5,340,100	4,585,254	4,766,229
Western Middle:					
Breakers	12,721,704	11,540,524	13,040,147	12,147,528	12,405,178
Washeries	538,875	130,789	530,246	591,652	240,157
Dredges	385,137	308,976	362,423	411,804	311,183
Total Western Middle	13,645,716	11,980,289	13,932,816	13,150,984	12,956,518
Southern:					
Breakers	12,194,069	10,916,769	11,817,427	11,643,971	11,622,538
Washeries	2,091,473	1,373,578	1,386,125	237,131	496,194
Dredges	983,046	896,250	761,131	796,174	664,350
Total Southern	15,268,588	13,186,597	13,964,683	12,677,276	12,783,082
Northern:					
Breakers	27,794,639	[1] 23,503,306	26,227,918	25,831,439	25,839,648
Washeries	531,338	[1] 735,041	925,427	890,368	719,676
Dredges	4,554		8,840	11,728	12,471
Total Northern	28,330,531	24,238,347	27,162,185	26,733,535	26,571,795
Total, excluding Sullivan County:					
Breakers	58,616,035	[1] 50,965,844	56,143,111	53,893,178	54,334,992
Washeries	3,565,374	[1] 2,581,524	3,124,279	2,034,165	1,754,628
Dredges	1,372,737	1,205,226	1,132,394	1,219,706	988,004
Total, excluding Sullivan County	63,554,146	54,752,594	60,399,784	57,147,049	57,077,624
Sullivan County:					
Breakers	147,217	149,505	85,402	[1] 42,960	62,324
Washeries		31,810	21,687	(1)	
Total Sullivan County	147,217	181,315	107,089	42,960	62,324
Grand total	63,701,363	54,933,909	60,506,873	57,190,009	57,139,948

[1] Small quantity of washery coal included with breaker.

TABLE 4.—Pennsylvania anthracite shipped, sold locally, and used as colliery fuel in 1948, by regions

Region	Shipments		Local sales		Colliery fuel		Total	
	Net tons	Value [1]	Net tons	Value	Net tons	Value	Net tons	Value [1]
Lehigh:								
Breakers	8,386,439	$70,283,740	468,173	$4,487,816	237,438	$1,380,114	9,092,050	$76,151,670
Washeries	303,872	1,047,583	6,851	59,007	405	1,948	311,128	1,108,538
Dredges	54,284	113,601					54,284	113,601
Total Lehigh	8,744,595	71,444,924	475,024	4,546,823	237,843	1,382,062	9,457,462	77,373,809
Schuylkill:								
Breakers	17,765,396	141,796,523	1,384,949	8,738,929	252,949	673,467	19,403,294	151,208,919
Washeries	710,347	3,209,897	11,167	52,748	2,310	5,422	723,824	3,268,067
Dredges	887,157	2,061,183	34,092	92,026			921,249	2,153,209
Total Schuylkill	19,362,900	147,067,603	1,430,208	8,883,703	255,259	678,889	21,048,367	156,630,195
Wyoming:								
Breakers	21,617,155	202,219,575	2,860,998	24,269,302	1,361,495	3,529,040	25,839,648	230,017,917
Washeries	710,905	2,511,737	2,333	16,313	6,438	9,020	719,676	2,537,070
Dredges			12,471	24,942			12,471	24,942
Total Wyoming	22,328,060	204,731,312	2,875,802	24,310,557	1,367,933	3,538,060	26,571,795	232,579,929
Total, excluding Sullivan County:								
Breakers	47,768,990	414,299,838	4,714,120	37,496,047	1,851,882	5,582,621	54,334,992	457,378,506
Washeries	1,725,124	6,769,217	20,351	128,068	9,153	16,390	1,754,628	6,913,675
Dredges	941,441	2,174,784	46,563	116,968			988,004	2,291,752
Total	50,435,555	423,243,839	4,781,034	37,741,083	1,861,035	5,599,011	57,077,624	466,583,933
Sullivan County: [2]								
Breakers	47,637	357,277	14,687	110,590			62,324	467,867
Grand total:								
1948	50,483,192	423,601,116	4,795,721	37,851,673	1,861,035	5,599,011	57,139,948	467,051,800
1947	51,052,413	375,938,145	4,232,871	31,673,736	1,904,725	5,407,605	57,190,009	413,019,486
Change, 1948—percent	−1.1	+12.7	+13.3	+19.5	−2.3	+3.5	−0.1	+13.1

[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 1948, 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	621,980	4,994,233	2,990,851	484,986		9,092,050
Washeries				311,128		311,128
Dredges					54,284	54,284
Total Lehigh	621,980	4,994,233	2,990,851	796,114	54,284	9,457,462
Schuylkill:						
Breakers	1,542,200	7,097,267	7,653,020	3,110,807		19,403,294
Washeries			105,089	618,735		723,824
Dredges					921,249	921,249
Total Schuylkill	1,542,200	7,097,267	7,758,109	3,729,542	921,249	21,048,367
Wyoming:						
Breakers	13,578,188	9,279,099	2,588,574	393,787		25,839,648
Washeries			15,340	704,336		719,676
Dredges					12,471	12,471
Total Wyoming	13,578,188	9,279,099	2,603,914	1,098,123	12,471	26,571,795
Total, excluding Sullivan County:						
Breakers	15,742,368	21,370,599	13,232,445	3,989,580		54,334,992
Washeries			120,429	1,634,199		1,754,628
Dredges					988,004	988,004
Total	15,742,368	21,370,599	13,352,874	5,623,779	988,004	57,077,624
Sullivan County: Breakers		62,324				62,324
Grand total	15,742,368	21,432,923	13,352,874	5,623,779	988,004	57,139,948

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TABLE 6.—Pennsylvania anthracite produced in 1948, 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 banks	From river dredging	Total
	Underground		Strip pits			
	Mechanically loaded	Hand-loaded				
Eastern Middle:						
Breakers	621,980	1,921,014	1,771,807	152,827		4,467,628
Washeries				298,601		298,601
Total Eastern Middle	621,980	1,921,014	1,771,807	451,428		4,766,229
Western Middle:						
Breakers	1,212,351	4,945,453	4,375,527	1,871,847		12,405,178
Washeries			38,008	202,149		240,157
Dredges					311,183	311,183
Total Western Middle	1,212,351	4,945,453	4,413,535	2,073,996	311,183	12,956,518
Southern:						
Breakers	329,849	5,225,033	4,496,537	1,571,119		11,622,538
Washeries			67,081	429,113		496,194
Dredges					664,350	664,350
Total Southern	329,849	5,225,033	4,563,618	2,000,232	664,350	12,783,082
Northern:						
Breakers	13,578,188	9,279,099	2,588,574	393,787		25,839,648
Washeries			15,340	704,336		719,676
Dredges					12,471	12,471
Total Northern	13,578,188	9,279,099	2,603,914	1,098,123	12,471	26,571,795
Total, excluding Sullivan County:						
Breakers	15,742,368	21,370,599	13,232,445	3,989,580		54,334,992
Washeries			120,429	1,634,199		1,754,628
Dredges					988,004	988,004
Total	15,742,368	21,370,599	13,352,874	5,623,779	988,004	57,077,624
Sullivan County: Breakers		62,324				62,324
Grand total	15,742,368	21,432,923	13,352,874	5,623,779	988,004	57,139,948

TABLE 7.—Pennsylvania anthracite shipped in 1948, by regions and sizes [1]

Size	Breaker shipments [2]								
	Lehigh region			Schuylkill region			Wyoming region		
	Outside region	Local sales	Total	Outside region	Local sales	Total	Outside region	Local sales	Total
NET TONS									
Lump [3] and Broken	68,540	244	68,784	121,033	2,878	123,911	50,078	10,757	60,835
Egg	478,014	856	478,870	1,024,288	4,586	1,028,874	1,361,434	6,208	1,367,642
Stove	1,717,491	19,034	1,736,525	2,926,727	86,628	3,013,355	6,107,430	142,721	6,250,151
Chestnut	1,808,088	145,014	1,953,102	3,739,975	244,621	3,984,596	6,359,297	643,985	7,003,282
Pea	690,445	162,567	853,012	1,427,822	220,133	1,647,955	1,399,827	816,641	2,216,468
Total domestic	4,762,578	327,715	5,090,293	9,239,845	558,846	9,798,691	15,278,066	1,620,312	16,898,378
Buckwheat No. 1	1,087,844	68,485	1,156,329	2,487,854	100,594	2,588,448	2,756,556	440,001	3,196,557
Buckwheat No. 2 (Rice)	716,740	54,479	771,219	1,548,587	54,373	1,602,960	1,463,862	265,936	1,729,798
Buckwheat No. 3 (Barley)	783,852	17,467	801,319	2,559,194	78,272	2,637,466	1,405,500	456,962	1,862,462
Buckwheat No. 4	540,228	27	540,255	1,210,055	524,538	1,734,593	311,931	35,755	347,686
Other (including silt)	495,197		495,197	719,861	68,326	788,187	401,240	42,032	443,272
Total steam	3,623,861	140,458	3,764,319	8,525,551	826,103	9,351,654	6,339,089	1,240,686	7,579.775
Grand total	8,386,439	468,173	8,854,612	17,765,396	1,384,949	19,150,345	21,617,155	2,860,998	24,478,153
VALUE									
Lump [3] and Broken	$786,244	$2,719	$788,963	$1,342,199	$31,776	$1,373,975	$553,810	$115,544	$669,354
Egg	5,457,127	10,143	5,467,270	11,490,647	51,714	11,542,361	15,186,240	78,044	15,264,284
Stove	19,640,881	224,407	19,865,288	33,181,348	983,766	34,165,114	68,621,711	1,687,919	70,309,630
Chestnut	20,702,652	1,732,885	22,435,537	42,560,593	2,798,112	45,358,705	71,247,833	7,565,506	78,813,339
Pea	6,561,064	1,620,965	8,182,029	13,323,919	2,031,812	15,355,731	13,031,440	7,993,393	21,024,833
Total domestic	53,147,968	3,591,119	56,739,087	101,898,706	5,897,180	107,795,886	168,641,034	17,440,406	186,081,440
Buckwheat No. 1	7,089,773	484,723	7,574,496	15,905,386	658,733	16,564,119	17,921,980	3,034,902	20,956,882
Buckwheat No. 2 (Rice)	3,961,319	333,486	4,294,805	8,318,776	293,823	8,612,599	8,028,207	1,553,760	9,581,967
Buckwheat No. 3 (Barley)	3,246,699	78,405	3,325,104	10,313,421	304,164	10,617,585	5,837,826	2,062,840	7,900,666
Buckwheat No. 4	1,600,413	83	1,600,496	3,431,922	1,406,879	4,838,801	937,764	93,933	1,031,697
Other (including silt)	1,237,568		1,237,568	1,928,312	178,150	2,106,462	852,764	83,461	936,225
Total steam	17,135,772	896,697	18,032,469	39,897,817	2,841,749	42,739,566	33,578,541	6,828,896	40,407,437
Grand total	70,283,740	4,487,816	74,771,556	141,796,523	8,738,929	150,535,452	202,219,575	24,269,302	226,488,877

See footnotes at end of table.

TABLE 7.—Pennsylvania anthracite shipped in 1948, by regions and sizes [1]—Continued

Size	Breaker shipments [2]								
	Lehigh region			Schuylkill region			Wyoming region		
	Outside region	Local sales	Total	Outside region	Local sales	Total	Outside region	Local sales	Total
AVERAGE VALUE PER TON									
Lump [3] and Broken	$11.47	$11.14	$11.47	$11.09	$11.04	$11.09	$11.06	$10.74	$11.00
Egg	11.42	11.85	11.42	11.22	11.28	11.22	11.15	12.57	11.16
Stove	11.44	11.79	11.44	11.34	11.36	11.34	11.24	11.83	11.25
Chestnut	11.45	11.95	11.49	11.38	11.44	11.38	11.20	11.75	11.25
Pea	9.50	9.97	9.59	9.33	9.23	9.32	9.31	9.79	9.49
Total domestic	11.16	10.96	11.15	11.03	10.55	11.00	11.04	10.76	11.01
Buckwheat No. 1	6.52	7.08	6.55	6.39	6.55	6.40	6.50	6.90	6.56
Buckwheat No. 2 (Rice)	5.53	6.12	5.57	5.37	5.40	5.37	5.48	5.84	5.54
Buckwheat No. 3 (Barley)	4.14	4.49	4.15	4.03	3.89	4.03	4.15	4.51	4.24
Buckwheat No. 4	2.96	3.07	2.96	2.84	2.68	2.79	3.01	2.63	2.97
Other (including silt)	2.50		2.50	2.68	2.61	2.67	2.13	1.99	2.11
Total steam	4.73	6.38	4.79	4.68	3.44	4.57	5.30	5.50	5.33
Grand total	8.38	9.59	8.44	7.98	6.31	7.86	9.35	8.48	9.25

Size	Breaker shipments [2]—Continued								
	Sullivan County			Total					
				Excluding Sullivan County			Including Sullivan County		
	Outside region	Local sales	Total	Outside region	Local sales	Total	Outside region	Local sales	Total
NET TONS									
Lump [3] and Broken				239,651	13,879	253,530	239,651	13,879	253,530
Egg				2,863,736	11,650	2,875,386	2,863,736	11,650	2,875,386
Stove	9,777	2,790	12,567	10,751,648	248,383	11,000,031	10,761,425	251,173	11,012,598
Chestnut	14,704	4,700	19,404	11,907,360	1,033,620	12,940,980	11,922,064	1,038,320	12,960,384
Pea	5,214	3,819	9,033	3,518,094	1,199,341	4,717,435	3,523,308	1,203,160	4,726,468
Total domestic	29,695	11,309	41,004	29,280,489	2,506,873	31,787,362	29,310,184	2,518,182	31,828,366
Buckwheat No. 1	3,807	734	4,541	6,332,254	609,080	6,941,334	6,336,061	609,814	6,945,875
Buckwheat No. 2 (Rice)		2,644	2,644	3,729,189	374,788	4,103,977	3,729,189	377,432	4,106,621
Buckwheat No. 3 (Barley)				4,748,546	552,701	5,301,247	4,748,546	552,701	5,301,247
Buckwheat No. 4				2,062,214	560,320	2,622,534	2,062,214	560,320	2,622,534
Other (including silt)	14,135		14,135	1,616,298	110,358	1,726,656	1,630,433	110,358	1,740,791
Total steam	17,942	3,378	21,320	18,488,501	2,207,247	20,695,748	18,506,443	2,210,625	20,717,068
Grand total	47,637	14,687	62,324	47,768,990	4,714,120	52,483,110	47,816,627	4,728,807	52,545,434
VALUE									
Lump [3] and Broken				$2,682,253	$150,039	$2,832,292	$2,682,253	$150,039	$2,832,292
Egg				32,134,014	139,901	32,273,915	32,134,014	139,901	32,273,915
Stove	$94,518	$26,510	$121,028	121,443,940	2,896,092	124,340,032	121,538,458	2,922,602	124,461,060
Chestnut	141,041	44,649	185,690	134,511,078	12,096,503	146,607,581	134,652,119	12,141,152	146,793,271
Pea	40,956	27,685	68,641	32,916,423	11,646,170	44,562,593	32,957,379	11,673,855	44,631,234
Total domestic	276,515	98,844	375,359	323,687,708	26,928,705	350,616,413	323,964,223	27,027,549	350,991,772
Buckwheat No. 1	22,818	3,815	26,633	40,917,139	4,178,358	45,095,497	40,939,957	4,182,173	45,122,130
Buckwheat No. 2 (Rice)		7,931	7,931	20,308,302	2,181,069	22,489,371	20,308,302	2,189,000	22,497,302
Buckwheat No. 3 (Barley)				19,397,946	2,445,409	21,843,355	19,397,946	2,445,409	21,843,355
Buckwheat No. 4				5,970,099	1,500,895	7,470,994	5,970,099	1,500,895	7,470,994
Other (including silt)	57,944		57,944	4,018,644	261,611	4,280,255	4,076,588	261,611	4,338,199
Total steam	80,762	11,746	92,508	90,612,130	10,567,342	101,179,472	90,692,892	10,579,088	101,271,980
Grand total	357,277	101,590	467,867	414,299,838	37,496,047	451,795,885	414,657,115	37,606,637	452,263,752

See footnotes at end of table.

TABLE 7.—Pennsylvania anthracite shipped in 1948, by regions and sizes [1]—Continued

Size	Breaker shipments [2]—Continued								
	Sullivan County			Total					
				Excluding Sullivan County			Including Sullivan County		
	Outside region	Local sales	Total	Outside region	Local sales	Total	Outside region	Local sales	Total
AVERAGE VALUE PER TON									
Lump [3] and Broken	----------	----------	----------	$11.19	$10.81	$11.17	$11.19	$10.81	$11.17
Egg	----------	----------	----------	11.22	12.01	11.22	11.22	12.01	11.22
Stove	$9.67	$9.50	$9.63	11.30	11.66	11.30	11.29	11.64	11.30
Chestnut	9.59	9.50	9.57	11.30	11.70	11.33	11.29	11.69	11.33
Pea	7.86	7.25	7.60	9.36	9.71	9.45	9.35	9.70	9.44
Total domestic	9.31	8.74	9.15	11.05	10.74	11.03	11.05	10.73	11.03
Buckwheat No. 1	5.99	5.20	5.87	6.46	6.86	6.50	6.46	6.86	6.50
Buckwheat No. 2 (Rice)	----------	3.00	3.00	5.45	5.82	5.48	5.45	5.80	5.48
Buckwheat No. 3 (Barley)	----------	----------	----------	4.09	4.42	4.12	4.09	4.42	4.12
Buckwheat No. 4	----------	----------	----------	2.89	2.68	2.85	2.89	2.68	2.85
Other (including silt)	4.10	----------	4.10	2.49	2.37	2.48	2.50	2.37	2.49
Total steam	4.50	3.48	4.34	4.90	4.79	4.89	4.90	4.79	4.89
Grand total	7.50	7.53	7.51	8.67	7.95	8.61	8.67	7.95	8.61

Size	Washery shipments			Dredge shipments			Grand total		
	Outside region	Local sales	Total	Outside region	Local sales	Total	Outside region	Local sales	Total
NET TONS									
Lump [3] and Broken							239,651	13,879	253,530
Egg							2,863,736	11,650	2,875,386
Stove	37,267	292	37,559				10,798,692	251,465	11,050,157
Chestnut	119,019	4,304	123,323	10		10	12,041,093	1,042,624	13,083,717
Pea	42,685	4,342	47,027	725	625	1,350	3,566,718	1,208,127	4,774,845
Total domestic	198,971	8,938	207,909	735	625	1,360	29,509,890	2,527,745	32,037,635
Buckwheat No. 1	61,733	4,360	66,093	11,994	1,924	13,918	6,409,788	616,098	7,025,886
Buckwheat No. 2 (Rice)	54,904	1,169	56,073	22,983	4,070	27,053	3,807,076	382,671	4,189,747
Buckwheat No. 3 (Barley)	114,473	196	114,669	201,963	560	202,523	5,064,982	553,457	5,618,439
Buckwheat No. 4	474,335	3,228	477,563	355,890	29,516	385,406	2,892,439	593,064	3,485,503
Other (including silt)	820,708	2,460	823,168	347,876	9,868	357,744	2,799,017	122,686	2,921,703
Total steam	1,526,153	11,413	1,537,566	940,706	45,938	986,644	20,973,302	2,267,976	23,241,278
Grand total	1,725,124	20,351	1,745,475	941,441	46,563	988,004	50,483,192	4,795,721	55,278,913
VALUE									
Lump [3] and Broken							$2,682,253	$150,039	$2,832,292
Egg							32,134,014	139,901	32,273,915
Stove	$403,927	$3,117	$407,044				121,942,385	2,925,719	124,868,104
Chestnut	1,243,240	45,039	1,288,279	$100		$100	135,895,459	12,186,191	148,081,650
Pea	378,176	36,441	414,617	4,850	$3,080	7,930	33,340,405	11,713,376	45,053,781
Total domestic	2,025,343	84,597	2,109,940	4,950	3,080	8,030	325,994,516	27,115,226	353,109,742
Buckwheat No. 1	365,734	25,885	391,619	31,024	8,265	39,289	41,336,715	4,216,323	45,553,038
Buckwheat No. 2 (Rice)	283,864	6,445	290,309	58,249	16,746	74,995	20,650,415	2,212,191	22,862,606
Buckwheat No. 3 (Barley)	446,498	910	447,408	491,922	1,736	493,658	20,336,366	2,448,055	22,784,421
Buckwheat No. 4	1,315,552	5,917	1,321,469	747,639	63,481	811,120	8,033,290	1,570,293	9,603,583
Other (including silt)	2,332,226	4,314	2,336,540	841,000	23,660	864,660	7,249,814	289,585	7,539,399
Total steam	4,743,874	43,471	4,787,345	2,169,834	113,888	2,283,722	97,606,600	10,736,447	108,343,047
Grand total	6,769,217	128,068	6,897,285	2,174,784	116,968	2,291,752	423,601,116	37,851,673	461,452,789

See footnotes at end of table.

TABLE 7.—Pennsylvania anthracite shipped in 1948, by regions and sizes [1]—Continued

Size	Washery shipments			Dredge shipments			Grand total		
	Outside region	Local sales	Total	Outside region	Local sales	Total	Outside region	Local sales	Total
AVERAGE VALUE PER TON									
Lump [3] and Broken							$11.19	$10.81	$11.17
Egg							11.22	12.01	11.22
Stove	$10.84	$10.67	$10.84				11.29	11.63	11.30
Chestnut	10.45	10.46	10.45	$10.00		$10.00	11.29	11.69	11.32
Pea	8.86	8.39	8.82	6.69	$4.93	5.87	9.35	9.70	9.44
Total domestic	10.18	9.46	10.15	6.73	4.93	5.90	11.05	10.73	11.02
Buckwheat No. 1	5.92	5.94	5.93	2.59	4.30	2.82	6.45	6.84	6.48
Buckwheat No. 2 (Rice)	5.17	5.51	5.18	2.53	4.11	2.77	5.42	5.78	5.46
Buckwheat No. 3 (Barley)	3.90	4.64	3.90	2.44	3.10	2.44	4.02	4.42	4.06
Buckwheat No. 4	2.77	1.83	2.77	2.10	2.15	2.10	2.78	2.65	2.76
Other (including silt)	2.84	1.75	2.84	2.42	2.40	2.42	2.59	2.36	2.58
Total steam	3.11	3.81	3.11	2.31	2.48	2.31	4.65	4.73	4.66
Grand total	3.92	6.29	3.95	2.31	2.51	2.32	8.39	7.89	8.35

[1] Changes for table 8 in Minerals Yearbook, 1947, pages 349 and 350 are as follows: Wyoming region: Buckwheat No. 4, should read 369,472 net tons valued at $921,367; average value, $2.49; Other (including silt), 398,590 tons, $695,082, $1.74. Total, excluding Sullivan County: Buckwheat No. 4, 2,429,772 tons, $5,965,274, $2.46; Other (including silt), 1,469,014 tons, $3,031, 078, $2.06. Total, including Sullivan County: Buckwheat No. 4, 2,429,772 tons, $5,965,274, $2.46; Other (including silt), 1,479,623 tons, $3,051,518, $2.06. Grand total: Buckwheat No. 4, 3,963,213 tons, $9,528,802, $2.40; Other (including silt), 2,339,676, $4,926,139, $2.11.

[2] Figures of shipments from breakers include some culm-bank coal handled in breakers.

[3] Quantity of Lump included is insignificant.

TABLE 8.—Pennsylvania anthracite produced in 1948, by counties

County	Total shipments		Sold to local trade		Colliery fuel		Total production	
	Net tons	Value [1]	Net tons	Value	Net tons	Value	Net tons	Value [1]
Berks, Lancaster, Lebanon, Northampton and Snyder [2]	301,022	$662,483	5,436	$16,446			306,458	$678,929
Carbon	2,920,091	23,758,384	137,736	1,285,325	57,890	$435,285	3,115,717	25,478,994
Columbia	1,375,092	12,064,494	56,829	486,843	42,182	90,943	1,474,103	12,642,280
Dauphin	252,185	564,777	14,428	59,440			266,613	624,217
Lackawanna	6,902,659	60,063,457	1,218,465	11,373,532	383,187	1,164,733	8,504,311	72,601,722
Luzerne	18,168,484	168,509,176	1,879,839	15,127,423	1,092,804	2,888,970	21,141,127	186,525,569
Northumberland	5,548,897	40,857,144	641,214	4,025,445	35,773	78,046	6,225,884	44,960,635
Schuylkill	14,848,041	116,357,799	826,987	5,365,651	242,707	931,601	15,917,735	122,655,051
Sullivan	47,637	357,277	14,687	110,590			62,324	467,867
Susquehanna and Wayne	119,084	406,125	100	978	6,492	9,433	125,676	416,536
Total	50,483,192	423,601,116	4,795,721	37,851,673	1,861,035	5,599,011	57,139,948	467,051,800

[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, 1946–48, 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		
	1946	1947	1948	1946	1947	1948	1946	1947	1948
Lump [1] and Broken	0.6	0.7	0.8	0.1	0.7	0.7	0.2	0.3	0.2
Egg	6.5	5.0	5.7	5.2	5.3	5.8	7.3	6.5	6.3
Stove	19.2	20.0	20.5	17.1	15.9	16.5	27.2	27.0	28.3
Chestnut	21.5	21.7	21.6	22.7	21.2	21.0	30.0	29.5	29.4
Pea	8.2	8.2	8.2	8.2	7.6	8.0	6.5	6.8	6.5
Total domestic	56.0	55.6	56.8	53.3	50.7	52.0	71.2	70.1	70.7
Buckwheat No. 1	13.7	13.5	13.0	15.0	14.1	14.0	12.9	13.1	12.7
Buckwheat No. 2 (Rice)	9.2	8.7	8.6	8.5	8.6	8.7	6.5	6.5	6.8
Buckwheat No. 3 (Barley)	10.4	10.1	9.3	13.9	14.6	14.4	6.3	6.8	6.5
Buckwheat No. 4	3.3	5.6	6.4	6.8	9.0	6.8	2.1	1.7	1.4
Other (including silt)	7.4	6.5	5.9	2.5	3.0	4.1	1.0	1.8	1.9
Total steam	44.0	44.4	43.2	46.7	49.3	48.0	28.8	29.9	29.3

Size	Sullivan County			Total					
				Excluding Sullivan County			Including Sullivan County		
Lump [1] and Broken				0.3	0.5	0.5	0.3	0.5	0.5
Egg				6.3	5.8	6.0	6.3	5.8	6.0
Stove	18.9	8.5	20.5	22.0	21.7	22.5	22.0	21.7	22.5
Chestnut	20.8	29.7	30.9	25.8	25.1	24.9	25.8	25.1	24.9
Pea	12.3	15.4	10.9	7.4	7.3	7.4	7.4	7.3	7.4
Total domestic	52.0	53.6	62.3	61.8	60.4	61.3	61.8	60.4	61.3
Buckwheat No. 1	16.4	10.2	8.0	13.9	13.5	13.3	13.9	13.5	13.3
Buckwheat No. 2 (Rice)	30.2	.6		7.8	7.7	7.8	7.8	7.7	7.8
Buckwheat No. 3 (Barley)				9.8	10.3	9.9	9.8	10.2	9.9
Buckwheat No. 4				4.0	5.1	4.3	4.0	5.1	4.3
Other (including silt)	1.4	35.6	29.7	2.7	3.0	3.4	2.7	3.1	3.4
Total steam	48.0	46.4	37.7	38.2	39.6	38.7	38.2	39.6	38.7

[1] Quantity of Lump included is insignificant.

TABLE 10.—Sizes of Pennsylvania anthracite shipped from breakers to points outside and inside anthracite-producing area in 1948, 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		
	Shipped outside region	Local sales	Total	Shipped outside region	Local sales	Total	Shipped outside region	Local sales	Total
Lump [1] and Broken	0.8	0.1	0.8	0.7	0.2	0.7	0.2	0.4	0.2
Egg	5.7	.2	5.4	5.8	.3	5.4	6.3	.2	5.6
Stove	20.5	4.0	19.6	16.5	6.3	15.7	28.3	5.0	25.5
Chestnut	21.6	31.0	22.1	21.0	17.7	20.8	29.4	22.5	28.6
Pea	8.2	34.7	9.6	8.0	15.9	8.6	6.5	28.5	9.1
Total domestic	56.8	70.0	57.5	52.0	40.4	51.2	70.7	56.6	69.0
Buckwheat No. 1	13.0	14.6	13.1	14.0	7.3	13.5	12.7	15.4	13.1
Buckwheat No. 2 (Rice)	8.6	11.6	8.7	8.7	3.9	8.4	6.8	9.3	7.1
Buckwheat No. 3 (Barley)	9.3	3.8	9.0	14.4	5.6	13.8	6.5	16.0	7.6
Buckwheat No. 4	6.4	(2)	6.1	6.8	37.9	9.0	1.4	1.2	1.4
Other (including silt)	5.9		5.6	4.1	4.9	4.1	1.9	1.5	1.8
Total steam	43.2	30.0	42.5	48.0	59.6	48.8	29.3	43.4	31.0

Size	Sullivan County			Total					
				Excluding Sullivan County			Including Sullivan County		
Lump [1] and Broken				0.5	0.3	0.5	0.5	0.3	0.5
Egg				6.0	.3	5.5	6.0	.3	5.5
Stove	20.5	19.0	20.2	22.5	5.3	21.0	22.5	5.3	20.9
Chestnut	30.9	32.0	31.1	24.9	21.9	24.6	24.9	22.0	24.7
Pea	10.9	26.0	14.5	7.4	25.4	9.0	7.4	25.4	9.0
Total domestic	62.3	77.0	65.8	61.3	53.2	60.6	61.3	53.3	60.6
Buckwheat No. 1	8.0	5.0	7.3	13.3	12.9	13.2	13.3	12.9	13.2
Buckwheat No. 2 (Rice)		18.0	4.2	7.8	8.0	7.8	7.8	8.0	7.8
Buckwheat No. 3 (Barley)				9.9	11.7	10.1	9.9	11.7	10.1
Buckwheat No. 4				4.3	11.9	5.0	4.3	11.8	5.0
Other (including silt)	29.7		22.7	3.4	2.3	3.3	3.4	2.3	3.3
Total steam	37.7	23.0	34.2	38.7	46.8	39.4	38.7	46.7	39.4

[1] Quantity of Lump included is insignificant.
[2] Less than 0.005 percent.

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 began to mine anthracite in the Lehigh and Schuylkill regions from lands of the operating companies and transported 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 compiled by the Bureau of Mines. In 1941, however, the anthracite industry began to purchase run-of-mine coal from the so-called "bootleggers" for preparation and shipment to market. In 1948 these purchases totaled 544,475 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 1941–48. As a result, the production statistics for the last 8 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 these 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 in the Employment section of this chapter.

By Weeks and Months.—Tables 11 and 12 summarize weekly and monthly production of anthracite in 1948. Statistics on current output are estimated from records of carloadings and from reports obtained from trade sources. The weekly and monthly figures have been adjusted to the annual total as ascertained by direct mail canvass of the operators.

TABLE 11.—Estimated weekly production of Pennsylvania anthracite in 1948

Week ended—	Net tons	Week ended—	Net tons
Jan. 3	[1] 264,000	July 17	1,071,000
10	1,102,000	24	1,193,000
17	1,212,000	31	1,233,000
24	1,182,000	Aug. 7	1,165,000
31	1,169,000	14	1,201,000
Feb. 7	1,172,000	21	1,172,000
14	1,039,000	28	1,173,000
21	1,231,000	Sept. 4	1,164,000
28	1,240,000	11	953,000
Mar. 6	1,178,000	18	1,230,000
13	1,216,000	25	1,202,000
20	1,184,000	Oct. 2	1,235,000
27	893,000	9	1,190,000
Apr. 3	857,000	16	1,225,000
10	851,000	23	1,187,000
17	1,055,000	30	1,016,000
24	1,164,000	Nov. 6	864,000
May 1	1,130,000	13	1,153,000
8	1,134,000	20	1,207,000
15	1,208,000	27	1,041,000
22	1,185,000	Dec. 4	1,139,000
29	1,200,000	11	947,000
June 5	1,012,000	18	941,000
12	1,212,000	25	969,000
19	1,182,000	31	932,000
26	1,118,000		
July 3	100,000	Calendar year	57,140,000
10	847,000		

[1] Figures represent output of working days in that part of week included in the calendar year 1948. Revised total for week of January 3, 1948, was 786,000 tons.

TABLE 12.—Estimated monthly production of Pennsylvania anthracite, 1941–48, in thousands of net tons [1]

Month	1941	1942	1943	1944	1945	1946	1947	1948
January	5,162	4,560	4,466	4,970	4,219	4,968	5,172	4,929
February	4,596	4,801	5,203	5,811	4,471	4,774	4,254	4,682
March	4,765	5,116	5,855	5,512	5,269	5,476	4,984	4,935
April	3,317	5,185	5,337	5,141	5,124	5,069	4,293	4,445
May	4,001	4,873	5,219	5,781	2,083	5,453	4,564	4,874
June	5,072	5,153	3,244	5,558	5,667	3,625	4,624	4,597
July	4,855	5,374	5,698	4,905	4,944	5,248	4,098	4,372
August	5,441	5,212	5,653	5,558	4,656	5,428	5,011	5,129
September	5,334	5,459	5,474	5,380	4,640	5,033	5,158	5,015
October	5,580	5,132	5,359	5,538	5,304	5,393	5,524	4,969
November	3,974	4,824	4,140	5,029	4,559	4,975	4,629	4,687
December	4,271	4,639	4,996	4,518	3,998	5,065	4,879	4,506
Total	56,368	60,328	60,644	63,701	54,934	60,507	57,190	57,140

[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 1941–48 some "bootleg" coal purchased by legitimate operators and prepared at their breakers.

Culm-Bank Coal.—Output of culm-bank coal totaled 5,623,779 tons in 1948, a decline of 12 percent from the production from this source in 1947. The production of coal from culm banks has been declining consistently since the record output of 9,600,180 tons in 1944. As the available supply of culm-bank coal is limited, it can be expected that the tonnage of anthracite recovered from this source will drop substantially in the next few years. Tables 13 and 14 give details on culm-bank output.

TABLE 13.—Production of Pennsylvania anthracite from culm banks, by regions, 1933–48, in net tons

Year	Lehigh	Schuylkill	Wyoming	Sullivan County	Total
1933	301, 222	1, 662, 959	1, 074, 059		3, 038, 240
1934	185, 213	1, 332, 503	625, 516		2, 143, 232
1935	192, 790	1, 748, 960	760, 718		2, 702, 468
1936	136, 058	2, 532, 116	525, 798		3, 193, 972
1937	101, 239	2, 178, 482	442, 878		2, 722, 599
1938	53, 037	1, 941, 896	345, 511		2, 340, 444
1939	64, 180	2, 159, 548	360, 086		2, 583, 814
1940	192, 878	2, 109, 557	480, 603		2, 783, 038
1941	326, 755	2, 881, 049	449, 062		3, 656, 866
1942	745, 934	3, 529, 757	459, 373		4, 735, 064
1943	1, 944, 047	4, 577, 917	1, 041, 841	19, 893	7, 583, 698
1944	2, 125, 317	5, 787, 036	1, 673, 994	13, 833	9, 600, 180
1945	2, 086, 864	4, 936, 907	1, 728, 440	34, 448	8, 786, 659
1946	1, 875, 590	4, 752, 141	1, 780, 874	22, 487	8, 431, 092
1947	1, 044, 501	3, 947, 016	1, 409, 217	2, 912	6, 403, 646
1948	796, 114	3, 729, 542	1, 098, 123		5, 623, 779

TABLE 14.—Culm-bank coal put through breakers, 1944–48, by fields, in net tons

Year	Northern	Eastern Middle	Western Middle	Southern	Total
1944	[1] 1, 156, 489	743, 867	2, 528, 221	1, 699, 875	6, 128, 452
1945	[1] [2] 996, 037	[2] 698, 876	2, 335, 200	2, 206, 187	6, 236, 300
1946	[1] 856, 247	708, 012	1, 902, 369	1, 845, 163	5, 311, 791
1947	[2] 525, 732	249, 151	1, 607, 166	2, 099, 299	4, 481, 348
1948	393, 787	152, 827	1, 871, 847	1, 571, 119	3, 989, 580

[1] A small quantity of culm-bank coal was put through breakers in Sullivan County.
[2] Includes some washery coal.

Historical Statistics.—Historical data on the Pennsylvania anthracite industry, 1890–1948, are given in table 15.

TABLE 15.—Statistical trends in the Pennsylvania anthracite industry, 1890–1948

Year	Production (net tons)	Value of production	Average value per net ton	Exports [1] (net tons)	Imports [1] (net tons)	Apparent consumption [2] (net tons)	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 [3] (net tons)	Quantity produced by stripping [4] (net tons)	Quantity loaded mechanically underground [5] (net tons)
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

See footnotes at end of table.

TABLE 15.—Statistical trends in the Pennsylvania anthracite industry, 1890–1948—Continued

Year	Production (net tons)	Value of production	Average value per net ton	Exports [1] (net tons)	Imports [1] (net tons)	Apparent consumption [2] (net tons)	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 [3] (net tons)	Quantity produced by stripping [4] (net tons)	Quantity loaded mechanically underground [5] (net tons)
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	6,497,245	9,556	53,900,000	78,145	271	[9] 2.84	770	1,232,828	12,858,930	15,619,162
1947	[8] 57,190,009	413,019,486	7.22	8,509,995	10,350	48,200,000	78,600	259	[9] 2.78	720	1,209,983	12,603,545	16,054,011
1948	[8] 57,139,948	467,051,800	8.17	6,675,914	945	50,200,000	76,215	265	[9] 2.81	745	1,016,757	13,352,874	15,742,368

[1] U. S. Department of Commerce.
[2] Before 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.

"Bootleg" Coal.—A survey by the Anthracite Committee in March 1949, revealed that 772 "bootleg" mines employing 2,617 men were active, whereas, on the same date in 1948, 835 mines employing 2,825 men were operating. There were 12 fatal accidents in 1948 compared with 15 in 1947. The production of anthracite from these operations totaled 1,839,227 tons, an increase of 13 percent over 1947. This output was the highest from this kind of mining since 1943. The record "bootleg" production was 6,300,000 tons in 1941. Details on "bootleg" mining for the period 1941–48 are given in tables 16 and 17.

TABLE 16.—Production, purchases by recognized operators, and fatalities at "bootleg" operations in the Pennsylvania anthracite industry, 1941–48

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	1945	1,026,000	260,342	16
1942	3,931,000	2,616,839	45	1946	1,448,529	352,112	19
1943	1,912,467	1,265,617	22	1947	1,634,635	604,060	15
1944	1,332,957	506,842	21	1948	1,839,227	544,475	12

[1] Anthracite Committee, Harrisburg, Pa.
[2] As reported to Federal Bureau of Mines.

TABLE 17.—Number of men employed in "bootleg" operations in the Pennsylvania anthracite industry, 1941–49

[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. 7, 1945	502	1,806
May 1, 1942	2,029	7,554	Mar. 30, 1946	526	1,939
Dec. 15, 1942	1,363	4,967	Mar. 31, 1947	863	2,817
Apr. 20, 1943	1,065	3,607	Mar. 31, 1948	835	2,825
Oct. 14, 1943	791	2,725	Mar. 31, 1949	772	2,617
Mar. 31, 1944	652	2,220			

VALUE OF SALES

An amended agreement between the anthracite operators and the United Mine Workers of America, effective July 1948, granted a substantial wage increase to the mine workers; and, largely because of increased mining costs occasioned by this increase, the average sales realization on breaker shipments advanced from $7.65 per net ton in 1947 to $8.67 in 1948. When colliery fuel, washery coal, local sales, and river coal are included, the average per ton value of the 1948 production is $8.17 compared with $7.22 in 1947. The average sales-realization figures in this study represent value at the breaker, washery, or dredge reported by the producing 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. See tables 18 to 20 for sales-realization and value data.

TABLE 18.—Average sales realization per net ton on Pennsylvania anthracite shipments from breakers, 1946–48, by regions and sizes

[Value does not include margins of separately incorporated sales companies]

Size	Lehigh region			Schuylkill region			Wyoming region		
	1946	1947	1948	1946	1947	1948	1946	1947	1948
Lump [1] and Broken	$9.14	$10.21	$11.47	$9.43	$10.10	$11.09	$9.26	$9.87	$11.06
Egg	9.32	10.23	11.42	9.48	10.11	11.22	9.33	10.01	11.15
Stove	9.42	10.23	11.44	9.52	10.02	11.34	9.33	9.98	11.24
Chestnut	9.40	10.24	11.45	9.54	10.07	11.38	9.34	9.98	11.20
Pea	7.72	8.44	9.50	7.89	8.17	9.33	7.74	8.19	9.31
Total domestic	9.15	9.97	11.16	9.27	9.77	11.03	9.19	9.81	11.04
Buckwheat No. 1	5.51	5.97	6.52	5.55	5.76	6.39	5.51	5.81	6.50
Buckwheat No. 2 (Rice)	4.50	4.93	5.53	4.54	4.78	5.37	4.52	4.84	5.48
Buckwheat No. 3 (Barley)	3.09	3.57	4.14	3.09	3.52	4.03	3.16	3.63	4.15
Buckwheat No. 4	2.26	2.65	2.96	2.14	2.39	2.84	1.85	2.49	3.01
Other (including silt)	1.95	2.21	2.50	1.83	2.16	2.68	1.86	1.74	2.13
Total steam	3.88	4.25	4.73	3.94	4.09	4.68	4.38	4.67	5.30
Total all sizes	6.83	7.43	8.38	6.78	6.97	7.98	7.81	8.27	9.35

Size	Sullivan County			Total— Excluding Sullivan County			Total— Including Sullivan County		
Lump [1] and Broken	------	------	------	$9.23	$10.07	$11.19	$9.23	$10.07	$11.19
Egg	------	------	------	9.38	10.08	11.22	9.38	10.08	11.22
Stove	$9.19	$11.36	$9.67	9.40	10.03	11.30	9.40	10.03	11.29
Chestnut	9.13	10.20	9.59	9.42	10.05	11.30	9.42	10.05	11.29
Pea	7.95	9.28	7.86	7.79	8.23	9.36	7.79	8.23	9.35
Total domestic	8.87	10.12	9.31	9.21	9.82	11.05	9.21	9.82	11.05
Buckwheat No. 1	4.70	3.98	5.99	5.53	5.82	6.46	5.53	5.82	6.46
Buckwheat No. 2 (Rice)	2.62	3.14	------	4.52	4.83	5.45	4.52	4.83	5.45
Buckwheat No. 3 (Barley)	------	------	------	3.11	3.56	4.09	3.11	3.56	4.09
Buckwheat No. 4	------	------	------	2.09	2.46	2.89	2.09	2.46	2.89
Other (including silt)	1.75	1.93	4.10	1.90	2.06	2.49	1.90	2.06	2.50
Total steam	3.31	2.39	4.50	4.08	4.32	4.90	4.08	4.32	4.90
Total all sizes	6.20	6.54	7.50	7.25	7.65	8.67	7.25	7.65	8.67

[1] Quantity of Lump included is insignificant.

TABLE 19.—Average sales realization per net ton on Pennsylvania anthracite shipments from breakers to points outside and inside anthracite-producing area in 1948, by regions and sizes

[Value does not include margins of separately incorporated sales companies]

Size	Lehigh region			Schuylkill region			Wyoming region		
	Sold outside region	Local sales	Total	Sold outside region	Local sales	Total	Sold outside region	Local sales	Total
Lump [1] and Broken	$11.47	$11.14	$11.47	$11.09	$11.04	$11.09	$11.06	$10.74	$11.00
Egg	11.42	11.85	11.42	11.22	11.28	11.22	11.15	12.57	11.16
Stove	11.44	11.79	11.44	11.34	11.36	11.34	11.24	11.83	11.25
Chestnut	11.45	11.95	11.49	11.38	11.44	11.38	11.20	11.75	11.25
Pea	9.50	9.97	9.59	9.33	9.23	9.32	9.31	9.79	9.49
Total domestic	11.16	10.96	11.15	11.03	10.55	11.00	11.04	10.76	11.01
Buckwheat No. 1	6.52	7.08	6.55	6.39	6.55	6.40	6.50	6.90	6.56
Buckwheat No. 2 (Rice)	5.53	6.12	5.57	5.37	5.40	5.37	5.48	5.84	5.54
Buckwheat No. 3 (Barley)	4.14	4.49	4.15	4.03	3.89	4.03	4.15	4.51	4.24
Buckwheat No. 4	2.96	3.07	2.96	2.84	2.68	2.79	3.01	2.63	2.97
Other (including silt)	2.50		2.50	2.68	2.61	2.67	2.13	1.99	2.11
Total steam	4.73	6.38	4.79	4.68	3.44	4.57	5.30	5.50	5.33
Total all sizes	8.38	9.59	8.44	7.98	6.31	7.86	9.35	8.48	9.25

Size	Sullivan County			Total					
				Excluding Sullivan County			Including Sullivan County		
Lump [1] and Broken				$11.19	$10.81	$11.17	$11.19	$10.81	$11.17
Egg				11.22	12.01	11.22	11.22	12.01	11.22
Stove	$9.67	$9.50	$9.63	11.30	11.66	11.30	11.29	11.64	11.30
Chestnut	9.59	9.50	9.57	11.30	11.70	11.33	11.29	11.69	11.33
Pea	7.86	7.25	7.60	9.36	9.71	9.45	9.35	9.70	9.44
Total domestic	9.31	8.74	9.15	11.05	10.74	11.03	11.05	10.73	11.03
Buckwheat No. 1	5.99	5.20	5.87	6.46	6.86	6.50	6.46	6.86	6.50
Buckwheat No. 2 (Rice)		3.00	3.00	5.45	5.82	5.48	5.45	5.80	5.48
Buckwheat No. 3 (Barley)				4.09	4.42	4.12	4.09	4.42	4.12
Buckwheat No. 4				2.89	2.68	2.85	2.89	2.68	2.85
Other (including silt)	4.10		4.10	2.49	2.37	2.48	2.50	2.37	2.49
Total steam	4.50	3.48	4.34	4.90	4.79	4.89	4.90	4.79	4.89
Total all sizes	7.50	7.53	7.51	8.67	7.95	8.61	8.67	7.95	8.61

[1] Quantity of Lump included is insignificant.

TABLE 20.—Average value per ton of Pennsylvania anthracite shipments, local sales, colliery fuel, and total production, 1947–48, by regions [1]

[Values include washery and dredge coal]

Region	1947				1948			
	Shipments	Local sales	Colliery fuel	Total production	Shipments	Local sales	Colliery fuel	Total production
Lehigh	$7.28	$8.63	$4.85	$7.26	$8.17	$9.57	$5.81	$8.18
Schuylkill	6.58	6.77	2.14	6.54	7.60	6.21	2.66	7.44
Wyoming	8.05	7.70	2.54	7.74	9.17	8.45	2.59	8.75
Total, excluding Sullivan County	7.36	7.49	2.84	7.22	8.39	7.89	3.01	8.17
Sullivan County	6.54	6.36		6.48	7.50	7.53		7.51
Grand total	7.36	7.48	2.84	7.22	8.39	7.89	3.01	8.17

[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 data shown in table 21 were furnished voluntarily to the Bureau of Mines by producers, wholesalers, and dock operators and represent the seventh in a series of reports on the distribution of Pennsylvania anthracite. Distribution data are collected on a coal-year basis, as it more nearly corresponds with the heating season; therefore, no direct comparison is possible with annual statistics presented elsewhere in the chapter on production, method of movement, etc.

Reported shipments of anthracite in the 1948–49 coal year totaled 48,407,035 net tons, as compared with 55,362,344 tons for the 1947–48 coal year. The sharp decline was due largely to the fact that the winter of 1948–49 was one of the warmest on record, to competition of other fuels, and to a marked decrease in shipments to Europe. The Canadian market remained virtually unchanged, however, as is evidenced by the 4,389,355 net tons reported for the 1948–49 coal year. As indicated in the table, all consuming areas except the Lake States show a decline in tonnages received during the 1948–49 coal year; however, due to influence exerted by the drop in exports to Europe, the percentages shown for areas in the United States and Canada are higher than for the 1947–48 coal year.

TABLE 21.—Distribution of Pennsylvania anthracite, Apr. 1, 1948, to Mar. 31, 1949, 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	Buckwheat No. 1	Rice	Barley	Buckwheat No. 4	All other sizes	Total steam		
United States:														
New England States:														
Connecticut	3, 896	24, 837	353, 343	384, 144	35, 352	801, 572	59, 688	39, 189	40, 278		97	139, 252	940, 824	1. 94
Maine		26, 182	126, 537	100, 668	4, 714	258, 101	18, 503	10, 272			3	28, 778	286, 879	. 59
Massachusetts	3, 321	235, 377	1, 075, 342	601, 933	45, 276	1, 961, 249	151, 804	98, 337	37, 271	2, 611	80	290, 103	2, 251, 352	4. 65
New Hampshire		19, 421	97, 581	67, 248	4, 047	188, 297	21, 154	27, 322	76, 468		333	125, 277	313, 574	. 65
Rhode Island		17, 284	139, 724	100, 626	6, 636	264, 270	15, 051	11, 118				26, 169	290, 439	. 60
Vermont	188	12, 421	100, 544	70, 727	8, 037	191, 917	35, 490	17, 810	22, 984	50		76, 334	268, 251	. 56
Total	7, 405	335, 522	1, 893, 071	1, 325, 346	104, 062	3, 665, 406	301, 690	204, 048	177, 001	2, 661	513	685, 913	4, 351, 319	8. 99
Middle Atlantic States:														
New Jersey	17, 076	109, 843	883, 500	1, 803, 173	503, 499	3, 317, 091	730, 331	547, 525	1, 071, 552	407, 057	67, 374	2, 823, 839	6, 140, 930	12. 69
New York	84, 849	726, 433	3, 416, 061	3, 054, 210	1,017,193	8, 298, 746	3, 328, 454	1, 052, 509	1, 121, 635	413, 540	300, 120	6, 216, 258	14, 515, 004	29. 99
Pennsylvania [1]	88, 034	235, 848	1, 129, 653	2, 855, 633	2,142,293	6, 451, 461	1, 317, 416	1, 382, 145	2, 411, 291	1, 626, 879	763, 475	7, 501, 206	13, 952, 667	28. 82
Total	189, 959	1, 072, 124	5, 429, 214	7, 713, 016	3,662,985	18, 067, 298	5, 376, 201	2, 982, 179	4, 604, 478	2, 447, 476	1, 130, 969	16, 541, 303	34, 608, 601	71. 50
South Atlantic States: [2]														
Delaware	52	11, 891	69, 648	161, 681	14, 278	257, 550	7, 003	6, 381	14, 912	25, 173	8, 904	62, 373	319, 923	. 66
District of Columbia	50	10, 013	71, 165	89, 842	17, 804	188, 874	25, 917	1, 205			50	27, 172	216, 046	. 45
Maryland	1, 185	31, 738	205, 880	219, 413	33, 170	491, 386	69, 130	7, 312	24, 320	3, 230	331	104, 323	595, 709	1. 23
Virginia	915	7, 858	31, 519	43, 538	6, 012	89, 842	24, 716	108		289	352	25, 465	115, 307	. 24
Total	2, 202	61, 500	378, 212	514, 474	71, 264	1, 027, 652	126, 766	15, 006	39, 232	28, 692	9, 637	219, 333	1, 246, 985	2. 58
Lake States: [3]														
Illinois	11, 633	40, 429	47, 374	104, 192	1, 869	205, 497	8, 780	19, 929	13, 741	19, 926	22, 444	84, 820	290, 317	. 60
Michigan	988	43, 852	132, 691	99, 411	3, 868	280, 810	8, 043	12, 761		1, 037	129, 113	150, 954	431, 764	. 89
Minnesota		597	20, 079	28, 944	1, 831	51, 451	1, 394	285		24, 741	337	26, 757	78, 208	. 16
Ohio	580	15, 813	5, 209	47, 482	374	69, 458	2, 393	1, 300	1, 903	2, 100	41, 734	49, 430	118, 888	. 25
Wisconsin	928	1, 787	161, 629	256, 276	28, 290	448, 910	11, 663	3, 497		158, 172	371, 573	544, 905	993, 815	2. 05
Total	14, 129	102, 478	366, 982	536, 305	36, 232	1, 056, 126	32, 273	37, 772	15, 644	205, 976	565, 201	856, 866	1, 912, 992	3. 95
All other States	875	11, 189	12, 008	95, 911	3, 316	123, 299	9, 611	1, 744	703	2, 469	33, 933	48, 460	171, 759	. 35
Total United States	214, 570	1, 582, 813	8, 079, 487	10, 185, 052	3,877,859	23, 939, 781	5, 846, 541	3, 240, 749	4, 837, 058	2, 687, 274	1, 740, 253	18, 351, 875	42, 291, 656	87. 37
Canada:														
Province:														
Ontario	12, 374	370, 872	1, 342, 888	1, 100, 836	76, 329	2, 903, 299	131, 633	102, 786	4, 822	3, 098	4, 916	247, 255	3, 150, 554	6. 51
Quebec	96	66, 765	362, 510	224, 995	13, 791	668, 157	289, 833	125, 821	47, 378	2, 578	21, 969	487, 579	1, 155 736	2. 39
Other Provinces		10, 755	25, 214	30, 630	685	67, 284	9, 520	6, 242			19	15, 781	83, 065	. 17
Total Canada	12, 470	448, 392	1, 730, 612	1, 356, 461	90, 805	3, 638, 740	430, 986	234, 849	52, 200	5, 676	26, 904	750, 615	4, 389, 355	9. 07
Other countries	729	277, 611	4, 300	2, 133	152, 665	437, 438	33, 729	81, 289	33, 248	377, 284	763, 036	1, 288, 586	1, 726, 024	3. 56
Grand total	227, 769	2, 308, 816	9, 814, 399	11, 543, 646	4,121,329	28, 015, 959	6. 311, 256	3. 556, 887	4, 922. 506	3, 070, 234	2, 530, 193	20, 391, 076	48, 407, 035	100. 00

[1] Includes "local sales."
[2] 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."

Anthracite shipments from the mines to destinations in the United States declined less than 1 percent in 1948 as compared with 1947, according to data compiled from records of the Pennsylvania State Department of Mines. In 1948, 83 percent of the shipments destined to points in this country moved from the mines by rail and 17 percent by truck, as compared to 85 and 15 percent, respectively, in 1947. Pennsylvania received 84 percent of the truck shipments in 1948, New Jersey 8 percent, and New York 6 percent. Anthracite rail shipments, by States of destination for 1945–48, are shown in table 22 and the movement of anthracite by truck in 1948, by months and States of destination, in table 23.

TABLE 22.—Rail shipments of Pennsylvania anthracite, 1945–48, by destinations, in net tons

[Pennsylvania Department of Mines]

Destination	1945	1946	1947	1948
New England States	4,867,051	5,367,460	4,456,476	4,600,429
New York	13,867,150	15,440,475	14,530,238	14,526,250
New Jersey	7,963,782	7,945,666	6,697,055	6,213,667
Pennsylvania	9,647,371	11,360,229	10,138,523	9,706,429
Delaware	297,056	287,173	295,288	283,106
Maryland	784,863	918,195	830,546	626,948
District of Columbia	269,278	280,324	228,383	214,291
Virginia	128,642	126,187	116,650	118,611
Ohio	109,508	96,179	98,729	118,735
Indiana	87,123	100,077	78,303	94,492
Illinois	529,549	343,354	285,648	286,888
Wisconsin	470,501	524,066	486,975	627,366
Minnesota	108,210	55,231	19,749	48,683
Michigan	239,031	285,351	354,643	351,304
Other States	72,573	65,502	62,575	57,070
Total United States	39,441,688	43,195,469	38,679,781	37,874,269
Canada	3,059,062	3,818,303	3,828,980	3,977,698
Other foreign countries	16,079		1,854,042	913,920
Grand total	42,516,829	47,013,772	44,362,803	42,765,887

TABLE 23.—Truck shipments of Pennsylvania anthracite in 1948, by months and by States of destination, in net tons [1]

Destination	January	February	March	April	May	June	July
Pennsylvania:							
Within region	512,117	479,991	397,502	302,622	283,407	259,491	259,914
Outside region	180,916	205,407	200,803	181,631	198,548	194,721	171,425
New York	41,409	43,952	46,435	35,275	34,856	33,434	41,233
New Jersey	45,499	57,652	63,002	50,757	60,197	57,704	46,431
Delaware	3,467	4,311	7,060	1,969	2,029	811	998
Maryland	7,773	10,250	7,900	4,313	5,375	8,990	5,025
District of Columbia						7	68
Other States	475	1,514	1,551	1,323	1,055	880	1,370
Total: 1948	791,656	803,077	724,253	577,890	585,467	556,038	526,464
1947	680,682	662,980	681,035	614,001	472,430	457,960	566,736

See footnotes at end of table.

TABLE 23.—Truck shipments of Pennsylvania anthracite in 1948, by months and by States of destination, in net tons [1]—Continued

Destination	August	September	October	November	December	Total	Percent of total trucked
Pennsylvania:							
Within region	218,978	270,281	365,890	305,457	444,740	4,100,390	53.9
Outside region	178,482	182,027	218,887	182,694	214,019	2,309,560	30.3
New York	32,549	38,564	50,719	31,033	48,193	477,652	6.3
New Jersey	44,605	45,054	49,785	34,451	37,174	592,311	7.8
Delaware	1,091	973	2,562	1,902	2,356	29,529	.4
Maryland	5,867	6,171	9,204	5,123	6,026	82,017	1.1
District of Columbia			109			184	(2)
Other States	1,372	2,048	2,461	1,997	2,506	18,552	.2
Total: 1948	482,944	545,118	699,617	562,657	755,014	7,610,195	100.0
1947	389,878	488,443	605,141	602,535	739,863	6,961,684	100.0

[1] Compiled from reports of Pennsylvania Department of Mines.
[2] Less than 0.05 percent.

In the past, the regular annual schedule of the Bureau of Mines covering production statistics of the Pennsylvania anthracite industry has requested data for "local sales" only on total tonnages sold locally within the anthracite region. However, the Bureau received so many requests for local sales data on a size basis that it was deemed advisable to insert an item in the 1948 form requesting the industry to report local sales by sizes. As indicated in the tables, sales of anthracite within the region totaled 4,795,721 tons in 1948. It is of interest to note that, of the total local sales shipped (excluding river coal), 53 percent consists of domestic sizes, while 47 percent was steam sizes. These percentages compare with 60 and 40 percent, respectively, for the same size groups of shipments (excluding river coal) to points outside the local sales area. In other words, on a percentage basis more domestic coal is shipped outside the region than is used locally. This is probably accounted for by the fact that virtually all industries within the anthracite-producing area use steam-size anthracite to generate power.

Data compiled from records of the Massachusetts Division on the Necessaries of Life and the Anthracite Emergency Tidewater Bureau indicate that rail receipts of Pennsylvania anthracite in New England increased 3 percent over 1947; tidewater receipts increased 10 percent. Details on anthracite movement to New England are given in table 24. Loadings at Lake Erie ports and receipts at upper Lake docks increased 20 and 24 percent, respectively, over 1947. The substantial gain in Lake Erie loadings in 1944–48 over previous years can be attributed largely to the increased use of the smaller steam sizes of anthracite by briquet manufacturers in the Great Lakes region.

Shipments of anthracite from the Lehigh, Schuylkill, and Wyoming regions, 1850–1948, inclusive, are presented graphically in figure 1.

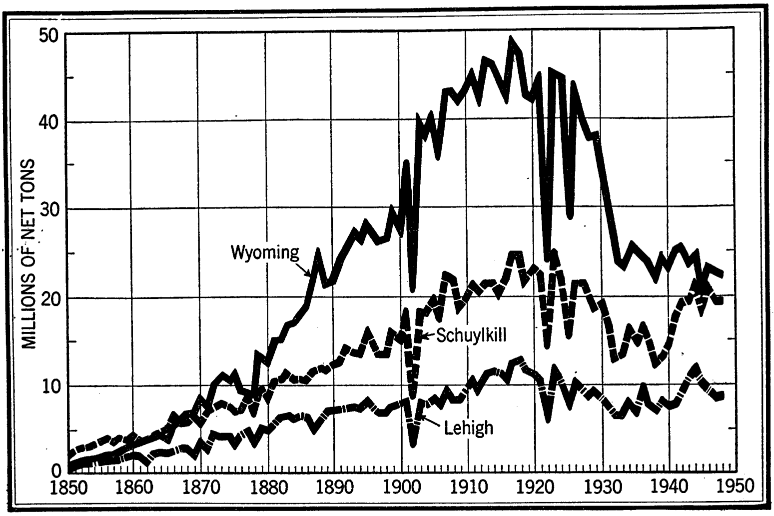

FIGURE 1.——Anthracite shipped from the Lehigh, Schuylkill, and Wyoming regions, 1850–1948.

TABLE 24.—Receipts of anthracite in New England, 1917, 1920, 1923, 1927, and 1940–48, 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
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						581	5,393	139	5,835
1943						575	5,310	164	5,721
1944						398	5,836	12	6,222
1945	(4)	(4)	(4)	(4)	(4)	331	4,750	(5)	5,081
1946						399	5,244	--------	5,643
1947						240	4,498	--------	4,738
1948						217	4,646	--------	4,863

[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.

CONSUMPTION

Apparent consumption of anthracite in the United States in 1948 totaled 50,200,000 tons, an increase of 4 percent over 1947. Apparent consumption is calculated on the basis of production, plus imports, minus exports, and changes in producers' stocks, but no attempt is made to reflect changes in retail dealer stocks, as data for this group are incomplete. In the absence of complete data on dealers' stocks, it is obviously impossible to measure actual consumption; however, in view of the extremely mild weather prevailing throughout the winter of 1948–49, it must be concluded that actual consumption was considerably lower than apparent consumption. Consumption by class 1 railroads in 1948 totaled 905,063 tons, a decline of 4 percent from 1947; electric power utilities consumed 3,965,965 tons, an increase of almost 13 percent. Anthracite used in the manufacture of fuel briquets and packaged fuel increased to 1,151,752 tons in 1948, a gain of 8 percent over 1947.

Competitive Fuels in the United States and Principal Markets.—Of the total shipments of anthracite to points in the United States in 1948, about 96 percent was 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 95,927,000 net tons in 1948, an increase of 5 percent over 1947. All of the gain was the result of increased consumption of heating and range oils. Fuel oil surpassed anthracite consumption in this area for the first time in 1947 on an equivalent B. t. u. or heating-value basis and, in 1948, accounted for 52 percent of the total consumption of the fuels indicated in table 25.

As indicated in table 26, supplies of various fuels generally used for space-heating purposes in the United States in 1948 increased over 1947, a substantial gain being indicated in sales of heating and range oils.

TABLE 25.—Apparent consumption of anthracite and selected competitive fuels in the principal anthracite markets, 1945–48

[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]									
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	322	980	281	49,241	56.0
1947	4,457	[2] 14,924	[2] 7,177	16,127	316	895	228	44,124	48.3
1948	4,600	[2] 15,004	[2] 6,806	16,116	313	709	215	43,763	45.6
Imports: [3]									
1945	-----	-----	-----	-----	-----	-----	-----	(4)	(5)
1946	-----	-----	-----	-----	-----	-----	-----	-----	-----
1947	-----	7	-----	-----	-----	-----	-----	7	(5)
1948	-----	-----	-----	-----	-----	1	-----	1	(5)
Briquets:									
Domestic use:									
1945	83	67	16	52	3	10	2	233	.3
1946	121	94	28	50	4	21	2	320	.4
1947	49	49	32	126	1	29	2	288	.3
1948	59	44	26	88	1	24	3	245	.3
Imports: [3]									
1945	-----	-----	-----	-----	-----	-----	-----	(4)	(5)
1946	-----	-----	-----	-----	-----	-----	-----	(4)	(5)
1947	-----	-----	-----	-----	-----	-----	-----	(4)	(5)
1948	-----	-----	-----	-----	-----	-----	-----	-----	-----
Coke:									
Domestic use:									
1945	1,371	1,375	552	334	5	2	2	3,641	4.6
1946	1,085	987	469	291	3	5	(4)	2,840	3.2
1947	834	693	407	220	(4)	1	-----	2,155	2.4
1948	778	689	386	242	1	(4)	-----	2,096	2.2
Imports: [3]									
1945	1	19	-----	-----	-----	-----	-----	20	(5)
1946	(4)	11	-----	-----	-----	-----	-----	11	(5)
1947	1	-----	-----	-----	-----	-----	-----	1	(5)
1948	1	38	-----	-----	-----	-----	-----	39	(5)
Oil: Heating and range: [6]									
1945	11,205	10,095	5,037	2,728	154	1,136	584	30,939	38.6
1946	12,924	11,554	5,713	3,175	184	1,327	665	35,542	40.4
1947	16,855	12,940	7,153	4,880	257	1,929	793	44,807	49.0
1948	18,652	14,390	8,224	5,207	278	2,256	776	49,783	51.9

See footnotes at end of table.

TABLE 25.—Apparent consumption of anthracite and selected competitive fuels in the principal anthracite markets, 1945–48—Continued

[Thousands of net tons]

Fuel	New England	New York	New Jersey	Pennsylvania	Delaware	Maryland	District of Columbia	Total	Percent of total fuels
Total fuel: [7]									
1945	17,527	26,044	14,271	18,890	505	2,016	858	80,111	100.0
1946	19,497	28,749	14,873	21,041	513	2,333	948	87,954	100.0
1947	22,196	28,613	14,769	21,353	574	2,854	1,023	91,382	100.0
1948	24,090	30,165	15,442	21,653	593	2,990	994	95,927	100.0

[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] U. S. Department of Commerce.
[4] Less than 1,000 tons.
[5] Less than 0.05 percent.
[6] Converted to coal equivalent upon basis of 4 barrels of fuel oil equaling 1 ton of coal.
[7] Excludes bituminous coal.

TABLE 26.—Total supplies of fuels commonly used for space-heating purposes in the United States, 1937 and 1945–48

[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	1945	1946	1947	1948
SOLID FUELS (NET TONS)					
Anthracite:					
Production:					
Shipments of domestic sizes	29,092,974	28,610,174	31,607,802	29,210,251	29,509,890
Shipments of Buckwheat No. 1	6,859,707	6,681,171	7,181,843	6,557,076	6,409,788
Shipments of smaller steam sizes [1]	10,250,463	13,251,106	15,318,942	15,285,086	14,563,514
Local sales	2,981,391	4,273,864	4,435,536	4,232,871	4,795,721
Total commercial production	49,184,535	52,816,315	58,544,123	55,285,284	55,278,913
Exports [2]	1,914,173	3,691,247	6,497,245	8,509,995	6,675,914
Imports for consumption [2]	395,737	149	9,556	10,350	945
Fuel briquets [3]	977,254	2,588,819	2,841,341	2,923,223	2,920,921
Packaged-fuel production	146,037	208,143	190,919	182,881	157,013
Coke:					
Oven-coke sales for domestic use	7,807,792	6,574,526	4,947,085	3,917,402	3,398,696
Beehive sales for domestic use	299,726	200,982	149,648	59,926	46,613
Imports for consumption [2]	286,364	51,964	52,188	104,093	161,400
Retort-coke sales	[4] 350,700	431,361	355,336	282,666	199,123
Petroleum-coke production	1,306,600	2,023,000	2,124,200	2,415,400	2,898,800
Anthracite and semianthracite production outside of Pennsylvania	468,852	[5]	[5]	[5]	[5]
Lignite production [6]	3,218,419	2,668,310	2,667,619	2,873,653	[7]
Bituminous-coal sales for domestic use	[8]	[8]	[8]	[8]	[8]
OIL (BARRELS OF 42 GALLONS)					
Oil sales for heating buildings:					
Range oil	32,259,000	51,021,000	60,564,000	74,114,000	84,163,000
Heating oils (domestic and commercial) [9]	116,617,000	165,216,000	189,371,000	234,761,000	258,663,000
Liquefied petroleum gases (domestic)	972,000	12,697,000	18,059,000	27,394,000	35,078,000
GAS (MILLION CUBIC FEET)					
Natural-gas consumption for domestic and commercial use [10]	489,234	837,499	902,622	1,087,363	[9] 1,232,770
Manufactured-gas sales for: [11]					
Domestic use	193,325	311,043	335,369	[7]	[7]
House heating	45,200				

[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] Includes all grades of fuel oil used for heating buildings.
[10] Includes gas used for heating offices, hotels, apartments, hospitals, stores, and other large buildings, as well as houses.
[11] American Gas Association.

Mechanical Stokers.—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 3,364 units in 1947 to 9,524 units in 1948. Sales of class 2 stokers (capacity 61 to 100 pounds of coal per hour) increased from 391 units in 1947 to 761 units in 1948. Stokers for burning anthracite have been improved greatly in the past 2 or 3 years, and the industry expects sales to increase substantially in the future.

STOCKS

Producers' stocks, which totaled 510,610 tons in January 1948, declined to a low of 51,043 tons in July but reached 963,839 tons in December. Most of the coal in storage was Buckwheat No. 1 and smaller, although some domestic sizes were stored in the closing months of the year. Stocks on the upper Lake docks totaled 380,024 net tons on December 31, 1948, an increase of 19 percent over those held on the same date in 1947. Stocks held by electric power utilities increased 12 percent over 1947, while stocks of class 1 railroads declined 16 percent.

PRICES

Saward's Journal quoted f. o. b. mine prices for anthracite at the beginning of 1948 varying from $10.95 to $11.50 per net ton on Broken and Egg; $11.00 to $11.50 on Stove and Chestnut sizes; $9.00 to $9.55 on Pea; $6.50 to $7.00 on Buckwheat No. 1; $5.35 to $5.95 on Rice; and $4.10 to $4.35 on Barley size. The mine workers were granted a wage increase in July, and to compensate the producers for the added costs of production (caused principally by the wage increase), circular prices were advanced. At the end of the year, the quoted price per ton f. o. b mine on Egg was $12.15 to $12.85; Stove and Chestnut varied from $12.25 to $12.85; Pea $10.20 to $10.75; Buckwheat No. 1 $6.95 to $8.25; Rice $5.95 to $6.65; and Barley $4.60 to $4.90. A number of companies normally sell coal from some mines or of certain grades at a small premium over the quoted circular prices. Details on prices are given in table 27.

Data compiled from reports of the Bureau of Labor Statistics, United States Department of Labor, showing retail prices of anthracite, bituminous coal, coke, and heating oils in selected cities, by months, for 1948, are shown in table 28.

TABLE 27.—Quoted prices per net ton for Pennsylvania anthracite, December 1948

[Saward's Journal]

	Egg	Stove	Chestnut	Pea	Buckwheat No. 1	Buckwheat No. 2 (Rice)	Buckwheat No. 3 (Barley)
Philadelphia & Reading Coal & Iron Co	$12.15	$12.25	$12.25	$10.25	$7.00	$6.00	$4.60
Hudson Coal Co	12.15	12.30	12.25	10.25	7.05	6.05	4.60
The M. A. Hanna Co	12.20	12.30	12.30	10.20	6.95	5.95	4.60
Cleveland-Cliffs Iron Co., Inc Delaware, Lackawanna & Western Coal Co	12.25	12.25	12.25	10.25	7.00	6.00	4.60
Lehigh Valley Coal Sales Co., "Wyoming Coal"	12.25	12.40	12.25	10.30	7.05	6.00	4.60
Pattison & Bowns, Inc	12.30	12.30	12.30	10.30	7.00	6.00	4.60
Dickson Fuel Corp., "Mammoth" Wilkes-Barre Coal Sales Co	12.50	12.50	12.50	10.50	7.00	6.00	4.60
Thorne Neale & Co., Inc	12.50	12.50	12.50	10.50	7.25	6.25	4.60
Lehigh Valley Coal Sales Co., other than "Wyoming coal" Payne Coal Co., Inc	12.50	12.65	12.50	10.55	7.30	6.25	4.60
Jeddo-Highland Coal Co	12.55	12.55	12.55	10.60	7.25	6.20	4.60
Weston Dodson & Co., Inc	12.55	[1] 12.55	[1] 12.55	10.50	7.25	6.25	4.60
Lehigh Navigation Coal Co., other than "Greenwood coal"	12.60	12.60	12.60	10.50	7.25	6.25	4.65
Pittston Coal Sales Co	12.75	12.75	12.75	10.75	8.25	6.65	-------
Lehigh Navigation Coal Co., "Greenwood coal"	12.85	12.85	12.85	10.75	7.50	6.50	4.90

[1] "Salem Hill" (red ash), $12.85.

TABLE 28.—Retail prices of selected fuels in 1948, 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.: [2]												
Anthracite:												
Stove	$17.86	$17.95	$17.95	$17.95	$18.01	$18.30	$19.02	$20.11	$20.14	$20.14	$20.14	$20.14
Buckwheat No. 1	13.41	13.53	13.53	13.53	13.66	13.69	14.02	14.48	14.48	14.48	14.48	14.48
Heating oil: Fuel oil No. 2	12.17	12.17	12.17	11.83	11.73	11.73	11.73	11.73	12.04	12.14	12.14	12.14
Boston, Mass.:												
Anthracite:												
Stove	19.88	20.25	20.25	20.25	20.31	20.44	20.82	21.80	21.80	21.95	21.95	21.95
Buckwheat No. 1	14.95	15.25	15.25	15.25	15.31	15.44	15.62	16.00	16.00	16.15	16.15	16.15
Coke, Egg	19.25	19.75	19.75	19.56	19.50	19.90	19.90	21.30	21.30	21.30	21.41	21.45
Heating oil: Fuel oil No. 2	12.32	12.32	12.32	12.32	12.18	12.18	12.18	12.18	12.36	12.46	12.46	12.28
Buffalo, N. Y.: [3]												
Anthracite: Stove	18.32	18.32	18.32	18.32	18.75	19.02	20.74	20.74	20.82	20.82	20.82	20.82
Coke, Nut	16.01	16.61	16.61	16.61	17.27	17.93	19.14	19.14	19.64	19.64	19.64	19.64
Heating oil:												
Fuel oil No. 2	13.84	13.84	13.84	13.84	13.84	13.84	13.84	13.84	13.84	13.84	13.84	13.84
Fuel oil No. 3	13.84	13.84	13.84	13.84	13.84	13.84	13.84	13.84	13.84	13.84	13.84	13.84
Milwaukee, Wis.:												
Anthracite: Stove	20.05	20.05	20.05	20.05	20.40	20.40	20.95	22.10	22.10	22.10	22.10	22.10
Bituminous coal, low-volatile Stove	17.45	17.45	17.45	17.45	18.50	19.02	19.02	19.33	19.50	19.50	19.50	19.50
Coke, Nut	19.24	19.24	19.24	19.24	19.24	19.24	19.24	20.49	20.49	20.49	20.49	20.49
Heating oil:												
Fuel oil No. 2	14.44	14.68	14.48	14.18	14.10	14.22	14.34	14.34	14.22	14.22	14.10	14.10
Fuel oil No. 3	14.60	14.90	14.65	14.28	14.15	14.30	14.45	14.45	14.30	14.28	14.15	14.15
New York, N. Y.: [2]												
Anthracite:												
Stove	18.69	18.69	18.69	18.69	18.71	19.14	19.59	20.61	20.76	20.76	20.78	20.78
Buckwheat No. 1 [4]	12.81	12.81	12.81	12.80	12.82	12.90	13.07	13.45	13.59	13.59	13.59	13.59
Coke, Nut	19.57	19.57	19.57	19.59	19.59	20.29	20.58	21.05	21.28	21.28	21.28	21.28
Heating oil: Fuel oil No. 2	13.27	13.90	13.70	12.76	12.53	12.49	12.57	12.90	13.04	13.04	13.06	12.71
Philadelphia, Pa.:												
Anthracite:												
Stove	17.95	17.95	17.95	17.95	17.95	18.18	18.18	19.50	19.50	19.50	19.50	19.50
Buckwheat No. 1	12.82	12.82	12.82	12.82	12.82	12.82	12.82	13.75	13.75	13.75	13.75	13.75
Coke, Nut	18.38	18.25	18.25	18.25	18.25	19.25	19.25	20.25	20.25	20.25	20.25	20.25
Heating oil: Fuel oil No. 2	11.76	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
Portland, Maine:												
Anthracite:												
Stove	19.52	19.60	19.60	19.36	19.28	19.86	19.98	20.89	21.49	21.49	21.49	21.54
Buckwheat No. 1	14.58	14.65	14.65	14.50	14.38	14.68	14.72	15.12	15.88	15.88	15.88	15.88
Coke, Egg	18.87	18.93	18.93	18.69	18.59	19.05	19.24	20.16	20.78	20.63	20.63	20.63
Heating oil: Fuel oil No. 2	12.28	12.28	12.28	11.54	11.54	11.54	11.56	11.76	12.30	12.36	12.46	12.30
Washington, D. C.:												
Anthracite:												
Stove	17.85	17.85	17.85	17.85	17.94	18.08	18.20	19.32	19.42	19.42	19.42	19.42
Buckwheat No. 1	13.19	13.19	13.19	13.19	13.29	13.29	13.29	13.82	13.98	13.98	13.98	13.98
Bituminous coal, low-volatile Stove	15.16	15.34	15.34	15.34	15.78	15.78	16.38	16.38	16.45	16.45	16.45	16.45
Heating oil: Fuel oil No. 2	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.30

[1] Compiled from reports of Bureau of Labor Statistics. Prices are as of the 15th of each month. Data are preliminary.
[2] Includes 2-percent sales tax.
[3] Includes 1-percent sales tax
[4] Commercial.

EMPLOYMENT

The average number of men employed in the Pennsylvania anthracite industry in 1948 totaled 76,215, a decline of 3 percent from the number employed in 1947. The men worked an average of 265 days, and the average annual output per man was 745 net tons, a slight increase over the annual per man output of 720 tons in 1947. Of the total employees, 54 percent were employed in operations in the Wyoming region, 17 percent in the Lehigh, and 29 percent in the Schuylkill region.

Data on employment, as shown in this study, do not include workers employed in "bootleg" coal-mining operations, conducted principally in the Schuykill region. According to the Anthracite Committee, 2,617 men were working 772 "bootleg" holes in March 1949. Although these workers are not included in the employment data, the coal produced by some (544,475 net tons in 1948) was purchased by the recognized industry for preparation and shipment to market, and the coal so purchased is included in the production tables of this chapter. Complete employment data on the "bootleg" holes from which this coal was produced are not available. Therefore, the purchased coal was deducted from the total tonnage reported by the operators and the resulting net production was then used to calculate the output per man per day. Although it is true that men employed at preparation plants of the recognized companies were engaged part time in the preparation of this purchased coal for market, the omission of such time will not detract materially from the validity of the per-ton figure obtained. See tables 29 and 30 for details on labor statistics.

TABLE 29.—Men employed and days worked at operations producing Pennsylvania anthracite in 1948, by regions [1]

[Includes operations of strip contractors]

Region	Average number of men employed: Underground: Miners and their laborers	Underground: Other	Underground: Total underground	Surface: In strip pits	Surface: In preparation plant	Surface: Other	Surface: Total surface	Grand total	Average number of days plant operated	Man-days of labor	Average tons per man per day
Lehigh:											
Breaker	4,862	3,168	8,030	1,691	753	2,039	4,483	12,513	254	3,182,346	[2] 2.86
Washery [3]					41	61	102	102	224	22,810	13.64
Dredge					10	6	16	16	184	2,942	18.45
Total Lehigh	4,862	3,168	8,030	1,691	804	2,106	4,601	12,631	254	3,208,098	[2] 2.95
Schuylkill:											
Breaker	7,502	4,467	11,969	3,968	2,037	3,681	9,686	21,655	247	5,338,131	[2] 3.53
Washery [3]				51	96	196	343	343	235	80,697	8.97
Dredge					159	271	430	430	233	100,000	9.21
Total Schuylkill	7,502	4,467	11,969	4,019	2,292	4,148	10,459	22,428	246	5,518,828	[2] 3.72
Wyoming:											
Breaker	20,735	10,802	31,537	1,284	1,881	6,128	9,293	40,830	278	11,369,804	2.27
Washery [3]				11	84	101	196	196	199	39,067	18.42
Dredge					4	3	7	7	140	980	12.73
Total Wyoming	20,735	10,802	31,537	1,295	1,969	6,232	9,496	41,033	278	11,409,851	2.33
Total, excluding Sullivan County:											
Breaker	33,099	18,437	51,536	6,943	4,671	11,848	23,462	74,998	265	19,890,281	[2] 2.70
Washery [3]				62	221	358	641	641	222	142,574	12.31
Dredge					173	280	453	453	229	103,922	9.51
Total	33,099	18,437	51,536	7,005	5,065	12,486	24,556	76,092	265	20,136,777	[2] 2.81
Sullivan County	68	25	93		22	8	30	123	240	29,520	2.11
Grand total	33,167	18,462	51,629	7,005	5,087	12,494	24,586	76,215	265	20,166,297	[2] 2.81

[1] Men employed in "bootleg" operations excluded.
[2] Output per man per day calculated on legitimate tonnages only; "bootleg" purchases excluded.
[3] Represents washeries for which both production and employment were separately reported.

TABLE 30.—Men employed at operations producing Pennsylvania anthracite, 1947–48, by counties

[Includes operations of strip contractors]

County	1947	1948	County	1947	1948
Berks, Lancaster, Lebanon, Northampton, and Snyder [1]	149	148	Northumberland	6,380	5,977
Carbon	5,163	4,812	Schuylkill	18,010	17,261
Columbia	2,110	2,118	Sullivan	115	123
Dauphin	384	213	Susquehanna and Wayne	54	43
Lackawanna	12,198	11,707	Total	78,600	76,215
Luzerne	34,037	33,813			

[1] Counties producing dredge coal only.

MINING METHODS AND EQUIPMENT

Mechanical Loading.—The quantity of anthracite loaded mechanically underground in 1948 totaled 15,742,368 tons, a decline of 2 percent from that of 1947. Virtually all of the decreases took place in the Western Middle and Southern fields, as slight increases are shown for the Northern and Eastern Middle fields. The relatively flat coal seams of the Northern fields are more adaptable to present-day mechanical loading methods than the sharply pitching seams in the other three fields, and for this reason 86 percent of the total tonnage mechanically loaded underground was produced in the former field whereas only 14 percent was produced in the other fields. Mechanically loaded coal accounted for 42 percent of the total underground production in 1948; coal loaded by hand comprised 58 percent. Details on anthracite loaded mechanically underground are given in tables 31 to 33.

The trend in underground mechanical-loading, hand-loading, and in stripping in the Pennsylvania anthracite regions, 1928–48, is illustrated graphically in figure 2.

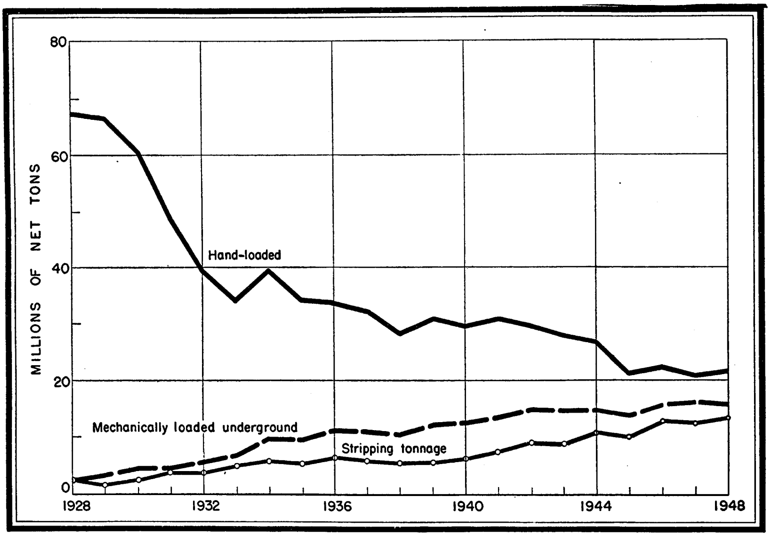

FIGURE 2.—Relative trend of mechanical-loading, hand-loading, and stripping of Pennsylvania anthracite, 1928–48.

TABLE 31.—Pennsylvania anthracite loaded mechanically underground, 1947–48, by fields, in net tons

Field	Scraper loaders [1]		Pit-car loaders		Hand-loaded face conveyors, all types [2]		Total mechanically loaded underground	
	1947	1948	1947	1948	1947	1948	1947	1948
Northern	2,143,164	2,394,262	336,303	87,219	10,960,358	11,096,707	13,439,825	13,578,188
Eastern Middle	92,773	114,481	26,648	101,351	[3] 501,194	406,148	620,615	621,980
Western Middle	249,614	257,074	87,954	55,161	1,141,231	900,116	1,478,799	1,212,351
Southern	18,056	16,020	8,000	15,542	488,716	298,287	514,772	329,849
Total	2,503,607	2,781,837	458,905	259,273	13,091,499	12,701,258	16,054,011	15,742,368

[1] Includes mobile loaders.
[2] Shaker chutes, etc., including those equipped with duckbills.
[3] Revised figure.

TABLE 32.—Pennsylvania anthracite loaded mechanically underground, 1944–48

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
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
1947	594	2, 371, 370	25	132, 237	3, 457	13, 550, 404	4, 076	16, 054, 011
1948	643	2, 721, 180	19	60, 657	3, 562	12, 960, 531	4, 224	15, 742, 368

[1] Includes duckbills and other self-loading conveyors.

TABLE 33.—Relative growth of mechanical loading, hand loading, and stripping in Pennsylvania anthracite mines, 1927–48

[Mechanical loading includes coal handled on pit-car loaders and hand-loaded face conveyors]

Year	Net tons			Index numbers: 1937=100		
	Mechanical loading underground	Stripping	Hand loading	Mechanical loading underground	Stripping	Hand loading
1927	[1] 2, 223, 281	2, 153, 156	71, 434, 537	20	38	224
1928	[1] 2, 351, 074	2, 422, 924	67, 373, 788	22	43	211
1929	3, 470, 158	1, 911, 766	66, 493, 690	32	34	209
1930	4, 467, 750	2, 536, 288	60, 458, 344	42	45	190
1931	4, 384, 780	3, 813, 237	49, 074, 722	41	67	154
1932	5, 433, 340	3, 980, 973	38, 400, 820	51	70	120
1933	6, 557, 267	4, 932, 069	34, 474, 844	61	87	108
1934	9, 284, 486	5, 798, 138	39, 290, 255	87	102	123
1935	9, 279, 057	5, 187, 072	34, 503, 819	87	91	108
1936	10, 827, 946	6, 203, 267	33, 898, 560	101	109	106
1937	10, 683, 837	5, 696, 018	31, 882, 514	100	100	100
1938	10, 151, 669	5, 095, 341	27, 990, 628	95	89	88
1939	11, 773, 833	5, 486, 479	30, 797, 715	110	96	97
1940	12, 326, 000	6, 352, 700	29, 190, 837	115	112	92
1941	13, 441, 987	7, 316, 574	30, 435, 277	126	128	95
1942	14, 741, 459	9, 070, 933	30, 495, 240	138	159	96
1943	14, 745, 793	8, 989, 387	27, 990, 005	138	158	88
1944	14, 975, 146	10, 953, 030	26, 800, 270	140	192	84
1945	13, 927, 955	10, 056, 325	20, 957, 744	130	177	66
1946	15, 619, 162	12, 858, 930	22, 465, 295	146	226	70
1947	16, 054, 011	12, 603, 545	20, 909, 101	150	221	66
1948	15, 742, 368	13, 352, 874	21, 432, 923	147	234	67

[1] As reported by Commonwealth of Pennsylvania, Department of Mines.

Strip-Pit Operations.—Strip-pit activities throughout the anthracite region have expanded greatly since 1940, reaching a peak production in 1948 of 13,352,874 tons (26 percent of the total fresh-mined output), a gain of 6 percent over 1947. The Lehigh and Schuylkill regions are the scenes of the largest strip-pit operations in the anthracite fields, having supplied 80 percent of the total 1948 strip-pit output, the Wyoming region supplying the remaining 20 percent. The high proportionate tonnage obtained by stripping in the Lehigh and Schuylkill regions is due largely to the relative ease of mining thick-bed outcrops, whereas the beds in the Wyoming region are thinner, limiting the quantity of coal recoverable by strip-pit operations. Draglines are used extensively in removing overburden and, at some pits, in loading coal. Details of strip-pit operations are given in tables 34 and 35. Figure 3 illustrates graphically the production of anthracite from strip pits, by regions, 1928–48.

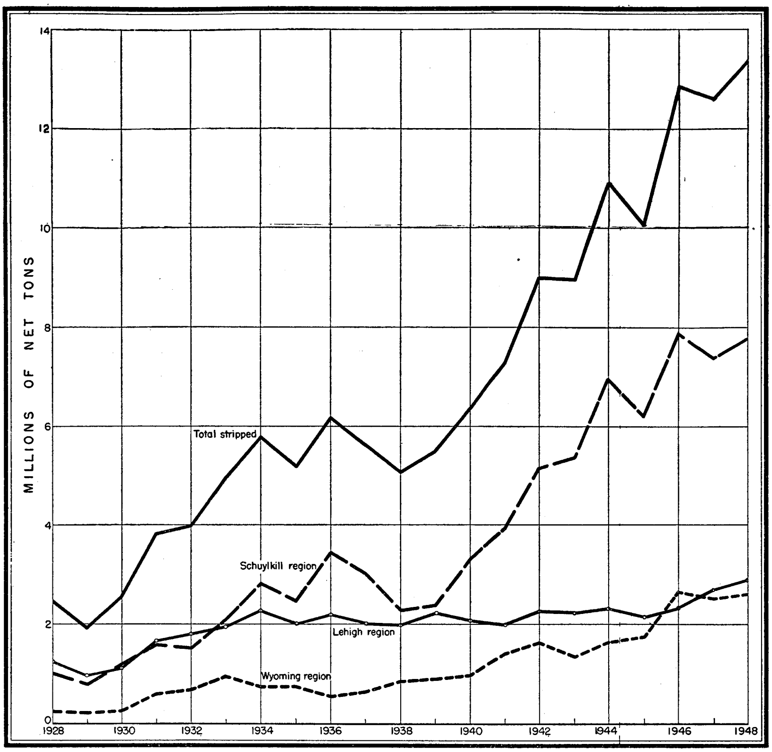

FIGURE 3.—Pennsylvannia anthracite mined from strip pits, by regions, 1928-48.

TABLE 34.—Relative growth of Pennsylvania anthracite mined from strip pits, 1915, 1920, 1925, 1930, and 1944–48

	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)
1944	10,953,030	20.8	5,595	246
1945	10,056,325	22.4	5,314	238
1946	12,858,930	25.2	6,152	252
1947	12,603,545	25.4	7,264	242
1948:				
Lehigh region	2,990,851	34.7	1,691	261
Schuylkill region	7,758,109	47.3	4,019	258
Wyoming region	2,603,914	10.2	1,295	267
Total [2]	13,352,874	26.5	7,005	260

[1] Data not available.
[2] No production by stripping in Sullivan County in 1948.

TABLE 35.—Power shovels and draglines used in stripping Pennsylvania anthracite, by type of power, 1946–48

Type of power	1946			1947			1948		
	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	68	20	88	75	23	98	65	8	73
Electric	33	44	77	47	46	93	54	46	100
Diesel	155	254	409	158	256	414	182	256	438
All other	6		6	4		4	3		3
Total	262	318	580	284	325	609	304	310	614

Cutting Machines.—The quantity of anthracite cut by machines declined from 1,209,983 tons in 1947 to 1,016,757 tons in 1948. The number of cutting machines in use in 1948 were 177 "permissible" and 28 "all other types," compared with 184 "permissible" and 27 "all other types" in 1947.

Dredge Coal.—Dredging anthracite from the rivers and creeks is an important industry to many operators along the banks of the streams that drain the anthracite region. The output of anthracite from this source of mining reached a peak of 1,517,563 tons in 1941, and declined to 988,004 tons by 1948. Most of the coal drained from the streams is Buckwheat No. 3, and smaller sizes used principally for industrial purposes at points relatively near the streams from which the coal is dredged. Details on river coal production are shown in tables 36 and 37.

TABLE 36.—Pennsylvania anthracite produced by dredges, 1909–48, by rivers (including tributaries)

Year	Net tons				Value	
	Lehigh River	Schuylkill River	Susquehanna River	Total	Total	Average per ton
1909				107,788		
1910				102,853		
1911				106,005	(1)	(1)
1912				96,009		
1913				150,064		
1914				115,257		
1915	(1)	(1)	(1)	138,421	$100,744	$0.73
1916				160,507	110,831	.69
1917				170,672	206,754	1.21
1918				282,930	366,565	1.30
1919				693,093	868,746	1.25
1920				740,453	862,296	1.16
1921				623,329	650,654	1.04
1922				904,108	989,709	1.09
Total, 1909–22 [2]	(1)	(1)	(1)	4,391,489	[3] 4,156,299	1.12
1923	106,092	97,254	753,022	956,368	811,065	.85
1924	80,301	74,359	670,734	825,394	681,181	.83
1925	99,614	173,639	742,455	1,015,708	929,292	.91
1926	58,544	131,654	724,566	914,764	828,398	.91
1927	85,177	127,705	758,935	971,817	794,807	.82
1928	89,304	157,449	696,648	943,401	821,530	.87
1929	87,241	133,720	495,983	716,944	626,187	.87

See footnotes at end of table.

TABLE 36.—Pennsylvania anthracite produced by dredges, 1909–48, by rivers (including tributaries)—Continued

Year	Net tons				Value	
	Lehigh River	Schuylkill River	Susquehanna River	Total	Total	Average per ton
1930	60,219	138,236	444,836	643,291	$538,268	$0.84
1931	33,014	90,855	334,881	458,750	379,682	.83
1932	42,091	105,990	331,969	480,050	445,799	.93
1933	51,083	106,004	381,837	538,924	452,153	.84
1934	91,346	100,873	459,961	652,180	636,038	.98
1935	78,578	73,326	438,563	590,467	517,304	.88
1936	63,327	31,669	451,688	546,684	581,679	1.06
1937	[3] 95,065	(3)	665,409	760,474	842,052	1.11
1938	[3] 123,452	(3)	447,572	571,024	570,579	1.00
1939	62,134	67,539	574,187	703,860	746,000	1.06
1940	[3] 78,947	(3)	863,997	942,944	1,097,000	1.16
1941	47,838	396,522	1,073,203	1,517,563	1,839,784	1.21
1942	9,385	268,919	1,006,729	1,285,033	1,478,719	1.15
1943	37,452	342,815	954,470	1,334,737	1,972,777	1.48
1944	40,894	494,371	837,472	1,372,737	2,084,431	1.52
1945	41,409	366,161	797,656	1,205,226	1,924,148	1.60
1946	37,441	247,757	847,196	1,132,394	2,091,324	1.85
1947	46,478	158,102	1,015,126	1,219,706	2,480,068	2.03
1948	54,284	67,871	865,849	988,004	2,291,752	2.32
Total, 1923–48	[3] 1,700,710	[3] 3,952,790	17,634,944	23,288,444	28,462,017	1.22
Grand total	(1)	(1)	(1)	27,679,933	(1)	(1)

[1] Data not available.
[2] Figures for value cover 1915–22.
[3] Schuylkill included with Lehigh in 1937, 1938, and 1940.

TABLE 37.—Pennsylvania anthracite produced by dredges in 1948, by rivers

River (including tributaries)	Net tons	Value	
		Total	Average
Lehigh	54,284	$113,601	$2.09
Schuylkill	67,871	166,708	2.46
Susquehanna	865,849	2,011,443	2.32
Total	988,004	2,291,752	2.32

FOREIGN TRADE [3]

Although shipments of Pennsylvania anthracite to foreign countries in 1948 declined 22 percent from the all-time record established in 1947, the total (6,675,914 net tons) was the highest for any year except 1947. Canada and Europe received virtually all of the tonnage—4,931,918 and 1,692,967 net tons, respectively. Because of the unusually mild weather in Canada during the last 3 months of 1948, consumption was considerably below normal, and this no doubt will be reflected in the quantity imported from the United States in 1949. Production of coal in European countries has been increasing considerably; as a consequence, exports of anthracite to Europe probably will show a decline in 1949. Statistics on United States imports and exports are shown in tables 38 and 39.

[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.

TABLE 38.—Anthracite exported from the United States, 1947–48, by countries and customs districts, in net tons

[U. S. Department of Commerce]

Country	1947	1948
North America:		
Bermuda	557	130
Canada	4,470,034	4,931,918
Mexico	8,988	11,681
Newfoundland and Labrador	7,880	1,675
West Indies:		
British	787	26
Cuba	23,794	3,522
Other North America	40	----------
South America:		
Argentina	25,405	----------
Bolivia	53	----------
Brazil	901	50
Chile	575	78
Surinam	570	----------
Other South America	6	----------
Europe:		
Belgium-Luxembourg	1,367,636	209,400
Denmark	40,550	----------
France	1,404,785	1,425,322
Ireland	9,177	20
Italy	157,945	53,386
Netherlands	41,907	4,839
Norway	201,135	----------
Portugal	2,464	----------
Sweden	577,999	----------
Switzerland	114,851	----------
Other Europe	14	----------
Asia:		
China	286	18
Japan	----------	30,820
Malaya, Federation of	10,044	----------
Palestine and Trans-Jordan	28,369	----------
Other Asia	100	168
Africa:		
Belgian Congo	2,448	2,859
Egypt	10,640	----------
Other Africa	55	2
Total	8,509,995	6,675,914

Customs district	1947	1948
North Atlantic:		
Maine and New Hampshire	42,365	31,942
Massachusetts	38	----------
New York	787,549	231,386
Philadelphia	2,738,308	1,472,406
Rhode Island	3,930	----------
South Atlantic:		
Maryland	511,904	10,261
Puerto Rico	10	----------
South Carolina	2	----------
Virginia	2,150	20
Gulf Coast:		
Florida	47	6
Galveston	5	----------
Mobile	570	----------
New Orleans	125	6
Mexican border:		
Arizona	23	47
El Paso	13	8
Laredo	7	----------
Pacific Coast:		
Alaska	55	10
San Diego	45	3
Washington	93	16,433
Northern border:		
Buffalo	2,639,285	2,968,582
Dakota	4,383	4,412
Duluth and Superior	8,557	7,984
Michigan	1,454	30,037
Montana and Idaho	----------	4,296
Ohio	6,197	12,523
Rochester	153,115	126,683
St. Lawrence	1,608,294	1,725,344
Vermont	1,471	2,705
Total	8,509,995	[1] 6,675,914

[1] Includes 30,820 tons shipped on vessels operated by the U. S. Army or Navy.

TABLE 39.—Anthracite imported for consumption in the United States, 1947–48, by countries and customs districts, in net tons

[U. S. Department of Commerce]

Country	1947	1948	Customs district	1947	1948
Argentina	----------	1	Laredo	50	----------
Canada	10,293	144	Maryland	----------	800
Chile	7	----------	Montana and Idaho	10,293	----------
Mexico	50	----------	New York	7	1
United Kingdom	----------	800	Washington	----------	144
Total	10,350	945	Total	10,350	945

CANADA

The production of coal in Canada totaled 18,406,938 net tons in 1948, a gain of approximately 16 percent over the 1947 output. Although all of the coal-producing Provinces shared in the increased output, Nova Scotia accounted for 91 percent of the gain and 35 percent of the total coal production in 1948. Coal and coke statistics for Canada are shown in tables 40 and 41.

TABLE 40.—Coal and coke production and foreign trade of Canada, 1947-48, in thousands of net tons [1]

	Coal								Coke from coal	
	Anthracite		Bituminous and subbituminous		Lignite		Total			
	1947	1948	1947	1948	1947	1948	1947	1948	1947	1948
Production			14,298	16,821	1,571	1,586	15,869	18,407	3,501	3,946
Imports	4,464	5,143	26,100	25,907			30,564	31,050	563	562
Exports			706	1,263	8	10	714	1,273	107	167
Available for consumption	4,464	5,143	39,692	41,465	1,563	1,576	45,719	48,184	3,957	4,341

[1] Monthly Coal and Coke Statistics for Canada, December 1948. Production data revised through May 1948.

TABLE 41.—Canadian coal production, 1947-48, by Provinces and by kinds, in net tons [1]

Province	Bituminous		Subbituminous		Lignite		Total	
	1947	1948	1947	1948	1947	1948	1947	1948
Alberta	4,835,371	4,917,371	3,235,059	3,175,304			8,070,430	8,092,675
British Columbia	1,763,899	1,777,632					1,763,899	1,777,632
New Brunswick	345,194	520,155					345,194	520,155
Nova Scotia	4,118,196	6,430,943					4,118,196	6,430,943
Saskatchewan					1,571,147	1,585,533	1,571,147	1,585,533
Total	11,062,660	13,646,101	3,235,059	3,175,304	1,571,147	1,585,533	15,868,866	18,406,938

[1] Monthly Coal and Coke Statistics for Canada, December 1948. Figures revised through May 1948.

WORLD PRODUCTION

The total production of anthracite throughout the world has been increasing consistently since 1945, the United States being the largest producer. Available data on world production, by countries, for 1943-48 are given in table 42.

TABLE 42.—World production of anthracite, in metric tons, 1943-48 [1]

Country [1]	1943	1944	1945	1946	1947	1948
China [2]	(3)	(3)	1,451,000	757,114	878,062	(3)
France	8,205,000	4,964,000	6,611,458	8,313,230	(3)	(3)
Indochina, French	954,500	499,400	217,700	261,696	247,777	340,315
Ireland	123,387	130,198	123,468	122,886	121,824	180,000
Italy	122,075	59,028	53,446	104,989	115,731	[4] 80,000
Korea	4,157,101	4,530,262	673,796	[4] 1,071,800	[4] 1,815,200	[5] 699,234
Morocco, French	102,290	134,400	178,600	221,750	268,500	290,300
New Zealand	(3)	(3)	2,571	2,308	1,632	1,773
Peru	22,716	14,545	36,848	82,089	82,045	45,969
Portugal [6]	368,321	389,638	436,117	379,526	377,000	386,763
Rumania	21,476	12,000	17,000	15,994	23,779	(3)
Spain	1,151,762	1,516,035	1,529,532	1,457,529	1,411,355	1,421,685
Switzerland	104,150	51,232	101,993	74,544	15,066	(3)
United Kingdom	4,196,671	3,652,881	3,213,405	3,582,084	(3)	(3)
United States (Pennsylvania)	55,014,679	57,788,602	49,834,944	54,890,625	51,881,632	51,836,218
Total (estimate)	116,414,000	112,550,000	103,622,000	117,466,000	118,908,000	120,815,000

[1] In addition to countries listed, Belgium, Bulgaria, 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] Excludes Kwantung Peninsula.
[3] Data not available; estimate by author of chapter included in total.
[4] Estimate.
[5] South Korea only.
[6] Quality in doubt; may be bituminous.

Cobalt

By HUBERT W. DAVIS

GENERAL SUMMARY

CONSUMPTION of cobalt in the United States exceeded 5,000,000 pounds for the first time in 1948 and was 21 percent more than in 1947. Usage of cobalt for all important purposes was larger than in 1947. However, permanent-magnet alloys and high-temperature alloys continued to lead in the postwar demand for cobalt; these two outlets accounted for 40 percent of the total quantity of cobalt consumed in 1948. Despite the much greater demand for cobalt in 1948, supplies substantially exceeded industry requirements, chiefly because of the record output of 4,322 metric tons from Belgian Congo ores.

Sales of cobalt metal in the United States were 36 percent greater in 1948 than in 1947; sales to industry were 17 percent larger, but those to the national strategic stock pile were 60 percent greater. The metal was supplied chiefly by imports but partly by withdrawals from suppliers' stocks and by production in the United States. Imports and domestic production of metal declined 13 and 6 percent, respectively, in 1948 from 1947, and suppliers' stocks in the United States dropped 45 percent.

The demand for cobalt oxide was also greater in 1948 than in 1947, chiefly because of greater use in ground-coat frit for porcelain enamel and pigments. Despite a 69-percent gain in output of oxide in the United States, it was inadequate for requirements. The deficit was met by imports, which were 5 percent greater.

Production of cobalt hydrate, salts, and driers and shipments of hydrate were smaller in 1948 than in 1947, but sales of salts and driers were larger.

The bulk of the cobalt metal, oxide, hydrate, and other cobalt products sold in the United States is made from crude cobalt (alloy) produced in the Belgian Congo. Imports of alloy from Belgian Congo were 33 percent more in 1948 than in 1947. Some of the cobalt products sold are made from domestic and Canadian ores. Output of domestic ore was slightly greater than in 1947, and imports of Canadian ore by refiners were up 66 percent. Consumption of cobalt alloy and ore was 2 percent larger.

A noteworthy contribution to the literature on cobalt was made by Roland S. Young,[1] chief research chemist, Rhokana Corp. Ltd., who

[1] Young, R. S., Cobalt: Reinhold Publishing Corp., New York, 1948, 181 pp.

assembled and reviewed critically existing data and presented certain unpublished features and developments which had come within his experience with this metal and its compounds.

DOMESTIC PRODUCTION

Despite the fact that the United States is the largest consumer of cobalt in the world, only a small part of its requirements has been furnished by domestic ore, as is evident from the next table, which shows production and shipments through 1946; the Bureau of Mines is not at liberty to publish figures for 1947 and 1948.

Cobalt ore produced and shipped in the United States through 1946 [1]

Year	Produced		Shipped from mines	
	Gross weight (short tons)	Cobalt content (pounds)	Gross weight (short tons)	Cobalt content (pounds)
Previous to 1921 (partly estimated)	(2)	730,000	(2)	730,000
1921–32 (partly estimated)	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
1945	19,770	1,099,654	17,528	1,281,681
1946	15,620	518,378	15,542	506,884
	(2)	5,303,950	(2)	5,154,308

[1] Bureau of Mines not at liberty to publish figures for 1947 and 1948.
[2] Data not available.

Production of cobalt ore in the United States in 1948 was slightly greater than in 1947, but shipments declined.

The Bethlehem Steel Co. was the only producer of commercial cobalt ore in the United States in 1948. The cobalt-bearing material (averaging 1.3 percent cobalt in 1948) is contained in the sulfides that accompany the magnetite mined at Cornwall, Pa. The cobalt-bearing material is shipped to the Pyrites Co., Wilmington, Del., where it is processed to metal and other cobalt products.

The Sullivan Mining Co., Kellogg, Idaho, continued to recover cobalt at its electrolytic zinc plant in 1948 but, as in previous years, made no shipments. In 1948 it recovered 140 short tons of residues containing 9,962 pounds of cobalt.

Underground development and exploratory work were continued in 1948 at the Blackbird mine near Forney, Idaho, by the Calera Mining Co., a wholly owned subsidiary of the Howe Sound Co. A development crew of about 35 men was maintained. Underground development comprised 3,120 feet of drifts and crosscuts, 601 feet of raises.

and 1,248 feet of diamond drilling. A 30-ton pilot mill was constructed and operated for a few months to produce cobalt concentrates for test work. The ore carries copper and gold, as well as cobalt. According to the Howe Sound Co.:[2]

Research to determine the best process for separating the metals contained in this complex ore and for refining the cobalt product has been practically concluded. Based on results so obtained, design of the necessary plants will be undertaken by our organization. Preliminary construction will begin in the summer of 1949 and it now seems possible that this work may be completed by the end of 1950. At agreement has been made with the Idaho Power Co. to furnish necessary power for this project. Mine development and exploration is continuing.

A summary of the results of Bureau of Mines laboratory and small-scale pilot-plant investigations of beneficiation of the Blackbird ore has been published.[3]

There was again no commercial production of cobalt in Missouri. However, the St. Louis Smelting & Refining Division of National Lead Co., which has been studying the problem of making a successful recovery of separate products of cobalt and nickel, continued this investigation in 1948 and reported that the work thus far done indicated satisfactory technical progress. Investigation will proceed along the economic phases of the work.

CONSUMPTION

Refiners or Processors.—Consumption by refiners or processors of cobalt contained in alloy and ore was 2,715,605 pounds in 1948, an increase of 2 percent over 1947. However, usage of cobalt intermediates by refiners or processors was 20 percent smaller. Of the alloy and ore consumed in 1948, much the greater part was utilized in making cobalt metal. The remainder of the alloy and ore and all of the other cobalt raw materials were used in manufacturing the cobalt products shown in the accompanying table.

Cobalt consumed [1] by refiners or processors in the United States, 1945–48

Cobalt material	Pounds of cobalt			
	1945	1946	1947	1948
Alloy and ore	4,808,825	2,009,018	2,672,991	2,715,605
Fines and granules	453,538	499,737	528,544	393,725
Rondelles	64,872	148,197	128,937	107,520
Hydrate	133,831	128,740	152,102	150,826
Carbonate	18,460	19,243	6,904	4,608

[1] The fines, granules, rondelles, hydrate, and carbonate consumed originated from alloy and ore; therefore, combining alloy and ore with these materials would result in duplication.

Industrial Consumers.—Consumption of cobalt by industrial consumers established a new record in 1948; it was 5,049,597 pounds, a gain of 21 percent over 1947. Permanent-magnet alloys continued

[2] Howe Sound Co., Annual Report: 1948, p. 3.
[3] Wells, H. R., and others, Concentration of Copper-Cobalt Ores from the Blackbird District, Lemhi County, Idaho: Bureau of Mines Rept. of Investigations 4279, 1948, 21 pp.

Specified cobalt products [1] produced and shipped in the United States, 1947–48, in pounds

Product	Production		Shipments	
	Gross weight	Cobalt content	Gross weight	Cobalt content
1947				
Oxide	325,442	228,755	315,303	221,278
Hydrate	460,866	182,295	452,316	176,877
Salts:				
Acetate	191,200	45,072	171,351	40,453
Carbonate	165,108	77,361	127,600	59,451
Sulfate	489,321	101,161	381,652	78,703
Other	63,751	14,927	49,107	11,348
Driers	9,792,481	597,612	9,637,876	590,755
1948				
Oxide	547,393	385,774	540,270	380,462
Hydrate	399,110	154,049	420,245	162,700
Salts:				
Acetate	165,095	38,634	180,695	42,321
Carbonate	117,212	53,140	134,309	61,077
Sulfate	385,949	80,407	470,394	98,060
Other	30,937	8,082	36,306	8,173
Driers	9,869,595	590,684	10,008,193	597,893

[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.

to be the largest single use for cobalt and accounted for 24 percent of the total quantity consumed in 1948; moreover, usage for this purpose was 33 percent greater than in 1947. Each year brings improvements in permanent-magnet alloys and new applications. A new method of sintering Alnico 5 permits the design of intricate shapes with higher external energy than was previously possible and allows economical production of small parts, finer grained and less brittle, with smooth surfaces and close dimensional tolerances.[4] The new sintered material is now being used in relays, meters, fountain pens, electronic reproducers, and compasses. The manufacture of permanent magnets by powder metallurgy has been described.[5] Among the applications for permanent magnets announced in 1948 was a wall-type can opener; the magnet is attached to an adjustable arm on the side of the can opener, and after the lid is cut off the magnet snaps it up and holds it tight until the can is removed.[6] To eliminate ink-stained pockets and to faciliate closing, a permanent magnet has been molded into the cap of a fountain pen to hold the cap firmly in place and permit it to be flicked off by the touch of the thumb.[7] Permanent magnets have improved television; they control electronic action and thus eliminate blurring of the television picture.

The peacetime demand for cobalt-base high-temperature alloys continued to expand; as a consequence, the quantity of cobalt utilized in cast cobalt-chromium-tungsten alloys was 29 percent greater in 1948 than in 1947. Moreover, this usage accounted for the second-

[4] American Metal Market, vol. 55, No. 65, Apr. 6, 1948, p. 2.
[5] Franks, A. E. (Indiana Steel Products Co.), Powder Metallurgy as Applied to Permanent Magnets: Iron Age, vol. 161, No. 15, Apr. 8, 1948, pp. 82–85.
[6] American Metal Market, vol. 56, No. 1, Jan. 1, 1949, p. 12.
[7] Nickel Topics, vol. 1, No. 2, March 1948, p. 4.

largest quantity or 16 percent of the total cobalt consumed in 1948. Informative articles on high-temperature alloys were published.[8] [9]

Noteworthy gains in the use of cobalt in high-speed and other steels, alloy hard-facing rods and materials, and cemented carbides were also recorded in 1948. Utilization of cobalt in ground-coat frit for porcelain enamel continued its upward trend but the gain (1 percent) in 1948 was less than in 1947 and 1946. Similarly, the gain in usage of cobalt in pigments was less pronounced than in recent years.

Much publicity was given to the testing at four institutions of radioactive cobalt from an atomic pile for treatment of cancer patients. Experiments at the University of California College of Pharmacy were reported to show that penicillin action can be greatly increased by the presence of cobalt.

Cobalt consumed in the United States, 1946–48, by uses

Use	Pounds of cobalt		
	1946	1947	1948
Metallic:			
High-speed steel	224,049	223,148	289,391
Magnet steel	1,463,539	121,223	165,698
Permanent magnet alloys		894,924	1,186,673
Other steel	201,949	386,354	503,082
Cast cobalt-chromium-tungsten alloys	526,504	642,452	826,329
Alloy hard-facing rods and materials	53,874	71,545	116,313
Cemented carbides	45,100	62,734	115,687
Other metallic	81,988	99,476	115,255
Total metallic	2,597,003	2,501,856	3,318,428
Nonmetallic (exclusive of salts and driers):			
Ground-coat frit	412,766	607,316	613,745
Pigments	170,662	207,928	232,725
Other nonmetallic	39,596	51,439	66,699
Total nonmetallic	623,024	866,683	913,169
Salts and driers: Lacquers, varnishes, paints, inks, pigments, enamels, glazes, feed, electroplating, etc. (estimate)	885,000	797,000	818,000
Grand total	4,105,027	4,165,539	5,049,597

PRICES

Since July 1, 1947, the price of cobalt metal (97–99 percent, in kegs of 550 pounds) has been \$1.65 a pound delivered east of Chicago; and for quantities under 100 pounds, \$1.72 a pound. The price of oxide to ceramic plants was \$1.27½ a pound.

FOREIGN TRADE [10]

Imports.—Imports of cobalt into the United States established a new record in 1948; they were 7 percent greater than in 1947, the previous record year. The Belgian Congo continued to be the chief

[8] Grant, N. J., and others, A Summary of Heat-Resistant Alloys from 1,200° to 1,800° F.: Iron Age, vol. 161, No. 12, Mar. 18, 1948, pp. 73–78; No. 15, Apr. 8, 1948, pp. 75–81; No. 16, Apr. 15, 1948, pp. 84–93.

[9] Smith, R. H., Selection of High-Temperature Materials for Gas Turbines: Iron Age, vol. 161, No. 4, Jan. 22, 1948, pp. 56–60.

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

source of imports; in 1948 it supplied 3,541,746 pounds of metal and 4,879,413 pounds of alloy containing 2,179,473 pounds of cobalt. Belgium supplied 1,724,725 pounds of metal and 790,300 pounds of oxide containing 561,116 pounds of cobalt; both the metal and oxide were produced from Belgian Congo alloy. Canada supplied 8,167,545 pounds of ore containing 870,519 pounds of cobalt, of which 7,054,500 pounds containing 742,000 pounds of cobalt were imported by the United States Government; this ore had been stored at Deloro, Ontario, Canada. The United Kingdom furnished 1,374 pounds (gross weight) of salts and compounds and 50 pounds of metal.

Cobalt imported for consumption in the United States, 1944–48, by classes

[U. S. Department of Commerce]

Year	Alloy [1] (pounds)		Ore [2]		
			Pounds		Value
	Gross weight	Cobalt content	Gross weight	Cobalt content	
1944	8,500,516	3,737,000	473,529	61,123	$53,434
1945	8,397,145	3,616,000	859,940	109,112	91,554
1946	1,648,595	717,337	657,787	73,892	59,861
1947	3,751,452	1,640,952	751,438	77,721	58,920
1948	4,879,413	2,179,473	8,167,545	870,519	647,000

Year	Metal		Oxide		Salts and other compounds	
	Pounds	Value	Pounds (gross weight)	Value	Pounds (gross weight)	Value
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
1947	[3] 6,035,153	[3] 7,994,347	752,150	753,916	[4] 530	[4] 1,856
1948	[3] 5,266,521	7,743,679	790,300	828,667	1,374	4,514

[1] Reported by importer to Bureau of Mines; not separately classified by U. S. Department of Commerce. Value not available.
[2] Data for 1944 and 1946 adjusted by Bureau of Mines to exclude alloy.
[3] Adjusted by Bureau of Mines.
[4] Revised figures.

The accompanying table shows the imports of cobalt for 1923–48, by classes. Corresponding figures for earlier years are not available. However, imports of cobalt apparently did not exceed 500,000 pounds annually until 1926; from that year they increased steadily through 1929, when they reached 1,212,000 pounds. Imports declined abruptly during 1930–32, dropping to 303,000 pounds in 1932. Since 1933, however, imports of cobalt have increased almost steadily and reached an all-time high of 8,821,000 pounds in 1948.

During the 26 years, 1923–48, the receipts of alloy comprised about 43 percent of the total imports and virtually all was from Belgian Congo. Imports of cobalt metal represented the second-largest quantity (39 percent), most of which was supplied by Belgium and Belgian Congo. Smaller quantities of metal have been received from Austria, Canada, Finland, France, Germany, Japan, Sweden, and United Kingdom. About 13 percent of the imports of cobalt have been in the form of oxide, which came chiefly from Belgium. Substantial quantities of oxide have also been received from Germany and Canada, and smaller quantities from Australia, Finland, and France. Receipts of cobalt ore have accounted for about 5 percent of the total imports; Canada has been the largest source; most of the remainder came from Australia and French Morocco.

Cobalt imported for consumption in the United States, 1923–48, in pounds

Year	Gross weight					Total	
	Alloy	Ore	Metal	Oxide	Sulfate and other compounds	Gross weight	Cobalt content (estimated)
1923	----------	58,719	225,639	258,574	45,644	588,576	426,000
1924	----------	28,786	118,952	226,703	797	375,238	283,000
1925	----------	34,782	198,669	287,265	13,256	533,972	408,000
1926	----------	154,468	387,076	333,132	37,342	912,018	642,000
1927	----------	60,382	407,198	369,747	55,127	892,454	680,000
1928	----------	107,498	535,817	364,154	68,281	1,075,750	819,000
1929	----------	434,443	806,640	475,928	64,782	1,781,793	1,212,000
1930	----------	199,642	460,251	425,881	55,303	1,141,077	794,000
1931	----------	83,895	164,967	321,891	46,317	617,070	410,000
1932	----------	27,193	123,112	225,896	92,098	468,299	303,000
1933	----------	556,119	281,713	568,057	99,231	1,505,120	769,000
1934	439,476	748,513	506,119	328,730	43,787	2,066,625	1,000,000
1935	378,848	419,110	563,866	557,083	80,554	1,999,461	1,167,000
1936	----------	1,039,760	883,377	813,642	46,658	2,783,437	1,580,000
1937	----------	587,499	1,073,129	842,847	56,585	2,560,060	1,734,000
1938	----------	449,984	938,476	373,215	41,867	1,803,542	1,249,000
1939	----------	611,083	2,130,296	680,644	76,664	3,498,687	2,665,000
1940	7,843,828	2,653,891	130,321	756,759	11,468	11,396,267	4,200,000
1941 [1]	9,970,589	2,443,725	554,030	38,002	4,980	[1] 13,011,326	[1] 4,328,000
1942	10,313,867	834,797	148,304	----------	200	11,297,168	4,280,000
1943	10,110,879	10,556,042	266,670	58,928	56	20,992,575	5,626,000
1944	8,500,516	473,529	73,088	225,609	115	9,272,857	3,798,000
1945	8,397,145	859,940	946,475	120,672	224	10,324,456	4,615,000
1946	1,648,595	657,787	1,935,582	1,074,630	350	5,316,944	3,451,000
1947	3,751,452	751,438	6,035,153	752,150	530	11,290,723	8,206,000
1948	4,879,413	8,167,545	5,266,521	790,300	1,374	19,105,153	8,821,000

[1] In addition to classes shown, 4,796,000 pounds of Burmese speiss containing 335,721 pounds of cobalt were imported.

Exports.—Exports of cobalt from the United States are small; 435 pounds of metal valued at $1,520 and 134,763 pounds (gross weight) of ore and concentrates valued at $182,480 were exported in 1948. Some oxide, salts, and driers are also exported, but the figures are not separately recorded by the United States Department of Commerce.

Tariff.—The duty on cobalt oxide continued to be 10 cents a pound, sulfate 5 cents a pound, linoleate 10 cents, and other salts and compounds 30 percent ad valorem. Cobalt metal and ore entered the United States duty free.

WORLD REVIEW

Virtually all cobalt is found associated with other minerals, such as copper, nickel, iron, arsenic, lead, zinc, manganese, silver, and gold. Belgian Congo and Northern Rhodesia, where cobalt occurs associated with copper, have been the chief producing countries in recent years, followed by the United States, French Morocco, and Canada. These five countries have contributed about 94 percent of the world output of cobalt in recent years. Iron pyrites from Finland, Germany, Greece, Italy, Norway, Spain, and Sweden contains cobalt, some of which is recovered. Although the quantities of cobalt present in iron pyrites are generally very small—often only 0.05 percent—and its recovery is only 50 to 60 percent, the very large tonnage treated during and preceding the war contributed greatly to the cobalt production in Germany. It is reported [11] that about 10 tons of cobalt concentrates are obtained from 100,000 tons of cinder. A complete record of output of cobalt from iron pyrites is lacking.

World mine production of cobalt, by countries, 1940–48, in metric tons [1]

[Compiled by B. B. Mitchell]

Country [1]	Cobalt content								
	1940	1941	1942	1943	1944	1945	1946	1947	1948
Australia	12	13	14	15	9	10	11	12	(2)
Belgian Congo	2,301	2,256	1,656	2,061	1,877	2,800	2,150	3,563	4,322
Bolivia (exports)	2	2	(3)	(3)	----	----	----	----	----
Burma	218	73	----	----	----	----	----	----	(3)
Canada [4]	360	119	38	80	16	49	34	260	701
Chile	(2)	2	(3)	3	5	1	----	----	(2)
Finland	(2)	(2)	98	79	86	84	101	50	(2)
Italy	89	81	69	27	7	6	(2)	(2)	(2)
Japan	----	(3)	1	3	15	11	7	6	(3)
Morocco, French	330	65	3	216	243	100	200	370	278
Northern Rhodesia [5]	1,223	650	914	943	978	874	552	420	367
Sweden	----	----	----	----	----	9	----	----	----
United States (shipments)	58	237	300	346	253	581	230	(6)	(6)
Total (estimate)	5,000	4,000	3,500	4,200	3,900	4,700	3,500	5,200	6,200

[1] In addition to countries listed, Brazil, China, Germany, and Spain produce cobalt, but production data are not available. Estimate by author of chapter included in total.
[2] Data not available; estimate by author of chapter included in total.
[3] Less than 1 ton.
[4] Figures comprise Canadian ore processed in Canada and exported (irrespective of year when mined), plus cobalt content of oxide made from Sudbury ore at Port Colborne. However, figures exclude the cobalt recovered by the Mond Nickel Co. at Clydach (Wales) from the nickel-copper ores of the Sudbury district, for which estimate by author of chapter has been included in world total.
[5] Year ended June 30 of year stated.
[6] Bureau of Mines not at liberty to publish figure.

[11] Dennis, W. H., Recovery of Nonferrous Metals from Pyrite: Mine and Quarry Eng. (London), vol. 13, No. 12, December 1947, pp. 358–362.

Belgian Congo.—The world's premier source of cobalt continues to be Belgian Congo, where the Union Minière du Haut Katanga is the sole producer. Output was 4,322 metric tons in 1948, a new record and 21 percent greater than in 1947. Production of cobalt in Belgian Congo was begun in 1924, when 273 metric tons were produced; since that year output has increased almost without interruption and total production through 1948 has been about 33,500 metric tons. 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 the company has six single-phase electric furnaces (monthly capacity about 300 tons) for smelting 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 company refining plants at Niagara Falls, N. Y., and Oolen, Belgium, for processing the crude cobalt to metal, oxide, salts, and driers. The solutions used in the electrolytic plants contain cobalt, recovered by 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. The total refining capacity of the company plants at Niagara Falls, N. Y., Oolen, Belgium, and Jadotville, Belgian Congo, is about 7,500 tons annually. On the basis of a rate of production of 4,000 metric tons annually, the company reported developed reserves of cobalt adequate for 40 to 50 years, and it anticipates that these reserves will increase as a result of further development of its copper deposits.

Canada.—Production of cobalt in Canada is measured by the quantities of Canadian ores processed and exported, irrespective of the year when mined, plus the cobalt content of oxide made by the International Nickel Co. of Canada, Ltd., at Port Colborne, Ontario. During the war substantial quantities of cobalt ores were mined and stock-piled in Canada for the United States Government, and concurrently the Deloro Smelting & Refining Co., which treated African ores, accumulated Canadian ores. In 1948 the ore stocked by the United States Government was shipped to the United States, and the entire quantity has been included in the production figure for 1948. Similarly, the quantity of Canadian ores processed by Deloro Smelting & Refining Co. in 1948 has likewise been included. Canadian production figures, however, do not include the cobalt recovered by the Mond Nickel Co. at its Clydach (Wales) nickel refinery from the nickel-copper ores of the Sudbury district.

According to the Dominion Bureau of Statistics, production of cobalt (content) in Canada was 1,544,852 pounds in 1948 compared with 572,673 pounds in 1947. The major portion of the output credited to Canada in 1948 came from accumulations during the war years rather than from ores hoisted during the year. According to the United States Department of Commerce, ore containing 870,519 pounds of cobalt was imported into the United States from Canada in 1948.

The International Nickel Co. of Canada, Ltd., at its Canadian nickel refinery, continued the recovery of cobalt as oxide from the nickel-copper ores of the Sudbury district. Output of cobalt in oxide was reported as 15 short tons monthly, but an increase was contemplated.

In the cobalt area of northern Ontario, the Silanco Mining & Refining Co., Ltd., was again the chief producer. It operated the Colonial concentrator, which treated ore from the reopened Agaunico mine and tailings from the Temiskaming mine. The construction of a smelter by this company, noted in previous chapters of this series, remained uncompleted in 1948.

Falconbridge Nickel Mines, Ltd., has begun construction of a plant to recover the cobalt contained in the matte produced from Sudbury nickel-copper ores. The cobalt plant, which is being erected at the company nickel refinery at Kristiansand, Norway, will produce cobalt oxide and electrolytic cobalt; production of several hundred thousand pounds of cobalt annually is expected to begin in 1951.

French Morocco.—Production of cobalt ore in French Morocco was 2,094 metric tons containing 278 tons of cobalt in 1948 compared with 2,660 tons containing 370 tons of cobalt in 1947. The ore, which also contains nickel, gold, and silver, is shipped to Belgium for processing to oxide and speiss, which are exported to France, where the speiss is refined to metal. Indicated shipments of cobalt ore from French Morocco were 3,349 metric tons containing 483 tons of cobalt in 1948. Stocks of ore at the mines were 1,437 tons on December 31, 1948, compared with 2,692 tons at the end of 1947.

The deposits were described as follows: [12]

> The cobalt deposits of French Morocco lie in a rocky desert region in the south of the Atlas Mountains near Bou-Azzer about 250 kilometers (155 miles) east of the port of Agadir. They are the property of La Société Minière de Bou-Azzer et du Graara, whose head office is at Casablanca. The deposits of cobalt and nickel are found in veins at or near the contact of serpentine and diorite rocks. The gangue is principally carbonate. Smaltite, skutterudite, and safflorite are the cobalt minerals, while niccolite and other nickel-arsenic minerals are also present. Gold, varying from 3 to 300 grams per ton, is found in smaltite-skut-

[12] Young, R. S., work cited in footnote 1, pp. 14–15.

terudite minerals. Silver is also found in varying quantities but always less than 50 grams per ton. In general the commercial ore of Morocco does not have nickel or iron exceeding 20 percent of the cobalt, although some deposits have more nickel than cobalt. Bou-Azzer is about 186 miles from the railroad at Marrakech and this limits its development. Proved resources are 36,000 metric tons. At present the mine has several levels, the deepest being 175 meters (574 feet). The average cobalt content of commercial ore is 11 to 12 percent, although there are other commercial-grade ores with a cobalt content as low as 0.75 to 1.25 percent.

Northern Rhodesia.—The second-largest producer of cobalt in the world continues to be Northern Rhodesia; but, chiefly because of shortage of coal deliveries, output has declined regressively since 1945. The output of alloy was 1,081 short tons containing 405 short tons of cobalt in the year ended June 30, 1948, compared with 1,225 tons containing 463 tons of cobalt in 1947. The Rhokana Corp., which has been producing cobalt since 1933, is the sole producer; total output through June 30, 1948, has been 12,053 metric tons.

The Rhodesian occurrences were described thus: [13]

> In Northern Rhodesia the cobalt occurs chiefly as carrollite, but an oxidized form of cobalt is also found and forms a small and varying proportion of the cobalt content in the mill feed of Rhokana Corporation. The carrollite is closely associated with the copper minerals throughout the sediments of the ore horizon, but it is not evenly distributed and the cobalt content of the ore varies from a trace to over 3 percent, with an average of 0.25 in the Nkana North and South orebodies and 0.07 percent in the Mindola orebody. This gives an average mill feed to Rhokana concentrator of about 0.13 percent Co. Where the cobalt content is low, around 0.07 percent, it appears to be fairly evenly distributed throughout the ore. Where the cobalt content is high, around 0.50 percent, the carrollite tends to be concentrated in the porous sandstone and cherty ore which are the two upper members of the ore horizon, and to some extent in the lowest part of the argillite forming the hanging wall. * * * Practically all of the cobalt present in the copper and cobalt concentrates at Nkana is free and unattached. It is possible by gravity concentration to produce a high grade cobalt concentrate with a good recovery from the flotation middlings if the product is classified and the sands treated on tables.

Uganda.[14]—Deposits of copper near Kilembe on the eastern slope of the Ruwenzori Mountains were discovered by Tanganyika Concessions in 1927; and a license to exploit the area was held by it until 1940, when it was relinquished because development was considered uneconomic. During the war the Uganda Government Department of Mines produced small quantities of copper concentrates from this area for manufacture of copper sulfate in Kenya. Meanwhile, preliminary geological and geophysical surveys were made. Development of the Kilembe deposits has been retarded by transportation and power problems. The deposits are 250 miles from the railroad

[13] Young, R. S., work cited in footnote 1, pp. 13-14.
[14] Hyland, Frances, Foreign Service Clerk, Nairobi, Kenya, Development of Kilembe Copper Deposits, Uganda Protectorate: U. S. Cons. Rept., Oct. 19, 1948, 5 pp.

and 170 miles from the nearest lake port. These problems are to be solved eventually by a hydroelectric plant at Jinga, which is now under way, and the Katonga Canal from a point near Kilembe to Lake Victoria.

Economic exploitation of the deposits is now considered feasible; in 1947 additional investigation was undertaken by Frobrican Exploration Co., Ltd., which has acquired exclusive control of all copper deposits in this district, and development of the Kilembe mines has begun. A 2- to 2½-year diamond-drilling program, now under way, is proposed to complete at least 20,000 feet and possibly 50,000 feet of drilling. The major program, which would bring the property into production on a 3,000-ton daily basis, will extend over 5 years at least. Estimates of ore reserves in the five known ore bodies vary widely. Average grade of the ore reserves in the five ore bodies—over a strike length of 2,000 feet and an average width of 55 feet—is estimated to be 3.5 percent copper and 0.13 percent cobalt. A large tonnage of ore already developed on three levels over a length of 800 feet averaged 0.25 percent cobalt. Metallurgical tests have indicated an over-all recovery of 90 percent of the copper and 80 percent of the cobalt. If the project can be developed to the proposed capacity of 3,000 tons of ore daily, an annual production of 52,000,000 pounds of copper is indicated.[15]

[15] The anticipated production of cobalt was not stated, but an annual output of 1,500,000 to 2,000,000 pounds is indicated.

Coke and Coal Chemicals

By J. A. DeCARLO, J. A. CORGAN, and MAXINE M. OTERO

GENERAL SUMMARY

THE coke industry shared in the high tempo of industrial activity in the United States in 1948 and produced the largest quantity of coke on record. Total output of oven and beehive coke—74,861,928 tons—was 2 percent greater than the 1947 figure and 824,111 tons (1 percent) higher than the previous record set in 1944. This outstanding performance was due largely to a substantial increase in oven-coke output, which more than compensated for a slight decline in beehive production. Production of oven coke, after dropping slightly in April because of a work stoppage in the bituminous-coal mines, increased steadily thereafter, reaching a peak in December when the rate of production averaged 196,800 tons per day. Beehive output normally fluctuates more than oven-coke production because work stoppages at mines immediately curtail production as beehive operators do not carry stock piles of coal. Interruptions in coal mining during parts of March, April, and July reduced production drastically during those months. However, by December the rate of beehive-coke production had reached

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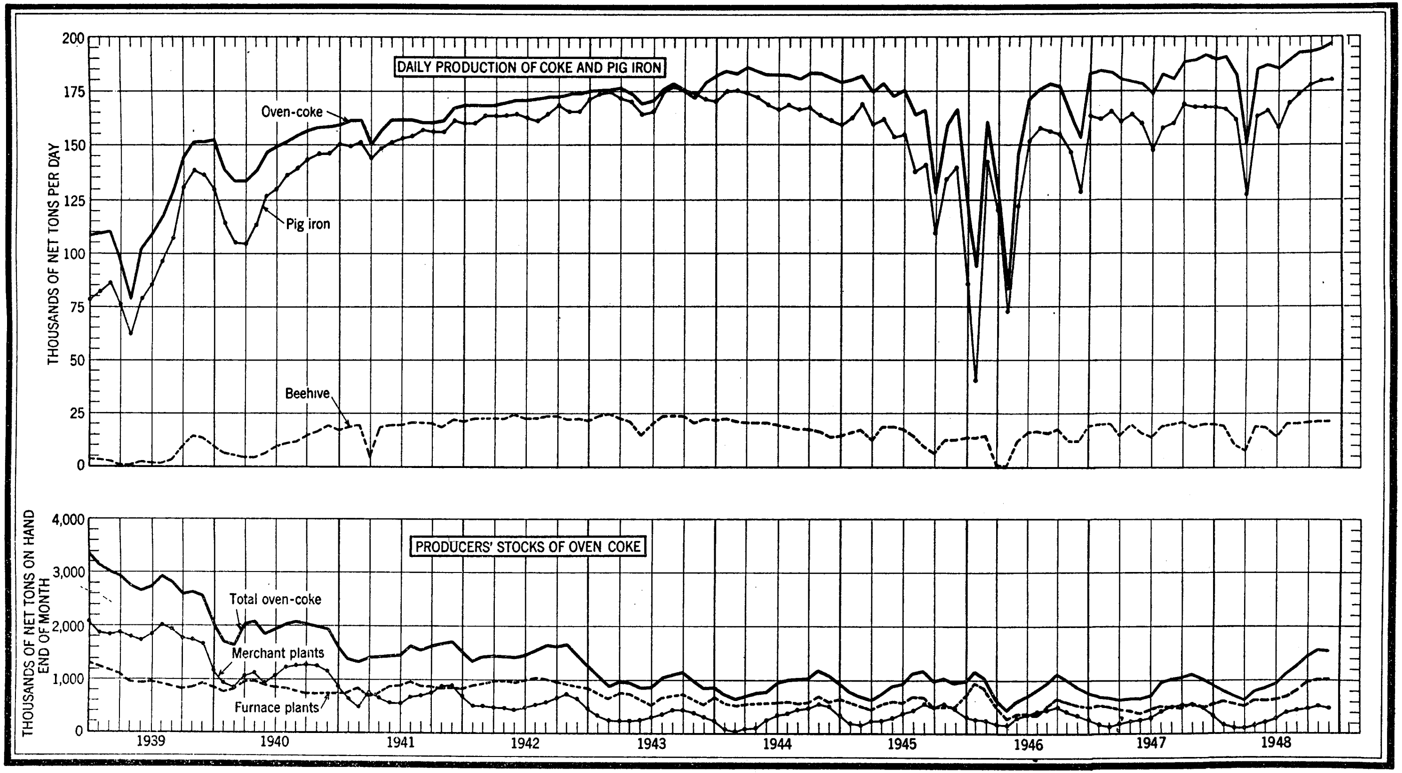

FIGURE 1.—Average daily production of beehive and oven coke and pig iron and producers' stocks of oven coke, 1939–48, by months.

the highest level since February 1944. The upward trend in oven-coke production noted at the close of 1948, if continued, should soften the demand for beehive coke.

The coke industry has been particularly concerned with the quality and supply of coking coal in recent years. One of the bright spots in the industry in 1948 was the marked improvement in these factors during the latter part of the year. Although coke-plant operators had a better selection of coal, much inferior coal was stocked during the first half of the year; as a result, a large amount of poor coal was carbonized. Carbonization of this inferior coal had a marked effect on the yield of coke. Thus, while the total quantity of coal carbonized in 1948 increased 2 percent over the 1947 total, the relative yield of oven and beehive coke decreased from 69.91 percent of the coal charged into the ovens in 1947 to 69.60 percent, the lowest since 1935, whereas the yield of breeze increased from 5.68 to 5.80 percent.

Costs of coal continued to rise in 1948, reaching new levels. The sharp rise at oven-coke plants was due not only to increase in mining costs but also to advances in transportation charges. The average cost of coal delivered at oven-coke plants increased $1.35 per ton (20 percent) over 1947, and the average cost of coal at beehive plants advanced $0.68 per ton (15 percent).

The enormous requirements of coke for industrial purposes in the United States during 1948 encouraged the expansion of coke-making facilities, and 495 new ovens were completed. In addition, extensive repairs were made on many ovens, and several old batteries were rebuilt. Although some old ovens were taken out of production, the annual coke capacity of oven plants at the end of the year increased 1,950,800 tons over 1947, and totaled nearly 74.5 million tons. Demand for beehive coke in 1948 also made it necessary for many operators to reactivate old plants, and the number of beehive ovens totaled 14,078 at the end of the year—an increase of 635.

Coke prices depend directly upon the cost of coal and have shown marked increases since the end of the war. This upward trend in coke prices continued throughout 1948. Average receipts per ton of oven coke sold (merchant sales) advanced $2.83 for blast-furnace coke, $3.99 for foundry, $2.28 for water-gas, $2.45 for other industrial, and $1.98 for domestic. For beehive coke, gains of $2.54 were registered for blast-furnace, $3.12 for foundry, $2.05 for water-gas, $2.08 for other industrial, and $1.81 for domestic.

The use pattern of coke in 1948 varied only slightly from that of 1947, with the metallurgical industries consuming an increasing proportion at the expense of "other industrial" and "domestic" coke. Blast furnaces used 80 percent of the oven and beehive coke shipped from the ovens; iron foundries, 5 percent; producer gas and water gas combined, 6 percent; other industrial, 4 percent; and domestic heating, 5 percent. The total sold for domestic heating was the lowest in 24 years.

Coke requirements in the United States made it necessary to curtail shipments to foreign countries; as a consequence, exports in 1948 decreased 128,869 tons (15 percent) from 1947. Canada, which has always been an important market for a number of the coke producers, received 79 percent of the total exported. Shipments to European countries declined about 55 percent, and exports to South America decreased nearly 61 percent. Imports, although increasing 55 percent over 1947, were small, representing only 0.2 percent of indicated national consumption.

There were no significant changes in employment at coke plants during the year. According to preliminary data from the Bureau's 1948 annual survey of employment at coke plants, 21,900 men were employed at oven-coke plants, working 63,590,000 man-hours—increases over 1947 of 1,122 men and 3,318,174 man-hours. The number of men employed at beehive plants increased from 2,927 in 1947 to 3,100 in 1948, and man-hours worked increased from 5,846,933 to 5,950,000.

The markets for coal-chemical materials in 1948 continued to show the tendency to expand so manifest in recent years. All coke co-products registered moderate quantitative increases over 1947. However, the gains made by crude tar, ammonia, and light oil were not proportionate with the increase made in the output of oven coke, as the relative yield of these products per ton of coal charged has continued to decrease more sharply than that of coke. Whereas the production of coke-oven gas increased at a slightly higher rate than coke, the relative yield of this product also declined. Prices on virtually all coal chemicals increased substantially in 1948 owing to advances in the costs of manufacture and to the stimulation created by a strong demand. Thus, the total realized from the sales of all coal-chemical materials increased 20 percent over 1947, reaching $267,126,556 for an all-time high. The gross value of all coke, breeze, and coal-chemical materials combined increased 20 percent over the 1947 figure.

TABLE 1.—Salient statistics of the coke industry in the United States in 1948

	Coke ovens	Beehive ovens	Total
Coke produced—			
At merchant plants:			
Net tons	13,332,499	[1]	[1]
Value	$191,564,563		
At furnace plants:			
Net tons	54,951,858		
Value	$657,154,520		
Total:			
Net tons	68,284,357	6,577,571	74,861,928
Value	$848,719,083	$79,562,771	$928,281,854
Screenings or breeze produced:			
Net tons	5,765,576	108,267	5,873,843
Value	$20,017,861	$241,290	$20,259,151
Coal charged into ovens:			
Bituminous:			
Net tons	96,984,143	10,321,568	107,305,711
Value	$788,778,359	$52,738,368	$841,516,727
Average per ton	$8.13	$5.11	$7.84
Anthracite:			
Net tons	256,175		256,175
Value	$1,672,248		$1,672,248
Average per ton	$6.53		$6.53
Total:			
Net tons	97,240,318	10,321,568	107,561,886
Value	$790,450,607	$52,738,368	$843,188,975
Average per ton	$8.13	$5.11	$7.84
Average yield in percent of total coal charged:			
Coke	70.22	63.73	69.60
Breeze (at plants actually recovering)	5.93	2.72	5.80
Ovens:			
In existence January 1	14,728	13,443	28,171
In existence December 31	15,139	14,078	29,217
Dismantled during year	84	485	569

See footnotes at end of table.

TABLE 1.—Salient statistics of the coke industry in the United States in 1948—Continued

	Coke ovens	Beehive ovens	Total
Ovens—Continued.			
In course of construction December 31	350	----------	350
Annual coke capacity December 31 ---- net tons	74, 499, 900	9, 076, 200	83, 576, 100
Coke used by producer—			
In blast furnaces:			
Net tons	38, 995, 137	261, 789	39, 256, 926
Value	$466, 383, 833	$4, 109, 360	$470, 493, 193
In foundries:			
Net tons	91, 670	----------	91, 670
Value	$1, 144, 099	----------	$1, 144, 099
To make producer gas:			
Net tons	800, 056	----------	800, 056
Value	$9, 107, 026	----------	$9, 107, 026
To make water gas:			
Net tons	1, 511, 310	----------	1, 511, 310
Value	$16, 657, 979	----------	$16, 657, 979
For other purposes:			
Net tons	414, 157	3, 160	417, 317
Value	$4, 090, 125	$39, 225	$4, 129, 350
Coke sold—			
To financially affiliated companies—			
For blast-furnace use:			
Net tons	12, 021, 531	1, 554, 780	13, 576, 311
Value	$140, 842, 993	$14, 479, 032	$155, 322, 025
For foundry use:			
Net tons	62, 056	----------	62, 056
Value	$1, 402, 291	----------	$1, 402, 291
For manufacture of water gas:			
Net tons	685, 197	----------	685, 197
Value	$9, 024, 330	----------	$9, 024, 330
For other purposes:			
Net tons	247, 144	5, 752	252, 896
Value	$3, 102, 754	$83, 318	$3, 186, 072
To other consumers—			
For blast-furnace use:			
Net tons	2, 936, 675	3, 515, 594	6, 452, 269
Value	$40, 468, 842	$43, 554, 897	$84, 023, 739
For foundry use:			
Net tons	3, 100, 181	496, 752	3, 596, 933
Value	$58, 209, 845	$7, 482, 338	$65, 692, 183
For manufacture of water gas:			
Net tons	1, 546, 592	204, 254	1, 750, 846
Value	$20, 264, 943	$2, 665, 553	$22, 930, 496
For other industrial use:			
Net tons	1, 847, 245	468, 515	2, 315, 760
Value	$25, 389, 694	$6, 316, 072	$31, 705, 766
For domestic use:			
Net tons	3, 398, 696	46, 613	3, 445, 309
Value	$44, 759, 620	$553, 744	$45, 313, 364
Disposal of screenings or breeze:			
Used by producer—			
For steam raising:			
Net tons	3, 625, 109	15, 623	3, 640, 732
Value	$11, 829, 909	$38, 291	$11, 868, 200
To make producer or water gas:			
Net tons	147, 131	----------	147, 131
Value	$732, 761	----------	$732, 761
For other purposes:			
Net tons	773, 636	6	773, 642
Value	$2, 470, 888	$103	$2, 470, 991
Sold:			
Net tons	1, 121, 611	43, 384	1, 164, 995
Value	$4, 612, 058	$100, 544	$4, 712, 602
Average receipts per ton sold (merchant sales):			
Furnace coke	$13. 78	$12. 39	$13. 02
Foundry coke	$18. 78	$15. 06	$18. 26
Water-gas coke	$13. 10	$13. 05	$13. 10
Other industrial coke	$13. 74	$13. 48	$13. 69
Domestic coke	$13. 17	$11. 88	$13. 15
Screenings or breeze	$4. 11	$2. 32	$4. 05
Stocks on January 1, 1949:			
Furnace coke ---- net tons	940, 727	30, 629	971, 356
Foundry coke ---- do	7, 003	964	7, 967
Domestic and other ---- do	612, 851	1, 267	614, 118
Screenings or breeze ---- do	1, 485, 710	6, 231	1, 491, 941
Exports ---- do	(1)	(1)	706, 190
Imports ---- do	(1)	(1)	161, 400
Indicated consumption ---- do	(1)	(1)	73, 755, 934

See footnotes at end of table.

TABLE 1.—Salient statistics of the coke industry in the United States in 1948—Continued

	Coke ovens	Beehive ovens	Total
Coal-chemical materials produced:			
Tar ... gallons	738, 755, 106		738, 755, 106
Ammonium sulfate or equivalent ... pounds	1, 859, 386, 041		1, 859, 386, 041
Gas ... M cubic feet	994, 852, 626		994, 852, 626
Burned in coking process ... percent	37. 26		37. 26
Surplus sold or used ... do	61. 09		61. 09
Wasted ... do	1. 65		1. 65
Crude light oil ... gallons	256, 089, 065		256, 089, 065
Yield of coal-chemical materials per ton of coal:			
Tar ... do	7. 60		7. 60
Ammonium sulfate or equivalent ... pounds	19. 52		19. 52
Gas ... M cubic feet	10. 23		10. 23
Crude light oil ... gallons	2. 73		2. 73
Value of coal-chemical materials sold:			
Tar:			
Sold	$41, 957, 748		$41, 957, 748
Used by producer	$14, 566, 552		$14, 566, 552
Ammonia (sulfate and liquor)	$37, 179, 268		$37, 179, 268
Gas (surplus)	$125, 555, 996		$125, 555, 996
Crude light oil and derivatives	$42, 220, 588		$42, 220, 588
Other coal-chemical materials [2]	$20, 212, 956		$20, 212, 956
Total value of coke and breeze produced and coal-chemical materials sold [3]	$1, 150,430,052	$79, 804, 061	$1, 230, 234, 113

[1] Not separately recorded.
[2] Naphthalene, tar derivatives, and miscellaneous coal-chemical materials.
[3] Includes value of tar used by producer.

TABLE 2.—Statistical trends of the coke industry in the United States, 1937 and 1945–48

	1937	1945	1946	1947	1948
Production:					
Oven coke ... net tons	49, 210, 748	62, 094, 288	53, 929, 447	66, 758, 549	68, 284, 357
Beehive coke ... do	3, 164, 721	5, 213, 893	4, 568, 401	6, 687, 301	6, 577, 571
Total ... do	52, 375, 469	67, 308, 181	58, 497, 848	73, 445, 850	74, 861, 928
Percent oven coke	94. 0	92. 3	92. 2	90. 9	91. 2
Stocks of coke, end of year ... net tons	2, 595, 287	931, 813	928, 766	1, 032, 237	1, 593, 441
Exports, all coke ... do	526, 683	1, 478, 746	1, 231, 327	835, 059	706, 190
Imports, all coke ... do	286, 364	51, 964	52, 188	104, 093	161, 400
Indicated consumption, all coke ... do	51, 271, 929	66, 074, 271	57, 321, 756	72, 611, 413	73, 755, 934
Disposal, all coke sold or used:					
Furnace coke ... do	36, 751, 969	51, 002, 921	43, 700, 492	57, 636, 505	59, 285, 506
Foundry coke ... do	2, 038, 822	2, 636, 731	2, 996, 202	3, 650, 001	3, 750, 659
Other industrial coke (including producer and water gas) ... net tons	4, 597, 894	6, 937, 553	6, 593, 870	8, 028, 791	7, 733, 382
Domestic coke ... do	8, 107, 518	6, 775, 508	5, 096, 733	3, 977, 328	3, 445, 309
Carbonizing equipment:					
Coke ovens in existence, end of year	12, 718	14, 510	14, 494	14, 728	15, 139
Beehive ovens in existence, end of year	12, 194	12, 179	12, 864	13, 443	14, 078
Coke ovens under construction, end of year	259	335	824	572	350
Cost of coal charged, oven-coke plants, average per ton	$3. 74	$5. 28	$5. 77	$6. 78	$8. 13
Prices of coke:					
Average spot price of Connellsville furnace coke, f. o. b. ovens	$4. 29	$7. 29	$8. 13	$10. 49	$13. 44
Average realization on oven coke sold (merchant sales):					
Furnace coke	$4. 34	$7. 87	$8. 85	$10. 95	$13. 78
Foundry coke	$8. 47	$11. 48	$12. 62	$14. 79	$18. 78
Other industrial coke (including water gas)	$6. 08	$8. 35	$9. 58	$11. 13	$13. 45
Domestic coke	$6. 53	$8. 69	$9. 90	$11. 19	$13. 17
Yield of coal-chemical materials per ton of coal charged:					
Tar ... gallons	8. 67	7. 95	7. 82	7. 78	7. 60
Ammonium sulfate or equivalent ... pounds	21. 84	20. 22	19. 79	19. 66	19. 52
Crude light oil ... gallons	2. 86	2. 84	2. 77	2. 75	2. 73
Surplus gas sold or used ... M cubic feet	6. 66	6. 33	6. 29	6. 27	6. 25
Average gross receipts for coal-chemical materials per ton of coke produced:					
Tar sold and used	$0. 502	$0. 447	$0. 466	$0. 605	$0. 828
Ammonia and its compounds	$0. 326	$0. 356	$0. 361	$0. 423	$0. 545
Crude light oil and its derivatives (including naphthalene)	$0. 435	$0. 503	$0. 467	$0. 566	$0. 685
Surplus gas sold or used	$1. 483	$1. 413	$1. 542	$1. 678	$1. 839
Total coal-chemical materials (including breeze)	$2. 974	$3. 069	$3. 207	$3. 710	$4. 419

TABLE 3.—Coke produced, value, number of ovens, coal charged, and average yield in the United States in 1948, by States

[Exclusive of screenings or breeze]

State	Oven coke						
	Plants	Ovens	Coal charged (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens	
						Total	Per ton
Alabama	7	1,311	8,410,868	71.52	6,015,460	$57,611,881	$9.58
California	1	90	482,289	61.53	296,749	(1)	(1)
Colorado	1	262	1,413,355	69.09	976,504	(1)	(1)
Illinois	8	852	5,221,320	70.39	3,675,284	54,396,850	14.80
Indiana	5	1,863	11,884,929	72.23	8,584,225	125,355,310	14.60
Maryland	1	483	3,005,794	71.45	2,147,787	(1)	(1)
Massachusetts	2	215	1,478,402	71.48	1,056,701	(1)	(1)
Michigan	4	568	4,000,171	71.24	2,849,601	39,637,987	13.91
Minnesota	3	196	1,178,266	71.82	846,246	12,425,815	14.68
New Jersey	2	304	1,956,052	72.13	1,410,941	(1)	(1)
New York	8	1,142	8,204,974	69.31	5,687,225	72,756,957	12.79
Ohio	15	2,292	14,960,890	70.60	10,562,486	128,843,686	12.20
Pennsylvania	13	3,852	24,229,905	68.72	16,649,689	189,729,879	11.40
Tennessee	1	44	342,466	73.42	251,428	(1)	(1)
Texas	2	125	907,830	70.96	644,225	(1)	(1)
Utah	2	308	1,741,411	60.78	1,058,501	(1)	(1)
West Virginia	5	718	4,738,217	69.61	3,298,090	33,090,297	10.03
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	6	514	3,083,179	73.73	2,273,215	32,259,021	14.19
Undistributed						102,611,400	13.08
Total 1948	86	15,139	97,240,318	70.22	68,284,357	848,719,083	12.43
At merchant plants	31	2,983	18,672,468	71.40	13,332,499	191,564,563	14.37
At furnace plants	55	12,156	78,567,850	69.94	54,951,858	657,154,520	11.96
Total 1947	86	14,728	94,587,328	70.58	66,758,549	711,100,409	10.65

State	Beehive coke						Total	
	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 of coke at ovens
					Total	Per ton		
Alabama							6,015,460	$57,611,881
California							296,749	(1)
Colorado							976,504	(1)
Illinois							3,675,284	54,396,850
Indiana							8,584,225	125,355,310
Maryland							2,147,787	(1)
Massachusetts							1,056,701	(1)
Michigan							2,849,601	39,637,987
Minnesota							846,246	12,425,815
New Jersey							1,410,941	(1)
New York							5,687,225	72,756,957
Ohio							10,562,486	128,843,686
Pennsylvania	11,384	8,906,194	64.38	5,733,835	$67,303,836	$11.74	22,383,524	257,033,715
Tennessee							251,428	(1)
Texas							644,225	(1)
Utah	797	356,982	52.83	188,586	(1)	(1)	1,247,087	(1)
Virginia	750	344,612	58.30	200,911	2,886,723	14.37	200,911	2,886,723
West Virginia	952	550,047	64.08	352,494	4,801,771	13.62	3,650,584	37,892,068
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	195	163,733	62.14	101,745	(1)	(1)	2,374,960	(1)
Undistributed					4,570,441	15.74		139,440,862
Total: 1948	14,078	10,321,568	63.73	6,577,571	79,562,771	12.10	74,861,928	928,281,854
1947	13,443	10,474,536	63.84	6,687,301	65,305,111	9.77	73,445,850	776,405,520

[1] Included with "Undistributed."

SCOPE OF REPORT

This chapter is based on data supplied to the Bureau of Mines by coke-plant operators. The statistics are confined to oven and beehive coke and their related products. In accordance with usual procedure, most of the tables herein include comparable data for 3 or 4 preceding years. In recent years, commercial operation of a few low- and medium-temperature carbonization plants has placed coal products on the market that are different in character from those mentioned above. The chief products of these processes are semicokes and tar. The semicoke ranges from 3 to 16 percent in volatile content and is suitable as a smokeless fuel. The tar, which is in demand for distillation, contains a high percentage of light fractions and tar acids. The difference in characteristics of these products compared with those produced by other carbonizing processes is attributed to the lower temperature and to different coking-chamber and heating-flue design, which causes less alteration of the volatile matter expelled during carbonization. In order to follow the progress made in low- and medium-temperature carbonization, a separate table containing salient statistics for this group of plants has been prepared (table 4). Retort coke, as the name infers, is the product made by city-gas companies in coal-gas retorts and has limited application to industrial needs. For this reason, it is used mainly for heating retorts, steam raising, gas manufacture, and domestic heating. Pertinent statistics on retort coke are given in table 5. Coke is made by other processes not covered in this report, including the refining of petroleum and of crude tar. Preliminary figures for 1948 indicate that the production of coke at petroleum refineries totaled 2,898,800 net tons and coal-tar pitch coke 47,000 net tons. The standard unit of measurement in the coke industry in the United States is the short or net ton of 2,000 pounds.

MEDIUM- AND LOW-TEMPERATURE COKE

TABLE 4.—Salient statistics of medium- and low-temperature carbonization plants in the United States in 1948

	Quantity	Value
Coke produced net tons	127,218	$1,335,022
Coal carbonized do	224,975	779,907
Average per ton		3.47
Average yield of coke in percent of coal carbonized	56.55	
Ovens and retorts:		
In existence December 31	56	
Annual coke capacity December 31 net tons	288,900	
Tar produced gallons	1,921,696	
Yield per ton of coal do	8.54	
Value of coke and breeze produced and coal-chemical materials sold		1,661,366

RETORT COKE

TABLE 5.—Salient statistics of the coal-gas industry in the United States in 1948 [1]

	Horizontal retorts	Vertical retorts	Total
Coke produced:			
Net tons	164, 651	364, 723	529, 374
Value	$1, 897, 891	$3, 953, 327	$5, 851, 218
Screenings or breeze produced ... net tons	19, 272	58, 545	77, 817
Coal charged into retorts:			
Net tons	269, 826	627, 352	897, 178
Value	$2, 893, 238	$6, 627, 618	$9, 520, 856
Average per ton	$10. 72	$10. 56	$10. 61
Average yield in percent of coal charged:			
Coke	61. 02	58. 14	59. 00
Breeze (at plants actually recovering)	8. 62	10. 00	9. 62
Retorts:			
In existence December 31	694	382	1, 076
In operation December 31	543	346	889
Annual coal capacity ... net tons	294, 900	711, 400	1, 006, 300
Coke used by producers:			
Net tons	99, 305	222, 138	321, 443
Value	$1, 095, 746	$2, 247, 598	$3, 343, 344
Coke sold to other consumers:			
Net tons	69, 039	130, 084	199, 123
Value	$846, 127	$1, 574, 009	$2, 420, 136
Stocks on January 1, 1949:			
Coke ... net tons	12, 156	61, 464	73, 620
Breeze ... do	2, 701	5, 607	8, 308
Coal-chemical materials:			
Tar:			
Production ... gallons	3, 125, 159	9, 258, 016	12, 383, 175
Sales ... do	3, 558, 651	8, 450, 562	12, 009, 213
Value of sales	$232, 940	$700, 426	$933, 366
Stocks on January 1, 1949 ... gallons	447, 780	1, 685, 493	2, 133, 273
Per ton of coal charged ... do	11. 58	14. 76	13. 80
Ammonia liquor (NH_3 content):			
Production ... pounds		496, 525	496, 525
Sales ... do		485, 568	485, 568
Value of sales		$11, 116	$11, 116
Stocks on January 1, 1949 ... pounds		52, 110	52, 110
Per ton of coal charged ... do		2. 70	2. 70
Crude light oil: [2]			
Production ... gallons	19, 512	197, 430	216, 942
Sales ... do	18, 403	163, 423	181, 826
Value of sales	$1, 266	$15, 682	$16, 948
Stocks on January 1, 1949 ... gallons	11, 562	36, 171	47, 733
Per ton of coal charged ... do	0. 75	0. 94	0. 92

[1] Additional data in Production of Coke and Coal Chemicals from Coal-Gas Retorts in 1948, Bureau of Mines Mineral Market Rept. 1712, Apr. 13, 1949.
[2] Includes drip and holder oil.

OVEN AND BEEHIVE COKE AND COKE BREEZE

GROWTH OF INDUSTRY

TABLE 6.—Historical Statistics of the coke industry in the United States, 1880 and 1890–1948

Year	Production (million net tons)			Percent of total production from slot-type ovens	Ovens in existence		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)			
	Oven coke	Beehive coke	Total		Slot type	Beehive					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]
1897	.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
1947	66.8	6.7	73.5	90.9	14,728	13,443	572	105.0	69.9	10.57	65	711	248	1,024
1948	68.3	6.6	74.9	91.2	15,139	14,078	350	107.6	69.6	12.40	79	849	302	1,230

[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 oven-coke plants is included for those years for which it was reported, namely, 1916, 1917, and 1919–48. 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

Monthly data on oven and beehive coke, shown in tables 7 to 9, are based upon reports received from producers after minor adjustments have been made. Weekly production of beehive coke is estimated from reports of carloadings received from all coke-carrying railroads. The totals shown in table 10 have been adjusted to the annual total, ascertained by direct canvass of the producers. Data on weekly production of beehive coke are published by the Bureau of Mines in the Weekly Anthracite and Beehive-Coke Report, and monthly data for both oven and beehive coke are published in the Monthly Coke Report. These reports are distributed, free of charge, upon request to the Publications Distribution Section, Bureau of Mines, Washington 25, D. C.

TABLE 7.—Coke produced in the United States, 1937 and 1946–48, by months and average per day, in net tons [1]

Month	1937		1946		1947		1948	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
Oven coke:								
January	4, 360, 700	140, 700	3, 822, 300	123, 300	5, 650, 600	182, 300	5, 886, 500	189, 900
February	3, 992, 900	142, 600	2, 647, 200	94, 500	5, 158, 500	184, 300	5, 534, 600	190, 800
March	4, 495, 500	145, 000	5, 029, 700	162, 200	5, 690, 700	183, 600	5, 666, 800	182, 800
April	4, 350, 900	145, 000	3, 874, 800	129, 200	5, 413, 500	180, 400	4, 507, 500	150, 300
May	4, 479, 700	144, 500	2, 588, 900	83, 500	5, 561, 900	179, 400	5, 746, 000	185, 400
June	4, 024, 800	134, 200	4, 444, 400	148, 100	5, 352, 900	178, 400	5, 616, 500	187, 200
July	4, 423, 900	142, 700	5, 354, 500	172, 700	5, 403, 300	174, 300	5, 738, 000	185, 100
August	4, 573, 400	147, 500	5, 494, 600	177, 300	5, 664, 700	182, 700	5, 873, 800	189, 500
September	4, 427, 800	147, 600	5, 376, 500	179, 200	5, 426, 900	180, 900	5, 789, 100	193, 000
October	4, 035, 100	130, 200	5, 545, 200	178, 900	5, 833, 100	188, 200	5, 992, 400	193, 300
November	3, 222, 300	107, 400	4, 954, 300	165, 100	5, 682, 500	189, 400	5, 832, 900	194, 400
December	2, 823, 800	91, 100	4, 797, 000	154, 700	5, 920, 000	191, 000	6, 100, 300	196, 800
Total	49, 210, 800	134, 800	53, 929, 400	147, 800	66, 758, 600	182, 900	68, 284, 400	186, 600
Beehive coke:								
January	274, 300	10, 600	418, 500	13, 500	594, 100	19, 100	616, 100	19, 900
February	294, 600	12, 300	379, 400	13, 600	538, 200	19, 200	547, 900	18, 900
March	357, 300	13, 200	478, 200	15, 500	606, 100	19, 500	331, 500	10, 700
April	309, 700	11, 900	22, 100	700	445, 800	14, 900	249, 200	8, 300
May	326, 500	12, 600	27, 800	900	611, 800	19, 800	599, 400	19, 300
June	274, 800	10, 600	377, 900	12, 600	471, 100	15, 700	561, 300	18, 700
July	285, 100	11, 000	482, 800	15, 600	437, 100	14, 100	453, 100	14, 600
August	259, 000	10, 000	539, 900	17, 400	588, 700	19, 000	640, 100	20, 600
September	253, 900	9, 800	500, 100	16, 700	593, 600	19, 800	617, 200	20, 600
October	225, 500	8, 700	573, 900	18, 500	627, 000	20, 200	651, 500	21, 000
November	168, 800	6, 500	372, 100	12, 400	559, 600	18, 700	640, 200	21, 400
December	135, 200	5, 200	395, 700	12, 800	614, 200	19, 800	670, 100	21, 600
Total	3, 164, 700	10, 200	4, 568, 400	12, 500	6, 687, 300	18, 300	6, 577, 600	17, 900
Total:								
January	4, 635, 000	151, 300	4, 240, 800	136, 800	6, 244, 700	201, 400	6, 502, 600	209, 800
February	4, 287, 500	154, 900	3, 026, 600	108, 100	5, 696, 700	203, 500	6, 082, 500	209, 700
March	4, 852, 800	158, 200	5, 507, 900	177, 700	6, 296, 800	203, 100	5, 998, 300	193, 500
April	4, 660, 600	156, 900	3, 896, 900	129, 900	5, 859, 300	195, 300	4, 756, 700	158, 600
May	4, 806, 200	157, 100	2, 616, 700	84, 400	6, 173, 700	199, 200	6, 345, 400	204, 700
June	4, 299, 600	144, 800	4, 822, 300	160, 700	5, 824, 000	194, 100	6, 177, 800	205, 900
July	4, 709, 000	153, 700	5, 837, 300	188, 300	5, 840, 400	188, 400	6, 191, 100	199, 700
August	4, 832, 400	157, 500	6, 034, 500	194, 700	6, 253, 400	201, 700	6, 513, 900	210, 100
September	4, 681, 700	157, 400	5, 876, 600	195, 900	6, 020, 500	200, 700	6, 406, 300	213, 600
October	4, 260, 600	138, 900	6, 119, 100	197, 400	6, 460, 100	208, 400	6, 643, 900	214, 300
November	3, 391, 100	113, 900	5, 326, 400	177, 500	6, 242, 100	208, 100	6, 473, 100	215, 800
December	2, 959, 000	96, 300	5, 192, 700	167, 500	6, 534, 200	210, 800	6, 770, 400	218, 400
Grand total	52, 375, 500	145, 000	58, 497, 800	160, 300	73, 445, 900	201, 200	74, 862, 000	204, 500

[1] Before 1941 daily average production of beehive coke was calculated by subtracting Sundays and holidays in each month; 1942–48 daily average has been calculated by dividing total monthly production by total number of days in month.

TABLE 8.—Oven coke produced in the United States in 1948, by States and months, in net tons

[Based on reports from producers]

State	January	February	March	April	May	June	July
Alabama	524, 400	495, 700	481, 300	322, 500	530, 300	514, 400	516, 600
California	28, 300	25, 500	27, 000	25, 900	26, 600	25, 300	23, 900
Colorado	79, 200	76, 000	78, 200	72, 500	84, 300	82, 600	81, 700
Illinois	322, 200	302. 400	310, 500	252, 800	308, 700	298, 900	308, 600
Indiana	743, 800	700, 100	722, 700	631, 600	706, 500	702, 300	700, 200
Maryland	157, 300	153, 100	174, 600	146, 900	190, 700	186, 500	190, 700
Massachusetts	101, 000	90, 100	102, 000	87, 000	99, 500	93, 500	90, 900
Michigan	244, 300	231, 400	242, 400	188, 200	244, 100	238, 400	245, 600
Minnesota	76, 600	71, 800	75, 100	64, 600	66, 400	65, 600	68, 200
New Jersey	125, 000	115, 600	122, 300	93, 200	121, 000	117, 400	120, 100
New York	476, 700	449, 300	472, 400	382, 000	452, 300	447, 600	487, 200
Ohio	906, 700	867, 100	893, 000	685, 500	902, 200	872, 900	884, 900
Pennsylvania	1, 456, 500	1, 363, 100	1, 367, 400	1, 110, 500	1, 387, 900	1, 346, 800	1, 380, 300
Tennessee	21, 100	20, 500	21, 500	19, 700	21, 300	21, 100	22, 000
Texas	56, 000	52, 600	56, 600	50, 500	55, 200	52, 600	56, 400
Utah	100, 600	98, 300	76, 000	23, 600	87, 100	97, 500	97, 700
West Virginia	273, 200	241, 000	251, 700	188, 700	268, 000	263, 700	269, 600
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	193, 600	181, 000	192, 100	161, 800	193, 900	189, 400	193, 400
Total	5, 886, 500	5, 534, 600	5, 666, 800	4, 507, 500	5, 746, 000	5, 616, 500	5, 738, 000
At merchant plants	1, 183, 900	1, 080, 900	1, 147, 900	929, 500	1, 127, 700	1, 108, 000	1, 130, 600
At furnace plants	4, 702, 600	4, 453, 700	4, 518, 900	3, 578, 000	4, 618, 300	4, 508, 500	4, 607, 400

State	August	September	October	November	December	Total
Alabama	505, 100	514, 100	537, 900	519, 500	553, 700	6, 015, 500
California	11, 700	22, 200	27, 200	25, 300	27, 900	296, 800
Colorado	87, 200	84, 700	82, 400	79, 100	88, 600	976, 500
Illinois	318, 000	310, 600	319, 700	305, 700	317, 200	3, 675, 300
Indiana	746, 100	721, 500	748, 300	724, 900	736, 200	8, 584, 200
Maryland	190, 900	183, 900	189, 400	184, 200	199, 600	2, 147, 800
Massachusetts	81, 300	74, 900	63, 200	84, 100	89, 200	1, 056, 700
Michigan	245, 800	238, 100	246, 100	239, 100	246, 100	2, 849, 600
Minnesota	69, 000	69, 600	74, 000	71, 700	73, 700	846, 300
New Jersey	119, 900	116, 300	121, 100	117, 400	121, 600	1, 410, 900
New York	498, 500	505, 200	512, 300	486, 200	517, 500	5, 687, 200
Ohio	909, 900	889, 500	922, 900	900, 200	927, 700	10, 562, 500
Pennsylvania	1, 429, 700	1, 415, 500	1, 473, 400	1, 422, 500	1, 496, 100	16, 649, 700
Tennessee	21, 300	20, 800	20, 700	20, 300	21, 100	251, 400
Texas	52, 600	44, 200	54, 500	55, 000	58, 000	644, 200
Utah	93, 500	96, 000	88, 100	98, 500	101, 600	1, 058, 500
West Virginia	300, 200	293, 500	312, 400	308, 200	327, 900	3, 298, 100
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	193, 100	188, 500	198, 800	191, 000	196, 600	2, 273, 200
Total	5, 873, 800	5, 789, 100	5, 992, 400	5, 832, 900	6, 100, 300	68, 284, 400
At merchant plants	1, 128, 700	1, 100, 100	1, 129, 200	1, 113, 700	1, 152, 300	13, 332, 500
At furnace plants	4, 745, 100	4, 689, 000	4, 863, 200	4, 719, 200	4, 948, 000	54, 951, 900

TABLE 9.—Beehive coke produced in the United States in 1948, by States and months, in net tons

[Based on reports from producers]

State	January	February	March	April	May	June	July
Kentucky	7, 500	8, 100	6, 300	6, 600	9, 900	8, 300	8, 100
Pennsylvania	551, 500	486, 700	290, 000	214, 400	522, 400	491, 500	390, 700
Utah	7, 700	6, 800	3, 200	1, 400	18, 900	17, 700	15, 000
Virginia	19, 400	18, 600	11, 400	8, 900	18, 200	16, 000	11, 500
West Virginia	30, 000	27, 700	20, 600	17, 900	30, 000	27, 800	27, 800
Total	616, 100	547, 900	331, 500	249, 200	599, 400	561, 300	453, 100

TABLE 9.—Beehive coke produced in the United States in 1948, by States and months, in net tons—Continued

State	August	September	October	November	December	Total
Kentucky	9,900	8,400	9,900	9,500	9,300	101,800
Pennsylvania	555,400	535,300	561,900	553,700	580,300	5,733,800
Utah	24,000	22,500	23,800	22,700	24,900	188,600
Virginia	17,600	19,300	21,200	19,100	19,700	200,900
West Virginia	33,200	31,700	34,700	35,200	35,900	352,500
Total	640,100	617,200	651,500	640,200	670,100	6,577,600

TABLE 10.—Beehive coke produced in the United States in 1948, by weeks

[Estimated from railroad shipments]

Week ended—	Net tons	Week ended—	Net tons	Week ended—	Net tons
Jan. 3	[1] 54,800	May 15	149,300	Sept. 25	148,200
Jan. 10	143,100	May 22	155,900	Oct. 2	148,800
Jan. 17	144,300	May 29	146,200	Oct. 9	153,400
Jan. 24	134,200	June 5	141,600	Oct. 16	150,800
Jan. 31	139,700	June 12	152,500	Oct. 23	148,600
Feb. 7	138,000	June 19	147,300	Oct. 30	156,200
Feb. 14	142,200	June 26	151,800	Nov. 6	135,800
Feb. 21	138,500	July 3	28,100	Nov. 13	147,600
Feb. 28	139,200	July 10	51,200	Nov. 20	157,700
Mar. 6	132,800	July 17	83,300	Nov. 27	149,000
Mar. 13	129,000	July 24	141,400	Dec. 4	154,200
Mar. 20	59,900	July 31	138,900	Dec. 11	156,900
Mar. 27	14,100	Aug. 7	141,900	Dec. 18	143,600
Apr. 3	10,200	Aug. 14	148,900	Dec. 25	142,300
Apr. 10	12,400	Aug. 21	149,500	Jan. 1	[2] 111,500
Apr. 17	33,900	Aug. 28	144,900		
Apr. 24	67,000	Sept. 4	152,100	Total	6,577,600
May 1	96,100	Sept. 11	127,700		
May 8	141,600	Sept. 18	149,500		

[1] 3 days only.
[2] 6 days only.

PRODUCTION BY FURNACE AND MERCHANT PLANTS

The criteria used by the Bureau of Mines for classifying "furnace" and "merchant" oven-coke plants were given in detail in the 1947 coke chapter and therefore need not be repeated here.

The total number of active plants in 1948 was the same as in 1947; however, the plant at Fairmont, W. Va., formerly owned and operated by the Domestic Coke Corp., was purchased by the Sharon Steel Corp. on February 1, 1948, and the classification was changed from merchant to furnace plant, as shown in table 11. This change naturally decreased the output from merchant plants, but the sharp increase in furnace output was not due entirely to this transfer. The growth in output of furnace plants in the past decade is due largely to the increased demand for blast-furnace coke. To meet these mounting requirements, expansion of carbonizing capacity at integrated iron and steel works has been necessary. As a result, a greater proportion of coke is being produced by furnace plants. For example, in 1937 furnace plants supplied slightly over 73 percent of the total production, whereas in 1948 the proportion had risen to over 80 percent. Furnace and merchant plants operated at a uniform rate throughout the year, except for a 2-week period in April. Monthly and daily average production data for both types of plants are shown in table 12.

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 1946–48

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
1946	53	32	41, 540, 962	12, 388, 485	77.0	23.0
1947	54	32	52, 860, 850	13, 897, 699	79.2	20.8
1948	55	31	54, 951, 858	13, 332, 499	80.5	19.5

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 1947–48, in net tons

Month	1937		1947		1948	
	Furnace plants	Merchant plants	Furnace plants	Merchant plants	Furnace plants	Merchant plants
Monthly production:						
January	3, 241, 600	1, 119, 100	4, 465, 300	1, 185, 300	4, 702, 600	1, 183, 900
February	2, 996, 500	996, 400	4, 071, 800	1, 086, 700	4, 453, 700	1, 080, 900
March	3, 355, 000	1, 140, 500	4, 491, 300	1, 199, 400	4, 518, 900	1, 147, 900
April	3, 310, 300	1, 040, 600	4, 286, 600	1, 126, 900	3, 578, 000	929, 500
May	3, 375, 600	1, 104, 100	4, 383, 300	1, 178, 600	4, 618, 300	1, 127, 700
June	2, 917, 500	1, 107, 300	4, 228, 000	1, 124, 900	4, 508, 500	1, 108, 000
July	3, 316, 100	1, 107, 800	4, 270, 600	1, 132, 700	4, 607, 400	1, 130, 600
August	3, 469, 300	1, 104, 100	4, 488, 500	1, 176, 200	4, 745, 100	1, 128, 700
September	3, 334, 700	1, 093, 100	4, 283, 000	1, 143, 900	4, 689, 000	1, 100, 100
October	2, 910, 500	1, 124, 600	4, 643, 200	1, 189, 900	4, 863, 200	1, 129, 200
November	2, 142, 700	1, 079, 600	4, 524, 200	1, 158, 300	4, 719, 200	1, 113, 700
December	1, 764, 400	1, 059, 400	4, 725, 100	1, 194, 900	4, 948, 000	1, 152, 300
Total	36, 134, 200	13, 076, 600	52, 860, 900	13, 897, 700	54, 951, 900	13, 332, 500
Average daily production:						
January	104, 600	36, 100	144, 100	38, 200	151, 700	38, 200
February	107, 000	35, 600	145, 500	38, 800	153, 500	37, 300
March	108, 200	36, 800	144, 900	38, 700	145, 800	37, 000
April	110, 300	34, 700	142, 900	37, 500	119, 300	31, 000
May	108, 900	35, 600	141, 400	38, 000	149, 000	36, 400
June	97, 300	36, 900	140, 900	37, 500	150, 300	36, 900
July	107, 000	35, 700	137, 800	36, 500	148, 600	36, 500
August	111, 900	35, 600	144, 800	37, 900	153, 100	36, 400
September	111, 200	36, 400	142, 800	38, 100	156, 300	36, 700
October	93, 900	36, 300	149, 800	38, 400	156, 900	36, 400
November	71, 400	36, 000	150, 800	38, 600	157, 300	37, 100
December	56, 900	34, 200	152, 400	38, 600	159, 600	37, 200
Average for year	99, 000	35, 800	144, 800	38, 100	150, 200	36, 400

PRODUCTION BY STATES AND DISTRICTS

Oven coke was produced in 22 States in 1948, the same number that reported production in 1947. Increases in production over that of 1947 were reported by 13 States, and decreases up to 12 percent occurred in the 9 remaining States. Production increases are as follows: Texas led with a gain of 145 percent; West Virginia, 17 percent; Colorado, 15 percent; Maryland and Utah, 9 percent each; and Ohio, 5 percent. The largest tonnage increases were reported by Ohio, West Virginia, and Texas. These States combined accounted for 89 percent of the gain in output over 1947.

Production of oven coke by geographic areas is shown in table 14. This tabulation proves that the Middle Atlantic area, which includes Maryland, New Jersey, New York, and Pennsylvania, contributed the largest share of the Nation's output, supplying 38 percent of the total. Illinois, Indiana, and Missouri combined furnished 18 percent, and Ohio ranked third with 16 percent of the total. The rapid expansion of the iron and steel industry in the Western States has greatly increased the requirements for metallurgical coke, and total production in this area has increased more than fourfold since 1937.

In 1948 Pennsylvania continued to surpass all other States combined in the production of beehive coke, supplying 87 percent of the national output. Closing of the only beehive-coke plant in Colorado in 1947 removed that State from the list of producers, leaving only five States in 1948. Production declined in three States, gained slightly in Kentucky, and increased 179 percent in Utah. The tremendous gain in Utah was due to rehabilitation of the large plant at Columbia by Kaiser & Frazer Parts Corp.

TABLE 13.—Coke produced in the United States, 1937 and 1945–48, by States, in net tons

[Exclusive of screenings or breeze]

State	1937	1945	1946	1947	1948
Oven coke:					
Alabama	4,259,771	5,400,925	4,665,939	5,869,738	6,015,460
California	----------	256,092	260,470	332,244	296,749
Colorado	486,945	639,099	558,545	849,697	976,504
Illinois	2,998,663	3,681,516	3,192,395	3,805,374	3,675,284
Indiana	5,467,061	7,814,247	6,651,567	8,785,687	8,584,225
Maryland	1,513,651	2,024,609	1,661,606	1,975,201	2,147,787
Massachusetts	1,130,620	1,149,448	1,046,267	1,196,010	1,056,701
Michigan	2,283,518	2,805,970	2,499,664	2,818,941	2,849,601
Minnesota	704,631	825,620	860,754	897,739	846,246
New Jersey	1,015,073	1,284,020	1,258,854	1,432,210	1,410,941
New York	4,946,964	5,789,974	5,042,674	5,670,333	5,687,225
Ohio	6,737,881	9,405,710	8,451,580	10,069,237	10,562,486
Pennsylvania	13,701,262	15,255,137	12,794,721	16,474,893	16,649,689
Tennessee	89,451	236,979	229,751	241,925	251,428
Texas	----------	140,254	----------	263,006	644,225
Utah	149,659	731,306	487,133	975,772	1,058,501
Washington	14,656	----------	----------	----------	----------
West Virginia	1,817,993	2,462,477	2,162,453	2,822,381	3,298,090
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	1,892,949	2,190,905	2,105,074	2,278,161	2,273,215
Total	49,210,748	62,094,288	53,929,447	66,758,549	68,284,357
Beehive coke:					
Colorado	64,222	72,678	58,761	21,489	----------
Kentucky	----------	74,404	85,400	95,285	101,745
Pennsylvania	2,559,048	4,583,720	4,027,167	5,913,133	5,733,835
Tennessee	14,982	----------	----------	----------	----------
Utah	6,657	4,205	5,234	67,693	188,586
Virginia	240,425	191,032	171,242	211,876	200,911
West Virginia	279,387	287,854	220,597	377,825	352,494
Total	3,164,721	5,213,893	4,568,401	6,687,301	6,577,571
Grand total	52,375,469	67,308,181	58,497,848	73,445,850	74,861,928

TABLE 14.—Production of oven coke, by geographic areas, 1937, 1940, and 1945–48, in net tons

Geographic areas	1937	1940	1945	1946	1947	1948
Connecticut, Massachusetts, and Rhode Island	1,717,558	1,779,306	1,855,396	1,663,316	1,890,973	1,746,550
Maryland, New Jersey, New York, and Pennsylvania	21,176,950	22,641,242	24,353,740	20,757,855	25,552,637	25,895,642
Ohio	6,737,881	7,897,929	9,405,710	8,451,580	10,069,237	10,562,486
Illinois, Indiana, and Missouri	8,730,680	9,660,017	11,763,201	10,109,231	12,868,508	12,539,204
Michigan, Minnesota, and Wisconsin	3,589,795	3,944,410	4,236,020	3,970,174	4,342,188	4,327,342
Alabama, Kentucky, Tennessee, and West Virginia	6,606,624	7,328,908	8,713,470	7,671,143	9,614,287	10,237,154
California, Colorado, Texas, Utah, and Washington	651,260	762,497	1,766,751	1,306,148	2,420,719	2,975,979
Total	49,210,748	54,014,309	62,094,288	53,929,447	66,758,549	68,284,357

TABLE 15.—Oven coke produced in the United States in 1948, 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	3,583	22,996,777	70.77	16,273,957	$211,137,804	$12.97
Pittsburgh-Youngstown	21	4,594	30,460,533	68.75	20,942,588	231,935,216	11.07
Cleveland-Detroit	10	1,652	11,009,149	70.92	7,808,000	100,213,106	12.83
Chicago	19	3,170	19,475,640	71.97	14,016,945	207,354,391	14.79
Southern	10	1,480	9,661,164	71.53	6,911,113	69,705.763	10.09
Western	4	660	3,637,055	64.11	2,331,754	28,372,803	12.17
Total	86	15,139	97,240,318	70.22	68,284,357	848,719,083	12.43

TABLE 16.—Coke produced in Pennsylvania in 1948, 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 [1]	5	796	4,677,800	71.20	3,330,476	$43,794,762	$13.15
Western [2]	8	3,056	19,552,105	68.12	13,319,213	145,935,117	10.96
Total	13	3,852	24,229,905	68.72	16,649,689	189,729,879	11.40
Beehive coke:							
Fayette County	41	8,169	6,320,764	64.40	4,070,790	45,346,848	11.14
Westmoreland County	20	2,516	1,776,716	64.56	1,147,125	15,310,609	13.35
Other counties [3]	4	699	808,714	63.80	515,920	6,646,379	12.88
Total	65	11,384	8,906,194	64.38	5,733,835	67,303,836	11.74
Grand total	78	15,236	33,136,099	67.55	22,383,524	257,033,715	11.48

[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

Coke Ovens.—Modernization of existing facilities and construction of new ovens continued at a rapid pace in 1948. In all, 495 new ovens with an annual coke capacity of 2,571,700 tons were built during the year. In addition, 28 old ovens were completely rebuilt in Alabama, and minor repairs were made on a number of ovens in various other places. One battery of 17 ovens in Ohio and another of 61 in Pennsylvania were demolished; failure of 2 ovens in Alabama and 4 in Illinois brought the total number abandoned to 84. The net gain in ovens in 1948 was 411, which raised the total number in existence at the end of the year to 15,139, a new record. In spite of the extensive construction activity of the past several years, the proportion of ovens more than 25 years old is still high. Table 18 shows the number and capacity of all ovens in existence on December 31, 1948, according to age groups. It is evident from the large number of overage ovens shown in this tabulation that extensive construction work must be continued if the current rate of production is to be maintained. Coke-plant operators are endeavoring to meet rising coke requirements by constructing new ovens. At the close of the year 350 new ovens were under actual construction, and contracts were let for erecting several additional batteries.

Beehive Ovens.—Beehive ovens played an important part in meeting blast-furnace coke requirements during World War II, and a large number continued to operate in 1948 to help supply the insatiable demand for metallurgical coke. The average number of beehive ovens in blast during the year ranged from a low of 9,965 in April to a peak of 12,403 in December. The decline in average number of active ovens in April was due to the closing of 1,310 ovens in Pennsylvania by the H. C. Frick Coke Co. Beehive ovens require comparatively less time and money to rehabilitate than slot-type ovens and therefore offer a quick way of adding to the total carbonizing capacity. Hence, the number of beehive ovens needed to satisfy excess metallurgical-coke requirements may be expected to fluctuate more directly with the demand for steel.

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TABLE 17.—Ovens completed and abandoned in the United States in 1948 and total number in existence at end of year, by States

State	Plants in existence Dec. 31	Ovens: In existence Dec. 31 — Number	Ovens: In existence Dec. 31 — Annual coke capacity (net tons)	Ovens: New — Number	Ovens: New — Annual coke capacity (net tons)	Ovens: Abandoned during year	Ovens: Under construction Dec. 31 — Number	Ovens: Under construction Dec. 31 — Annual coke capacity (net tons)
Oven coke:								
Alabama	7	1,311	6,581,400			2		
California	1	90	355,000				45	177,500
Colorado	1	262	972,300					
Connecticut	1	70	(1)					
Illinois	8	852	3,810,600			4	51	190,000
Indiana	5	1,863	9,341,800				142	911,000
Kentucky	1	120	(1)					
Maryland	1	483	2,520,000	61	396,000			
Massachusetts	2	215	1,289,800					
Michigan	4	568	2,984,500					
Minnesota	3	196	872,400					
Missouri	1	64	(1)					
New Jersey	2	304	1,427,000				37	130,000
New York	8	1,142	6,249,400					
Ohio	15	2,292	10,922,800			17	40	237,000
Pennsylvania	13	3,852	18,922,100	328	1,579,700	61	35	235,000
Rhode Island	1	65	(1)					
Tennessee	1	44	252,100					
Texas	2	125	713,300					
Utah	2	308	1,180,600					
West Virginia	5	718	3,774,000	106	596,000			
Wisconsin	2	195	(1)					
Undistributed			2,330,800					
Total	86	15,139	74,499,900	[2] 495	2,571,700	84	350	1,880,500
At merchant plants	31	2,983	14,199,900			4	88	320,000
At furnace plants	55	12,156	60,300,000	495	2,571,700	80	262	1,560,500
Beehive coke:								
Kentucky	1	195	172,000					
Pennsylvania	65	11,384	7,717,100	[3] 564	382,400	485		
Utah	2	797	305,000	[3] 500	185,000			
Virginia	5	750	376,200					
West Virginia	8	952	505,900	[3] 56	25,500			
Total	81	14,078	9,076,200	[3] 1,120	592,900	485		

[1] Included with "Undistributed."
[2] Does not include 28 ovens in Alabama that were completely rebuilt.
[3] Old ovens rehabilitated.

TABLE 18.—Age of coke ovens in the United States on December 31, 1948, by merchant and furnace plants [1]

Age	Merchant plants — Number of ovens	Merchant plants — Annual coke capacity (net tons)	Furnace plants — Number of ovens	Furnace plants — Annual coke capacity (net tons)	Total — Number of ovens	Total — Percent of total	Total — Annual coke capacity (net tons)	Total — Percent of total
Under 5 years	202	1,042,300	1,744	9,151,400	1,946	12.9	10,193,700	13.7
From 5 to 10 years	351	1,839,500	2,254	12,331,200	2,605	17.2	14,170,700	19.0
From 10 to 15 years	157	634,300	1,264	7,281,200	1,421	9.3	7,915,500	10.6
From 15 to 20 years	479	2,685,200	450	2,486,800	929	6.1	5,172,000	7.0
From 20 to 25 years	667	3,402,500	1,538	7,926,200	2,205	14.6	11,328,700	15.2
25 years and over	1,127	4,596,100	4,906	21,123,200	6,033	39.9	25,719,300	34.5
Total	2,983	14,199,900	12,156	60,300,000	15,139	100.0	74,499,900	100.0

[1] Determined by first year of operation or after rebuilding or major repairs.

TABLE 19.—Coke ovens, by kinds, in the United States at end of 1948, by States

State	Koppers	Koppers-Becker	Semet-Solvay	Wilputte	All others [1]	Total
Alabama	459	549	180	123		1,311
California		90				90
Colorado	116	146				262
Connecticut		70				70
Illinois	374	195	120	163		852
Indiana	406	812	161	484		1,863
Kentucky			120			120
Maryland	300	183				483
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	439	293	322		2,292
Pennsylvania	1,550	1,888	88	206	120	3,852
Rhode Island	40	25				65
Tennessee			24	20		44
Texas		125				125
Utah		308				308
West Virginia	154	419		145		718
Wisconsin	100	15	80			195
Total	5,263	6,434	1,592	1,670	180	15,139
At merchant plants	680	1,110	722	411	60	2,983
At furnace plants	4,583	5,324	870	1,259	120	12,156

[1] Comprises 52 American Foundation, 120 Cambria, and 8 Piette.

TABLE 20.—Average number of beehive ovens active in the United States in 1948, by months

Month	Number	Month	Number	Month	Number
January	11,563	May	11,782	September	12,006
February	11,539	June	11,887	October	12,218
March	10,177	July	11,959	November	12,349
April	9,965	August	11,931	December	12,403

CAPACITY OF OVEN-COKE PLANTS

The potential annual coke capacity of oven-coke plants, as reported by operators, was 3 percent higher on December 31, 1948, than at the end of the preceding year. This increase was due principally to the addition of new ovens, as there was but little change in the capacity of ovens reported in existence on December 31, 1947. The basis for calculating the potential annual capacity of a coke plant is the minimum coking time necessary to produce a coke with qualities suitable for the intended use. Thus, the potential capacity of a plant is subject to change from year to year, depending on the age and condition of ovens, character and quality of coal charged, type of coke required, and related economic conditions. The potential capacity, reported by operators to the Bureau of Mines may differ, therefore, from the rated capacity estimated by the builders at the time of construction. It is believed, though, that the potential capacity, as shown in table 21, serves to keep the practical operating capacity up to date.

The coke producers were forced to operate ovens as close to potential capacity as possible throughout 1948 to meet the intense demand for coke. As a consequence, the rate of coke production averaged 92.0 percent of productive capacity, the highest since 1944. The rate of production undoubtedly would have been higher had it not been for the mine shut-down in April. The operators lengthened the coking periods during that time to conserve their coal stocks.

TABLE 21.—Potential maximum annual coke capacity of all oven-coke plants in existence in the United States, 1937 and 1944–48

Year	Plants	Ovens	Potential maximum annual coke capacity (net tons)	Percent of change from 1937
1937	87	12,718	62,727,100	
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
1947	86	14,728	72,549,100	+15.7
1948	86	15,139	74,499,900	+18.8

TABLE 22.—Relationship of production to potential maximum capacity [1] at oven-coke plants in the United States, 1937 and 1945–48, by months, in percent

Month	1937	1945	1946	1947	1948	Month	1937	1945	1946	1947	1948
January	83.0	89.1	61.8	91.0	94.8	August	86.0	82.4	88.4	90.5	93.1
February	83.5	89.6	47.4	92.0	94.7	September	86.1	84.0	89.4	89.3	94.9
March	84.9	90.2	81.3	91.7	90.9	October	76.0	64.1	89.2	91.3	93.9
April	84.9	86.3	64.6	90.1	74.6	November	62.8	80.5	82.4	91.9	94.0
May	84.6	88.4	41.7	89.6	92.0	December	53.1	83.2	77.2	92.6	95.0
June	78.6	85.3	73.9	89.1	93.3						
July	83.2	88.3	86.2	86.9	92.2	Year	78.8	84.3	73.8	90.5	92.0

[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

The coke industry ranked first among the consumers of bituminous coal in the United States in 1948 and carbonized about one-fifth of all bituminous coal produced. The quantity charged into ovens in 1948 increased 2.5 million tons (2 percent) over 1947 and was 2,197,825 tons higher than the 1944 peak. In addition, 256,175 tons of anthracite fines were used at nine oven-coke plants for blending purposes. The feasibility of using anthracite for blending has been known for many years; but it was not until the early 1940's, when the shortage of low-volatile bituminous coal became acute, that the practice was established at a number of plants.

States that led in coking-coal consumption are those in which large iron and steel plants are concentrated. Pennsylvania, Ohio, Indiana, Alabama, and New York are the principal consuming States, in the order named. These five States used 71 percent of the total coking coal carbonized in 1948. Other States using large quantities annually are Illinois, West Virginia, and Michigan, which combined charged 14,509,755 tons, or 13 percent of the Nation's total in 1948.

The cost of coal has been rising rapidly in the past 10 years, and the 1948 average was 116 percent higher than the 1937 figure. The average cost of coal at oven-coke plants in 1948 increased 20 percent over 1947 and established an all-time peak. A large part of the coal used at oven-coke plants is "long-haul" coal, which necessarily increases the cost at ovens. West Virginia, which obtains coal from nearby fields, had the lowest average cost in 1948, while Minnesota, because of its distance from sources of supply, had the highest. Details on the quantity and cost of coal at the ovens are shown in table 24.

TABLE 23.—Coal consumed in coke ovens in the United States, 1937 and 1947–48, by months, in net tons

Month	1937			1947			1948		
	Coke oven	Beehive	Total	Coke oven [1]	Beehive	Total	Coke oven [2]	Beehive	Total
Jan	6,198,700	426,600	6,625,300	7,961,500	929,100	8,890,600	8,393,300	999,600	9,392,900
Feb	5,679,900	458,500	6,138,400	7,244,600	841,700	8,086,300	7,908,500	880,600	8,789,100
Mar	6,387,000	556,800	6,943,800	8,031,800	948,300	8,980,100	8,092,600	522,300	8,614,900
Apr	6,183,800	480,800	6,664,600	7,665,800	698,000	8,363,800	6,482,300	407,000	6,889,300
May	6,368,500	509,700	6,878,200	7,865,400	957,500	8,822,900	8,175,500	933,400	9,108,900
June	5,729,200	430,500	6,159,700	7,593,500	738,700	8,332,200	8,032,700	874,500	8,907,200
July	6,217,200	441,700	6,658,900	7,703,900	684,400	8,388,300	8,215,000	721,400	8,936,400
Aug	6,425,800	401,100	6,826,900	8,035,800	923,200	8,959,000	8,345,900	994,900	9,340,800
Sept	6,220,700	392,800	6,613,500	7,666,300	930,300	8,596,600	8,193,200	956,300	9,149,500
Oct	5,664,800	351,600	6,016,400	8,289,500	982,400	9,271,900	8,495,700	1,009,600	9,505,300
Nov	4,527,000	264,000	4,791,000	8,101,600	877,800	8,979,400	8,263,700	986,900	9,250,600
Dec	3,972,800	212,700	4,185,500	8,427,600	963,200	9,390,800	8,641,900	1,035,100	9,677,000
Total	69,575,400	4,926,800	74,502,200	94,587,300	10,474,600	105,061,900	97,240,300	10,321,600	107,561,900

[1] Includes 262,200 tons of anthracite fines.
[2] Includes 256,200 tons of anthracite fines.

TABLE 24.—Quantity and value at ovens of coal used in manufacturing coke in the United States in 1948, by States

State	Coal used (net tons)	Cost of coal		Coal per ton of coke	
		Total	Average per ton	Net tons	Cost
Oven coke:					
Alabama	8,410,868	$54,528,863	$6.48	1.40	$9.06
California	482,289	(1)	(1)	1.63	(1)
Colorado	1,413,355	(1)	(1)	1.45	(1)
Illinois	5,221,320	48,963,467	9.38	1.42	13.32
Indiana	11,884,929	111,162,579	9.35	1.38	12.95
Maryland	3,005,794	(1)	(1)	1.40	(1)
Massachusetts	1,478,402	(1)	(1)	1.40	(1)
Michigan	4,000,171	33,051,581	8.26	1.40	11.60
Minnesota	1,178,266	11,661,927	9.90	1.39	13.78
New Jersey	1,956,052	(1)	(1)	1.39	(1)
New York	8,204,974	77,754,657	9.48	1.44	13.67
Ohio	14,960,890	121,367,478	8.11	1.42	11.49
Pennsylvania	24,229,905	174,897,673	7.22	1.46	10.50
Tennessee	342,466	(1)	(1)	1.36	(1)
Texas	907,830	(1)	(1)	1.41	(1)
Utah	1,741,411	(1)	(1)	1.65	(1)
West Virginia	4,738,217	29,114,350	6.14	1.44	8.83
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	3,083,179	27,113,784	8.79	1.36	11.93
Undistributed		100,834,248	8.90		12.86
Total	97,240,318	790,450,607	8.13	1.42	11.58
At merchant plants	18,672,468	163,244,593	8.74	1.40	12.24
At furnace plants	78,567,850	627,206,014	7.98	1.43	11.41
Beehive coke:					
Kentucky	163,733	(1)	(1)	1.61	(1)
Pennsylvania	8,906,194	45,013,375	5.05	1.55	7.85
Utah	356,982	(1)	(1)	1.89	(1)
Virginia	344,612	1,817,504	5.27	1.72	9.05
West Virginia	550,047	2,883,574	5.24	1.56	8.18
Undistributed		3,023,915	5.81		10.42
Total	10,321,568	52,738,368	5.11	1.57	8.02

[1] Included with "Undistributed."

Although coal costs at beehive plants rose to a new high, they are not generally so great as at oven-coke plants, as beehive ovens usually are located in the immediate vicinity of the mines. However, some beehive operators have been burdened with an additional cost in trucking part of their coal requirements. The average cost of coal charged into beehive ovens was 15 percent higher than in 1947, being lowest in Pennsylvania and highest in Kentucky and Utah.

TABLE 25.—Average cost per net ton of coal carbonized at oven-coke plants in the United States, 1937 and 1944–48, by States

State	1937	1944	1945	1946	1947	1948
Alabama	$2.33	$4.03	$4.47	$4.96	$5.57	$6.48
Illinois	4.62	6.04	6.16	6.70	8.00	9.38
Indiana	4.71	6.11	6.23	6.75	8.01	9.35
Michigan	4.16	5.39	5.55	5.97	6.79	8.26
Minnesota	5.24	6.35	6.52	6.86	8.33	9.90
New York	4.55	5.88	6.04	6.71	7.76	9.48
Ohio	3.76	5.03	5.27	5.72	6.76	8.11
Pennsylvania	2.98	4.28	4.40	4.79	5.87	7.22
West Virginia	2.54	3.32	3.56	3.84	4.72	6.14
Other States [1]	4.53	5.72	5.94	6.51	7.46	8.88
United States average	3.74	5.08	5.28	5.77	6.78	8.13
Cost of coal per ton of coke	5.27	7.16	7.45	8.17	9.60	11.58

[1] California, Colorado, Connecticut, Kentucky, Maryland, Massachusetts, Missouri, New Jersey, Rhode Island, Tennessee, Texas, Utah, and Wisconsin.

TABLE 26.—Cost of coal and value of products per net ton of coke produced in the United States, 1918, 1929, 1937, and 1944–48

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
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	8.03
1947	9.60	10.65	3.71	14.36	6.94	9.77
1948	11.58	12.43	4.42	16.85	8.02	12.10

[1] Includes value of breeze produced.

YIELD OF COKE PER TON OF COAL

TABLE 27.—Yield of coke from coal in the United States, 1937 and 1946–48, by States, in percent

State	1937		1946		1947		1948	
	Oven coke	Beehive coke	Oven coke	Beehive coke	Oven coke	Beehive coke	Oven coke	Beehive coke
Alabama	72.37	----------	71.45	----------	70.88	----------	71.52	----------
California	----------	----------	61.97	----------	61.90	----------	61.53	----------
Colorado	67.36	55.71	67.10	64.69	68.15	67.02	69.09	----------
Illinois	70.54	----------	70.86	----------	71.01	----------	70.39	----------
Indiana	72.04	----------	72.31	----------	73.62	----------	72.23	----------
Maryland	72.62	----------	72.36	----------	71.89	----------	71.45	----------
Massachusetts	69.99	----------	69.87	----------	72.45	----------	71.48	----------
Michigan	71.05	----------	72.00	----------	72.32	----------	71.24	----------
Minnesota	70.27	----------	72.17	----------	71.67	----------	71.82	----------
New Jersey	70.78	----------	72.39	----------	72.05	----------	72.13	----------
New York	71.75	----------	70.93	----------	70.27	----------	69.31	----------
Ohio	71.61	----------	70.87	----------	70.88	----------	70.60	----------
Pennsylvania	68.83	65.50	68.80	64.07	68.70	64.15	68.72	64.38
Tennessee	69.00	53.89	73.09	----------	74.23	----------	73.42	----------
Texas	----------	----------	----------	----------	70.64	----------	70.96	----------
Utah	56.67	54.25	60.32	45.30	60.48	53.11	60.78	52.83
Virginia	----------	58.33	----------	58.67	----------	57.73	----------	58.30
Washington	56.11	----------	----------	----------	----------	----------	----------	----------
West Virginia	70.67	61.74	70.38	62.23	69.95	64.74	69.61	64.08
United States average	70.73	64.23	70.63	63.74	70.58	63.84	70.22	63.73

PREPARATION AND SOURCE OF COAL

Washed and Unwashed Coal.—The quantity of coal mechanically cleaned for use in the manufacture of coke during 1948 increased 6 percent over 1947 and was the largest in the history of the industry. Mechanical mining of coal, although increasing productivity with a consequent reduction in mining costs, often results in an increase in the refuse content of the run-of-mine coal, so that mechanical cleaning is essential in some areas for the production of satisfactory coke. A number of large and efficient coal-cleaning plants are being erected to bring the coal up to the high standard required for the manufacture of metallurgical coke. One of the principal advantages of clean coal (especially for metallurgical coke) is its consistent quality, resulting in higher uniformity in the physical and chemical properties of the coke.

In 1948, more than 29 percent of the bituminous coal charged into slot-type ovens and 18 percent of the coal for beehive ovens was washed, compared with 26 and 14 percent, respectively, in 1940. Pneumatic cleaning and wet washing methods usually are employed in preparing coal for charging into the ovens, depending upon local conditions. All coal mined and used for the manufacture of coke in Colorado in 1948 was washed; most of Tennessee's and Alabama's and about one-third of Pennsylvania's were also washed before being carbonized. Data in table 28 include coal cleaned at the mines by coal producers, as well as that cleaned at coke plants by coke-plant operators. Bituminous coal cleaned at the mines was used by 41 oven-and 8 beehive-coke plants and comprised 73 percent of the washed coal carbonized; the remainder (8,204,596 tons) was washed at 7 plants having cleaning installations at the ovens.

TABLE 28.—Washed and unwashed coal used in manufacturing coke in the United States in 1948, by States in which used, in net tons

State	Coke ovens				Beehive ovens		
	Bituminous		Anthracite	Total	Bituminous		
	Washed	Unwashed			Washed	Unwashed	Total
Alabama	8, 137, 500	273, 368		8, 410, 868			
California	427, 424	54, 865		482, 289			
Colorado	1, 413, 355			1, 413, 355			
Illinois	1, 137, 391	4, 062, 257	21, 672	5, 221, 320			
Indiana	749, 135	11, 135, 794		11, 884, 929			
Maryland		3, 005, 794		3, 005, 794			
Massachusetts		1, 478, 402		1, 478, 402			
Michigan	202, 524	3, 688, 192	109, 455	4, 000, 171			
Minnesota		1, 178, 266		1, 178, 266			
New Jersey		1, 956, 052		1, 956, 052			
New York	1, 452, 990	6, 712, 070	39, 914	8, 204, 974			
Ohio	3, 930, 449	11, 023, 506	6, 935	14, 960, 890			
Pennsylvania	9, 055, 600	15, 132, 924	41, 381	24, 229, 905	1, 597, 151	7, 309, 043	8, 906, 194
Tennessee	224, 209	118, 257		342, 466			
Texas	420, 104	487, 726		907, 830			
Utah		1, 741, 411		1, 741, 411	299, 362	57, 620	356, 982
Virginia						344, 612	344, 612
West Virginia	1, 327, 541	3, 398, 605	12, 071	4, 738, 217		550, 047	550, 047
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	51, 070	3, 007, 362	24, 747	3, 083, 179		163, 733	163, 733
Total	28, 529, 292	68, 454, 851	256, 175	97, 240, 318	1, 896, 513	8, 425, 055	10, 321, 568
At merchant plants	1, 518, 277	17, 107, 052	47, 139	18, 672, 468			
At furnace plants	27, 011, 015	51, 347, 799	209, 036	78, 567, 850			

Sources.—The greatest concentration of coking coal in the United States is found in the Appalachian region, extending from Alabama to Pennsylvania. States in this region supplied 94 percent of all coal used in the manufacture of oven coke in 1948. West Virginia and Pennsylvania are by far the largest suppliers and in 1948 furnished 36 and 32 percent, respectively, of the total coal obtained for coke making by oven-coke-plant operators. Coking coal originating in Kentucky comprised 15 percent of the total, and Alabama contributed 9 percent. The combined tonnages of coking coal supplied by all other States in the Appalachian region (Virginia, Tennessee, Ohio, and Maryland) amounted to 3 percent of the total. The blending of midwestern coals with high-rank eastern coal (both high and low volatile) is receiving more attention, and 641,156 tons of Illinois coal and 154,519 tons of Indiana coal were purchased for this purpose by midwestern oven-coke-plant operators in 1948. States west of the Mississippi River supplied 1 percent of the total in 1937 but furnished 5 percent in 1948. This sharp increase was due to the large expansion in coal-carbonizing capacity in Texas, Colorado, Utah, and California.

Many of the coke-producing companies, especially those connected with the iron and steel industry, own or control "captive" mines that supply them with coking coal. In 1948 annual reports submitted by coke-plant operators showed that more than 56 percent of the total carbonized by oven-coke plants was received from such mines. Plants connected with the iron and steel industry—those classified by the Bureau as "furnace" plants—obtained 81,436,423 tons of coal in 1948, of which 63 percent came from captive mines. For the nonfurnace or merchant segment of the oven-coke industry, only 30 percent of the 18,936,304 tons of coal received was "captive." Tables 29 and 30 contain statistics on the origin of the coal used and on States of consumption in 1948.

Blending.—The practice of mixing or blending various types of coals before charging into the ovens is widely used in the oven-coke industry as an important part of coal preparation. Blending has several aims and considers many factors important to the oven-coke-plant operators. The primary objective is to produce, economically, a quality coke satisfactory for the use intended. It also permits the use of coals that have good coking properties but otherwise may be objectionable from the standpoint of excessive ash, sulfur, or phosphorus content and that could not be used alone as a 100-percent charge. Thus, in addition to providing a means of controlling the quality and strength of the coke and the yield of coproducts, blending permits flexible operations at oven-coke plants and use of a wider variety of coking coal.

Although virtually all oven-coke plants mix or blend coals before charging them into the ovens, the blending of coals of different volatile content was practiced at 77 oven-coke plants in 1948, of which 45 used high- and low-volatile coal; 26, high-, medium-, and low-; 2, high- and medium-; and 4, low- and medium-volatile. Of the plants that did not blend coals of different volatile content, 5 plants used straight high-volatile and 4 medium-volatile. The proportion of the different kinds of coals mixed before charging into ovens, where practiced, varies widely from plant to plant according to local conditions. Classification of all coal purchased for coking in slot-type ovens in 1948 showed, however, that 65 percent was high-volatile, 13 percent medium-volatile, and 22 percent low-volatile.

TABLE 29.—Coal received for manufacturing oven coke in the United States in 1948, by fields of origin

State and district where coal was produced	Quantity received (net tons)	States where coal was consumed, in order of importance
Alabama	8,822,325	Alabama and Texas.
Arkansas	389,994	Utah, Colorado, Texas, and California.
Colorado	942,286	Colorado.
Illinois	641,156	Indiana, Illinois, Missouri, and Minnesota.
Indiana	154,519	Illinois, Wisconsin, and Indiana.
Kentucky:		
Elkhorn	6,623,775	Indiana, Michigan, Ohio, New York, Illinois, New Jersey, Pennsylvania, Massachusetts, Minnesota, Wisconsin, Kentucky, Connecticut, and West Virginia.
Harlan	6,770,521	Indiana, Ohio, Illinois, Minnesota, Pennsylvania, New York, and Missouri.
Hazard	11,504	Pennsylvania, Ohio, and New York.
Kenova-Thacker	939,168	Ohio, Pennsylvania, New York, Indiana, and Illinois.
Southern Appalachian	203,639	Tennessee, Ohio, Pennsylvania, and Illinois.
Maryland	49,556	Pennsylvania.
New Mexico	564,537	Colorado and Texas.
Ohio	20,304	New York.
Oklahoma	836,585	Texas and Colorado.
Pennsylvania:		
Anthracite	264,136	Michigan, Pennsylvania, New York, Illinois, Missouri, West Virginia, Ohio, and Minnesota.
Bituminous:		
Central Pennsylvania:		
High-volatile	753,975	New York and Pennsylvania.
Medium-volatile	773,746	New York, Pennsylvania, Maryland, and Minnesota.
Low-volatile	2,655,225	Pennsylvania, New York, Ohio, and Minnesota.
Connellsville	14,998,880	Pennsylvania, Ohio, New York, Illinois, Minnesota, and Maryland.
Freeport	2,328,399	West Virginia, Ohio, Michigan, New York, Pennsylvania, and Minnesota.
Pittsburgh	9,688,486	Pennsylvania, New York, Ohio, West Virginia, and Michigan.
Somerset	543,571	Pennsylvania, West Virginia, and New York.
Westmoreland	271,782	New York, Pennsylvania, Ohio, Wisconsin, and Maryland.
Tennessee	250,946	Tennessee, Pennsylvania, New York, and Ohio.
Utah	2,022,689	Utah and California.
Virginia:		
Clinch Valley	1,019,960	Michigan, Ohio, Maryland, Indiana, Wisconsin, New York, Pennsylvania, and West Virginia.
Pocahontas	1,129,784	Indiana and New York.
Southwestern	357,864	New Jersey, New York, Missouri, West Virginia, Pennsylvania, Minnesota, Illinois, and Michigan.
West Virginia:		
Fairmont	6,762,395	Maryland, Pennsylvania, West Virginia, New York, Michigan, Massachusetts, and Ohio.
Kanawha	7,107,482	Ohio, Illinois, Pennsylvania, Kentucky, Massachusetts, West Virginia, Indiana, New Jersey, Connecticut, Michigan, Rhode Island, New York, Minnesota, Wisconsin, and Missouri.
Kenova-Thacker	122,147	Connecticut, Ohio, Wisconsin, Indiana, Illinois, and Massachusetts.
Logan	3,227,447	Indiana, Pennsylvania, New Jersey, Ohio, New York, Wisconsin, Illinois, Connecticut, Massachusetts, West Virginia, and Minnesota.
New River:		
High-volatile	857,850	New York, New Jersey, Rhode Island, and Michigan.
Medium-volatile	181,438	Ohio, Pennsylvania, and New York.
Low-volatile	581,796	Maryland, Pennsylvania, Michigan, and Ohio.
Pocahontas	13,603,817	Indiana, Ohio, Illinois, Michigan, New York, Pennsylvania, Maryland, Minnesota, Wisconsin, Kentucky, Alabama, Connecticut, West Virginia, Missouri, Tennessee, and Rhode Island.
Randolph-Barbour	625,198	Pennsylvania, Ohio, and Wisconsin.
Webster-Gauley	916,702	Pennsylvania, New York, New Jersey, Ohio, and Maryland.
Winding Gulf	2,357,143	Massachusetts, Ohio, New Jersey, West Virginia, New York, Michigan, Indiana, Rhode Island, Illinois, Pennsylvania, Kentucky, and Wisconsin.
Total	100,372,727	

TABLE 30.—Coal received for manufacturing oven coke in the United States in 1948, by States where produced and where consumed and by merchant and furnace plants, in net tons

State where coal was consumed	Coal produced in—															
	Alabama	Arkansas	Colorado	Illinois	Indiana	Kentucky	Maryland	New Mexico	Ohio	Oklahoma	Pennsylvania	Tennessee	Utah	Virginia	West Virginia	Total
Alabama:																
Merchant plants	1, 135, 794														155, 189	1, 290, 983
Furnace plants	7, 577, 156														8, 826	7, 585, 982
Total Alabama	8, 712, 950														164, 015	8, 876, 965
California:																
Furnace plant		57, 455											429, 039			486, 494
Colorado:																
Furnace plant		120, 706	942, 286					534, 301		61, 299						1, 658, 592
Illinois:																
Merchant plants						30, 413					25, 709				579, 411	635, 533
Furnace plants				261, 338	110, 701	1, 975, 738					149, 500			2, 919	2, 099, 997	4, 600, 193
Total Illinois				261, 338	110, 701	2, 006, 151					175, 209			2, 919	2, 679, 408	5, 235, 726
Indiana:																
Merchant plants					13, 857									90, 251	1, 012, 238	1, 116, 346
Furnace plants				344, 153		4, 837, 935								1, 098, 492	4, 619, 450	10, 900, 030
Total Indiana				344, 153	13, 857	4, 837, 935								1, 188, 743	5, 631, 688	12, 016, 376
Maryland:																
Furnace plant											91, 026			91, 104	3, 142, 388	3, 324, 518
Massachusetts:																
Merchant plants						91, 076									1, 381, 139	1, 472, 215
Michigan:																
Merchant plants						63					210, 929			168, 972	625, 867	1, 005, 831
Furnace plants						1, 363, 505					321, 023			260, 487	1, 003, 471	2, 948, 486
Total Michigan						1, 363, 568					531, 952			429, 459	1, 629, 338	3, 954, 317
Minnesota:																
Merchant plant				5, 245		38, 836					23, 262			3, 012	253, 707	324, 062
Furnace plants						558, 264					13, 083				333, 579	904, 926
Total Minnesota				5, 245		597, 100					36, 345			3, 012	587, 286	1, 228, 988
New Jersey:																
Merchant plants						281, 461								158, 103	1, 583, 350	2, 022, 914

TABLE 30.—Coal received for manufacturing oven coke in the United States in 1948, by States where produced and where consumed and by merchant and furnace plants, in net tons—Continued

State where coal was consumed	Coal produced in—															
	Alabama	Arkansas	Colorado	Illinois	Indiana	Kentucky	Maryland	New Mexico	Ohio	Oklahoma	Pennsylvania	Tennessee	Utah	Virginia	West Virginia	Total
New York:																
Merchant plants						513, 260					1, 681, 845			120, 479	1, 766, 120	4, 081, 704
Furnace plants						426, 416			20, 304		2, 852, 673	12, 951		47, 345	1, 165, 322	4, 525, 011
Total New York						939, 676			20, 304		4, 534, 518	12, 951		167, 824	2, 931, 442	8, 606, 715
Ohio:																
Merchant plants						167, 725								178, 724	1, 388, 251	1, 734, 700
Furnace plants						3, 303, 902					4, 937, 261	366		197, 210	4, 886, 383	13, 325, 122
Total Ohio						3, 471, 627					4, 937, 261	366		375, 934	6, 274, 634	15, 059, 822
Pennsylvania:																
Merchant plants											16, 750				879, 888	896, 638
Furnace plants						785, 834	49, 556				19, 409, 095	13, 420		12, 325	4, 353, 083	24, 623, 313
Total Pennsylvania						785, 834	49, 556				19, 425, 845	13, 420		12, 325	5, 232, 971	25, 519, 951
Tennessee:																
Furnace plant						108, 658						224, 209			30, 714	363, 581
Texas:																
Furnace plants	109, 375	64, 072						30, 236		775, 286						978, 969
Utah:																
Furnace plants		147, 761											1, 593, 650			1, 741, 411
West Virginia:																
Merchant plants											720				1, 248, 717	1, 249, 437
Furnace plants						3, 095					2, 501, 447			11, 312	953, 941	3, 469, 795
Total West Virginia						3, 095					2, 502, 167			11, 312	2, 202, 658	4, 719, 232
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin:																
Merchant plants				30, 420	29, 961	87, 591					43, 877			66, 873	2, 847, 219	3, 105, 941
Grand total	8, 822, 325	389, 994	942, 286	641, 156	154, 519	14, 573, 772	49, 556	564, 537	20, 304	836, 585	32, 278, 200	250, 946	2, 022, 689	2, 507, 608	36, 318, 250	100, 372, 727
At merchant plants	1, 135, 794			35, 665	43, 818	1, 210, 425					2, 003, 092			786, 414	13, 721, 096	18, 936, 304
At furnace plants	7, 686, 531	389, 994	942, 286	605, 491	110, 701	13, 363, 347	49, 556	564, 537	20, 304	836, 585	30, 275, 108	250, 946	2, 022, 689	1, 721, 194	22, 597, 154	81, 436, 423

TABLE 31.—Coal received for manufacturing oven coke in the United States in 1948, by States where consumed and by volatile content [1]

State where coal was consumed	High-volatile		Medium-volatile		Low-volatile		Total coal received (net tons)
	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total	
Alabama:							
Merchant plants	107, 527	8. 3	1, 028, 267	79. 6	155, 189	12. 1	1, 290, 983
Furnace plants	341, 796	4. 5	7, 235, 360	95. 4	8, 826	. 1	7, 585, 982
Total Alabama	449, 323	5. 1	8, 263, 627	93. 1	164, 015	1. 8	8, 876, 965
California: Furnace plant	429, 039	88. 2			57, 455	11. 8	486, 494
Colorado: Furnace plant	1, 476, 587	89. 0			182, 005	11. 0	1, 658, 592
Illinois:							
Merchant plants	30, 413	4. 8	367, 949	57. 9	237, 171	37. 3	635, 533
Furnace plants	3, 189, 338	69. 3			1, 410, 855	30. 7	4, 600, 193
Total Illinois	3, 219, 751	61. 5	367, 949	7. 0	1, 648, 026	31. 5	5, 235, 726
Indiana:							
Merchant plants	503, 950	45. 1	134, 703	12. 1	477, 693	42. 8	1, 116, 346
Furnace plants	5, 794, 812	53. 2			5, 105, 218	46. 8	10, 900, 030
Total Indiana	6, 298, 762	52. 4	134, 703	1. 1	5, 582, 911	46. 5	12, 016, 376
Maryland: Furnace plant	2, 118, 700	63. 7	295, 927	8. 9	909, 891	27. 4	3, 324, 518
Massachusetts: Merchant plants	896, 511	60. 9	287, 809	19. 5	287, 895	19. 6	1, 472, 215
Michigan:							
Merchant plants	404, 195	40. 2	168, 981	16. 8	432, 655	43. 0	1, 005, 831
Furnace plants	2, 299, 112	78. 0			649, 374	22. 0	2, 948, 486
Total Michigan	2, 703, 307	68. 4	168, 981	4. 3	1, 082, 029	27. 3	3, 954, 317
Minnesota:							
Merchant plant	188, 500	58. 2	33, 680	10. 4	101, 882	31. 4	324, 062
Furnace plants	571, 347	63. 1			333, 579	36. 9	904, 926
Total Minnesota	759, 847	61. 8	33, 680	2. 8	435, 461	35. 4	1, 228, 988
New Jersey: Merchant plants	1, 105, 267	54. 6	524, 634	25. 9	393, 013	19. 5	2, 022, 914
New York:							
Merchant plants	3, 027, 144	74. 2	635, 941	15. 6	418, 619	10. 2	4, 081, 704
Furnace plants	2, 714, 692	60. 0	384, 090	8. 5	1, 426, 229	31. 5	4, 525, 011
Total New York	5, 741, 836	66. 7	1, 020, 031	11. 9	1, 844, 848	21. 4	8, 606, 715
Ohio:							
Merchant plants	1, 059, 277	61. 1	158, 800	9. 2	516, 623	29. 7	1, 734, 700
Furnace plants	9, 066, 153	68. 0	460, 303	3. 5	3, 798, 666	28. 5	13, 325, 122
Total Ohio	10, 125, 430	67. 2	619, 103	4. 1	4, 315, 289	28. 7	15, 059, 822
Pennsylvania:							
Merchant plants	461, 371	51. 4	311, 587	34. 8	123, 680	13. 8	896, 638
Furnace plants	20, 403, 673	82. 9	961, 676	3. 9	3, 257, 964	13. 2	24, 623, 313
Total Pennsylvania	20, 865, 044	81. 8	1, 273, 263	5. 0	3, 381, 644	13. 2	25, 519, 951
Tennessee: Furnace plant	108, 658	29. 9	224, 209	61. 7	30, 714	8. 4	363, 581
Texas: Furnace plants	621, 503	63. 5	54, 552	5. 6	302, 914	30. 9	978, 969
Utah: Furnace plants	1, 593, 650	91. 5			147, 761	8. 5	1, 741, 411
West Virginia:							
Merchant plants	1, 241, 847	99. 4			7, 590	. 6	1, 249, 437
Furnace plants	2, 968, 496	85. 6			501, 299	14. 4	3, 469, 795
Total West Virginia	4, 210, 343	89. 2			508, 889	10. 8	4, 719, 232
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin: merchant plants	2, 089, 121	67. 2	157, 191	5. 1	859, 629	27. 7	3, 105, 941
Grand total	64, 812, 679	64. 6	13, 425, 659	13. 4	22, 134, 389	22. 0	100, 372, 727
At merchant plants	11, 115, 123	58. 7	3, 809, 542	20. 1	4, 011, 639	21. 2	18, 936, 304
At furnace plants	53, 697, 556	65. 9	9, 616, 117	11. 8	18, 122, 750	22. 3	81, 436, 423

[1] Low-volatile—dry volatile matter 22 percent or less and more than 14 percent; medium-volatile—dry volatile matter 31 percent or less and more than 22 percent; high-volatile—dry volatile matter more than 31 percent.

COKE BREEZE

TABLE 32.—Coke breeze recovered at coke plants in the United States in 1948, by States

State	Yield per ton of coal [1] (percent)	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	3.86	324,776	$1,761,527	150,852	$543,734	50,949	$273,726	139,568	$1,029,160		31,497
California	6.33	30,535	(2)			22,277	(2)	7,787	(2)	471	33,310
Colorado	6.77	95,632	(2)	30,790	(2)	42,770	(2)	27,036	(2)		564
Illinois	6.70	349,990	1,087,604	163,303	433,992	25,771	111,885	136,143	467,268	15,832	99,531
Indiana	5.92	703,170	2,157,943	387,212	1,272,691	157,262	397,254	153,684	462,018	691	92,876
Maryland	7.73	232,362	(2)	74,696	(2)	27,462	(2)	55,247	(2)		293,213
Massachusetts	8.67	128,244	(2)	99,538	(2)	5,598	(2)	19,812	(2)		8,618
Michigan	6.06	242,359	921,248	153,050	580,320	28,089	98,029	61,819	241,536		51,216
Minnesota	8.61	101,395	385,353	57,030	196,210	7,174	(2)	34,505	148,687		45,348
New Jersey	5.74	112,330	(2)	114,160	(2)			140	(2)		1,315
New York	6.37	522,570	2,456,097	310,389	1,436,351	169,120	821,448	47,195	214,020		66,074
Ohio	6.10	912,099	3,130,871	550,062	1,813,632	217,640	644,522	171,425	764,982	3,438	184,847
Pennsylvania	5.82	1,410,626	4,002,017	1,167,046	3,284,168	63,997	204,462	119,286	341,362		484,012
Tennessee	2.64	9,052	(2)	8,027	(2)			1,499	(2)		1,244
Texas	3.82	34,704	(2)			14,876	(2)	5,065	(2)		24,840
Utah	9.82	170,989	(2)	73,862	(2)	41,475	(2)	69,465	(2)		22,588
West Virginia	4.35	206,132	495,540	130,406	319,564	46,307	(2)	53,003	112,841		31,254
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	5.79	178,611	654,515	154,686	535,190			18,932	96,032		13,363
Undistributed			2,965,146		1,414,057		652,323		734,152		
Total 1948	5.93	5,765,576	20,017,861	3,625,109	11,829,909	920,767	3,203,649	1,121,611	4,612,058	20,432	1,485,710
At merchant plants	5.97	1,115,179	4,832,113	796,224	3,111,914	142,169	718,236	190,729	1,040,413	1,992	120,383
At furnace plants	5.92	4,650,397	15,185,748	2,828,885	8,717,995	778,598	2,485,413	930,882	3,571,645	18,440	1,365,327
Total 1947	5.79	5,474,113	16,165,758	3,482,874	9,662,237	681,691	1,988,342	1,106,720	3,950,108	5,114	1,204,140
Beehive coke:											
Pennsylvania	2.73	87,107	178,021	14,675	(2)			39,950	90,876	30,883	2,094
Utah	3.96	14,152	(2)	948	(2)			2,779	(2)	6,308	4,117
Virginia	1.12	1,881	(2)			6	103			1,855	20
West Virginia	1.94	5,127	12,920					655	(2)	4,472	
Undistributed			50,349		38,291				9,668		
Total 1948	2.72	108,267	241,290	15,623	38,291	6	103	43,384	100,544	[3] 43,518	6,231

[1] Computed by dividing production of breeze by coal charged at plants actually recovering.
[2] Included with "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

The bulk of the oven coke produced in the United States was consumed in integrated metallurgical operations in 1948, and only about 38 percent of the total output was loaded for shipment outside the producing plant. The principal method of movement is by rail, which accounted for 88 percent of the total shipments in 1948, the same as in 1947. Truck shipments declined slightly from 1947 and represented 8 percent of the total. Shipments by boat are relatively small and were equivalent to only 4 percent of the total.

Unlike oven coke, which is mostly consumed at the points of production, beehive coke is made in the vicinity of the mines, and nearly all is loaded for shipment to centers of consumption. Railroads transport virtually all of the beehive coke shipped and handled 99 percent of all shipments in 1948. The remainder moved either by truck or barge.

TABLE 33.—Coke and breeze sold and loaded at plants in the United States for shipment in 1948, 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	1,241,980	--------	9,495	1,251,475	139,568	--------	--------	139,568
California	23,868	--------	--------	23,868	7,238	--------	549	7,787
Colorado	68,420	--------	1,429	69,849	26,989	--------	47	27,036
Illinois	1,856,459	--------	20,063	1,876,522	134,079	--------	2,064	136,143
Indiana	2,452,127	--------	65,183	2,517,310	153,635	--------	49	153,684
Maryland	--------	--------	--------	--------	31,842	23,405	--------	55,247
Massachusetts	419,614	59,826	408,705	888,145	3,569	--------	16,243	19,812
Michigan	1,176,338	43,619	124,380	1,344,337	59,854	1,854	111	61,819
Minnesota	290,147	--------	18,879	309,026	34,505	--------	--------	34,505
New Jersey	569,757	310,282	270,694	1,150,733	--------	--------	140	140
New York	2,284,273	57,841	438,293	2,780,407	45,913	1,071	211	47,195
Ohio	2,234,371	199,437	95,778	2,529,586	162,053	6,116	3,256	171,425
Pennsylvania	7,017,481	307,916	151,843	7,477,240	109,419	7,678	2,189	119,286
Tennessee	154,846	--------	--------	154,846	1,499	--------	--------	1,499
Texas	130,607	--------	--------	130,607	5,065	--------	--------	5,065
Utah	110,326	--------	6,997	117,323	69,465	--------	--------	69,465
West Virginia	1,109,793	--------	1,215	1,111,008	52,926	--------	77	53,003
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	1,698,546	67,117	347,372	2,113,035	13,970	--------	4,962	18,932
Total	22,838,953	1,046,038	1,960,326	25,845,317	1,051,589	40,124	29,898	1,121,611
At merchant plants	8,670,007	529,520	1,719,153	10,918,680	152,794	12,787	25,148	190,729
At furnace plants	14,168,946	516,518	241,173	14,926,637	898,795	27,337	4,750	930,882
Beehive coke:								
Kentucky	101,745	--------	--------	101,745	--------	--------	--------	--------
Pennsylvania	5,530,750	12,178	16,639	5,559,567	38,486	1,464	--------	39,950
Utah	75,230	--------	1,462	76,692	2,042	--------	737	2,779
Virginia	202,763	--------	229	202,992	--------	--------	--------	--------
West Virginia	351,168	--------	96	351,264	655	--------	--------	655
Total	6,261,656	12,178	18,426	6,292,260	41,183	1,464	737	43,384

TABLE 34.—Beehive coke loaded for shipment on originating railroads, waterways, and trucks in the United States in 1948, by routes, as reported by producers

Route	Producing State	Net tons		Percent of total
		By States	Total	
Railroads:				
Baltimore & Ohio	Pennsylvania	1, 206, 334	1, 426, 376	22. 7
	West Virginia	220, 042		
Chesapeake & Ohio	Kentucky	101, 745	145, 096	2. 3
	West Virginia	43, 351		
Denver & Rio Grande Western	Utah	75, 230	75, 230	1. 2
Interstate	Virginia	172, 235	172, 235	2. 7
Louisville & Nashville	do	1, 448	1, 448	(1)
Monongahela	Pennsylvania	1, 508, 122	1, 508, 122	24. 0
New York Central	West Virginia	75, 466	75, 466	1. 2
Norfolk & Western	Virginia	29, 080	29, 080	. 5
Pennsylvania	Pennsylvania	2, 687, 485	2, 687, 485	42. 7
Pittsburgh & Lake Erie	do	128, 809	128, 809	2. 0
Western Maryland	West Virginia	12, 309	12, 309	. 2
Total railroad shipments		6, 261, 656	6, 261, 656	99. 5
Waterways: Monongahela & Ohio Rivers	Pennsylvania	12, 178	12, 178	. 2
Trucks	(2)	18, 426	18, 426	. 3
Grand total		6, 292, 260	6, 292, 260	100. 0

[1] Less than 0.05 percent.
[2] Pennsylvania, Utah, Virginia, and West Virginia.

DISTRIBUTION OF OVEN AND BEEHIVE COKE

The largest tonnage of coke on record was distributed by coke-plant operators in 1948. Total shipments exceeded the 1947 figure by 922,231 tons and were 526,044 tons higher than the previous peak in 1944. There were no significant changes in the use pattern of coke or in the States of destination when compared with 1947. Pennsylvania, as usual, was the ranking coke-consuming State, accounting for 27 percent of all coke distributed. Ohio maintained its position as second-largest consumer, with 17 percent of the total. Indiana, New York, Illinois, and Alabama followed in that order and combined, took 32 percent of the total. The large tonnage of coke consumed in the six States mentioned is attributable to the centralization of heavy industries in those States.

Coke was used as blast-furnace fuel in 18 States in 1948, and the quantity utilized for that purpose (excluding exports) was equivalent to 80 percent of the total shipments. Iron foundries are located in all of the States but one, hence the movement of foundry coke is widespread. A large demand for castings existed in 1948; and the quantity of coke shipped to foundrymen was the highest on record, amounting to 5 percent of total shipments. Although consumption of coke for use in the manufacture of producer gas dropped below the 1947 figure, the increase in shipments for water-gas production offset this decline to the extent that total shipments for all gas making increased only 121 tons and constituted 6 percent of the total. The distribution of coke for other industrial purposes in 1948 declined 11 percent from 1947 while shipments for domestic or household heating were the lowest in 24 years. These two consumer classes used 4 and 5 percent, respectively, of the 1948 shipments as compared with 3 and 14 percent in 1940.

Table 36 shows the comparative consumption of coke by geographic regions, for 1940 and 1948. The Southwest, Mountain, and Pacific region shows the largest percentage increase in consumption, with a gain of 244 percent during this period because of the new coking facilities in Texas, Colorado, Utah, and California, which were built to supply metallurgical coke to integrated blast furnaces in those States. This region reported less than 2 percent of the national coke consumption in 1940 but utilized almost 5 percent in 1948. The Southeast region showed the second-largest relative gain in consumption, with an increase of 44 percent over 1940. This marked rise in consumption was due to the substantial increase in the use of blast-furnace and "other industrial" coke in West Virginia, Alabama, Kentucky, and Tennessee. The Middle Atlantic region surpassed all others in consumption, with 40 percent of the national total in 1948. This region showed the largest quantitative increase over 1940, with a gain of 5,567,103 tons, most of which was used in blast furnaces. The marked reduction in the use of coke for domestic heating in the New England, Michigan, Missouri Valley, and Lake Dock regions was the principal reason for the decreased consumption in those regions since 1940.

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TABLE 35.—Oven and beehive coke and breeze distributed to each State in 1948, in net tons

[Based upon reports from all United States producers showing destination of coke used by producer or sold in 1948. Does not include imported coke which totaled 161,400 tons in 1948]

Consuming State	Coke							Coke breeze
	Furnace use	Foundry use	Making producer gas	Making water gas	Other industrial use	Domestic use	Total	
Alabama	4,860,183	232,666		4,018	157,326	64,684	5,318,877	247,610
Arizona		5,344			131		5,475	
Arkansas		1,067			181		1,248	
California	281,084	77,913			67,561		426,558	30,585
Colorado	917,194	15,256			23,260	385	956,095	100,596
Connecticut		57,559	59,091	143,060	14,119	127,785	401,614	40,467
Delaware		4,814		626	4,956	1,059	11,455	1,379
District of Columbia		130					130	
Florida		1,424		41,993	2,419	1,750	47,586	5,305
Georgia		20,081		12,734	14,899	8,882	56,596	36
Idaho		301			1,749	136	2,186	372
Illinois	4,986,196	335,358		15,054	157,728	150,287	5,644,623	319,043
Indiana	6,099,774	197,902	16,931	48,136	154,348	158,411	6,675,502	588,660
Iowa		86,952			26,566	5,904	119,422	14,693
Kansas		15,917			2,235		18,152	825
Kentucky	637,170	26,902		29,825	106,823	32,033	832,753	85,953
Louisiana		9,259			67,597	1,350	78,206	42
Maine		10,070		14,274		26,220	50,564	
Maryland	2,516,603	50,275		11,083	55,704	251	2,633,916	141,175
Massachusetts	127,571	81,158	146,216	182,999	23,168	494,626	1,055,738	125,321
Michigan	1,459,683	601,281			238,311	307,108	2,606,383	231,497
Minnesota	545,881	48,388	1,190	6,376	36,253	93,354	731,442	100,569
Mississippi		1,699			296	559	2,554	
Missouri		88,683		8,989	39,212	6,403	143,287	6,482
Montana		1,723			11,544		13,267	39,125
Nebraska		4,347		38	1,773	408	6,566	118
Nevada		36			5,834		5,870	
New Hampshire		6,646		594	272	28,739	36,251	
New Jersey		115,866	109,292	377,206	131,196	385,730	1,119,290	132,671
New Mexico		992			1,392		2,384	
New York	3,530,986	181,412	288,064	1,025,342	426,278	688,587	6,140,669	530,622
North Carolina		20,062		1,929	2,096	3,888	27,975	155
North Dakota		286			236	665	1,187	
Ohio	11,738,066	390,760		248,794	223,064	193,329	12,794,013	855,367
Oklahoma		6,275			205		6,480	34,630
Oregon		6,633			15,060		21,693	958
Pennsylvania	18,393,283	412,290	76,198	320,571	353,483	241,768	19,797,593	1,450,863
Rhode Island		19,541	37,562	19,584	1,123	88,685	166,495	23,510
South Carolina		10,360		1,618	4,328	5,519	21,825	3,691
South Dakota		479			347	858	1,684	
Tennessee	102,435	87,589		61,807	70,722	5,736	328,289	138,033
Texas	553,309	47,993		737	50,824		652,863	20,076
Utah	1,079,243	12,613			69,534	5,666	1,167,056	143,283
Vermont		6,372		2,790	1,669	12,244	23,075	
Virginia	78,285	51,465		345,898	87,829	1,998	565,475	48
Washington		7,653			9,335		16,988	4,447
West Virginia	1,339,124	39,739		965,652	93,683	811	2,439,009	192,468
Wisconsin		193,206	65,512	55,020	21,044	176,416	511,198	89,093
Wyoming					1,688		1,688	
Total	59,246,070	3,594,737	800,056	3,946,747	2,779.401	3,322,234	73,689,245	5,699,768
Exported	39,436	155,922		606	206,572	123,075	525,611	26,732
Grand total	59,285,506	3,750,659	800,056	3,947,353	2,985,973	3,445,309	74,214,856	5,726,500

TABLE 36.—Comparative tonnage of oven and beehive coke consumed in each State, by regions, 1940 and 1948, in net tons

[Exclusive of imported coke and of screenings or breeze]

Consuming region and State	Furnace use		Foundry use		Other industrial use		Domestic use		Total		
	1940	1948	1940	1948	1940	1948	1940	1948	1940	1948	Increase or decrease
New England:											
Maine			2,956	10,070	2,181	14,274	49,473	26,220	54,610	50,564	−4,046
New Hampshire			1,443	6,646	1,616	866	55,709	28,739	58,768	36,251	−22,517
Vermont			5,433	6,372	3,291	4,459	32,587	12,244	41,311	23,075	−18,236
Massachusetts	88,830	127,571	48,872	81,158	162,598	352,383	933,356	494,626	1,233,656	1,055,738	−177,918
Connecticut			34,847	57,559	128,140	216,270	203,534	127,785	366,521	401,614	+35,093
Rhode Island			10,199	19,541	24,424	58,269	154,770	88,685	189,393	166,495	−22,898
Total	88,830	127,571	103,750	181,346	322,250	646,521	1,429,429	778,299	1,944,259	1,733,737	−210,522
Middle Atlantic:											
New York	2,615,108	3,530,986	141,372	181,412	1,383,937	1,739,684	1,563,584	688,587	5,704,001	6,140,669	+436,668
New Jersey			86,161	115,866	433,524	617,694	488,890	385,730	1,008,575	1,119,290	+110,715
Pennsylvania	14,319,836	18,393,283	219,232	412,290	313,431	750,252	537,204	241,768	15,389,703	19,797,593	+4,407,890
Delaware			2,758	4,814	1,962	5,582	2,326	1,059	7,046	11,455	+4,409
Maryland	1,849,917	2,516,603	23,891	50,275	57,437	66,787	28,050	251	1,959,295	2,633,916	+674,621
District of Columbia			395	130	64,505		2,430		67,330	130	−67,200
Total	18,784,861	24,440,872	473,809	764,787	2,254,796	3,179,999	2,622,484	1,317,395	24,135,950	29,703,053	+5,567,103
Ohio	8,619,762	11,738,066	304,373	390,760	192,476	471,858	460,339	193,329	9,576,950	12,794,013	+3,217,063
Michigan	1,076,370	1,459,683	333,791	601,281	253,488	238,311	1,135,694	307,108	2,799,343	2,606,383	−192,960
Illinois-Indiana:											
Illinois	3,332,028	4,986,196	172,455	335,358	174,023	172,782	683,630	150,287	4,362,136	5,644,623	+1,282,487
Indiana	4,305,518	6,099,774	106,063	197,902	137,587	219,415	380,826	158,411	4,929,994	6,675,502	+1,745,508
Total	7,637,546	11,085,970	278,518	533,260	311,610	392,197	1,064,456	308,698	9,292,130	12,320,125	+3,027,995
Missouri Valley:											
Missouri			34,426	88,683	63,769	48,201	269,036	6,403	367,231	143,287	−223,944
Iowa			33,721	86,952	31,186	26,566	10,915	5,904	75,822	119,422	+43,600
Nebraska			2,320	4,347	20,177	1,811	819	408	23,316	6,566	−16,750
Kansas			7,510	15,917	2,787	2,235	50		10,347	18,152	+7,805
Total			77,977	195,899	117,919	78,813	280,820	12,715	476,716	287,427	−189,289

TABLE 36.—Comparative tonnage of oven and beehive coke consumed in each State, by regions, 1940 and 1948, in net tons—Continued

[Exclusive of imported coke and of screenings or breeze]

Consuming region and State	Furnace use		Foundry use		Other industrial use		Domestic use		Total		
	1940	1948	1940	1948	1940	1948	1940	1948	1940	1948	Increase or decrease
Lake Dock:											
Wisconsin			99,327	193,206	120,925	141,576	432,778	176,416	653,030	511,198	−141,832
Minnesota	225,569	545,881	15,684	48,388	42,003	43,819	331,682	93,354	614,938	731,442	+116,504
North Dakota				286	267	236	1,491	665	1,758	1,187	−571
South Dakota			181	479	501	347	1,767	858	2,449	1,684	−765
Total	225,569	545,881	115,192	242,359	163,696	185,978	767,718	271,293	1,272,175	1,245,511	−26,664
Southeast:											
Virginia	52,715	78,285	31,258	51,465	374,841	433,727	8,957	1,998	467,771	565,475	+97,704
West Virginia	787,694	1,339,124	12,657	39,739	474,713	1,059,335	4,369	811	1,279,433	2,439,009	+1,159,576
North Carolina			13,410	20,062	6,353	4,025	4,169	3,888	23,932	27,975	+4,043
South Carolina			3,613	10,360	2,736	5,946	3,160	5,519	9,509	21,825	+12,316
Georgia			13,765	20,081	10,957	27,633	15,478	8,882	40,200	56,596	+16,396
Florida			1,017	1,424	30,290	44,412	4,961	1,750	36,268	47,586	+11,318
Kentucky	221,698	637,170	20,341	26,902	12,532	136,648	41,993	32,033	296,564	832,753	+536,189
Tennessee	54,312	102,435	59,724	87,589	44,455	132,529	18,658	5,736	177,149	328,289	+151,140
Alabama	4,099,434	4,860,183	123,394	232,666	42,982	161,344	99,102	64,684	4,364,912	5,318,877	+953,965
Mississippi			821	1,699		296	1,385	559	2,206	2,554	+348
Total	5,215,853	7,017,197	280,000	491,987	999,859	2,005,895	202,232	125,860	6,697,944	9,640,939	+2,942,995
Southwest, Mountain, and Pacific:											
Louisiana			2,883	9,259	21,656	67,597	7,374	1,350	31,913	78,206	+46,293
Arkansas			1,444	1,067	567	181	38		2,049	1,248	−801
Oklahoma			2,205	6,275	172	205	19		2,396	6,480	+4,084
Texas		553,309	15,991	47,993	31,409	51,561	225		47,625	652,863	+605,238
New Mexico			1,018	992	219	1,392			1,237	2,384	+1,147
Arizona			4,053	5,344	140	131	155		4,348	5,475	+1,127
Colorado	521,698	917,194	11,604	15,256	12,391	23,260	201	385	545,894	956,095	+410,201
Utah	163,790	1,079,243	10,337	12,613	55,234	69,534	2,113	5,666	231,474	1,167,056	+935,582
Nevada			28	36	29	5,834			57	5,870	+5,813
Wyoming					2,470	1,688	2		2,472	1,688	−784
Montana			2,060	1,723	22,733	11,544			24,793	13,267	−11,526
Idaho			69	301	3,831	1,749		136	3,900	2,186	−1,714
Washington			3,089	7,653	1,609	9,335	21		4,719	16,988	+12,269
Oregon			2,821	6,633	1,788	15,060			4,609	21,693	+17,084
California		281,084	36,426	77,913	30,266	67,561	988		67,680	426,558	+358,878
Total	685,488	2,830,830	94,028	193,058	184,514	326,632	11,136	7,537	975,166	3,358,057	+2,382,891
Grand total	[1] 42,334,279	59,246,070	2,061,438	3,594,737	[1] 4,800,608	7,526,204	7,974,308	3,322,234	57,170,633	73,689,245	+16,518,612

[1] Revised figure. Difference of 67,718 tons reported for furnace use in 1940 transferred to other industrial use.

CONSUMPTION OF COKE

The indicated consumption of coke in the United States in 1948—allowing for imports, exports, and changes in producers' stocks—was the greatest on record, surpassing the mark established in 1944 by 784,533 tons. Although stocks increased 561,204 tons during 1948, the rise in consumption was made possible by the gain in production. Blast furnaces, as might be expected, were the largest consumers of coke, accounting for 80 percent of the indicated consumption. The ratio of net tons of coke used to each net ton of pig iron and ferro-alloys produced increased for the fourth straight year. This decline in fuel efficiency has been attributed largely to deterioration in the quality of coal used in manufacturing blast-furnace coke. Fuel efficiency should improve in the future, because coke-plant operators undoubtedly will have a better selection of coking coals as demand slackens in this country and abroad and because more preparation plants are scheduled to be placed in operation. The quantity of coke consumed for other purposes (in foundries and for gas making, chemical processes, nonferrous smelting, and household heating) dropped slightly from 1947. The decline was due chiefly to a further curtailment in domestic coke sales because of diversion to iron blast furnaces.

TABLE 37.—Coke consumed in manufacture of pig iron and for other purposes in the United States, 1913, 1918, 1937, and 1946–48, 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	37, 599, 911	73. 3	13, 672, 018	26. 7
1946	58, 497, 848	52, 188	1, 231, 327	−3, 047	57, 321, 756	43, 178, 789	75. 3	14, 142, 967	24. 7
1947	73, 445, 850	104, 093	835, 059	+103, 471	72, 611, 413	57, 147, 644	78. 7	15, 463, 769	21. 3
1948	74, 861, 928	161, 400	706, 190	+561, 204	73, 755, 934	59, 128, 129	80. 2	14, 627, 805	19. 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.

TABLE 38.—Coke and coking coal consumed per net ton of pig iron made in the United States, 1913, 1918, 1937, and 1946–48

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	1946	1, 894. 0	70. 0	2, 705. 7
1918	2, 120. 7	66. 4	3, 193. 8	1947	1, 926. 0	69. 9	2, 755. 4
1937	1, 830. 6	70. 3	2, 604. 0	1948	1, 937. 2	69. 6	2, 783. 3

[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, 1,868.0 in 1946, 1,900.0 in 1947, and 1,908.0 in 1948.

The accompanying tables summarize the disposal of coke by principal end uses during 1948. A large proportion of the oven-coke output is used by the producers at the point of production, whereas nearly all beehive coke is shipped to points of consumption. Iron blast furnaces are the largest users of coke in the United States and are supplied mainly by "furnace" and beehive plants. The proportion of blast-furnace requirements supplied by "furnace" plants has been increasing in recent years because of the substantial expansion of coke-making facilities at those plants. For example, "furnace" plants supplied 96 percent of all oven coke distributed to blast furnaces in 1948, compared with 91 percent in 1940. "Merchant" plants supply the bulk of the coke used for all other industrial purposes and domestic heating. In 1948, this type of plant furnished 82 percent of the total sold for foundry use, 81 percent for other industrial (including gas making), and 79 percent of the domestic coke.

Normally, beehive ovens supply a greater proportion of their production to blast furnaces than slot-type ovens. In 1948, 81 percent of all beehive coke produced was shipped to blast furnaces. Sales of beehive coke in 1948 for foundry use, other industrial, and domestic heating varied only slightly from 1947.

TABLE 39.—Oven coke produced and sold or used by producer in the United States in 1948, 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	6, 015, 460	$57, 611, 881	4, 728, 190	$39, 842, 705	18, 124	$152, 406	270, 105	$2, 765, 988
California	296, 749	(3)	259, 807	(3)	385	(3)	20, 658	(3)
Colorado	976, 504	(3)	902, 629	(3)	4, 649	(3)	----------	----------
Illinois	3, 675, 284	54, 396, 850	1, 732, 778	23, 923, 347	16, 592	219, 891	1, 303, 637	19, 610, 626
Indiana	8, 584, 225	125, 355, 310	5, 876, 400	83, 330, 788	112, 058	1, 467, 179	1, 783, 272	26, 808, 536
Maryland	2, 147, 787	(3)	2, 094, 791	(3)	9, 327	(3)	----------	----------
Massachusetts	1, 056, 701	(3)	----------	----------	162, 691	(3)	127, 571	(3)
Michigan	2, 849, 601	39, 637, 987	1, 314, 521	(3)	177, 061	2, 104, 652	298, 431	3, 680, 554
Minnesota	846, 246	12, 425, 815	531, 906	(3)	9, 031	80, 471	52, 989	(3)
New Jersey	1, 410, 941	(3)	----------	----------	245, 946	(3)	85, 126	(3)
New York	5, 687, 225	72, 756, 957	1, 677, 277	(3)	1, 163, 495	13, 313, 322	1, 668, 055	18, 831, 971
Ohio	10, 562, 486	128, 843, 686	7, 706, 185	91, 155, 556	90, 972	1, 195, 181	1, 305, 546	16, 579, 718
Pennsylvania	16, 649, 689	189, 729, 879	8, 850, 817	100, 480, 232	174, 552	1, 917, 643	6, 605, 463	73, 572, 506
Tennessee	251, 428	(3)	97, 938	(3)	----------	----------	21, 645	(3)
Texas	644, 225	(3)	529, 142	(3)	94	(3)	11, 495	(3)
Utah	1, 058, 501	(3)	957, 221	(3)	2, 275	(3)	----------	----------
West Virginia	3, 298, 090	33, 090, 297	1, 735, 535	(3)	449, 611	(3)	541, 842	4, 309, 667
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	2, 273, 215	32, 259, 021	----------	----------	180, 330	2, 026, 025	862, 371	10, 138, 747
Undistributed	----------	102, 611, 400	----------	127, 651, 205	----------	8, 522, 459	----------	5, 013, 522
Total 1948	68, 284, 357	848, 719, 083	38, 995, 137	466, 383, 833	2, 817, 193	30, 999, 229	14, 958, 206	181, 311, 835
At merchant plants	13, 332, 499	191, 564, 563	----------	----------	2, 435, 877	27, 398, 417	2, 168, 432	30, 145, 646
At furnace plants	54, 951, 858	657, 154, 520	38, 995, 137	466, 383, 833	381, 316	3, 600, 812	12, 789, 774	151, 166, 189
Total 1947	66, 758, 549	711, 100, 409	37, 694, 964	378, 744, 040	2, 892, 675	26, 648, 780	14, 573, 477	165, 125, 146

TABLE 39.—Oven coke produced and sold or used by producer in the United States in 1948, by States—Continued

State	Sold—Continued							
	Foundry [4]		Other industrial (including water gas) [5]		Domestic		Total	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Alabama	516,633	$8,268,189	364,114	$5,318,170	100,623	$1,106,129	1,251,475	$17,458,476
California	322	(3)	2,888	(3)	----------	----------	23,868	(3)
Colorado	6,050	(3)	63,381	(3)	418	(3)	69,849	(3)
Illinois	373,483	7,373,082	99,316	1,309,179	100,086	1,206,876	1,876,522	29,499,763
Indiana	463,179	(3)	100,991	(3)	169,868	1,913,836	2,517,310	39,449,244
Maryland	----------	----------	----------	----------	----------	----------	----------	----------
Massachusetts	105,820	(3)	222,754	(3)	432,000	(3)	888,145	(3)
Michigan	547,489	(3)	199,381	(3)	299,036	4,274,395	1,344,337	20,860,954
Minnesota	104,405	(3)	44,144	(3)	107,488	(3)	309,026	(3)
New Jersey	58,793	(3)	554,108	(3)	452,706	(3)	1,150,733	(3)
New York	14	(3)	461,871	(3)	650,467	8,448,778	2,780,407	33,531,780
Ohio	251,163	4,788,886	766,194	9,824,258	206,683	2,437,346	2,529,586	33,630,208
Pennsylvania	213,731	4,156,924	346,304	4,618,325	311,742	3,337,020	7,477,240	85,684,775
Tennessee	12,472	(3)	120,729	(3)	----------	----------	154,846	(3)
Texas	47,068	(3)	72,044	(3)	----------	----------	130,607	(3)
Utah	----------	----------	111,521	(3)	5,802	(3)	117,323	(3)
West Virginia	11,134	135,708	471,352	4,653,126	86,680	718,241	1,111,008	9,816,742
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	450,481	8,676,231	325,086	4,583,477	475,097	7,162,712	2,113,035	30,561,167
Undistributed	----------	26,213,116	----------	27,475,186	----------	14,154,287	----------	42,972,203
Total 1948	3,162,237	59,612,136	4,326,178	57,781,721	3,398,696	44,759,620	25,845,317	343,465,312
At merchant plants	2,577,777	48,980,513	3,485,344	47,815,797	2,687,127	37,458,378	10,918,680	164,400,334
At furnace plants	584,460	10,631,623	840,834	9,965,924	711,569	7,301,242	14,926,637	179,064,978
Total 1947	3,145,842	46,782,990	4,357,174	48,000,872	3,917,402	43,835,479	25,993,895	303,744,487

[1] Comprises 91,670 tons, valued at $1,144,099 used in foundries; 800,056 tons, $9,107,026 to make producer gas; 1,511,310 tons, $16,657,979 to make water gas; and 414,157 tons, $4,090,125 for other purposes.
[2] Includes 12,021,531 tons, valued at $140,842,993 sold to financially affiliated companies.
[3] Included with "Undistributed."
[4] Includes 62,056 tons, valued at $1,402,291 sold to financially affiliated companies.
[5] Includes 685,197 tons, valued at $9,024,330 for manufacture of water gas and 247,144 tons, $3,102,754 for other industrial use sold to financially affiliated companies; and 1,546,592 tons, $20,264,943 for manufacture of water gas sold to other consumers.

TABLE 40.—Beehive coke produced and sold or used by producer in the United States, in 1948, by States

State	Produced		Used by producer—In blast furnaces		Used by producer—For other purposes		Sold—Furnace [1]	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Kentucky	101,745	(2)					33,365	(2)
Pennsylvania	5,733,835	$67,303,836	152,341	(2)	3,135	(2)	4,711,962	$53,254,054
Utah	188,586	(2)	109,448	(2)			64,933	(2)
Virginia	200,911	2,886,723					74,596	1,056,018
West Virginia	352,494	4,801,771			25	(2)	185,518	2,385,386
Undistributed		4,570,441		$4,109,360		$39,225		1,338,471
Total: 1948	6,577,571	79,562,771	261,789	4,109,360	3,160	39,225	5,070,374	58,033,929
1947	6,687,301	65,305,111	291,766	2,941,524	3,031	29,272	5,076,298	47,274,992

State	Sold—Continued—Foundry		Other industrial (including water gas) [3]		Domestic		Total	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Kentucky			68,380	(2)			101,745	(2)
Pennsylvania	403,556	$6,036,122	399,798	$5,159,571	44,251	$526,071	5,559,567	$64,975,818
Utah	562	(2)	11,197	(2)			76,692	(2)
Virginia	37,950	(2)	88,848	1,213,907	1,598	(2)	202,992	2,915,753
West Virginia	54,684	(2)	110,298	1,580,117	764	(2)	351,264	4,785,270
Undistributed		1,446,216		1,111,348		27,673		2,458,113
Total: 1948	496,752	7,482,338	678,521	9,064,943	46,613	553,744	6,292,260	75,134,954
1947	415,827	4,966,055	864,243	9,733,310	59,926	603,567	6,416,294	62,577,924

[1] Includes 1,554,780 tons valued at $14,479,032 sold to financially affiliated companies for blast-furnace use.
[2] Included with "Undistributed."
[3] Includes 5,752 tons valued at $83,318 sold to financially affiliated companies for other industrial use and 204,254 tons, $2,665,553 for manufacture of water gas.

STOCKS OF COKE AND COKING COAL

Coke.—In spite of the extremely large demand for coke in 1948, year-end stocks increased 54 percent over reserves carried at the end of 1947. This marked increase was due to a gain of 585,078 tons (151 percent) of "furnace" coke, as stocks of "foundry" and all other kinds decreased slightly. The total quantity in stock at producers' plants, however, was not abnormal and, when calculated on the basis of the production rate prevailing at the end of the year, was equivalent to 7.3 days. Most of the coke stocks were at oven-coke plants (98 percent), as beehive producers customarily carry but a few tons at any time.

Coal.—Coal stocks are of extreme importance to oven-coke producers because the ovens must operate continuously. Any disruption in coal production or in the delivery of coal to the plant can cause serious damage to the coke ovens if they cool too rapidly because of a lack of coal. For this reason, oven-coke producers attempt to maintain at least a 30-day supply of coking coal in reserve at the plants. Stocks of coal at oven plants averaged about 31 days' supply in the first quarter of 1948 but dropped sharply in April due to work stoppages in the bituminous coal industry. Stocks increased substantially in

May and June but declined in July because of the vacation period of the bituminous-coal miners. However, in succeeding months, stocks of coal at oven-coke plants increased steadily and at the close of the year were the highest on record. At that time, quantity on hand was sufficient for 43.4 days' supply at the rate of consumption prevailing in December.

TABLE 41.—Summary of total stocks of coke on hand at all coke plants in the United States on Jan. 1, 1937 and 1945–49, in net tons

[Exclusive of screenings or breeze]

	1937	1945	1946	1947	1948	1949
Oven-coke plants:						
Furnace	282, 144	478, 133	425, 438	445, 763	376, 097	940, 727
Foundry	8, 981	18, 265	24, 509	12, 565	12, 362	7, 003
Domestic and other	1, 408, 350	590, 048	477, 052	434, 585	631, 397	612, 851
Total	1, 699, 475	1, 086, 446	926, 999	892, 913	1, 019, 856	1, 560, 581
Beehive-coke plants:						
Furnace	5, 622	33, 649	2, 455	30, 750	10, 181	30, 629
Foundry	8, 508	766	270	1, 508	50	964
Domestic and other	18, 461	3, 824	2, 089	3, 595	2, 150	1, 267
Total	32, 591	38, 239	4, 814	35, 853	12, 381	32, 860
Total:						
Furnace	287, 766	511, 782	427, 893	476, 513	386, 278	971, 356
Foundry	17, 489	19, 031	24, 779	14, 073	12, 412	7, 967
Domestic and other	1, 426, 811	593, 872	479, 141	438, 180	633, 547	614, 118
Grand total	1, 732, 066	1, 124, 685	931, 813	928, 766	1, 032, 237	1, 593, 441

TABLE 42.—Stocks of furnace, foundry, and domestic coke and of breeze in the United States on Jan. 1, 1949, by States, in net tons

State	Coke				Breeze
	Furnace	Foundry	Domestic and other	Total	
Oven coke:					
Alabama	65, 291	1, 399	9, 573	76, 263	31, 497
California	18, 820			18, 820	33, 310
Colorado	8, 512			8, 512	564
Illinois	71, 887	605	4, 832	77, 324	99, 531
Indiana	95, 172	1, 253	17, 770	114, 195	92, 876
Maryland	72, 813			72, 813	293, 213
Massachusetts		258	93, 582	93, 840	8, 618
Michigan	12, 357	731	6, 903	19, 991	51, 216
Minnesota	1, 289	557	3, 682	5, 528	45, 348
New Jersey			66, 586	66, 586	1, 315
New York	91, 892	5	199, 012	290, 909	66, 074
Ohio	221, 874	1, 222	16, 013	239, 109	184, 847
Pennsylvania	236, 622	439	67, 465	304, 526	484, 012
Tennessee	965	80		1, 045	1, 244
Texas	10, 104		7, 280	17, 384	24, 840
Utah	15, 259		23, 148	38, 407	22, 588
West Virginia	17, 174	100	17, 191	34, 465	31, 254
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	696	354	79, 814	80, 864	13, 363
Total	940, 727	7, 003	612, 851	1, 560. 581	1, 485, 710
At merchant plants	5, 487	5, 469	477, 047	488, 003	120, 383
At furnace plants	935, 240	1, 534	135, 804	1, 072, 578	1, 365, 327
Beehive coke:					
Pennsylvania	25, 792	898	937	27, 627	2, 094
Utah	2, 625			2, 625	4, 117
Virginia	376	66	230	672	20
West Virginia	1, 836		100	1, 936	
Total	30, 629	964	1, 267	32, 860	6, 231

TABLE 43.—Stocks of oven coke at furnace and merchant plants in the United States at end of each month, 1947–48, in net tons

[Includes furnace, foundry, and domestic, but not breeze]

Month	Furnace plants		Merchant plants		Total	
	1947	1948	1947	1948	1947	1948
January	523,439	553,944	273,582	357,915	797,021	911,859
February	527,103	617,770	188,929	189,708	716,032	807,478
March	503,735	587,060	171,886	128,467	675,621	715,527
April	460,302	533,247	191,369	113,034	651,671	646,281
May	444,576	644,315	225,924	157,585	670,500	801,900
June	400,298	641,128	268,163	214,507	668,461	855,635
July	458,311	652,288	314,609	287,389	772,920	939,677
August	544,175	716,446	437,892	406,609	982,067	1,123,055
September	508,688	818,759	520,400	468,125	1,029,088	1,286,884
October	513,346	985,707	549,921	488,598	1,063,267	1,474,305
November	588,949	1,058,954	562,152	529,930	1,151,101	1,588,884
December	510,609	1,072,578	509,247	488,003	1,019,856	1,560,581

TABLE 44.—Stocks of bituminous coal at oven-coke plants in the United States at end of each month, 1937 and 1946–48, in net tons

Month	1937	1946	1947	1948
January	8,030,871	5,665,131	5,919,455	8,670,875
February	8,687,389	6,392,605	6,644,699	8,807,168
March	9,638,317	8,269,360	7,516,564	7,434,582
April	8,543,774	4,116,899	5,417,111	4,307,878
May	8,187,883	2,565,010	6,454,434	7,773,429
June	7,770,256	3,629,535	7,095,832	10,474,191
July	7,432,741	3,871,156	4,803,819	8,974,663
August	7,455,932	5,229,600	5,483,859	10,289,146
September	7,760,533	5,925,815	6,216,127	10,967,839
October	8,066,938	6,593,083	7,300,931	11,347,876
November	8,114,094	6,355,321	8,206,627	11,463,542
December	7,273,403	5,238,762	9,147,808	12,104,428

VALUE AND PRICE

The term "value," as used in this report, represents the value of the coke at the ovens as reported by producers. For that part of the output sold, the value is the amount received for the coke f. o. b. ovens. However, the greater part of the coke produced in the United States is made in ovens operated by corporations which not only mine the coal used in the manufacture of coke but also operate blast furnaces and steel mills consuming the entire output of their ovens. Under such conditions, fixing a value for coal charged and for coke produced is purely arbitrary. For example, at some plants the cost of coke to the furnace department equals the cost of production; at others, a margin of profit is added; or the reported value is based on what the coke would cost if purchased. The line between sales and interdepartmental transfers is difficult to draw among such affiliated interests, as a large part of the furnace coke reported as sold actually goes to iron furnaces that are in some way connected with the coke producers. The average value of all coke produced, measured in this way, increased $1.83 to $12.40 per ton, the highest figure ever recorded and a gain of 17 percent over 1947 (table 45).

The average price received for each ton of coke sold f. o. b. ovens (merchant sales) in 1948 established a new record and was 15 percent over the 1947 figure. Table 46 shows average receipts from sales, classified by uses and by States. It will be noted that prices vary notably with the distances from the mines. Thus, the highest average prices are those reported for the New England and Lake Dock States, where the coal must be hauled great distances.

TABLE 45.—Average value per net ton of coke produced and average receipts per net ton from coke sold in the United States, 1937, and 1944–48

Year	Value per ton produced			Receipts per ton sold		
	Oven coke	Beehive coke	Total	Oven coke	Beehive coke	Total
1937	$5.03	$4.31	$4.98	$6.11	$4.23	$5.83
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
1947	10.65	9.77	10.57	11.69	9.75	11.30
1948	12.43	12.10	12.40	13.29	11.94	13.03

TABLE 46.—Average receipts per net ton of coke sold (merchant sales) in the United States in 1948, by States

State	Oven coke				Beehive coke			
	Furnace	Foundry	Other industrial, including water gas	Domestic	Furnace	Foundry	Other industrial, including water gas	Domestic
Alabama	$14.16	$16.00	$14.61	$10.99	--------	--------	--------	--------
California, Colorado, Texas, and Utah	15.36	16.05	13.58	6.28	(1)	(1)	(1)	--------
Connecticut, Massachusetts, and Rhode Island	--------	19.16	13.89	14.58	--------	--------	--------	--------
Illinois	15.86	(1)	13.91	12.06	--------	--------	--------	--------
Indiana	(1)	(1)	(1)	11.27	--------	--------	--------	--------
Kentucky, Missouri, and Tennessee	10.24	18.81	14.96	15.06	(1)	--------	(1)	--------
Michigan, Minnesota, and Wisconsin	14.42	19.69	13.19	14.65	--------	--------	--------	--------
New Jersey and New York	15.32	19.90	(1)	13.42	--------	--------	--------	--------
Ohio	14.70	19.07	12.73	11.79	--------	--------	--------	--------
Pennsylvania	13.62	19.58	13.67	10.70	$12.28	$14.96	$12.91	$11.89
Virginia	--------	--------	--------	--------	14.16	(1)	13.66	(1)
West Virginia	(1)	15.27	9.87	8.29	12.86	(1)	14.32	(1)
Undistributed	16.46	19.38	14.43	--------	13.62	15.52	13.97	11.72
United States average 1948	13.78	18.78	13.45	13.17	12.39	15.06	13.35	11.88
At merchant plants	13.84	18.88	13.88	13.94	--------	--------	--------	--------
At furnace plants	13.64	18.33	12.06	10.26	--------	--------	--------	--------
United States average 1947	10.95	14.79	11.09	11.19	9.85	11.94	11.27	10.07

[1] Included with "Undistributed."

FOREIGN TRADE [1]

Exports.—The shipment of coke to foreign countries in 1948 decreased 15 percent in quantity and 2 percent in value from 1947. Although the United States has always exported a larger tonnage than it has imported, exports have generally accounted for less than 2 percent of the total production. Exports averaged 534,400 tons annually for the period 1937–39 and 924,200 tons during 1946–48 (table 47). Despite heavy foreign demand for metallurgical coke during and since the end of World War II, exports have been limited because of domestic shortages. The exportation of metallurgical coke, the grade in

[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.

shortest supply, has been restricted to the Western Hemisphere by Government export controls. A quota of 50,000 long tons per quarter was established in 1948 for countries in the Western Hemisphere other than Canada; the Dominion was not limited to a quota. In the immediate prewar years, 90 percent of the coke exported from the United States went to Canada; in 1948, exports to that country comprised 79 percent of the total.

TABLE 47.—Coke exported from the United States, 1946–48, by countries and customs districts

[U. S. Department of Commerce]

	1946		1947		1948	
	Net tons	Value	Net tons	Value	Net tons	Value
COUNTRY						
North America:						
Canada	875,110	$8,182,362	585,965	$6,701,624	561,029	$7,699,494
Mexico	5,496	50,761	16,108	216,419	36,786	664,079
Panama, Republic of	10	244	66	1,856		
West Indies:						
Cuba	13,810	171,204	21,429	351,903	17,730	347,507
Trinidad and Tobago			77	1,749	104	2,502
Other North America	833	19,330	1,304	39,552	1,228	45,929
South America:						
Argentina	471	9,198	41,872	875,217	10,146	235,298
Bolivia	727	16,900	682	19,597	1,188	47,951
Brazil	9,536	186,711	24,435	721,806	9,599	366,117
Chile	5,005	91,518	8,189	214,413	6,424	177,166
Peru	622	14,475	2,186	63,540	644	23,633
Uruguay	1,285	26,388	3,009	74,302	2,798	117,179
Venezuela	1,047	25,188	938	29,469	737	30,212
Other South America	216	5,752	529	13,304	545	21,196
Europe:						
Belgium-Luxembourg			3,745	65,877		
Denmark	868	9,829	32	614	43	834
Finland	15,200	203,148				
France	125	3,198	10,479	85,902		
Ireland			7,388	137,540		
Italy	7,482	80,414	104	1,945		
Netherlands	5,456	103,363				
Norway			55,425	432,802	46,598	589,777
Portugal	8,948	113,779	37	406		
Sweden	254,190	3,016,325	37,316	431,218	7,958	87,404
Switzerland	1,010	11,550	6,539	72,919		
Yugoslavia	21,771	232,449				
Other Europe	6	402	404	14,033		
Asia:						
China	766	18,105	752	7,376	33	1,512
Philippines, Republic of	1,336	42,964	2,474	107,587	2,511	117,349
Other Asia			62	2,765	89	4,147
Africa:						
Portuguese Guinea and Angola			3,360	48,715		
Other Africa			153	3,155		
Oceania: French Pacific Islands	1	36				
Total	1,231,327	12,635,593	835,059	10,737,605	706,190	10,579,286
CUSTOMS DISTRICT						
Buffalo	600,443	5,322,030	287,029	2,872,216	271,733	3,161,885
Chicago	9,015	80,871	3,400	30,600		
Dakota	11,929	121,830	18,757	242,159	20,664	330,742
Duluth and Superior	10,081	105,766	6,153	83,782	6,728	114,971
El Paso	2	56			5,273	132,238
Florida	5,914	74,530	4,348	81,524	1,432	30,026
Laredo	1,914	24,061	11,859	181,501	29,784	487,159
Maryland	209,234	2,431,856	131,133	1,561,401	63,728	944,638
Michigan	215,659	2,299,621	239,253	3,083,378	210,826	3,475,554
Mobile	7,159	86,413	2,002	30,644	45	1,053
Montana and Idaho					15,519	96,866
New Orleans	29,856	503,974	36,043	903,951	21,696	699,621
New York	3,258	79,772	5,002	177,918	1,179	32,150
Ohio	11,182	77,760	5,223	77,009	7,692	117,046
Philadelphia	65,730	802,597	10,455	193,786	793	16,797

TABLE 47.—Coke exported from the United States, 1946–48, by countries and customs districts—Continued

	1946		1947		1948	
	Net tons	Value	Net tons	Value	Net tons	Value
CUSTOMS DISTRICT—con.						
Sabine	----------	----------	26, 258	$499, 522	9, 249	$179, 915
St. Lawrence	11, 949	$120, 821	13, 578	161, 008	4, 250	69, 444
San Diego	414	6, 960	512	8, 438	965	20, 478
San Francisco	1, 816	59, 191	2, 077	86, 835	1, 872	82, 451
Vermont	2, 946	31, 161	9, 286	101, 952	12, 984	148, 938
Virginia	27, 819	369, 663	15, 555	284, 506	6, 491	193, 599
Washington	1, 390	17, 259	1, 897	32, 820	9, 948	174, 607
Other districts	3, 617	19, 401	5, 239	42, 655	3, 339	69, 108
Total	1, 231, 327	12, 635, 593	835, 059	10, 737, 605	706, 190	10, 579, 286

Imports.—Imports of coke fill but a small part of the Nation's requirements and are restricted to a few localities. Statistics on United States imports do not distinguish between coal coke and petroleum coke, although the two varieties are listed separately in export statistics. Total imports of all types of coke comprise only a fraction of 1 percent of the indicated consumption of the United States. In the prewar years 1937–39, imports averaged 187,800 tons annually and were received principally from Canada, Belgium, Germany, and the United Kingdom. During the 3-year period (1946–48) the average was 105,900 tons, all of which came from Canada in 1946 and 1947 and all but 605 tons in 1948 (table 48). Most of the imported coke enters the United States by rail through the Montana-Idaho customs district where the coke is probably used for smelting nonferrous metals. Significant tonnages also enter the Michigan, Buffalo, and Wisconsin customs districts, where it is used principally for domestic heating.

TABLE 48.—Coke imported for consumption in the United States, 1946–48, by countries [1] and customs districts

[U. S. Department of Commerce]

Customs district	1946		1947		1948	
	Net tons	Value	Net tons	Value	Net tons	Value
Buffalo	9, 951	$167, 434	129	$2, 300	38, 399	$646, 606
Chicago	----------	----------	----------	----------	37	621
Dakota	34	343	----------	----------	1, 682	28, 577
Hawaii	----------	----------	33	368	----------	----------
Maine and New Hampshire	544	5, 419	314	4, 026	350	4, 707
Michigan	179	1, 305	15, 948	121, 385	39, 597	649, 510
Minnesota	220	441	----------	----------	----------	----------
Montana and Idaho	40, 428	309, 307	61, 993	544, 695	62, 342	696, 024
New York	683	21, 097	----------	----------	----------	----------
Puerto Rico	----------	----------	----------	----------	605	14, 212
St. Lawrence	----------	----------	57	599	----------	----------
Vermont	116	1, 130	120	1, 371	109	1, 157
Washington	33	308	35	398	615	7, 223
Wisconsin	----------	----------	25, 464	87, 585	17, 664	61, 638
Total	52, 188	506, 784	104, 093	762, 727	161, 400	2, 110, 275

[1] All from Canada 1946–47; 1948: Canada 160,795 tons valued at $2,096,063; Netherlands 605 tons valued at $14,212.

TECHNOLOGY

Considerable scientific and technical work was done in 1948 by the Federal Government and State agencies, coal-research laboratories, colleges, and individual companies in the field of coal technology. The Federal Bureau of Mines, which has conducted scientific and technologic investigations on coal and related products since its creation by the Congress in 1910, continued its research work in these fields during 1948. The work done by the Bureau of Mines in 1948 was highlighted by the initiation of a long-range program to augment the coking-coal resources of the United States as of January 1, 1948. This study is being conducted in three phases:

1. The investigation of known minable coking-coal reserves.
2. Upgrading of marginal coking coals by improved coal preparation methods.
3. Extension of coking-coal reserves by carbonization studies.

The field work of investigating the known coking-coal reserves consists of contacting owners of coal lands and the operators of coal mines to explain the purpose of the study and to secure, if possible, the following: (*a*) A map of the property, (*b*) maps of mines showing extent of workings, (*c*) thickness of the coal beds and location of outcrops, (*d*) maps giving locations of drill holes, (*e*) logs of drill holes giving bed sections and bed names, (*f*) chemical analyses of the coals, and (*g*) life production of each mine. Maps are prepared from the date obtained, and the average thickness of coal and the remaining coal reserves are computed from them. Where the productive life of a mine and the average thickness of the coal bed are known, the percentage of recovery may be calculated. Estimates are made of the removable reserves by quadrangles as the work progresses and will be regrouped and reported by counties or other suitable geographic areas. This work started simultaneously in western Pennsylvania, southern West Virginia, and eastern Kentucky and later will spread to other States until all coking-coal deposits have been investigated.

An intensive study was undertaken to investigate the washing characteristics of that part of the Pittsburgh bed in southwestern Pennsylvania and northern West Virginia, the last large reserve of Pittsburgh coal available to the steel industry of Pittsburgh. Work was also started to determine the washing characteristics of the Pocahontas No. 6 coal bed in the smokeless field of West Virginia. Low-volatile Pocahontas coals are of major importance in the manufacture of metallurgical coke, and more attention is being given the lesser-known Pocahontas beds, such as No. 6, because Nos. 3 and 4 seams are becoming depleted.

Progress continued on the extension of potential reserves of readily usable coking coals by the accumulation of data on the carbonizing properties of untested coals and coal blends. A brief résumé of the special studies by Bureau engineers on the carbonizing properties, plasticity, expansion, and oxidation of coal in the fiscal year ending July 1, 1948, is given in a report released in 1949.[2]

The research program of the Illinois Geological Survey on the use of Illinois coal in the production of metallurgical coke was actively pursued and has been extended to include investigation of the blending of

[2] Fieldner, A. C., and Gottlieb, Sidney, Annual Report of Research and Technologic Work on Coal, Fiscal Year 1948: Bureau of Mines Inf. Circ. 7518, 1949, 87 pp.

inerts, especially char from Illinois coal. Comprehensive reports of the work done on this subject by the Survey have been published.[3]

The outstanding work initiated by E. J. Gardner and his associates for Inland Steel Co. in 1944 on the effect of coke quality on blast-furnace performance was continued in 1948.[4]

The importance of properly sizing, screening, and preparing blast-furnace coke was established in studies made by Cromwell and Covington at the Campbell plant of the Youngstown Sheet & Tube Co.[5]

The American Iron and Steel Institute, in cooperation with the American Coke and Coal Chemicals Institute, is sponsoring research on the quality of coke currently being produced and its effect on blast-furnace operation. One of the main objectives of this work is to select or determine sampling and test procedures that will adequately identify essential coke properties. It is planned to correlate the results of these tests with those on the iron-smelting properties of the coke in the blast furnace.

The influence of blending anthrafines on the quality of commercially produced cokes was summarized.[6]

The Koppers Co. made studies on the expansion properties of coal, blends, and the correlation of plasticity with coking properties in its laboratories at Kearny, N. J.[7] The Russell movable-wall oven, which provides reliable data on the quality of the coke, was used in determining expansion. The oven has been widely adopted by steel companies, and the Bureau of Mines uses a similar oven in its experimental work.

WORLD PRODUCTION

Production of coke is a good barometer for measuring the industrial activity of a country. Thus, the rise in production of coke in 1948 in virtually all countries of the world indicated that progress was being made in most countries in industrial production. Estimated world production in 1948 was 11 percent higher than in 1947, but it was 13,910,000 tons (8 percent) below the record wartime output in 1943. The decrease in 1948 from the 1943 total may be attributed to the huge reduction in German output, which has been under control of the Allied Nations since the end of World War II. The United States continued to lead the world in coke production, supplying 42 percent of the estimated world total in 1948. German output increased substantially over 1947 and equaled 12 percent of the total. Precise data on the production of coke in the Soviet Union are not available, but it is known that this country has substantial coal-carbonizing capacity and doubtless ranks second to the United States in metallurgical coke production. Other important coke-producing countries in 1948 were Great Britain, France, Czechoslovakia, Poland, Belgium, and Canada, which combined furnished 24 percent of the total.

[3] Reed, F. H., Jackman, H. W., Rees, O. W., Yoke, G. R., and Henline, P. W., Use of Illinois Coals for Production of Metallurgical Coke: Illinois Geol. Surv. Bull. 71, 1947, 132 pp.

Reed, F. H., Jackman, H. W., and Henline, P. W., The Use of Illinois Coals in the Production of Metallurgical Coke: Coal Technol., vol. 3, No. 4, November 1948, 12 pp.

[4] Gardner, E. J., Effect of Coke Quality on Blast-Furnace Iron Tonnage: Blast Furnace and Steel Plant, vol. 36, No. 6, June 1948, pp. 707–711.

[5] Cromwell, D. M., and Covington, C. A., Proper Screening and Preparation of Blast-Furnace Coke: Blast Furnace and Steel Plant, vol. 36, No. 8, August 1948, pp. 965–971.

[6] Clendenin, J. D., and Kohlberg, J., The Blending of Anthrafines in Coke Production: Pennsylvania State College Min. Indus. Exper. Sta. Tech. Paper 136, 1948, 271 pp.

[7] Perch, Michael, and Russell, Chas. C., A Study of Coal Classification and Its Application to the Coking Properties of Coal: Min. Eng., vol. 1, No. 6, June 1949, pp. 205–214.

TABLE 49.—Coke produced in the principal countries of the world, 1938 and 1941–48, in metric tons [1] [2]

[Compiled by Helen L. Hunt]

Country	1938	1941	1942	1943	1944	1945	1946	1947	1948
Australia:									
New South Wales	1,153,670	1,738,864	1,644,897	1,592,325	1,402,310	1,061,822	1,069,192	1,323,044	(3)
Queensland	31,481	30,991	22,529	15,304	14,637	15,903	13,757	18,261	(3)
Austria	(3)	(3)	(3)	(3)	618,949	69,600	138,000	319,609	657,899
Belgium	4,398,520	3,662,400	3,588,190	3,497,450	1,456,240	1,346,610	2,399,778	[4] 3,065,705	3,733,858
Brazil	----	21,068	10,267	19,845	[5] 16,000	[5] 20,000	133,542	182,674	265,753
Bulgaria	3,923	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Canada	1,808,588	2,431,942	2,536,165	2,709,354	3,118,481	3,023,248	2,592,357	2,697,070	3,116,221
China	[6] 11,630	[7] 318,445	[7] 388,734	[7] 379,822	[7] 302,466	44,000	95,910	109,000	[5] 92,600
Czechoslovakia	2,766,000	3,696,000	3,889,000	4,280,000	4,528,000	1,900,557	2,249,859	3,845,000	5,224,000
France	7,636,150	4,892,860	5,008,360	4,989,580	2,908,655	2,730,485	5,150,774	5,852,000	6,155,000
Saar	3,107,000	3,264,830	3,241,439	(3)	(3)	(3)	276,484	1,187,387	1,967,000
Germany	40,404,082	[8] 47,636,121	[8] 47,996,026	[8] 47,804,000	[8] 41,596,000	[9] 5,338,000	[10] 10,040,000	16,154,000	[9] 18,979,000
India	1,738,178	2,280,507	2,129,182	1,815,534	1,656,578	(3)	(3)	(3)	(3)
Indochina, French	3,503	----	4,357	5,293	2,064	----	----	----	----
Italy	1,739,417	1,833,388	1,668,188	1,521,820	546,140	39,203	(3)	1,626,480	2,283,000
Japan	[11] 3,724,000	[11] 5,222,000	[11] 5,842,000	6,192,000	4,944,000	2,400,000	924,000	1,164,000	1,932,000
Korea	377,937	399,860	582,918	851,307	733,216	69,106	[12] 2,657	[12] 6,644	[12] 10,971
Mexico	(3)	(3)	(3)	(3)	(3)	(3)	(3)	530,400	(3)
Netherlands	3,158,065	2,256,423	2,048,819	2,163,444	1,575,371	(3)	1,241,000	1,527,520	1,927,899
New Caledonia	49,875	99,700	83,661	(3)	(3)	(3)	(3)	(3)	----
Norway	(3)	89,092	101,226	110,406	78,558	----	----	----	----
Peru	----	(3)	(3)	(3)	(3)	(3)	----	1,641	1,763
Poland	2,290,925	2,556,382	3,170,076	3,250,344	4,544,211	1,743,239	3,328,000	4,123,000	4,659,000
Rumania	86,030	84,741	86,115	84,212	49,000	37,000	51,000	47,000	(3)
Southern Rhodesia	47,986	81,016	71,402	78,566	79,857	85,103	85,820	63,689	(3)
Spain	571,469	753,108	814,355	801,122	862,574	770,714	783,014	815,644	832,493
Sweden	112,107	(3)	(3)	81,617	32,175	----	14,592	(3)	80,000
Turkey	85,348	170,696	178,114	182,974	208,623	[13] 182,281	[13] 221,531	323,029	337,471
Union of South Africa	163,315	226,503	232,498	240,724	176,524	208,147	308,149	(3)	(3)
U. S. S. R. (estimate)	20,700,000	(3)	[14] 6,085,000	[14] 7,801,000	11,000,000	13,000,000	14,500,000	(3)	(3)
United Kingdom [15]	13,031,396	14,780,211	15,138,701	14,684,421	14,307,360	14,210,170	14,211,085	14,036,730	15,584,175
United States	29,479,553	59,135,960	64,018,735	65,023,091	67,165,627	61,060,636	53,068,078	66,628,606	67,913,244
Total	139,645,000	167,638,000	171,556,000	174,410,000	167,510,000	112,690,000	115,885,000	144,300,000	160,500,000

[1] Excludes gas-house coke.
[2] Coke is also produced in New Zealand, but data are not available.
[3] Data not available; estimate by senior author of chapter included in total.
[4] Revised; previous figure included gas-house coke.
[5] Estimate.
[6] Exports.
[7] Areas designated as Free China during the period of Japanese occupation.
[8] Includes Silesian production.
[9] Excludes French and Russian zones.
[10] Revised; previous figure excluded French zone.
[11] Preliminary data for fiscal year ended March 31 of year following that stated.
[12] South Korea only.
[13] Subject to revision.
[14] Production of Siberia and Urals only.
[15] In Great Britain production of gas-house coke is especially important: 10,770,130 tons in 1938, averaged 11,000,000 tons per year 1941-45, and increased 15 percent for 1946 and 1947.

COAL-CHEMICAL MATERIALS

GENERAL SUMMARY

The importance of coal-chemical materials cannot be adequately measured by the volume of production or by the revenue derived from their sale. The value of these materials to the industrial economy of the Nation is difficult to estimate because the various coal products enter many fields; the finished product of one industry may become the raw material for another in a chain of processes leading to the manufacture of the final commodity. The starting point in the creation of this wide variety of materials, so essential to the public welfare, is the carbonization of bituminous coal. The materials to grow our foods, clothe our bodies, and heal our ills are made from the

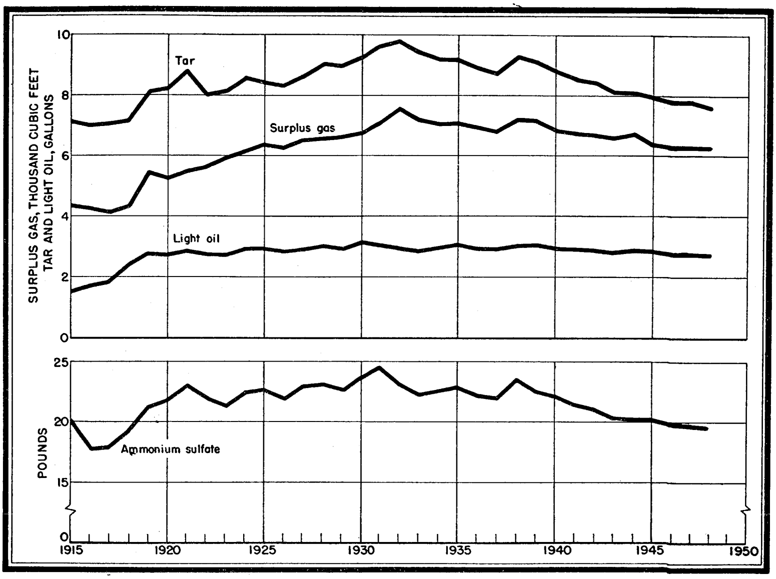

FIGURE 2.—Average yield of principal coal-chemical materials per net ton of coal carbonized in coke ovens, 1915–48. Yields of light oil and ammonium sulfate equivalent represent average for plants recovering these products.

gases and vapors recovered from the hundreds of coke ovens scattered throughout our land. Coke-plant operators are placing more emphasis on the recovery of basic products such as tar, light oil, and ammonia than ever before to meet rising demand and are processing them into benzol, toluol, xylol, creosote oil, naphthalene, pyridine, ammonium sulfate, and a host of other products. Although coke-oven gas is a potential source of chemical raw materials, such as hydrogen, methane, ethylene, etc., it is not being processed to any appreciable extent in this country, as virtually all of the production is used as industrial and domestic fuel. In spite of the emphasis being placed on the recovery of basic products, the relative yields of each has declined markedly in the past decade. For example, the yield of crude tar per ton of coal carbonized has dropped from 9.27 gallons in 1938 to 7.60 in 1948, a

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TABLE 50.—Coal-chemical materials obtained from coke-oven operations in the United States in 1948 [1]

[Exclusive of screenings or breeze]

Product	Production	Sales			On hand Dec. 31
		Quantity	Value		
			Total	Average	
Tar .... gallons..	738, 755, 106	402, 407, 480	$41, 957, 748	$0. 104	32, 828, 763
Tar derivatives:					
Creosote oil, distillate as such .... do....	24, 451, 530	23, 574, 143	4, 263, 606	. 181	907, 351
Creosote oil, in coal-tar solution .... do....	10, 533, 183	9, 464, 370	1, 643, 720	. 174	675, 496
Tar acid oil .... do....	14, 553, 270	14, 772, 782	4, 298, 486	. 291	440, 195
Phenol .... pounds..	8, 423, 440	8, 414, 711	967, 571	. 115	219, 493
Pitch of tar:					
Soft [2] .... net tons..	388, 599	3, 394	101, 353	29. 862	10, 052
Hard [3] .... do....	248, 316	....	....	......	572
Other tar derivatives [4]	....	....	2, 276, 559	......	....
Ammonia:					
Sulfate:					
From coke-oven ammonia .... pounds..	1, 661, 365, 037	1, 665, 530, 716	35, 561, 991	. 021	47, 850, 209
From purchased synthetic ammonia pounds..	61, 498, 005	60, 720, 455	1, 600, 154	. 026	877, 550
Liquor (NH_3 content) .... do....	49, 505, 251	46, 649, 246	1, 617, 277	. 035	992, 784
	....	....	[5] 37, 179, 268	......	....
Sulfate equivalent of all forms [6] .... do....	1, 859, 386, 041	1, 852, 127, 700	....	......	51, 821, 345
NH_3 equivalent of all forms [6] .... do....	464, 846, 510	463, 031, 925	....	......	12, 955, 336
Gas:					
Used under boilers, etc .... M cubic feet..	[7] 994, 852, 626	33, 152, 844	4, 086, 099	. 123	....
Used in steel or allied plants .... do....		369, 457, 173	57, 728, 546	. 156	....
Distributed through city mains .... do....		169, 347, 914	58, 229, 890	. 344	....
Sold for industrial use .... do....		35, 852, 904	5, 511, 461	. 154	....
	[7] 994, 852, 626	607, 810, 835	125, 555, 996	. 207	....
Crude light oil .... gallons..	[8] 256, 089, 065	17, 642, 761	2, 058, 469	. 117	3, 794, 999
Light-oil derivatives:					
Benzol:					
Motor .... do....	9, 014, 336	8, 552, 175	1, 171, 754	. 137	532, 143
All other grades .... do....	149, 998, 882	149, 124, 484	28, 758, 324	. 193	5, 696, 201
Toluol, crude and refined .... do....	28, 448, 259	28, 481, 798	6, 825, 957	. 240	877, 502
Xylol, crude and refined .... do....	7, 285, 338	7, 265, 770	1, 815, 895	. 250	408, 673
Solvent naphtha .... do....	5, 742, 697	5, 459, 112	958, 373	. 176	359, 583
Other light-oil products [9] .... do....	8, 061, 571	5, 525, 753	631, 816	. 114	346, 979
	208, 551, 083	204, 409, 092	40, 162, 119	. 196	8, 221, 081
Naphthalene, crude .... pounds..	105, 816, 670	102, 827, 490	4, 545, 867	. 044	5, 119, 129
Pyridine:					
Crude bases (dry basis) .... gallons..	416, 594	383, 824	392, 366	1. 022	105, 004
Refined or 2° .... pounds..	1, 071, 089	1, 099, 574	747, 897	. 680	15, 721
Sodium phenolate .... gallons..	2, 043, 589	2, 079, 536	324, 819	. 156	108, 493
Sulfur .... pounds..	6, 844, 528	7, 644, 030	108, 752	. 014	1, 617, 866
Other coal-chemical materials [10]	....	....	541, 960	......	....
Value of all coal-chemical materials sold	....	....	267, 126, 556	......	....

[1] Includes products of tar distillation conducted by coke-oven operators under same corporate name.
[2] Softening point less than 110° F. Includes some medium pitch of tar reported by 2 producers.
[3] Softening point over 160° F.
[4] Cresols, cresylic acid, crude anthracene, fuel oil, pitch coke, road tar, tar paint, and refined tar.
[5] Excludes value of sulfate made from purchased synthetic ammonia.
[6] Excludes sulfate made from purchased synthetic ammonia.
[7] Includes gas used for heating ovens and gas wasted.
[8] Refined on premises to make derived products shown: 242,956,216 gallons.
[9] Benzol still residue, dicyclopentadiene, orthoxylene, and vented vapors.
[10] Ammonium thiocyanate, cyanogen sludge, picolines, secondary oil, and sodium prussiate.

decline of 18 percent; ammonium sulfate equivalent, from 23.36 pounds to 19.52 (16 percent); crude light oil, from 2.99 gallons to 2.73 (9 percent); and coke-oven gas, from 11.04 M cubic feet to 10.23 (7 percent). These marked reductions in yield have been due to a number of factors, the principal ones being the deterioration in the quality of coal available to the coke-plant operators and the higher oven temperatures and shorter coking periods employed for maximum coke production since the beginning of World War II.

The market for coal chemicals in 1948 was unusually good, and prices on all commodities increased sharply. As a consequence, the gross receipt from the sale of coal-chemical materials was the highest on record, exceeding the 1947 total by $45,032,905 (20 percent). Although total realization from sales of all coke-oven products reached a new level because of the spectacular gains made by some, the percentage of revenue obtained by the sale of the coal-chemical materials did not change from 1947 and was far below the proportion credited to them in 1929. In that year, the revenue obtained from the sales of coal-chemical materials was equivalent to 36 percent of the total value of all products, whereas in 1948 it was only 23 percent. Of the coal-chemical materials, surplus coke-oven gas supplied the greatest income in 1948, followed in order by tar (sold and used), light oil and derivatives, and ammonia and its compounds. Details on the value of coal-chemical materials and of coke (including breeze), on the basis of each ton of coke produced, are shown in table 52. Table 50 summarizes data on the production, sales, value, and stocks of the various coal-chemical materials at coke plants.

TABLE 51.—Coal equivalent of coal-chemical materials produced at oven-coke plants in the United States, 1913, 1914, 1918, 1937, and 1946–48

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
1946	4,232	480	596,869	206,914	84,640	264,000	89,530	26,899	465,069	17,751,000	21.3
1947	5,474	593	736,174	254,978	109,480	326,150	110,426	33,147	579,203	22,107,000	21.0
1948	5,766	608	738,755	256,089	115,320	334,400	110,813	33,292	593,825	22,665,000	21.1

TABLE 52.—Value of coal-chemical materials and of coke, including breeze, per ton of coke produced in the United States, 1937 and 1945–48

Product	1937	1945	1946	1947	1948
Ammonia and its compounds	$0.326	$0.356	$0.361	$0.423	$0.545
Light oil and its derivatives (including naphthalene)	.435	.503	.467	.566	.685
Surplus gas sold or used	1.483	1.413	1.542	1.678	1.839
Tar sold	.375	.352	.395	.464	.614
Miscellaneous products	.066	.148	.154	.196	.229
	2.685	2.772	2.919	3.327	3.912
Tar used, not sold	.127	.095	.071	.141	.214
Breeze produced	.162	.202	.217	.242	.293
	2.974	3.069	3.207	3.710	4.419
Value of coke produced	5.026	7.572	8.345	10.652	12.429
Total value of coke and coal-chemical materials	8.000	10.641	11.552	14.362	16.848

COKE-OVEN GAS

Coke-oven gas is an important product of coal carbonization. Approximately 17 percent by weight of the coal charged into high-temperature slot-type ovens is recovered in the form of fuel gas. About one-third of the gas recovered is employed to heat the coke ovens, and the remainder (surplus gas) is used in allied metallurgical works, by neighboring industries, or is pumped through city mains for public consumption. The volume of gas produced in 1948 increased 2 percent over that of 1947 because of the larger quantity of coal charged; but, due to a decline in yield, was 13,947,300 M cubic feet below the 1944 peak output. The increase over 1947 made available larger quantities of surplus gas, and the increases in manufacturing costs were reflected in higher prices; hence gross value increased by 12 percent. The iron and steel industry is the largest consumer of coke-oven gas and in 1948 used about two-thirds of the surplus gas as boiler fuel or in metallurgical furnaces. Public utilities are the second-largest consumer and took about 28 percent of the total. Information on sales of surplus coke-oven gas for industrial purposes has been collected by the Bureau of Mines from coke producers since 1922, and in 1948 such sales amounted to 6 percent of the total. Unquestionably, however, a considerable part of the quantity sold to public utilities was used for industrial purposes, in addition to the amount specified above. Gas distribution through city mains brings higher prices than that sold or used by producers for industrial purposes; in 1948, the average unit value of this gas was the highest reported since 1925.

Table 55 shows the distribution of surplus gas, by type of plant. Furnace plants produce and distribute by far the largest amount of coke-oven gas; however, merchant plants contribute the largest part of the gas distributed through city mains. Public utilities or city-gas plants, built primarily to supply gas, receive the largest unit value for their product.

TABLE 53.—Coke-oven gas produced and sold in the United States in 1948, 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	85,126,822	39,030,349	44,381,147	$4,842,365	$0.109	1,715,326
California	1	5,329,088	407,006	4,791,480	(1)	(1)	130,602
Colorado	1	16,320,574	7,999,438	8,048,210	(1)	(1)	272,926
Illinois	8	51,557,079	18,241,151	32,485,115	4,973,259	.153	830,813
Indiana	5	115,986,479	51,564,158	60,911,731	14,243,656	.234	3,510,590
Maryland	1	31,211,900	8,825,501	21,301,267	(1)	(1)	1,085,132
Massachusetts	2	15,579,042	2,224,878	13,319,240	(1)	(1)	34,924
Michigan	4	40,785,418	6,342,229	34,404,210	5,441,892	.158	38,979
Minnesota	3	11,772,585	5,417,508	5,943,725	1,610,403	.271	411,352
New Jersey	2	21,403,530	5,497,759	15,905,771	(1)	(1)	
New York	8	86,772,518	23,937,577	62,238,956	20,754,335	.333	595,985
Ohio	15	148,216,428	65,517,700	80,326,233	13,219,327	.165	2,372,495
Pennsylvania	13	246,922,693	105,403,436	140,465,683	25,325,528	.180	1,053,574
Tennessee	1	3,288,247	1,428,135	1,826,232	(1)	(1)	33,880
Texas	2	9,743,324	3,600,476	4,529,193	(1)	(1)	1,613,655
Utah	2	20,359,749	5,154,637	13,657,195	(1)	(1)	1,547,917
West Virginia	5	51,734,216	14,345,068	36,419,975	4,804,404	.132	969,173
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	6	32,742,934	5,718,810	26,855,472	8,678,937	.323	168,652
Undistributed					21,661,890	.260	
Total 1948	86	994,852,626	370,655,816	607,810,835	125,555,996	.207	16,385,975
At merchant plants	31	191,921,183	45,086,718	144,873,565	50,670,392	.350	1,960,900
At furnace plants	55	802,931,443	325,569,098	462,937,270	74,885,604	.162	14,425,075
Total 1947	86	971,262,280	366,257,800	592,945,300	[2] 111,067,399	[2] .187	12,059,180

[1] Included with "Undistributed."
[2] Revised figure.

TABLE 54.—Coke-oven gas and other kinds of gas used in heating ovens in 1948, by States, in thousands of cubic feet [1]

State	Coke-oven gas	Producer gas	Blue-water gas	Blast-furnace gas	Other gases [2]	Total coke-oven gas equivalent
Alabama	39,030,349				562,065	39,592,414
California	407,006			1,858,393		2,265,399
Colorado	7,999,438					7,999,438
Illinois	18,241,151			15,254,867	2,745,348	36,241,366
Indiana	51,564,158	1,171,777	574,162		91,227	53,401,324
Maryland	8,825,501			4,513,559		13,339,060
Massachusetts	2,224,878	4,884,103				7,108,981
Michigan	6,342,229			9,944,114		16,286,343
Minnesota	5,417,508	151,062	118,631		171,495	5,858,696
New Jersey	5,497,759	4,119,338				9,617,097
New York	23,937,577	11,708,836	1,240,702	694,430		37,581,545
Ohio	65,517,700			2,936,844		68,454,544
Pennsylvania	105,403,436	1,966,518		1,847,387	678,023	109,895,364
Tennessee	1,428,135					1,428,135
Texas	3,600,476				648,187	4,248,663
Utah	5,154,637			3,041,762		8,196,399
West Virginia	14,345,068			5,607,000	741,500	20,693,568
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	5,718,810	6,303,127			1,817,479	13,839,416
Total	370,655,816	30,304,761	1,933,495	45,698,356	7,455,324	456,047,752
At merchant plants	45,086,718	29,947,779	1,814,864		6,503,338	83,352,699
At furnace plants	325,569,098	356,982	118,631	45,698,356	951,986	372,695,053

[1] Adjusted to an equivalent of 550 B. t. u. per cubic foot.
[2] Butane-air, natural, oil, propane-air, and spillage gases

TABLE 55.—Production and disposal of coke-oven gas in the United States by types of plants, 1934 and 1948

	1934				1948			
	Furnace plants	Merchant plants	Public utility plants	Total	Furnace plants	Merchant plants	Public utility plants	Total
Number of plants	41	19	23	83	55	19	12	86
Production ... M cubic feet	307,009,252	127,343,865	59,228,634	493,581,751	802,931,443	137,376,560	54,544,623	994,852,626
Percent of total	62.2	25.8	12.0	100.0	80.7	13.8	5.5	100.0
Used in heating ovens ... M cubic feet	128,290,937	41,932,577	5,645,009	175,868,523	325,569,098	41,388,458	3,698,260	370,655,816
Percent of total	72.9	23.8	3.3	100.0	87.8	11.2	1.0	100.0
Disposal of surplus:								
Used under boilers:								
M cubic feet	20,427,480	8,776,805	119,721	29,324,006	26,458,030	6,489,149	205,665	33,152,844
Percent of total	69.7	29.9	0.4	100.0	79.8	19.6	0.6	100.0
Value	$2,313,092	$546,059	$14,422	$2,873,573	$3,442,426	$610,694	$32,979	$4,086,099
Average per M cubic feet	$0.113	$0.062	$0.120	$0.098	$0.130	$0.094	$0.160	$0.123
Used in steel or allied plants:								
M cubic feet	118,974,642	722,242	19,575	119,716,459	362,348,540	7,108,633	----------	369,457,173
Percent of total	99.4	0.6	(1)	100.0	98.1	1.9	----------	100.0
Value	$10,920,087	$70,861	$10,916	$11,001,864	$56,967,428	$761,118	----------	$57,728,546
Average per M cubic feet	$0.092	$0.098	$0.558	$0.092	$0.157	$0.107	----------	$0.156
Distributed through city mains:								
M cubic feet	27,628,948	66,004,924	50,674,277	144,308,149	58,609,888	62,821,564	47,916,462	169,347,914
Percent of total	19.1	45.7	35.2	100.0	34.6	37.1	28.3	100.0
Value	$6,152,703	$18,595,593	$18,177,279	$42,925,575	$12,363,770	$26,709,043	$19,157,077	$58,229,890
Average per M cubic feet	$0.223	$0.282	$0.359	$0.297	$0.211	$0.425	$0.400	$0.344
Sold for industrial use:								
M cubic feet	7,222,527	7,441,343	1,558,873	16,222,743	15,520,812	18,240,631	2,091,461	35,852,904
Percent of total	44.5	45.9	9.6	100.0	43.3	50.9	5.8	100.0
Value	$1,131,838	$863,584	$462,405	$2,457,827	$2,111,980	$2,448,762	$950,719	$5,511,461
Average per M cubic feet	$0.157	$0.116	$0.297	$0.152	$0.136	$0.134	$0.455	$0.154
Wasted ... M cubic feet	4,464,718	2,465,974	1,211,179	8,141,871	14,425,075	1,328,125	632,775	16,385,975
Percent of total	54.8	30.3	14.9	100.0	88.0	8.1	3.9	100.0

[1] Less than 0.05 percent.

TABLE 56.—Disposal of surplus coke-oven gas in the United States in 1948, by States, in thousands of cubic feet

State	Used by producer—						Sold					
	Under boilers			In steel or allied plants			Distributed through city mains			For industrial purposes		
	Quantity	Value		Quantity	Value		Quantity	Value		Quantity	Value	
		Total	Average		Total	Average		Total	Average		Total	Average
Alabama	8,638,814	$867,780	$0.100	26,944,613	$3,038,084	$0.113	7,144,682	$771,792	$0.108	1,653,038	$164,709	$0.100
California	30,600	(1)	(1)	4,760,880	(1)	(1)						
Colorado				8,048,210	(1)	(1)						
Illinois	4,668,669	544,451	.117	7,259,790	(1)	(1)	19,706,889	2,736,381	.139	849,767	(1)	(1)
Indiana	2,434,398	361,698	.149	47,836,556	(1)	(1)	8,604,771	4,271,440	.496	2,036,006	(1)	(1)
Maryland				13,711,477	(1)	(1)	7,589,790	(1)	(1)			
Massachusetts	3,274	(1)	(1)				13,203,681	(1)	(1)	112,285	(1)	(1)
Michigan	2,622,183	(1)	(1)	29,724,956	4,472,742	.150				2,057,071	(1)	(1)
Minnesota	191,195	12,901	.067	2,074,273	(1)	(1)	2,925,117	(1)	(1)	753,140	(1)	(1)
New Jersey				325	(1)	(1)	15,905,446	(1)	(1)			
New York	1,506,800	244,245	.162	17,951,360	(1)	(1)	42,087,069	16,657,553	.396	693,727	(1)	(1)
Ohio	5,766,249	931,672	.162	58,666,810	9,508,151	.162	4,270,917	1,135,154	.266	11,622,257	1,644,350	.141
Pennsylvania	3,511,804	(1)	(1)	106,204,698	15,366,983	.145	23,875,295	8,698,328	.364	6,873,886	(1)	(1)
Tennessee	206,950	(1)	(1)				1,619,282	(1)	(1)			
Texas	1,546,896	(1)	(1)	2,982,297	(1)	(1)						
Utah	195,890	(1)	(1)	13,003,718	(1)	(1)	320,746	(1)	(1)	136,841	(1)	(1)
West Virginia	1,035,961	105,212	.102	30,287,210	4,172,086	.138				5,096,804	527,106	.103
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	793,161	126,095	.159				22,094,229	8,110,497	.367	3,968,082	442,345	.111
Undistributed		892,045	.110		21,170,500	.178		15,848,745	.381		2,732,951	.202
Total 1948	33,152,844	4,086,099	.123	369,457,173	57,728,546	.156	169,347,914	58,229,890	.344	35,852,904	5,511,461	.154
At merchant plants	6,694,814	643,673	.096	7,108,633	761,118	.107	110,738,026	45,866,120	.414	20,332,092	3,399,481	.167
At furnace plants	26,458,030	3,442,426	.130	362,348,540	56,967,428	.157	58,609,888	12,363,770	.211	15,520,812	2,111,980	.136
Total 1947	37,957,353	4,477,300	.118	[2] 348,236,552	[2] 48,508,482	.139	[2] 167,951,871	[2] 53,027,045	[2] .316	38,799,524	[2] 5,054,572	[2] .130

[1] Included with "Undistributed."
[2] Revised figure.

CRUDE COAL TAR

Production of crude coal tar increased slightly over 1947 but was about 29,052,065 gallons (4 percent) less than the record output in 1944. The yield of tar per ton of coal charged began to decline at the beginning of World War II and in 1948 was the lowest since 1918. The yield varies greatly from plant to plant, depending upon the kind of coal used, the temperature of oven operation, the completeness of tar recovery, and other factors. In modern plants using selected grades of coal for oven-coke manufacture, the tar yield is 6 to 8 gallons per ton of coal carbonized. There are, of course, a few plants where considerably higher yields are obtained, especially in the Western States where the practice is to use a larger proportion of high-volatile coals in their coal mixes. Details on production, quantities used by producers, and sales, by States, are shown in table 57. As indicated in this table, the operators of merchant or nonfurnace plants generally sell all tar produced. At plants integrated with iron and steel works more than half of the crude tar recovered is used by the producers. A number of furnace plants process a portion or all of their tar output to make tar products, while others use the tar advantageously in integrated open-hearth or other metallurgical operations. The quantity of tar processed by producers declined slightly from 1947, but the amount used as fuel increased. Sales of tar declined in quantity but increased sharply in value owing to an increase of 3 cents in the average price per gallon. Most of the coke-oven tar sold is shipped to tar distillers for refining into a number of tar products. Coke-oven tar comprises about 75 percent of the total processed in the United States; the remainder is made up of low-temperature coal tar, retort coal tar, water-gas tar, and oil-gas tar.

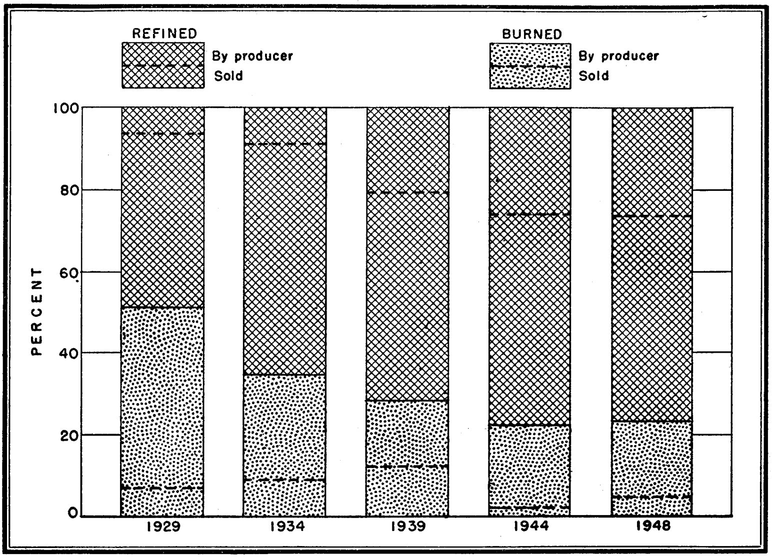

FIGURE 3.—Trend in disposal of coke-oven tar in the United States, 1929–48.

TABLE 57.—Coke-oven tar produced, used by producer, and sold in the United States in 1948, by States, in gallons

State	Produced		Used by producer—				Sold—					On hand Dec. 31
									Total			
										Value		
	Total	Per ton of coal coked	For refining or topping	As fuel under boilers	In open hearth or allied plants	Otherwise	For use as fuel [1]	For refining into tar products	Quantity	Total	Average	
Alabama	66,369,414	7.89	2,097,723	855,642	28,188,006	189,902		35,863,209	35,863,209	$3,710,225	$0.103	2,933,132
California	4,772,020	9.89	4,715,933									342,241
Colorado	13,483,589	9.54	8,048,450		5,447,806			68,313	68,313	(2)	(2)	162,007
Illinois	33,706,773	6.45		23,000		189,453	7,261,217	26,183,350	33,444,567	3,468,801	.104	1,561,610
Indiana	65,382,602	5.50	13,499,394		12,353,924	1,299,987	22,837	39,060,884	39,083,721	4,226,274	.108	2,866,218
Maryland	22,363,918	7.44			1,991,564			19,783,929	19,783,929	(2)	(2)	2,637,933
Massachusetts	9,987,510	6.76					452,433	8,344,644	8,797,077	(2)	(2)	1,314,342
Michigan	27,863,786	6.97			8,294,992			19,055,793	19,055,793	2,049,403	.108	1,910,525
Minnesota	6,683,443	5.67			1,988,744			4,743,334	4,743,334	(2)	(2)	731,282
New Jersey	14,707,451	7.52						14,933,959	14,933,959	(2)	(2)	434,041
New York	63,470,535	7.74	16,786,647			100	2,678,440	42,190,012	44,868,452	4,750,697	.106	3,450,971
Ohio	99,310,429	6.64	2,604,200	560,701	27,226,085	543,594	4,382,874	63,143,712	67,526,586	7,568,408	.112	4,683,975
Pennsylvania	215,140,091	8.88	146,482,182		39,562,970	118,438	155,093	29,512,401	29,667,494	2,859,021	.096	7,221,142
Tennessee	2,512,651	7.34						2,508,969	2,508,969	(2)	(2)	38,203
Texas	5,947,484	6.55						5,804,047	5,804,047	(2)	(2)	418,817
Utah	17,967,221	10.32			10,640,163			7,564,433	7,564,433	(2)	(2)	639,372
West Virginia	47,179,215	9.96			587,599		19,724,483	26,925,109	46,649,592	5,612,420	.120	665,563
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	21,906,974	7.11				330		22,044,005	22,044,005	1,924,265	.087	817,389
Undistributed										5,788,234	.090	
Total 1948	738,755,106	7.60	194,234,529	1,439,343	136,281,853	2,341,804	34,677,377	367,730,103	402,407,480	41,957,748	.104	32,828,763
At merchant plants	142,782,604	7.65	2,097,723			3,268	452,433	139,204,291	139,656,724	13,404,291	.096	5,874,420
At furnace plants	595,972,502	7.59	192,136,806	1,439,343	136,281,853	2,338,536	34,224,944	228,525,812	262,750,756	28,553,457	.109	26,954,343
Total 1947	736,174,480	7.78	200,473,652	865,913	120,682,190	2,229,529	32,075,780	375,897,345	407,973,125	30,981,953	.076	30,778,666

[1] Comprises 27,613,138 gallons sold to affiliated companies and 7,064,239 gallons to other purchasers.
[2] Included with "Undistributed."

The principal commercial tar products produced at coke plants are creosote oil and tar-acid oil. Creosote oil, a tar derivative used in the United States mainly for wood preservation, usually brings in about 50 percent of the revenue obtained by coke-plant operators from the sale of tar derivatives. Although the quantity of creosote oil produced (distillate, as such and in coal-tar solution) in 1948 decreased 14 percent from 1947, receipts from sales did not decline proportionately because the unit price increased 12 percent. Tar-acid-oil sales increased 14 percent in quantity and 85 percent in value, while sales of phenol reached almost a million dollars. Details on the production and sale of cresols, cresylic acid, anthracene, and other derivatives cannot be disclosed, as less than three producers reported these products to the Bureau. Virtually all of the pitch output, which decreased 3 percent from 1947, was used by the producers. The soft- or medium-melting-point pitches are cut back (usually with virgin tar) to the desired viscosity and used as metallurgical fuel. The hard pitch produced at several plants is pulverized and mixed with the coal charged into the ovens to improve the quality of the coke.

COKE-OVEN AMMONIA

All but 5 of the 86 active coke plants recovered ammonia in 1948; 64 converted the ammonia to ammonium sulfate, and 19 recovered it as ammonia liquor (2 plants produced both sulfate and liquor). In addition, purchased synthetic anhydrous ammonia was converted into sulfate at five coke plants in 1948. Data on production and sales of sulfate from purchased synthetic ammonia are shown separately in table 50 to avoid distorting the Bureau's series on coke-oven sulfate. The total production of coke-oven ammonia (NH_3 equivalent of all forms) in 1948 advanced 2 percent over the 1947 output but was 7,605,039 pounds lower than the record established in 1944 because of the decline in yield per ton of coal carbonized. An extremely heavy demand existed for nitrogenous materials for industrial and agricultural purposes in the United States as well as abroad; as a consequence, stocks of sulfate and liquor at the end of the year were 17 and 46 percent lower, respectively, than at the beginning of the year. Two laws were in force during 1948 which limited exports of chemical nitrogen and regulated distribution in the United States. Nitrogenous fertilizer materials for export purposes were controlled by the Second Decontrol Act, as extended by Public Law 606. To alleviate shortages of nitrogenous fertilizers in the United States, the Congress passed section 205 of Public Law 793, which provided that a portion of the anhydrous ammonia produced in plants operated by or for the Department of the Army be distributed to converters for the manufacture of nitrogenous fertilizer materials for use in the United States.

Prices of sulfate increased greatly in 1948 and reached the highest average unit level in 22 years, while the average price of the liquor (NH_3 content) was the highest since 1943. Data on the production and sales of coke-oven ammonia by States are given in table 58.

TABLE 58.—Coke-oven ammonia produced and sold in the United States in 1948, by States, in pounds

State	Active plants	Sulfate equivalent of all forms: Quantity	Sulfate equivalent of all forms: Per ton of coal coked	Produced as—: Sulfate	Produced as—: Liquor (NH_3 content)	Sold as: Sulfate: Quantity	Sold as: Sulfate: Value	Sold as: Liquor (NH_3 content): Quantity	Sold as: Liquor (NH_3 content): Value	On hand Dec. 31: Sulfate	On hand Dec. 31: Liquor (NH_3 content)
Alabama	7	192, 858, 634	22. 93	186, 195, 626	1, 665, 752	186, 068, 966	$4, 015, 884	1, 675, 568	(1)	5, 001, 716	18, 812
California	1	12, 994, 680	26. 94	12, 994, 680		12, 870, 480	(1)			70, 000	
Colorado	1	30, 131, 982	21. 32	30, 131, 982		28, 303, 342	(1)			2, 380, 820	
Illinois	6	84, 467, 456	18. 52	84, 467, 456		86, 211, 866	1, 780, 893			1, 405, 192	
Indiana	5	193, 073, 695	16. 25	170, 907, 539	5, 541, 539	172, 114, 564	3, 602, 430	5, 995, 989	$196, 009	7, 472, 229	128, 728
Maryland	1	62, 192, 745	20. 69	62, 192, 745		61, 175, 430	(1)			1, 277, 356	
Massachusetts	2	21, 357, 840	14. 90	21, 314, 800	10, 760	21, 768, 600	(1)	17, 480	(1)	428, 400	
Michigan	4	78, 569, 731	19. 64	27, 715, 091	12, 713, 660	27, 669, 490	(1)	10, 741, 495	(1)	103, 157	280, 547
Minnesota	3	18, 913, 850	16. 05	18, 913, 850		19, 092, 274	406, 231			715, 134	
New Jersey	2	35, 992, 003	18. 40	35, 992, 003		35, 772, 797	(1)			1, 748, 863	
New York	8	153, 670, 105	18. 73	125, 782, 461	6, 971, 911	128, 203, 755	2, 750, 245	6, 672, 211	229, 963	4, 191, 604	135, 997
Ohio	15	264, 364, 594	17. 67	213, 266, 394	12, 774, 550	209, 647, 407	4, 410, 835	11, 516, 583	405, 194	8, 289, 947	220, 313
Pennsylvania	13	507, 835, 733	20. 96	505, 811, 437	506, 074	513, 693, 613	10, 952, 947	519, 576	(1)	9, 595, 814	24, 862
Tennessee	1	7, 316, 989	21. 37	7, 316, 989		7, 171, 777	(1)			304, 949	
Texas	2	19, 755, 820	21. 76	19, 755, 820		19, 779, 280	(1)			200, 700	
Utah	2	45, 102, 057	25. 90	45, 102, 057		43, 973, 375	(1)			2, 036, 802	
West Virginia	3	74, 577, 055	21. 37	74, 577, 055		73, 036, 700	1, 614, 381			2, 341, 246	
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	5	56, 211, 072	18. 47	18, 927, 052	9, 321, 005	18, 977, 000	398, 239	9, 510, 344	319, 524	286, 280	183, 525
Undistributed							5, 629, 906		466, 587		
Total 1948	81	1, 859, 386, 041	19. 52	1, 661, 365, 037	49, 505, 251	1, 665, 530, 716	35, 561, 991	46, 649, 246	1, 617, 277	47, 850, 209	992, 784
At merchant plants	27	325, 628, 097	18. 87	195, 150, 049	32, 619, 512	197, 250, 756	4, 278, 254	35, 753, 431	1, 225, 984	5, 253, 031	856, 266
At furnace plants	54	1, 533, 757, 944	19. 67	1, 466, 214, 988	16, 885, 739	1, 468, 279, 960	31, 283, 737	10, 895, 815	391, 293	42, 597, 178	136, 518
Total 1947	82	1, 824, 622, 871	19. 66	1, 618, 879, 699	51, 435, 793	1, 624, 498, 995	26, 724, 821	47, 238, 610	1, 471, 300	57, 435, 750	1, 822, 645

[1] Included with "Undistributed."

CRUDE LIGHT OIL AND DERIVATIVES

Crude light oil is the basic raw material from which benzol, toluol, xylol, etc., are made. These hydrocarbons are of vital importance; and, although toluol and xylol are recovered in larger quantities from petroleum-refining processes, coal carbonization remains the principal source of benzol. The yield of crude light oil per ton of coal carbonized, as is the case with tar and ammonia, varies widely from plant to plant. There has been a gradual decline in yield in the past few years, and the yield in 1948 was the lowest since 1923. Production, although increasing over 1947, fell considerably short of equaling the wartime peak of 1944. Most of the crude light oil produced at coke plants is refined by the operators in adjacent facilities, and only about 5 percent of the annual output is sold to tar refiners for processing. In refining crude light oil, over 60 percent of the total quantity charged into the stills is recovered as pure benzol. In the years immediately preceding World War II, the demand for pure benzol was not large enough to absorb all that could be recovered from the available light oil. Consequently, the light oil was refined only into "motor benzol." Requirements for pure benzol increased rapidly during World War II, and the refining process was altered to produce the purer grades. This practice has continued, with every indication that it will continue in the future. Pure benzol is converted into about six chief derivatives, such as phenol, aniline, styrene, etc. These materials are the basis for many secondary and tertiary derivatives, namely, synthetic rubber, nylon, plastics, and some explosives. The demand for pure benzol influenced prices; the average unit value increased 2.9 cents per gallon (18 percent) over 1947, and the total realization from this product represented 72 percent of the total revenue obtained by coke-plant operators from the sale of all light-oil derivatives. Toluol production increased more than 2 million gallons (8 percent) over 1947. Production of xylol and solvent naphtha increased slightly, indicating a good demand for these aromatic solvents. Prices on toluol, xylol, and solvent naphtha advanced substantially over 1947 but were still below wartime levels.

TABLE 59.—Coke-oven crude light oil produced in the United States and derived products obtained and sold in 1948, 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	23, 210, 383	2. 76	22, 965, 327	19, 750, 054	18, 731, 681	$3, 639, 775	292, 355
California	1	1, 806, 935	3. 75	1, 805, 057	1, 505, 025	1, 369, 115	(3)	16, 087
Colorado	1	4, 348, 276	3. 08	4, 347, 809	3, 814, 043	3, 653, 814	(3)	48, 308
Illinois	7	12, 829, 663	2. 50	9, 583, 553	8, 083, 306	8, 105, 273	1, 609, 212	170, 842
Indiana	5	26, 690, 468	2. 25	27, 496, 005	24, 056, 956	24, 163, 684	4, 795, 562	339, 256
Maryland	1	11, 688, 811	3. 89	11, 601, 989	10, 208, 509	10, 190, 500	(3)	146, 084
Michigan	4	10, 460, 031	2. 61	5, 359, 936	4, 617, 732	4, 363, 922	(3)	195, 111
New York	8	20, 847, 657	2. 54	30, 139, 891	25, 927, 984	26, 523, 848	5, 237, 647	274, 391
Ohio	15	38, 664, 860	2. 58	34, 534, 509	26, 865, 877	26, 516, 784	5, 184, 467	471, 442
Pennsylvania	13	73, 761, 456	3. 04	70, 998, 464	63, 511, 275	62, 805, 400	12, 226, 403	1, 284, 429
Tennessee	1	883, 942	2. 58	880, 623	811, 728	275, 063	(3)	8, 541
Texas	2	2, 384, 858	2. 63	2, 382, 358	2, 015, 144	2, 086, 275	(3)	62, 605
Utah	2	6, 139, 400	3. 53	6, 060, 754	4, 806, 180	5, 033, 351	(3)	95, 436
West Virginia	5	13, 878, 593	2. 93	11, 435, 462	9, 645, 510	7, 490, 387	1, 555, 381	112, 745
Connecticut, Keutucky, Massachusetts, Minnesota, Missouri, New Jersey, and Wisconsin	7	8, 493, 732	1. 92	3, 364, 479	2, 931, 760	3, 099, 995	604, 805	277, 367
Undistributed							5, 308, 867	
Total 1948	79	256, 089, 065	2. 73	242, 956, 216	208, 551, 083	204, 409, 092	40, 162, 119	3, 794, 999
At merchant plants	26	34, 905, 294	2. 16	29, 918, 871	26, 580, 019	25, 030, 165	4, 809, 629	1, 004, 468
At furnace plants	53	221, 183, 771	2. 85	213, 037, 345	181, 971, 064	179, 378, 927	35, 352, 490	2, 790, 531
Total 1947	79	254, 978, 463	2. 75	241, 379, 524	208, 404, 180	203, 038, 079	33, 102, 258	4, 136, 019

[1] Comprises 238,083,088 gallons of crude light oil from own production and 4,873,129 gallons purchased from other coke plants.
[2] Excludes 17,642,761 gallons of crude light oil valued at $2,058,469 sold as such.
[3] Included with "Undistributed."

TABLE 60.—Trend in yields of products obtained from refining crude light oil at oven-coke plants, 1937 and 1940–48, in percent

Year	Benzol		Toluol crude and refined	Xylol crude and refined	Solvent naphtha	Other light oil products
	Motor	All other grades				
1937	52. 5	11. 9	11. 5	2. 5	3. 1	4. 5
1940	48. 8	15. 4	12. 7	2. 7	2. 5	3. 6
1941	47. 2	16. 8	13. 0	3. 4	2. 3	3. 6
1942	26. 8	35. 3	13. 4	3. 9	2. 2	3. 8
1943	8. 6	53. 9	13. 1	3. 6	2. 1	3. 6
1944	7. 1	56. 6	12. 9	3. 3	2. 1	3. 5
1945	12. 3	53. 9	11. 5	3. 2	2. 0	3. 3
1946	13. 8	55. 3	8. 3	3. 0	2. 2	3. 8
1947	6. 5	60. 1	10. 9	3. 0	2. 3	3. 5
1948	3. 7	61. 7	11. 7	3. 0	2. 4	3. 3

TABLE 61.—Production of benzol and toluol, by grades, at oven-coke plants 1941–48, in gallons

Year	Benzol				Toluol		
	Motor	Nitration or 1° C.	Pure commercial or 2° C.	All other	Nitration or 1° C.	Pure commercial or 2° C.	All other
1941	106, 372, 000	15, 414, 500	18, 286, 400	4, 182, 600	14, 689, 800	13, 268, 500	1, 378, 900
1942	64, 797, 600	25, 624, 400	53, 617, 900	6, 014, 700	25, 160, 200	5, 044, 800	2, 109, 600
1943	21, 267, 900	35, 047, 800	93, 246, 600	4, 144, 800	27, 152, 300	2, 394, 700	2, 725, 600
1944	18, 556, 600	41, 285, 800	102, 436, 500	3, 187, 600	29, 771, 100	2, 149, 600	1, 607, 500
1945	28, 788, 100	39, 166, 500	86, 237, 300	1, 266, 700	23, 355, 400	2, 219, 700	1, 494, 200
1946	27, 398, 900	35, 739, 300	71, 681, 700	2, 308, 000	12, 518, 000	2, 796, 400	1, 205, 400
1947	15, 802, 700	42, 475, 300	100, 111, 800	2, 470, 800	20, 514, 100	4, 989, 500	892, 800
1948	9, 014, 300	43, 541, 200	103, 356, 300	3, 101, 400	22, 899, 700	5, 280, 800	267, 800

NAPHTHALENE

TABLE 62.—Crude naphthalene produced and sold by coke-plant operators in the United States, 1937 and 1944–48

Year	Produced (pounds)	Sold			Receipts per ton of coke
		Pounds	Value		
			Total	Average per pound	
1937	60, 797, 108	60, 315, 581	$1, 182, 992	$0. 020	$0. 024
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
1947	98, 378, 875	98, 364, 997	3, 021, 152	. 031	. 045
1948	105, 816, 670	102, 827, 490	4, 545, 867	. 044	. 067

COKE OVENS OWNED BY CITY GAS COMPANIES (PUBLIC UTILITIES)

The accompanying table comparing statistics on the operations of coke plants owned by gas utilities with those not so owned is presented by the Bureau of Mines for the information of those who may wish to follow the activities of public utility plants. The adaptation of the coke oven to the needs of city-gas manufacture had induced a number of public utilities to install coke ovens to supplement—or even replace—their coal-gas plants at the end of World War I. In ensuing years a number of plants installed coke ovens, and the number so equipped reached a peak of 23 in 1934. In that year, gas utility companies produced 11 percent of the Nation's oven coke, 12 percent of the coke-oven gas and tar, 9 percent of the coke-oven ammonia, and 4 percent of the crude light oil. The development of long-distance pipe lines for transmitting natural gas and improved technology in the manufacture of water gas have reversed the trend in recent years, and a number of companies have substituted natural gas for coke-oven gas. As a result, coking operations at a number of locations have been discontinued; and the number of gas plants operating coke ovens has steadily declined until, by the end of 1948, only 12 such plants were in operation. These plants contributed 5 percent of the total production of oven coke, 5 percent of the gas, 5 percent of the crude tar, 4 percent of the ammonia, and 3 percent of the crude light oil. The reason that the proportion for crude light oil is lower than for other products is that some of the gas companies, to increase the calorific value of the gas, do not scrub out this product.

TABLE 63.—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 all other oven-coke plants, 1947–48

Product	1947			1948		
	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	73	13	86	74	12	86
Coke:						
Production ---- net tons	63, 175, 410	3, 583, 139	66, 758, 549	64, 830, 624	3, 453, 733	68, 284, 357
Value	$668, 961, 045	$42, 139, 364	$711, 100, 409	$797, 394, 409	$51, 324, 674	$848, 719, 083
Average per ton	$10. 59	$11. 76	$10. 65	$12. 30	$14. 86	$12. 43
Screenings or breeze:						
Production ---- net tons	5, 185, 244	288, 869	5, 474, 113	5, 404, 752	360, 824	5, 765, 576
Sales ---- do	1, 072, 581	34, 139	1, 106, 720	1, 101, 298	20, 313	1, 121, 611
Value of sales	$3, 823, 918	$126, 190	$3, 950, 108	$4, 529, 056	$83, 002	$4, 612, 058
Average per ton	$3. 57	$3. 70	$3. 57	$4. 11	$4. 09	$4. 11
Coal charged into ovens:						
Bituminous ---- net tons	89, 400, 632	4, 924, 500	94, 325, 132	92, 084, 237	4, 899, 906	96, 984, 143
Anthracite ---- do	217, 962	44, 234	262, 196	209, 756	46, 419	256, 175
Total ---- do	89, 618, 594	4, 968, 734	94, 587, 328	92, 293, 993	4, 946, 325	97, 240, 318
Value	$601, 517, 549	$39, 656, 275	$641, 173, 824	$743, 124, 632	$47, 325, 975	$790, 450, 607
Average per ton	$6. 71	$7. 98	$6. 78	$8. 05	$9. 57	$8. 13
Coke—						
Used by producer:						
Net tons	39, 093, 901	1, 493, 738	40, 587, 639	40, 456, 202	1, 356, 128	41, 812, 330
Value	$390, 980, 833	$14, 411, 987	$405, 392, 820	$480, 459, 356	$16, 923, 706	$497, 383, 062
Sold:						
Net tons	23, 999, 550	1, 994, 345	25, 993, 895	23, 726, 020	2, 119, 297	25, 845, 317
Value	$227, 137, 875	$26, 606, 612	$303, 744, 487	$308, 785, 885	$34, 679, 427	$343, 465, 312
Coal-chemical materials:						
Tar:						
Production ---- gallons	695, 891, 477	40, 283, 003	736, 174, 480	698, 812, 161	39, 942, 945	738, 755, 106
Sales ---- do	367, 988, 658	39, 984, 467	407, 973, 125	362, 324, 697	40, 082, 783	402, 407, 480
Value of sales	$28, 237, 834	$2, 744, 119	$30, 981, 953	$37, 772, 205	$4, 185, 543	$41, 957, 748
Ammonia:						
Production (NH_3 equivalent of all forms) ---- pounds	436, 567, 291	19, 588, 427	456, 155, 718	445, 998, 261	18, 848, 249	464, 846, 510
Liquor (NH_3 content):						
Production ---- do	48, 673, 103	2, 762, 690	51, 435, 793	47, 389, 668	2, 115, 583	49, 505, 251
Sales ---- do	44, 472, 455	2, 766, 155	47, 238, 610	44, 599, 274	2, 049, 972	46, 649, 246
Value of sales	$1, 399, 849	$71, 451	$1, 471, 300	$1, 563, 170	$54, 107	$1, 617, 277
Sulfate:						
Production ---- pounds	1, 551, 576, 751	67, 302, 948	1, 618, 879, 699	1, 594, 434, 373	66, 930, 664	1, 661, 365, 037
Sales ---- do	1, 557, 024, 670	67, 474, 325	1, 624, 498, 995	1, 597, 941, 697	67, 589, 019	1, 665, 530, 716
Value of sales	$25, 584, 853	$1. 139, 968	$26, 724, 821	$34, 134, 809	$1, 427, 182	$35, 561, 991
Gas:						
Production M cubic feet	916, 271, 433	54, 990, 847	971, 262, 280	940, 308, 003	54, 544, 623	994, 852, 626
Disposal of surplus:						
Used under boilers:						
M cubic feet	37, 774, 872	182, 481	37, 957, 353	32, 947, 179	205, 665	33, 152, 844
Value	$4, 449, 623	$27, 677	$4, 477, 300	$4, 053, 120	$32, 979	$4, 086, 099
Average per M cubic feet	$0. 118	$0. 152	$0. 118	$0. 123	$0. 160	$0. 123
Used in steel or allied plants:						
M cubic feet	348, 236, 552	----------	[2] 348, 236, 552	369, 457, 173	----------	369, 457, 173
Value	$48, 508, 482	----------	[2] $48, 508, 482	$57, 728, 546	----------	$57, 728, 546
Average per M cubic feet	$0. 139	----------	$0. 139	$0. 156	----------	$0. 156

See footnotes at end of table.

TABLE 63.—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 all other oven-coke plants, 1947–48—Continued

Product	1947			1948		
	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						
Gas—Continued						
Distributed through city mains:						
M cubic feet	119,823,501	[2] 48,128,370	[2] 167,951,871	121,431,452	47,916,462	169,347,914
Value	$34,656,479	[2] $18,370,566	[2] $53,027,045	$39,072,813	$19,157,077	$58,229,890
Average per M cubic feet	$0.289	[2] $0.382	[2] $0.316	$0.322	$0.400	$0.344
Sold for industrial use:						
M cubic feet	36,668,726	2,130,798	38,799,524	33,761,443	2,091,461	35,852,904
Value	$4,190,995	[2] $863,577	[2] $5,054,572	$4,560,742	$950,719	$5,511,461
Average per M cubic feet	$0.114	[2] $0.405	[2] $0.130	$0.135	$0.455	$0.154
Crude light oil:						
Production...gallons	247,849,742	7,128,721	254,978,463	249,439,265	6,649,800	256,089,065
Sales...do	11,924,699	3,222,777	15,147,476	14,865,168	2,777,593	17,642,761
Value of sales	$1,439,968	$241,075	$1,681,043	$1,795,008	$263,461	$2,058,469
Light oil derivatives:						
Production...gallons	204,697,979	3,706,201	208,404,180	204,935,568	3,615,515	208,551,083
Sales...do	199,678,808	3,359,271	203,038,079	200,638,617	3,770,475	204,409,092
Value of sales	$32,702,981	$399,277	$33,102,258	$39,611,675	$550,444	$40,162,119
Naphthalene, crude:						
Production...pounds	97,638,009	740,866	98,378,875	104,949,628	867,042	105,816,670
Sales...do	97,624,131	740,866	98,364,997	101,960,448	867,042	102,827,490
Value of sales	$3,003,588	$17,564	$3,021,152	$4,510,239	$35,628	$4,545,867
All other coal-chemical materials, value	$13,044,041	$59,076	$13,103,117	$15,563,462	$103,627	$15,667,089

[1] Coke ovens built by city gas companies some of which are operated in conjunction with coal- and water-gas plants. Does not include independent oven-coke plants which may sell gas to public-utility companies for distribution.
[2] Revised figure.

Copper

By CHARLES WHITE MERRILL AND HELENA M. MEYER

GENERAL SUMMARY

CONTINUATION of peak peacetime domestic consumption and determination of the United States Government to proceed toward its strategic stock-pile objective kept the copper-producing industry under pressure again in 1948 to meet the over-all demand. Ever since the period of work stoppages in mid-1946, domestic production rates had been close to what may be considered optimum capacity levels (nearly 875,000 tons annually). Prevailing conditions favored high production. Actual consumption plus stock-pile needs promised to take all copper made available, prices had risen sharply so that the annual average for 1948 established a 30-year peak, and inadequate labor supplies were largely overcome in most areas.

A strike of locomotive engineers inside the pit at the Kennecott Copper Corp's. Utah Copper mine, West Mountain (Bingham) district, Utah, largest producer in the United States, beginning October 24 and continuing beyond December 31, was almost entirely responsible for 1948 mine production falling short of the anticipated 875,000 tons; output was 834,813 tons. About 50,000 tons were lost from the 1948 supply as a result of the strike. The drop below the practical maximum in 1947 was due chiefly to a similar but briefer strike at the end of that year; production was 847,563 tons. Smelter output from domestic ores dropped only 2 percent to 842,477 tons in 1948, the full weight of changes in mine rates being reflected, as was natural, later in smelter than in mine totals.

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Imports of crude and refined copper rose to 507,251 tons from 413,894 tons in 1947, or 23 percent, and were at a new peacetime peak rate, although still far below tonnages entered during World War II. The quantity of foreign copper made available for domestic use was further increased by a small drop in exports of refined copper (from 147,642 tons in 1947 to 142,598 tons in 1948). The shortage of dollar exchange continued to deter normal exportation of copper and copper products. Export controls in 1948 still limited the shipment from the United States of copper and copper products made from domestic ores, but no quantitative restrictions were imposed on the exportation of copper from foreign ores and blister. In addition to foreign trade in copper, copper ore, and copper products there are always large but unmeasured net exports of copper in such manufactures as automobiles and electric motors. Industry and Government stocks (except the National Stock Pile) at the end of 1948 appeared to be close to an irreducible minimum considering the high rate of domestic consumption, but there was evidence that some stocking had taken place as a safeguard against difficulties in obtaining prompt delivery of the metal.

The price for electrolytic copper, delivered Connecticut Valley, was 21½ cents a pound at the end of 1947. In mid-1948, the price was advanced 2 cents a pound. Throughout 1947 and until the end of July 1948, the United States price for copper in the domestic market was below the United States export price and usually was considerably under the price of the British Ministry of Supply. Following the rise of 2 cents at the end of July, the United States price continued below the export price but was higher than that in the United Kingdom. The temporary excess over the United Kingdom figure was reversed again with the advance of £8 per long ton, to £140 (equivalent to 25.15 cents a pound), in the British Ministry of Supply price, effective October 1.

Congress adjourned in June 1948 without agreeing on any metal subsidy legislation. Copper mining had been a beneficiary under the metal subsidies that ceased June 1947.

World production in 1948, like that in the United States, appeared to be at practical capacity rates under prevailing conditions but at levels below peaks attained in World War II. Mine output is estimated as 2,558,000 short tons in 1948 compared with 2,436,000 tons in 1947.

Some of the plans in progress or prospect for major expansion or maintenance of present production rates are outlined in the following paragraphs.

Late in 1947 the Anaconda Copper Mining Co. announced that it would undertake a 5-year, $20,000,000 program to mine low-grade copper ore above the 3,400-foot level in the Butte Hill mines, called the "greater Butte project." An eventual output of 15,000 tons a day of the low-grade ore is anticipated, and the concentrator at Anaconda is being extended to treat the larger tonnages. Investigations indicate that more than 130,000,000 tons of ore, from which 20 pounds or more of copper a ton can be recovered, are available for treatment. Work in 1948 was reported to be proceeding according to schedule.

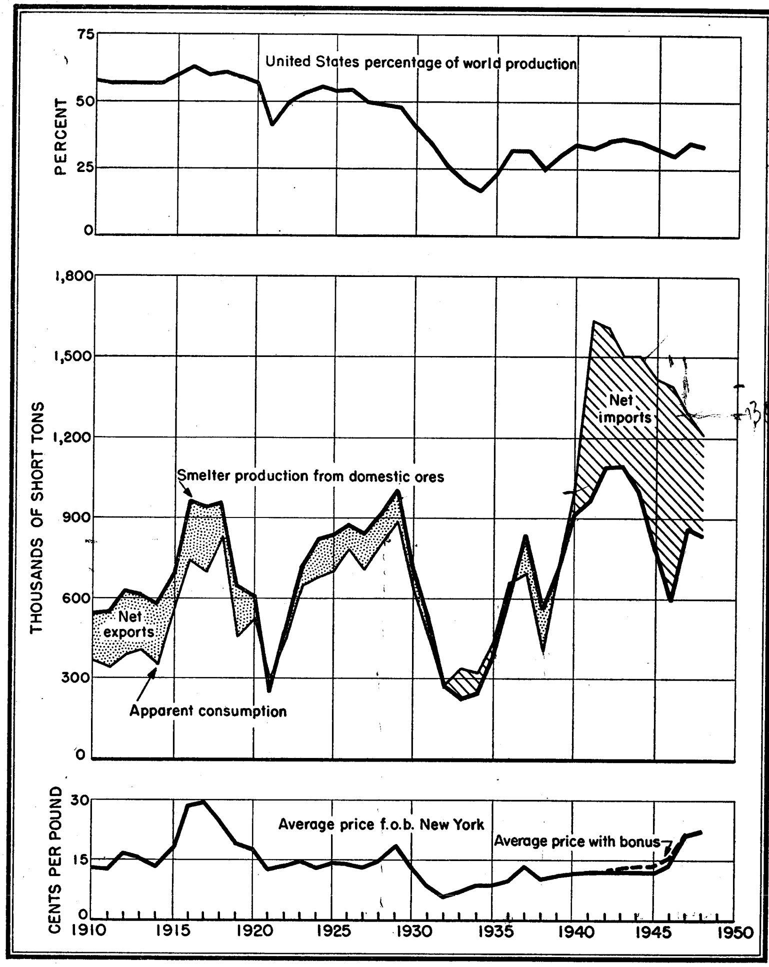

FIGURE 1.—Trends in production, consumption, and price of copper in the United States, 1910–48.

In addition to the large project in Montana, Anaconda is making even larger expenditures in Chile, where the oxide ores that have been worked to date are approaching exhaustion and where alterations must be made to treat the vast underlying reserves of sulfide ores.

The Kennecott Copper Corp. is constructing a copper refinery in the vicinity of the Magna mill, on the southern shore of Great Salt Lake. The company report for 1948 indicated that building foundations were nearing completion. The plant was planned originally to refine 12,000 tons a month but is being so constructed that the capacity can be increased quickly to 16,000 tons.

During the year the Phelps Dodge Corp. purchased from the Government facilities built and installed at Government expense during World War II and operated under lease by the corporation. These facilities included additions to the mine equipment and extensions to the concentrator and smelter plants at Morenci, Ariz., an extension to the refinery at El Paso, Tex., and a fabricating plant at Los Angeles, Calif. The company is constructing a new smelter at Ajo, Ariz.

This report for 1947 indicated that drilling of the San Manuel, Ariz., ore body was suspended indefinitely on February 23, 1948, following a campaign during which 123,499,580 tons of oxide ore, containing 0.767 percent copper, and 339,284,920 tons of sulfide ore, containing 0.788 percent copper—a total of 462,784,500 tons averaging 0.782 percent copper—were developed. Thus one of the largest copper ore bodies in the United States had been proved. During 1948 the necessary construction was undertaken and practically completed to provide power and other facilities for underground mining there.

In Northern Rhodesia plans included expansion of plant facilities; efforts continued to overcome rail and harbor conditions which had restricted transportation serving the mines. Expansion of present refinery capacity and new plants are said to be in prospect for the Belgian Congo.

Salient statistics of the copper industry in the United States, 1939–43 (average) and 1944–48, in short tons

	1939–43 (average)	1944	1945	1946	1947	1948
New copper produced—						
From domestic ores, as reported by—						
Mines	947,087	972,549	772,894	608,737	847,563	834,813
Ore produced:						
Copper ore [1]	78,675,088	91,063,648	77,472,983	62,232,342	87,864,898	84,729,043
Average yield of copper, percent	1.13	.99	.93	.91	.90	.92
Smelters	953,752	1,003,379	782,726	599,656	862,872	842,477
Percent of world total	33	35	33	29	35	33
Refineries	950,878	973,852	775,738	578,429	909,213	860,022
From foreign ores, matte, etc., refinery reports	351,563	247,335	332,861	300,233	250,757	247,424
Total new refined, domestic and foreign	1,302,441	1,221,187	1,108,599	878,662	1,159,970	1,107,446
Secondary copper recovered from old scrap only	377,626	456,710	497,095	406,453	503,376	505,464
Copper content of copper sulfate produced by refiners	6,648	8,269	8,237	5,070	6,161	6,132
Total production, new and old and domestic and foreign	1,686,715	1,686,166	1,613,931	1,290,185	1,669,507	1,619,042
Imports (unmanufactured) [2]	608,835	785,211	853,196	393,275	[3] 413,894	507,251
Refined [2]	247,159	492,395	531,367	154,371	[3] 149,482	249,124
Exports of metallic copper [4]	303,807	237,515	132,555	97,475	196,999	206,567
Refined (ingots, bars, rods, etc.)	239,468	69,002	53,572	[5] 52,629	[5] 147,642	[5] 142,598
Stocks at end of year	327,300	392,000	461,000	350,000	273,000	250,000
Refined copper	83,400	81,000	130,000	96,000	60,000	67,000
Blister and materials in solution	243,900	311,000	331,000	254,000	213,000	183,000
Withdrawals from total supply on domestic account:						
Total new copper	1,295,042	1,504,000	1,415,000	1,391,000	1,286,000	1,214,000
Total new and old copper (old scrap only)	1,672,668	1,961,000	1,912,000	1,797,000	1,789,000	1,719,000
Price average [6] cents per pound	11.4	11.8	11.8	14.4	20.9	21.7
World smelter production, new copper	2,853,000	2,848,000	2,409,000	2,046,000	2,481,000	2,581,000

[1] Includes old tailings.
[2] Data include copper imported for immediate consumption plus material entering country under bond.
[3] Revised figure.
[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; Premium Price Plan covered the period February 1, 1942, to June 30, 1947, inclusive.

The following Bureau of Mines reports of investigations, published recently, relate to copper in whole or in part.

4341. Ore Knob Copper Mine, Ashe County, N. C.
4344. Cape Rosier Zinc-Copper-Lead Mine, Hancock County, Maine.
4349. Rush & Brown Copper Mine, Kasaan Bay, Prince of Wales Island, southeastern Alaska.
4357. Sutherland Copper Prospect, Floyd County, Va.
4358. Salt Chuck Mine, Kasaan Peninsula, Prince of Wales Island, southeastern Alaska.
4362. Toncrae-Howard Copper Deposits, Floyd County, Va.
4364. Union Copper Mine, Cabarrus and Rowan Counties, N. C.
4378. Majuba Hill Copper-Tin Mine, Pershing County, Nev.
4384. Virgilina Copper District, Virginia and North Carolina.
4395. Ely Mine Copper Deposit, Orange County, Vt.
4397. Chestatee Copper and Pyrite Deposit, Lumpkin County, Ga.

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 recovery of metal 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, 1944–48, in short tons

Year	Mine	Smelter	Refinery
1944	972, 549	1, 003, 379	973, 852
1945	772, 894	782, 726	775, 738
1946	608, 737	599, 656	578, 429
1947	847, 563	862, 872	909, 213
1948	834, 813	842, 477	860, 022

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.

Arizona, as usual, easily led all other States in production in 1948, supplying 45 percent of the total for the United States, followed by Utah, with 27 percent. Arizona's output comes from a number of important copper-producing districts and mines, whereas Utah's is predominantly from one mine, the largest copper producer in the United States. Production from New Mexico, Montana, Nevada, and Michigan, ranking next in importance as copper producers in 1948, made up 25 percent of the total. The six States mentioned thus produced 97 percent of the United States total.

Classification of production by mining methods shows that approximately 68 percent of the total copper and 76 percent of the copper ore came from open pits in 1948. Most of the 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, in 1948, by months [1]

Month	Short tons	Month	Short tons
January	73, 643	August	74, 042
February	69, 419	September	70, 298
March	74, 578	October	69, 141
April	74, 827	November	52, 239
May	75, 264	December	53, 462
June	76, 076		
July	71, 824	Total	834, 813

[1] Monthly figures adjusted to final annual mine production total.

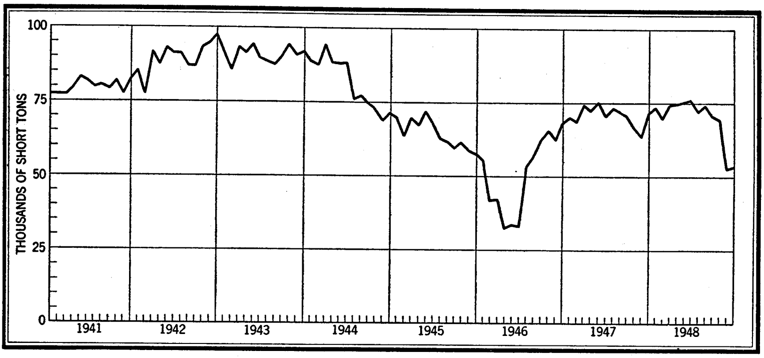

FIGURE 2.—Mine production of recoverable copper in the United States, 1941–48, by months, in short tons.

Mine production of recoverable copper in the United States, 1938–48, with production of maximum year, and cumulative production from earliest record to end of 1948, by States, in short tons

State	Maximum production [1]		Production by years											Total production from earliest record to end of 1948
	Year	Quantity	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	
Western States and Alaska:														
Alaska	1916	59,927	14,549	128	55	72	22	27	2	5	2	12	16	685,894
Arizona	1929	415,314	210,797	262,112	281,169	326,317	393,387	403,181	358,303	287,203	289,223	366,218	375,121	11,919,431
California	1909	28,644	806	4,180	6,438	3,943	1,058	8,762	12,721	6,473	4,240	2,407	481	628,712
Colorado	1938	14,171	14,171	13,215	12,152	6,748	1,102	1,028	1,048	1,485	1,754	2,150	2,298	255,159
Idaho	1907	5,445	2,139	2,516	3,349	3,621	3,430	2,324	1,688	1,548	1,038	1,640	1,624	111,051
Montana	1916	176,464	77,213	97,827	126,391	128,036	141,194	134,525	118,190	88,506	58,481	57,900	58,252	6,694,505
Nevada	1942	83,663	46,169	66,597	78,454	78,911	83,663	71,068	61,232	52,595	48,616	49,603	45,242	1,877,513
New Mexico	1942	80,100	20,439	46,142	69,848	73,478	80,100	76,163	69,730	56,571	50,191	60,205	74,687	1,485,091
Oregon	1916	1,791	38	48	88	83	103	6	3	1	7	14	2	12,359
South Dakota	1918	32			6		1		1					106
Texas	1928	224	16	34	30	6	99	81	115	55	3	6	23	1,338
Utah	1943	323,989	108,126	171,890	231,864	266,838	306,691	323,989	282,575	226,376	114,284	266,533	227,007	5,393,981
Washington	1940	9,612	6,017	8,998	9,612	8,686	8,030	7,315	6,169	5,821	4,527	2,240	5,665	86,831
Wyoming	1900	2,102			2	4					1			16,326
Total			500,480	673,687	819,458	896,743	1,018,880	1,028,469	911,777	726,639	572,367	808,928	790,418	29,168,297
West Central States:														
Missouri	1945	3,399			685	1,400	1,300	1,340	3,302	3,399	1,857	1,760	2,370	[2] 23,808
States east of the Mississippi:														
Alabama	1907	42												(3)
Georgia	1917	465			13									(3)
Maine	1918	383												(3)
Maryland	1917	146												(3)
Massachusetts	1906	5												(3)
Michigan	1916	136,846	46,743	43,985	45,198	46,440	45,679	46,764	42,421	30,401	21,663	24,184	27,777	4,871,451
New Hampshire	1908	[4] 94												(3)
North Carolina	1930	(5)	(6)	(6)	(6)	(6)	(6)	(6)	(6)					(3)
Pennsylvania	1942	(5)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(3)
South Carolina	(3)	(3)	(6)		(7)	(7)	(7)	(7)						(3)
Tennessee	1930	(5)	[6] 10,540	[6] 10,648	[6] 12,732	[6] 13,566	[6] 14,174	[6] 13,855	[6] 12,860	[6] 12,385	[6] 12,850	[6] 12,686	[6] 14,248	(3)
Vermont	1946	(5)						290	1,898	(6)	(6)	(6)	(6)	(3)
Virginia	1944	291	(6)				28	100	291	70		5		(3)
Wisconsin	1914	5												(2)
Total			57,283	54,633	57,943	60,006	59,881	61,009	57,470	42,856	34,513	36,875	42,025	[8] 5,467,534
Grand total	1943	1,090,818	557,763	728,320	878,086	958,149	1,080,061	1,090,818	972,549	772,894	608,737	847,563	834,813	[9] 34,659,639

[1] For Missouri and States east of the Mississippi, maximum since 1905.
[2] Small quantity for Wisconsin included with Missouri.
[3] Data not available.
[4] The 1908 volume of Mineral Resources credits this figure to Massachusetts and New Hampshire; the 1909 volume credits it to New Hampshire alone.
[5] Bureau of Mines not at liberty to publish figure.
[6] Tennessee includes other States indicated by footnote 6; Bureau of Mines not at liberty to publish separate figures.
[7] Less than 1 ton.
[8] For States other than Michigan, figures represent largely smelter output. Excludes small quantity, not separable, for Wisconsin shown with Missouri.
[9] Largely smelter production for States east of the Mississippi except Michigan.

Mine production of copper in the principal districts [1] of the United States, 1944–48, in terms of recovered copper, in short tons

District or region	State	1944	1945	1946	1947	1948
West Mountain (Bingham)	Utah	281, 100	224, 284	112, 083	264, 315	225, 225
Copper Mountain (Morenci)	Arizona	106, 926	100, 826	95, 366	147, 899	148, 316
Globe-Miami	do	95, 305	78, 646	88, 556	91, 032	88, 478
Central (including Santa Rita)	New Mexico	65, 520	[2] 55, 197	[2] 48, 806	57, 071	[2] 72, 784
Summit Valley (Butte)	Montana	117, 363	87, 948	57, 905	57, 187	57, 712
Ajo	Arizona	46, 250	37, 950	45, 233	49, 687	55, 615
Robinson (Ely)	Nevada	54, 651	49, 175	45, 777	47, 524	44, 491
Lake Superior	Michigan	42, 421	30, 401	21, 663	24, 184	27, 777
Yavapai County (mostly Verde (Jerome) district).	Arizona	32, 273	24, 903	22, 909	21, 936	22, 444
Warren (Bisbee)	do	32, 683	12, 567	4, 605	17, 059	19, 204
Mineral Creek (Ray)	do	27, 452	19, 671	16, 355	18, 935	18, 753
Pioneer (Superior)	do	12, 722	8, 365	12, 244	15, 922	18, 720
Chelan Lake	Washington	6, 119	5, 803	4, 494	2, 214	5, 654
Southeastern Missouri	Missouri	3, 302	3, 399	1, 857	1, 760	2, 370
San Juan Mountains	Colorado	512	1, 018	1, 333	1, 430	1, 865
Lordsburg	New Mexico	2, 359	1, 146	1, 196	1, 770	1, 708
Coeur d'Alene	Idaho	1, 289	1, 018	810	1, 312	1, 388
Cochise	Arizona	115	493	987	1, 036	968
Cope	Nevada	(3)	(3)	(3)	1, 105	14
Ione	California	237	827	1, 004	837	--------
Copperopolis	do	2, 122	1, 123	91	(3)	--------
Klamath River	do	7, 891	1, 526	--------	--------	--------
Burro Mountain	New Mexico	1, 261	(2)	(2)	1, 140	(2)
Flat Creek [4]	California	1, 292	1, 843	(3)	698	(3)
Lebanon (Cornwall mine) [4]	Pennsylvania	(3)	(3)	(3)	(3)	(3)
Ducktown [4]	Tennessee	(3)	(3)	(3)	(3)	(3)
Orange County [4]	Vermont	(3)	(3)	(3)	(3)	(3)

[1] Districts producing 1,000 short tons or more in any year of the period 1944–48.
[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 figure.
[4] Not listed in order of output.

Twenty-five leading copper-producing mines in the United States in 1948, 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	Chino	Central	New Mexico	Kennecott Copper Corp	Do.
4	Butte Mines	Summit Valley (Butte)	Montana	Anaconda Copper Mining Co	Copper, zinc-lead ores.
5	New Cornelia	Ajo	Arizona	Phelps Dodge Corp	Copper ore.
6	Inspiration	Globe-Miami	do	Inspiration Consolidated 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	Calumet and Hecla Cons	Lake Superior	Michigan	Calumet and Hecla Cons. Copper Co	Copper ore and tailings.
11	Copper Queen	Warren (Bisbee)	Arizona	Phelps Dodge Corp	Copper, zinc-lead, gold-silver ores.
12	Magma	Pioneer (Superior)	do	Magma Copper Co	Copper ore.
13	Ray Mines	Mineral Creek (Ray)	do	Kennecott Copper Corp	Do.
14	United Verde	Verde (Jerome)	do	Phelps Dodge Corp	Copper, zinc-copper ores.
15	Consolidated Coppermines Group	Robinson (Ely)	Nevada	Consolidated Coppermines Co	Copper ore.
16	Bagdad	Eureka (Bagdad)	Arizona	Bagdad Copper Corp	Do.
17	Burra Burra, Eureka, Boyd, Mary, Calloway.	Polk County	Tennessee	Tennessee Copper Co	Copper-bearing pyrites.
18	Holden	Chelan Lake	Washington	Howe Sound Co	Zinc-copper ore.
19	Cornwall	Lebanon County	Pennsylvania	Bethlehem Steel Co	Magnetite-pyrite-chalcopyrite ore.
20	Isle Royale	Lake Superior	Michigan	Isle Royale Copper Co	Copper ore.
21	Quincy	do	do	Quincy Mining Co	Copper-ore tailings.
22	Elizabeth	Orange County	Vermont	Vermont Copper Co	Copper ore.
23	Bonney and Miser's Chest Group	Lordsburg	New Mexico	Banner Mining Co	Do.
24	Treasury Tunnel Mines	Upper San Miguel	Colorado	Idarado Mining Co	Zinc-lead-copper ore.
25	United States and Lark	West Mountain (Bingham)	Utah	U. S. Smelting, Refining & Mining Co	Gold-silver, lead, silver, zinc-lead ores.

The first 5 mines in the foregoing table produced 67 percent of the United States total, 10 produced 84 percent, and the entire 25 furnished 98 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 1947; complete details for 1948 are not yet available. Of the total copper produced from copper ores in the United States during 1947, 92 percent was obtained from ores concentrated before smelting, 4 percent from direct-smelting ores, and 4 percent from ore treated by straight leaching. These percentages for 1947 compared with 91 percent obtained from concentrated ore, 4 percent from direct-smelting ores, and 5 percent by straight leaching in 1946.

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 1947, 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			
Arizona	37,810,448	[1] 709,708,360	0.94	75,711	2,583,264	$0.13
California	15,993	[1 2] 1,879,400	5.88	[2] 371	[2] 19,811	1.93
Colorado	16,572	1,017,995	3.07	859	203,389	12.92
Idaho	3,303	256,146	3.88	201	4,452	3.35
Michigan	5,129,774	48,368,000	.47		3,089	
Montana	1,838,580	[1] 105,903,087	2.88	12,872	1,784,945	1.12
Nevada	5,828,016	[1] 96,330,400	.83	42,673	285,249	.30
New Mexico	6,772,030	[1] 88,612,370	.65	1,756	178,794	.03
Oregon	109	14,000	6.42	39	721	18.51
Texas	68	4,291	3.16		140	1.87
Utah	29,021,293	[1] 507,207,298	.87	366,289	3,102,648	.54
Washington [3]	232,241	4,427,000	.95	12,024	48,926	2.00
East of the Mississippi (except Mich.)	1,196,471	[1 4] 25,372,000		403	100,616	
Total	[3] 87,864,898	[4] 1,589,100,347	.90	513,198	8,316,044	.29

[1] Excludes copper recovered from precipitates as follows: Arizona, 15,392,462 pounds; California, 8,800 pounds; Montana, 6,004,223 pounds; Nevada, 2,607,400 pounds; New Mexico, 30,306,293 pounds; Utah, 21,149,066 pounds; Virginia, 10,000 pounds.
[2] Includes metal recovered from pyritic ore (residue).
[3] Includes ore from Washington classed as zinc-copper ore and copper, gold, and silver recovered therefrom.
[4] Copper from magnetite-pyrite-chalcopyrite ore included with that from copper ore.

Copper ore, old tailings, etc., concentrated in the United States in 1947, 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] 33, 494, 441	1, 098, 003	[2] 586, 856, 015	0. 88
California	560	93	31, 300	2. 79
Colorado	5, 632	331	154, 400	1. 37
Michigan	5, 129, 774	42, 704	48, 368, 000	. 47
Montana	1, 816, 069	192, 773	[3] 104, 452, 092	2. 88
Nevada	5, 739, 109	184, 131	92, 080, 500	. 80
New Mexico	6, 675, 713	204, 059	[4] 86, 677, 899	. 65
Utah	29, 009, 573	790, 257	506, 366, 157	. 87
Washington [5]	232, 158	9, 672	4, 395, 800	. 95
East of the Mississippi (except Mich.)	1, 180, 051	[6] 73, 932	[7] 25, 216, 000	
Total	83, 283, 080	2, 595, 955	1, 454, 598, 163	. 87

[1] In addition 3,671,800 tons were treated by straight leaching.
[2] In addition 67,918,108 pounds of copper were recovered by straight leaching.
[3] Includes 455,724 pounds from iron concentrates.
[4] Excludes 30,306,293 pounds of copper recovered from precipitates.
[5] Includes ore classed as zinc-copper ore.
[6] Includes concentrates from magnetite-pyrite-chalcopyrite ore from Pennsylvania.
[7] Includes copper from magnetite-pyrite-chalcopyrite ore from Pennsylvania.

Copper ore, old tailings, etc., smelted in the United States in 1947, 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				24, 000
Arizona	644, 207	54, 934, 237	4. 26	[1] 732, 436, 000
California	15, 433	1, 848, 100	5. 99	[2] 4, 814, 000
Colorado	10, 940	863, 595	3. 95	4, 300, 000
Idaho	3, 303	256, 146	3. 88	3, 280, 000
Michigan				48, 368, 000
Missouri				3, 520, 000
Montana	22, 511	1, 450, 995	3. 22	[1] 115, 800, 000
Nevada	88, 907	4, 249, 900	2. 39	[1] 99, 206, 000
New Mexico	96, 317	1, 934, 471	1. 00	[1] 120, 410, 000
Oregon	109	14, 000	6. 42	28, 000
Texas	68	4, 291	3. 16	12, 000
Utah	11, 720	841, 141	3. 59	[1] 533, 066, 000
Washington	83	31, 200	18. 80	4, 480, 000
East of the Mississippi (except Mich.)	16, 420	156, 000	. 48	25, 382, 000
Total	910, 018	66, 584, 076	3. 66	1, 695, 126, 000

[1] Considerable copper was recovered from precipitates.
[2] Mostly from ores not classed as copper ores.

Copper ores produced in the United States, 1938–42 (average) and 1943–47, 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
1938-42 (average)	2,194,418	4.38	61,491,615	1.08	66,627,963	1.19	0.0075	0.267	$0.45
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
1946	742,666	3.12	58,520,635	.88	[2] 62,232,342	.91	.0046	.091	.23
1947	910,018	3.66	83,283,080	.87	[2] 87,864,898	.90	.0058	.095	.29

[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 842,477 short tons in 1948, a decrease of 2 percent from the total of 862,872 tons for 1947. Such 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 was slightly above 35 percent, and in 1945–48 it ranged from 29 to 35 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 1.

Copper produced (smelter output) in the United States, 1939–43 (average) and 1944–48, and total, 1845–1948

Year	Short tons	Value [1]
1939–43 (average)	953,752	$219,276,000
1944	1,003,379	236,797,000
1945	782,726	184,723,000
1946	599,656	172,701,000
1947	862,872	360,680,000
1948	842,477	365,635,000
Total, 1845–1948	34,736,590	10,315,249,000

[1] Excludes bonus payments of Office of Metals Reserve; Premium Price Plan in effect Feb. 1, 1942, to June 30, 1947.

Refinery Production.—The refinery output of copper in the United States in 1948 was made by 12 plants; 8 of these employed the electrolytic method only, 2 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 virtually all of the plant output was treated by this method in 1948. The El Paso plant of the Phelps Dodge Refining Corp. produced fire-refined copper in addition to the usual electrolytic grade. Of the plants specified above, the Lake refinery of the Copper Range Co. has been idle since October 9, 1945. That of the Quincy Mining Co., idle since 1933, was reopened in the final quarter of 1948.

In addition to the plants in the preceding paragraph, but included in the 12 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; but in 1946 more than one-third went directly to consuming plants. The latter practice was continued in 1947 and 1948 but on a considerably reduced scale.

Primary and secondary copper produced by primary refineries in the United States and imported, 1939–43 (average) and 1944–48, in short tons

	1939–43 (average)	1944	1945	1946	1947	1948
Primary:						
Domestic: [1]						
Electrolytic [2]	875,527	837,089	669,705	475,571	805,718	745,102
Lake [2]	44,636	41,597	29,995	21,567	23,998	26,511
Casting	30,715	95,166	76,038	81,291	79,497	88,409
Total	950,878	973,852	775,738	578,429	909,213	860,022
Foreign: [1]						
Electrolytic	350,376	247,335	298,128	300,233	250,757	247,424
Casting and best select	1,187		34,733			
Refinery production, new copper	1,302,441	1,221,187	1,108,599	878,662	1,159,970	1,107,446
Imports, refined copper [3]	247,159	492,395	531,367	154,371	149,482	249,124
Total new refined copper made available	1,549,600	1,713,582	1,639,966	1,033,033	1,309,452	1,356,570
Secondary:						
Electrolytic [4]	105,411	78,402	[5] 84,044	[5] 97,615	[5] 249,560	[5] 222,602
Casting	2,901	7,996	12,618	7,957	19,525	22,774
Total	108,312	86,398	96,662	105,572	269,085	245,376
Grand total	1,657,912	1,799,980	1,736,628	1,138,605	1,578,537	1,601,946

[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 1945–48.

The 13 plants indicated constitute what commonly are termed "regular refineries." Of these plants, eight 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 1,509,000 tons of refined copper a year. They produced at the rate of 81 percent of capacity in 1948.

The accompanying tables show the production of refined copper at regular refining plants, classified according to source, grade, and form in which cast.

Copper cast in forms at primary refineries in the United States, 1946–48

Form	1946		1947		1948	
	Short tons	Percent	Short tons	Percent	Short tons	Percent
Wire bars	502,000	51	885,000	62	783,000	58
Billets	112,000	11	160,000	11	187,000	14
Ingots and ingot bars	102,000	10	99,000	7	148,000	11
Cakes	142,000	15	178,000	13	134,000	10
Cathodes	115,000	12	87,000	6	76,000	5
Other forms	11,000	1	20,000	1	25,000	2
Total	984,000	100	1,429,000	100	1,353,000	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 24,500 short tons having a copper content of 6,132 tons in 1948 compared with 24,600 tons containing 6,161 tons in 1947. The output of copper sulfate by plants other than the regular primary refineries totaled 72,200 tons with a reported content of 18,054 tons in 1948 compared with 64,500 tons containing 16,115 tons of copper in 1947. Producers held 10,200 tons of copper sulfate at the beginning of 1948, total production was 96,700 tons, and shipments amounted to 93,100 tons. Some small purchases were made by producers during the year, and producers used a quantity equivalent to 2 percent of shipments. Inventories at the year end were 11,800 tons.

SECONDARY COPPER

Secondary copper includes material recovered from remelting old copper and copper scrap and from copper alloys or alloys treated without separation of the copper. The following table summarizes the production of secondary copper during 1939–48. Detailed information appears in the Secondary Metals—Nonferrous chapter of this volume.

Secondary copper produced in the United States, 1939–43 (average) and 1944–48, in short tons

	1939–43 (average)	1944	1945	1946	1947	1948
Copper recovered as unalloyed copper	142,122	102,135	112,856	136,909	303,092	284,026
Copper recovered in alloys [1]	612,267	848,807	893,660	666,637	658,649	688,762
Total secondary copper	754,389	950,942	1,006,516	803,546	961,741	972,788
From new scrap	376,763	494,232	509,421	397,093	458,365	467,324
From old scrap	377,626	456,710	497,095	406,453	503,376	505,464
Percentage equivalent of domestic mine output	80	98	130	132	113	117

[1] Includes copper in chemicals, as follows: 1939–43 (average), 10,582; 1944, 13,357; 1945, 18,666; 1946, 19,192; 1947, 18,838; 1948, 17,612.

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 manufacturing primary fabrications of copper is consumed. The method of calculating the quantity of copper available for consumption is shown in the accompanying 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 changes in consumers' stocks. Actual consumption of new copper has been at virtually constant rates, at peacetime peak levels, in the postwar period. The apparent consumption calculation is distorted in 1947 and 1948 by the fact that during this period unusual quantities of copper were imported in the form of scrap and reexported in refined form. Because refined exports cannot be broken down to show new and old copper, deductions were made from apparent consumption without making corresponding additions to supply.

New refined copper withdrawn from total year's supply on domestic account 1944–48, in short tons

	1944	1945	1946	1947	1948
Total supply of new copper	1,713,582	1,639,966	1,033,033	1,309,448	1,356,570
Stock at beginning of year	68,500	81,000	130,000	96,000	60,000
Total available supply	1,782,082	1,720,966	1,163,033	1,405,448	1,416,570
Copper exported [1]	68,373	48,563	52,629	147,642	142,598
Stock at end of year	81,000	130,000	96,000	60,000	67,000
Total	149,373	178,563	148,629	207,642	209,598
Withdrawn on domestic account [2]	1,504,000	1,415,000	1,391,000	1,286,000	[3] 1,214,000

[1] Includes refined copper in ingots, bars, or other forms.
[2] Adjusted for Office of Metals Reserve stock changes.
[3] Includes copper delivered to the National Strategic Stock Pile.

The Bureau of Mines began to compile figures on actual consumption of copper in 1945. Details for 1946 to 1948, inclusive, are shown in the accompanying 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.

The heavy consumption of wire bars in 1947 and 1948 is noteworthy.

Refined copper consumed in 1946–48, by classes of consumers, in short tons

Class of consumer	Cathodes	Wire bars	Ingots and ingot bars	Cakes and slabs	Billets	Other	Total
1946:							
Wire mills	1, 803	484, 004	15, 238				501, 045
Brass mills	97, 890	56, 834	170, 772	187, 614	102, 804	1, 678	617, 592
Chemical plants	60		4, 432			5, 661	10, 153
Secondary smelters	17, 180		12, 705	206	250	329	30, 670
Foundries and miscellaneous	2, 263	225	21, 954	180	645	2, 282	27, 549
Total	119, 196	541, 063	225, 101	188, 000	103, 699	9, 950	1, 187, 009
1947:							
Wire mills	2, 550	[1] 757, 529	17, 633			52	[1] 777, 764
Brass mills	68, 427	67, 065	117, 936	222, 203	173, 124	4	648, 759
Chemical plants	59		251			1, 662	1, 972
Secondary smelters	4, 107		3, 074	279	166	197	7, 823
Foundries and miscellaneous	1, 924	23	20, 299	113	489	4, 128	26, 976
Total	77, 067	[1] 824, 617	159, 193	222, 595	173, 779	6, 043	[1] 1, 463, 294
1948:							
Wire mills	13	743, 403	22, 390			43	765, 849
Brass mills	79, 235	62, 454	92, 889	209, 861	169, 875		614, 314
Chemical plants	45		655		5	2, 524	3, 229
Secondary smelters	4, 847		1, 411	242	178	127	6, 805
Foundries and miscellaneous	1, 585	216	23, 530	67	355	4, 634	30, 387
Total	85, 725	806, 073	140, 875	210, 170	170, 413	7, 328	1, 420, 584

[1] Revised figure.

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 with blister copper.

Over-all industry stocks continued to drop in 1948 as new supplies again fell short of large consumer needs.

Stocks of copper at primary smelting and refining plants in the United States at end of year, 1944–48, 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]
1944	81, 000	311, 000	1947	60, 000	213, 000
1945	130, 000	331, 000	1948	67, 000	183, 000
1946	96, 000	254, 000			

[1] Includes copper in transit from smelters in the United States to refineries therein.

Producers' (smelters and refineries) inventories of crude and refined copper, of which only about one-quarter was in the form of refined metal, fell 8 percent, aggregating 250,000 tons at the end of the year.

At the end of 1947 the Office of Metals Reserve held 9,986 tons of electrolytic and fire-refined copper in cathodes, shapes, and in-process copper. No copper remained in Metals Reserve hands at the end of 1948, having been sold to industry or shipped to the National Strategic Stock Pile.

Fabricators held 379,346 tons of refined copper (including in-process metal and primary fabricated shapes) at the end of 1948, according to the United States Copper Association, a decline of 10 percent compared with inventories when the year began. Working stocks were reported as 295,958 tons, or virtually unchanged from those on hand a year before. After accounting for unfilled purchases of metal, the deficiency of stocks in relation to unfilled orders was found to be 151,060 tons compared with 104,922 at the end of 1947.

Figures compiled by the Copper Institute show that domestic stocks of refined copper increased from 76,035 tons at the end of 1947 to 96,080 tons at the end of 1948. Inventory data of the Bureau of Mines and the Copper Institute always vary owing to somewhat different bases. Before 1947, a primary reason was that the Copper Institute coverage was limited to duty-free copper. The inclusion by the Copper Institute of all copper after January 1, 1947, reduced the differences chiefly to variations in individual interpretation. In the Bureau of Mines classification, cathodes to be used chiefly for melting and casting into shapes are considered stocks in process and not refined stocks.

Stocks of copper in fabricators' hands at end of year, 1944–48, 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
1944	334,017	53,538	289,160	285,654	−187,259
1945	375,618	44,100	268,490	362,436	−211,208
1946	411,013	59,421	286,418	526,648	−342,632
1947	423,432	103,765	293,859	338,260	−104,922
1948	379,346	81,496	295,958	315,944	−151,060

[1] Includes in-process metal and primary fabricated shapes. Also includes small quantities of refined copper held at refineries for fabricators' account.

PRICES

Reports to the Bureau of Mines from copper-selling agencies indicate that 1,377,000 short tons of copper were delivered to domestic and foreign purchasers in 1948 at an average price (f. o. b. refinery) of 21.7 cents a pound or 58 percent above that prevailing for 1942–47. The averages for 1942–47 exclude bonuses paid for overquota outputs of individual mines, which were first applicable to February 1942 tonnages; the Premium Price Plan ended June 30, 1947. The history of the Premium Price Plan is given briefly in the report of this series for 1947.

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Average monthly quoted prices of electrolytic copper for domestic and export shipments, f. o. b. refineries, in the United States, 1947–48, in cents per pound

Month	1947			1948		
	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	19.45	19.270	19.926	21.37	21.200	21.532
February	19.87	19.349	20.403	21.37	21.200	21.507
March	21.12	20.911	22.206	21.37	21.200	21.531
April	21.37	21.225	23.315	21.37	21.200	21.534
May	22.19	22.105	23.591	21.37	21.200	21.554
June	21.50	21.348	21.642	21.37	21.200	21.696
July	21.37	21.226	21.359	21.49	21.375	21.668
August	21.37	21.225	21.326	23.11	23.085	23.425
September	21.37	21.225	21.388	23.37	23.200	23.425
October	21.37	21.209	21.389	23.37	23.200	23.425
November	21.37	21.200	21.460	23.37	23.200	23.425
December	21.37	21.200	21.488	23.37	23.200	23.454
Average for year	21.15	20.958	21.624	22.20	22.038	22.348

[1] As reported by American Metal Market.
[2] As reported by E&MJ Metal and Mineral Markets.

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, 1939–48, in cents per pound

	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
Domestic f. o. b. refinery [1]	11.07	11.40	11.87	11.87	11.87	11.87	11.87	13.92	21.15	22.20
Domestic f. o. b. refinery [2]	10.965	11.296	11.797	11.775	11.775	11.775	11.775	13.820	20.958	22.038
Export f. o. b. refinery [2]	10.727	10.770	10.901	11.684	11.700	11.700	11.700	14.791	21.624	22.348
London spot [2] [3]	[4] 10.066	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)

[1] As reported by American Metal Market.
[2] As reported by E&MJ Metal and Mineral Markets.
[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 price changes.

Copper was in strong demand throughout 1948, but the price remained at 21.2 cents a pound for electrolytic copper, f. o. b. refinery, until the end of July. Sharp advances in prices for lead and zinc were followed by a rise for copper of 2 cents a pound in small producers' prices on July 29. By August 11 all producers were quoting the higher price, which prevailed throughout the remainder of the year. The average monthly price for export copper, f. o. b. refinery, was 0.3 to 0.5 cent higher than the domestic price in the first 8 months of the year, dropped to 0.225 cent in September–November, and was 0.254 cent in December.

London Price.—The official maximum price of the British Ministry of Supply for electrolytic copper in the London market was established at £132 per long ton (equivalent to 23.73 cents a pound) on July 14, 1947, and remained at that level until late in 1948. Following several advances in the United States price, the British price was raised to £140 per long ton (25.15 cents a pound), effective October 1, at which level it continued beyond the end of the year.

FOREIGN TRADE [1]

Before World War II United States imports and exports of copper constituted a well-balanced trade through which the smelting, refining, and manufacturing facilities of this country were utilized to treat foreign materials and to return refined copper and manufactures of copper abroad. Because of the excise tax on copper imported into the country, virtually no foreign metal was consumed in the United States, the imported copper being treated under bond and thus not subject to payment of the tax. This situation was changed during the war, when all copper imported had to be retained for the war program; because the Government became the importing agent during this period, the tax was ineffective. In the postwar period industry and Government again required all imported as well as domestic copper to fill above-normal requirements for the metal, and most of the imported copper again was consumed here. To encourage imports the excise tax was suspended, effective April 30, 1947—March 31, 1949.

IMPORTS

Total imports of unmanufactured copper gained 23 percent and were at a peacetime peak rate but continued well below records established in 1941–45. Total entries of the lower-grade imports were little changed in 1948 as compared with 1947; but the more important unrefined class dropped 7 percent, while the refined class rose 67 percent to lead other items by a substantial margin. Quantities of ores and concentrates received from the larger suppliers in 1948 differed somewhat from 1947; but totals for the two were similar, the greatest change being the drop in imports from Peru. In the unrefined grade, receipts from Northern Rhodesia were reported in 1948 but not in 1947; entries from Chile were larger but those from Mexico, Peru, Yugoslavia, and the Union of South Africa dropped, and Turkey disappeared from the list. Chile's shipments of refined copper to the United States rose sharply in 1948, Canada's likewise gained markedly, the unusual entry from Japan in 1947 was not repeated in 1948, and receipts from Peru dropped.

Copper (unmanufactured) imported into the United States, 1939–43 (average) and 1944–48 [1]

[U. S. Department of Commerce]

Year	Short tons	Year	Short tons
1939–43 (average)	608,835	1946	393,275
1944	785,211	1947	[2] 413,894
1945	853,196	1948	507,251

[1] Data include copper imported for immediate consumption plus material entering country under bond.
[2] Revised figure.

[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, by countries, 1947–48, in short tons [1]

[U. S. Department of Commerce]

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
1947						
Australia	2	320				196
Bolivia	337	6,415				
Canada	29	18,468	2,126	28	1,180	4,651
Chile	6,586	13,072	321	59,885	[3] 143,010	250
Cuba	50	14,848				55
Czechoslovakia				1,096		
Ecuador		132	58			
Japan					3,226	
Mexico	5,447	4,158	1,763	64,410	66	62
Newfoundland and Labrador		3,922				42
Peru	387	7,326	906	21,978	2,000	
Philippines, Republic of	(2)	[2] 2,130				55
Turkey				1,933		
Union of South Africa	1,658	65	49	7,903		91
Yugoslavia		172		10,145		
Other countries	169	165				551
Total	14,665	71,193	5,223	167,378	[3] 149,482	5,953
1948						
Australia	2	767				801
Bolivia	804	5,925				
Brazil						1,137
Canada	34	20,726	813	120	17,127	4,749
Canal Zone						173
Chile	5,052	14,480	341	70,542	230,288	
China		2			113	170
Cuba	41	16,134				16
Ecuador		482				
Malta, Gozo, and Cyprus		2,689				
Mexico	1,011	7,462	1,485	46,651	947	37
Netherlands				552		239
Newfoundland and Labrador		3,665				33
Northern Rhodesia [4]		131	14	18,916		
Panama, Republic of						101
Peru	431	4,582	638	13,434	233	
Philippines, Republic of	(2)	[2] 2,125				
Union of South Africa	794	1,636	32	3,321		143
United Kingdom					113	882
Yugoslavia				2,298		
Other countries	28	297	334	2	303	853
Total	8,197	81,103	3,657	155,836	249,124	9,334

[1] Data include copper imported for immediate consumption plus material entering the country under bond.
[2] Some copper in "ore" and "other" from Republic of the Philippines is not separately classified and is included with "concentrates"
[3] Revised figure.
[4] Tonnages credited to Southern Rhodesia by the U. S. Department of Commerce have been added to Northern Rhodesia.

EXPORTS

Refined copper continued in its usual position as by far the chief copper export class; shipments in 1948 were slightly smaller than in 1947. Of the larger recipients in 1947, United Kingdom, Netherlands, Sweden, and Italy obtained less in 1948, and India, Switzerland, France, and Germany received more. Sweden was shipped virtually none in 1948. Of the other export classes, the negligible ore and concentrates class gained, as did rods, pipes and tubes, wire (insulated), and old and scrap. On the other hand, smaller quantities of plates and sheets and wire (except insulated) were exported.

Copper exported from the United States, 1944–48

[U. S. Department of Commerce]

Year	Ore, concentrates, composition metal, and unrefined copper (copper content)	Refined copper and manufactures	Total (except "Other copper manufactures")		Other copper manufactures [1]	Grand total
	Short tons			Value		
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
1947	115	196,999	197,114	99,907,924	2,580,974	102,488,898
1948	2,473	206,567	209,040	110,801,691	2,249,857	113,051,548

[1] Weight not recorded.
[2] Less than 1 ton.

Copper exported from the United States, by countries, 1948, in short tons

[U. S. Department of Commerce]

Country	Ore, concentrates, composition metal, and unrefined copper (copper content)	Refined in bars, ingots, or other forms	Rods	Old and scrap	Pipes and tubes	Plates and sheets	Wire (except insulated)	Insulated wire and cable	Other copper manufactures
Algeria		2,733			10	11	4	10	
Argentina	6	4,327	(1)		194	31	475	1,546	
Belgium and Luxembourg		2,576		11	66	2	1	420	
Brazil	110	1,595	5		268	162	108	741	
Canada	3	44	341	93	511	111	339	3,658	
Canal Zone		30	(1)		22	26	1	447	
Chile		7	2		19	7	139	833	
China		326	66		95	137	207	5,880	
Colombia		4	2		98	784	261	1,833	
Cuba	3	3	9		910	85	783	2,248	
Denmark		1,593	670		12		(1)	17	
Dominican Republic		2			39	26	79	272	
France		10,222			16	1	25	1,514	
Germany		8,685		17	9	1		18	
Greece	2,200	125	8		26	70	462	44	
India		15,097		1,673	153	12	(1)	857	(2)
Italy		4,463	275	52	(1)	6	2,902	23	
Mexico	3	558	65	(1)	698	288	451	1,705	
Netherlands		8,776	6,363	57	398	63	18	255	
Norway		896			96	73	62	103	
Panama, Republic of					26	9	18	253	
Peru		6	4		59	33	70	433	
Philippines, Republic of	1	7	18		150	23	411	1,571	
Portugal		279		56	21	51	3	31	
Saudi Arabia		(1)			80	13	181	731	
Switzerland	20	11,317	167	56	40	40	4	105	
Turkey		3	34		9	16	210	364	
Union of South Africa		1	28		207	110	1,339	407	
United Kingdom	126	62,776	17	231	45	42	(1)	235	
Uruguay		160	1		166	54	109	236	
Venezuela	1	2	4		380	204	795	2,773	
Other countries		5,985	22	20	423	362	1,237	5,246	
Total: Short tons	2,473	142,598	8,101	2,266	5,246	2,853	10,694	34,809	(2)
Value	$1,029,106	$63,236,309	$3,899,348	$820,337	$4,709,342	$2,226,410	$6,413,024	$28,467,815	$2,249,857

[1] Less than 1 ton.
[2] Weight not recorded.

Brass and bronze exported from the United States, by classes, 1947–48

[U. S. Department of Commerce]

Class	1947		1948	
	Short tons	Value	Short tons	Value
Ingots	1,287	$521,433	424	$191,240
Scrap and old	3,157	1,061,627	6,584	2,247,385
Bars and rods	5,336	2,872,470	2,026	1,326,540
Plates and sheets	5,976	4,224,152	3,931	2,966,531
Pipes and tubes	2,895	2,345,650	2,484	2,303,487
Pipe fittings	467	777,858	595	1,031,969
Plumbers' brass goods	1,885	4,085,322	1,594	3,384,099
Wire of brass or bronze	3,201	3,257,442	2,455	2,638,524
Brass wood screws	(1)	185,082	(1)	138,850
Hinges and butts of brass or bronze	(1)	239,756	(1)	232,818
Other hardware of brass or bronze	(1)	1,388,781	(1)	774,014
Other brass or bronze manufactures	(1)	6,841,834	(1)	5,160,495
Total	(1)	27,801,407	(1)	22,395,952

1 Weight not recorded.

Unmanufactured brass (ingots, bars, rods, plates, and sheets) exported from the United States, 1944–48

[U. S. Department of Commerce]

Year	Short tons	Value	Year	Short tons	Value
1944	128,852	$46,610,439	1947	12,599	$7,618,055
1945	33,781	11,833,013	1948	6,381	4,484,311
1946	8,990	3,857,117			

Copper sulfate (blue vitriol) exported from the United States, 1944–48

[U. S. Department of Commerce]

Year	Short tons	Value	Year	Short tons	Value
1944	28,922	$2,843,941	1947	34,021	$4,099,551
1945	34,967	3,419,332	1948	42,135	6,514,960
1946	41,345	4,076,850			

WORLD REVIEW

The leading copper-producing countries of the world, with the exception of the United States, had larger outputs in 1948 than in 1947. There is, as usual, question regarding the U. S. S. R., for which precise data are not obtainable, but doubtless production rose in that country also. The drop in the United States resulted from the strike at the country's leading mine—the Utah Copper—from October 24 through the remainder of the year. Altogether a small increase in world production is indicated.

World mine production of copper, 1942–48, in metric tons

[Compiled by B. B. Mitchell]

Country	1942	1943	1944	1945	1946	1947	1948
North America:							
Canada	273, 815	260, 900	248, 145	215, 416	166, 892	204, 897	217, 614
Cuba	[1] 8, 916	6, 405	6, 584	9, 067	11, 323	13, 729	16, 299
Mexico	51, 379	49, 774	41, 302	61, 680	61, 054	64, 811	59, 076
Newfoundland	5, 666	5, 669	5, 021	4, 693	4, 458	3, 853	4, 126
United States	979, 811	989, 568	882, 277	701, 154	552, 234	768, 892	757, 326
Total North America	1, 319, 587	1, 312, 316	1, 183, 329	992, 010	795, 961	1, 056, 182	1, 054, 441
South America:							
Bolivia [1]	6, 376	6, 011	6, 170	6, 097	6, 127	6, 241	6, 616
Chile	489, 158	509, 378	498, 520	446, 398	358, 848	414, 478	448, 289
Ecuador [2]	1, 587	4, 418	3, 720	3, 289	2, 699	120	482
Peru	35, 332	33, 407	32, 396	31, 916	24, 592	22, 492	18, 068
Total South America	532, 453	553, 214	540, 806	487, 700	392, 266	443, 331	473, 455
Europe:							
Austria	982	1, 365	1, 500	320	125	259	982
Finland	16, 102	16, 363	15, 841	14, 978	13, 550	15, 409	23, 326
France	317	149	82	327	353	71	(3)
Germany [4]	23, 000	21, 600	23, 500	(3)	[5] 18, 300	[5] 17, 500	[6] 364
Hungary	980	910	[7] 750	(3)	160	[4] 300	(3)
Italy [8]	4, 082	[7] 2, 540	363	2, 177	(3)	(3)	(3)
Norway	15, 471	16, 248	14, 462	5, 203	12, 249	14, 707	13, 625
Spain [8]	10, 700	11, 100	11, 000	8, 300	8, 600	[4] 11, 800	(3)
Sweden	18, 056	17, 832	16, 121	14, 926	15, 362	13, 144	16, 329
U. S. S. R.[4 9 10]	135, 000	130, 000	135, 000	140, 000	150, 000	165, 000	180, 000
Yugoslavia [10]	32, 000	27, 000	22, 700	(3)	(3)	(3)	(3)
Total Europe [4 9]	257, 000	245, 000	241, 500	205, 000	240, 000	260, 000	290, 000
Asia:							
China [10 11]	1, 255	1, 146	1, 030	623	947	915	472
Cyprus [1]	----------	5, 177	1, 422	----------	71	12, 681	15, 735
Formosa	5, 067	6, 020	3, 985	(3)	(3)	(3)	1, 183
India	6, 706	6, 909	6, 706	6, 230	6, 060	5, 462	6, 316
Indonesia	60	60	60	(3)	(3)	(3)	(3)
Japan	[12] 83, 058	[12] 94, 729	[12] 86, 842	27, 984	17, 173	21, 892	25, 765
Korea (South)	[13] 1, 160	2, 052	2, 720	1, 251	522	389	66
Philippines, Republic of	(3)	(3)	(3)	(3)	----------	2, 502	3, 350
Turkey	8, 257	10, 000	[10] 11, 050	[10] 9, 858	[10] 10, 050	[10] 10, 080	12, 367
U. S. S. R.	(9)	(9)	(9)	(9)	(9)	(9)	(9)
Total Asia [4 9 14]	113, 000	135, 000	116, 000	48, 000	37, 000	56, 000	67, 000
Africa:							
Algeria	(3)	5	44	76	----------	----------	----------
Belgian Congo [10]	165, 938	156, 850	165, 484	160, 200	143, 885	150, 840	155, 481
French Morocco	267	227	635	43	60	67	449
Portuguese West Africa	234	224	71	52	88	28	394
Rhodesia:							
Northern	[10] 250, 564	258, 410	225, 685	199, 337	191, 546	197, 288	226, 472
Southern	20	20	5	(3)	(3)	(3)	(3)
South-West Africa [4]	1, 600	5, 000	(3)	----------	----------	3, 100	10, 800
Union of South Africa	24, 583	22, 731	22, 869	24, 016	26, 980	29, 330	29, 450
Total Africa	443, 206	443, 467	414, 793	383, 724	362, 559	380, 653	423, 046
Australia	20, 729	24, 716	28, 506	24, 914	18, 040	13, 334	13, 440
World total [4 14]	2, 686, 000	2, 714, 000	2, 525, 000	2, 141, 000	1, 846, 000	2, 210, 000	2, 321, 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] British and Russian zones only.
[6] Bizonal area.
[7] January to June, inclusive.
[8] According to Yearbook of American Bureau of Metal Statistics.
[9] Output from U. S. S. R. in Asia included with U. S. S. R. in Europe.
[10] Smelter production.
[11] Data represent areas designated as Free China during the period of Japanese occupation.
[12] Preliminary data for fiscal year ended March 31 of year following that stated.
[13] Incomplete data.
[14] Includes estimate for Burma.

World smelter production of copper, 1942–48, in metric tons

[Compiled by B. B. Mitchell]

Country	1942	1943	1944	1945	1946	1947	1948
North America:							
Canada	[1] 244,040	[1] 232,740	[1] 224,049	[1] 198,427	[1] 151,434	179,997	192,624
Mexico	44,729	43,013	32,974	53,287	52,371	58,475	48,761
United States [2]	1,111,458	1,103,918	1,022,382	784,173	592,229	857,007	839,550
Total North America	1,400,227	1,379,671	1,279,405	1,035,887	796,034	1,095,479	1,080,935
South America:							
Chile	477,733	489,320	489,906	440,289	351,989	409,161	424,866
Ecuador [3]	----------	4,030	3,708	3,285	2,659	----------	----------
Peru	29,473	28,215	26,888	25,550	19,595	17,824	12,809
Total South America	507,206	521,565	520,502	469,124	374,243	426,985	437,675
Europe:							
Austria	2,761	5,711	6,051	1,454	----------	378	2,288
Belgium [4]	16,950	18,320	4,310	----------	----------	----------	(5)
Finland	13,263	15,535	6,756	13,686	20,952	21,087	18,555
France [6]	140	82	20	25	2	(5)	(5)
Germany	[7] 38,300	[7] 31,300	[7] 24,000	(5)	[8] 38,809	[8 9] 32,016	[8 9] 62,244
Italy	878	1,172	279	2,181	526	520	(5)
Norway	4,597	2,014	937	1,692	7,549	7,920	8,674
Rumania	46	70	(5)	(5)	1,116	(5)	(5)
Spain	11,590	10,952	10,891	6,268	9,917	17,287	20,776
Sweden	15,147	15,938	15,062	18,249	14,471	14,258	15,457
U. S. S. R. [7 10]	135,000	130,000	135,000	140,000	150,000	165,000	180,000
Yugoslavia	32,000	27,000	22,700	(5)	(5)	(5)	(5)
Total Europe [7 10]	271,000	258,000	226,000	215,000	265,000	278,000	335,000
Asia:							
China	[11] 1,225	[11] 1,146	[11] 1,030	623	947	915	472
India	5,968	6,198	5,822	6,096	6,412	6,426	5,957
Japan	[12] 102,062	[12] 119,858	[12] 102,352	45,737	23,043	36,812	54,330
Korea	4,330	4,554	5,193	[13] 427	[13] 527	[13] 392	[13] 514
Turkey	8,258	9,730	11,050	9,858	10,050	10,080	10,979
Total Asia [7 10]	121,900	141,500	125,500	62,800	41,000	55,000	72,252
Africa:							
Belgian Congo	165,938	156,850	165,484	160,200	143,885	150,840	155,481
Northern Rhodesia	250,564	255,027	224,397	197,192	185,607	195,610	217,044
Union of South Africa	23,877	22,150	22,397	23,665	26,723	29,026	28,993
Total Africa	440,379	434,027	412,278	381,057	356,215	375,476	401,518
Australia	25,004	20,785	20,217	20,827	23,023	19,613	13,305
World total [7]	2,766,000	2,756,000	2,584,000	2,185,000	1,856,000	2,251,000	2,341,000

[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: 1942, 987,004; 1943, 991,492; 1944, 910,245; 1945, 710,073; 1946, 543,996; 1947, 782,780; 1948, 764,278. 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] Includes scrap.
[9] Bizonal area.
[10] Output from U. S. S. R. in Asia included with U. S. S. R. in Europe.
[11] Data represent areas designated as Free China during the period of Japanese occupation.
[12] Preliminary data for fiscal year ended Mar. 31 of year following that stated.
[13] South Korea only.

Canada.—Mine and smelter output of copper in Canada rose 6 and 7 percent, respectively, in 1948. The gains marked continuations from low points reached in 1946. Following decontrol in June 1947, the price of copper rose to 21½ cents a pound, delivered Toronto or Montreal. On August 3, 1948, the price was raised to 23½ cents, which remained in effect through the remainder of the year. Labor supplies more nearly filled needs in 1948 than in a number of preceding years. Consumption of refined copper was 107,353 tons in 1948 compared with 109,210 tons in 1947, or more than double the prewar rate.

Copper produced (mine output) in Canada, 1944–48, by Provinces, in short tons

Province	1944	1945	1946	1947	1948 (preliminary)
British Columbia	18,152	12,876	8,750	20,900	21,855
Manitoba	21,939	20,563	19,251	15,316	19,403
Ontario	142,654	119,726	89,712	113,934	118,795
Quebec	54,027	51,342	34,899	42,561	48,348
Saskatchewan	36,757	32,950	31,356	33,151	31,479
Northwest Territories	6				
Total	273,535	237,457	183,968	225,862	239,880

More than half of the mine output of copper in Canada usually comes from the nickel-copper ores of the Sudbury district, Ontario; in 1948 the proportion was 50 percent. The International Nickel Co. of Canada, Ltd., is the largest copper producer in Canada. Inasmuch as nickel is the chief value in the ore, conditions in the nickel market have an important bearing on the company rate of copper production. Heavy demand for copper in the war and postwar years constituted a drain on reserves, and plans were made for economic recovery and use of lower-grade underground ore. The tonnage of ore mined in 1948 (10,866,862) was slightly more than in 1947 and nearly double the 1938 rate. Proved ore reserves, nonetheless, rose to 246,177,000 short tons at the end of 1948 from 221,843,000 at the end of 1947. The nickel-copper content at the end of 1948 was 7,503,000 tons, a gain over 7,171,000 tons a year earlier. Underground development totaled 84,152 feet in 1948 compared with 54,790 in 1947, bringing the total footage of underground development to 1,323,660 (250 miles). Copper sales amounted to 109,565 tons compared with 110,336 in 1947. About 52 percent in 1948 was sold in Canada and 48 percent was exported. The Falconbridge Nickel Mines, Ltd.—the other important producer in Ontario—hoisted 821,284 tons in 1948 compared with 730,965 in 1947. Ore reserves at the Falconbridge mine were 8,098,500 tons, averaging 1.63 percent nickel and 0.88 percent copper, and at outside holdings (including the McKim mine) were 5,909,000 tons, averaging 1.88 percent nickel and 1.02 percent copper. The McKim mine is expected soon to become a regular shipper of ore to company treatment plants.

Quebec was as usual the second most important copper-producing Province in 1948, supplying, however, considerably less than half as much copper as Ontario. Noranda Mines, Ltd., is an outstanding producer in Quebec. A total of 977,403 tons of ore was hoisted at the Horne mine; 603,516 tons were milled, and 509,401 tons of ore and concentrates were smelted. The smelter also treated 327,049 tons of custom material. Copper output for the Horne mine was 21,866 tons out of a total smelter output of new copper of 48,878 tons. In addition to copper, the Horne mine produced 142,273 ounces of gold and 437,493 ounces of silver. Developed ore reserves above the 2,975-foot level were 4,528,000 tons of sulfide ore averaging 7.16 percent copper, 14,000,000 tons of sulfide ore averaging 0.67 percent copper, and some siliceous fluxing ore. The property of the Quemont Mining Corp., Ltd., which adjoins the Horne mine and in which Noranda has a substantial interest, it is said, will soon be a large-scale producer of gold, copper, and silver. A total of 236,844 tons of ore, containing 2.85 percent copper, 8.12 percent zinc, and 0.035 ounce of gold and 2.66 ounces of silver per ton, were milled by Normetal Mining Corp., Ltd. The copper concentrate produced was smelted at Noranda, and the zinc concentrate was shipped to the United States. Estimated ore reserves were 1,625,900 tons of ore containing 3.51 percent copper and 7.67 percent zinc. Waite Amulet Mines, Ltd. (controlled by Noranda), milled 422,785 tons of ore in 1948, containing 22,256 tons of copper, 14,521 tons of zinc, 12,460 ounces of gold, and 418,826 ounces of silver. A small quantity of ore was hoisted from the Waite mine, reported exhausted the year before. Completion of mining of known ore at the "C" and "F" shafts was reported to be expected by the end of 1949. Reserves at Amulet Dufault were reported as 1,251,204 tons of ore averaging 5.67 percent copper and 4.06 percent zinc, and 113,200 tons averaging 1.8 percent copper and 6.5 percent zinc. Canadian Copper Refiners, Ltd., controlled by Noranda, produced 95,410 tons of copper compared with 88,930 tons in 1947. The extension program, which will increase refinery capacity by about one eighth and provide for production of special shapes, was scheduled for completion in June 1949.

The copper produced in Saskatchewan and Manitoba comes from the Hudson Bay Mining & Smelting Co., Ltd. (Flin Flon mine), and Sherritt Gordon Mines, Ltd. A total of 1,865,835 tons of ore, averaging 2.30 percent copper, 5.0 percent zinc, and 0.084 ounce of gold and 1.32 ounces of silver to the ton, was mined and milled at the Hudson Bay property. The copper smelter treated 371,181 tons of Hudson Bay ores and concentrates and 45,182 tons of custom concentrates. Shipments to the refinery for company account were 39,799 tons of copper, 127,007 ounces of gold, 1,889,718 ounces of silver, and 138,597 ounces of selenium. Life of the mine of Sherritt Gordon Mines, Ltd., at Sherridon was prolonged by prevailing high prices for copper and zinc, making it possible to mine certain narrow and low-grade sections of the ore body not included in ore reserves. Company estimates place exhaustion of the ore body at about the end of 1950. Ore milled totaled 458,325 tons yielding 9,988 tons of copper, 5,352 ounces of gold, 171,856 ounces of silver, and 11,159 tons of zinc concentrate. No new ore was found, so ore reserves were reduced by the tonnage of ore produced minus the mined marginal ore not counted as reserves. Reserves were 762,100 tons, averaging 2.55 percent copper and 1.99 percent zinc. Development work at the Lynn Lake property was continued. No new reserves were developed, the total at the end of 1948 remaining 8,300,000 tons, averaging 1.514 percent nickel and

0.687 percent copper, plus 153,000 tons, averaging 1.113 percent copper and 2.491 percent zinc.

Chief producers in British Columbia are the Granby Consolidated Mining, Smelting & Power Co., Ltd., and the Britannia Mining & Smelting Co., Ltd.

Exports of ingots, bars, and billets from Canada in 1948 as compared with 1947 were as follows, by countries of destination, in short tons:

Destination:	*1947*	*1948*
United Kingdom	55, 740	63, 493
United States	1, 054	18, 085
France	12, 152	14, 098
Czechoslovakia	3, 579	6, 411
Switzerland	1, 903	4, 120
India	2, 992	2, 936
Netherlands	2, 904	2, 497
Poland	--------	2, 295
Sweden	6, 243	60
Other countries	911	2, 174
Total	87, 478	116, 169

Exports of copper in ore totaled 28,555 tons, of which 22,624 went to the United States, 5,346 to Norway, and 585 to the United Kingdom, compared with 29,093, 23,092, 5,499, and 502 tons, respectively, in 1947. In addition, 28,639 tons of rods, strips, sheet, and tubing and 5,236 tons of scrap were shipped from the country compared with 20,484 and 5,694 tons, respectively, in 1947.

Chile.—Mine output of copper rose 8 percent in 1948, and smelter production likewise was higher, gaining 4 percent; the former was the largest since 1944 and the latter since 1945. There was a growing shortage of all classes of underground labor and skilled workmen. Under martial law which continued in effect at all the larger mining centers, labor relations were said [2] to have remained peaceful throughout the year. An improvement in discipline and efficiency was noted.

At the Braden mine of the Kennecott Copper Corp., 9,603,379 short tons of ore, assaying 2.22 percent copper, were mined and milled. Smelter output was 164,252 tons of copper, an increase of 25,780 tons over 1947. A planned pipe line, 6 feet in diameter, to carry water discharged from the Pangal power plant turbines to the Coya power plant, a distance of 7 miles, will permit generation of several thousand kilowatts and make possible materially increased copper production in periods when power is a factor controlling output. Converter capacity is another limiting factor, but the planned installation within a few months of mechanical tuyère punchers, recently developed at Kennecott's Nevada unit, should relieve this condition in part.

The Chuquicamata mine of the Chile Exploration Co., a subsidiary of the Anaconda Copper Mining Co., produced 229,285 short tons of copper in 1948 compared with 243,565 tons in 1947. The 1948 report of the latter company outlined plans for the installation of new mining and reduction methods at the mine, necessitated by the change in the nature of ore to be treated in the future. The report states as follows:

[2] Kennecott Copper Corp. 1948 Annual Report to Stockholder

The ore occurs in three general subdivisions namely oxide, sulphide, and a mixture of both. From the beginning of operations in 1915 to the present, the recovery of copper has been exclusively by leaching from oxide ore and from the oxide content of mixed ore. The copper bearing solutions are electrolyzed and the cathodes are melted and cast into wirebars and cakes of the weights and sizes demanded by the trade.

While substantial tonnages of oxide ore remain in the mine, in order to provide for the future operation of the property it has become necessary to begin the construction of plant facilities to process the extraction of copper from sulphide ores and the sulphide content of mixed ores from which the principal future production of copper will come.

The processes to be used in this operation are standardized and the first units of the plant will consist of a concentrator, a smelter and a converting plant. These plants, together with 12 miles of railroad lines, a 45-mile water supply line capable of delivering 40,000 tons of water per day, additional housing for employees and miscellaneous facilities are estimated to cost $70,000,000. Operations should begin in 1952. These units coupled with the operation of the oxide plant will maintain the rated capacity of 540,000,000 pounds of copper per year.

The plants are so designed that future extensions may be made to maintain or increase production as the available supply of oxide ore diminishes and as economic conditions and metal demand may require.

At the Andes property 74,529 short tons of copper were produced, compared with 65,075 in 1947.

Difficulties in obtaining deliveries of equipment are delaying construction of the Paipote smelter.

Exports of the chief copper classes, by countries, are shown as follows, in metric tons:

	Electrolytic	*Standard (furnace refined)*	*Total*
United States	143, 162	124, 769	267, 931
France	19, 897	10, 516	30, 413
Great Britain	3, 301	26, 671	29, 972
Italy	11, 364	18, 239	29, 603
Czechoslovakia	3, 960	8, 103	12, 063
Argentina	12, 031	--------	12, 031
India	4, 514	5, 354	9, 868
Brazil	7, 161	--------	7, 161
Switzerland	2, 843	3, 433	6, 276
Poland	1, 000	2, 185	3, 185
Netherlands	2, 438	--------	2, 438
Germany	--------	1, 000	1, 000
China	272	--------	272
Sweden	253	--------	253
Other countries	1, 134	1, 000	2, 134
Total	213, 330	201, 270	414, 600

Finland.—Mine production of copper was at a high rate during the war and gained in postwar years, reaching a new all-time peak in 1948. Smelting and refining operations were curtailed by the war but rose markedly thereafter, establishing a new high record in 1947. The Finnish Government-owned company, Outokumpu Oy., operates, in addition to certain minor mines, the Outokumpu copper mine, near Joensuu in eastern Finland, one of the largest copper deposits in Europe. According to a recent report,[3] reserves at the Outokumpu deposit are thought to be large enough to support production at the present rate for 35 years. The company is integrated, having facilities to handle production from ore through the manufacture of semi-

[3] Kaukokallio, E., Operations of Finnish Mining Company, Outokumpu Oy., 1939-47: American Legation Rept. 52, Helsinki, Finland, May 12, 1948, 4 pp.

finished products. Capacity was increased in the fall of 1945 to 2,000 metric tons of crude and electrolytic copper a month. Capacity at the Outokumpu mine is 600,000 tons of ore annually; output was 441,300 tons in 1945, 436,400 in 1946, and 511,496 in 1947. Production of copper is shown in the world tables. Copper produced in 1947 was distributed as follows: 9,187 tons for the war-reparations industries, 2,328 tons for export, and 4,625 tons for domestic consumption. The latter, according to the report, was far below normal demand; consumption approximated 9,000 tons before 1939.

Germany.—According to a recent report,[4] the output of electrolytic copper in Bizonia is to be doubled from the current rate of about 50,000 tons annually to 100,000 tons in 1952–53. These figures compare with 209,700 tons for all of Germany in 1936, of which 126,900 were from Bizonia. Consumption in 1952–53 is expected to be 150,000 tons compared with 292,300 tons in all of Germany in the base period and 137,500 in the Bizone area. Imports in the 1952–53 year are expected to be 50,000 tons compared with 127,500 and 10,700 tons, respectively, for all of Germany and for Bizonia in 1936.

Japan.—A comprehensive report covering copper resources in Japan was published [5] in 1948. The report was summarized as follows:

> Japan has been the chief copper producer in the Orient for 1,200 years. Until World War I, it was the second largest producer in the world, although production was seldom more than one-tenth as much as in the United States. When huge, cheap producers were developed in Chile, Africa, Canada, and other countries, the relative position of Japan dropped to seventh, but its trade in the Orient was maintained. Japan's total copper production from antiquity through 1946 is estimated at 4,500,000 metric tons, plus-or-minus 25 percent.
>
> Unstable economic conditions in Japan since the end of World War II make it difficult to determine the true position of the Japanese copper industry. Lack of coal and coke has reduced copper smelting to one third of capacity, and inflation makes any quotation of prices and costs of temporary interest only. The limitation of foreign trade and the lack of a foreign currency exchange rate make impossible the conversion of prices into terms of more stable currencies. Therefore, this investigation has utilized the long-term records of Japan's copper industry to evaluate its competitive position in the world and the possibilities for the future.
>
> Before World War II, copper was produced by the largest units in Japan at a net cost generally below the New York price. This was due chiefly to the devaluation of the yen; but these copper-producing units benefited also from tariff protection, and they realized tremendous profits for many years. For several years the income of one large unit was double the sum of its expenses.
>
> The reason for Japan's mining success has been the efficiency of Japanese manual labor on the basis of cost per unit of output. Manual labor is particularly suited to the narrow veins common to Japanese copper mines. The attitude of the new labor unions will be a large factor in determining whether Japan continues to produce copper. With their new power, if unchecked, the unions could price themselves out of the copper industry.
>
> The importance of cartels and subsidies in the Japanese copper industry has been overemphasized. A cartel (the Suiyokai) did exist, but its price-fixing activities were distinctly limited by the overwhelming weight of the world market. It did, however, eliminate underselling among the five large Japanese producers.
>
> Most of the copper is obtained from three main types of deposits—pyritic replacement, quartz or chloritic veins, and complex sulfide-sulfate replacement deposits called "kuroko" (black ore) or "kuromono." The last type is believed unique among the world's mineral deposits.

[4] Metal Bulletin (London), Proposed Expansion of German Nonferrous Metals Production Under Marshall Plan: No. 3356, Jan. 7, 1949, p. 8.

[5] Bureau of Mines, Mineral Trade Notes: Copper in Japan, vol. 26, No. 5, Spec. Supp 26, May 1948, 72 pp. Taken from Copper in Japan, SCAP report 106, Tokyo, 1948.

Total ore reserves have been estimated as follows for 1946:

Class	Crude ore, metric tons	Percent copper	Copper content, metric tons	Percent accuracy, plus-or-minus
Proved	36,000,000	1.3	480,000	20
Probable	25,000,000	1.4	350,000	35
Possible	31,000,000	1.4	420,000	55
Exploration prospects	68,000,000	2.2	1,500,000	80
Total	160,000,000	1.7	2,750,000	45

The proved reserves are adequate for 7 years' production at the average rate of the 1920's and early 1930's.

The treatment processes for Japanese copper are notable for the proportion obtained by hand picking, although flotation mills are common. Smelter feed is low-grade, compared to American standards, but blast furnaces require coarse sizes, which has favored hand-sorted ore even though the average grade is only 5 percent copper.

Northern Rhodesia.—Mine production rose 15 percent and smelter output 11 percent in 1948; the former was the largest since 1943 and the latter since 1944. Inadequate rail facilities, leading to coal shortages, continued to impede capacity operation, and a number of total or partial shut-downs were experienced during the year. Labor relations, however, improved and efforts toward solving the rail problem continue.

Rhodesia Copper Refineries, which now operates the electrolytic refinery originally erected and operated by Rhokana Corp., Ltd., expects to complete its present expansion plans by the middle of 1950.[6] Its original capacity of 32,000 long (36,000 short) tons was increased to 62,000 (69,000) in 1940; and, when present extensions are completed, capacity is planned to be about 124,000 (139,000) tons—large enough for both Rhokana and Nchanga to have their entire output for sale in the form of electrolytic copper.

A total of 2,899,000 short dry tons of ore, containing 2.26 percent copper, was mined at the Roan Antelope mine in the fiscal year ended June 30, 1948, or 19 percent more than in the preceding 12 months. Production of blister copper amounted to 57,968 short tons in 1947–48 compared with 55,598 tons in 1946–47. Ore reserves at the end of June 1948 were estimated at 95,017,471 tons, containing 3.26 percent copper, a reduction of the entire production during the year.

The Rhokana Corp., Ltd., produced 106,254 (98,275 in 1946–47) short tons of copper in the year ended June 30, 1948, of which 13,108 (12,700 in 1947) tons were Nkana blister copper, 28,843 (24,096) were Nchanga blister copper, and 64,573 (61,479) were Nkana electrolytic copper. Ore reserves at the end of June 1948 totaled, in the Nkana north ore body, 32,879,700 short tons containing 3.23 percent copper, in the Nkana south ore body 20,165,000 tons containing 2.78 percent copper, and in the Mindola ore body 57,128,200 tons containing 3.67 percent copper—a grand total of 110,172,900 tons containing 3.37 percent copper.

The extension program at Nchanga—to increase production from 27,000 to 64,000 long (30,000 to 72,000 short) tons—according to the company report to stockholders, may reasonably be expected to be

[6] Mining Journal (London), Rhokana Corporation: Annual Review Number, 1949, April 1949, p. 149.

completed by the end of 1950. According to the Yearbook of the American Bureau of Metal Statistics for 1948, reserves at the Nchanga mine in 1948 were 140,866,000 short tons, averaging 4.66 percent copper.

Mufulira Copper Mines, Ltd., produced 59,763 short tons of copper n the year ended June 30, 1948, compared with 53,198 tons in the previous 12-month period. Ore reserves on June 30 totaled 148,060,600 short tons, averaging 3.85 percent copper, in the Mufulira, Chambishi, and Baluba mines. The company plans construction at Mufulira of an electrolytic refinery with an initial capacity of 36,000 long (40,000 short) tons. Production of cathodes in 1952 is anticipated.

Peru.—Production (mine) of copper declined from 22,492 metric tons in 1947 to 18,068 tons in 1948. The new electrolytic refinery of the Cerro de Pasco Copper Corp. at La Oroya was completed during the year, and cathode production was begun in October. The corporation produced 16,810,037 pounds of copper from corporation ores and 11,428,442 pounds from other sources, a total of 28,238,479 pounds, in 1948 — declines from 21,565,664, 17,354,759, and 38,920,423 pounds, respectively, in 1947. The absorption of 5,000,000 pounds of copper as basic inventory in the new refinery, a nonrecurring item, and other factors (including a furnace failure at the smelter), are said by the corporation to explain the drop in output in 1948. A substantial expansion appeared in prospect for 1949. The corporation operates mines at Cerro de Pasco, Morococha, San Cristobal, Casapalca, Yauricocha, and Julcani; concentrators at Cerro de Pasco, Morococha, Casapalca, and Mahr; and copper and lead smelters at La Oroya, where also are plants for the production of refined silver, refined lead, electrolytic copper, bismuth, and antimony.

South-West Africa.—The only copper producer in the territory is the Tsumeb mine, whose reopening was mentioned in the report of this series for 1947. The new selective flotation mill was placed in operation in May 1948.[7] Designed in three sections to have a capacity of 300 tons each daily, the mill was found to have a total capacity of 1,050 to 1,200 tons daily. Because of exhaustion of the supplies of suitable surface dump ore, the jig plant, placed in operation in 1947, was closed in April 1948. The over-all production of the company in the fiscal year ended June 1948 was 68,290 dry short tons of copper-lead concentrates assaying 31.35 percent lead, 9.53 percent copper, and 13.28 percent zinc; 5,187 tons of zinc flotation concentrates; 1,191 tons of residues, assaying 28.05 percent lead, 10.66 percent copper, and 7.14 percent zinc; and a few hundred tons of flue dust and pig lead. Copper-lead concentrates were contracted to be shipped half to El Paso, Tex., and half to Hoboken, Belgium. Metals accounted for by smelters during the fiscal year ended June 30, 1948, were 32,242,043 pounds of lead, 10,461,298 pounds of copper, 59,869 pounds of cadmium, and 321,796 ounces of silver. In the 6 months ended December 31, 1948, production was 32,745,458 pounds of lead,

[7] Fuess, John C., Copper Mining in South-West Africa: Consular Rept. 26, Capetown, South Africa, Apr. 28, 1949, 6 pp.

7,596,953 pounds of copper, 4,645,960 pounds of zinc, 232,861 pounds of cadmium, and 225,301 ounces of silver. The major difficulty encountered by the company is inadequate transportation from the mine to the port at Walvis Bay. Concentrates must now be shipped 258 miles on a 24-inch-gage track before reaching the main railroad line whence shipment continues to Walvis Bay. The limited capacity of the railroad (7,000–8,000 short wet tons of concentrate monthly) has caused the flotation mill to be operated at only two thirds capacity. Obtaining adequate labor, equipment, and supplies has also presented problems.

Uganda.—Prospects for developing long-known copper deposits in Uganda were outlined [8] recently. Copper was discovered in the Ruwenzori Mountains in 1906 and since has been reported in various localities in this range. The deposits near Kilembe on the eastern slope were discovered by Tanganyika Concessions in 1927. Early estimates of ore reserves varied widely, but those apparently most dependable gave 4 million tons of ore, assaying 4.21 percent copper, 0.37 percent cobalt, and 0.02 percent nickel. Later surveys indicate possibilities of 10 to 15 million tons of copper-cobalt ore. Development of the Kilembe deposits has been discouraged by distance of the property from transportation—250 miles to railhead and 170 miles to nearest lake port. Lack of fuel has been another deterrent. To solve these problems, construction of a hydroelectric plant at Jinja is actually under way, and the Katonga Canal to provide a waterway from a point near Kilembe to Lake Victoria is in the survey stage. Additional investigations of the deposits were undertaken by the Frobrican Exploration Co., Ltd., associated with the Canadian firm—Frobisher, Ltd. As a result Frobisher, Ltd, acquired exclusive control of all copper deposits in this district. A diamond-drilling program is under way. Proposals to bring the property into production are anticipated to require a minimum of 5 years.

United Kingdom.—The United Kingdom stands second only to the United States among copper-consuming countries. Consumption of 538,655 long tons in 1948 (of which 356,793 were virgin copper and 181,862 scrap) was virtually unchanged from the 540,886 tons (350,119 virgin and 190,767 scrap) used in 1947. Of the totals shown for 1948, 316,155 tons were used in unalloyed form, 214,995 as alloys (chiefly brass), and 7,505 tons in copper sulfate. Stocks of virgin blister and of refined copper (Government and industry) in the United Kingdom totaled 120,721 tons at the end of 1948 compared with 110,231 tons at the beginning of the year. These inventories cover electrolytic (including rods), fire-refined, and blister, and also stocks in transit in the United Kingdom.

The British Ministry of Supply continued bulk purchasing of copper in 1948. During most of the year the maximum prices maintained by the Government were considerably above corresponding United States prices in cents per pound (see section on Prices). Supplies of copper

[8] Hyland, Frances, Development of Kilembe Copper Deposits, Uganda Protectorate: Consular Rept. 151, Nairobi, Kenya, Oct. 19, 1948, 5 pp.

came again from Northern Rhodesia, Canada, United States, and Chile. Imports of the important classes in 1948, in long tons, were as follows:

Source:	Electrolytic	Standard	Total
Northern Rhodesia	33, 283	124, 174	157, 457
Canada	55, 601	-------	55, 601
Belgium	23, 447	-------	23, 447
Belgian Congo	16, 099	-------	16, 099
United States	58, 097	-------	58, 097
Chile	3, 002	30, 095	33, 097
Other countries	12, 983	3	12, 986
Total	202, 512	154, 272	356, 784

The gross weight of copper ore imported—all from Canada—was 26,403 tons. Exports in 1948 were as follows:

	Long tons
Copper ingots, etc	21, 243
Plates, sheets, etc	15, 499
Wire in coils	25, 187
Tubes	5, 777
Other manufactures	4, 085
Total	71, 791

According to a recent report,[9] overseas sales of copper sulfate by the British Sulphate of Copper Association, Ltd., in the fiscal year 1947–48 were the lowest in the 24 years of the association's existence. Doubtless the war years were excluded from consideration. Exports were 52,698 long tons in 1945–46, and 30,103 in 1946–47, and fell to 24,666 in 1947–48. The drop was attributed to import restrictions in various countries, the shortage of pounds sterling, carry-over inventories from the previous season, and weather conditions unfavorable to maximum consumption of copper sulfate. A total of 36,000 long tons was the export target for 1949.

[9] Chemical Age (London), vol. 59, No. 1531, Nov. 13, 1948, p. 650.

Feldspar

By ROBERT W. METCALF

GENERAL SUMMARY

SALES of ground feldspar by merchant mills in 1948 rose 5 percent to a new record and topped a half million tons for the first time, totaling 506,451 short tons valued at $6,462,231. Production of crude feldspar increased slightly compared with 1947. Production of aplite declined. Imports of Canadian crude feldspar in 1948 (31,047 long tons) were 86 percent higher than in 1947 and were the largest since 1924. Crude nepheline syenite imported in 1948 decreased slightly, although imports of ground material were much higher than in recent years.

Salient statistics of the feldspar industry in the United States, 1940–44 (average), and 1945–48

	1940–44 (average)	1945	1946	1947	1948
Crude feldspar:					
Domestic sales:					
Long tons	316, 275	373, 054	508, 380	459, 910	460, 713
Value	$1, 559, 673	$2, 021, 529	$2, 594, 099	$2, 410, 940	$2, 564, 387
Average per long ton	$4. 93	$5. 42	$5. 10	$5. 24	$5. 57
Imports:					
Long tons	11, 149	14, 924	16, 365	16, 685	31, 047
Value	$80, 467	$114, 917	$127, 654	$124, 587	$219, 785
Average per long ton	$7. 22	$7. 70	$7. 80	$7. 47	$7. 08
Ground feldspar:					
Sales by merchant mills:					
Short tons	329, 385	381, 728	470, 199	482, 700	506, 451
Value	$3, 565, 610	$4, 246, 961	$5, 346, 107	$5, 861, 141	$6, 462, 231
Average per short ton	$10. 83	$11. 13	$11. 37	$12. 14	$12. 76

Sales of crude feldspar in Maine in 1948 increased 11 percent over 1947, and Colorado and Arizona sales were 43 and 34 percent, respectively, more than in 1947. Most of the other producing States showed moderate declines in tonnage. Sales of ground feldspar in 1948 in North Carolina–Tennessee increased 1 percent over 1947; sales from Colorado and Maine were about one-fifth greater; and those from New Hampshire and Arizona were approximately 50 percent higher than in 1947. Shipments of ground feldspar from New York, South Dakota, and New Jersey–Connecticut were less in 1948 than in 1947.

DOMESTIC PRODUCTION

CRUDE FELDSPAR

Output of crude feldspar in 1948 was 0.2 percent over that of 1947. The total value increased 6 percent and the average value per ton in

1948 rose to $5.57, the highest realization since 1931. Production was reported from 12 States. No tonnage was reported in 1948 from Maryland or Texas.

Crude feldspar sold or used by producers in the United States, 1943–48

Year	Long tons	Value: Total	Value: Average	Year	Long tons	Value: Total	Value: Average
1943	308,180	$1,646,277	$5.34	1946	508,380	$2,594,099	$5.10
1944	327,408	1,813,937	5.54	1947	459,910	2,410,940	5.24
1945	373,054	2,021,529	5.42	1948	460,713	2,564,387	5.57

Crude feldspar sold or used by producers in the United States, 1946–48, by States

State	1946 Long tons	1946 Value	1947 Long tons	1947 Value	1948 Long tons	1948 Value
Colorado	37,312	$145,975	43,676	$218,593	62,497	$253,227
Connecticut	16,555	98,407	15,408	100,152	12,110	78,772
Maine	18,922	110,237	16,898	97,565	18,774	130,486
North Carolina	230,367	1,200,638	220,997	1,081,514	201,774	1,116,825
South Dakota	74,540	299,852	58,959	284,378	54,037	270,889
Virginia	32,960	204,588	41,820	261,741	34,770	231,607
Wyoming	20,345	83,496	18,801	90,258	16,760	78,080
Undistributed [1]	77,379	450,906	43,351	276,739	59,991	404,501
Total	508,380	2,594,099	459,910	2,410,940	460,713	2,564,387

[1] Includes Arizona, Georgia, New Hampshire, and New York; also California in 1947–48, Maryland in 1947, and Texas in 1946–47.

Production of crude feldspar in Arizona, Colorado, Maine, and New Hampshire was considerably higher in 1948 than in 1947. Most other States, including North Carolina, South Dakota, Virginia, and Wyoming, showed small to substantial losses in feldspar output in 1948 compared with 1947. North Carolina in 1948 produced 44 percent of the total feldspar mined. Colorado attained second place in 1948, followed by South Dakota, New Hampshire, and Virginia.

GROUND FELDSPAR

Sales of ground feldspar by merchant mills in 1948 topped the former record year (1947) by 5 percent in tonnage and 10 percent in value, rising to 506,451 short tons valued at $6,462,231. Feldspar marketed in New York, South Dakota, and Tennessee in 1948 was somewhat under the 1947 tonnage. All other States showed small to appreciable gains over 1947. Sales in North Carolina-Tennessee mills accounted for 43 percent of the total feldspar ground by merchant mills, compared with 45 percent in 1947 and 37 percent in 1945. Colorado mills supplied 16 percent of the total in 1948, compared with 14 percent in 1947 and 11 percent in 1945.

Ground feldspar sold by merchant mills [1] in the United States, 1944–48

Year	Active mills	Domestic feldspar: Short tons	Domestic feldspar: Value: Total	Domestic feldspar: Value: Average	Canadian feldspar: Short tons	Canadian feldspar: Value: Total	Canadian feldspar: Value: Average	Total: Short tons	Total: Value
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
1947	26	464,179	[2] 5,461,576	[2] 11.77	18,521	[2] 399,565	21.57	482,700	5,861,141
1948	28	487,070	5,991,059	12.30	19,381	471,172	24.31	506,451	6,462,231

[1] Excludes potters and others who grind for consumption in their own plants.
[2] Corrected figure.

As for many years, North Carolina was the largest producer of ground feldspar. Colorado and South Dakota ranked second and third, respectively, followed by Virginia, Tennessee, and New Hampshire. Ground spar sold by North Carolina-Tennessee mills in 1948 totaled 219,720 short tons, a new high, 1 percent greater than in 1947, the former record year. Arizona, Colorado, Maine, and New Hampshire made large increases in 1948 compared with 1947, and Illinois and Virginia showed small gains over 1947. Small declines were reported for New York and Connecticut-New Jersey mills.

Ground feldspar sold by merchant mills [1] in the United States, 1946–48, by States

State	1946: Active mills	1946: Short tons	1946: Value	1947: Active mills	1947: Short tons	1947: Value	1948: Active mills	1948: Short tons	1948: Value
California	2	294	$5,276						
Colorado	2	55,251	448,011	2	66,940	$616,973	2	81,049	$825,476
Connecticut	2	22,464	405,828	2	24,537	426,952	2	23,412	446,060
New Jersey	2			1			1		
Maine	3	14,822	235,636	3	17,414	280,154	3	20,789	347,492
North Carolina	4	207,527	2,194,552	4	217,109	2,360,352	4	219,720	2,377,030
Tennessee	2			2			2		
Undistributed [2]	11	169,841	2,056,804	12	156,700	2,176,710	14	161,481	2,466,173
Total	28	470,199	5,346,107	26	482,700	5,861,141	28	506,451	6,462,231

[1] Excludes potters and others who grind for consumption in their own plants.
[2] Includes (number of active mills in parentheses) Arizona (1), Georgia (1 in 1948), Illinois (1), New Hampshire (2 in 1946–47, 3 in 1948), New York (3), South Dakota (2 in 1946, 3 in 1947–48), and Virginia (2).

The new froth-flotation plant of the Feldspar Flotation Co. at Spruce Pine, N. C., was reported to have been completed, and operations started in the latter part of the year.[1] Officers of the company are associated with the Feldspar Milling Co., Burnsville, N. C., and Feldspar Producing Co., Erwin, Tenn. Since the latter part of 1947, the Whitehall Co., Inc., 17 Battery Place, New York, N. Y., has been searching for feldspar in the Kingman and Wickenburg districts,

[1] Engineering and Mining Journal, vol. 149, No. 7, July 1948, pp. 125–126.
Rock Products, vol. 51, No. 9, September 1948, p. 65.

Ariz., and in adjacent California, utilizing airplanes in its initial explorations and ground crews for more detailed work. Several promising properties have been discovered.[2] A brief description was published of the mining and milling operations of the new flotation plant of the Consolidated Feldspar Corp., at Parkdale, Colo.[3] Extraction and preparation of glass and pottery spar by the same company's dry-process plant at Custer, S. Dak., also was described.[4] A new firm, the Ray Sanders Development Co., was reported to have been organized to develop claims near Keystone, S. Dak.[5]

Feldspar possibilities in the Topsham, Maine, area were studied.[6] Papers on the pegmatites of Jasper County, Ga.,[7] and the pegmatite resources in Southwestern States[8] were reported. Possible resources of ceramic raw materials in New Jersey were investigated, particularly certain granitic rocks said to be rich in high-grade feldspar.[9]

CONSUMPTION AND USES

Crude Feldspar.—Many of the merchant grinders also mine feldspar, either themselves or through affiliated firms. A large part of the crude feldspar mined, however, is obtained from small operators who sell their product principally to the merchant mills. The tonnage of feldspar and feldspathic rocks treated in flotation plants is increasing.

Most of the consumers of feldspar buy material already ground, sized, and ready for use in their products from the merchant grinders. Some pottery and enamel manufacturers and soapmakers, however, purchase all or part of their requirements in crude form and crush or grind it to their own specifications in their own mills. Some Canadian crude spar is purchased direct by consumers in this country. Manufacturers of artificial teeth annually consume a small tonnage of very carefully selected crude spar, which must be free from grit and is marketed at a considerable premium over No. 1 grade commercial feldspar.

Ground Feldspar.—As in 1947, 98 percent of the total feldspar ground in merchant mills in the United States was consumed in the glass, pottery, and enamel industries. Shipments to glass factories increased 1 percent to 270,065 short tons in 1948; shipments to potteries rose 10 percent to a new high, reaching 202,905 tons; and shipments to enamel manufacturers were 5 percent higher than in 1947. Consumption of ground feldspar in soaps and abrasives in 1948 also was greater than in 1947.

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[2] Mining World, Airplane Used Extensively in Search for Feldspar: Vol. 10, No. 7, June 1948, p. 62. Engineering and Mining Journal, vol. 149, No. 7, July 1948, p. 130.
[3] Rock Products, vol. 51, No. 1, January 1948, p. 104. Mining Congress Journal, vol. 34, No. 7, July 1948, p. 73.
[4] Mining World, Black Hills Feldspar: Vol. 10, No. 10, September 1948, p. 24.
[5] Mining World, vol. 10, No. 10, September 1948, p. 79.
[6] Shainin, Vincent E., Summary of Economic Investigations of some Pegmatites in Topsham, Maine: Rept. State Geologist, Maine, 1945–46 (published in 1947), pp. 47–53.
[7] Warriner, L. P., and Burgess, B. C., Pegmatites of Jasper County, Georgia: Pit and Quarry, vol. 41, No. 6, December 1948, p. 85 (abs.).
[8] Jahns, Richard H., Pegmatite Resources in the Southwest: Pit and Quarry, vol. 41, No. 6, December 1948, p. 86.
[9] Parker, John M., III, New Jersey's Potential Feldspar Resources: Rutgers Univ. Bureau of Min. Research Bull. 5, pt. 1, New Brunswick, 1948, 66 pp.; Econ. Geol., vol. 43, No. 8, December 1948, p. 692 (abs.) Ceramic Industry, vol. 51, No. 3, September 1948, p. 41 (abs.).

Ground feldspar sold by merchant mills in the United States, 1946–48, by uses

Use	1946		1947		1948	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Ceramic:						
Glass	289,559	61.6	266,720	55.3	270,065	53.3
Pottery	154,340	32.8	183,829	38.1	202,905	40.1
Enamel	22,500	4.8	24,159	5.0	25,282	5.0
Other ceramic uses	144		60			
Soaps and abrasives	3,081	.7	7,871	1.6	8,135	1.6
Other uses	575	.1	61		64	
Total	470,199	100.0	482,700	100.0	506,451	100.0

Ground feldspar shipped from merchant mills in 1948 reached at least 24 States and 5 foreign countries. The larger volume, however, was concentrated in six States—Pennsylvania (17 percent of the total shipments), Illinois and Ohio (13 percent each), West Virginia (12 percent), New Jersey (10 percent), and Indiana (8 percent)—totaling 73 percent of all sales. Shipments to virtually all of the more important consuming States showed moderate increases in 1948 compared with 1947, except for Illinois, Indiana, and Tennessee.

Ground feldspar shipped from merchant mills in the United States, 1943–48, by destinations, in short tons

Destination	1943	1944	1945	1946	1947	1948
California	8,669	9,788	8,735	8,641	7,395	8,406
Illinois	49,302	49,434	53,114	68,737	72,212	66,064
Indiana	40,873	40,057	47,321	47,756	44,864	37,774
Maryland	9,028	7,593	9,411	18,374	19,531	19,832
Massachusetts	3,855	3,508	3,258	3,009	3,906	4,437
New Jersey	40,259	38,158	35,735	41,340	43,969	52,587
New York	18,024	21,886	19,005	19,420	20,279	20,887
Ohio	42,536	41,208	48,151	47,031	63,939	64,805
Oklahoma	(1)	(1)	(1)	14,411	13,248	13,315
Pennsylvania	36,190	47,803	47,217	70,706	84,026	87,021
Tennessee	2,677	4,983	8,881	18,337	10,263	10,211
West Virginia	48,940	45,658	58,653	66,024	51,129	60,310
Wisconsin	8,718	7,993	7,058	10,317	9,958	11,741
Other destinations [2]	26,739	25,132	35,189	36,096	37,981	49,061
Total	335,810	343,201	381,728	470,199	482,700	506,451

[1] Included with "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 Washington, and shipments that cannot be segregated by States; also small shipments to Canada, England, Mexico, and other countries.

Names and addresses of merchant grinders of feldspar in the United States are listed below:

Abingdon Potteries, Inc., Abingdon, Ill.
Appalachian Minerals Co., Monticello, Ga.
Black Hills Tin Co., Tinton, S. D.
Carolina Mineral Co., Inc., Kona, N. C. (mills in North Carolina and Virginia).
Clinchfield Sand & Feldspar Corp., 618 Mercantile Bldg., Baltimore, Md. (mill in Virginia).
Consolidated Feldspar Corp., Trenton Trust Bldg., Trenton, N. J. (mills in Arizona, Colorado, Maine, New York (2), South Dakota (2), and Tennessee).
Eureka Mica Mining & Milling Co., Portland, Conn. (Eureka Flint & Spar Co., Inc., New York Ave., Trenton, N. J., sales agent.)

Feldspar Flotation, Inc., Spruce Pine, N. C.
Feldspar Milling Co., Burnsville, N. C.
Genesee Feldspar Co., 360 Boxart St., Rochester 12, N. Y.
Golding-Keene Co., Box 2151, Trenton, N. J. (mill in New Hampshire).
Interstate Feldspar Corp., 707 Kayser Bldg., Baltimore 2, Md. (mill in North Carolina).
J. F. Morton & Co., Walpole, N. H.
North Carolina Feldspar Corp., Erwin, Tenn.
Northern Feldspars Corp., West Rumney, N. H.
Standard Flint & Spar Corp., New York Ave., Trenton 7, N. J.
Topsham Feldspar Co., Brunswick, Maine.
United Feldspar & Minerals Corp., 10 E. 40th St., New York, N. Y. (mills in Maine and North Carolina).
Western Feldspar Milling Co., 1333 W. Maple Ave., Denver, Colo.
Worth Spar Co., P. O. Box 763, Middletown, Conn.

APLITE

Carolina Mineral Co., Inc., Kona, N. C. (mill in Virginia).
Dominion Minerals, Inc., Piney River, Va.

PRICES

Trade papers do not carry quotations for crude feldspar. Average values per ton, however, are computed from the returns of producers reporting their output annually to the Bureau of Mines. The average realization for all feldspar mined in the United States in 1948 rose to $5.57 per long ton, an increase of 6 percent over the 1947 figure ($5.24). Increases in average values occurred in most States, especially in the East. Colorado and Wyoming were the only important States showing decreases in realization in 1948 compared with 1947.

The average value per short ton for ground feldspar in 1948 was $12.76, 5 percent higher than that for 1947, and nearly reached the realization reported for 1936 ($12.99). Virtually all States had higher average values in 1948 than in 1947, the increase varying from 1 to 15 percent. The realization for the combined shipments of North Carolina and Tennessee showed a very small decrease. Average values ranged from $10.18 in Colorado to $23.43 in New York.

Quotations on ground feldspar appearing in E&MJ Metal and Mineral Markets in 1948 were: Potash feldspar, in bulk, 200-mesh white, f. o. b. North Carolina, $17 per short ton, and f. o. b. Maine, $18; and soda spar, f. o. b. North Carolina or Maine, 200-mesh, white in bulk, $19. Quotations on Maine feldspar were discontinued early in March 1948, and North Carolina spar, bulk, carlots, was quoted as follows: 200-mesh, $17 per ton; 325-mesh, $21. In early December, these quotations were raised $1.50 per ton. North Carolina glass spar remained throughout the year at $12.50 for No. 17 grade and $11.75 for semigranular material. (Bags and bagging added $3 per ton to bulk quotations.)

Quotations on Virginia feldspar at the beginning of 1948, as reported by the same source, were: No. 1, 230-mesh, $18 per short ton; 200-mesh, $17; No. 17 glassmakers' spar, $11.75; and No. 18, $12.50. Enamelers' spar was quoted at $14 to $16 per ton either on Spruce Pine, N. C., or Keene, N. H., basis. In early December, quotations on 230- and 200-mesh spars were raised 50 cents per ton, and enamelers' spar, $1 per ton. Glass feldspars remained at the same levels throughout the year.

FOREIGN TRADE [10]

Feldspar.—Imports for consumption of crude feldspar in 1948 totaled 31,047 long tons and were higher than in any recorded year since 1924 (35,139 tons). The value of imports was the highest since 1929. All the crude feldspar imported in 1948 originated in Canada. Very small quantities of ground spar were imported in 1948 from Canada, United Kingdom, and Netherlands.

Feldspar imported for consumption in the United States, 1944–48

[U. S. Department of Commerce]

Year	Crude		Ground		Year	Crude		Ground	
	Long tons	Value	Short tons	Value		Long tons	Value	Short tons	Value
1944	11,686	$95,956	10	$203	1947	16,685	$124,587		
1945	14,924	114,917			1948	31,047	219,785	(1)	$328
1946	16,365	127,654	(1)	2					

[1] Less than 1 ton.

Ground feldspar exported from the United States, as reported by the merchant grinders in 1948, totaled 1,434 short tons, compared with 1,750 tons in 1947 and 2,822 tons in 1946. Destinations in 1948 were listed as Canada, Cuba, Mexico, Switzerland, and United Kingdom.

Cornwall Stone.—Cornwall stone imported for consumption in 1948 amounted to 1,124 long tons, a substantial increase in both quantity and value over 1947, although much smaller than in most prewar years. The only source of imports of crude or ground material is the United Kingdom.

Cornwall stone imported for consumption in the United States, 1944–48

[U. S. Department of Commerce]

Year	Unmanufactured		Ground		Year	Unmanufactured		Ground	
	Long tons	Value	Long tons	Value		Long tons	Value	Long tons	Value
1944	463	$6,394	10	$225	1947	706	$9,522	148	$3,124
1945	838	11,317			1948	1,124	15,633	117	2,719
1946	456	6,031	80	1,806					

NEPHELINE SYENITE

Nepheline syenite is a quartz-free crystalline rock consisting largely of nephelite and albite and microcline feldspar. Impurities may be the iron-bearing minerals, black mica and magnetite, and other minerals such as zircon and corundum. Used originally almost entirely in glass manufacture, substantial quantities now are consumed in the making of pottery.

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

Domestic Deposits.—Domestic deposits of nepheline syenite have not proved suitable for the manufacture of ceramic ware, although a large roofing-granule plant has been established in Arkansas, utilizing the extensive reserves of this material occurring in that State. Efforts are being made to reduce the iron content of Arkansas syenite to make it more suitable for ceramic purposes.

Uses.—An article on the advantages of the use of nepheline syenite in sanitary ware, floor and wall tile, electrical porcelain, semivitreous bodies, and low-temperature vitreous bodies was presented. In general, lower firing temperatures, increased firing range, increased strength, and savings in fuel consumption, refractories, and losses from excessive warpage were effected.[11]

Nepheline syenite was studied as a major component of various fluxes and the results published.[12] The higher alumina content introduced into porcelain enamels through the use of nepheline syenite is said to result in a reduction of solubility and a lighter-color ground coat.[13]

Prices.—Price quotations on crude nepheline syenite are not reported in trade journals; however, crude values for this material may be approximated in the average values per ton of imports for consumption in the United States. These values for the last 5 years were: 1944, $3.50; 1945, $3.77; 1946, $3.98; 1947, $3.57; and 1948, $4.01. According to the Oil, Paint and Drug Reporter, quotations on ground nepheline syenite during the whole of 1948 were as follows: Glass grade (24-mesh), bulk, f. o. b. Rochester, N. Y., $14.25; and pottery grade (200-mesh), bulk, f. o. b. Rochester, N. Y., $18.25. Nepheline syenite in bags was $3 per ton higher than bulk.

Foreign Trade.—Imports for consumption of crude nepheline syenite were slightly less in 1948 than in 1947, although the total value rose 11 percent. Imports in 1948 were higher than in any other year except 1947. Imports of ground nepheline syenite totaled 7,577 short tons, a record, and judging by the reported average value per ton ($17.27) apparently consisted largely of higher-grade material. All imports of both crude and ground nepheline syenite came from Canada.

Nepheline syenite imported for consumption in the United States, 1944–48

[U. S. Department of Commerce]

Year	Crude		Ground		Year	Crude		Ground	
	Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
1944	39,043	$136,664			1947	54,382	$194,283		
1945	51,785	194,975	1,073	$11,461	1948	53,570	214,747	7,577	$130,860
1946	51,852	206,613	1,018	11,137					

[11] Ceramic Industry, Nepheline Syenite Cuts Firing Heat: Vol. 51, No. 2, August 1948, pp. 78, 80.
[12] Ceramic Industry, Report on Flux Studies: Vol. 50, No. 1, January 1948, p. 62.
[13] Ceramic Industry, vol. 51, No. 2, August 1948, p. 63.

Canada.—A record output of nepheline syenite in Canada, and unusually large exports were indications of the active ceramic market for this material. The ceramic industry in the United States has obtained nepheline syenite almost wholly from the deposits of American Nepheline, Ltd., near Lakefield, Ontario, Canada, at Blue Mountain. Detailed descriptions of the mining, processing, and utilization of this product, including data relative to the new plant at Lakefield, were published.[14] Both open-cut and underground mining methods are used and high-intensity magnetic separation combined with dry-processing in the milling operations.

Europe and Asia.—Deposits of nepheline syenite on the Kola Peninsula, U. S. S. R., in northern Europe, have been mined, and considerable research has been expended on this product in that country, particularly in the field of glass and enamel manufacture and as a source of alumina. Statistics regarding output are not available. Deposits in India and Finland also are known.

APLITE

Production of aplite in 1948 declined compared with 1947. The average value per ton remained unchanged. Virtually all of the aplite produced was consumed in the manufacture of glass, particularly container glass, and the decline in 1948 reflected the slackened activity in this field. The only producers of aplite are Dominion Minerals, Inc., Piney River, Va., and Carolina Mineral Co., Inc., Kona, N. C., in Amherst and Nelson Counties, Va., near Piney River. The Bureau of Mines is not at liberty to publish output or sales data.

TECHNOLOGY

The use of finely crushed feldspar mixed with carefully measured quantities of magnesium oxide and magnesium fluoride to manufacture synthetic mica at the Colorado School of Mines, Golden, Colo., has been revealed by the War Department.[15] The ingredients are melted in a special furnace to temperatures up to 2,700° F. and allowed to cool slowly. Mica crystals form as the melt cools. Crystals obtained so far have been small.

Another interesting development is the coating of seeds with powdered feldspar or volcanic ash to add bulk so that even microscopically small seeds can be planted one at a time and spaced. This procedure eliminates thinning, and certain seeds may be planted 2 weeks earlier without danger of damage by cold. Chemicals included in the coating are said to keep the seeds alive and to make the plants grow faster.[16]

Factors determining the desired properties of artificial teeth and the influence of the relative amounts of feldspar and other raw materials were discussed.[17] An analysis of the changes in composition

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[14] Deeth, H. R. and Koenig, C. J., Mining, Processing, and Application of Nepheline Syenite from Blue Mountain, Ontario: Am. Inst. Min. and Met. Eng., Mining Technology, vol. 12, No. 4, Tech. Pub. 2406, July 1948, 8 pp.

[15] Mining Congress Journal, Synthetic Mica Perfected: Vol. 34, No. 9, September 1948, p. 108.

[16] Rock Products, vol. 51, No. 11, November 1948, p. 49.

[17] Kiefer, C., and Levecque, M. (Artificial Dentures: A Review): Ind. Ceram., 1947, No. 374, 204; British Ceram. Abs., 1947, 309 A; British Abs., B-I, July 1948, pp. 310-311.

of container glass during the period 1932 to 1946 was published.[18] The use of feldspar in chemical stoneware and the properties and applications of this product were presented.[19] The physical properties of various whiteware bodies, including many containing feldspar, were studied by the Committee on Classification and Nomenclature of the White Wares Division of the American Ceramic Society.[20] A classification of whiteware bodies and a table giving general batch compositions of typical bodies, showing the average content of feldspar and other ingredients were published.[21] A rapid quantitative spectrographic method of analysis of powdered ceramic materials, applicable to quality control of pulverized industrial chemicals and minerals including feldspar, was discussed.[22] The use of fire clay, feldspar, feldspathic sands, pegmatite, and other materials as sources of alumina in the manufacture of Fourcault window glass in Russia during periods of raw-material shortages was described.[23]

Employment of chemical staining methods on samples of crushed pegmatite and on products of mineral-dressing tests proved effective in detecting potash and soda feldspar.[24] The results of experimental work on the effect of acidity, temperature, and concentrations of aluminum and potassium on the formation of sericite, kaolin, and pyrophyllite were presented in the form of phase diagrams.[25] A Finnish investigation of the decomposition of potash feldspar was reported.[26]

WORLD REVIEW

The estimated known world output of feldspar in 1948 rose to 800,000 metric tons, or 13 percent higher than in 1947. Not included in the total is production in Brazil, China, and U. S. S. R., where feldspar is known to be produced; no actual or estimated data are available for these countries.

Countries showing large increases in output of feldspar in 1948 compared with 1947 include Canada, Germany (Bavaria), Italy, Japan, Spain, and Uruguay.

Because of the greater output in foreign countries and only a slightly larger production in this country, the ratio of United States output to known world production declined in 1948 to 59 percent.

Australian resources of feldspar were described—two reports included discussions of occurrence, mining and utilization.[27] Discovery

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18 Moore, H., and Lyle, A. K., Container Glass Compositions, 1932–46; Glass Ind., vol. 28, No. 11, November 1947, pp. 563–566, 588, 590, 592.

19 Industrial and Engineering Chemistry, Chemical Stoneware: Vol. 40, No. 10, Oct. 11, 1948, p. 1785.

20 American Ceramic Society Bulletin, Properties of Whiteware Products: Vol. 27, No. 7, July 15, 1948, pp. 272–273.

21 Industrial and Engineering Chemistry, vol. 40, No. 10, Oct. 11, 1948, pp. 1782–1783.

22 Zander, J. M., and Terry, J. H., Quantitative Spectrographic Analysis of Powdered Ceramic Materials: Am. Ceram. Soc. Jour., vol. 30, No. 12, Dec. 1, 1947, pp. 366–370.

23 S. Ya. Raf. Stekal'naya i Keram. Prom., (Methods of Introducing Al_2O_3 into the Composition of Sheet Glass Made in Fourcault Machines): 1946, Nos. 11–12, pp. 5–8; Am. Ceram. Soc. Jour., vol. 31, No. 5, May 1, 1948, p. 98.

24 Munson, Gerald A., and Barrett, E. P., Quantitative Estimation of Potash and Soda Feldspars in Pegmatite Rock by Means of Chemical Coloration—A Review of Selected Literature: Bureau of Mines Inf. Circ. 7412, 1947, 5 pp.

25 Folk, R. L., Alteration of Feldspar and its Products as Studied in the Laboratory: Am. Jour. Science, vol. 245, No. 6, 1947, pp. 388–394; Am. Ceram. Soc. Jour., vol. 13, No. 1, Jan. 1, 1948, p. 21 (abs.).

26 Tomula, E. S., (Decomposition of Potassium Feldspar): Suomen Kem., 1948, 19, B, 67–72; British Abs., B-I, July 1948, p. 298.

27 Fisher, N. H., Canavan, F., and Ludbrock, N. H., Feldspar (Including Cornish Stone): Mineral Resources of Australia, Bureau of Mineral Resources, Geology and Geophysics, Commonwealth of Australia, Summary Rept. 14, Canberra. 1946, 24 pp.

Lynch, Charles, Feldspar Supplies in Australia: Mining Mag. (London), vol. 79, No. 3, September 1948, pp. 149–150.

World production of feldspar, by countries, in metric tons, 1941–48 [1]

[Compiled by Pauline Roberts]

Country [1]	1941	1942	1943	1944	1945	1946	1947	1948
Argentina (shipments)	2,981	5,622	2,000	3,468	5,375	4,755	5,000	(2)
Australia:								
New South Wales	452	1,469	3,890	4,756	3,785	4,844	5,363	(2)
South Australia [3]	1,081	1,026	522	818	955	1,317	1,958	[4] 2,300
Victoria	69	175	58	143	217	------	------	(2)
Western Australia	4,173	3,304	2,351	1,990	1,254	1,822	1,246	1,027
Austria	(2)	(2)	(2)	(2)	(2)	(2)	951	1,144
Canada (shipments)	23,623	20,203	21,644	21,327	27,439	31,972	32,753	45,612
Chile	------	------	8	------	124	44	217	885
Czechoslovakia	(2)	(2)	(2)	(2)	5,944	7,171	(2)	(2)
Egypt	52	19	32	50	40	------	------	------
Eritrea	(2)	(2)	(2)	(2)	(2)	50	150	(2)
Finland	2,132	3,392	3,571	3,584	3,400	3,620	[5] 4,431	(2)
France	25,094	14,870	19,340	9,609	16,372	28,190	53,995	(2)
Germany: Bavaria	12,973	12,332	12,824	41,200	(2)	[4] 18,000	21,251	32,921
India	1,257	2,100	1,340	343	340	1,304	1,750	(2)
Italy	12,758	7,497	6,664	1,474	854	6,244	10,727	[4] 13,300
Japan	[6] 2,436	[6] 2,527	[6] 2,939	[6] 2,313	[6] 1,377	[7] 7,514	16,917	54,500
Kenya	(2)	(2)	(2)	(2)	110	44	36	10
Madagascar	(2)	9	2	34	------	12	(2)	(2)
Norway	7,527	6,269	5,712	[5] 7,108	3,943	[5] 7,319	[5] 23,513	(2)
Palestine and Israel	(2)	(2)	85	65	37	53	19	(2)
Portugal	(2)	(2)	(2)	639	(2)	(2)	(2)	(2)
Rumania	749	1,383	1,261	(2)	(2)	(2)	(2)	(2)
Spain	(2)	4,251	1,093	2,567	390	525	3,939	9,807
Sweden	21,988	19,243	25,879	15,537	15,172	25,276	37,953	(2)
Union of South Africa	------	------	------	669	635	1,382	1,676	2,101
United Kingdom: Northern Ireland	------	10	203	172	------	------	------	(2)
United States (sold or used)	344,299	321,240	313,126	332,663	379,042	516,539	467,292	468,107
Uruguay	(2)	(2)	(2)	264	[4] 265	513	843	4,877
Total [8]	475,000	440,000	440,000	465,000	500,000	675,000	710,000	800,000

[1] In addition to countries listed, feldspar is produced in Brazil, China, and U. S. S. R., but data are not available.
[2] Data not available; estimate by author of chapter included in total.
[3] Includes some china stone.
[4] Estimate.
[5] Exports.
[6] Data for fiscal year ended March 31 of year following that stated.
[7] January to October, inclusive.
[8] Estimated by author of chapter. No estimates included for countries listed in footnote 1.

of a large deposit of feldspar in Japan was reported.[28] Types and occurrences of both industrial and gem feldspar in India were described,[29] and data presented regarding analyses, mining, and processing. The results of tests on feldspar and other glass raw materials from many parts of India were published.[30] Geographical data on the occurrence of feldspar and numerous other minerals in U. S. S. R. were presented.[31] Feldspar occurrences in Ethiopia were noted.[32] Palestine deposits of feldspar and other minerals were described.[33] Feldspar has been located in the territory of Amapa in northern Brazil.[34]

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[28] Ceramic Industry, vol. 51, No. 3, September 1948, pp. 57–58.
[29] Spencer, E., Feldspar: Trans. Indian Ceram. Soc., vol. 3, No. 2, 1944, pp. 105–115; Am. Ceram. Soc. Jour., vol. 31, No. 4, Apr. 1, 1948, pp. 87–88.
[30] Karimullah, A. Ram, Saboor, M. A., and Verman, L. C., Survey of Indian Resources of Sands and Rocks Required for the Glass Industry: Jour. Sci. Ind. Res., India, 1948, 7, A, pp. 163–195; British Abs., November 1948, p. 602.
[31] South African Mining and Engineering Journal, Mineral Production in the U. S. S. R.: Vol. 58, pt. II, No. 2849, 1947, pp. 65–67.
[32] Mining Magazine (London), vol. 78, No. 5, May 1948, p. 309.
[33] Shaw, S. H., Metallurgia, vol. 36, 1947, pp. 348–349; Chem. Abs., vol. 42, No. 2, Jan. 20, 1948, p. 495.
[34] Chemical and Engineering News, Brazil's Amapa Region Rich in Minerals: Vol. 26, No. 51, Dec. 20, 1948, p. 3782.

Ferro-Alloys

By NORWOOD B. MELCHER

GENERAL SUMMARY

FERRO-ALLOYS are in-process materials that do not reach the ultimate consumer as such. The term "ferro-alloys" is used in referring both to alloys and to compounds whose principal use is to add various elements to iron and steel in their manufacture. Some ferro-alloys contain elements that are employed as scavengers for removing impurities or rendering their presence harmless. This type includes silicon, which is used mainly in removing oxygen from steel, and manganese, which combines with sulfur in steel and eliminates the objectionable quality of hot-shortness which results when sulfur is combined with iron rather than manganese. The other ferro-alloys are used mainly to obtain desired properties in steel that result from addition of the alloying elements. Consequently, the demand for the latter group depends upon the rate of alloy-steel production, whereas the former group, which is used in all steels, both carbon and alloy, will follow a use-trend dependent upon the rate of total steel production. During 1948 ferro-alloy production increased 4 percent over the previous year; shipments from producing plants increased 6 percent in quantity and 24 percent in value. Total steel production increased 4 percent over 1947, while alloy-steel output increased 15 percent.

The United States depends upon imports for most of the ores used in the manufacture of ferro-alloys; molybdenum and silicon are produced domestically in tonnages sufficient to meet all requirements, and the bulk of vanadium requirements is produced domestically. Manganese, chromium, tungsten, nickel, columbium, and zirconium, however, are supplied to the United States steel industry chiefly from foreign mines. As the ores from which ferro-alloys are produced are considered essential for national security, those which are obtained from foreign sources are given special consideration in strategic stock piling. All are classified by the Munitions Board in group I, comprising those strategic and critical materials for which stock piling is deemed necessary to insure an adequate supply for a future emergency.

The ferro-alloying ores and metals are discussed in detail in chapters of this volume dealing with particular metals. These chapters are Chromium, Manganese, Molybdenum, Titanium, Tungsten, Vanadium, and Minor Metals.

PRODUCTION AND SHIPMENTS

The production of ferro-alloys in 1948 totaled 1,892,521 net tons compared with 1,813,783 net tons in 1947, an increase of 4 percent. In 1948 ferro-alloys were made at 13 blast-furnace plants, 19 electric-furnace plants, and 2 aluminothermic-furnace plants; in addition, 2 plants using electric furnaces produced ferrosilicon, and 6 produced ferrophosphorus as a byproduct. Shipments of all classes of ferro-alloys from furnaces increased 6 percent in quantity and 24 percent in value over 1947. Pennsylvania again led all other States in production and shipments of ferro-alloys, having produced 33 percent of the United States total tonnage and 40 percent of the value, compared with 31 and 36 percent, respectively, in 1947. This State increased its production 20 percent over 1947. New York was second, supplying 19 percent of the tonnage, which represented 24 percent of the value. Production and shipments of ferro-alloys also were reported from Alabama, California, Florida, Indiana, Iowa, Montana, New Jersey, Ohio, Oregon, South Carolina, Tennessee, Virginia, Washington, and West Virginia.

Ferro-alloys produced and shipped from furnaces in the United States, 1947–48

Alloy	1947			1948		
	Production (net tons)	Shipments		Production (net tons)	Shipments	
		Net tons	Value		Net tons	Value
Ferromanganese	614,626	614,647	$79,972,673	647,617	659,193	$90,126,657
Spiegeleisen	134,329	124,517	4,980,030	112,610	108,960	5,261,650
Ferrosilicon	769,653	766,316	53,271,432	814,297	818,974	71,711,831
Ferrophosphorus	33,072	81,169	2,016,122	32,297	72,453	2,006,254
Ferrotungsten	2,094	2,101	6,677,298	2,324	2,305	7,190,027
Ferrotitanium, Ferrovanadium	7,681	8,189		9,029	8,161	
Ferromolybdenum, Molybdic oxide, Calcium molybdate and compounds	13,195	13,142	73,104,419	20,737	21,443	97,154,001
Other ferro-alloys [1]	239,133	231,601		253,610	260,757	
Total	1,813,783	1,841,682	220,021,974	1,892,521	1,952,246	273,450,420

[1] Silicomanganese, manganese briquets, ferrochromium, ferrocolumbium, ferroboron, zirconium-ferrosilicon, and miscellaneous ferro-alloys.

Ferromanganese.—The ferromanganese produced in 1948 averaged 78 percent manganese and came from four electric and six blast-furnace plants. Of the manganese ore used in 1948 for the manufacture of ferromanganese, 92 percent was foreign compared with 91 percent in 1947. In all, 670,774 short tons of ferromanganese were consumed during 1948, virtually by the iron and steel industries alone. During the year steel producers used 12.7 pounds of metallic manganese as ferro-alloys per ton of steel produced. Of this quantity 11.3 pounds were in the form of ferromanganese.

Spiegeleisen.—The production of spiegeleisen in 1948 decreased 16 percent from 1947, and shipments from furnaces decreased 12 percent. The output came from three blast-furnace plants and averaged 24.6 percent manganese compared with 21.9 percent in the previous year.

Shipments from furnaces in 1948 totaled 108,960 tons valued at $5,261,650 f. o. b. furnaces, or $48.29 per ton, compared with $39.99 per ton in 1947 and $32.99 per ton in 1946. Three-tenths pound of metallic manganese in the form of spiegeleisen was used per ton of steel produced in 1948.

Ferrosilicon.—Shipments of ferrosilicon from furnaces during 1948 accounted for 42 percent of the tonnage of ferroalloys shipped during the year, and the value of shipments represented 26 percent of the total. The production of ferrosilicon increased 6 percent over 1947. Of the 814,297 tons of ferrosilicon produced, 35 percent (283,556 tons) were made in blast furnaces and 65 percent (530,741 tons) in electric furnaces. The latter figure includes 585 tons of ferrosilicon produced as a byproduct in the manufacture of artificial abrasives. The ferrosilicon made in blast furnaces (silvery pig iron) contained an average of 9.8 percent Si. Electric-furnace output, mostly ferrosilicon containing over 20 percent Si, averaged 40 percent. Shipments of all grades of ferrosilicon (including silvery pig iron) totaled 818,974 net tons valued at $71,711,831. Of the 298,651 net tons of ferrosilicon and miscellaneous silicon alloys consumed in the manufacture of steel ingots and castings, 52 percent or 156,033 net tons were of the standard 50-percent grade, 57, 608 net tons silvery pig iron, and 43,894 the 75-percent grade. "Other grades" constituted the remaining 41,116 net tons. The most important grade of ferrosilicon is the standard 50-percent, which is employed as a deoxidizer and solidifier in manufacturing most grades of killed and semikilled steel. Only a small quantity of this alloy is used in iron foundries and other industries. Alloys containing 75 percent silicon and miscellaneous silicon alloys are used as 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 the various grades of silicon alloys according to major consuming industry groups.

Consumption of ferrosilicon, silicon metal, and miscellaneous silicon alloys in the United States in 1948, by industries, in net tons

Alloy	Steel ingots and castings [1]	Steel castings [1]	Miscellaneous	Total
Silvery pig iron:				
5–20 percent silicon	57, 608	19, 476	331, 302	408, 386
Ferrosilicon:				
50 percent silicon	156, 033	15, 525	15, 132	186, 690
75 percent silicon	43, 894	278	2, 991	47, 163
Other grades [2]	41, 116	299	78, 156	119, 571
Total	298, 651	35, 578	427, 581	761, 810

[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 1948 was produced in electric furnaces as a byproduct in the manufacture of phosphate fertilizers and other chemicals. Shipments of ferrophosphorus decreased 11 percent from 1947 as a result of a drop in demand for ferrophosphorus for metallurgical and chemical uses. Production totaled 32,297 tons—a decrease of 2 percent from 1947. Shipments from plants totaled 72,453 tons at a value of $2,006,254, most of which was exported.

Ferrotungsten.—The ferrotungsten produced in the United States during 1948 was made in electric furnaces using both foreign and domestic ores. Total consumption of tungsten concentrates in the United States in 1948 was 9,300 net tons (60-percent WO_3 basis), 4,100 tons of which was consumed in the manufacture of ferrotungsten. The domestic material was obtained from eight States and Alaska in 1948, but three States—Nevada, North Carolina, and California—supplied 94 percent of the total. Imports for consumption of tungsten ores and concentrates in 1948 were equivalent to 7,931 net tons of 60-percent WO_3, a 25-percent increase over 1947. These ores and concentrates came from 17 foreign countries in 1948 but four—Bolivia, Brazil, China, and Korea—supplied 80 percent of the total.

Ferrochromium.—All of the ferrochromium output in the United States in 1948 was produced in electric furnaces, mainly from foreign ores. Reported consumption of ferrochromium in the United States during 1948 totaled 122,753 net tons, an increase of 8 percent over the 1947 consumption of 113,491 net tons. The consumption of ferrochromium canvassed by the Bureau of Mines represents about 85 percent of the total. Exports in 1948 increased 119 percent over 1947 and amounted to 6,754 net tons valued at $2,371,367. Imports amounted to 9,019 net tons, compared with 10,680 net tons in 1947.

Ferromolybdenum.—The ferromolybdenum produced in 1948 was made by the aluminothermic process and in electric furnaces using domestic ores. This alloy was produced at Langeloth and Washington, Pa., and Niagara Falls, N. Y.

Molybdic Oxide, Calcium Molybdate, and Molybdenum Compounds.—Molybdenum compounds used as alloying agents in the production of iron and steel are included with ferro-alloys. These materials are much less expensive than ferromolybdenum and consequently are used to a greater extent. As with ferromolybdenum, virtually all these compounds are made from domestic raw materials.

Producers of ferro-alloys in the United States in 1948

Producer	Plant	Alloy
American Agricultural Chemical Co.	South Amboy, N. J.	Ferrophosphorus (byproduct).
Anaconda Copper Mining Co.	Black Eagle, Mont.	Ferromanganese.
Bethlehem Steel Co.	Johnstown, Pa.	Do.
Climax Molybdenum Co.	Langeloth, Pa.	Ferromolybdenum, calcium molybdate, molybdenum oxide, oxide briquets, molybdenum trioxide, sodium molybdate, ferrotungsten, molybdenum silicide, ammonium molybdate, molybdenum sulphide.
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, ferroboron, ferrocolumbium, ferrotitanium, ferromolybdenum.
General Abrasive Co., Inc.	Niagara Falls, N. Y.	Ferrosilicon (byproducts).
Globe Iron Co.	Jackson, Ohio	Silvery pig iron.
Hanna Furnace Corp.	Buffalo, N. Y.	Do.
Jones & Laughlin Steel Co.	Aliquippa, Pa.	Spiegeleisen.
Jackson Iron & Steel Co.	Jackson, Ohio	Silvery pig iron.
Keokuk Electro-Metals Co.	Keokuk, Iowa	Ferrosilicon, silvery pig iron.

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Producers of ferro-alloys in the United States in 1948—Continued

Producer	Plant	Alloy
E. J. Lavino & Co.	Reusens, Va.; Sheridan, Pa.	Ferromanganese.
Metal & Thermit Corp.	Carteret, N. J.	Ferrotitanium.
Molybdenum Corp. of America	Washington, Pa.	Ferrotungsten, ferromolybdenum, calcium molybdate, molybdic 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, silicon briquets.
Pittsburgh Metallurgical Co.	Charleston, S. C.; Niagara Falls, N. Y.	Ferrosilicon, silvery pig iron, ferrochromium.
Sloss-Sheffield Steel & Iron Co.	N. Birmingham, Ala.	Ferromanganese.
Tennessee Products & Chemical Corp. (Southern Ferro-Alloys Div.).	Chattanooga, Tenn.	Ferromanganese, ferrosilicon, silicon briquets.
Tennessee Valley Authority	Muscle Shoals, Tenn.	Ferrophosphorus (byproduct).
Titanium Alloy Mfg. Div., National Lead Co.	Niagara Falls, N. Y.	Ferrotitanium.
U. S. Steel Corp. subsidiaries	Clairton, Pa.; Etna, Pa.; Gary, Ind.	Ferromanganese, spiegeleisen.
Vanadium Corp. of America	Niagara Falls, N. Y.; Bridgeville, Pa.	Ferrosilicon, silicon briquets, alsifer, ferrochromium, ferrovanadium, ferrotitanium, grainals, aluminum vanadium, ammonium meta vanadette, titanium aluminum, cupro vanadium, mangano vanadium.
Victor Chemical Works	Mt Pleasant, Tenn.	Ferrophosphorus (byproduct).
Virginia-Carolina Chemical Corp.	Nichols, Fla.	Do.

Ferrotitanium.—In 1948 most of the ferrotitanium was produced in electric furnaces, but a small quantity was made by the aluminothermic process. The ferrotitanium produced in 1948 averaged 19.5 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.

Ferrovanadium.—All ferrovanadium produced in 1948 was made in electric furnaces, and both foreign and domestic ores were used in its manufacture. The alloy averaged 48 percent vanadium in 1948, compared with 45 percent in 1947.

Ferroboron.—Shipments of ferroboron in 1948 averaged 11.6 percent boron. 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 1948 the output of ferrocolumbium averaged 55 percent columbium and was produced in electric furnaces.

Zirconium-Ferrosilicon.—The zirconium-ferrosilicon produced in 1948 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 1948 averaged 67 percent manganese and was made in electric furnaces. This alloy is used mainly in the steel industry in the manufacture of steel ingots.

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 1948 averaged 57 percent manganese.

FOREIGN TRADE[1]

Ferromanganese was by far the chief ferro-alloy import in 1948, although important quantities of ferrochromium and ferrosilicon were received. The ferromanganese is largely manufactured in Canada and Norway from Gold Coast ore, which in effect added nearly 200,000 tons of manganese ore equivalent to United States receipts from Gold Coast.

Ferro-alloys and ferro-alloy metals imported for consumption in the United States, 1947–48,[1] by varieties

[U. S. Department of Commerce]

Variety of alloy	1947			1948		
	Gross weight (net tons)	Content (net tons)	Value	Gross weight (net tons)	Content (net tons)	Value
Calcium silicide (calcium-silicon content)	------	------	------	([2])	215	$52,378
Chrome or chromium metal	([3])	([2])	$4	------	------	------
Ferrochrome or ferrochromium containing 3 percent or more of carbon	10,680	6,450	1,725,400	9,019	4,714	1,470,653
Ferromanganese:						
Containing over 1 and less than 4 percent carbon	9,154	7,534	1,723,148	15,590	12,828	3,081,813
Containing not less than 4 percent carbon	72,153	57,647	9,123,888	82,630	65,598	11,434,780
Ferrosilicon	13,859	2,141	465,360	7,344	734	179,998
Ferrotitanium	45	([2])	27,766	28	([2])	17,346
Manganese-boron, manganese metal, and spiegeleisen not more than 1 percent carbon (manganese content)	([2])	([3])	11	------	------	------
Silicon-aluminum and aluminum-silicon	([4])	([2])	8	------	------	------
Tungsten and combinations, in lump, grains, or powder: Tungsten metal (tungsten content)	([2])	5	18,414	([2])	([5])	366
Tungstic acid	([2])	4	148	------	------	------

[1] Change for table in Minerals Yearbook, 1947, p. 496. Spiegeleisen in 1946 should read: Gross weight, 321 tons.
[2] Not recorded.
[3] Less than 1 pound.
[4] 50 pounds.
[5] 224 pounds.

[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.

Ferromanganese and ferrosilicon imported for consumption in the United States, 1947–48, by countries

[U. S. Department of Commerce]

Country	Ferromanganese (manganese content)				Ferrosilicon (silicon content)			
	1947		1948		1947		1948	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Canada	54,809	$8,697,897	57,477	$9,957,681	2,141	$465,360	733	$179,668
Italy							1	330
Norway	10,372	2,149,139	20,949	4,558,912				
Total	65,181	10,847,036	78,426	14,516,593	2,141	465,360	734	179,998

Ferro-alloys and ferro-alloy metals exported from the United States, 1944–48, by varieties

[U. S. Department of Commerce]

Variety of alloy	1944		1945		1946		1947		1948	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Spiegeleisen	202	$6,508	2,393	$82,699	7,513	$271,827	305	$12,632	51	$2,227
Ferrochrome	532	175,698	1,471	487,755	2,510	732,221	3,081	1,057,359	6,754	2,371,367
Ferromanganese	600	101,445	836	175,556	2,951	381,194	20,168	2,811,653	19,696	2,990,645
Ferromolybdenum	2,214	2,665,920	884	1,050,863	370	456,574	477	630,813	594	806,420
Ferrophosphorus	41	3,440	603	42,204	1,228	80,037	6,041	241,464	52,988	1,310,260
Ferrosilicon	2,483	283,360	1,089	114,520	3,163	244,625	1,357	187,973	2,476	427,259
Ferrotitanium and ferro-carbon-titanium	792	125,987	744	122,887	550	63,723	509	80,590	480	82,874
Ferrotungsten	1,177	3,664,242	431	1,344,281	91	270,325	41	134,546	628	1,838,397
Ferrovanadium	596	2,212,490	86	246,862	57	161,289	89	266,040	119	390,428
Other ferro-alloys	143	176,111	73	33,016	218	61,489	206	88,289	183	102,709
Total	8,780	9,415,201	8,610	3,700,643	18,651	2,723,304	32,274	5,511,359	83,969	10,322,586

Fluorspar and Cryolite

By HUBERT W. DAVIS

FLUORSPAR

GENERAL SUMMARY

SHIPMENTS of fluorspar from mines in the United States established a peacetime record and imports an all-time high in 1948. Moreover, consumption of fluorspar in the United States in 1948 was only 1 percent under the all-time record established in 1944. However, production of finished fluorspar declined moderately. The continued high level of operations in the steel and hydrofluoric-acid industries was chiefly responsible for the accelerated activity in fluorspar in 1948.

Illinois maintained its rank as the premier producer of fluorspar in 1948 by supplying 52 percent of the total domestic shipments. Furthermore, shipments from Illinois were 3 percent greater than in 1947. Shipments from mines in Nevada and Utah established new records in 1948, and shipments from Montana were reported for the first time. However, Arizona, Colorado, Kentucky, New Mexico, and Texas shipped less fluorspar in 1948 than in 1947.

For the eighth consecutive year Mexico has continued to be the largest source of foreign fluorspar to the United States, and in 1948 it supplied 71 percent of the total imports. Moreover, imports of fluorspar from Mexico were 53 percent greater than in 1947. For the first time since 1939, fluorspar was received from Germany. Substantially larger imports were also received from Newfoundland.

The steel industry continued to be the predominant user of fluorspar and absorbed proportionately more (57 percent) of the total consumed in 1948 than in 1947 (55 percent). The average consumption of fluorspar per long ton of basic open-hearth steel produced increased for the second consecutive year; it was 5.86 pounds in 1948 compared with 5.54 pounds in 1947. The hydrofluoric-acid industry, the second largest utilizer of fluorspar, consumed 7 percent more than in 1947—26.4

percent of the total in 1948 compared with 26.7 percent in 1947. Larger quantities of fluorspar were also used in 1948 than in 1947 at iron foundries, nonferrous smelters, and plants making ferro-alloys, cement, and special fluxes. However, consumption of fluorspar by the glass and enamel trades in 1948 dropped 10 percent from the all-time high established in 1947.

Deliveries of fluorspar to consumers in the United States totaled 442,336 short tons in 1948 (331,105 tons from domestic mines and 111,231 tons from foreign sources). In 1947, deliveries to consumers had totaled 397,465 tons (319,195 tons from domestic mines and 78,270 tons from foreign sources); in addition, 9,109 tons of finished fluorspar from domestic mines were delivered to the Government stock pile. Total deliveries to steel plants in the United States advanced to 269,304 tons (230,224 tons in 1947), and those to hydrofluoric-acid plants increased to 106,857 tons (102,013 tons in 1947); however, sales to glass and enamel plants fell to 45,602 tons (50,054 tons in 1947).

Salient statistics of fluorspar in the United States, 1939–48, in short tons

Year	Shipments from domestic mines	Foreign trade		Consumption	Industry stocks at end of year		
		Imports for consumption	Exports		Domestic mines [1]	Consumers' plants	Total
1939	182,771	16,302	2,976	176,800	38,619	90,400	129,019
1940	233,600	11,873	8,482	218,500	43,866	102,100	145,966
1941	320,669	7,524	12,184	303,600	31,997	108,900	140,897
1942	360,316	2,151	9,020	360,800	19,429	96,000	115,429
1943	406,016	43,769	9,068	388,885	19,026	105,933	124,959
1944	413,781	87,200	1,980	410,170	19,021	98,446	117,467
1945	323,961	104,925	1,420	356,090	19,863	103,148	123,011
1946	277,940	29,852	1,729	303,190	18,957	98,663	117,620
1947	329,484	78,725	1,180	376,138	33,101	114,150	147,251
1948	331,749	111,626	666	406,269	37,344	146,869	184,213

[1] Finished fluorspar only.

The average composite selling price ($32.14 a short ton) of all grades of fluorspar (both domestic and foreign) delivered to consumers in the United States in 1948 was $0.34 less than in 1947.

Hourly wage increases of 7 to 10 cents were made by many fluorspar-mining companies in 1948.

The total quantity of fluorspar shipped in and imported into the United States from about 1870 through 1948 was approximately 8,809,000 short tons, comprising about 83 percent from domestic mines and 17 percent from foreign sources.

RESERVES

Information on reserves of fluorspar in the United States, prepared by the Bureau of Mines and Geological Survey, was published in hearings before a Subcommittee of the Committee on Public Lands, United States Senate, Eightieth Congress, first session, 1947 (pp. 242–245); an abstract is contained in the chapter of this series for 1947 (pp. 498–499).

PRODUCTION AND SHIPMENTS

Production of finished fluorspar totaled 336,000 short tons in 1948, including 156,246 tons of flotation concentrates; however, the output also included 2,100 tons of finished fluorspar recovered from milling crude ore that had been mined before 1948. Thus, total production (expressed in terms of finished fluorspar) was 333,900 tons in 1948 compared with 338,600 tons in 1947. Of the mine output in 1948, 11 mines (producing over 10,000 tons each) supplied 167,500 tons or 50 percent, 7 mines (producing 5,000 to 10,000 tons each) supplied 58,700 tons or 18 percent, 29 mines (producing 1,000 to 5,000 tons each) supplied 76,300 tons or 23 percent, and 12 mines (producing 500 to 1,000 tons each) supplied 8,300 tons or 2 percent; thus, 59 mines produced 310,800 tons or 93 percent of the total. Of the remaining output (23,100 tons or 7 percent), some (in quantities ranging from a few tons to 500) came from an undetermined number of small mines and prospects, but much was derived from treated tailings from previous milling operations.

In 1948 mines operated by consumers produced 89,600 tons of finished fluorspar compared with 99,300 tons in 1947.

Fluorspar shipments from domestic mines in 1948 aggregated 331,749 short tons valued at $11,227,452, increases of 0.7 percent in quantity and 2.5 percent in value over 1947. Of the 1948 total, 71,696 tons were shipped by river or river-rail for delivery to consumers compared with 60,630 tons in 1947.

Illinois (52 percent) and Kentucky (26 percent) supplied 78 percent of the fluorspar shipped in 1948 compared with 78 percent also in 1947. Shipments from Illinois and Kentucky were virtually the same in both years compared with a gain of 3 percent from other producing States.

The average value of all grades of domestic finished fluorspar shipped in 1948 ($33.84) established a new peak and was $0.59 more than the previous high of 1947.

Fluorspar shipped from mines in the United States, by States, 1947–48

State	1947			1948		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Colorado	32,153	$950,882	$29.57	27,698	$831,218	$30.01
Illinois	167,157	6,148,654	36.78	172,561	6,322,246	36.64
Kentucky	90,256	2,713,508	30.06	84,889	2,663,377	31.37
New Mexico	27,526	841,095	30.56	24,968	911,682	36.51
Other States:						
Arizona	1,601	300,736	24.27	1,271	498,929	23.06
Montana				318		
Nevada	8,042			9,615		
Texas	1,019			906		
Utah	1,730			9,523		
	329,484	10,954,875	33.25	331,749	11,227,452	33.84

Fluorspar shipped[1] from mines in the United States, by States, 1944–48, with shipments of maximum year and cumulative shipments from earliest record to end of 1948, in short tons[2]

State	Maximum shipments		Shipments by years						Total shipments[1] from earliest record to end of 1948	
							1948			
	Year	Short tons	1944	1945	1946	1947	Short tons	Percent of total	Short tons	Percent of total
Arizona	1939	1,608	976	1,126	389	1,601	1,271	0.4	15,296	0.2
California	1934	181	26	--------	--------	--------	--------	--------	341	(3)
Colorado[4]	1944	65,209	65,209	52,437	32,539	32,153	27,698	8.3	533,804	7.3
Illinois[4]	1943	198,789	176,259	147,251	154,525	167,157	172,561	52.0	3,868,674	53.1
Kentucky[4]	1941	142,862	112,791	95,142	63,143	90,256	84,889	25.6	2,450,902	33.6
Montana	1948	318	--------	--------	--------	--------	318	.1	318	(3)
Nevada	1948	9,615	7,293	7,038	6,234	8,042	9,615	2.9	87,102	1.2
New Hampshire	1917	1,274	--------	--------	--------	--------	--------	--------	8,302	.1
New Mexico	1944	42,973	42,973	14,449	17,584	27,526	24,968	7.5	288,153	4.0
Tennessee	1906	360	--------	--------	--------	--------	--------	--------	1,197	(3)
Texas	1944	4,769	4,769	3,413	1,118	1,019	906	.3	12,290	.2
Utah	1948	9,523	3,466	2,973	2,370	1,730	9,523	2.9	24,991	.3
Washington	1945	132	--------	132	38	--------	--------	--------	382	(3)
Wyoming	1944	19	19	--------	--------	--------	--------	--------	19	(3)
	1944	413,781	413,781	323,961	277,940	329,484	331,749	100.0	7,291,771	100.0

[1] Figures for 1880–1905 represent production.
[2] Quantity and value figures, by States, for 1880–1925 in Mineral Resources, 1925, pt. 2, pp. 13–14, and for 1910–40 in Minerals Yearbook, Review of 1940, p. 1297.
[3] Less than 0.1 percent.
[4] 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 (estimated) included in "Total shipments" column as follows: Colorado, 4,400 tons; Illinois, 20,000 tons; and Kentucky, 600 tons.

Fluorspar shipped from mines in the United States, by grades and industries 1947–48, in short tons

Grade and industry	1947	1948
Fluxing gravel and foundry lump:		
Ferrous	[1,2] 158,789	[1] 167,733
Nonferrous	1,734	1,286
Cement	812	950
Miscellaneous	3,489	4,780
Government stock pile	9,109	----------
	[1,2] 173,933	[1] 174,749
Ground and flotation concentrates:		
Ferrous[3]	[1,2] 13,073	[1] 11,714
Nonferrous	783	[3] 1,093
Glass and enamel	49,559	45,375
Hydrofluoric acid	89,667	96,848
Miscellaneous	1,288	1,325
Exported	1,180	644
	[1,2] 155,550	[1] 156,999

Grade and industry	1947	1948
Acid lump: Nonferrous	1	1
Total:		
Ferrous	171,862	179,447
Nonferrous	2,518	2,380
Cement	812	950
Glass and enamel	49,559	45,375
Hydrofluoric acid	89,667	96,848
Miscellaneous	4,777	6,105
Government stock pile	9,109	----------
Exported	1,180	644
	329,484	331,749

[1] Fluxing gravel includes (and flotation concentrates exclude) the following quantities of flotation concentrates blended with fluxing gravel: 1947, 19,110 tons; 1948, 16,666 tons.
[2] Revised figure.
[3] Includes pelletized gravel.

Fluorspar shipments in 1948 comprised 174,749 tons of fluxing gravel (including 16,666 tons of flotation concentrates which were blended with fluxing gravel) and foundry lump, 156,999 tons of ground and flotation concentrates, and 1 ton 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, and to smelters of secondary metals. Of the ground and flotation concentrates shipped in 1948, hydrofluoric-acid plants took 62 percent and glass and enamel plants 29 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.

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.

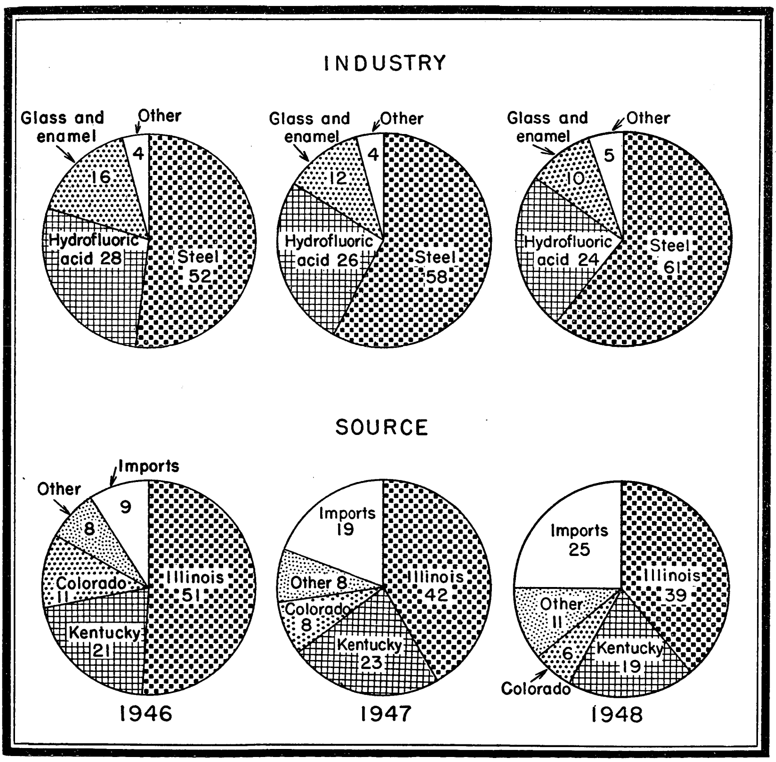

FIGURE 1.—Fluorspar sales (domestic and foreign) to consumers in the United States, 1946–48, by consuming industries and sources, in percent.

Fluorspar shipped from mines in the United States, by uses, 1947–48

Use	1947				1948			
	Quantity		Value		Quantity		Value	
	Percent of total	Short tons	Total	Average	Percent of total	Short tons	Total	Average
Steel	50.2	165,427	$4,799,531	$29.01	51.4	170,633	$5,058,866	$29.65
Iron foundry	1.3	4,439	133,728	30.13	2.0	6,667	220,512	33.08
Glass	12.4	40,843	1,434,905	35.13	10.9	35,960	1,294,211	35.99
Enamel	2.6	8,716	315,491	36.20	2.8	9,415	362,111	38.46
Hydrofluoric acid	27.2	89,667	3,662,409	40.84	29.2	96,848	3,852,678	39.78
Miscellaneous	3.1	10,103	346,532	34.30	3.5	11,582	414,255	35.77
Government stock pile	2.8	9,109	218,600	24.00				
Exported	.4	1,180	43,679	37.02	.2	644	24,819	38.54
	100.0	329,484	10,954,875	33.25	100.0	331,749	11,227,452	33.84

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 1948 totaled 100,286 tons, or 10 percent more than in 1947. These stocks comprised 37,344 tons of finished fluorspar and 62,942 tons of crude fluorspar (calculated to be equivalent to 27,000 tons of finished fluorspar).

Stocks of fluorspar at mines or shipping points in the United States, by States, Dec. 31, 1946, 1947, and 1948, in short tons

State	1946		1947		1948	
	Crude [1]	Finished	Crude [1]	Finished	Crude [1]	Finished
California	150		150		150	
Colorado	4,207	579	7,135	674	6,498	757
Idaho	50		50		50	
Illinois	28,814	10,006	23,545	15,313	36,090	12,509
Kentucky	3,129	8,007	8,266	16,526	13,928	23,423
Nevada				41		292
New Mexico	34,939	226	19,186	395	6,046	312
Texas				103	180	2
Utah		139		49		49
	71,289	18,957	58,332	33,101	62,942	37,344

[1] This crude (run-of-mine) fluorspar must be beneficiated before it can be marketed.

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, by industries, 1947–48, in short tons

Industry	1947			1948		
	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	189,773	77,820	4,488	207,342	111,260	8,589
Electric-furnace steel	19,481			25,241		
Bessemer steel	141			104		
Iron foundry	4,089	1,759	171	6,209	2,161	5
Ferro-alloys	2,478	870	101	2,608	801	----------
Hydrofluoric acid [1]	100,363	19,693	554	107,280	19,530	297
Primary aluminum [2]	896	909	----------	1,156	605	----------
Primary magnesium						
Glass	42,130	7,682	692	37,247	6,734	759
Enamel	8,938	1,780	243	8,871	1,987	373
Cement	811	1,263	----------	1,078	1,152	----------
Miscellaneous	7,038	2,374	238	9,133	2,639	111
	376,138	114,150	6,487	406,269	146,869	10,134

[1] Fluorspar used in making artificial cryolite and aluminum fluoride (aluminum raw materials) is included in the figures for hydrofluoric acid, which is an intermediate in their manufacture.
[2] Figures on consumption represent fluorspar used as a flux; see footnote 1.

Production of basic open-hearth steel and consumption and stocks of fluorspar (domestic and foreign) at basic open-hearth steel plants, 1944–48

	1944	1945	1946	1947	1948
Production of basic open-hearth steel ingots and castings .... long tons	71,387,000	64,510,000	54,034,000	68,506,000	70,830,000
Consumption of fluorspar in basic open-hearth steel production .... short tons	201,788	176,488	145,631	189,773	207,342
Consumption of fluorspar per long ton of basic open-hearth steel made .... pounds	5.7	5.5	5.4	5.5	5.9
Stocks of fluorspar at basic open-hearth steel plants at end of year .... short tons	53,100	63,900	61,600	68,400	106,300

Fluorspar (domestic and foreign) consumed in the United States, 1927–48, 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
1947	209,395	100,363	42,130	8,938	6,567	8,745	376,138
1948	232,687	107,280	37,247	8,871	8,817	11,367	406,269

Fluorspar was reported consumed in 40 States and the District of Columbia in 1948, but 3 States—Illinois, Ohio, and Pennsylvania—used 228,693 tons or 56 percent of the total consumption. Pennsylvania was again the chief consuming State; it ranked first in consumption of fluorspar in both steel and glass and advanced to third from seventh place in hydrofluoric acid. Illinois maintained its rank as the largest consumer of fluorspar in hydrofluoric acid in 1948.

The accompanying table shows, so far as possible without revealing the figures of individual companies, the consumption of fluorspar, by States, in 1947 and 1948.

Fluorspar (domestic and foreign) consumed in the United States, by States, 1947–48, in short tons

State	1947	1948	State	1947	1948
Alabama Georgia	10,076	12,435	Kentucky Maryland	6,179	7,483
Arkansas Florida Louisiana Mississippi North Carolina South Carolina	21,740	17,269	Maine Massachusetts Rhode Island	1,441	1,503
California	9,185	10,612	Michigan	10,545	9,994
Colorado Iowa Utah	14,161	15,308	Minnesota Wisconsin	2,888	3,870
Connecticut	549	950	Missouri	3,935	4,041
Delaware District of Columbia New Jersey	27,535	26,984	New York	12,823	14,588
Illinois	59,646	63,304	Ohio	62,871	67,725
Indiana	27,916	30,077	Oklahoma	1,445	900
Kansas Nebraska South Dakota	82	272	Oregon Washington	1,966	2,358
Wyoming	----------		Pennsylvania	84,949	97,664
			Tennessee	1,257	1,084
			Texas	9,736	12,387
			Virginia	132	61
			West Virginia	5,081	5,400
				376,138	406,269

REVIEW BY STATES

Arizona.—Production of fluorspar in Arizona was 1,271 short tons in 1948 compared with 1,601 tons in 1947. The 1948 output came chiefly from Cochise County, but some came from Greenlee, Maricopa, and Yuma Counties. The fluorspar from Cochise County was from the Lone Star mine operated by Cooper Shapley, Jr., and was shipped to steel plants. The fluorspar from Maricopa County, which was also shipped to steel plants, was from the Queen mine operated by Isaac Campbell and the Jumbo mine operated by J. A. Campbell. A small quantity of fluorspar was recovered as a by-product of the Sonora lead mine in Yuma County and shipped to a steel plant and a nonferrous smelter. The fluorspar from Greenlee County was shipped to a flotation plant; the concentrates recovered from the fluorspar, rather than the milling ore, have been credited to Arizona in the statistics.

California.—The Industrial Minerals & Chemical Co., West Berkeley, ground some Nevada fluorspar, which it sold to an iron foundry, an enamel plant, and a Canadian customer. The company also ground some Nevada fluorspar on a toll basis for Balfour, Guthrie & Co., Ltd., which sold it to an enamel plant. A carload of Nevada fluorspar was also ground by Kennedy Minerals Co., Inc., Los Angeles, for L. H. Butcher Co. The ground fluorspar has been credited to Nevada in the statistics.

Colorado.—Production of finished fluorspar in Colorado decreased to 27,800 short tons in 1948 from 32,200 tons in 1947. However, the 1948 production includes 700 tons of finished fluorspar recovered from milling crude ore mined before 1948. Consequently, production (expressed in terms of finished fluorspar) totaled 27,100 tons in 1948 compared with 33,600 tons in 1947. Output in 1948 came from Boulder, Chaffee, Jackson, and Mineral Counties.

Shipments of fluorspar from Colorado were 27,698 tons in 1948 compared with 32,153 tons in 1947. The 1948 shipments comprised 18,449 tons of flotation concentrates and 9,249 tons of metallurgical-grade fluorspar.

The Ozark-Mahoning Co., operating a flotation mill near Jamestown, produced 9 percent more flotation concentrates in 1948 than in 1947. The flotation-mill feed comprised ore chiefly from the Emmett and Blue Jay mines, but some was also contributed by the Argo mine. These mines are in Boulder County and were operated by Harry M. Williamson & Son. The shaft at the Argo mine was sunk an additional 100 feet and that at the Blue Jay was being sunk an additional 150 feet, of which 80 feet had been completed December 31. The Ozark-Mahoning Co. also operates a flotation mill at Rosiclare, Ill.

The flotation mill of the General Chemical Division, Allied Chemical & Dye Corp., near Jamestown, produced 13 percent more concentrates than in 1947. The flotation-mill feed comprised ore chiefly from the company-operated Burlington and Yellow Girl mines in Boulder County, but a small quantity was purchased from other Colorado mines. On March 30, 1948, the company added to its holdings in Chaffee County by purchasing the mine and flotation-jig mill of Colorado Fluorspar Mines, Inc., but they were not operated. The General Chemical Division, Allied Chemical & Dye Corp., also has a flotation mill at Deming, N. Mex.

Colorado Fluorspar Mines, Inc., operated its combination flotation-jig mill and mine near Salida, Chaffee County, until March 30, when they were sold to the General Chemical Division, Allied Chemical & Dye Corp. During the period January 1 to March 30 it produced 881 tons of flotation concentrates and 60 tons of fluxing-gravel fluorspar.

The Aksarben mine near Salida, Chaffee County, was under development by Fluorspar, Inc., which produced some ore that it treated at the flotation mill formerly operated by United States Fluorspar, Inc. Operation of the flotation mill was begun in December 1948.

The Wagon Wheel Gap mine of the Colorado Fuel & Iron Corp., in Mineral County, produced 6 percent more fluxing-gravel fluorspar in 1948 than in 1947. The company made general repairs and improvements to its mill in 1948.

The heavy-medium mill built on its property near Northgage, Jackson County, in 1943 by the Defense Plant Corp. was purchased by the Colorado Fluorspar Corp., effective November 1, 1948. The mill was formerly operated by the Western Fluorspar Corp. and was closed on August 26, 1945. The mill was not operated in 1948.

Illinois.—Illinois maintained its premier position as a fluorspar-producing State. Production of finished fluorspar was 169,700 short tons in 1948; about 95 percent came from Hardin County and the remainder from Pope County. In addition, some crude ore equivalent to 3,000 tons of finished fluorspar was mined but not milled in 1948. Thus, total mine production (expressed in terms of finished fluorspar) was 172,700 tons in 1948 compared with 169,300 tons in 1947. 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, Crystal, Deardorff, Douglas, East Green, Fairview, Geely Shaft, Hawkins Shaft, Interstate, Knox, Mahoning Shaft No. 2, Mahoning Shaft No. 3, Midway-North Boundary-Air Shaft-Hillside, Minerva, Pell Shaft, Redd, Rosiclare, South Boundary, Victory, and West Green properties supplied about 97 percent of the fluorspar produced in Illinois in 1948. Most of the remainder came from many mines and prospects, chiefly the Empire, Eureka, Humm, Jefferson, Lead Hill, Rose Creek, and Stewart; some was recovered from tailings from previous milling operations.

Shipments of fluorspar from Illinois (172,561 tons) were 3 percent more than in 1947 and contributed 52 percent of the total domestic shipped. Of the 1948 total, 50,441 tons were shipped by river or river-rail to consumers compared with 41,319 tons in 1947.

The Alcoa Mining Co. produced 3 percent less flotation concentrates in 1948 than in 1947. The mill feed comprised ore from the company-operated Argo, Blue Diggings, and Fairview mines. The ore from these mines is first treated in the company heavy-medium unit, which supplies an enriched product for flotation feed. The Argo-Blue Diggings vein system was worked through the Blue Diggings-Fairview shafts on the Argo 240-, 500-, 600-, 700-, and 800-foot levels; the Fairview-Blue Diggings vein was worked on the 400-, 500-, 600-, 700-, 800-, and 900-foot levels and on the 300-foot level of vein "J," a minor vein of this system. Thirty-pound rail was laid for operation of larger mine locomotives and cars on the main haulageways of the Fairview-Blue Diggings mines, and signal lights to control traffic on the single track on the 500- and 700-foot levels between the Fairview shaft and Argo-Blue Diggings vein intersection were installed.

The Crystal Fluorspar Co. produced 20 percent less finished fluorspar in 1948 than in 1947. The loss in output resulted partly from a strike of employees from June 9 to July 6 at the Crystal mine and from June 16 to July 6 at the Jefferson mine, and partly from mining lower-grade ore. Production in 1948 was obtained from the Crystal and Jefferson mines and from re-treating log-washer fines at the Patton flotation mill. At the Crystal mine 600 feet of drifting and 150 feet of raising were done in 1948. At the Jefferson mine, which has been under development since 1945, 538 feet of drifting, 147 feet of raising, and 38 feet of crosscutting were done in 1948. A new heavy-medium Mobil mill, to replace the present gravity-concentrating mill, was delivered late in December; it will be erected at the Crystal mine to serve it and the Jefferson mine.

The Inland Steel Co. discontinued fluorspar mining and milling operations at Rosiclare, and the mineral and mining rights of the Hillside mine were sold to the Rosiclare Lead & Fluorspar Mining Co. The Hillside mine and gravity-concentrating mill had been brought into operation about May 1, 1922, by Hillside Fluor Spar Mines. Future fluorspar production by Inland Steel Co. will be centered chiefly in its Keystone mine near Marion, Ky. Some ore was mined in 1948 at the Hillside mine by Inland Steel Co. before its disposition, and a small quantity of concentrates was produced at the company flotation plant. Its gravity-concentrating mill at Rosiclare, however, did not operate. Some ore from the Rosiclare mill was transferred to and treated at the company heavy-medium mill at the Keystone mine.

The Ozark-Mahoning Co. produced 28 percent more fluorspar flotation concentrates in 1948 than in 1947. The mill feed in 1948 comprised ore from the Deardorff, East Green, Mahoning Shaft No. 2, Mahoning Shaft No. 3, and West Green mines near Cave in Rock, Ill., the Delhi-Babb and Commodore mines near Salem and Marion, Ky., respectively, and some purchased ore, chiefly from the Mineral Ridge mine also near Salem. Production of finished fluorspar in 1948 comprised 76 percent acid grade, 12 percent pelletized gravel, and 12 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 Delhi-Babb, Commodore, and Mineral Ridge mines have been credited to Kentucky in the statistics. The Ozark-Mahoning Co. displaced the Rosiclare Lead & Fluorspar Mining Co. as the largest producer of fluorspar in the United States in 1948.

The Rosiclare Lead & Fluorspar Mining Co. operated the Eureka, Geely, Hawkins, Interstate, Midway-North Boundary-Air Shaft-Hillside, Pell, Rosiclare, and South Boundary properties in 1948, but the Rosiclare mine was again the chief producing mine of the company. The ore from the company mines is mill feed for its heavy-medium, jig, and flotation mills. Production of finished fluorspar of all grades was 12 percent less in 1948 than in 1947 but shipments were 4 percent more. Denver mineral jigs were added in the company mill for the reclamation of the fractional lead content in the gravel fines. A sizable ore body was being developed on the Interstate property about 4 miles northwest of Rosiclare. The ore body, which has been opened to a length of 250 feet, showed widths up to 16 feet at the 70-foot level; a stope started above the 70-foot level showed a maximum width of about 22 feet. The fluorspar is gravel in character and of very good grade. Sinking of the shaft to 140 feet to develop the downward extension of the ore body is contemplated.

Operations at the mine and flotation mill of Minerva Oil Co. continued on a 6-day week in 1948; but, chiefly because of a 17-day strike by employees in June, output of fluorspar flotation concentrates was 6 percent less than in 1947. The company was sinking a 6-foot air and escape shaft at its mine and was continuing prospect drilling on or near its properties.

Production in 1948 at the Douglas mine in Pope County, operated by the Hicks Creek Fluorspar Mining Co., was seven times that in 1947. The Redd mine, also in Pope County, operated by the H. C. B. Mining Co., the Knox, Rose Creek, and Austin mines in Hardin County, operated by Knox Fluorspar Co., Yingling Mining Co., and J. F. E. Austin, respectively, were the largest of the many smaller mines worked in Illinois in 1948.

Kentucky.—Production of finished fluorspar in Kentucky in 1948 was 7 percent less than in 1947 and 5 percent under the average for the 5 years 1943–47. Output in 1948 was 91,800 short tons. In addition, some crude ore equivalent to 1,700 tons of finished fluorspar was mined but not milled in 1948. Thus, total mine production (expressed in terms of finished fluorspar) was 93,500 tons in 1948 compared with 101,100 tons in 1947. Shipments were also less; they were 84,889 tons—a 6-percent decline from 1947. Of the 1948 shipments, 21,255 tons were shipped by river or river-rail compared with 19,311 tons in 1947.

Reflecting greatly accelerated activity at the Hughett mine, operated by the C & L Fluorspar Co., output in Caldwell County increased to 5,200 tons in 1948 from 1,700 tons in 1947. The Crowder mine contributed virtually all of the remainder of the output in the county.

The major part of the 1948 output in Crittenden County came from the Blue, Davenport, Delhi-Babb, Hicks, Keystone, Pigmy, Tabb No. 1, and Yandell No. 22 mines. Most of the remainder came from many smaller producing mines, including the Ainsworth, Crystal, Hickory Cane, Krausse, La Rue, Mary Belle, Reiter, Tabb No. 2, and Watkins; and some was recovered from tailings from previous milling operations.

Production and shipments of fluorspar in 1948 by the United States Coal & Coke Co., the largest producer in Kentucky, were 21 and 28 percent, respectively, less than in 1947. Output came from the Tabb No. 1, Tabb No. 2, and Yandell No. 22 mines. Its Big Four mine was idle, and the Asbridge No. 21 and Tabb No. 2 mines have been exhausted of known ore.

The Kentucky Fluor Spar Co. and affiliates shipped 19 percent less fluorspar and "fluorbarite" than in 1947. The company operates a mill at Marion and, through its mining division (Roberts & Frazer), operated the Carr and Wright mines in Livingston County. Only about one-fifth of the supply came from company mines in 1948; most of it was supplied by the Austin, Blue, Crowder, Hughett, Keystone, Knox, Krausse, Lead Hill, Redd, and Rose Creek mines and the flotation mills of Butler & Moodie, C & L Fluorspar Co., Crider Bros. Fluorspar Co., and Minerva Oil Co.

The Keystone mine and new heavy-medium mill of Inland Steel Co. were operated throughout 1948. Output at the Keystone mine was about double that in 1947. Production at its heavy-medium mill was 3.7 times that in 1947, when it was only operated a little over 4 months. The company completed a barge-loading station on the Kentucky bank of the Ohio River, opposite Elizabethtown, Ill.

Output of fluorspar at the Pigmy mine of the Pigmy Corp. (subsidiary of the Rosiclare Lead & Fluorspar Mining Co.) declined for the fourth consecutive year and was 37 percent less in 1948 than in 1947.

In 1948 the Delhi Fluorspar Corp. made a small production at its Hickory Cane mine but it was inadequate for its needs. Consequently, the company purchased fluorspar from many local producers, as well as some Mexican fluorspar, which was blended with domestic fluorspar. The domestic fluorspar came chiefly from the Austin, Douglas, Knox, and Redd mines in Illinois. The Mexican fluorspar so blended and shipped has not been included in the statistics for

Kentucky. Total shipments by Delhi Fluorspar Corp. were 107 percent greater than in 1947.

L. Conyer shipped 18 percent less fluorspar in 1948 than in 1947. He operates a jig mill near Marion and depends on purchases of local ore and tailings for his mill feed. Most of his output of finished fluorspar in 1948 was derived from milling tailings purchased from various mills in Illinois and Kentucky.

Ben E. Clement sold 22 percent more fluorspar in 1948 than in 1947. He purchased fluorspar from local producers and some acid-grade fluorspar from Mexico. The Mexican fluorspar was used to raise the grade of locally purchased fluorspar. The Mexican fluorspar has not been included in the statistics for Kentucky.

Crider Bros. Fluorspar Co. worked the Blue mine near Mexico, Ky., and the Jameson mine near Lola, reclaimed some fluorspar from the Haffaw dump, and purchased fluorspar from local producers. The ore from the company mines is mill feed for its gravity-concentrating and flotation mills. Output in 1948 comprised 70 percent metallurgical-grade fluorspar and 30 percent flotation concentrates. The company reopened the No. 1 shaft at the Blue mine and hoisted a substantial tonnage of ore from the 300-foot level. A new gravity-concentrating mill was erected at the Blue mine. Sales of fluorspar by the company were 10 percent smaller than in 1947.

The C & L Fluorspar Co., which operated the Hughett mine in Caldwell County, purchased the flotation mill of Minerals Flotation Corp. at Marion during the second quarter of 1948 and operated it the remainder of the year. The mill feed comprised tailings from local mines.

Davenport Mines, Inc., operated the Davenport and Hicks mines near Salem in 1948. It did much underground exploratory work in anticipation of completion of its new heavy-medium mill to serve these mines. The mill was completed in November. As a consequence of exploratory work and mill construction, output of fluorspar by the company declined 36 percent from 1947.

The Aluminum Ore Co. (Alcoa Mining Co. beginning January 1, 1949) did not mine any fluorspar in Kentucky in 1948, but its Mary Belle mine was leased to and operated by F. B. Moodie, Jr. However, the company did prospect core drilling on the Eagle-Butler, Eagle-Babb, Klondike-Schoolhouse, Coker, Danakay, Grassham, Tyner, Trabue-Skelton, F. W. Davis, Lewis Heirs, Haynes, Snyder, Howard Damron, George Damron, Alonzo Watson, and Eagle-Hutson properties.

In Livingston County production of finished fluorspar declined to 9,800 tons in 1948 from 17,200 tons in 1947. The output in 1948 came chiefly from the Carr and Mineral Ridge mines and from reworking the Klondike tailings.

Output at the Carr and Wright mines of Roberts & Frazer was 56 percent less than in 1947.

The Mineral Ridge mine was operated by Alco Lead Corp. throughout 1948; output was at about the same as in 1947. The heavy-medium mill completed at this mine in early 1948 was later dismantled and moved to the company lead mine in Illinois.

Butler & Moodie continued to reclaim fluorspar from Klondike tailings at its flotation mill near Mullikin.

In the Central Kentucky district production and shipments of finished fluorspar declined to 2,476 and 2,717 tons, respectively, in 1948 (5,771 and 6,030 tons in 1947). In addition to the finished fluorspar shipped in 1948, 250 tons of milling ore was shipped to a mill at Marion, Ky. The largest producer in this district is Hageman Properties, Inc.; in 1948 it operated the Faircloth and Haydon mines in Woodford County near Wilmore. A small quantity of fluorspar was produced at the Lone Oak mine in Mercer County near Harrodsburg by Albert Brauer in 1948; the mine has been abandoned.

Montana.—The first commercial production of fluorspar in Montana was reported made in 1948; it totaled 318 tons and was produced by Jay Bettles at the property of Coeur d'Alene Extension Mines, Inc., in Mineral County near Superior. The fluorspar was uncovered by bulldozing operations; it was reported to have averaged 94.6 percent calcium fluoride and was shipped to Pacific coast steel plants.

Nevada.—Shipments of fluorspar from Nevada established a new high in 1948; they were 9,615 short tons, an increase of 20 percent over 1947 and 7 percent greater than in 1941, the previous record year. Most of the 1948 output went to steel plants; but some was shipped to cement, glass, and enamel plants, iron foundries, and nonferrous smelters, and a little was exported to Canada. The fluorspar moving to glass and enamel plants and to Canada was ground by Industrial Minerals & Chemical Co., West Berkeley, Calif., and Kennedy Minerals Co., Inc., Los Angeles, Calif.

The chief producing mine in Nevada in 1948 was the Daisy in Nye County, operated by J. Irving Crowell, Jr.; its production was 129 percent more than in 1947. The Baxter mine in Mineral County, operated by V. S. Baxter, was the second-largest producing mine in Nevada in 1948; its output, however, declined 23 percent from 1947. A car of fluorspar was produced at the Cirac Review Group in Churchill County by C. P. Cirac.

New Mexico.—Production of finished fluorspar in New Mexico was 24,900 short tons in 1948, a loss of 10 percent from 1947. However, the 1948 production includes 6,200 tons of finished fluorspar recovered from treating some crude ore mined before 1948. Consequently, total mine production (expressed in terms of finished fluorspar) was 18,700 tons in 1948 compared with 22,000 tons in 1947. The 1948 output came from Dona Ana, Grant, Hidalgo, Luna, Sierra, and Valencia Counties. The Zuñi and Mirabal mines in Valencia County, Shrine mine in Grant County, and Howard (White Eagle) mine in Luna County supplied about 86 percent of the fluorspar produced in New Mexico in 1948. Most of the remainder came from many mines and prospects, and some was recovered from tailings from previous milling operations.

Shipments of fluorspar from New Mexico likewise decreased and totaled 24,968 tons in 1948, a loss of 9 percent from 1947.

The flotation mill of General Chemical Division, Allied Chemical & Dye Corp., at Deming produced 1 percent less concentrates in 1948 than in 1947. The mill feed comprised ore from the company Shrine mine in Grant County and Florida mine in Luna County and purchased ore from local mines, chiefly the Howard (White Eagle) mine in Luna County.

The flotation mill of Zuñi Milling Co. at Los Lunas produced 80 percent more concentrates than in 1947. The mill feed comprised ore from the company mines near Grants in Valencia County, tailings from previous milling operations, and purchased ore from local mines, chiefly the Howard (White Eagle) mine in Luna County and the Mirabal mine in Valencia County. Output of milling ore at the company mines almost tripled that in 1947.

The Howard (White Eagle) mine in Luna County, operated by J. H. Harrison, was the second-largest producing mine in New Mexico in 1948; except for a carload to a cement plant, the fluorspar was sold to local flotation mills.

Texas.—Production of finished fluorspar in Texas was 805 short tons in 1948, a loss of 28 percent from 1947; shipments (906 tons) were 11 percent smaller. Production was from the Eagle Mountains mine in Hudspeth County near Van Horn, operated by J & L Fluorite Co. until April 10, when it was sold to Texas Fluorspar Mines, Inc., which operated the remainder of the year. The new operator did much development at the mine and overhauled its mill, to which a second ball mill was added, increasing milling capacity to 80 tons per 24 hours. Geologic mapping covering some 5 square miles is reported to have resulted in a substantial increase in inferred ore reserves. The fluorspar deposits controlled by the Texas Fluorspar Mines, Inc., were described.[1]

Utah.—Production of fluorspar in Utah established a new high in 1948; it was 9,523 short tons, an increase of 481 percent over 1947 and 173 percent greater than in 1944, the previous record year. The bulk of the production came from Juab County near Delta, where there was a short-lived mining "boom" in 1948. George Spor & Sons, who first mined fluorspar in the Delta area, again operated, and Chesley & Black, Willden Bros., and Ward Leasing Co. made initial outputs. All the ore produced, which was reported to average about 85 percent calcium fluoride and less than 2 percent silica, was shipped to the steel plant at Geneva. A car of fluorspar was shipped from a property in Beaver County by Fred Staats, and a few tons were shipped from the Blue Spar prospect in Grand County near Grand Junction by N. B. Knight, Jr. The fluorspar deposits in Juab County were described.[2]

MILL DEVELOPMENTS

Davenport Mines, Inc., completed a heavy-medium separation plant near Salem, Ky., to serve its Davenport and Hicks mines. A heavy-medium mill was delivered in late December to the Crystal Fluorspar Co., Elizabethtown, Ill.; it will be erected at the Crystal mine to serve it and the Jefferson mine. The heavy-medium mill installed by Alco Lead Corp. at the Mineral Ridge mine near Salem, Ky., in early 1948 was later dismantled and moved to its Patrick lead mine in Illinois. The heavy-medium mill built on the property of Colorado Fluorspar Corp. near Northgate, Colo., by the Defense Plant Corporation in 1943 was purchased by the former company effective November 1, 1948. A new gravity-concentrating mill to serve the Blue mine near Mexico, Ky., was completed by Crider Bros. Fluorspar Co. A second ball mill was added to the flotation

[1] Colorado Mining Association, Colorado Group Explores Fluorspar Deposit in West Texas: Mining Year Book, 1949, pp. 168–170.

[2] Fitch, C. A., Jr., and Barker, C. S., Utah's New Mining District: Eng. and Min. Jour., vol. 150, No. 3, March 1949, pp. 63–66.

plant, which was overhauled, of Texas Fluorspar Mines, Inc., near Van Horn, Tex., thus increasing milling capacity to 80 tons per 24 hours.

A report [3] on Bureau of Mines flotation work on samples from nine fluorspar properties in western Kentucky was published. Two new processes for obtaining selectivity in floating fluorite with oleic acid were described.[4]

Output of flotation concentrates from domestic ore totaled 156,246 short tons in 1948 compared with 151,110 tons in 1947. No Mexican ore was treated in flotation mills in the United States in 1948.

PRICES

Metallurgical-grade fluorspar containing 70 percent or more effective calcium fluoride content was quoted at $35 a short ton f. o. b. Illinois-Kentucky mines until October 14, when the price was advanced to $37. Corresponding increases were made in the prices for other grades of metallurgical-grade fluorspar. On April 15 the selling price, f. o. b. Illinois mines, of acid-grade fluorspar containing a minimum of 97 percent calcium fluoride was advanced from $40 a ton to $42; and on October 14 it was raised to $44.

The average selling price of all grades of domestic fluorspar shipped in 1948 was $33.84 a short ton—a new peak—compared with $33.25 in 1947.

FOREIGN TRADE [5]

Imports.—Receipts of imported fluorspar into the United States established a new record of 111,626 short tons in 1948, a gain of 42 percent over 1947 and of 11 percent over 1945, the previous peak.

Fluorspar imported for consumption in the United States, which represents the quantity on which the duty was paid, also established a new record of 111,626 tons, a gain of 42 percent over 1947 and of 6 percent over 1945, the previous peak. The imports in 1948 comprised 20,196 tons containing more than 97 percent calcium fluoride and 91,430 tons of lower grade. They were valued [6] at $1,825,094. The value assigned to the higher-grade foreign fluorspar averaged $26.31 a ton in 1948 and that to the lower grade $14.15. The cost to consumers in the United States also includes duty, loading charges, 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.

In 1948, 3,776 tons of Mexican fluorspar were blended with fluxing-gravel fluorspar from the Illinois-Kentucky district. The Mexican fluorspar so blended has been excluded from the statistics on shipments from mines in the United States and included in the figures on imports.

[3] Fine, M. M., Concentration of Fluorite from Tailings and Mine Waste Rock in Crittenden and Livingston Counties, Ky.: Bureau of Mines Rept. of Investigations 4370, 1948, 21 pp.

[4] Ramsey, R. H., General Advance Marks All Fields in Milling: Eng. and Min. Jour., vol. 150, No. 2, February 1949, p. 110.

[5] 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.

[6] 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."

Fluorspar imported for consumption in the United States in 1948, by countries and customs districts

[U. S. Department of Commerce]

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: Vermont	(1)	$10			(1)	$10
Germany: Philadelphia			1,375	$11,582	1,375	11,582
Italy: Philadelphia			4,745	41,265	4,745	41,265
Mexico:						
Arizona	1,636	24,110	13,695	201,881	15,331	225,991
El Paso	61	1,206	4,619	46,828	4,680	48,034
Galveston			59	808	59	808
Laredo	4,219	77,574	54,841	799,868	59,060	877,442
New Orleans			61	891	61	891
San Diego			43	589	43	589
San Francisco			174	2,552	174	2,552
	5,916	102,890	73,492	1,053,417	79,408	1,156,307
Newfoundland:						
Buffalo			2,100	61,992	2,100	61,992
Philadelphia	14,280	428,400			14,280	428,400
	14,280	428,400	2,100	61,992	16,380	490,392
Spain: Philadelphia			9,718	125,538	9,718	125,538
Total: 1948	20,196	531,300	91,430	1,293,794	111,626	1,825,094
1947	15,623	346,468	63,102	910,258	78,725	1,256,726

1 Less than 1 ton.

The following table, compiled from data supplied to the Bureau of Mines by importers and domestic companies milling foreign fluorspar, shows the quantities of imported fluorspar delivered to consumers in the United States in 1947 and 1948, irrespective of the year of importation into the United States. It differs from the preceding table, which shows the quantity and grade imported into the United States. The quantities in the following table are based upon the actual outturn weights and include the finished fluorspar recovered from milling and drying foreign ore, rather than the ore milled or concentrate dried.

Imported fluorspar delivered to consumers in the United States, 1947–48, by uses

Use	1947			1948		
	Short tons	Selling price at tidewater, border, or f. o. b. mill in the United States, including duty		Short tons	Selling price at tidewater, border, or f. o. b. mill in the United States including duty	
		Total	Average		Total	Average
Steel	64,797	$1,665,629	$25.71	98,671	$2,458,384	$24.91
Hydrofluoric acid	12,346	506,497	41.03	10,009	468,861	46.84
Ferro-alloys	229	7,900	34.50	265	6,201	23.40
Glass and enamel	495	21,902	44.25	227	11,478	50.56
Other	403	13,377	33.19	2,059	69,033	33.53
	78,270	2,215,305	28.30	111,231	3,013,957	27.10

Exports.—Producers of fluorspar reported exports of 644 short tons of fluorspar valued at $24,819 in 1948 compared with 1,180 tons valued at $43,679 in 1947. The exports (all ceramic ground and flotation concentrates) by producers in 1948 comprised 536 tons to Canada, 57 tons to Brazil, 50 tons to Cuba, and 1 ton to Mexico. In addition to the fluorspar exported by producers in 1948, dealers exported 12 tons to Chile, 10 tons to Colombia, and 550 pounds to Turkey.

Fluorspar reported by producers as exported from the United States, 1943–48

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1943	9,044	$246,973	$27.31	1946	1,729	$63,797	$36.90
1944	1,980	65,909	33.29	1947	1,180	43,679	37.02
1945	1,420	45,939	32.35	1948	644	24,819	38.54

WORLD REVIEW

The accompanying table shows world production of fluorspar, by countries, 1943–48, insofar as statistics are available.

World production of fluorspar, by countries, 1943–48, in metric tons [1]
[Compiled by P. Roberts]

Country [1]	1943	1944	1945	1946	1947	1948
Argentina (shipments)	1,713	2,674	3,012	2,133	2,400	(2)
Australia:						
Queensland	544	520	801	875	887	361
Victoria	468	266	145	326	332	151
Bolivia (exports)	(2)	(2)	19	(2)	28	227
Brazil	—	—	—	—	841	751
Canada	10,169	6,281	6,685	7,296	6,519	9,556
France	24,160	13,400	14,535	19,235	25,834	(2)
Germany	198,536	[3] 170,000	(2)	[3] 30,910	[4] 19,235	[4] 37,549
India	1,667	1,249	438	(2)	(2)	(2)
Italy	34,486	6,757	3,333	7,806	20,282	[3] 41,000
Japan	7,282	7,967	3,207	(2)	[3] 100	68
Korea:						
North	[3] 50,000	[3] 60,000	19,434	(2)	(2)	(2)
South				—	—	—
Mexico (exports)	22,469	56,450	50,251	21,949	45,737	75,381
Newfoundland (shipments)	56,478	44,912	25,300	23,366	36,191	47,833
Norway	905	3,119	2,516	1,440	1,089	(2)
Southern Rhodesia	297	—	—	—	154	12
Spain	35,911	55,595	9,643	8,712	13,885	30,250
Sweden	2,107	1,836	3,448	3,722	2,780	(2)
Switzerland	582	520	—	—	—	—
Tunisia	16	—	—	—	—	525
Union of South Africa	4,646	3,481	3,657	4,821	4,815	3,754
United Kingdom	55,106	48,927	44,281	47,200	45,016	71,124
United States (shipments)	368,330	375,374	293,891	252,142	298,901	300,956
Total (estimate)	1,034,000	1,040,000	677,000	567,000	664,000	790,000

[1] In addition to countries listed China, South-West Africa, Soviet Zone of Germany, and U. S. S. R. produce fluorspar, but data of output are not available; estimates by author of chapter included in total.
[2] Data not available; estimates by author of chapter included in total.
[3] Estimate.
[4] Bizonal area.

Canada.—According to the Dominion Bureau of Mines, production of fluorspar in Canada was 9,556 metric tons [7] (all from Ontario) in 1948 compared with 6,519 tons in 1947. In Canada output falls short of consumption, and the greater part of the deficiency is met

[7] 1 metric ton is equivalent to 1.10231 short tons.

by importations, chiefly from Mexico, Newfoundland, and the United States. Imports into Canada were 38,829 metric tons during the first 10 months of 1948 compared with 29,031 tons in the entire year 1947.

Mexico.—Chiefly as a result of a near-record demand by the United States, production of flourspar (as measured by exports) in Mexico established a high of 75,381 metric tons, an increase of 65 percent over 1947 and 34 percent greater than in 1944, the previous peak. About 2,200 tons of Mexican fluorspar are used in local metallurgical plants, and some is exported to Canada.

Newfoundland.—The St. Lawrence Corp. of Newfoundland, Ltd., and Newfoundland Fluorspar, Ltd. (a subsidiary of Aluminum Co. of Canada, Ltd.), are the only producers of fluorspar in Newfoundland. Shipments of fluorspar from Newfoundland were 47,833 metric tons in 1948 compared with 36,191 tons in 1947.

The St. Lawrence Corp. of Newfoundland, Ltd., which has developed and opened several mines, has a gravity-concentrating mill and a flotation mill in Newfoundland for treating the ore; and a subsidiary, St. Lawrence Fluorspar, Inc., has a plant at Wilmington, Del., for drying the flotation concentrate. Shipments by the St. Lawrence Corp. of Newfoundland, Ltd., and St. Lawrence Fluorspar, Inc., were 16,963 metric tons in 1948 compared with 16,151 tons in 1947.

Newfoundland Fluorspar, Ltd., has two mines and ships crushed fluorspar principally to Arvida, Quebec, where the Aluminum Co. of Canada, Ltd., has a flotation plant. Shipments by Newfoundland Fluorspar, Ltd., were 30,870 metric tons in 1948 (20,040 tons in 1947) and comprised 26,976 tons to Arvida and 3,894 tons to other customers. Production was resumed in 1948 at the reopened Director mine, where development was continued on the 250-foot level, from which came all ore hoisted. Development was also continued at the Tarefare mine until May.

The fluorspar deposits of Newfoundland were described in much detail.[8]

South-West Africa.—During 1948 the Tsumeb Corp. did geologic mapping, trenching, and diamond drilling on company claims at Okurusu, 90 miles southwest of Tsumeb, where surface outcrops give promise of an important fluorspar deposit.[9] The fluorspar deposit of the Tsumeb Corp. was described by the Department of Mines, Union of South Africa, as follows: [10]

> The deposit is situated on the farm Marburg I about 12 miles northwest of Otjikango station in the Otjiwarongo district and about 36 miles from the village of Otjiwarongo. The fluorspar occurrence is located in the Marburg mountain, a large hill of metamorphosed sedimentaries of the Damara system surrounded by granites of the Salem type. The fluorspar, which is locally associated with a very pure hematite, is light green in color and occurs in steeply dipping parallel bands striking almost due north and south. These bands, of which there are three, are reported to have been traced over a strike of more than a mile and are individually of the order of 100 to 150 feet wide.
>
> On the southern flank of the hill one of these bands has been opened up by means of an adit driven about 150 feet into the hillside. Near the end of this adit a winze has been sunk to a depth of 100 feet. All this work was accomplished in massive fluorspar, which indicates the extensive nature of the body.

[8] Van Alstine, R. E., Geology and Mineral Deposits of the St. Lawrence Area, Burin Peninsula, Newfoundland: Newfoundland Geol. Survey Bull. 23, 1948, 64 pp.
[9] South African Mining and Engineering Journal, vol. 59, No. 2910, part II, Nov. 20, 1948, p. 347.
[10] Kent, L. E., and others, Fluorspar in the Union of South Africa and South-West Africa: Union of South Africa, Dept. of Mines, Geol. Series Bull. 14, 1943, 69 pp.

Apart from the hematite mentioned above, the only other mineral present in quantity is quartz which is seen disseminated in certain sections of the ore body. As, however, fluorspar is principally used for fluxing the presence of quartz cannot be considered a serious drawback.

The grade of massive ore varies from about 70 percent to over 90 percent depending on the quantity of quartz. No doubt selected portions of the ore body will yield almost pure fluorspar but such rich pockets have not as yet been encountered. Beneficiation of the low grade ores could be tried out but will be wasteful on account of the small difference in specific gravity between the fluorspar and the quartz and the generally intimate intermixture of these two minerals.

The deposit, while not of high grade, is certainly the largest of its kind in Southern Africa and the reserves must run into millions of tons. Should there be a considerable expansion of the iron and steel industry in the Union, this deposit will be exploited.

CRYOLITE

Cryolite occurs in commercial quantity and is mined at only one place—Ivigtut, Greenland. The mine at Ivigtut, the grades of ore produced, methods of processing and purification, and various uses of cryolite have been described.[11]

Synthetic cryolite was manufactured in the United States in 1948 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.

Imports of cryolite into the United States were 2,101 long tons valued at $210,050 in 1948 compared with 19,650 tons valued at $1,564,380 in 1947. The cryolite imported in both years came from Greenland.

Exports of cryolite from the United States were 637 long tons valued at $139,027 in 1948 compared with 836 tons valued at $216,357 in 1947. Of the 1948 exports, 543 tons went to Canada, 61 tons to Brazil, 24 tons to Mexico, and 9 tons elsewhere.

Production of synthetic cryolite by the fluoboric acid process was summarized [12] as follows:

Formation of fluoboric acid by the interaction of calcium fluoride, boric acid and sulfuric acid in an aqueous medium, offers a simple and attractive method of winning fluoride values from fluorspar. Fluoboric acid obtained in this manner has a high fluoride content and does not have the disagreeable fuming characteristics of hydrogen fluoride or its aqueous solutions. This key reaction can serve as the starting point for the formation of fluoborates, cryolite and other fluorides.

This investigation covers the study and development of a simplified cyclic process for the production of cryolite from fluorspar, through the intermediate formation of fluoboric acid. The term, fluoboric acid cryolite process, has been used to identify this method of forming cryolite. Specifically, cryolite is formed by the interaction of fluoboric acid with hydrated alumina and sodium carbonate, boric acid being regenerated and then recycled to form more fluoboric acid.

Cyclic process studies were carried out on a 40-gal. scale. The encounter of a number of unforeseen difficulties emphasized the importance of not depending too much on reaction studies made with pure synthetic solutions, but rather operating with the same liquor for a large number of cycles and with various lots of raw materials so that cumulative effects of accidental and unavoidable impurities can be investigated and overcome at an early stage of the development—at least before too large a scale of operation is adopted.

[11] Gibbs, A. E. (technical director, Pennsylvania Salt Manufacturing Co.), Cryolite as a Chemical Raw Material: Chem. Ind., vol. 38, No. 5, May 1936, pp. 471–476.

[12] Heiser, H. W., Production of Cryolite by Fluoboric Acid Process: Chemical Engineering Progress, vol. 45, No. 3, March 1949, pp. 169–179.

Fuel Briquets and Packaged Fuel[1]

By GERTRUDE S. GOODMAN

GENERAL SUMMARY

THE production of fuel briquets, after rising steadily for 10 years, dropped slightly in 1948 to 3,128,477 net tons. Packaged fuel declined in 1948 to 157,013 tons, the lowest annual output since 1937.

The fuel-briquetting industry in the United States consists of a relatively few large plants (36 in 1948), producing a small, hard, pillow-briquet suitable for shipment. The packaged-fuel industry, on the other hand, consists of a large number of small plants (62 in 1948), producing 3- to 4-inch, more or less friable cubes wrapped (usually 6 to a package) in sturdy paper sealed with gummed tape, suitable for local consumption but not as a rule for transportation over long distances; the cubes are designed for burning in the package.

In 1940, packaged fuel equaled 27 percent of the fuel-briquet production; by 1948 it had declined to 5 percent. The packaged-fuel industry (begun about 1928 but canvassed only since 1935) expanded spectacularly from 1935 to its peak in 1940; however, further growth was interrupted by World War II shortages and high costs of labor, raw fuels, and critical materials. Labor shortages and high manufacturing costs continue to be cited by some operators as causes of lowered production in 1948.

The total supplies of solid fuels commonly used for space heating in the United States in 1948 (see Coal—Pennsylvania Anthracite chapter, Minerals Yearbook, 1948, table 26) in order of their importance were as follows: Bituminous coal (including lignite), exact tonnage not available; Pennsylvania anthracite, 55,300,000 tons; coke (all kinds), 6,700,000; fuel briquets, 2,900,000 tons; and packaged fuel, 157,000.

An interesting 100-page booklet entitled "Fuel Briquetting" (by R. A. Strong, E. Swartzman, and E. J. Burrough), was published in 1937 by the Department of Mines and Resources, Ottawa, Canada. The principal subjects include history of briquetting, processes, binders, equipment, investigations of briquetting in North America, economics of the industry, and an appendix review of patent literature.

The Bureau of the Census, United States Department of Commerce, in its 1947 Census of Manufactures, has covered the fuel-briquetting and packaged-fuel industries, data for which are included in the

[1] Briquets made from charcoal, wood scrap, and fruit pits not included in Bureau of Mines review.

chapter "Petroleum and Coal Products."[2] The report includes data on employment and cost of materials, fuels, etc., consumed in the manufacture of fuel briquets and packaged fuel.

Costs of packaged-fuel manufacture by various processes were analyzed a few years ago.[3]

FUEL BRIQUETS

Statistics of the fuel-briquetting industry from 1944 to 1948 are summarized in table 1. Production by regions from 1917 to 1948 is shown in figure 1.

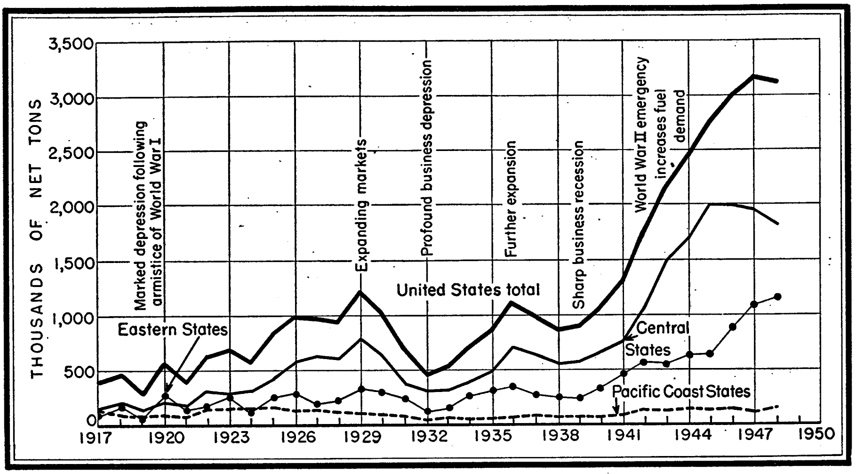

FIGURE 1.—Production of fuel briquets in the United States, by regions, 1917–48.

TABLE 1.—Salient statistics of the fuel-briquetting industry in the United States, 1935–39 (average), and 1944–48

	1935–39 (average)	1944	1945	1946	1947 [1]	1948
Production:						
Eastern States..net tons..	285, 248	625, 779	637, 740	880, 109	1, 089, 705	1, 151, 041
Central States.......do....	588, 573	1, 704, 005	1, 991, 733	1, 986, 234	1, 966, 834	1, 820, 074
Pacific Coast States.do....	75, 196	135, 177	132, 731	137, 684	115, 057	157, 362
Total..................	949, 017	2, 464, 961	2, 762, 204	3, 004, 027	3, 171, 596	3, 128, 477
Imports................do....	11, 792	538	722	653	387	329
Exports................do....	[2] 18, 206	163, 672	174, 107	163, 339	248, 760	207, 885
Consumption, apparent [3] net tons..	942, 603	2, 301, 827	2, 588, 819	2, 841, 341	2, 923, 223	2, 920, 921
Plants in operation............	32	30	32	35	35	36
Value of production............	$6, 083, 308	$18, 434, 579	$21, 678, 886	$25, 299, 612	$30, 762, 253	$36, 011, 322
Average value per net ton f. o .b. plant:						
Eastern States............	$4. 28	$5. 42	$5. 65	$6. 61	$7. 82	$9. 55
Central States............	$7. 08	$8. 03	$8. 40	$9. 03	$10. 56	$12. 58
Pacific Coast States.......	$9. 23	$10. 07	$10. 04	$11. 26	$12. 77	$13. 51
World production..net tons..	68, 382, 000	78, 456, 000	44, 503, 000	67, 276, 000	67, 026, 000	73, 043, 000

[1] Peak year of United States fuel-briquet production.
[2] 1937–39 average. Not reported separately prior to 1937.
[3] Production plus imports minus exports.

[2] Copies of Petroleum and Coal Products (M. C. 29), Census of Manufactures, Bureau of the Census, Department of Commerce, may be obtained from Supt. of Documents, Government Printing Office, Washington 25, D. C., price 15 cents.

[3] Parry, V. F., Technical and Economic Study of Packaged Fuel: Bureau of Mines Rept. of Investigations 3757, 1944, 45 pp.

DOMESTIC PRODUCTION

The output of fuel briquets in 1948 totaled 3,128,477 tons, with a total sales value at the plant of $36,011,322—a 1.4-percent decrease in tonnage but a 17-percent increase in value as compared with 1947.

As fuel briquets are used almost entirely for house heating, their manufacture is highly seasonal; decreased production in 1948 may therefore be attributed largely to the unusually mild weather which prevailed in the winter months in most sections of the United States.

Production rose in the Eastern and Pacific Coast States but declined in the Central States (table 2).

Briquets were made in 17 States in 1948, with production centered in Wisconsin, followed by Pennsylvania, West Virginia, Missouri, and Illinois, in that order. Production in Wisconsin (11 plants totaling 1,218,699 tons valued at $16,203,556) declined 9 percent since 1947. Pennsylvania's four plants produced 675,880 tons valued at $6,326,305 (a 16-percent increase in production and 32-percent increase in value over 1947). Increases in three of the Central States did not offset decreases in the other producing States in this region. Production for the other producing States cannot be shown without revealing individual plant data.

TABLE 2.—Production of fuel briquets in the United States, 1947–48

	1947			1948				
	Plants[1]	Net tons	Value	Plants[1]	Net tons	Value	Percent of change from 1947 in— Tonnage	Percent of change from 1947 in— Value
Eastern States	8	1,089,705	$8,519,741	8	1,151,041	$10,996,787	+5.6	+29.1
Central States	24	1,966,834	20,773,184	25	1,820,074	22,888,763	−7.5	+10.2
Pacific Coast States	3	115,057	1,469,328	3	157,362	2,125,772	+36.8	+44.7
Total	35	3,171,596	30,762,253	36	3,128,477	36,011,322	−1.4	+17.1

[1] 10 plants in 1947 and 11 plants in 1948 in Wisconsin; 4 plants in Pennsylvania; 3 plants in 1947 and 2 plants in 1948 in Illinois; 2 each in Arkansas, Kansas, Michigan, Missouri, and West Virginia; and 1 each in California, Massachusetts, Minnesota, Nebraska, New York, North Dakota, Oregon, Washington, and Wyoming (1948 only).

Twenty-one plants operated every month of the year, accounting for 80 percent of the total output. Production for the last 4 months of 1948 in the Eastern and Central States regions was 21 and 20 percent less, respectively, than in the corresponding months in 1947.

Number of Plants.—Thirty-six plants reported production in 1948; 32 of these were also active in 1947.[4] The four new briquetting

[4] Years plants (active in 1948) started producing are given in the 1948 Fuel Briquet Directory (which also shows type of raw fuel used), M. M. S. 1722, obtainable on request from the Bureau of Mines, Washington 25, D. C.

plants (three of which were reported under construction in 1947 and which started commercial operations in 1948) were Arko Briquettes, Inc., Fort Smith, Ark.; Chicago Briquet Co., Hanna, Wyo.; D. & M. Manufacturing Corp., Rutherford Heights, Pa.; and Arthur Kuesel Coal Co., Milwaukee, Wis. However, the new plant at Hanna, Wyo., which started operating in January 1948, reported operations permanently abandoned in September 1948. A briquetting plant of approximately 100,000 tons annual capacity was reported under construction at McComas, W. Va., by the Chicago Briquet Co.

The DeAngelis Coal Co., of Carbondale, Pa., whose briquetting plant at Buena Vista, Calif., was reported under construction in 1946 and 1947, has abandoned the idea of making lignite briquets and in June 1948 changed its name to the American Lignite Products Co., Division of DeAngelis Coal Co., and is engaged in the recovery of montan wax, sap brown, etc., from lignite by distillation methods of extraction at its California location.

The Lehigh Briquetting Co., engaged in the manufacture of lignite briquets since 1929 at Dickinson, N. Dak., changed hands January 1, 1949, being succeeded by Dakota Briquets & Tar Products, Inc. The plant of the Dunnebacke Co., Kenosha, Wis., active since 1937, was taken over July 1948, and operations were continued by the Haas Coal & Dock Co.

Four plants were idle in 1948; of these, the American Briquet Co. plant at Lykens, Pa. (operating from 1919 to May 1947), reported lack of raw coal as cause of idleness, and the Great Lakes Carbon Corp. plant at Casper, Wyo. (operating 1935–42; 1944–45), reported briquetting operations permanently abandoned in 1948.

The Super-Heat Fuel Co., Inc., Belleville, Ill., also permanently abandoned operations after a fire burned its plant to the ground January 5, 1948 (this was the only fire reported at briquetting plants during 1948).

Of the 36 plants active in 1948, 22 reported their equipment (employing various processes) installed by Komarek-Greaves & Co., Chicago, Ill., 3 by the Webb Corp., Webb City, Mo., and 3 by Glenn Smith, Chicago, Ill. Eight plants reported installation of additional equipment in 1948.[5]

Capacity.—Annual capacities of 100,000 tons or more were reported by 5 out of 8 plants in the Eastern States, by 10 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 production in 1948 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 5 years on capacity and relative production for the United States as a whole.

[5] A revised list of manufacturers of machinery used in making fuel briquets and packaged fuel, M. M. S. 1715, is 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, 1944–48

	Active plants		Production		
				Percent of—	
	Number	Annual capacity (net tons)	Net tons	Annual capacity	Annual production
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	35	4,533,300	3,004,027	66.3	100.0
1947	35	4,615,160	3,171,596	68.7	100.0
1948:					
Capacity of—					
Less than 5,000 tons	2	18,010	5,357	29.7	.2
5,000 to less than 10,000	2				
10,000 to less than 25,000	4	50,500	31,459	62.3	1.0
25,000 to less than 100,000	12	601,000	248,254	41.3	7.9
100,000 to less than 200,000	7	781,000	564,931	72.3	18.1
200,000 to less than 400,000	6	1,720,000	1,392,043	80.9	44.5
400,000 or more	3	1,500,000	886,433	59.1	28.3
Total	36	4,670,510	3,128,477	67.0	100.0
Production of—					
Less than 2,000 tons	4	103,010	9,357	9.1	.3
2,000 to less than 5,000	2				
5,000 to less than 10,000	6	204,000	47,593	23.3	1.5
10,000 to less than 25,000	4	206,500	65,289	31.6	2.1
25,000 to less than 100,000	8	556,000	398,026	71.6	12.7
100,000 or more	12	3,601,000	2,608,212	72.4	83.4
Total	36	4,670,510	3,128,477	67.0	100.0

Raw Fuels.—Nine kinds of raw fuels entered into the manufacture of 11 types of briquets in 1948 (tables 4 and 5). Pennsylvania anthracite, bituminous low-volatile, and Arkansas hard coals, in the order cited, were the principal fuels used in the manufacture of fuel briquets in 1948 and accounted for 87 percent of the total raw fuels used. The use of bituminous low-volatile declined 12 percent since 1947.

In the Eastern States region Pennsylvania anthracite fines and bituminous low- and high-volatile coals were the raw fuels used by plants near mines in Pennsylvania and West Virginia. In the Central States region—with plants in 10 States and production concentrated in the Lake dock territory—all fuels except residual carbons were used. In the Pacific coast region residual carbons from the manufacture of oil gas and pyrolysis of natural gas were the raw fuels used.

Briquet production at coal mines in the Eastern States has more than doubled in the past 6 years—from 544,671 tons at three plants in 1943 to 1,149,533 tons at six plants in 1948 (table 6).

Raw fuels, other than yard screenings, accounted for 91 percent of the total raw fuels used in the manufacture of fuel briquets in 1948 (table 4).

TABLE 4.—Raw fuels used in making fuel briquets in the United States, 1948

Character of raw fuels used	Plants	Net tons	Plants using—	Plants	Raw fuels used (net tons): Yard screenings	Raw fuels used (net tons): Other raw fuels	Raw fuels used (net tons): Total
Pennsylvania anthracite	16	1,151,752	Yard screenings exclusively (from own or other yards)	5	25,263	----------	25,263
Arkansas hard coals	8	310,812					
Bituminous low-volatile	17	1,090,286					
Bituminous high-volatile	5	180,158	Raw fuels (other than yard screenings) exclusively	24	----------	1,841,919	1,841,919
Semicoke (lignite char)	1	174,705					
Residual carbon from pyrolysis of natural gas	1		Both yard screenings and other raw fuels	7	232,751	847,928	1,080,679
Residual carbon from manufacture of oil gas	2						
Petroleum coke	3	40,148					
Total	[1] 36	2,947,861	Total	36	258,014	2,689,847	2,947,861

[1] 17 plants used 1 kind of fuel only, 3 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, 1947–48

Raw fuel used	1947: Plants	1947: Briquets produced: Net tons	1947: Briquets produced: Percent of total	1948: Plants	1948: Briquets produced: Net tons	1948: Briquets produced: Percent of total
Pennsylvania anthracite	3	146,995	4.6	2	1,380,122	44.1
Mixture of Pennsylvania anthracite and bituminous low-volatile	10	1,366,417	43.1	11		
Mixture of Pennsylvania anthracite and bituminous high-volatile	2	443,896	14.0	3	558,275	17.8
Mixture of Pennsylvania anthracite and bituminous high- and low-volatile	1			----------	----------	----------
Semianthracite	[1] 6	400,491	12.6	6	336,502	10.8
Arkansas hard coals (mixture)	[1] 2			2		
Bituminous low-volatile	4	518,644	16.4	6	496,108	15.9
Bituminous high-volatile	2	121,535	3.9	2	157,007	5.0
Semicoke (lignite char)	1			1		
Residual carbon from pyrolysis of natural gas	1	115,057	3.6	1	157,362	5.0
Residual carbon from manufacture of oil gas	2			2		
Petroleum coke	2	58,561	1.8	3	43,101	1.4
Mixture of petroleum coke and bituminous low-volatile	1			----------	----------	----------
Total	[2] 35	3,171,596	100.0	[2] 36	3,128,477	100.0

[1] 1 of these plants also used Oklahoma semianthracite.
[2] In 1947, 2 plants made 2 kinds of briquets; in 1948, 3 plants made 2 kinds; hence the sum of the items shown exceeds the total number of plants active in the respective years.

Binders.—Asphalt binders predominate in briquetting practice in the United States (table 7). In 1948, 34 operators used approximately 198,000 tons of asphaltic types and small quantities of coal-tar pitch, oil-gas tar pitch, rosin, and wax; and 2 operators 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 6.—Production of fuel briquets, grouped according to location of plants with reference to supply of raw fuel, 1947–48

Location of plant	1947		1948		Change in 1948	
	Plants	Production (net tons)	Plants	Production (net tons)	Net tons	Percent
Near lake coal docks:						
Lake Superior	4	927,452	4	840,864	−86,588	−9.3
Lake Michigan	7	483,986	8	458,269	−25,717	−5.3
Lake Huron	1		1			
	12	1,411,438	13	1,299,133	−112,305	−8.0
Near coal mines:						
Eastern States	6	1,089,044	6	1,149,533	+60,489	+5.6
Central States	9	516,995	9	489,927	−27,068	−5.2
	15	1,606,039	15	1,639,460	+33,421	+2.1
Near petroleum refineries and oil- and natural-gas plants:						
Central States	1	138,106	1	174,421	+36,315	+26.3
Pacific Coast States	3		3			
	4	138,106	4	174,421	+36,315	+26.3
Other locations:						
Eastern States	2	16,013	2	15,463	−550	−3.4
Central States	2		2			
	[1] 4	16,013	[1] 4	15,463	−550	−3.4
Total United States	35	3,171,596	36	3,128,477	−43,119	−1.4

[1] Fall River, Mass.; Flint, Mich.; Omaha, Nebr.; and Syracuse, N. Y.

The percentage of binder in the briquets (by weight) ranged from less than 5 to 9 percent or more. Fifteen plants, accounting for 49 percent of the total 1948 production, used binders ranging from 5 to 7 percent; 2 used less than 5 percent; 12, 7 to 9 percent; and 5, 9 percent or more.

TABLE 7.—Classification of briquetting plants in the United States by type of binder used, 1945–48

	1945		1946		1947		1948	
	Plants	Percent of total briquet production	Plants	Percent of total briquet production	Plants	Percent of total briquet production	Plants	Percent of total briquet production
Type of binder used:								
No binder [1]	3	4.3	2	92.3	2	95.8	2	95.9
Asphalt	26	86.7	30		30		31	
Asphalt and coal-tar pitch	1	9.0	1	7.7	1	4.2	1	4.1
Asphalt and starch	1		1		1		------	
Oil-gas tar pitch	------		1		1		1	
Starch	1		------		------		------	
Rosin and wax	------		------		------		1	
	32	100.0	35	100.0	35	100.0	36	100.0
Production (net tons)	------	2,762,204	------	3,004,027	------	3,171,596	------	3,128,477

[1] Residual carbon from manufacture of oil gas and bituminous coal were raw fuels used at plants employing no binder.

Weight and Shape.—Briquets in the United States in 1948 (pillow-, barrel-, cube-, and log-shaped) ranged in weight from 1½ to 32 ounces, Pillow shapes under 5 ounces (except for an 11-ounce bituminous, high-volatile pillow by Coal Processing Corp., Buckner, Ill.) were made at 32 plants and accounted for 83 percent of the total production in 1948; 2½-ounce cylindrical (barrel-shaped) briquets were made at 2 plants; 18- and 20-ounce cubes at 1 plant; and 32-ounce logs at 1 plant.

Commercial production of the log-shaped briquet (called "Cologs") was reported by the D. & M. Manufacturing Corp., Rutherford Heights, Pa. The round logs—12 inches long and 2 inches in diameter—weigh 2 pounds each (32 ounces), are packed 12 to a carton, and are sold by the carton for fireplace use. The tonnage reported for 1948 was small.

The plant making cubes reported wrapping several hundred tons—a small part of its total production—in 10-pound packages suitable for burning in the package if desired.

Seven plants reported bagging or packing a part of their production in bags or cartons; but as a rule, this is merely a merchandising feature for delivery purposes only.

SHIPMENTS

The tonnage produced in 1948 was distributed widely, being shipped to 37 States and the District of Columbia, and exported principally to Canada (tables 8 and 11). The major proportion of the output at most of the briquetting operations entered markets outside the States of manufacture, but six plants producing 3 percent of the total sales disposed of their output entirely within the States of origin.

Fifty-nine percent, more than half of the total shipments within the United States, was destined for Wisconsin, Minnesota, Missouri, and Michigan, which apparently are the largest briquet-consuming States.

Shipments from each producing State cannot be shown, because there are only one or two producers in each of the States (except Wisconsin and Pennsylvania) and individual operations would thus be revealed. However, figure 2 presents graphically the centers of production, with corresponding States of destination for 1948; similar graphs for 1928 and 1936 are shown on page 965 of Minerals Yearbook, 1937.

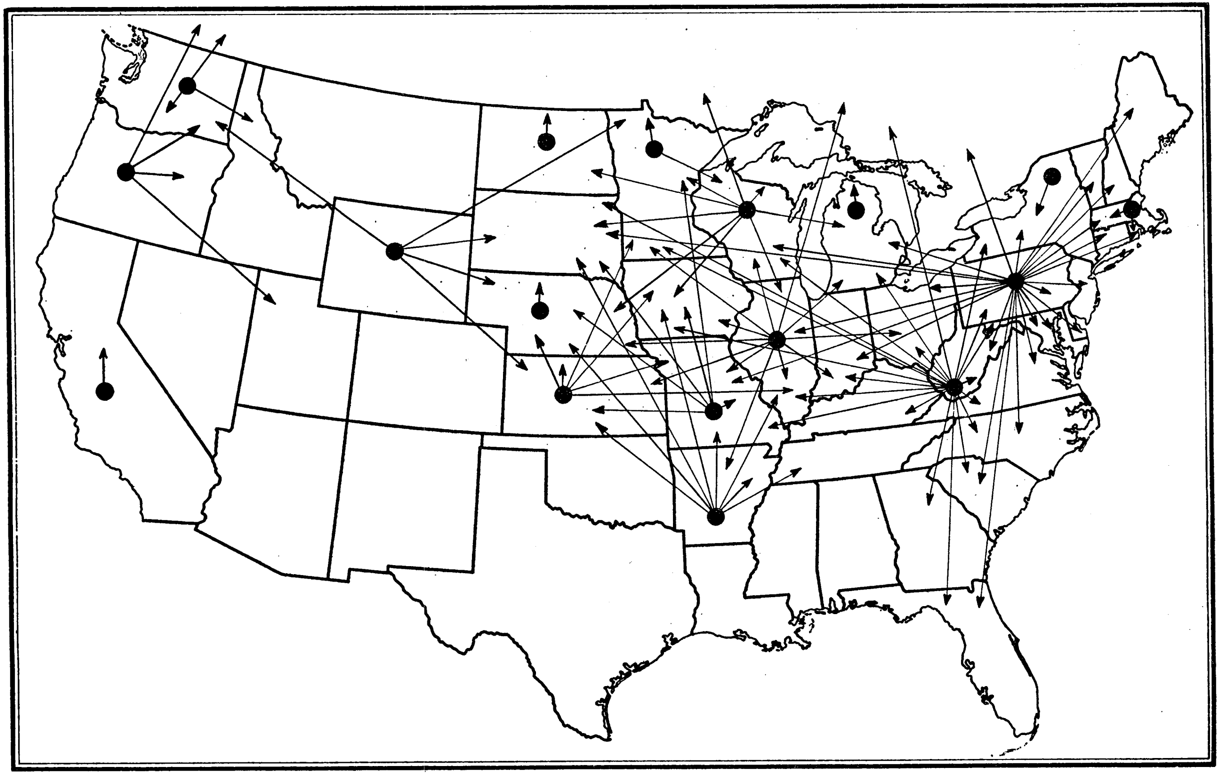

FIGURE 2.—Distribution of fuel briquets in 1948. Solid circles indicate States in which briquets were produced, and arrowheads indicate States into which fuel briquets were shipped from each producing State.

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The difference between production in 1948 (3,128,477 tons) and shipments within the United States (2,810,246 tons), amounting to 318,231 tons, represents briquets exported, used at plants for power or heat, and variation in year-end stocks.

Briquets are used almost entirely for domestic heating, but four operators reported a total of 22,283 tons used for power or heat at their plants in 1948.

TABLE 8.—Shipments of fuel briquets of domestic manufacture in the United States, by States of destination, as reported by producers, 1947–48, in net tons[1]

State of destination	1947	1948	State of destination	1947	1948
Arkansas	1, 249	1, 098	New Hampshire	5, 419	6, 616
California	11, 119	13, 245	New Jersey	32, 403	25, 852
Connecticut	5, 101	3, 958	New York	48, 462	44, 411
Delaware	785	937	North Carolina	24, 184	23, 761
District of Columbia	2, 174	2, 569	North Dakota	127, 671	118, 092
Florida	283	517	Ohio	96, 562	87, 027
Georgia	49	104	Oregon	67, 642	78, 303
Idaho	293	186	Pennsylvania	126, 135	87, 994
Illinois	156, 167	134, 509	Rhode Island	3, 417	3, 707
Indiana	80, 286	82, 253	South Carolina	6, 565	6, 577
Iowa	110, 701	101, 201	South Dakota	122, 615	112, 041
Kansas	27, 357	23, 085	Tennessee		49
Kentucky	5, 955	5, 558	Utah		52
Maine	8, 732	10, 930	Vermont	3, 573	3, 972
Maryland	28, 551	24, 555	Virginia	36, 824	36, 449
Massachusetts	23, 219	29, 361	Washington	22, 092	36, 977
Michigan	290, 482	339, 137	West Virginia	4, 305	2, 135
Minnesota	453, 198	434, 595	Wisconsin	542, 169	542, 634
Missouri	350, 200	343, 743			
Nebraska	59, 719	42, 056	Total	2, 885, 658	2, 810, 246

[1] For shipments outside the United States see export statistics, table 10.

Generally, rail movement represents shipments to considerable distances and shipments by truck, local, and nearby consumption (table 9). Eighty-two percent of the total shipments of fuel briquets moved by rail and 18 percent by truck in 1948. In the Eastern States region nearly all the briquets were shipped by rail; in the Central and Pacific coast regions 73 percent moved by rail and 27 percent by truck.

TABLE 9.—Direct shipments of fuel briquets by rail and truck, as reported by producers, 1947–48, in net tons[1]

Produced in—	1947			1948		
	Rail	Truck	Total	Rail	Truck	Total
Eastern States	1, 068, 409	20, 349	1, 088, 758	1, 118, 492	32, 826	1, 151, 318
Central States	1, 516, 103	549, 456	1, 958, 439	1, 421, 330	534, 041	1, 812, 736
Pacific Coast States			[2] 107, 120			[2] 142, 635
Total United States	2, 584, 512	569, 805	[3] 3, 154, 317	2, 539, 822	566, 867	[3] 3, 106, 689

[1] Includes shipments outside the United States.
[2] Includes small tonnage shipped by scow.
[3] An additional 14,807 tons were used by 6 producers as fuel at their plants in 1947 and 22,283 tons by 4 producers in 1948.

PRICES

Monthly retail prices of fuel briquets from 1941 to 1945 for 21 cities, published in yearbooks of this series, were compiled from data collected by the Bureau of Labor Statistics, United States Department of Labor.[6] Collection of briquet-price data has, however, been discontinued, except for the following cities, for which the December prices are quoted for 1944 to 1948 (prices for Pittsburgh are not available before 1948). Retail briquet prices increased from 45 to 63 percent in these cities during the 5-year period 1944–48. The marked increases after 1946 followed termination of Government price control on all commodities (except sugar and rice) effective November 10, 1946.

TABLE 10.—Retail briquet prices in selected cities, December 1944–48

Year	Chicago, Ill.	Milwaukee, Wis.	Minneapolis, Minn.	St. Louis, Mo.	Pittsburgh, Pa.
1944	$12.97	$12.88	$14.35	$11.76	
1945	13.17	13.13	14.59	12.06	
1946	14.99	14.13	15.69	13.69	
1947	18.54	16.85	18.88	16.12	
1948	21.19	18.70	21.83	17.14	$17.48
Percent change, 1944–48	+63	+45	+52	+46	

The trend in prices in the Eastern, Central, and Pacific Coast States is indicated by the average values shown in table 1; these are values received by producers and not the retail prices (table 10) which include transportation costs to markets and wholesalers' margins. Sales values received by producers (f. o. b. plant) vary widely because of the different local conditions under which briquets are manufactured and sold. The outstanding factors influencing the value per ton realized at any plant are cost of raw materials and labor and prices of competing fuels.

In the Eastern States nearly all the output comes from plants in the anthracite region of Pennsylvania and the bituminous low-volatile fields of southern West Virginia, where the cost of raw fuel does not involve freight charges; the value f. o. b. plant is therefore relatively low. Of the 1948 production in the Central States 71 percent came from plants at coal docks on the Great Lakes; the raw fuel for these plants involves a considerable freight charge, reflected in higher values per ton f. o. b. plant. In the Pacific Coast States (where the raw fuels used were residual carbons from manufacture of oil gas and pyrolysis of natural gas), the average per ton represents the highest value f. o. b. plant in the United States.

FOREIGN TRADE [7]

Imports of fuel briquets into the United States before 1922 were negligible. The anthracite shortages of 1922–23 and 1925–26, however, created a demand for European briquets (mostly from Germany,

[6] Bureau of Labor Statistics, U. S. Department of Labor, Retail Prices of Fuels by Cities (monthly reports).

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

Belgium, and France and mainly for consumption in the anthracite-consuming States), which in 1926 reached a record of 123,593 net tons. Imports continued at a comparatively high level in the following years through 1932, when they amounted to 80,288 tons, but thereafter they dropped sharply and during the recent war period virtually ceased. Since 1941, imports have amounted to but a few hundred tons a year, virtually all from Canada; in 1948 they amounted to 329 tons valued at $3,301.

Exports of briquets, nearly all to Canada, were reported separately by the Bureau of Foreign and Domestic Commerce for the first time in 1937. The lowest year on record was 1939, with 12,576 tons exported; the highest 1947, with 248,760 tons. In 1948, the United States exported 207,885 tons valued at $2,653,982, a decrease of 40,875 tons, or 16 percent less than in 1947 (tables 1 and 11).

TABLE 11.—Briquets (coal and coke) exported from the United States, 1946–48, by countries of destination and customs districts

[U. S. Department of Commerce]

	1946		1947		1948	
	Net tons	Value	Net tons	Value	Net tons	Value
COUNTRY						
Canada	163,305	$1,355,869	238,081	$2,633,912	207,142	$2,644,598
Cuba	23	500				
Denmark			8	180	20	374
Dominican Republic	1	60	4	89		
French West Africa			10,621	156,453		
Ireland			30	613	4	90
Mexico	8	194	10	130	48	480
Newfoundland and Labrador					671	8,440
Panama, Republic of	2	35				
Trinidad and Tobago			6	58		
Total	163,339	1,356,658	248,760	2,791,435	207,885	2,653,982
CUSTOMS DISTRICT						
Arizona			10	130	48	480
Buffalo	41,871	381,445	86,033	1,040,963	104,715	1,383,557
Dakota	20,071	175,300	50,996	515,135	37,862	478,505
Duluth and Superior	34,428	312,266	39,579	417,164	22,322	294,613
Florida	22	500				
Maine and New Hampshire	934	6,385	1,022	11,970	261	3,130
Maryland			10	195		
Michigan	40,502	252,523	18,696	162,024	13,095	125,932
New Orleans	2	35	10,627	156,511		
New York			14	320	20	374
Ohio			202	2,465	4,319	40,839
Philadelphia			4	99	675	8,530
Puerto Rico	1	60	4	89		
Rochester	15,859	130,859	26,920	256,914	7,569	86,783
St. Lawrence	6,302	62,315	13,788	218,722	8,542	138,793
San Diego	8	194				
Vermont	3,302	34,307	45	320	430	4,799
Virginia			10	179		
Washington	37	469	800	8,235	8,027	87,647
Total	163,339	1,356,658	248,760	2,791,435	207,885	2,653,982

TECHNOLOGIC DEVELOPMENTS

Interest in research on coal briquetting continues active, particularly on coals of Illinois, North Dakota, Pennsylvania, Utah, and Wyoming.

Research on the briquetting of Illinois coals, initiated by the Illinois State Geological Survey in 1931, has been in continuous progress since that time—in laboratory-scale stage from 1931 to 1939 and pilot-plant stage since 1939. A complete report of its experimental work recently published by the Illinois Geological Survey [8] consists of eight extensive articles, as follows: (1) Design and Operation of Commercial-Scale Equipment; (2) Factors Affecting Characteristics of Briquets; (3) Smoke-Index Method of Measuring the Smokiness of Fuel; (4) Influence of Fusain on Smoke-Index of Briquets; (5) Smokeless Briquets from Hot Partially Volatilized Illinois Coals; (6) Preliminary Study of Cleaning Illinois Coal Sludges by Oil Flotation; (7) Relative Importance of Volatile Matter and Fixed Carbon in High-Volatile Coals and Briquets; (8) Mathematical Analysis of Briquetting Phenomena.

In 1945 the Pennsylvania State College and the Anthracite Institute joined in investigating the possibilities of producing fuel briquets or pellets by extrusion methods, utilizing accumulations of anthracite silt available in enormous quantities in the Pennsylvania anthracite region.[9] The program has progressed from laboratory experiments to full-scale pilot plants near the institute at Wilkes-Barre, Pa. The process is not considered universally applicable to all fines but a possible beneficiation process for many of the silts and culm now available and being made available. The most suitable applications for the pellets (which range from ⅛ to ¾ inch in diameter) appear to be for commercial and industrial traveling-grate stokers for the ⅛- and $\frac{3}{16}$-inch-diameter pellets and for small domestic equipment for the ⅜- to ¾-inch-diameter pellets.

A lignite research laboratory under construction at Grand Forks, N. Dak., for the Bureau of Mines, at a cost of $750,000, is scheduled for completion in 1949.[10] The Bureau of Mines is also cooperating with the Wyoming Natural Resources Research Institute, Laramie, Wyo., in its research studies on the briquetting of low-rank coals of the Rocky Mountain region.[11]

Improvement of the physical qualities of weakly coking Utah coals through briquetting was reported as the result of experiments at the University of Utah, Salt Lake City.[12]

Experiments in the briquetting of coke breeze were conducted at a foundry of one of the General Motors divisions and reported as highly successful.[13]

WORLD PRODUCTION

Data compiled and published since 1913 on world production of briquets are included in annual volumes of Minerals Yearbook and its predecessor, Mineral Resources.

In addition to the countries listed in table 12, briquets are also produced in U. S. S. R. and in small quantities in a few other countries,

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[8] Piersol, R. J., Briquetting Illinois Coals Without Binder: Illinois State Geol. Survey Bull. 72, 1948, 198 pp.

[9] Saward's Journal, Anthracite Silt—New Developments for Utilizing Hard Coals—Unused Resources Announced: Vol. 31, No. 33, Nov. 13, 1948, p. 459.

Mulcey, Paul A., and Eckerd, Jas. W., Upgrading the Fine Sizes of (Pennsylvania) Anthracite by Extrusion—Part I: Trans. 5th Ann. Anthracite Conference, Lehigh University, Bethlehem, Pa. (Paper 9), May 8, 1947, pp. 155–181; Part II: Trans. 6th Ann. Anthracite Conference, Lehigh University, Bethlehem, Pa. (Paper 11), May 7, 1948, pp. 159–194.

[10] Black Diamond, Start Lignite Laboratory Construction: Vol. 121, No. 3, July 31, 1948, p. 12.

[11] Fisk, H. G., Wyoming Natural Resources Research Institute in Fifth Year of Operation: Chem. and Eng. News, vol. 26, No. 10, Mar. 8, 1948, p. 677.

Lynn, John R., Certain Chemical and Physical Properties of Several Wyoming Subbituminous Coals: University of Wyoming Natural Resources Research Institute, Bull. 1, May 1946, 23 pp.

[12] Hamilton, J. H., and Wolf, Clayton, S., Coking Experiments on Western Coals: Ind. and Eng. Chem., vol. 41, No. 3, March 1949, pp. 556–563.

[13] Steel, Briquette Coke Breeze: Vol. 122, No. 14, Apr. 5, 1948, p. 58.

but production figures for them are not available. According to the records at hand, world production of fuel briquets was lowest in 1917 with about 33,000,000 metric tons, and highest in 1943, with 80,000,000. Although data for 1948 are incomplete, Germany appears to lead in production, with approximately 46,000,000 metric tons, followed by France, with 6,000,000, and the United States, with 3,000,000.

TABLE 12.—World production of fuel briquets, 1943–48, by countries, in metric tons [1]

[Compiled by P. Roberts]

Country [1]	1943	1944	1945	1946	1947	1948
Algeria	50,765	87,440	101,756	97,518	82,888	(2)
Australia: Victoria [3]	435,727	462,380	512,349	522,157	(2)	(2)
Belgium	1,013,410	456,990	787,530	1,079,620	1,352,690	[4] 975,000
Canada	244,892	277,707	275,625	298,960	290,880	(2)
Czechoslovakia:						
Coal	553,000	464,000	71,309	209,180	(2)	(2)
Lignite	323,000	328,000	192,485	252,452	(2)	291,326
France	3,045,910	1,588,490	3,465,670	5,162,450	5,009,000	5,948,000
Germany:						
Coal [5]	[3] 6,419,404	(2)	[6] 1,323,000	[6] 1,902,293	[6] 2,176,000	[6] 2,972,[illegible]00
Lignite [7]	[3] 61,550,277	55,407,000	[6] 4,568,000	39,991,000	38,677,000	42,898,000
Hungary:						
Coal	227,480	(2)	(2)	20,210	} 70,970	(2)
Lignite	58,250	[8] [9] 20,450	[8] [10] 13,450	33,670		
India	-----------	-----------	7,528	19,761	(2)	(2)
Indochina, French	29,860	17,620	1,940	4,710	(2)	12,000
Ireland	90,188	123,749	118,558	85,781	52,327	-----------
Japan	[3] 538,508	[3] 237,999	[3] 383,481	(2)	(2)	577,501
Morocco, French	10,872	25,198	38,530	22,202	(2)	(2)
Netherlands:						
Coal	896,192	608,316	412,571	725,859	910,046	935,865
Lignite	55,457	42,959	35,757	43,655	41,673	62,988
New Zealand	12,386	12,661	9,941	13,183	11,592	(2)
Poland:						
Coal	813,098	765,217	93,078	529,082	632,258	[4] 726,750
Lignite	(2)	(2)	-----------	27,190	41,697	113,633
Portugal	46,601	48,698	72,177	96,000	97,418	(2)
Rumania	175,877	(2)	(2)	(2)	(2)	(2)
Spain	653,994	924,862	1,049,520	833,445	789,535	(2)
Tunisia	-----------	-----------	16,619	32,347	36,764	(2)
Turkey	31,108	34,276	23,782	12,572	15,130	(2)
United Kingdom	749,845	883,964	1,002,841	1,567,765	1,863,436	1,452,000
United States:						
Briquets	1,963,136	2,236,163	2,505,816	2,725,193	2,877,208	2,838,092
Packaged fuel	195,592	159,455	188,823	173,198	165,906	142,439
Total	80,225,000	71,174,000	40,372,000	61,031,000	60,805,000	66,263,000

[1] In addition to countries listed, briquets are produced in Bulgaria, Italy, Mexico, Netherlands Indies, Sweden, U. S. S. R., and Yugoslavia, but production figures are not available; estimate not included in total.
[2] Data not available; estimate included in total.
[3] Fiscal year ended Mar. 31 of year following that stated.
[4] Estimate.
[5] Figures include production from East Upper Silesia through 1944.
[6] Bizonal area.
[7] Figures include production from Sudetenland through 1944.
[8] Data represent Trianon Hungary subsequent to October 1944.
[9] January to June, inclusive.
[10] June to December, inclusive.

PACKAGED FUEL

Packaged fuel is the trade name applied by the industry to a combination of briquetting and packaging of screenings or other raw fuels compressed into 3- to 4-inch cubes, wrapped (generally six to the package) in sturdy paper sealed with gummed tape, designed primarily for local consumption and to be burned in the package.

The growth of the packaged-fuel industry from 1935 (year of first survey) through 1940 and its decline during the following years of World War II are illustrated in figure 3. A study of the development of the packaged-fuel industry from its beginning in 1928 to its peak in 1940 was made by V. F. Parry [14] of the Bureau of Mines; this study includes brief discussions of the various processes employed in the manufacture of packaged fuel and analysis of costs in typical plants.

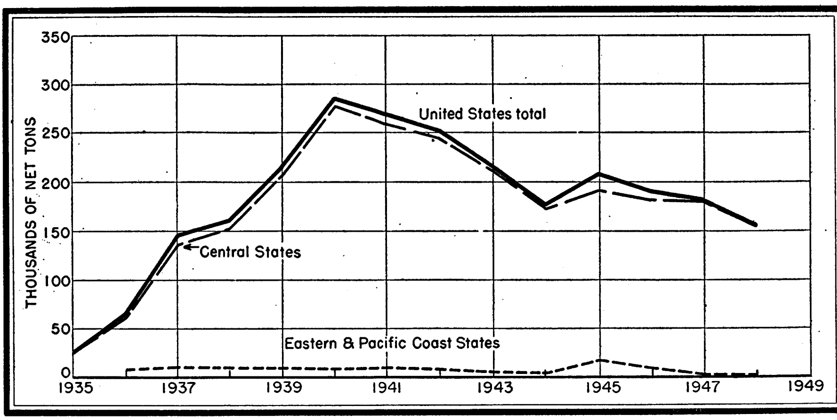

FIGURE 3.—Production of packaged fuel in the United States, by regions, 1935–48. (No production in Pacific Coast States, 1943–48.)

TABLE 13.—Salient statistics of the packaged-fuel industry in the United States, 1935–39 (average), 1940, and 1944–48

	1935–39 (average)	1940 (peak year of production)	1944	1945	1946	1947	1948
Production:							
Eastern States...net tons..	5,052	6,349	3,788	16,606	9,065	2,153	1,859
Central States.......do....	116,218	276,994	171,982	191,537	181,854	180,728	155,154
Pacific Coast States..do....	1,563	1,170	----------	----------	----------	----------	----------
Total....................	122,833	284,513	175,770	208,143	190,919	182,881	157,013
Plants in operation............	63	106	68	61	70	62	62
Value of production............	$1,050,566	$2,391,922	$2,053,343	$2,518,636	$2,496,388	$2,882,105	$2,735,861
Average value per net ton f. o. b. plant:							
Eastern States.............	$9.45	$9.02	$12.26	$12.86	$12.93	$16.58	$17.64
Central States.............	$8.50	$8.36	$11.67	$12.04	$13.08	$15.75	$17.42
Pacific Coast States........	$9.91	$12.82	----------	----------	----------	----------	----------

DOMESTIC PRODUCTION

The 62 plants active in 1948 produced 157,013 net tons of packaged fuel with a total sales value at the plant of $2,735,861 (table 14). This is the lowest production recorded since 1937. Production in 1948 decreased 14 percent in tonnage and 5 percent in value from the preceding year. Output declined in 8 of the 12 producing states. Michigan, Wisconsin, and Ohio led in production; and the largest

[14] Parry, V. F., Technical and Economic Study of Packaged Fuel: Bureau of Mines Rept. of Investigations 3757, 1944, 45 pp.

individual producers were Johnson Coal Cubing Co., Inc., Detroit, Mich., and Cleveland-Cliffs Iron Co., Green Bay, Wis.

High manufacturing costs were cited by operators as a major cause of decreased output. Although the production of packaged fuel decreased so markedly in 1948, interest in this type of fuel is still keen. At its June 1948 annual meeting, the National Association of Packaged Fuel Manufacturers[15] discussed new and more economical equipment for the manufacture of packaged fuel, which has been in process of development for several years and now is in pilot-plant stage. This machinery is not yet on the market.

Forty-nine plants operated 9 to 12 months of the year, accounting for 95 percent of the total production; 23 plants operated every month.

TABLE 14.—Production of packaged fuel in the United States, 1947–48, by States

States	1947			1948		
	Plants	Net tons	Value	Plants	Net tons	Value
Eastern States	[1] 3	2,153	$35,705	[1] 3	1,859	$32,794
Central States:						
Illinois	2	(2)	(2)	2	(2)	(2)
Indiana	2	(2)	(2)	2	(2)	(2)
Iowa	1	(2)	(2)	1	(2)	(2)
Kentucky				1	(2)	(2)
Michigan	24	66,156	1,036,844	22	55,559	897,647
Minnesota	4	24,155	416,084	4	17,401	372,507
Missouri	1	(2)	(2)	1	(2)	(2)
Nebraska	1	(2)	(2)	1	(2)	(2)
Ohio	15	27,704	443,106	17	27,776	509,169
Wisconsin	9	42,392	634,694	8	35,143	600,658
Undistributed [2]		20,321	315,672		19,275	323,086
Total Central States	59	180,728	2,846,400	59	155,154	2,703,067
Total United States	62	182,881	2,882,105	62	157,013	2,735,861

[1] Maine, 1; and Virginia, 2.
[2] Data which the Bureau of Mines is not at liberty to publish separately are combined as "Undistributed."

The values received by the operators comprise cost of coal at the mine, freight rate, direct and indirect manufacturing costs, and profit.

The trend in per ton value received by the packaged-fuel operators in the Eastern States and Central States regions, shown in table 13, reveals a 44-percent increase in the Eastern and 49 percent in the Central States for the 5-year period 1944–48. However, increases in the individual States for this 5-year period ranged from 75 percent in Illinois to 31 percent in Maine, as follows:

	Percent		Percent
Illinois	+75	Virginia	+50
Ohio	+68	Wisconsin	+49
Iowa	+63	Michigan	+38
Minnesota	+61	Nebraska	+35
Indiana	+51	Maine	+31

The average sales values in 1948 received by individual producers (f. o. b. plant) ranged from $13 to $22.58 per ton. It should be pointed out that the packaged-fuel values f. o. b. plant reported by the operators vary considerably, as they may represent small pick-up purchases of packages at the plant by passenger cars, sales in ton lots to homes or small dealers, or a combination of such sales.

[15] Black Diamond, Iverson Elected by Packaged Fuel Makers: Vol. 120, No. 13, June 19, 1948, p. 21c.

Number of Plants.—Sixty-two plants produced packaged fuel in 1948 (the same number as in 1947);[16] 57 of these plants were also active in 1947. Twenty-three plants are located in the Detroit and Cleveland areas and contributed 40 percent of the total production. The Chicago Packaged Fuel Co., Chicago, Ill., reported under construction in 1947, began commercial operations in February 1948, using equipment by Blaw-Knox Co.[17] Twelve plants were idle and 8 went out of business. One plant was reported under construction in 1948 with equipment by Eberling at Universal, Pa., and expected to start operating in 1949.

Capacity of Plants.—Table 15 points out the large number of small plants in the packaged-fuel industry. In 1948, 28 plants produced less than 1,000 tons each, contributing 12,111 tons, or 8 percent of the total production, and utilizing 18 percent of the combined capacity of this group. There were 43 plants, each with an annual capacity under 5,000 tons, that produced 35,791 tons, or 23 percent of the total production and utilized 32 percent of their combined capacity. Conversely, among the larger plants, eight produced 82,861 tons—53 percent of the total 1948 production and 41 percent of their combined capacity. The largest annual capacities in 1948 were reported for the plants of the Johnson Coal Cubing Co., Inc., Detroit, Mich., and the Cleveland-Cliffs Iron Co., Green Bay, Wis.

TABLE 15.—Annual capacity and production of packaged-fuel plants in the United States, 1944–48

	Active plants		Production		
	Number	Annual capacity (net tons)	Net tons	Percent of— Annual capacity	Percent of— Annual production
1944	68	428,600	175,770	41.0	100.0
1945	61	452,320	208,143	46.0	100.0
1946	70	530,760	190,919	36.0	100.0
1947	62	427,200	182,881	42.8	100.0
1948:					
Capacity of—					
Less than 5,000 tons	43	112,820	35,791	31.7	22.8
5,000 to less than 10,000	8	45,300	15,992	35.3	10.2
10,000 to less than 15,000	3	36,000	22,369	62.1	14.2
15,000 to less than 25,000	6	} 203,500	} 82,861	} 40.7	} 52.8
25,000 to less than 40,000	1				
40,000 to less than 60,000					
60,000 tons or more	1				
Total	62	397,620	157,013	39.5	100.0
Production of—					
Less than 500 tons	17	36,200	4,241	11.7	2.7
500 to less than 1,000	11	32,500	7,870	24.2	5.0
1,000 to less than 3,000	24	120,920	40,403	33.4	25.7
3,000 to less than 5,000	3	46,000	9,322	20.3	6.0
5,000 to less than 10,000	4	54,000	29,369	54.4	18.7
10,000 to less than 25,000	1	} 108,000	} 65,808	} 60.9	} 41.9
25,000 tons or more	2				
Total	62	397,620	157,013	39.5	100.0

[16] Years plants (active in 1948) started producing are given in the 1948 Packaged-Fuel Directory (which also shows type of raw fuel used), M. M. S. 1721, obtainable on request from the Bureau of Mines, Washington 25, D. C.

[17] Black Diamond, Open Modern Coal-Packaging Plant: Vol. 120, No. 6, Mar. 13, 1948, pp. 24–25.

Processes.—Fifty-six of the 62 active operations used the Eberling process;[18] 2 used Glenn Smith equipment;[19] 2 used equipment designed by Johnson Coal Cubing Co., Inc.;[20] 1 used Leemon equipment;[21] and 1 (the new plant of the Chicago Packaged Fuel Co., Chicago, Ill.) used Blaw-Knox equipment.[22] (These processes are briefly discussed by V. F. Parry in Bureau of Mines Report of Investigations 3757, previously cited.) Additional machinery was installed at two plants in 1948.

Raw Fuels.—Five kinds of raw fuels (table 16) entered into the manufacture of six types of packaged fuel in 1948 (table 17). Bituminous low-volatile coal at 57 plants in the Eastern and Central States (used exclusively at 55 plants and in combination with other fuels at 2 plants) accounted for 94 percent of the total packaged fuel produced. Bituminous high-volatile (in Michigan and Ohio) was used exclusively at three plants. Semianthracite (in Iowa, Missouri, and Nebraska), petroleum coke (in Illinois, Minnesota, Nebraska, and Wisconsin), and a small tonnage of Pennsylvania anthracite (in Virginia) were the other raw fuels used. Raw fuels, other than yard screenings, accounted for two-thirds of the raw fuels made into cubes in 1948.

The cubes measure approximately 3 to 4 inches. Fifty-six plants wrapped 6 cubes to a package, 5 plants 8 to a package, and 1 wrapped 4 to a package; 21 plants reported wrapping by machine, 10 by hand, and 31 a combination of machine and hand. The packages weigh 9 to 15 pounds, depending on the number and size of cubes contained; 10-pound packages predominate and were made at 47 plants. Several hundred tons of cubes were sold in bulk (unwrapped); these were made by one of the larger producers, using bituminous low-volatile and asphalt binder.

TABLE 16.—Raw fuels used in making packaged fuel in the United States, 1948

Character of raw fuels used	Plants	Net tons
Bituminous low-volatile	57	146,821
Bituminous high-volatile	5	3,526
Pennsylvania anthracite	1	3,603
Semianthracite	3	
Petroleum coke	6	2,184
Total	[1] 62	156,134

Plants using—	Plants	Raw fuels used (net tons): Yard screenings	Raw fuels used (net tons): Other raw fuels	Raw fuels used (net tons): Total
Yard screenings exclusively (from own or other yards)	33	36,310		36,310
Raw fuels (other than yard screenings) exclusively	12		77,643	77,643
Both yard screenings and other raw fuels	17	15,908	26,273	42,181
Total	[1] 62	52,218	103,916	156,134

[1] 53 plants used 1 kind of fuel only, 7 used 2 kinds (separately), 1 used a mixture of 2 kinds, and 1 used a mixture of 3 kinds; hence the sum of the items shown exceeds the total number of active plants.

[18] 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.

[19] Black Diamond, Briquetting Plant Solves Slack Problem: Vol. 98, No. 6, Mar. 13, 1937, p. 60.

[20] Black Diamond, A Mammoth Package-Fuel Plant: Vol. 102, No. 7, Apr. 8, 1939, p. 23; Packaging Coal at the Johnson Plant at Detroit: Vol. 115, No. 2, July 21, 1945, p. 20.

[21] Black Diamond, vol. 102, No. 12, June 17, 1939, p. 15.

[22] White Glove Packaged Fuel Division of Blaw-Knox Co. (Pittsburgh, Pa.), The Story of White Glove Packaged Fuel: Bull. 2085, c. 1946, 4 pp.

TABLE 17.—Classification of plants and production of packaged fuel in the United States, by kinds of raw fuel used, 1947–48

Raw fuel used	1947			1948		
	Plants	Packaged fuel produced		Plants	Packaged fuel produced	
		Net tons	Percent of total		Net tons	Percent of total
Bituminous low-volatile	56	165,936	90.7	55	146,600	93.4
Bituminous high-volatile	4			3		
Mixture of bituminous low- and high-volatile	-------			1		
Mixture of bituminous low- and high-volatile and Pennsylvania anthracite	-------	10,589	5.8	1	4,776	3.0
Mixture of bituminous low-volatile and petroleum coke	1			-------		
Semianthracite	3	3,977	2.2	3	3,453	2.2
Petroleum coke	6	2,379	1.3	6	2,184	1.4
Total	[1] 62	182,881	100.0	[1] 62	157,013	100.0

[1] In 1947, 2 types were made at 8 plants and in 1948, 2 types were made at 7 plants; hence the sum of the items shown exceeds the total number of plants active in the respective years.

Binders.—In 1948 the percentage of binder in packaged fuel, by weight, ranged from 0.5 to 6.7. Starch, totaling 859 tons and averaging about 15 pounds per ton of packaged fuel produced, is the principal type of binder used and was employed exclusively at 57 plants producing 125,343 tons, or 80 percent of the total output. Asphalt, totaling 1,936 tons and averaging about 125 pounds per ton of packaged fuel produced, was employed exclusively by three plants making bituminous low-volatile cubes. A combination of asphalt and starch in the manufacture of petroleum-coke cubes was used at one plant, and cement was used at two plants making bituminous low-volatile cubes. Data on binders used at packaged-fuel plants for 1945–48 are given in table 18.

TABLE 18.—Classification of packaged-fuel plants in the United States by type of binder used, 1945–48

	1945		1946		1947		1948	
	Plants	Percent of total packaged-fuel production	Plants	Percent of total packaged-fuel production	Plants	Percent of total packaged-fuel production	Plants	Percent of total packaged-fuel production
Type of binder used:								
Starch	58	72.5	65	72.7	58	77.9	57	79.8
Asphalt	3	27.5	3	26.0	2		3	19.5
Starch and asphalt	1		1	1.3	1	22.1	1	.7
Cement	------	---------	2		2		2	
Total	[1] 61	100.0	[1] 70	100.0	[1] 62	100.0	[1] 62	100.0
Production (net tons)	-------	208,143	-------	190,919	-------	182,881	-------	157,013

[1] In 1945–48, 1 plant making 2 types of packaged fuel used starch binder for 1 and asphalt and starch for the other; hence the sum of the items shown exceeds the number of active plants.

SHIPMENTS

Local sales (called for by passenger car or delivered by truck) amounted to 128,661 tons and comprised 82 percent of the 1948 total sales; other than local (shipped by truck to points in Wisconsin, Minnesota, Indiana, and Michigan), 11 percent; and shipments by rail (to points in Wisconsin, Minnesota, and Michigan), 7 percent (table 19).

TABLE 19.—Shipments of packaged fuel in the United States by method of transportation, 1944–48, in net tons

Year	Shipped by truck			Shipped by rail	Total
	Local sales [1]	Other than local sales	Total truck		
1944	139,026	24,302	163,328	12,389	175,717
1945	171,621	23,381	195,002	11,713	206,715
1946	150,770	25,262	176,032	14,555	190,587
1947	147,599	23,749	171,348	11,270	182,618
1948	128,661	17,753	146,414	10,272	156,686

[1] Includes sales called for and delivered.

Gem Stones

By SYDNEY H. BALL [1] AND G. W. JOSEPHSON

THE JEWELRY INDUSTRY IN 1948

AMERICAN jewelers found that in 1948 competition for consumers' dollars was increasing from dealers retailing other durable goods, long unobtainable, and further found their customers more discriminating. In consequence, sales ($1,203,000,000) were below those enjoyed in 1947. The 1948 Christmas trade was satisfactory; but expensive items, particularly large diamonds, moved slowly. Retailers' stocks decreased somewhat in the latter part of 1948; and although wholesale jewelers' sales ($530,000,000) were slightly higher than those of 1947, this fact is accounted for by extremely heavy sales in the first half of the year, which overbalanced slack sales in the latter half.

The industry operated under an exceptionally prosperous national economv, high industrial wages, a record national income and large exports especially to Latin American countries. The marriage rate, while high, was lower than in 1947.

FASHIONS IN JEWELS

Interest in jewels increased in 1948. Jewelry is yearly becoming more individualistic. On the whole, jewelry designs are becoming more delicate, graceful, and lacy, and the old compact, solid look is passing. In 1948 the dominant motifs were flowers, leaves, and, to a smaller extent, birds, bowknots, and butterflies.

Clips, brooches, and pins were approximately as popular as necklaces, earrings, and ear clips. Bracelets, rings, and tiny watches hidden in bracelets or rings were also frequently seen.

A large number of gem stones were mounted—diamonds notably, then emeralds, rubies, and sapphires. Among some 20 other gem stones used, amethysts, pearls, and aquamarines ranked high. Few "fancies" (decidely colored diamonds) were mounted; but, of course, such stones are rare.

[1] Deceased April 8, 1949. This chapter was compiled principally from an incomplete manuscript and notes left by Mr. Ball.

Wide use of the diamond and a certain popularity of pearls, real and cultured, caused colorless gems to be by far the most widely used, followed by green, red, and blue and then by purple and yellow stones.

Sets of jewels of the same design and set with the same stone are still popular, as are "utility" jewels, which can be separated into two or more components. Pendants commonly hang from necklaces or dangle from earrings. Odd cuts of diamonds support the brilliant and square cut more frequently. Scatter pins became popular late in the year. They were even used on sandals, as were other stones, and the latter were even set in spectacle frames.

Forty years ago the possession of a diamond-set ring indicated that the American man had attained financial success; now he rarely wears a diamond, although he may wear a star sapphire. A definite attempt last year to interest Americans in masculine jewelry apparently met but little success.

DOMESTIC PRODUCTION

In the past 129 years or thereabouts, the United States has produced a large number of different gem stones but has never been an important factor in world gem production. Exceptions might be the Maine tourmaline deposits over 125 years ago, the turquoise deposits of the Southwest in prewhite days, agate and variscite deposits in the recent past, and jade deposits in the present and near future. But gem mining has been and probably will be one of our minor mining industries.

No large gem-mining companies exist in the United States, but several prospectors in a number of instances have banded together to work certain deposits for a time; a few small companies have been formed to mine jade; and certain professional lapidary shops employ a few miners. In addition, amateur lapidaries spend many weekends searching for material, particularly of the agate family, to feed their lathes. If they are not collectors the product goes to the local jeweler or to one of a host of roadside curio shops, particularly in the Northwestern States, California, Arizona, New Mexico, Utah, and the Black Hills, stocked with souvenirs of local or of pretended local origin. The chief customers are automobile tourists. As a fad or a quasi-business, the lapidary craft is spreading rapidly.

No reliable statistics exist as to the value of the domestic output of gem stones; in the rough, it may approximate $400,000 to $500,000 and more than double that after cutting.

The many forms of agate, attractive and widely distributed, led the field, with jade second and turquoise a poor third. Of the States and Territories, Oregon, Wyoming, and Washington were the leaders.

Agate.—Agate production in Oregon, including "thunder eggs," is holding its own, and interest in the lapidary craft grows. The well-known Yellowstone River moss-agate locality in Montana is still producing but appears yearly to be nearer exhaustion. Production is falling, and good material is getting scarce; prices consequently are rising. Much of it is cut locally and sold in roadside shops. The Black Hills lapidaries are reported to depend on Montana for their rough moss agate, claiming that it is better than their own.

Considerable agate is produced in west Texas, although some authorities state that intensive exploitation in recent years has reduced the reserves markedly. Most of it is sent to California for cutting.

Washington produces considerable agate of several varieties.

A relatively large amount of agatized wood is collected on the borders of the Petrified Forest National Monument, Ariz. Other localities in Arizona have furnished agate for cutting.

Apparently the Wyoming moss-agate deposits and the plume-agate deposits of New Mexico were not vigorously exploited in 1948.

Utah produces considerable agate. In the past year or two, fine moss agate has been coming from a locality east of Park City.

Georgia reports a new locality for heliotrope in Catoosa County.

Jade.—Allan Branham of Lander, Wyo., stated that the old Wyoming deposits furnishing light-green jade have been largely depleted, although three or four individuals hold some. He further reported that the tremolite-jade mine changed hands and that, in the summer of 1948, it was vigorously worked, the product being sent to Denver in truck loads.

"Thunder," said to be the largest statuette ever carved in jade (20 inches high, weight 104 pounds) portrays an American Indian sitting cross-legged on rain clouds and pulling thunder from a small drum suspended from his shoulder. Donald Hord of San Diego, Calif., was the sculptor. The rough was found by Marcia Branham near Lander, Wyo., and the original boulder weighed 460 pounds.

Bert Rhodes produced considerable jade from a property 60 miles southeast of Lander. Some was said to have been exported to Shanghai, China.

Robert M. Hawk, a manufacturing jeweler of Denver, reports that in 1946, while on a fishing trip, he and two companions found a large jade deposit north of Lander. This was producing during the summer of 1948. The jade is in place; it is claimed that there are 50,000 tons of it. It varies in color from light green to black and is said to be worth $3 to $50 a pound. Some will be cut in Denver into lamp bases, book ends, etc., while some has been exported to China.

Although the Alaska jade deposits of the Kobuk River region were not worked in 1948, considerable was reported to have been exported during the year from Pacific ports to China.

Some nephrite was sold from Monterey County, Calif. A nephrite dike in place is said to have been recently found in San Benito County near King City, Calif.

Green-stained quartz is reported to have been produced somewhere in Colorado and sold under names such as "king jade."

Turquoise.—In 1948 the Southwest probably produced less turquoise than in recent years. The Southwest Gem & Jewelry Co. in 1948 produced about 200 pounds from its Mineral Park, Ariz., deposit. Dr. G. M. Butler reported that, as depth is attained at the Castle Dome Copper Co. property, the quantity of turquoise decreases. In 1948 the company ceased trying to recover turquoise as a byproduct, but some recovery by miners probably continued. Dr. Butler stated that much of the Arizona turquoise is artificially colored and that even a clever imitation of matrix turquoise is on the market.

Some turquoise was produced at Battle Mountain and Tonopah, Nev. The King mine at Manassa, Conejos County, Colo., was operated on a small scale; in addition, some turquoise was sorted from the dump. The Cerrillos mine, New Mexico, was not operated during 1948.

Other Gem Stones.—Alfred M. Buranek reported that Utah mines in 1948 produced about the normal amount of variscite. Most of it came from the Clay Canyon deposit but a little from Grantsville and Lucin.

Utah, according to Prof. Junius J. Hayes, produced a new gem stone, a transparent yellow labradorite which occurs as phenocrysts in an andesite from Clear Lake, Millard County. Stones are small, and cut stones seldom exceed 1 carat; stones weighing as much as 10 to 15 carats are very rare. They are being sold cut at Salt Lake City for $3 to $6 per carat.

The Barton Mines Corp., North Creek, Warren County, N. Y., miners of abrasive garnet, produced a few gem garnets. Pyrope garnets late in 1947 and early in 1948 were cut at Moab, Utah, in considerable quantities.

Montana reported no sapphire production in 1948, either from its dredges or from its lode mine. The latter, Yogo Gulch, Judith Basin County, was up for sale in 1948 but so far as known no transfer of title resulted. Guy B. Ellermeier of Denver reported that at the old sapphire locality near Turret, Colo., first discovered in 1886, the stones occur in a bed of corundum schist 1 foot thick lying on garnetiferous metamorphic limestone. While the corundum stones are a fine blue, they are too small to be of commercial interest.

Arkansas continued to produce some rock crystals, and the sale of these—largely to mineral collectors—continued to be an important source of revenue to a few of the individuals.

It was hoped in 1947 that changes of ownership in certain gem mines in the Pala area near San Diego would increase the California production of tourmaline, aquamarine, kunzite, and topaz in the Aguanga Mountain area nearby. The hope has only partly been fulfilled, although a little kunzite, aquamarine, garnet, and topaz has been produced.

Other gem stones produced in small amounts in 1948 in the United States follow: Plume agate, New Mexico; agate, Illinois; amethyst, Georgia (Union County); apatite, yellow, Mesilla Park, N. Mex.; aquamarine, Pikes Peak, Colo.; carnelian, New Mexico; rose quartz, South Dakota; satin spar, Perry Peak, Colo.; and topaz, Pikes Peak and Tarryall Mountains, Colo., and Topaz Mountain, Utah.

CANADIAN GEM STONES

Again in 1948 Canada produced little in the way of gem stones. Rock crystal (Black Rapids, Ontario), peristerite (Lyndoch Township, Ontario), and some other attractive gem-stone material is either exported to the United States or sold to an enthusiastic coterie of amateur lapidaries in Toronto. The Labrador labradorite, the finest in the world, can now be credited to Canada.

The annual value of Canada's gem-stone production probably does not exceed a few hundred dollars.

GOVERNMENT REGULATIONS

The jewelry industry doubtless has never been subject to as many regulations as at present. Most of the laws attempt to increase national revenue, keep currency at home, or obtain dollar exchange. A few examples follow.

Both Canada and the United States continued their luxury sales taxes. Exports of certain industrial diamonds from the United States required a special export license and customs inspection. Some countries, such as the Union of South Africa, prohibited import of jewelry from nonsterling areas. Importation of diamonds into India, Pakistan, and Ceylon was subject to various restrictive rules. There were severe limitations on any movement of jewelry over the borders of Hungary.

IMPORTS [2]

Imports of gem stones, exclusive of industrial diamonds, in 1948, as reported by the United States Department of Commerce, totaled $115,990,280, about 5 percent more than in 1947. Of the total, diamonds comprised 87 percent.

Precious and semiprecious stones (exclusive of industrial diamonds) imported for consumption in the United States, 1947–48 [1]

[U. S. Department of Commerce]

Commodity	1947		1948	
	Carats	Value	Carats	Value
Diamonds:				
Rough or uncut (suitable for cutting into gem stones), duty free	[2] 996, 514	[2] $42, 589, 592	912, 762	$44, 460, 365
Cut but unset, suitable for jewelry, dutiable	347, 810	53, 471, 539	389, 314	56, 244, 934
Emeralds:				
Rough or uncut, duty free	7, 385	258, 062	4, 937	28, 054
Cut but not set, dutiable	[2] 2, 286	[2] 75, 420	11, 213	286, 565
Pearls and parts, not strung or set, dutiable:				
Natural		[2] 366, 624		772, 763
Cultured or cultivated		737, 753		748, 302
Other precious and semiprecious stones:				
Rough or uncut, duty free		298, 393		258, 553
Cut but not set, dutiable		[2] 3, 664, 048		3, 160, 778
Imitation, except opaque, dutiable:				
Not cut or faceted		118, 168		53, 133
Cut or faceted:				
Synthetic		483, 313		777, 224
Other		7, 688, 827		8, 904, 941
Imitation, opaque, including imitation pearls, dutiable		15, 566		59, 610
Marcasites, dutiable:				
Real		300, 175		216, 003
Imitation		8, 549		19, 055
Total		[2] 110, 076, 029		115, 990, 280

[1] In the corresponding table in Minerals Yearbook, 1947, p. 536, revisions for 1946 are as follows: Diamonds, cut but unset—carats, 566,313; value, $110,465,703. Other precious and semiprecious stones, cut but not set, $8,932,984. Total value, $181,515,265.

[2] Revised figure.

[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.

DIAMOND

The year 1948 was a good one for diamond producers and wholesalers, fair for retailers, and poor for cutters.

World production was about 3 percent greater than in 1947. Output in the Union of South Africa was approximately the same as in the previous year, but the Belgian Congo registered an increase. In Tanganyika, production also increased markedly percentagewise.

Sales of rough by the principal wholesalers, the subsidiaries of the Diamond Corp., were a little over £38,000,000 in 1948 as compared with about £24,500,000 in 1947. In July the corporation took over marketing of Tanganyika Territory's production and that of French Equatorial Africa; and its buyers sometimes purchase in the "outside" alluvial fields of South Africa, Brazil, and British Guiana.

Retail sales in the United States were only fair, and retail prices declined. High-price articles moved very sluggishly.

Prices of rough were strong during the early part of the year but weakened considerably during the latter part.

Share Dealings.—From 1944 to date the diamond shares have lacked sparkle as market performers. In 1948 the four principal quoted shares had an average gain of 5½ percent but only fluctuated between 100 and 110 percent. Quotations were at their peak early in May and then declined. All the principal diamond-mining companies except Premier paid dividends in 1948.

Cutting.—In 1948 the cutting industry expanded its world-wide personnel to 29,500–31,000, a 10- to 12-percent increase over 1947. Half the cutters were Belgians. The Palestine industry had a hectic year. The number of cutters was too great for the rough available and the demand for cut; hence black markets, unemployment, reduced wages, and price deterioration of cut followed.

Netherlands, the United States, and South Africa are considered most firmly established as cutters of large stones, and Belgium and perhaps Palestine of small.

Imports.—Imports of gem-grade diamonds into the United States increased from $96,061,131 (revised figure) in 1947 to $100,705,299 in 1948, an increase of 5 percent. The dollar value of both rough and cut increased. The quantity of cut increased, whereas that of rough decreased. Belgium furnished 56 percent of the cut (value) in 1948.

Diamonds (exclusive of industrial diamonds) imported for consumption in the United States, 1947–48,[1] by countries

[U. S. Department of Commerce]

Country	Rough or uncut			Cut but unset		
	Carats	Value		Carats	Value	
		Total	Average		Total	Average
1947						
Austria				2	$300	$150.00
Belgian Congo [1]	70	$16,455	$235.07			
Belgium [1]				205,650	30,368,217	147.67
Brazil	[2] 25,918	[2] 498,631	[2] 19.24	7,227	900,317	124.58
British Guiana	822	39,155	47.63	223	26,356	118.19
British Malaya				320	62,884	196.51
British West Africa	1,680	11,680	6.95			
Canada				7	1,924	274.86
China				1,033	245,648	237.80
Cuba				6,422	866,997	135.00
Egypt				6	4,126	687.67
France [1]				4,339	756,758	174.41
French West Indies	21,093	351,188	16.65			
Germany				1	250	250.00
Hungary				125	23,374	186.99
India				136	28,158	207.04
Italy				9	3,861	429.00
Mexico [1]				1,021	318,211	311.67
Netherlands				24,011	3,742,952	155.88
Palestine and Trans-Jordan				35,474	4,297,767	121.15
Portugal				96	13,940	145.21
Siam				102	4,902	48.06
Switzerland				4,798	625,621	130.39
Syria				10	2,000	200.00
Union of South Africa	[2] 892,022	[2] 40,054,332	[2] 44.90	38,255	8,749,590	228.72
U. S. S. R.				9,270	707,959	76.37
United Kingdom	10,725	480,310	44.78	9,273	1,719,427	185.42
Venezuela	44,184	1,137,841	25.75			
Total 1947	[2] 996,514	[2] 42,589,592	[2] 42.74	347,810	53,471,539	153.74
1948						
Austria				1	215	215.00
Belgian Congo	119	3,870	32.52			
Belgium				213,207	31,475,999	147.63
Brazil	15,878	295,294	18.60	4,762	578,774	121.54
British Guiana	786	29,219	37.17	116	12,535	108.06
Canada				21	13,388	637.52
China				328	67,032	204.37
Colombia				20	5,683	284.15
Cuba				4,790	657,520	137.27
Egypt				14	1,875	133.93
France				13,471	925,673	68.72
French Morocco				61	13,300	218.03
Germany				11,624	399,714	34.39
Hong Kong				324	83,282	257.04
Iran				113	12,724	112.60
Italy				3	1,088	362.67
Jamaica				2	230	115.00
Japan				2	539	269.50
Lebanon				23	6,283	273.17
Mexico				80	9,954	124.43
Netherlands				34,246	5,109,945	149.21
Pakistan				1	488	488.00
Palestine and Trans-Jordan	1,120	114,921	102.61	39,995	4,139,345	103.50
Portugal				99	10,439	105.44
Siam				1,049	197,868	188.63
Sweden				1	450	450.00
Switzerland				18,298	3,044,693	166.39
Tangier				2	1,067	533.50
Union of South Africa	832,022	42,379,244	50.94	33,060	7,974,210	241.20
U. S. S. R.				9,303	775,378	83.35
United Kingdom	6,112	310,098	50.74	4,297	724,968	168.71
Venezuela	56,725	1,327,719	23.41			
Yugoslavia				1	275	275.00
Total 1948	912,762	44,460,365	48.71	389,314	56,244,934	144.47

[1] In the corresponding table in Minerals Yearbook, 1947, p. 537, revisions for 1946 are as follows: Cut but unset—Cuba is deleted. Total—carats, 566,313; value, $110,465,703; average value, $195.06. For 1947. imports were erroneously reported for Belgian Congo, Belgium, France, and Mexico.

[2] Revised figure.

World Production.—Accurate figures on diamond production are not available for all countries, but the figures in the accompanying table are believed to be close approximations. World production (gems and industrials) is estimated to have been 10,028,000 carats (2.21 short tons) in 1948, worth at the mine some $70,000,000, which compares with 9,742,000 carats (2.15 short tons) and $75,000,000 in 1947. Therefore, as compared with 1947, production in 1948 increased 3 percent in weight and decreased 7 percent in value. It is estimated that, by weight, 2,244,600 carats or 990 pounds were gem stones and 7,783,400 carats or 3,432 pounds industrials.

Belgian Congo was the leading producer by weight (58 percent), although it represented only 13 percent of the value. On the other hand, the British Commonwealth produced 29 percent by carats and over 66 percent by value of the total.

Among noteworthy developments were the increases in output in the Belgian Congo and Tanganyika. With few exceptions, production in French territories compared favorably with the previous year.

World production of diamonds, 1945–48, by countries, in metric carats

[Including industrial diamonds]

Country	1945	1946	1947	1948
Africa:				
Angola	803,887	806,961	799,210	795,509
Belgian Congo	10,386,000	6,033,452	5,474,469	5,824,567
French Equatorial Africa	82,849	87,381	107,076	[1] 100,000
French West Africa	79,802	51,834	62,310	77,970
Gold Coast [2]	812,451	653,196	852,493	[1] 850,000
Sierra Leone	504,309	559,229	605,554	465,518
South-West Africa	152,629	163,611	179,554	200,691
Tanganyika	115,666	119,446	92,229	148,169
Union of South Africa:				
Lode	878,713	1,025,019	918,042	[1] 930,000
Alluvial	262,529	256,768	[3] 286,692	[1, 3] 270,000
Total Union of South Africa	1,141,242	1,281,787	1,204,734	[1] 1,200,000
Brazil [1]	275,000	325,000	275,000	250,000
British Guiana	15,442	22,413	24,669	36,301
Venezuela	12,769	20,917	61,634	75,513
Other countries	2,000	[4] 1,600	[5] 3,500	[5] 3,500
Grand total	14,384,000	10,127,000	9,742,000	10,028,000

[1] Estimated.
[2] Exports.
[3] Includes an estimate of 100,000 carats for State Mines of Namaqualand.
[4] Partly estimated; includes India, Borneo, Australia (New South Wales), and U. S. S. R.
[5] Includes India, Russia, Borneo, New South Wales, and United States.

Industrial Diamonds.—Sales of industrial diamonds in 1948 were very large. American and other industries purchased normal quantities, and in addition Government missions to London purchased large quantities for the American strategic stock pile. Prices slashed by the Diamond Corp. at the outbreak of the war were again increased. Its present stocks are small. For economy's sake, the trend is toward the use of smaller stones wherever possible.

The use of diamond drills in exploring for and breaking ore (blasthole drilling) and in developing oil fields where the rock is hard is expanding. The use of diamond-impregnated wheels, particularly the vitrified type, for shaping carbide tools is increasing.

Figure 1 shows the tremendous increase in quantity and the sharp decline in the price per carat of American imports of industrial diamonds in the past 26 years.

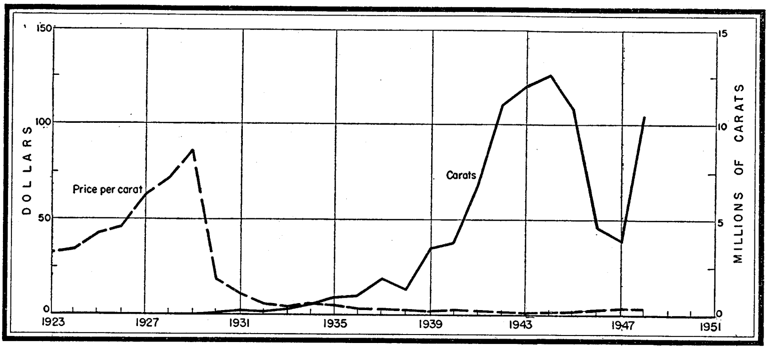

FIGURE 1.—United States imports and average price per carat of industrial diamonds, 1923–48.

In 1948 imports of industrials into the United States were much greater than in 1947. Imports of industrial diamonds during the past 5 years are shown in the accompanying table.

Industrial diamonds (glaziers', engravers', and miners') imported for consumption in the United States, 1944–48

[U. S. Department of Commerce]

Year	Carats	Value		Year	Carats	Value	
		Total	Average			Total	Average
1944	12, 614, 507	$22, 894, 244	$1. 81	1947 [1]	3, 999, 119	$13, 312, 668	$3. 33
1945	10, 733, 411	12, 823, 962	1. 19	1948	10, 418, 316	32, 521, 501	3. 12
1946	4, 625, 282	14,297, 536	3. 09				

[1] Revised figures.

In 1948 the United States exported 47,747 carats of industrial diamonds valued at $312,364.

RUBY, SAPPHIRE, AND EMERALD

These fine gem stones are increasing in price due to short supply of fine newly mined stones. Notwithstanding the excellence of the synthetic star sapphires and rubies introduced to the market in September 1947, natural stones are more popular then ever, and prices are more than holding their own.

The Anakie sapphire field, Queensland, whose principal center is now Rubyvale, was described.[3] The gravel, up to 50 feet thick, is worked either by open-cuts or shafts with drifts. The gravel is dry-sieved and hand-picked. Dark blues predominate; but fine yellows, greens, and particolored stones also occur. Zircon, pleonaste, tourmaline, and jasper are associated. The years from 1907 to 1925, except

[3] Squires, S. J., Commonwealth Jeweler and Watchmaker, Dec. 11, 1948, pp. 104–105.

for the First World War years, were the most productive and at times 1,000 diggers worked the field. The Rubyvale miners in 1947 sold gems to the value of £3,540.

The Black Star of Queensland widely exhibited in 1948 by American jewelers came from this field. It weighed rough 1,156 carats and cut 733 carats.

In 1948 a giant blue sapphire (1,958 carats) was found in the same general region by a digger's wife on a picnic. It was sold to the manager of a nearby claim.

A water shortage restricted production at the Willow Fields sapphire field.

South Africa continues to produce a few emeralds (1946, 11,533 carats; 1947, 7,753 carats). Six thousand, four hundred and ninety-two carats were exported in 1946 valued at £3,101, or 9s. 6.6d. per carat. A few are mounted locally.

Interesting data regarding Colombian emeralds were presented.[4] Emeralds of good color but of poor water occur in Mewar, India. The association is the frequent one, biotite schist intercalated in hornblende schist.[5]

According to Guhler's (see Bibliography) valuable study of Siamese gem stones, a few rubies have been mined for 500 or more years at several places. The sapphire deposits of Bo Ploi are described in some detail. Large sapphires are rare. Most gems are cut in Bangkok by Siamese, Chinese, or Gulas. Guhler considers the future of the industry bright. Siam ships considerable quantities of gems to the United States.

Ceylon produces not only ruby and sapphire but also alexandrite and cat's eye and a variety of stones of lesser value. All except moonstone are recovered from gravels by placer mining including some dredging. Singhalese are the only miners; dealers buy the stones in the field at auctions or private sales and Moslems then cut them. A half million dollars worth of gems is produced in a year.

LESSER GEMS

The Australian Government is to study whether, by pushing the production of its opal fields, by far the most important in the world, its supply of dollars can be increased.

At present only about 100 men are engaged in Australian opal mining; and the 1947 production—practically all of which came from South Australia (Coober Pedy and Andamooka)—was valued at only A£63,000. At Lightning Ridge, New South Wales, only a score of men mine and cut the black opal. The gem occurs as seams or nodules in a Cretaceous sandstone, beneath conglomerate and quartzite. The opal bearing layer is from a few inches to 2 feet thick.[6] A little opal is coming from Quilpi, Queensland. Most foreign gem purchasers buy from dealers in Sydney, Brisbane, or Melbourne, who visit the fields periodically.

There are three zircon-mining centers in French Indo-China (Bokeo, Pailin, and Cheon-Ksam). Burmans mine the stones, which occur

[4] Apolmor, Hermano Maria, Acad. Colomb. Rev. 7, No. 27, 1947, pp. 324–327.
[5] India Geological Survey, Minerals, vol. 1, No. 1, 1947, pp. 28–30.
[6] Squires, S. J., The Commonwealth Jeweler and Watchmaker, (Sydney, Australia), July 10, 1948.

almost at the surface, so little equipment is required. The stones are heat-treated and cut locally. They range in value from $0.50 to $660. Annual production, according to the Department of Commerce, is about $140,000. The mines are close to the Siamese border. The zircon production of Cambodia is large.

The Lithuanian amber industry with its center at Palanga was almost destroyed during the war but is recovering.

Brazil continued to produce a large caratage of the lesser gems Madagascar is producing little owing to the effects of war and rebellion. Because of the war damage to Pforzheim, where the stones were cut and mounted, the production of South-West Africa has declined.

Before the war, Turkey exported meerschaum crude to Germany and Austria but now makes it into smoking utensils and souvenirs.

The turquoise deposits of Southern Sinai were described.[7] The author believes that the flat-lying deposits were formed by post-Tertiary meteoric waters. Even today the Arabs produce a little, either re-sorting the ancient dumps now over 2,000 years old, or doing a little gouging.

TECHNOLOGY

Tourmaline is being used in piezo-electric gages for measuring blast pressures in air and under water. It has recently been synthesized.[8]

Mullite refractories can be made from topaz.

Synthetic spinel watch jewels heated after shaping are apparently as satisfactory as synthetic sapphire jewels, quicker to make, and cheaper to produce.

Synthetic sapphire bearings, acid proof and having great hardness, are finding wide application in industry. There is also a continuing interest in the use of natural sapphire in precision instruments.

The California (Chatham, San Francisco) method of making synthetic emerald has been described.[9] The crystal grows from seed in about 10 months. They are now on the market. The German method was described.[10]

There may come on the market in the near future synthetic rutile, supposedly as a cheap substitute for the diamond. These products have high dispersion and birefringence. They have a hardness of 6½ on Mohs' scale, and careful polishing is required to eliminate scratching; careful crystallographic orientation in cutting is required.

A film of fluoride on zircon has recently been detected in some stones in the trade. This appears to be a new method to "doctor" gems. The film is inert to most acids and to fairly high temperatures. In strong daylight or bright artificial light, the coating becomes a dull iridescent film.

Education and Laboratories.—Not only are the universities of America enlarging their courses in the study of gems but the City College of New York has this year an evening course in lapidary, said to be the sole course of its kind in America.

The excellent correspondence courses and resident lectures of the Gemological Institute of America (Los Angeles and New York) are

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[7] Davey, John C., Mining Magazine, March 1948, pp. 148–152; April 1948, p. 212.
[8] American Mineralogist, vol. 32, November-December 1947, pp. 680–681.
[9] Chemical Engineering, vol. 55, No. 2, 1948, p. 174.
[10] Geological Magazine (London), vol. 8, No. 2, 1947, pp. 98–100.

open to qualified students. Similar institutes exist in England and Australia. It and the American Gem Society work together on a number of problems. They have decided to substitute "flawless" for "perfect" in diamond grading.

The Diamond Council of America was organized early in 1949 to further the study of gemology. Prof. Paul J. Storm of the University of Pennsylvania is to conduct the classes.

The Gem Trade Laboratory, 36 West Forty-seventh Street, New York, was established to furnish identification of gem stones and pearls. Dr. A. E. Alexander is director.

During 1948 the Cincinnati branch of the Gemological Institute of America established a laboratory for gem identification under the direction of Edward Herschede, Jr.

A Diamond Trading Club similar to the New York Diamond Dealers Club was organized in Los Angeles. There are about 40 local members and additional members from San Francisco and San Diego. Los Angeles is said to be the third largest jewelry manufacturing city in the United States and second in retail diamond sales.

It is stated that over 15,000 veterans of World War II are studying, with Government aid, to become jewelers.

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Gold and Silver

By CHARLES WHITE MERRILL AND HELENA M. MEYER

GENERAL SUMMARY

UNITED STATES mine production of gold in 1948 decreased 5 percent compared with 1947, thus reversing the uptrend from the low reached in 1945. The 1948 output of 2,014,257 fine ounces was only 41 percent of the all-time high of 4,869,949 ounces set in 1940. Silver production in 1948 increased for the second successive year, but the output of 38,096,031 fine ounces was far below the level prevailing at the beginning of World War II. 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 producing in 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 prewar profit margins. Continued inflation during 1948, with little evidence that inflationary forces soon would be arrested, discouraged those who might otherwise have promoted new gold-producing enterprises. Moreover, in many instances the years of idleness had resulted in deterioration of plants and mine workings which required very large capital outlays for rehabilitation.

The expanding silver production was largely explained by the unprecedented peacetime demand for the base metals, particularly lead and copper, from the ores of which most United States silver is recovered as a byproduct. In addition, the higher Treasury buying price for silver domestically mined after July 1, 1946, continued to encourage production expansion.

California remained in first place as a gold producer, but outputs in South Dakota and Utah were very nearly as large. Although each of the three States showed a decline from 1947, nevertheless together they furnished 58 percent of domestic mine production. California output came principally from straight gold mines (both placer and lode), South Dakota production came almost entirely from gold ore produced at the Homestake mine, and Utah production was recovered mainly from copper ore mined in the West Mountain (Bingham) district. Idaho continued to be the leading silver producer, followed in importance by Utah and Montana. These three States supplied 69 percent of the domestic output. About one-half of the Idaho production was recovered from dry ores, but most of the rest from the three States was a byproduct of ores treated principally for base metals.

The recovery of gold was divided fairly evenly among smelting of crude ores and concentrates (only a very small part of which was recovered by the direct smelting of ore), placer methods, and amalgamation-cyanidation mills. Over 85 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.

Outside of the United States, production of gold increased slightly, more than offsetting the drop in this country and causing a small gain for the world as a whole. Both the United States and the remainder of the world had greater outputs of silver in 1948 than in 1947, but the over-all rise was only 3 percent. Current gold and silver world-production rates are far below prewar averages.

Shaft sinking and continued exploratory drilling in the vicinity of Odendaalsrus, Orange Free State, 150 miles southwest of Johannesburg, in 1948 brought encouraging results. A large gold field was forecast, and a boom of major proportions continued.

Owing to restrictions on the international movement of gold and silver and to measures taken by governments to stabilize the exchange value of currencies, gold and silver have lost much of their monetary significance in recent years. International Monetary Fund policies continue to affect the economics of the monetary metals, particularly gold. The Fund in its Annual Report,[1] April 30, 1948, presented the following analysis of the world situation particularly its activities concerning gold sales at premium prices and the payment of subsidies to producers.

The Fund is pledged to the promotion of exchange stability as one of its primary objectives. The par values of the currencies of all members are 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, and variations may only be made in accordance with the Fund Agreement. The Fund has, accordingly, been concerned over external gold transactions at prices in excess of the gold values of member currencies.

Private gold transactions consummated in United States dollars have been reported at various times at prices ranging up to US $50 per fine ounce and occasionally reports appear of transactions at even higher premia. International gold transactions for which high premia are quoted frequently take place in inconvertible currencies, particularly in countries where confidence in the future value of the national currency is lacking or where political conditions are disturbed. When a United States dollar price is quoted for such transactions in inconvertible currencies, it is merely the figure arrived at by converting the local currency price at the official rate of exchange, regardless of the fact that the local currency proceeds can only be converted into hard currency through black markets at substantial rates of discount.

[1] International Monetary Fund, Annual Report of the Executive Directors for the Fiscal Year ended Apr. 30, 1948: Washington, 1948, pp. 39-44.

On June 18, 1947, the Fund addressed to all members a statement, reproduced in full in last year's Annual Report, in which it deprecated external purchases or sales of gold at prices which directly or indirectly produce exchange transactions at depreciated rates. It was the Fund's view that this practice if not checked might become extensive and might as a consequence tend to undermine the exchange relationships among the members of the Fund. Moreover, transactions of this kind involve a wasteful use of gold since much of the metal goes into private hoards rather than into central holdings. In reply to a member's inquiry, the Fund has stated that its opposition to external gold transactions at premium prices extends not only to transactions between members of the Fund but also to transactions between members and non-members.

Some countries, including certain major gold producers, indicated that their practices were in accord with the Fund's policy. Others explained that their gold sales had been authorized before the Fund defined its policy but that they were ready to change their policy to conform to the Fund's views. Certain other countries revised their regulations in order to meet the Fund's policy.

Mexico informed the Fund that in compliance with the Fund's policy it had discontinued external sales of gold at premium prices. Canada's Minister of Finance stated that the policy of his Government was to prohibit exports of gold to "free markets" and to refuse to permit exports at prices above parity. Immediately after the receipt of the Fund's letter, the United States National Advisory Council on International Monetary and Financial Problems announced it was in full accord with the Fund's views. After a public hearing, the United States Treasury Department announced that its Provisional Regulations under the Gold Reserve Act of 1934 would be amended, effective November 24, 1947, with a view to curbing international gold transactions at premium prices in accordance with the Fund's request. The Bank of England advised bullion dealers that the prohibition on transactions at premium prices was extended to cover dealings as agents for non-residents. Transactions by London bullion dealers as principals had never been allowed except at prices within 1 per cent of US $35 per fine ounce.

In spite of the encouraging reaction of members to the Fund's letter of June 18, 1947, there is ample room left for greater support of the Fund's policy. There should be more vigorous enforcement of the gold regulations in certain countries, especially importing countries. It has been noted that international transactions in fabricated gold articles or jewelry with a fine gold content just below the minimum legal fineness of monetary gold have assumed increasing importance. Some countries have no legal basis for the effective supervision of trans-shipped gold; in most cases trans-shipped or bonded goods attract certain conditions and privileges which include freedom from import or export licensing, especially where it can be shown that the commodity is foreign-owned. In other instances, where exchange controls place little or no restrictions on gold dealings or shipments, a revision of existing gold regulations may be necessary in order that gold may be treated as a part of the potential national monetary reserves, rather than as an article of trade. Furthermore, some gold transactions at premium prices are being conducted by or through non-member countries or their nationals.

In order to enable the Fund to consider what further action may be called for, a letter has been sent to all members, requesting the text of their laws, decrees, and regulations (together with particulars of changes made since June 18, 1947), and a statement of the administrative practices they follow regarding international transactions in gold and in articles having a large content of gold, as well as data on international movements of gold.

* * * * * * *

Countries in balance of payments difficulties have sought ways and means of encouraging gold production. After consultation with the Fund, Canada announced on December 11, 1947, its intention of instituting a new program to stimulate gold production. The Canadian proposal provides for a payment to individual gold mines, designed to assist the mines in defraying part of their increased costs of production. The subsidy payment will be determined by taking half of the amount by which the current cost of gold production of any mine exceeds $18 an ounce and applying this to the amount by which production in the current year exceeds two-thirds of the production in the base year July 1, 1946, to June 30, 1947. Assistance will be given for a three-year period, effective January 1, 1948.

* * * * * * *

In its general statement the Fund asked member countries to consult with it prior to introducing any new measures to subsidize their gold production. The Fund took the position that a subsidy in the form of a uniform payment per ounce for all or part of the gold produced would constitute an increase in price which would not be permissible if the total price paid by the member for gold were thereby raised to any amount in excess of parity plus the prescribed margin of one quarter of one per cent. The Fund emphasized that other types of subsidy may constitute an increase in the price of gold and that each proposal for subsidy must be examined on its merits with regard to its specific provisions and in the light of surrounding circumstances. The Fund stated that any subsidy on gold production, regardless of its form, is inconsistent with * * * the Fund Agreement if it undermines or threatens to undermine exchange stability. The Fund promised to study and review with its members their gold policies and any proposed changes with a view to determining if they are in accordance with the provisions of the Fund Agreement and conducive to a sound international policy regarding gold.

In March 1948, the Government of Australia, in conformity with the Fund's general policy statement, consulted the Fund regarding a proposal to grant temporary assistance to certain gold mines in desert areas in Western Australia which were threatened with abandonment. The measure was designed to enable some marginal and isolated mines to continue operations despite rising costs, so as to sustain the population of certain communities whose existence is wholly dependent on the gold mining industry. The proposed aid was to be determined for each gold mine individually according to its costs, ore reserves, values, and dependent population, and would not affect the price of gold. The plan was not intended to increase gold production. The measures proposed by Australia were deemed not to contravene the obligations of members under the Fund Agreement to engage only in gold transactions at prices based on the par values of members' currencies and to collaborate with the Fund in promoting exchange stability. Neither were the measures proposed by Australia considered to violate the policy enunciated by the Fund on December 11, 1947, regarding gold subsidies.

A 15-percent rise in Canadian gold production in 1948 compared with 1947 reflected, at least in part, the stimulating effect of the first full year of that country's recently initiated subsidy program.

The International Monetary Fund prepared a document "Information on Silver as Submitted by Member Countries," which Herbert Bratter digested [2] in a recently published article.

Information by countries covering a number of years is presented on silver stocks, coinage, coinage debasement, demonetization, international movements, and other economic aspects.

[2] Bratter, Herbert, Silver as Money: Eng. and Min. Jour., vol. 150, No. 1, January 1949, pp. 79–80.

Salient statistics of gold and silver in the United States,[1] 1939–43 (average) and 1944–48

	1939–43 (average)	1944	1945	1946	1947	1948
Mine production, fine ounces:						
Gold	3,822,956	998,394	954,572	1,574,505	2,109,185	2,014,257
Silver	59,481,872	34,473,540	29,024,197	22,914,604	35,823,563	38,096,031
Ore (dry and siliceous) produced (short tons):						
Gold ore	12,361,580	1,964,680	1,364,308	2,395,500	3,523,715	3,261,194
Gold-silver ore	1,065,162	364,698	276,530	389,681	366,454	569,760
Silver ore	1,056,654	290,297	343,458	209,626	344,649	370,647
Percentage derived from—						
Dry and siliceous ores:						
Gold	54	30	30	40	39	39
Silver	40	17	24	24	26	27
Base-metal ores:						
Gold	17	58	51	23	29	31
Silver	60	83	76	75	74	73
Placers:						
Gold	29	12	19	37	32	30
Silver	(2)	(2)	(2)	(2)	(2)	(2)
Net industrial consumption:						
Gold	$38,281,283	$97,298,283	$108,944,332	$153,687,000	$48,900,000	$44,986,000
Silver, fine ounces	76,188,584	120,100,000	126,300,000	87,000,000	98,500,000	105,289,000
Imports:						
Gold	$1,944,828,106	$113,836,359	$93,718,050	$532,961,768	$2,079,588,406	$1,981,175,178
Silver	$51,960,097	$23,373,037	$27,278,396	$57,577,888	$68,140,343	$70,884,513
Exports:						
Gold	$7,704,792	$959,227,923	$199,967,940	$221,467,636	$213,240,800	$300,771,144
Silver	$11,333,285	$126,915,344	$90,936,901	$36,454,690	$30,648,742	$12,400,060
Monetary stocks:[3]						
Gold		$20,619,000,000	$20,065,000,000	$20,529,000,000	$22,754,000,000	$24,244,000,000
Silver, fine ounces		2,345,000,000	2,005,000,000	1,951,000,000	1,953,000,000	1,952,000,000
Price, average, per fine ounce:						
Gold	$35.00	$35.00	$35.00	$35.00	$35.00	$35.00
Silver	$0.704+	$0.711+	$0.711+	$0.808	$0.905	$0.905
World production, fine ounces (estimated):						
Gold	37,500,000	26,400,000	26,100,000	27,500,000	28,900,000	29,600,000
Silver	251,800,000	180,800,000	156,800,000	133,200,000	165,600,000	171,000,000

[1] Philippine Islands and Puerto Rico excluded.
[2] Less than 0.5 percent.
[3] Owned by Treasury Department; privately held coinage not included.

A clarification of Treasury regulations promulgated under the Gold Reserve Act of 1934 governing the sale of gold with regard to transactions in unprocessed or "natural" gold came late in 1948. The legality of domestic trade and holding of "natural" gold, under section 19 of the Provisional Regulations issued under the act, was established in these terms:

> Gold in its natural state may be acquired, transported within the United States * * * without the necessity of holding a license therefor.

As a result, much publicity was given to the possibilities of producers developing a premium market for their product among hoarders preferring gold to currency and speculators anticipating a rising price for the metal. Production that could qualify as "natural" gold suitable for trading was limited. Most placer gold was disqualified because of amalgamation during recovery—neither amalgam nor sponge gold was termed "natural." Some placer gold is recovered without mercurcy, and some operators could recover a "natural" gold product with a very small change in the washing methods. In addition to "natural" gold recovered from gravels, a few lode-mine operators found it practicable to recover from their ores free gold that would qualify as "natural" gold.

A special canvass was made of 1948 gold producers to determine the quantity of "natural" gold sold at premium prices and the total amount of the premiums. Most of the respondents reported no such sales. Not all those reporting sales were willing to furnish data on quantities sold and premiums received. However, "natural" gold containing approximately 10,000 fine ounces was reported as reaching the premium market, and it was estimated that the total may have reached 25,000 fine ounces. Premium prices were variously reported up to $43 per fine ounce or possibly a little higher.

To facilitate the "natural" gold trade, methods were devised for packaging and providing acceptable assays of lot finenesses. The use of sealed-leather pokes and the casting of predetermined quantities of gold dust of known fineness in lucite blocks were reported among the methods of preparing suitable hoarding and trading units. At least one large New York brokerage firm [3] dealing in securities and commodities developed a standard contract for the sale and delivery of gold. Although the sales of natural gold at premium prices were very small compared with the total domestic mine output, there was evidence that additional quantities of gold were involved where producers were delaying shipments through normal channels to the Bureau of the Mint in the hope of participation in the premium market.

International trade in silver was dominated by the regulations of various governments. The United States Treasury continued to purchase silver domestically mined after July 1, 1946, at $0.9050505+ per fine ounce, a price substantially above the New York price for metal that could not qualify for Treasury acceptance. Import duties imposed in India resulted in the Bombay silver market operating almost completely on an internal basis. Late in 1948 the Mexican Government imposed a 15-percent ad valorem tax on exports including silver. Other markets also were restricted by silver and exchange regulations. The New York market experienced

[3] Bache & Co., Gold Versus Uncertainty: New York, 1948, 8 pp.

a remarkable degree of stability during 1948, with a range from a high of $0.7775 to a low of $0.7025 per ounce of silver 0.999 fine.

Silver consumed for coinage, particularly for Mexico, Saudi Arabia, Sweden, and the United States, totaled well over 50,000,000 ounces in 1948 and was greatly in excess of the quantities returning to the world markets from demonitization programs

The Treasury buying price for gold and silver throughout 1948 continued at $35 and $0.9050505+ per fine ounce, respectively. The price for silver that could not qualify for Treasury purchase fluctuated.

The net inflow of gold and silver, reestablished in 1946 after a period when war expenditures had depleted the United States holdings, increased in volume in 1947 and continued nearly unabated in 1948. The gain in gold, which was only 10 percent less in 1948 than in 1947, carried the total United States stock to a new all-time high by the end of January 1948, exceeding the former high set at the end of October 1941. Thereafter the end of each month set a new all-time record.

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 44 years, 1905–48, shows a total excess of gold of 254,197 ounces (a difference of 0.17 percent) and a total excess of silver of 15,562,876 ounces (a difference of 0.65 percent).

Gold and silver produced in the United States, 1905–48, in fine ounces, according to mine and mint returns, in terms of recovered metals

Year	Mine		Mint	
	Gold	Silver	Gold	Silver
1905–43	141, 727, 251	2, 252, 464, 669	142, 041, 568	2, 264, 726, 370
1944	998, 394	34, 473, 540	1, 022, 238	35, 651, 049
1945	968, 062	29, 024, 197	928, 893	29, 063, 255
1946	1, 574, 505	22, 914, 604	1, 462, 354	21, 103, 269
1947	2, 109, 185	35, 823, 563	2, 165, 318	38, 587, 069
1948	2, 014, 257	38, 096, 031	2, 025, 480	39, 228, 468
Total 1905–48	149, 391, 654	2, 412, 796, 604	149, 645, 851	2, 428, 359, 480

MINE PRODUCTION

During the war years 1943–45, for the first time on record, over half of the domestic gold output was recovered from base-metal ores, but in the years since both dry ores and placer gravels exceeded base-metal ores in yield of gold. This recovery in gold mining, however, has not restored the industry to its prewar level. High wages, difficulties in recruiting labor forces, and high prices for equipment and supplies, together with an unchanged gold price, retarded recovery. The postwar production rate has not yet returned to half of the all-time peak established in 1940, and 1948 output compared with that for 1947 showed a downward trend.

Silver production, which had declined without interruption from 1940 to 1946, reversed the trend in 1947 and by 1948 had recovered to 38,096,031 ounces from the 1946 low of 22,914,604 ounces. An analysis of silver production, by ores, shows that almost three-fourths was recovered as a byproduct from base-metal ores in both 1947 and 1948. 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.

Mine production of gold and silver in the United States, in 1948, by months, in fine ounces

	Gold	Silver		Gold	Silver
January	162, 419	3, 158, 416	August	199, 146	3, 267, 344
February	148, 694	3, 026, 694	September	212, 745	3, 199, 698
March	153, 363	3, 417, 750	October	182, 811	3, 141, 741
April	156, 626	3, 445, 399	November	156, 046	3, 020, 331
May	156, 140	3, 293, 245	December	138, 531	2, 963, 150
June	160, 449	3, 123, 798			
July	187, 287	3, 038, 465	Total	2, 014, 257	38, 096, 031

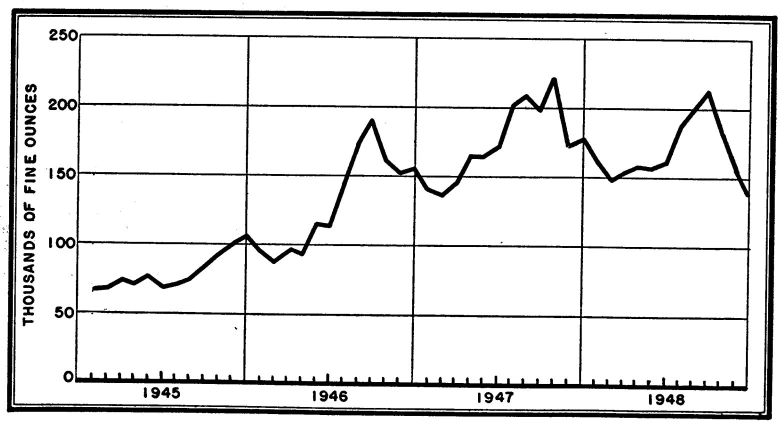

FIGURE 1.—Mine production of gold in the United States, 1945–48, by months, in terms of recovered gold.

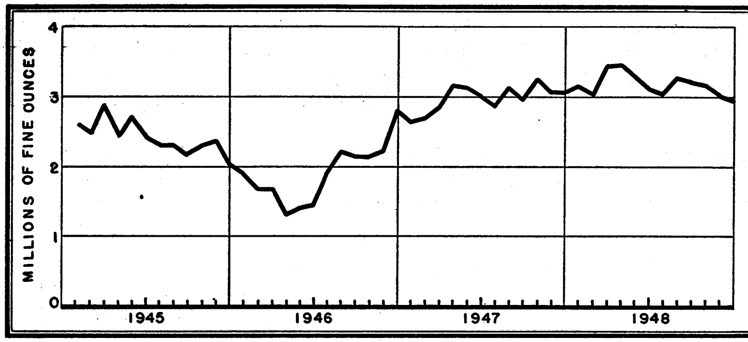

FIGURE 2.—Mine production of silver in the United States, 1945–48, by months, in terms of recovered silver.

Mines are grouped into two main classes—placers and lodes. The placers are those in which gold and silver as native metals or 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 placer 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 bucket-line dredging, dragline dredging, and treatment in nonfloating 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, a position held through 1948. Almost half of the domestic mine output was mined in the four leading districts in 1948. Included in the first four districts is the Yukon River Basin, Alaska, with 189,143 ounces.

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 1948. The three leading districts accounted for more than half of the total United States output of silver in 1948.

Mine production of recoverable gold in the United States by districts that produced 10,000 fine ounces or more during any year, 1944–48, in fine ounces [1]

District or region	State	1944	1945	1946	1947	1948
Lawrence County	South Dakota	11,621	55,947	312,246	407,192	377,836
West Mountain (Bingham)	Utah	312,493	248,923	140,877	384,414	332,588
Folsom	California	23,789	32,851	93,718	102,121	104,196
Grass Valley-Nevada City	do	(2)	31,064	49,033	68,383	94,398
Yuba River	do	(2)	(2)	(2)	(2)	(2)
Cripple Creek	Colorado	30,886	28,524	47,640	58,158	53,569
Chelan Lake	Washington	26,198	40,207	32,353	12,024	41,826
Ajo	Arizona	29,020	24,772	33,083	30,477	38,647
Upper San Miguel	Colorado	18,542	17,779	24,648	38,155	38,188
Robinson (Ely)	Nevada	48,120	45,063	39,234	39,490	37,453
Republic	Washington	20,479	17,363	18,563	22,590	28,196
Yellow Pine	Idaho	7,753	4,862	10,842	31,006	27,158
Oroville	California	9,859	4,217	17,891	22,589	20,800
Summit Valley (Butte)	Montana	14,441	12,052	6,882	19,777	19,163
Park City Region	Utah	15,149	13,822	16,956	17,052	19,087
Warren (Bisbee)	Arizona	38,401	15,863	5,680	20,131	19,083
Snelling	California	5	(2)	3,732	(2)	(2)
California (Leadville)	Colorado	20,149	15,706	10,749	(2)	(2)
Bullion	Nevada			12,473	17,058	16,676
Cosumnes River	California		389	(2)	10,691	13,956
Animas	Colorado	28,450	21,870	15,905	18,496	13,428
La Grange	California	5,018	7,544	(2)	(2)	(2)
Boise Basin	Idaho	426	1,858	7,758	7,894	11,732
Comstock	Nevada	3,655	661	5,419	5,028	11,591
Verde (Jerome)	Arizona	8,620	8,602	8,132	6,931	11,374
Big Bug	do	5,409	8,395	8,629	9,720	11,058
Tintic	Utah	11,417	14,536	17,799	15,385	11,007
Pioneer (Superior)	Arizona	6,630	5,007	7,260	9,339	10,054
Fairplay	Colorado	2	7,338	(2)	(2)	8,489
Sheepeater	Montana	7,143	7,812	9,822	10,140	6,498
Klamath River	California	3,256	(2)	5,853	11,295	5,033
Camanche	do	(2)	(2)	13,933	9,229	(2)
Manhattan	Nevada	7,689	9,870	13,478	1,618	782
Potosi	do	(2)	10,752	17		

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

Of the 25 leading gold-producing mines, 9 were lode gold mines, 5 were placers worked by bucket-line dredges, 4 were copper mines, 2 were lead-zinc mines, 1 was a copper-zinc mine, and 1 was a gold-antimony mine; 3 produced more than 1 type of ore. The 3 leading mines contributed 39 percent of the total gold produced in the United States in 1948 and the 25 on the list, 69 percent.

Only 3 of the 25 leading silver-producing mines depended exclusively on silver ore; ores valuable chiefly for copper, lead, zinc, and gold supplied most of the silver production. The 8 leading mines each producing over 1,000,000 ounces of silver in 1948 contributed 49 percent of the United States total. The list of 25 mines accounted for over two-thirds of the United States output. 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 and regions that produced 200,000 fine ounces or more during any year, 1944–48, in fine ounces

District or region	State	1944	1945	1946	1947	1948
Coeur d'Alene Region	Idaho	8,669,371	7,115,646	5,655,672	9,234,906	10,598,338
Summit Valley (Butte)	Montana	5,955,608	4,936,770	2,417,422	5,251,095	6,099,790
West Mountain (Bingham)	Utah	4,671,478	3,628,229	2,030,182	4,816,611	4,694,674
Park City Region	do	1,429,650	1,033,830	1,009,422	1,352,748	1,703,864
Warren (Bisbee)	Arizona	1,550,506	963,180	721,135	1,522,558	1,432,172
Tintic	Utah	1,070,214	1,086,435	619,724	1,076,726	1,123,460
Pioche	Nevada	444,309	350,259	403,358	426,229	684,321
Copper Mountain (Morenci)	Arizona	281,153	345,863	265,151	540,232	605,153
Upper San Miguel	Colorado	169,650	274,559	355,604	392,540	526,742
Ajo	Arizona	319,320	285,719	390,401	353,789	455,411
Big Bug	do	229,490	320,559	338,062	386,452	425,079
Animas	Colorado	228,015	301,957	339,088	362,888	417,887
Red Cliff	do	134,211	49,171	57,353	233,351	416,032
Verde (Jerome)	Arizona	589,538	475,290	418,578	367,778	408,669
Coso (Darwin)	California	252,900	575,069	871,091	1,093,709	393,761
Rush Valley	Utah	(1)	(1)	(1)	(1)	(1)
Pioneer (Superior)	Arizona	386,429	251,062	243,667	314,126	308,448
Creede	Colorado	518,161	433,177	355,110	317,712	297,926
Ten Mile	do	47,385	67,223	88,995	106,481	271,944
Warm Springs	Idaho	618,947	460,357	418,599	427,242	266,226
Yellow Pine	do	117,156	42,909	78,094	255,043	236,031
Virginia City	Montana	16,020	86,175	236,318	96,515	225,784
California (Leadville)	Colorado	496,634	417,427	332,024	(1)	(1)
Harshaw	Arizona	176,438	144,841	105,672	168,800	210,533
Central	New Mexico	216,554	(1)	(1)	167,538	(1)
Bayhorse	Idaho	270,644	200,631	84,052	204,264	166,246
Robinson (Ely)	Nevada	213,663	199,970	151,548	161,806	144,015
Flint Creek	Montana	249,141	208,260	10,255	173,716	31,858

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

Twenty-five leading gold-producing mines in the United States in 1948, 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	New Bunswick-Idaho-Maryland	Grass Valley-Nevada City	do	Idaho Maryland Mines Corp	Gold ore.
7	Empire-Star group	do	do	Empire Star Mines, Ltd	Do.
8	Holden	Chelan Lake	Washington	Howe Sound Co	Zinc-copper ore.
9	New Cornelia	Ajo	Arizona	Phelps Dodge Corp	Copper ore.
10	Smuggler Union, etc	Upper San Miguel	Colorado	Telluride Mines, Inc	Gold ore.
11	Yellow Pine	Yellow Pine	Idaho	Bradley Mining Co	Gold-antimony ore.
12	Ruth and Copper Flat	Robinson (Ely)	Nevada	Kennecott Copper Corp	Copper ore.
13	Knob Hill	Republic	Washington	Knob Hill Mines, Inc	Gold ore.
14	Capital Dredge	Folsom	California	Capital Dredging Co	Dredge.
15	United States and Lark	West Mountain (Bingham)	Utah	U. S. Smelting, Refining & Mining Co	Gold-silver, lead, silver, zinc-lead ores.
16	Copper Queen	Warren (Bisbee)	Arizona	Phelps Dodge Corp	Copper, zinc-lead ores.
17	Cresson	Cripple Creek	Colorado	Cresson Consolidated Gold Mining & Milling Co.	Gold ore.
18	Butte Mines	Summit Valley (Butte)	Montana	Anaconda Copper Mining Co	Copper, zinc-lead ores.
19	Goldacres	Bullion	Nevada	Consolidated Goldacres Co. and London Extension Mining Co.	Gold ore.
20	Park Galena and Mayflower	Park City	Utah	New Park Mining Co	Zinc-lead ore.
21	Portland, Vindication, etc	Cripple Creek	Colorado	United Gold Mines Co	Gold ore.
22	Butte Unit	Oroville	California	Yuba Consolidated Gold Fields	Dredge.
23	Resurrection, etc	California (Leadville)	Colorado	Resurrection Mining Co	Zinc-lead ore.
24	Ajax, etc	Cripple Creek	do	Golden Cycle Corp	Gold ore.
25	Consolidated Coppermines group	Robinson (Ely)	Nevada	Consolidated Coppermines Corp	Copper ore.

Twenty-five leading silver-producing mines in the United States in 1948, 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-lead ores.
2	Sunshine	Evolution	Idaho	Sunshine Mining Co	Silver ore.
3	Utah Copper	West Mountain (Bingham)	Utah	Kennecott Copper Corp	Copper ore.
4	United States & Lark	do	do	U. S. Smelting, Refining & Mining Co	Gold-silver, lead, silver, zinc-lead ores.
5	Bunker Hill & Sullivan	Yreka	Idaho	Bunker Hill & Sullivan Mining & Concentrating Co.	Zinc-lead, lead ores.
6	Polaris	Evolution	do	Sunshine Mining Co	Silver ore.
7	Copper Queen	Warren (Bisbee)	Arizona	Phelps Dodge Corp	Copper, lead, zinc-lead, gold-silver ores.
8	St. Germain & Purim	Evolution	Idaho	Silver Dollar Mining Co	Silver ore.
9	Chief, Gemini, etc	Tintic	Utah	Chief Consolidated Mining Co	Silver, lead, zinc-lead ores.
10	Morenci	Copper Mountain	Arizona	Phelps Dodge Corp	Copper ore.
11	Silver King	Park City	Utah	Silver King Coalition Mines Co	Silver, lead, zinc-lead ores.
12	Page	Yreka	Idaho	Federal Mining & Smelting Co	Zinc-lead ore.
13	Park Utah	Park City	Utah	Park Utah Consolidated Mining Co	Do.
14	New Cornelia	Ajo	Arizona	Phelps Dodge Corp	Copper ore.
15	Iron King	Big Bug	do	Shattuck Denn Mining Corp	Zinc-lead ore.
16	Eagle	Red Cliff	Colorado	New Jersey Zinc Co. (Empire Zinc Division).	Gold-silver, copper, zinc ores.
17	Pioche group	Pioche	Nevada	Combined Metals Reduction Co	Zinc, zinc-lead ores.
18	United Verde	Verde (Jerome)	Arizona	Phelps Dodge Corp	Copper, zinc-copper ores.
19	Darwin group	Coso (Darwin)	California	Anaconda Copper Mining Co	Zinc-lead, lead ores.
20	Park Galena & Mayflower	Park City	Utah	New Park Mining Co	Zinc-lead ore.
21	Osburn tailings	Evolution	Idaho	Hecla Mining Co. & Zanetti Bros	Zinc-lead old tailings.
22	Emma	Summit Valley (Butte)	Montana	Anaconda Copper Mining Co	Zinc-lead ore.
23	Treasury Tunnel Mines	Upper San Miguel	Colorado	Idarado Mining Co	Zinc-lead-copper ore.
24	Sherman	Lelande	Idaho	Day Mines, Inc	Lead ore.
25	Magma	Pioneer (Superior)	Arizona	Magma Copper Co	Copper ore.

Mine production of recoverable gold in the United States, 1938–48, with production of maximum year, and cumulative production from earliest record to end of 1948, by States, in fine ounces

	Maximum production [1]		Production by years											Total production from earliest record to end of 1948
	Year	Quantity	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	
Western States and Alaska:														
Alaska	1906	1,066,030	664,973	676,737	755,970	695,467	487,621	99,583	49,296	68,117	226,781	279,988	248,395	26,611,811
Arizona	1937	332,694	305,043	316,453	294,807	315,392	253,651	171,810	112,162	77,223	79,024	95,860	109,487	11,073,506
California	1852	3,932,631	1,311,129	1,435,264	1,455,671	1,408,793	847,997	148,328	117,373	147,938	356,824	431,415	421,473	102,734,107
Colorado	1900	1,391,364	367,468	366,852	367,336	380,029	268,627	137,558	111,455	100,935	142,613	168,279	154,802	39,381,024
Idaho	1871	212,850	103,513	116,662	146,480	149,816	95,020	30,808	25,008	17,780	42,975	64,982	58,454	7,964,185
Montana	1865	870,750	203,313	264,173	272,602	246,475	146,892	59,586	50,021	44,597	70,507	90,124	73,091	17,215,336
Nevada	1910	913,265	296,434	361,518	383,933	366,403	295,112	144,442	119,056	92,265	90,680	89,063	111,532	25,717,596
New Mexico	1915	70,681	43,050	36,979	35,943	27,845	11,961	5,563	6,918	5,604	4,009	3,146	3,414	2,189,395
Oregon	1940	113,402	81,729	93,372	113,402	96,565	46,233	1,097	1,369	4,467	17,598	18,979	14,611	5,725,142
South Dakota	1939	618,536	594,847	618,536	586,662	600,637	522,098	106,444	11,621	55,948	312,247	407,194	377,850	21,831,345
Texas	1929	1,279	439	324	312	306	236	4	----	----	9	45	57	8,392
Utah	1947	421,662	200,630	277,751	355,494	356,501	391,544	390,470	344,223	279,979	178,533	421,662	368,422	11,433,062
Washington	1939	90,420	74,175	90,420	82,136	84,176	75,396	65,244	47,277	57,860	51,168	34,965	70,075	2,283,710
Wyoming	1869	7,498	798	583	740	478	23	----	20	2	105	1,486	115	79,642
Total	----	----	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	2,107,188	2,011,778	274,248,253
West Central States: Missouri	1900	33	----	----	----	----	----	----	----	----	----	----	----	33
States east of the Mississippi:														
Alabama	1936	4,726	41	3	5	30	1	----	----	5	1	----	----	49,495
Georgia	1882	12,094	872	670	961	311	30	12	5	----	21	76	19	870,642
Indiana	(2)	(2)	----	4	5	----	----	----	----	----	----	----	----	(3)
Maryland	1937	1,040	855	71	----	----	----	----	----	----	----	----	----	6,102
Michigan	1890	4,354	----	----	----	----	----	----	----	----	----	----	----	33,297
North Carolina	1887	10,884	1,878	495	1,943	3,244	4,077	131	21	----	----	----	----	1,164,588
Pennsylvania	1942	2,499	1,422	1,815	1,840	2,422	2,499	2,218	2,115	1,588	1,150	1,518	2,200	[4] 29,002
South Carolina	1941	15,508	11,681	13,833	13,076	15,508	7,824	147	----	----	----	----	----	318,801
Tennessee	1930	696	236	163	173	227	159	303	222	148	95	303	156	21,424
Vermont	1946	165	----	----	----	----	----	17	100	104	165	100	104	[5] 623
Virginia	1938	2,943	2,943	364	458	240	109	50	132	12	----	----	----	167,558
Total	----	----	19,928	17,418	18,461	21,982	14,699	2,878	2,595	1,857	1,432	1,997	2,479	2,661,532
Grand total	----	----	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	2,109,185	2,014,257	276,909,818

[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] 1908–48 only.
[5] 1905–48 only.

Mine production of recoverable silver in the United States, 1938–48, with production of maximum year, and cumulative production from earliest record to end of 1948, by States, in fine ounces

	Maximum production [1]		Production by years											Total production from earliest record to end of 1948
	Year	Quantity	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	
Western States and Alaska:														
Alaska	1916	1,379,171	479,853	201,054	191,679	191,522	119,704	42,788	13,362	9,983	41,793	66,150	67,341	19,923,789
Arizona	1937	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	4,569,084	4,837,740	302,094,238
California	1924	3,629,223	2,590,804	2,599,139	2,359,776	2,154,188	1,450,440	609,075	778,936	986,798	1,342,651	1,597,442	724,771	110,522,301
Colorado	1893	25,838,600	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	2,557,653	3,011,011	735,995,342
Idaho	1937	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	10,345,779	11,448,875	542,280,066
Montana	1892	19,038,800	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	6,326,190	6,930,716	762,406,729
Nevada	1913	16,090,083	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	1,377,579	1,790,020	592,771,311
New Mexico	1885	2,343,800	1,229,860	1,400,878	1,407,839	1,328,317	676,170	463,583	535,275	465,127	338,000	515,833	537,674	68,808,238
Oregon	1941	276,158	100,507	105,388	219,112	276,158	87,376	10,523	20,243	10,461	6,927	30,379	13,596	5,269,287
South Dakota	1900	536,200	162,295	167,584	175,514	170,771	186,937	35,886	5,445	26,564	86,901	111,684	94,693	9,894,386
Texas	1938	1,433,008	1,433,008	1,341,945	1,326,150	1,096,027	672,781	10,284	5,355	23,265	42,922	20,547	3,065	33,291,975
Utah	1925	21,276,689	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	7,780,032	8,045,329	734,997,880
Washington	1902	721,450	380,938	442,063	365,175	402,030	369,038	370,440	321,608	281,444	264,453	293,736	375,831	13,499,440
Wyoming	1901	21,400	328	75	114	94	52	------	3	31	26	95	11	74,798
Total	------	------	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	35,592,183	37,880,673	3,931,829,780
West Central States: Missouri	1938	292,000	292,000	213,400	147,306	169,027	69,106	111,285	92,243	94,822	69,401	93,600	114,187	4,369,784
States east of the Mississippi:														
Alabama	1936	869	4	------	3	3	------	------	------	1	------	------	------	5,239
Georgia	1904	1,500	71	58	630	38	7	------	------	------	------	13	3	10,963
Illinois	1924	8,891	576	675	4,766	8,138	104	2,153	2,437	2,198	2,302	1,790	4,047	143,179
Maryland	1917	1,092	24	2	------	------	------	------	------	------	------	------	------	2,595
Michigan	1916	716,640	93,634	101,878	88,657	60,796	61,674	48,479	54,218	21,863	------	3,089	------	10,256,112
New York	1937	41,500	37,200	37,250	35,720	37,734	40,012	38,004	25,238	14,271	15,786	22,409	18,788	430,319
North Carolina	1906	30,769	5,500	3,961	6,480	7,439	8,259	7,169	1,461	------	------	------	------	357,223
Pennsylvania	1942	15,501	9,360	13,558	13,064	15,016	15,501	13,095	13,545	10,434	7,887	9,863	13,731	205,148
South Carolina	1940	8,047	3,951	5,480	8,047	6,525	5,064	135	------	------	------	------	------	35,325
Tennessee	1920	110,719	38,333	31,994	38,610	39,161	34,671	52,058	45,907	35,391	18,016	79,147	39,692	3,157,189
Vermont	1946	35,275	------	------	------	------	------	2,721	18,862	20,586	35,275	21,469	24,910	[2] 150,431
Virginia	1944	18,993	502	1,780	271	135	1,793	14,947	18,993	1,300	------	------	------	79,389
Total	------	------	189,155	196,636	196,248	174,985	167,085	178,761	180,661	106,044	79,266	137,780	101,171	14,833,112
Grand total	------	------	61,705,837	64,373,281	70,436,354	67,048,134	54,090,765	41,460,826	34,473,540	29,024,197	22,914,604	35,823,563	38,096,031	3,951,032,676

[1] States east of the Mississippi 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] Includes a small quantity by New Hampshire.

ORE PRODUCTION, 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 in 1948. 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 metal recovery has been used continuously in succeeding years, except for modifications necessitated by the improvement in metallurgy and the lowering of the grade of complex ores treated. 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; and ore that carries any grade of lead exclusively is called a lead ore. Zinc smelting ores (chiefly oxides) had ranged from 16 to 45 percent zinc, but with the development of slag fuming, which permits some oxidized ore in the charge and with high zinc prices, the minimum has declined to as low as 5 percent recoverable 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.

Ore produced in the United States and average recovery, in fine ounces, of gold and silver per ton in 1948 [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	1,715	2.828	0.731				80		58.000
Arizona	13,117	.421	1.697	15,265	0.050	2.503	27,708	0.022	9.089
California	402,860	.332	.154	16,680	.041	2.745	4,687	.022	5.445
Colorado	430,178	.199	.443	215,023	.078	2.814	38,842	.009	10.941
Idaho	672,681	.047	.372	6	.500	13.333	149,691	.001	38.319
Montana	156,296	.148	.383	32,200	.181	8.814	28,752	.015	6.612
Nevada	500,213	.094	.147	165,369	.079	2.504	32,972	.018	11.245
New Mexico	662	.279	2.654	33	.545	22.000	735	.008	16.600
Oregon	3,019	.684	3.475	100	.240	4.490			
South Dakota	1,003,859	.376	.093						
Texas									
Utah	4,949	1.149	2.498	125,084	.061	2.616	85,679	.023	5.049
Washington	70,742	.399	2.525				1,501		3.115
Wyoming	867	.125	.013						
Total	3,261,158	.229	.293	569,760	.079	3.011	370,647	.012	20.109
States east of the Mississippi	36	.528	.083						
Total	3,261,194	.229	.293	569,760	.079	3.011	370,647	.012	20.109

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 1948 [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	14	0.357	1.786	4,005	0.184	6.315	------	------	------
Arizona	39,072,204	.002	.072	23,231	.045	3.464	242	0.041	6.640
California	152	.401	227.737	22,005	.038	9.152	------	------	------
Colorado	5,831	.092	21.245	69,601	.035	2.613	15	.067	45.733
Idaho	1,383	.027	1.782	253,648	.003	3.704	5	------	4.200
Montana	1,511,069	.007	1.254	25,398	.050	5.360	------	------	------
Nevada	6,209,049	.006	.023	32,598	.030	7.523	102	.010	10.324
New Mexico	7,139,147	------	.023	12,671	.004	1.215	103	------	2.291
Oregon	------	------	------	------	------	------	------	------	------
South Dakota	------	------	------	------	------	------	------	------	------
Texas	957	------	.188	893	.064	3.231	------	------	------
Utah	24,458,362	.013	.108	27,416	.110	9.975	3	------	1.333
Washington	52	.038	3.019	15,350	.001	1.522	------	------	------
Wyoming	------	------	------	------	------	------	------	------	------
Total	78,398,220	.006	.100	486,816	.023	4.365	470	.026	7.674
States east of the Mississippi	5,721,960	------	.011	------	------	------	------	------	------
Total	84,120,180	.005	.094	486,816	.023	4.365	470	.026	7.674

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	------	------	------	200	0.010	0.835	6,014	0.930	5.217
Arizona	3,966	0.004	0.730	769,953	.021	2.111	39,925,686	.003	.121
California	5,233	.013	4.458	75,159	.003	4.135	526,776	.258	1.335
Colorado	168,365	.012	.783	510,264	.066	2.644	1,438,119	.098	2.092
Idaho	[2] 79,674	------	.301	2,824,758	.002	1.590	[2] 3,981,846	.009	2.874
Montana	[3] 34,048	.001	.426	1,232,544	.012	3.528	[3] 3,020,307	.019	2.294
Nevada	186,286	.007	.752	46,022	.065	8.717	7,172,611	.014	.249
New Mexico	454,891	.002	.442	124,921	.002	1.121	7,733,163	------	.070
Oregon	------	------	------	------	------	------	3,119	.670	3.507
South Dakota	------	------	------	1,480	.047	.624	1,005,339	.376	.094
Texas	------	------	------	------	------	------	1,850	.031	1.657
Utah	[4] 46,136	.003	.518	994,282	.038	4.351	[4] 25,741,911	.014	.313
Washington	364	------	.148	886,248	.047	.191	974,257	.072	.386
Wyoming	------	------	------	------	------	------	867	.125	.013
Total	978,963	.005	.574	7,465,831	.020	2.299	91,531,865	.015	.413
States east of the Mississippi	1,838,376	------	.001	1,334,046	------	.016	[5] 8,894,418	([5])	[5] .010
Total	2,817,339	.002	.200	8,799,877	.017	1.953	100,426,283	.014	.377

[1] Missouri excluded.
[2] Includes 48,131 tons of old lead-smelter slag.
[3] Includes 22,727 tons of zinc slag fumed.
[4] Includes 34,818 tons of zinc slag.
[5] Excludes magnetite-pyrite-chalcopyrite ore and gold and silver therefrom.

Gold, gold-silver, and silver ores containing too little copper, lead, or zinc to be classified as copper, lead, zinc, or mixed base-metal 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 its name from its products—a name that is also justified by the mineralogical content and final recovery of metals. The "dry ores" thus are 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 States east of the Rocky Mountains 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, 1939–43 (average) and 1944–48, by percent from sources and in total fine ounces

Year	Percent from—						Total fine ounces
	Placers	Dry ore	Copper ore	Lead ore	Zinc ore	Zinc-lead, zinc-copper, lead-copper, and zinc-lead-copper ores	
1939-43 (average)	28.8	54.1	14.1	0.5	(1)	2.5	3,822,956
1944	12.4	29.8	45.4	.9	0.8	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
1947	32.2	38.5	23.8	.5	.4	4.6	2,109,185
1948	29.8	39.5	22.4	.5	.2	7.6	2,014,257

1 Less than 0.1 percent.

Mine production of silver in the United States, 1939–43 (average) and 1944–48, by percent from sources and in total fine ounces

Year	Percent from—						Total fine ounces
	Placers	Dry ore	Copper ore	Lead ore	Zinc ore	Zinc-lead, zinc-copper, lead-copper, and zinc-lead-copper ores	
1939-43 (average)	0.2	39.6	29.2	5.5	0.5	25.0	59,481,872
1944	(1)	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
1947	.2	25.7	23.1	8.0	2.1	40.9	35,823,563
1948	.2	26.6	20.7	5.9	1.5	45.1	38,096,031

1 Less than 0.1 percent.

Mine production of gold in the United States in 1948, by States and sources, in fine ounces, in terms of recovered metals

State	Placers	Dry ore	Copper ore	Lead ore	Lead-copper ore	Zinc ore	Zinc-lead, zinc-copper, and zinc-lead-copper ores	Tota
Alaska	242,802	4,850	5	736			2	248,395
Arizona	838	6,898	84,391	1,045	10	17	16,288	109,487
California	285,556	134,710	61	837		66	243	421,473
Colorado	13,247	102,963	538	2,467	1	1,948	33,638	154,802
Georgia		19						19
Idaho	20,776	32,096	38	717		20	4,807	58,454
Montana	16,541	29,406	10,888	1,282		32	14,942	73,091
Nevada	8,178	60,656	37,385	973	1	1,332	3,007	111,532
New Mexico	9	209	1,998	48		861	289	3,414
Oregon	12,522	2,089						14,611
Pennsylvania			[1] 2,200					2,200
South Dakota		377,780					70	377,850
Tennessee			156					156
Texas				57				57
Utah	14	15,223	312,536	3,003		144	37,502	368,422
Vermont			104					104
Washington	10	28,209	2	8			41,846	70,075
Wyoming	7	108						115
Total	600,500	795,216	450,302	11,173	12	4,420	152,634	2,014,257

[1] From magnetite-pyrite-chalcopyrite ore.

Mine production of silver in the United States in 1948 by States and sources, in fine ounces, in terms of recovered metals

State	Placers	Dry ore	Copper ore	Lead ore	Lead-copper ore	Zinc ore	Zinc-lead, zinc-copper, and zinc-lead-copper ores	Total
Alaska	35,965	5,894	25	25,290			167	67,341
Arizona	136	312,285	2,814,833	80,464	1,607	2,895	1,625,520	4,837,740
California	21,482	133,163	34,616	201,399		23,330	310,781	724,771
Colorado	2,812	1,220,734	123,877	181,857	686	131,800	1,349,245	3,011,011
Georgia		3						3
Idaho	5,919	5,986,332	2,464	939,500	21	24,021	4,490,618	11,448,875
Illinois							4,047	4,047
Michigan								
Missouri				[1] 114,187	(1)			114,187
Montana	2,717	533,727	1,894,759	136,135		14,520	4,348,858	6,930,716
Nevada	1,463	858,595	142,435	245,239	1,053	140,081	401,154	1,790,020
New Mexico	2	14,684	166,018	15,396	236	201,259	140,079	537,674
New York						1,903	16,885	18,788
Oregon	2,657	10,939						13,596
Pennsylvania			[2] 13,731					13,731
South Dakota		93,769					924	94,693
Tennessee			39,692					39,692
Texas			180	2,885				3,065
Utah		772,186	2,649,771	273,487	4	23,921	4,325,960	8,045,329
Vermont			24,910					24,910
Washington		183,329	157	23,358		54	168,933	375,831
Wyoming		11						11
Total	73,153	10,125,651	7,907,468	2,239,197	3,607	563,784	17,183,171	38,096,031

[1] A little silver recovered from lead-copper ore from one mine included with that from lead ore.
[2] From magnetite-pyrite-chalcopyrite ore.

Gold and silver produced in the United States from ore and old tailings, in 1948, 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 mills							Crude ore to smelters		
		Short tons	Recovered in bullion		Concentrates smelted and recovered metal			Short tons	Gold (fine ounces)	Silver (fine ounces)
			Gold (fine ounces)	Silver (fine ounces)	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)			
Western States and Alaska:										
Alaska	6,014	5,837	4,196	736	1,005	1,220	30,352	177	177	288
Arizona	[2] 36,172,489	35,412,392	46	22	1,502,513	78,047	[3] 3,314,406	760,097	30,556	1,523,096
California	526,776	491,405	126,493	49,836	22,156	5,449	385,808	35,371	3,975	267,645
Colorado	1,438,119	1,416,321	74,752	15,463	168,025	62,492	2,534,908	21,798	4,311	457,828
Idaho	[4] 3,981,846	3,903,183	1,608	923	313,663	34,863	11,254,623	[4] 78,663	1,207	187,410
Montana	[5] 3,020,307	2,893,171	13,528	12,475	425,768	29,557	6,318,126	[5] 127,136	13,465	597,398
Nevada	7,172,611	7,069,013	53,849	387,174	213,789	43,948	701,109	103,598	5,557	700,274
New Mexico	7,733,163	7,615,219	28	105	329,341	1,718	389,652	117,944	1,659	147,915
Oregon	3,119	2,966	546	116	176	1,009	9,390	153	534	1,433
South Dakota	1,005,339	1,005,339	377,780	93,769	130	70	924			
Texas	1,850	240			24		71	1,610	57	2,994
Utah	25,741,911	25,517,522			929,030	351,029	[6] 6,953,487	224,389	17,379	1,091,835
Washington	974,257	954,502	3,889	25,376	59,480	60,551	314,327	19,755	5,625	36,128
Wyoming	867	850	93	6				17	15	5
Total	87,778,668	86,287,960	656,808	586,001	3,965,100	669,953	32,207,183	1,490,708	84,517	5,014,249
States east of the Mississippi	[7] 8,894,418	[7] 8,884,508	19	3	730,955	2,460	101,168	9,910		
Total	96,673,086	95,172,468	656,827	586,004	4,696,055	672,413	32,308,351	1,500,618	84,517	5,014,249

[1] Missouri excluded.
[2] Excludes 3,753,197 tons of ore leached from which no gold or silver was recovered.
[3] Excludes 80 ounces from copper precipitates smelted.
[4] Includes 48,131 tons of old lead-smelter slag smelted and fumed.
[5] Includes 22,727 tons of zinc slag fumed.
[6] Excludes 7 ounces from copper precipitates smelted.
[7] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.

Gold and silver produced at amalgamation and cyanidation mills in the United States and percentage of gold and silver recovered from all sources, 1939–43 (average) and 1944–48 [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
1939–43 (average)	730,675	178,174	786,926	3,678,844	19.1	0.3	20.6	6.2	31.5	93.3	28.8	0.2
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
1947	378,578	80,756	272,039	273,646	17.9	.2	12.9	.8	37.0	98.8	32.2	.2
1948	378,590	104,598	278,237	481,406	18.8	.3	13.8	1.3	37.6	98.2	29.8	.2

[1] Illinois, Michigan, and Missouri excluded 1939–46; Missouri excluded, 1947–48.
[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 1948, by States

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	1,552	4,196	736				1.69	1.09		
Arizona	213	46	22				.04			
California	307,280	73,921	13,304	80,276	52,572	36,532	17.54	1.84	12.47	5.04
Colorado	208,277	33,665	10,177	[1] 229,074	41,087	5,286	21.75	.34	26.54	.18
Idaho	13,719	1,608	923				2.75	.01		
Montana	54,447	9,867	4,415	90,160	3,661	8,060	13.50	.06	5.01	.12
Nevada	39,152	3,816	2,790	610,196	50,033	384,384	3.42	.16	44.86	21.47
New Mexico	230	25	8	12	3	97	.73		.09	.02
Oregon	1,296	542	114	30	4	2	3.71	.84	.03	.01
South Dakota	896,932	250,782	72,100	1,003,494	126,998	21,669	66.37	76.14	33.61	22.88
Washington	83	10		51,091	3,879	25,376	.01		5.54	6.75
Wyoming	850	[2] 93	[2] 6	850	(2)	(2)	[2] 80.87	[2] .55	(2)	(2)
Total	1,524,031	378,571	104,595	2,065,183	278,237	481,406	18.82	.28	13.83	1.27
States east of the Mississippi	36	19	3				.77			
Grand total	1,524,067	378,590	104,598	2,065,183	278,237	481,406	18.80	.28	13.81	1.27

[1] Chiefly sands and slimes from ore first roasted and amalgamated.
[2] Gold and silver produced by cyanidation included with amalgamation.

PLACERS

Almost one-third of the gold produced in 1948 was derived from placer mines. Of the 600,500 ounces of placer gold, 473,366 ounces or 79 percent was recovered by bucket-line dredges. Although this dredge output was over fourfold that of 1944, the wartime low, it was far below the all-time high of 904,149 ounces established in 1940. A number of dredge properties remained idle during 1948 because of the unfavorable economic situation for gold production. As gold dredges are not converted readily to other uses, many idle properties had much of their operating equipment intact. It appeared probable, therefore, that gold output from this type of mining would be expanded if the ratio of gold price to dredging cost improved appreciably.

The quantity of gold recovered by bucket-line dredges from the inception of the industry as a commercial factor in 1896 to the end of 1948 is recorded as 20,901,485 (revised) ounces, originating by States as follows: California, 12,560,173 ounces; Alaska, 5,744,783 (revised) (including the production from single-dipper dredges and some gold by hydraulicking); Montana, 774,715; Idaho, 660,393; Oregon and Colorado together, 993,803; and other States, 167,618.

The second most important source of placer gold was the nonfloating-washing-plant method, with mechanical earth-moving equipment for gravel delivery. This was the only one of the more productive methods to show increased output in 1948 compared with 1947. Production by this method has shown an uninterrupted rise since 1944. Dragline dredging, a method that had had a phenomenal rise from 1933 until World War II, dropped from second to third place in 1948. Of the other methods, hydraulicking was the most productive, although a sharp decrease in 1948 as compared with 1947 reduced output to less than twice that recorded for small-scale hand methods.

California produced 48 percent of the United States placer gold in 1948 and Alaska, 40 percent. Other larger producers named in order of importance were Idaho, Montana, Colorado, Oregon, and Nevada. In 1948 California was the leader in all but three methods of placer-gold production. Alaska led in hydraulic and nonfloating-washing-plant production and Nevada in dry placering.

The accompanying table shows the placer gold produced in the United States, classified by mining methods, in 1944–48.

Additional information on placer mining may be found in the State reviews in this volume.

Gold production at placer mines in the United States, by classes of mines and methods of recovery, 1944–48 [1]

Class and method	Mines producing	Washing plants (dredges)	Material treated (cubic yards)	Gold recovered: Fine ounces	Gold recovered: Value	Gold recovered: Average value per cubic yard
Surface placers:						
Gravel mechanically handled:						
Bucket line dredges:						
1944	17	20	25,843,685	104,284	$3,649,940	$0.141
1945	35	48	41,183,846	153,991	5,389,685	.131
1946	59	75	108,197,919	470,693	16,474,255	.152
1947	60	79	120,362,326	514,931	18,022,585	.150
1948	56	77	119,927,532	473,366	16,567,810	.138
Dragline dredges:						
1944	[2] 2	[2] 2	[3] 1,213,000	[2] 6,241	[2] 218,435	.180
1945	9	9	457,100	2,646	92,610	.203
1946	65	64	7,506,360	38,351	1,342,285	.179
1947	71	65	10,325,994	55,448	1,940,680	.188
1948	42	41	5,224,260	31,446	1,100,610	.211
Becker-Hopkins dredges:						
1944–45						
1946	1	1	5,000	32	1,120	.224
1947–48						
Suction dredges:						
1944–45						
1946	3	3	37,900	267	9,345	.247
1947	12	10	79,590	588	20,580	.259
1948	8	9	84,200	473	16,555	.197
Nonfloating washing plants:						
1944	[2] 17	[2] 17	[3] 288,500	[2] 1,585	[2] 55,475	.192
1945	38	38	1,174,800	9,762	341,670	.291
1946	93	93	3,479,600	42,796	1,497,860	.430
1947	137	136	4,281,440	57,356	2,007,460	.469
1948	154	153	6,120,070	67,718	2,370,130	.387
Gravel hydraulically handled:						
Hydraulic:						
1944	[2] 24		[3] 243,550	[2] 1,022	[2] 35,770	.147
1945	111		1,200,320	14,161	495,635	.413
1946	157		2,724,350	32,278	1,129,730	.415
1947	167		2,838,440	38,722	1,355,270	.477
1948	137		1,708,650	16,976	594,160	.348
Small-scale hand methods:						
Wet:						
1944	[2] 100		[3] 125,392	[2] 2,269	[2] 79,415	.633
1945	173		126,590	3,174	111,090	.878
1946	268		681,630	5,567	194,845	.286
1947	284		783,852	11,122	389,270	.497
1948	275		296,776	9,800	343,000	1.156
Dry:						
1944	5		1,000	68	2,380	2.380
1945	1		100	2	70	.700
1946	17		7,400	262	9,170	1.239
1947	19		2,800	161	5,635	2.013
1948	10		3,900	170	5,950	1.526
Underground placers:						
Drift:						
1944	[2] 16		[3] 6,395	[2] 522	[2] 18,270	2.857
1945	15		5,513	927	32,445	5.885
1946	26		12,407	358	12,530	1.010
1947	28		7,248	517	18,095	2.497
1948	42		20,105	551	19,285	.959
Unclassified placers:						
1944	189		(4)	7,331	256,585	(4)
1945–48						

See footnotes at end of table.

Gold production at placer mines in the United States, by classes of mines and methods of recovery, 1944-48 [1]—Continued

Class and method	Mines producing	Washing plants (dredges)	Material treated (cubic yards)	Gold recovered: Fine ounces	Gold recovered: Value	Gold recovered: Average value per cubic yard
Grand total placers:						
1944	[5] 367		[3] 27, 721, 522	123, 322	$4, 316, 270	$0. 146
1945	382		44, 148, 269	184, 663	6, 463, 205	. 146
1946	689		122, 652, 566	590, 604	20, 671, 140	. 169
1947	778		138, 681, 690	678, 845	23, 759, 575	. 171
1948	724		133, 385, 493	600, 500	21, 017, 500	. 158

[1] Most of the detailed figures for 1944-47 are revised to reflect a reclassification of certain outputs in Alaska and Idaho; grand totals are unchanged.
[2] Data for Alaska not separately available; included with "Unclassified placers."
[3] Data for Alaska not available and not included.
[4] Data not available.
[5] A mine using more than one method of recovery is counted but once in arriving at total for all methods.

REFINERY PRODUCTION

The accompanying table contains official estimates of production of gold and silver in the United States, made by the Bureau of the Mint, based upon arrivals at United States mints and assay offices and at privately owned refineries. The mints and assay offices determine the State source of all newly mined unrefined material at the time deposits are received. The State source of material received by privately owned refineries is determined from information submitted by them and by intervening smelters, mills, etc., involved in the reduction processes.

Gold and silver refined in the United States,[1] 1944-48, and approximate distribution of source, by States, in 1948, in fine ounces

[U. S. Bureau of the Mint]

State or Territory	Gold	Silver
1944	1, 022, 238	35, 651, 049
1945	928, 893	29, 063, 255
1946	1, 462, 354	21, 103, 269
1947	2, 165, 318	38, 587, 069
1948:		
Alaska	221, 471	55, 709
Arizona	103, 872	4, 930, 017
California	423, 759	1, 067, 886
Colorado	161, 348	3, 156, 138
Georgia	21	3
Idaho	64, 171	11, 620, 665
Illinois		832
Michigan		1, 008
Missouri		108, 169
Montana	74, 754	6, 643, 623
Nevada	118, 603	1, 950, 012
New Mexico	9, 349	603, 985
New York		10, 451
North Carolina	4	(2)
Oregon	14, 914	18, 357
Pennsylvania	2, 204	13, 710
South Dakota	378, 080	93, 781
Tennessee	140	36, 507
Texas	54	10, 180
Utah	384, 050	8, 451, 152
Vermont	104	24, 710
Virginia		40
Washington	68, 483	431, 529
Wyoming	99	4
Total	2, 025, 480	39, 228, 468

[1] Includes Philippine Islands production, 1944-45. [2] Less than 1 ounce.

Gold and silver produced in the United States, 1792–1948 [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
1874–1948	218, 957, 340	5, 261, 046, 675	3, 843, 405, 380	2, 883, 959, 185
Total	280, 165, 788	6, 526, 333, 675	3, 989, 933, 480	3, 077, 995, 185

[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 that can be made available to industry and the arts without smelter or refinery preparation. In contrast, the gold and silver that enter 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. Comparison of 1948 gold figures with those for 1947 shows an 8-percent decrease in the return from industrial use, in issue for industrial use, and in net consumption. The issue for industrial use and the net use in 1948 both are far below the levels prevailing in 1944–46. Despite the decline, nevertheless, the net absorption by industry and the arts comprised nearly two-thirds of the total new gold produced from domestic mines during 1948.

Net industrial consumption of gold and silver in the United States, 1939–43 (average) and 1944–48

[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
1939–43 (average)	25, 828, 978	64, 110, 261	38, 281, 283	28, 406, 127	104, 594, 711	76, 188, 584
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
1947	49, 229, 578	98, 129, 578	48, 900, 000	27, 866, 359	126, 366, 359	98, 500, 000
1948	45, 142, 764	90, 128, 764	44, 986, 000	23, 897, 173	129, 186, 173	105, 289, 000

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Silver.—The 1948 consumption of silver in industry and the arts, though below the average for the war years, was well above that for 1946 and 1947. The consumption exceeded any annual output ever achieved by domestic mines.

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 have continued to absorb much silver since.

MONETARY STOCKS

Gold holdings of the United States rose $1,490,000,000 (7 percent) from $22,754,000,000 on January 1, 1948, to $24,244,000,000 on January 1, 1949, according to the Federal Reserve Bulletin. Total world reserves are not positively known, inasmuch as data are not available from some countries, including Germany, Japan, Australia, and U. S. S. R. Currency stabilization funds secretly held add to the difficulties in reaching an approximation.

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, and the United States net increase in 1948 substantially exceeded world mine output.

United States Treasury silver holdings decreased 1,000,000 fine ounces during 1948 to 1,952,000,000 ounces. The holdings do not include 410,553,011 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 Treasury buying price for silver domestically 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 Congress) 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 90.50505+ cents an ounce; there has been no price change since.

According to the Director of the Mint, the following prices for silver prevailed in London and New York (exchange-free-New York on London, $4.03) in 1947 and 1948: London price, per ounce, 0.999 fine, opened in 1947 at 55.5d., receded irregularly to a low of 37d. at midyear and recovered to 45d. late in the year, a level maintained past midyear 1948 when after a short upward movement the price fell to 42.5d. by the year end. New York price per ounce, 0.999 fine, established a high of $0.8375 in January 1947, after which, except for a briefly held peak in March, it declined irregularly to set the year's low of $0.5975 near midyear and then recovered to $0.74625 late in the year, a level held past midyear 1948. Thereafter a rise took place followed by a sharp decline to an average of $0.70000 for December.

FOREIGN TRADE [4]

The excess of gold imports over exports in 1948, though smaller than in 1947, nevertheless approach 1¾ billion dollars. The gains from imports plus the output from domestic mines greatly exceeded consumption in the arts and industries, and thus gold monetary stocks increased. Consumption of silver, however, exceeded the supply from mine output plus net imports, with the result that stocks were drawn upon.

Value of gold and silver imported into and exported from the United States, 1947–48, by classes

[U. S. Department of Commerce]

	Imports	Exports	Excess of imports over exports [1]
1947			
Gold:			
Contained in ore and base bullion	$34,945,046	$120,750	$34,824,296
Bullion refined	1,904,557,160	189,104,113	1,715,453,047
United States coin	294	638	−344
Foreign coin	140,085,906	24,015,299	116,070,607
Total	2,079,588,406	213,240,800	1,866,347,606
Silver:			
Contained in ore and base bullion	21,615,718		21,615,718
Bullion refined	39,243,429	21,206,271	18,037,158
United States coin	969,008	710,650	258,358
Foreign coin	6,312,188	8,731,821	−2,419,633
Total	68,140,343	30,648,742	37,491,601
1948			
Gold:			
Contained in ore and base bullion	35,135,904		35,135,904
Bullion refined	1,898,916,122	186,995,482	1,711,920,640
United States coin	920	4,893	−3,973
Foreign coin	47,122,232	113,770,769	−66,648,537
Total	1,981,175,178	300,771,144	1,680,404,034
Silver:			
Contained in ore and base bullion	25,698,252	2,491	25,695,761
Bullion refined	36,911,374	950,983	35,960,391
United States coin	2,466,597	567,000	1,899,597
Foreign coin	5,808,290	10,879,586	−5,071,296
Total	70,884,513	12,400,060	58,484,453

[1] Excess of exports over imports indicated by minus sign.

[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.

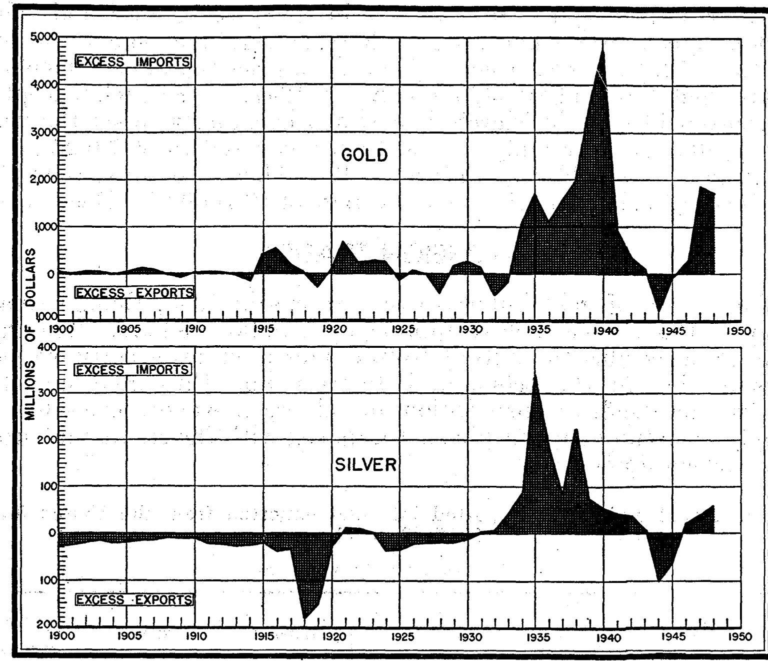

FIGURE 3.—Gold and silver imports and exports, with net movements, 1900–48.

WORLD REVIEW

World gold output gained in 1948, continuing the movement in progress since 1946, but the greater quantities produced replaced only in small part the loss in production sustained from 1940 to 1946.

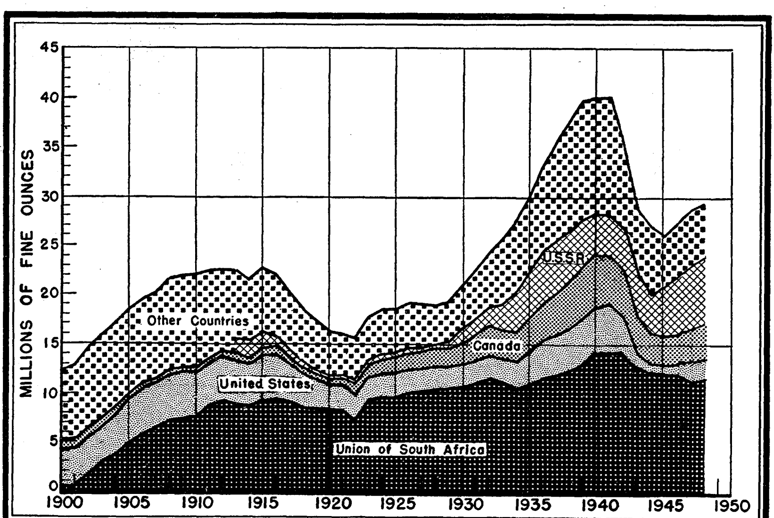

FIGURE 4.—World production of gold, 1900–48.

The decline in silver production, uninterrupted since 1940, was reversed in 1947, and a further small rise is indicated in 1948. World silver output, like that for gold, continued far below prewar averages.

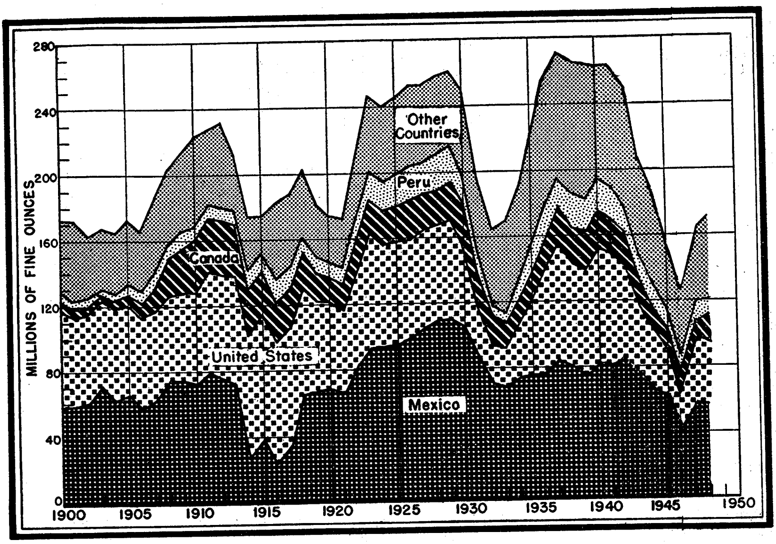

FIGURE 5.—World production of silver, 1900–48.

World production of gold, 1943–48, by countries, in fine ounces [1]

[Compiled by B. B. Mitchell]

Country	1943	1944	1945	1946	1947	1948
North America:						
United States (including Alaska) [2]	1,380,758	1,022,238	915,403	1,462,354	2,165,318	2,025,480
Canada	3,651,301	2,922,911	2,696,727	2,832,554	3,070,221	3,527,574
Central America and West Indies:						
Costa Rica [3]	6,957	3,606	3,054	1,251	1,988	1,096
Cuba	51	39	[3] 423	1,105	364	334
Dominican Republic (exports)	816	683	486	646	------	------
Guatemala	409	[3] 126	[3] 66	[3] 36	[3] 35	[3] 16
Haiti	310	161	[3] 73	41	------	------
Honduras	20,734	19,774	17,078	12,833	12,037	16,887
Nicaragua (exports)	220,430	222,635	206,360	203,390	213,454	222,627
Panama	------	------	------	------	------	1,000
Salvador (exports)	28,411	22,813	16,526	21,798	10,755	20,778
Mexico	631,537	508,882	499,301	420,500	464,739	367,612
Newfoundland	18,735	18,329	15,354	15,751	13,583	12,252
Total	5,960,500	4,742,200	4,370,900	4,972,300	5,952,500	6,195,700
South America:						
Argentina	16,300	5,369	3,381	8,038	[4] 8,000	(5)
Bolivia	8,374	6,265	5,888	16,700	20,108	[6] 4,063
Brazil (estimate)	191,300	178,300	212,200	175,000	167,000	156,900
Chile	269,807	243,883	180,462	230,880	168,855	156,521
Colombia	565,501	553,530	506,695	437,176	383,027	335,260
Ecuador	111,101	85,039	68,038	75,254	57,250	79,207
Guiana:						
British	19,470	18,986	22,533	19,793	21,111	16,518
French	20,609	18,583	20,641	19,741	14,918	13,625
Netherlands (Surinam)	5,795	5,723	5,895	4,648	4,134	4,177
Peru	199,637	175,180	172,661	158,378	116,016	111,162
Uruguay	[4] 1,000	[4] 1,000	[4] 1,000	(5)	(5)	------
Venezuela	82,390	77,716	76,839	48,558	21,830	49,730
Total	1,491,000	1,370,000	1,276,000	1,194,000	982,000	935,000

See footnotes at end of table.

World production of gold, 1943–48, by countries, in fine ounces[1]—Continued

Country	1943	1944	1945	1946	1947	1948
Europe:						
Austria	2,315	-----	-----	-----	-----	(5)
Czechoslovakia	8,404	5,014	1,529	1,903	2,090	(5)
Finland	9,337	9,800	6,633	7,327	11,285	(5)
France	34,112	21,959	39,738	48,355	32,890	(5)
Hungary	[7] 61,350	[7] 28,215	193	1,318	1,993	(5)
Italy	11,992	6,334	1,768	(5)	(5)	(5)
Portugal	-----	-----	-----	-----	15,754	(5)
Rumania	82,370	74,590	90,987	80,377	74,686	90,000
Spain	-----	1,961	2,025	3,729	2,714	(5)
Sweden	156,606	112,560	85,585	91,372	75,586	(5)
U. S. S. R. (estimate) [8]	4,000,000	4,000,000	5,000,000	6,000,000	7,000,000	7,000,000
Total	4,400,000	4,300,000	5,200,000	6,200,000	7,200,000	7,300,000
Asia:						
China	88,184	-----	-----	-----	107,535	(5)
Formosa	52,364	25,917	592	(5)	7,750	13,115
Cyprus	5,480	958	-----	-----	-----	-----
India	252,228	188,206	168,366	131,775	171,704	180,114
Indochina, French [9]	64	13	-----	-----	-----	-----
Japan	230,071	168,438	65,300	43,154	57,597	69,819
Korea	490,009	656,678	96,452	193,000	329,000	[10] 2,098
Malaya, Federation of	2,213	1,212	287	445	5,312	10,212
Philippines, Republic of	[11] 13,764	-----	[11] 13,490	360	64,441	209,225
Saudi Arabia	42,643	[6] 8,683	[6] 37,972	48,000	52,000	74,000
U. S. S. R.	(8)	(8)	(8)	(8)	(8)	(8)
Total	1,177,000	1,050,000	383,000	425,000	795,000	600,000
Africa:						
Bechuanaland	12,966	11,575	11,297	9,739	7,381	1,507
Belgian Congo [12]	451,171	364,204	346,971	331,304	301,445	299,774
Cameroun (French)	21,798	20,416	16,300	11,927	11,574	(5)
Egypt	890	1,036	3,014	2,793	2,090	3,853
Eritrea	83	169	[4] 322	3,411	3,674	(5)
Ethiopia	[4] 48,000	[6] 38,156	[6] 56,176	[6] 51,528	[6] 27,382	(5)
French Equitorial Africa	93,462	84,106	76,069	71,535	70,170	63,715
French Guinea	(5)	(5)	(5)	4.405	7,395	88,029
French West Africa	7,973	8,777	6,945	7,009	5,564	20,512
Gold Coast	567,282	523,225	539,252	585,910	505,153	672,388
Kenya	45,118	42,259	38,517	29,892	21,959	23,429
Liberia	30,823	30,772	[6] 9,016	16,506	16,987	13,797
Madagascar	9,195	9,388	6,430	3,890	(5)	2,095
Morocco, French	2,476	2,572	161	(5)	(5)	(5)
Nigeria	15,323	7,916	8,108	4,881	2,203	2,899
Portuguese East Africa	6,481	7,577	7,897	5,766	4,441	5,427
Portuguese West Africa	2,000	1,296	822	552	360	443
Rhodesia:						
Northern	703	307	265	[13] 6,838	[13] 779	180
Southern	656,684	592,729	568,241	544,596	522,735	514,440
Sierra Leone	2,748	1,026	274	183	2,400	2,193
South-West Africa	155	97	83	67	34	455
Sudan	2,127	1,820	1,623	3,670	3,725	(5)
Swaziland	2,734	2,299	3,583	4,914	5,637	3,110
Tanganyika (exports)	72,723	55,148	49,302	48,428	47,317	57,557
Uganda (exports)	3,820	2,593	2,295	2,176	1,535	1,158
Union of South Africa	12,804,379	12,279,629	12,224,629	11,927,165	11,200,281	11,584,849
Total	14,861,000	14,089,000	13,978,000	13,679,000	12,776,000	13,412,000

See footnotes at end of table.

World production of gold, 1943-48, by countries, in fine ounces [1]—Continued

Country	1943	1944	1945	1946	1947	1948
Oceania:						
Australia:						
Commonwealth	751,279	656,867	657,212	824,480	937,654	890,428
New Guinea				661	59,202	86,556
Fiji	61,505	40,407	94,964	82,402	94,353	93,059
New Zealand	149,150	142,287	128,364	119,271	112,260	93,903
Total	961,934	839,561	880,540	1,026,814	1,203,469	1,163,946
World total (estimate) [1]	28,900,000	26,400,000	26,100,000	27,500,000	28,900,000	29,600,000

[1] 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 Bulgaria, Germany, Norway, Sarawak, and Yugoslavia; estimate not included in total. In addition, production in Burma, Indonesia, and Papua was negligible, and Thailand produced none in 1943-47.
[2] Refinery production. Excludes production of the Philippines.
[3] Imports into United States.
[4] Estimate.
[5] Data not available; estimate included in total.
[6] Exports.
[7] Includes gold mined in Transylvania which temporarily formed part of Hungary.
[8] Output from U. S. S. R. in Asia included with U. S. S. R. in Europe.
[9] Lode only.
[10] South Korea only.
[11] Figure published by Director of the Mint, representing gold of Philippine origin refined but not necessarily mined during the year.
[12] Includes Ruanda-Urundi.
[13] Included is yield from Nkana mine refinery slimes accumulated during the war: 6,594 ounces in 1946 and 547 in 1947.

World production of silver, 1943-48, by countries, in fine ounces [1]

[Compiled by B. B. Mitchell]

Country	1943	1944	1945	1946	1947	1948
North America:						
United States [2]	40,874,050	35,651,049	29,046,047	21,103,269	38,587,069	39,228,468
Canada	17,344,569	13,627,109	12,942,906	12,544,100	11,773,619	14,569,280
Central America and West Indies:						
Costa Rica [3]	1,154	3,506	1,380	604	1,470	3,029
Cuba	[3] 142,420	[3] 42,985	[3] 107,195	127,222	146,932	185,216
Honduras	3,161,901	3,115,352	3,003,495	2,682,910	2,413,399	3,170,871
Nicaragua (exports)	251,901	248,529	240,197	260,637	213,417	212,463
Salvador (exports)	202,064	305,922	223,705	313,180	265,104	216,342
Mexico	76,633,062	65,460,073	61,097,727	43,263,132	58,843,863	57,519,703
Newfoundland	1,258,708	1,163,206	1,076,129	1,107,827	956,052	882,263
Total	139,870,000	119,618,000	107,739,000	81,403,000	113,201,000	115,988,000
South America:						
Argentina	2,319,194	1,695,000	2,760,000	3,090,000	[4] 2,435,400	[4] 1,201,900
Bolivia (exports)	7,299,730	6,797,631	6,683,561	6,106,165	6,233,354	7,562,208
Brazil	30,048	28,722	28,385	21,968	20,293	23,095
Chile	1,093,543	1,171,895	1,070,219	823,220	981,048	990,450
Colombia	209,950	197,323	168,699	151,971	110,352	109,188
Ecuador	362,013	441,345	235,500	192,200	156,931	226,664
Peru	14,659,742	15,832,440	12,997,741	12,334,150	10,782,909	10,421,502
Total	25,974,000	26,164,000	23,944,000	22,720,000	20,720,000	20,535,000

See footnotes at end of table.

World production of silver, 1943–48, by countries, in fine ounces [1]—Continued

Country	1943	1944	1945	1946	1947	1948
Europe:						
Austria	11,028	13,960	-----	-----	(5)	(5)
Czechoslovakia [4]	740,000	675,000	300,000	600,000	1,400,000	1,600,000
Finland	87,579	90,344	45,236	146,929	188,821	(5)
France	310,737	240,134	350,025	535,213	(5)	(5)
Germany	(5)	(5)	(5)	(5)	(5)	[6] 867,459
Hungary	1,124,311	[7] 614,300	[7] 3,200	14,854	(5)	(5)
Italy	239,845	81,052	1,382	298,400	460,900	601,000
Norway	231,485	170,399	131,818	202,550	228,270	147,900
Rumania	78,994	71,310	189,610	(5)	481,264	(5)
Spain	656,422	778,016	497,661	669,009	638,192	[4] 206,000
Sweden	1,306,220	1,292,299	1,135,178	1,294,935	1,088,656	(5)
United Kingdom	33,885	33,742	26,808	23,285	25,000	25,000
Total (estimate)	14,000,000	13,000,000	10,000,000	11,000,000	14,000,000	15,000,000
Asia:						
Burma	-----	-----	-----	-----	-----	[4] 450,000
China	(5)	(5)	(5)	(5)	1,747	(5)
Formosa	224,367	127,873	3,156	(5)	(5)	6,870
Cyprus	17,282	4,882	-----	-----	-----	-----
India	18,611	14,299	14,154	9,821	12,422	(5)
Japan	6,376,553	5,029,341	[8] 853,377	1,281,625	1,909,433	2,231,261
Korea	2,829,265	2,577,525	-----	[4] 130,500	[4] 195,400	[9] 38,505
Philippines, Republic of	26,071	-----	17,208	3,600	6,586	150,760
Saudi Arabia	47,008	[10] 7,290	[10] 28,255	29,475	(5)	(5)
Total (estimate)	10,000,000	8,000,000	1,000,000	1,500,000	2,200,000	3,000,000
Africa:						
Algeria	15,432	48,612	14,661	39,996	(5)	(5)
Bechuanaland	1,221	1,319	1,237	1,704	1,086	233
Belgian Congo	3,105,762	2,732,813	4,141,016	5,047,666	4,057,295	3,805,619
Gold Coast (exports)	50,288	56,820	36,666	54,525	(5)	(5)
Kenya	16,354	11,500	16,659	5,493	3,859	3,184
Morocco, French	85,714	65,427	107,609	117,157	(5)	(5)
Nigeria	[4] 2,100	1,079	1,106	666	2,130	4,270
Portuguese East Africa	559	844	998	805	734	712
Rhodesia:						
Northern	41	-----	2,269	[11] 634,392	[11] 73,277	-----
Southern	119,322	103,776	95,975	95,168	91,900	81,404
South-West Africa	-----	-----	-----	-----	-----	301,168
Swaziland	-----	78	163	-----	211	124
Tanganyika (exports)	18,304	17,120	21,377	21,096	20,794	25,010
Tunisia	8,906	35,205	34,369	60,122	(5)	(5)
Uganda (exports)	468	306	275	205	(5)	(5)
Union of South Africa	1,334,042	1,213,051	1,243,426	1,207,373	1,147,694	1,170,951
Total	4,759,000	4,288,000	5,718,000	7,287,000	5,620,000	5,613,000
Oceania:						
Australia:						
Commonwealth	10,329,830	9,365,726	8,076,740	9,045,280	9,527,140	10,057,519
New Guinea	-----	-----	-----	-----	[12] 35,421	(5)
Fiji	19,047	9,355	29,398	26,351	33,237	29,187
New Zealand	280,786	328,281	244,544	224,341	221,984	232,563
Total	10,630,000	9,703,000	8,351,000	9,296,000	9,818,000	10,360,000
World total (estimate) [1]	205,200,000	180,800,000	156,800,000	133,200,000	165,600,000	171,000,000

[1] Silver is also produced in Bulgaria, Greece, Hong Kong, Federation of Malaya, Indonesia, Poland, Portugal, Sarawak, Sierra Leone, Turkey, U. S. S. R., and Yugoslavia; production data are not available, but estimates are included in totals.
[2] Excludes 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] Estimate.
[5] Data not available; estimate included in total.
[6] Bizonal area.
[7] Data represent Trianon Hungary after October 1944.
[8] January to March, inclusive.
[9] South Korea only.
[10] Exports.
[11] Recovered from an accumulation of refinery slimes.
[12] Fiscal year ended May 31 of year following that stated.

Canada.—Gold production gained 15 percent in 1948, continuing the rise in progress since 1945. Silver output likewise increased in 1948 (17 percent), reversing the downtrend in progress since 1940. Output of gold in 1947 and 1948 was as follows, in fine ounces:

Province or Territory:	*1947*	*1948*
Alberta	78	72
British Columbia	249, 011	311, 711
Manitoba	72, 906	(1)
Northwest Territories	62, 517	101, 346
Nova Scotia	1, 271	189
Ontario	1, 944, 819	2, 090, 414
Quebec	598, 127	767, 026
Saskatchewan	93, 747	[1] 196, 211
Yukon	47, 745	60, 605
Total	3, 070, 221	3, 527, 574

[1] Manitoba included with Saskatchewan.

Canada exported 5,434,364 ounces of refined silver and 3,294,691 ounces in ores and concentrates in 1948 compared with 7,514,373 and 2,722,261 ounces, respectively, in 1947.

Mexico.—Mexico continued to be by far the leading silver-producing nation in the world. In July the Mexican Government decided [5] to allow the peso, for many years pegged at 20.62 cents U. S. currency, to seek its own level. It soon settled at about 14.5 cents, although no official rate was fixed. The coinage of 1-peso pieces was halted following exportation of some to the United States, presumably for melting and sale as bullion. Since October 21 silver exports, whether in coins or bars, have been subject to approval of the Banco de Mexico. The director general of the bank announced [6] recently that the Government bought and used 28,393,000 fine ounces of silver, almost half of the year's output, for making one- and five-peso coins in 1948.

Republic of the Philippines.—Gold production in the Philippines was estimated as 209,225 ounces in 1948 or sharply above the 64,441 ounces in 1947. The amount received for sales of bullion was reported [7] to be possibly 20–30 percent over the statutory price, as the open market for gold in Manila during the year varied from 86 to 100 pesos an ounce; pesos were convertible in unlimited amounts into United States dollars at 2 to 1. Largest producer of the year was Benguet-Balatoc mine group, credited with 80,556 ounces, followed by Atok-Big Wedge mine with 65,972, and Mindanao Mother Lode mine with 32,963 ounces.

Union of South Africa.—Although gold production in 1948 was above that in 1947, there was actually a continuing drop in the rate of output; production in the latter year was adversely affected by a lengthy labor strike said to have reduced the total about 500,000 ounces. The production rate has been downward since 1941. The year 1948 was marked also by a decreasing labor supply and rising costs. Monthly output dropped during 1948, being 992,185 ounces in January and 945,727 ounces in December.

[5] Leavens, Dickson H., Silver: Eng. and Min. Jour., vol. 150, No. 2, February 1949, pp. 73–74.
[6] Engineering and Mining Journal, vol. 150, No. 3, March 1949, p. 125.
[7] Engineering and Mining Journal, vol. 150, No. 4, April 1949, p. 151.

Salient statistics of gold mining in the Union of South Africa, 1945–48

[Transvaal Chamber of Mines]

	1945	1946	1947	1948
Ore milled (tons)	58, 897, 600	56, 927, 500	53, 712, 300	55, 285, 700
Gold recovered (fine ounces)	12, 213, 545	11, 917, 914	11, 197, 638	11, 574, 871
Gold recovered (dwt. per ton)	3. 997	4. 024	3. 982	4. 012
Working revenue	£101, 847, 382	£99, 249, 814	£92, 740, 023	£96, 179, 355
Working revenue per ton	34s. 7d.	34s. 10d.	34s. 7d.	34s. 9d.
Working cost	£69, 941, 061	£72, 920, 881	£71, 309, 136	£72, 383, 938
Working cost per ton of ore	23s. 9d.	25s. 7d.	26s. 7d.	26s. 2d.
Working cost per ounce of metal	118s. 10d.	127s. 4d.	133s. 4d.	130s. 7d.
Working profit	£31, 906, 321	£26, 328, 933	£21, 430, 887	£23, 790, 417
Working profit per ton	10s. 10d.	9s. 3d.	8s. 0d.	8s. 7d.
Dividends	£13, 056, 263	£13, 406, 349	£11, 845, 035	£13, 419, 443

The shortage of native labor has become the producers' principal problem. At the end of 1948 the native labor force was 254,964 compared with 273,902 and 278,048 at the end of 1947 and 1946, respectively. Favorable factors include further substantial progress on the Far East Rand in developing the Kimberly Reef by mechanical loaders. On the Far West Rand development results of both producers and nonproducers were said to be highly encouraging in many cases. The Venterspost mine produced the highest quantity in its history, and the Libanon mine was expected to begin production soon. In the Orange Free State, horizontal development began from the first completed shaft—the St. Helena incline. The company's vertical shaft was down 1,450 feet at the end of 1948. In addition to seven other shafts already being sunk, four more were planned in the district. Electric power reached the area during the year and greatly facilitated shaft sinking. Water supply from the Vaal River, however, was not expected to reach the gold field before the first mines are ready for production.

Gypsum

By JOSEPH C. ARUNDALE AND MAY G. DOWNEY

GENERAL SUMMARY

THE year 1948 saw new records established in all important phases of the gypsum industry. Domestic mine production of 7,254,535 short tons and imports of 2,859,209 short tons of crude gypsum were all-time highs. Improved supply and labor conditions, extensive modernization of existing facilities, and development of new capacity and expansions in response to very heavy demand made possible record production of most gypsum products. The residential building and industrial construction boom and the general effort at maximum industrial output during the year were reflected in substantial increases in production of such items as portland-cement retarder, fillers, and gypsum for bedding plate glass, gaging and molding, and other plasters, and the principal types of gypsum board. Most plants were operated at or near practical capacity. Although shortages of some gypsum products were reported, these had largely disappeared by the end of the year. Gypsum board and lath continued to be exported under license control; but demand from foreign consumers declined, as many new foreign deposits of gypsum were developed and new plants erected.

Wholesale prices for gypsum board and lath were increased moderately during the year.

During the winter of 1948–49, for the first time in several years, distributors were able to accumulate stocks of gypsum board and lath during the normal lull in building activity.

World production of gypsum and gypsum products was also at a record level. However, as more and more countries develop their domestic gypsum resources and become self-sufficient in the manufacture of gypsum products, exports of gypsum products from the United States have declined.

RESERVES

Domestic gypsum deposits are so extensive and abundant that reserves are considered virtually inexhaustible. Gypsum is widely distributed throughout the world; and, although many countries import gypsum, as a general rule they do so for economic reasons, such as cost of production, transportation, or utilization of available material and not for lack of resources.

In the past few years, many countries have intensified the survey of their gypsum reserves and economic research in the development and utilization of these reserves. In the United States an example of this is the intensive geologic investigation of Kansas gypsum deposits undertaken by the Kansas State Geological Survey in cooperation with the University of Kansas, with the expectation that this research program will aid in exploiting the State's high-quality deposits.[1]

Salient statistics of the gypsum industry in the United States, 1944–48

	1944	1945	1946	1947	1948
Active establishments [1]	77	75	80	93	95
Crude gypsum: [2]					
Mined ... short tons	3,761,234	3,811,723	5,629,398	6,208,216	7,254,535
Imported ... do	342,462	508,762	1,457,140	2,157,049	2,859,209
Apparent supply ... do	4,103,696	4,320,485	7,086,538	8,365,265	10,113,744
Calcined gypsum produced: [3]					
Short tons	2,363,143	2,485,090	4,169,662	5,010,918	6,243,392
Value	$13,841,399	$14,473,566	$29,272,960	$38,726,405	$48,144,806
Gypsum products sold: [3]					
Uncalcined uses:					
Short tons	1,056,276	1,147,797	1,641,279	1,950,181	2,226,026
Value	$2,953,564	$3,432,727	$5,105,789	$7,012,106	$7,927,266
Industrial uses:					
Short tons	200,473	157,796	207,178	207,226	219,472
Value	$2,550,649	$2,326,363	$3,160,988	$3,430,022	$3,731,489
Building uses:					
Value	$50,196,006	$54,389,504	$88,927,786	$117,973,351	$165,175,523
Total value	$55,700,219	$60,148,594	$97,194,563	$128,415,479	$176,834,278
Gypsum and gypsum products—					
Imported for consumption	$394,603	$548,707	$1,833,088	[4] $2,523,936	$3,114,762
Exported	$489,980	$1,502,668	$1,065,248	[4] $1,599,578	$1,317,042

[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.
[4] Revised figure.

DOMESTIC PRODUCTION

Crude.—Of the 64 active domestic mines producing gypsum during 1948, 40 were open-pit operations, 17 were underground, and 7 were combinations of these two types. Great improvement in labor and supply conditions, increased mechanization, expansions, and development of new deposits permitted total mine production to increase approximately 17 percent over the previous record year of 1947.

Calcined.—The tonnage of gypsum calcined, a good barometer of the condition of the industry because it includes imported as well as domestically mined material, was nearly 25 percent greater in 1948 than in 1947.

Mine and Calcining Plant Developments.—The National Gypsum Co. mine at Akron, N. Y., was being dismantled after more than 40 years of operation. The processing plant on the site will continue to operate on material from the Clarence Center mine.[2]

An expansion program designed to increase the production capacity of the mill and enlarge its office facilities was underway at the Certain-teed Products Co. plant at Blue Rapids, Kans.[3]

The Northwest Gypsum Co. has developed a deposit of gypsum on the Snake River near Weiser, Idaho. The capacity of the open-pit operations is expected to reach 1,000 to 3,000 tons per day.[4]

[1] Rock Products, vol. 51, No. 6, June 1948, p. 131.
[2] Pit and Quarry, vol. 41, No. 5, November 1948, p. 70.
[3] Pit and Quarry, vol. 41, No. 6, December 1948, p. 51.
[4] Rock Products, vol. 51, No. 9, September 1948, p. 66.

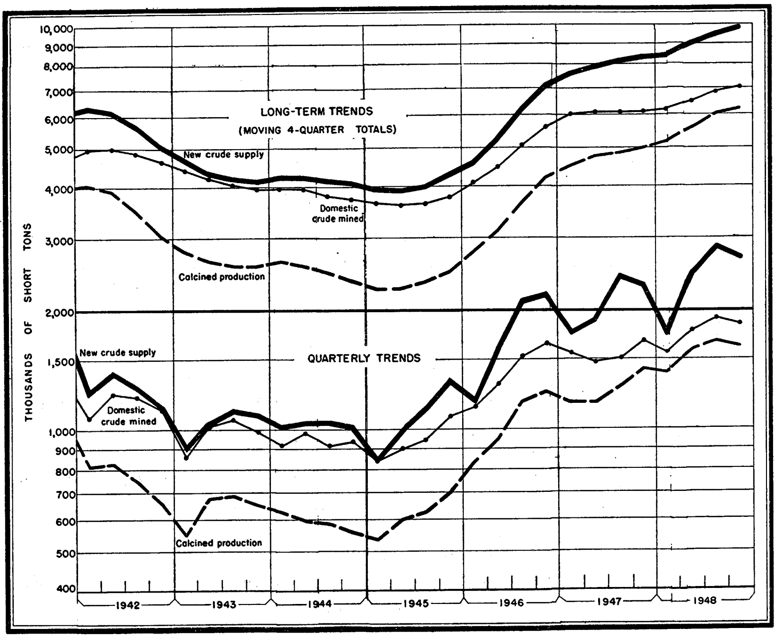

FIGURE 1.—Trends of new crude supply, domestic crude mined, and production of calcined gypsum, 1942–48, by quarters.

National Gypsum Co. is making plant and office additions at Fort Dodge, Iowa,[5] and also planned to expand capacity of its plant at Medicine Lodge, Kans.[6]

The U. S. Gypsum Co. announced plans to construct a new gypsum mill in northern Nevada, probably near Lovelock.[7]

Crude gypsum mined in the United States, 1946–48, by States

State	1946			1947			1948		
	Active mines	Short tons	Value	Active mines	Short tons	Value	Active mines	Short tons	Value
Arizona	2	212,231	$456,361	3	23,980	$128,725	3	264,738	$587,134
Arkansas	1			1	231,745	468,951	1		
Kansas	2			2			2		
New Mexico							1		
California	6	574,345	1,315,699	12	811,798	1,996,157	15	962,038	2,354,390
Colorado	3	199,895	474,704	3	205,979	644,583	2	217,299	717,072
Montana	2			2			2		
South Dakota	1			1			1		
Wyoming	2			3	22,643	112,238	2		
Iowa	5	560,094	1,172,500	4	656,982	1,677,217	4	729,880	1,753,545
Michigan	4	1,120,070	2,171,979	4	1,031,157	2,760,825	4	1,309,331	3,617,868
Nevada	3	490,253	1,164,083	7	526,972	1,377,143	7	519,552	1,222,070
New York	7	814,999	1,961,157	7	949,375	2,613,094	7	1,228,358	3,294,973
Ohio	2	584,755	1,482,269	2	589,808	1,837,846	2	1,129,635	3,422,078
Virginia	2			2			1		
Oklahoma	2	301,123	612,148	2	326,144	912,764	2		
Utah	2			2			3		
Texas	6	771,633	1,630,929	6	831,633	2,000,341	5	893,704	2,143,539
Total	52	5,629,398	12,441,829	63	6,208,216	16,529,884	64	7,254,535	19,112,669

[5] Rock Products, vol. 51, No. 2, February 1948, p. 75.
[6] Rock Products, vol. 51, No. 3, March 1948, p. 71.
[7] Mining World, vol. 10, No. 5, April 1948, p. 61.

Calcined gypsum [1] produced in the United States, 1947–48, by districts

District	1947		1948	
	Short tons	Value	Short tons	Value
New Hampshire, Massachusetts, and Connecticut	181,646	$1,561,512	213,923	$1,838,598
Eastern New York, New Jersey, Pennsylvania, Georgia, and Florida	1,566,423	13,581,278	1,215,707	10,814,164
Ohio, Virginia, Indiana, and Maryland			927,191	7,961,381
Western New York	625,513	4,267,028	696,087	4,647,079
Michigan	451,276	3,425,779	555,287	4,124,171
Iowa	530,472	4,000,575	560,573	3,730,060
Kansas and Oklahoma	266,308	2,115,216	313,901	2,386,526
Texas	547,350	3,803,464	625,632	3,867,656
Colorado, Wyoming, South Dakota, Montana, Utah, and New Mexico [2]	169,653	1,354,308	241,298	2,002,016
California, Nevada, and Arizona	672,277	4,617,245	893,793	6,773,155
Total	5,010,918	38,726,405	6,243,392	48,144,806

[1] Made from domestic, imported, and byproduct crude gypsum.
[2] No production from New Mexico in 1947 or from Wyoming in 1948.

Active calcining plants and equipment in the United States, 1946–48, by States

State	1946			1947			1948		
	Calcining plants	Equipment		Calcining plants	Equipment		Calcining plants	Equipment	
		Kettles	Other calciners [1]		Kettles	Other calciners [1]		Kettles	Other calciners [1]
California	4	10	4	4	10	5	4	10	5
Iowa	5	17	4	5	17	2	5	19	4
Michigan	4	19		4	19		4	20	
New York	7	20	6	7	22	6	7	22	6
Texas	5	28		5	31		4	27	
Other States [2]	25	64	23	28	75	24	29	77	26
Total	50	158	37	53	174	37	53	175	41

[1] Includes rotary and beehive kilns, grinding-calcining units, and hydrocal cylinders.
[2] Comprises calcining plants in 1946–48: 1 each in Arizona (none in 1946), Connecticut, Florida, Georgia, Indiana, Maryland (none in 1946), Massachusetts, New Hampshire, New Jersey, New Mexico (none in 1946–47), Oklahoma, Pennsylvania, South Dakota, and Wyoming; 2 each in Colorado, Kansas, Montana, Nevada, Ohio, Utah (3 in 1948), and Virginia (3 in 1947).

CONSUMPTION AND USES

Gypsum products were consumed during 1948 at a record rate. The enormous amount of residential and nonresidential building and maintenance created a strong demand for such building materials as gypsum lath, wallboard, sheathing, and the various building plasters. During the first part of the year it was still necessary for some producers to allocate shipments of lath and wallboard to distributors. However, by the end of the year, only local shortages were being reported, and some inventories were built up during the winter season of normally slower building activity.

The portland-cement industry consumed a record tonnage of gypsum as a retarder.

Several of the larger producers of lath and board notified the Government of their decision to decline to enter into a voluntary agreement to allocate their future output to users specified by the Government as "essential." Their reason for rejecting this proposal was that such an agreement was unnecessary in view of the expectation that output, as a result of expansions and improved methods and conditions, would be adequate to meet the estimated housing requirements for 1948.[8]

Gypsum-Products Plant Developments.—The National Gypsum Co. completed its expansion program at Clarence Center, N. Y. This new modern plant will turn out about 17,000,000 square feet of such gypsum products as wallboard, lath, and sheathing, plus about 6,000 tons of plaster monthly.[9] The company announced plans for a west coast factory. Its engineers have discovered a large high-grade gypsum deposit in Imperial County, Calif. The plant to be built will produce gypsum board, lath, plaster, and other gypsum products.[10]

The United States Gypsum Co. began production of plaster and wallboard at its new plant at Norfolk, Va., using raw gypsum from Nova Scotia. Expected output is about 120 tons of plaster and 350,000 square feet of board daily.[11] The company completed a major enlargement of its plant at Plaster City, Calif., in the Imperial Valley.[12]

The Western Gypsum Co. of Salt Lake City completed a new plant at Sigurd, Utah, and output was begun in April 1948. This plant will produce a full line of gypsum products.[13]

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8 Pit and Quarry, vol. 40, No. 12, June 1948, p. 59.
9 Pit and Quarry, vol. 40, No. 11, May 1948, p. 57.
10 Rock Products, vol. 51, No. 5, May 1948, p. 67.
11 Pit and Quarry, vol. 40, No. 8, February 1948, p. 58.
12 Rock Products, vol. 51, No. 5, May 1948, p. 67.
13 Pit and Quarry, vol. 41, No. 4, October 1948, pp. 80–84.

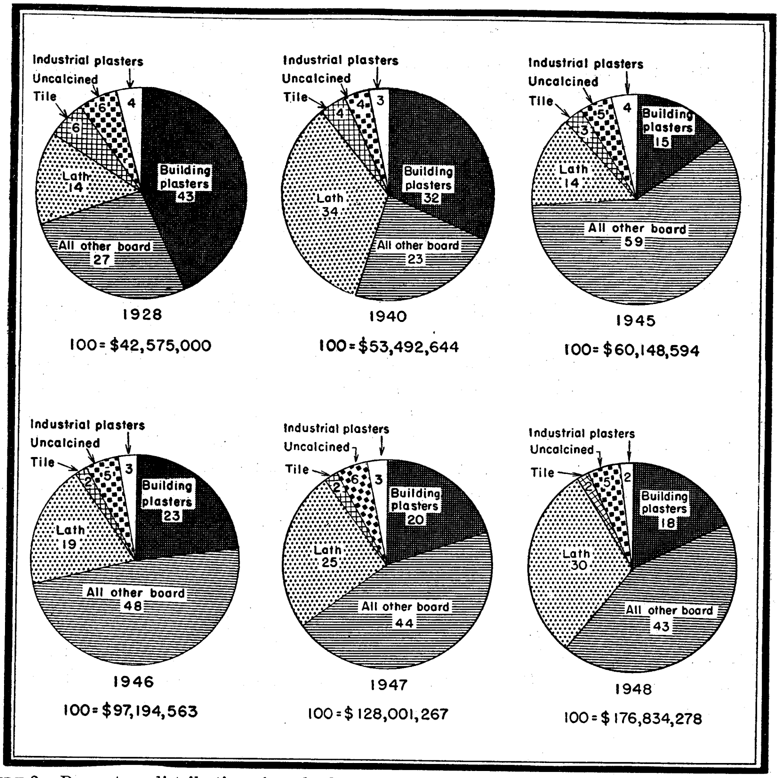

FIGURE 2.—Percentage distribution of total sales value, f. o. b. plant, of gypsum products in 1928, 1940, and 1945–48, by groups of products.

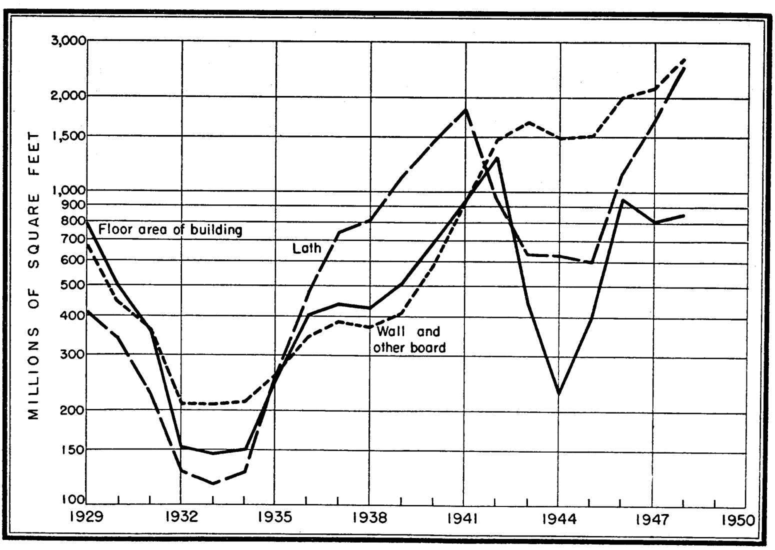

FIGURE 3.—Trends in sales of gypsum lath and wallboard and other board (includes wallboard, laminated board in terms of component board, and sheathing), compared with Dodge Corp. figures on floor area of residential and nonresidential building, 1929–48.

Gypsum products (made from domestic, imported, and byproduct crude gypsum) sold or used in the United States, 1947–48, by uses

Use	1947			1948				
	Short tons	Value		Short tons	Value		Percent of change in—	
		Total	Average		Total	Average	Tonnage	Average value
Uncalcined:								
Portland-cement retarder	1,341,859	$4,445,877	$3.31	1,674,944	$5,538,525	$3.31	+25	-------
Agricultural gypsum	575,626	2,236,994	3.89	516,899	2,054,298	3.97	−10	+2
Other uses [1]	32,696	329,235	10.07	34,183	334,443	9.78	+5	−3
Total uncalcined uses	1,950,181	7,012,106	-------	2,226,026	7,927,266	-------	+14	-------
Industrial:								
Plate-glass and terra-cotta plasters	36,364	376,543	10.35	47,195	559,452	11.85	+30	+14
Pottery plasters	48,934	735,588	15.03	48,017	774,353	16.13	−2	+7
Orthopedic and dental plasters	13,329	421,761	31.64	11,432	369,035	32.28	−14	+2
Other industrial uses [2]	108,599	1,896,130	17.46	112,828	2,028,649	17.98	+4	+3
Total industrial uses	207,226	3,430,022	-------	219,472	3,731,489	-------	+6	-------
Building:								
Cementitious:								
Plasters:								
Base-coat	1,724,888	19,029,965	11.03	2,007,696	23,423,112	11.67	+16	+6
Sanded	128,849	1,110,294	8.62	131,787	1,287,190	9.77	+2	+13
To mixing plants	17,503	154,763	8.84	19,267	193,160	10.03	+10	+13
Gaging and molding	174,337	2,356,757	13.52	197,197	2,820,133	14.30	+13	+6
Prepared finishes	18,816	607,345	32.28	18,640	790,570	42.41	−1	+31
Other [3]	93,812	2,038,018	21.72	114,722	2,461,121	21.45	+22	−1
Keene's cement	44,470	798,753	17.96	52,066	1,008,757	19.37	+17	+8
Total cementitious	2,202,675	26,095,895	-------	2,541,375	31,984,043	-------	+15	-------
Prefabricated:								
Lath	1,290,083	32,241,998	[4] 18.92	1,873,637	53,596,957	[4] 21.40	[5] +47	+13
Wallboard	1,698,671	53,122,413	[4] 25.96	[6] 2,102,901	[6] 72,071,432	[7] 28.40	[5] +22	+9
Sheathing board	111,895	3,534,686	[4] 33.20	137,885	4,431,544	[4] 34.19	[5] +22	+3
Laminated board	1,877	202,683	[4] 116.42	(6)	(6)	(8)	(8)	(8)
Tile	153,986	2,775,676	[9] 67.37	156,452	3,091,547	[9] 72.40	[5] +2	+7
Total prefabricated	3,256,512	91,877,456	-------	4,270,875	133,191,480	-------	[5] +34	-------
Total building uses	---------	117,973,351	-------	---------	165,175,523	-------	-------	-------
Grand total value	---------	128,415,479	-------	---------	176,834,278	-------	-------	-------

[1] Includes uncalcined gypsum sold for use as filler and rock dust, in brewer's fixe, in color manufacture, and for unspecified uses.
[2] Includes statuary, industrial casting and molding plasters, dead-burned filler, granite polishing, and miscellaneous uses.
[3] Includes insulating and roof-deck, 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] Laminated board included with wallboard in 1948.
[7] Average value per M square feet of wallboard.
[8] Bureau of Mines not at liberty to publish figure.
[9] Average value per M square feet of partition tile only.

Gypsum board and tile sold or used in the United States, 1944–48, by types

Year	Lath			Wallboard		
	M square feet	Value		M square feet	Value	
		Total	Average[1]		Total	Average[1]
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
1947	1,703,818	32,241,998	18.92	2,046,216	53,122,413	25.96
1948	2,504,733	53,596,957	21.40	[2] 2,531,865	[2] 72,071,432	[3] 28.40

Year	Sheathing			Laminated board			Tile[4]		
	M square feet	Value		M square feet[5]	Value		M square feet	Value	
		Total	Average[1]		Total	Average[1]		Total	Average[6]
1944	114,704	$2,300,069	$20.05	167,580	$4,714,096	$28.13	15,067	$1,426,560	$41.63
1945	100,627	2,304,165	22.90	116,908	4,002,216	34.23	17,988	1,824,736	42.62
1946	76,914	2,021,691	26.29	21,317	792,560	37.18	18,865	1,814,487	47.92
1947	106,482	3,534,686	33.20	1,741	202,683	116.42	26,769	2,775,676	67.37
1948	129,632	4,431,544	34.19	(2)	(2)	(7)	27,181	3,091,547	72.40

[1] Per M square feet, f. o. b. producing plant.
[2] Laminated board included with wallboard.
[3] Average value per M square feet of wallboard.
[4] Includes partition, roof, floor, soffit, shoe, and all other gypsum tiles and planks.
[5] Area of component board and not of finished product.
[6] Per M square feet, f. o. b. producing plant of partition tile only.
[7] Bureau of Mines not at liberty to publish figure.

PRICES

The average value of crude gypsum as mined was $2.63 per short ton as reported by producers. Only about one-fourth of the total gypsum mined is marketed in the crude or uncalcined form, and most of this is sold as portland-cement retarder or as agricultural gypsum. Average value of retarder remained unchanged from the previous year at $3.31 per short ton. Average value of agricultural gypsum was increased slightly to $3.97 per short ton. The prices of lath and wallboard were increased moderately during the year. Average values of most industrial and building plasters were also increased.

FOREIGN TRADE[14]

Imports of crude gypsum from Canada into the Eastern United States continued to increase rapidly and in 1948 represented one-fourth of the apparent domestic supply. A smaller but increasing tonnage was imported from Mexico (Lower California) to ports along the Pacific coast.

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

Gypsum and gypsum products imported for consumption in the United States, 1944–48

[U. S. Department of Commerce]

Year	Crude (including anhydrite)		Ground		Calcined		Keene's cement		Alabaster manufactures[1] (value)	Other manufactures, n. e. s. (value)	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value			
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	16,388	548,707
1946	1,457,140	1,621,666	354	7,308	255	6,918	162	3,686	119,937	73,573	1,833,088
1947	2,157,049	2,269,583	477	13,228	130	3,793	(2)	27	204,954	[3] 32,351	[3] 2,523,936
1948	2,859,209	2,977,809	404	13,960	11	610	12	728	83,245	38,410	3,114,762

[1] Includes imports of jet manufactures, which are believed to be negligible.
[2] Less than 1 ton.
[3] Revised figure.

Crude gypsum (including anhydrite) imported for consumption in the United States, 1946–48, by countries

[U. S. Department of Commerce]

Country	1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value
Canada	1,429,057	$1,559,544	2,020,886	$2,109,882	2,680,681	$2,763,722
China	(1)	34	(1)	23	(1)	11
Dominican Republic	9,312	42,005	9,782	39,931	5,756	24,185
Mexico	9,519	9,120	126,374	119,344	161,039	178,158
Newfoundland and Labrador	9,252	10,963			11,733	11,733
United Kingdom			7	403		
Total	1,457,140	1,621,666	2,157,049	2,269,583	2,859,209	2,977,809

[1] Less than 1 ton.

Gypsum and gypsum products exported from the United States, 1944–48

[U. S. Department of Commerce]

Year	Crude, crushed, or ground		Calcined		Plasterboard and wallboard		Other manufactures, n. e. s. (value)	Total value
	Short tons	Value	Short tons	Value	Square feet	Value		
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
1947	9,717	79,278	23,491	542,756	19,417,487	[1] 645,448	332,096	[1] 1,599,578
1948	1,404	25,050	9,393	234,678	16,506,127	615,845	441,469	1,317,042

[1] Revised figure.

TECHNOLOGY

The committee on gypsum, American Society for Testing Materials, plans to consider the need for a specification on artificial or synthetic gypsum. Action on standards included recommendations for discontinuing the specifications for gypsum pottery plaster and calcined gypsum for dental plasters, while a tentative revision has been recommended in the specifications for gypsum plaster that would change the strength requirements from tensile to dry compressive on 2-inch cubes.[15]

WORLD REVIEW

Australia.—The new gypsum wallboard plant of Concord Plaster Mills, Division of Colonial Sugar Refining Co., Ltd., at Sydney, Australia, was described. This plant will produce approximately 20 million square feet of wall board per year and will supply plaster of various grades. Gypsum is obtained from the company's leases in western New South Wales.[16]

Canada.—The National Gypsum Co. has acquired long-term leases on 440 acres of gypsum deposits at Brierly's Brook in Antigonish County, Nova Scotia. The operations of National Gypsum in Nova Scotia now include extensive quarry and harbor facilities at Dingwall and a fleet of freighters used to carry the Nova Scotia gypsum rock to the company's eastern seaboard plants in the United States.[17]

Handling of gypsum at Hantsport, Nova Scotia, was described.[18]

World production of gypsum, by countries, 1942–48, in metric tons [1]

[Compiled by Pauline Roberts]

Country [1]	1942	1943	1944	1945	1946	1947	1948
Algeria	23,720	17,920	17,120	22,250	28,600	31,000	(2)
Anglo-Egyptian Sudan	1,558	3,641	(2)	2,106	3,063	350	(2)
Argentina [3]	88,688	87,461	106,313	91,504	(2)	(2)	(2)
Australia:							
New South Wales	19,564	36,862	20,540	23,137	45,136	65,098	(2)
South Australia	58,124	40,157	47,294	66,653	91,878	108,672	[4] 139,500
Victoria	9,130	9,073	8,717	11,755	15,184	23,262	[4] 28,800
Western Australia	2,924	950	3,662	7,349	15,596	20,608	25,932
Austria	(2)	(2)	(2)	(2)	(2)	14,753	(2)
Belgian Congo	2,937	-----	-----	-----	-----	(2)	-----
Canada	723,137	390,833	486,571	753,615	1,838,895	2,362,365	2,855,812
Chile	33,634	39,472	38,670	47,162	77,000	84,000	35,056
China	[5] 37,900	(2)	(2)	(2)	(2)	50,000	[4] 55,000
Colombia	(2)	(2)	(2)	(2)	(2)	17,372	4,200
Cuba [4]	4,300	3,200	10,000	10,400	14,300	14,900	16,500
Cyprus (exports)	273	134	3,492	2,608	15,464	7,844	19,500
Dominican Republic	(2)	[6] 916	[6] 2,146	[6] 3,258	[6] 10,974	13,393	7,304
Egypt	118,931	91,881	106,299	96,565	78,316	80,000	95,243
France	840,030	722,217	701,704	724,000	1,746,375	585,000	(2)
French Morocco	(2)	(2)	(2)	8,740	13,335	[6] 25,631	(2)
Germany	(2)	181,458	(2)	(2)	[7] 71,000	(2)	[8] 235,325
Greece	-----	-----	-----	-----	5,150	[4] 5,000	(2)
India	64,386	83,587	85,049	92,229	77,643	38,300	(2)
Indochina, French	3,000	720	(2)	(2)	(2)	(2)	-----
Ireland	16,567	21,453	21,394	23,400	37,894	36,375	(2)
Italy	343,816	226,195	122,378	162,080	(2)	(2)	(2)
Japan	186,584	156,571	123,833	83,421	43,260	54,455	119,459
Kenya	(2)	40	254	209	508	659	1,016

See footnotes at end of table.

[15] Rock Products, vol. 51, No. 8, August 1948, p. 141.
[16] Rock Products, vol. 51, No. 2, February 1948, pp. 110–112, 126.
[17] Pit and Quarry, vol. 41, No. 4, October 1948, p. 65.
[18] Willis, S. A., Loading Gypsum at Hantsport, Nova Scotia; Canadian Min. Met. Bull. No. 433, May 1948, pp. 293–294.

World production of gypsum, by countries, 1942–48, in metric tons[1]—Continued

Country [1]	1942	1943	1944	1945	1946	1947	1948
New Caledonia	14,075	16,800	16,692	8,030	6,750	2,705	779
Palestine and Israel	8,118	5,990	7,428	7,542	14,512	(2)	(2)
Peru	23,417	24,391	43,694	42,223	43,391	41,330	(2)
Poland	(2)	(2)	(2)	(2)	9,787	14,917	14,183
Portugal	17,961	27,699	29,134	----------	----------	----------	(2)
Rumania	33,650	44,044	(2)	(2)	(2)	(2)	(2)
Spain	862,047	1,105,818	1,254,830	1,038,616	[9] 1,098,013	1,337,662	(2)
Sweden	(2)	740	173	288	(2)	(2)	(2)
Switzerland	38,000	42,000	46,000	97,000	68,000	165,000	[4] 165,000
Syria	5,000	2,500	(2)	----------	1,200	4,500	[4] 1,000
Thailand	(2)	589	133	(2)	87	71	200
Tunisia	(2)	(2)	(2)	8,900	8,985	----------	(2)
Union of South Africa (sales)	50,823	47,608	57,426	62,321	(2)	80,166	83,935
United Kingdom:							
Great Britain	1,231,613	1,389,914	1,344,485	1,347,888	1,715,060	1,773,733	1,175,570
Northern Ireland	(2)	556	(2)	71	----------	----------	----------
United States	4,261,540	3,517,628	3,412,116	3,457,919	5,106,877	5,631,969	6,581,169
Total (estimate) [1]	9,350,000	8,410,000	8,325,000	8,500,000	12,800,000	13,350,000	15,000,000

[1] In addition to the countries listed gypsum is produced in Angola, Brazil, Ethiopia, Iraq, Luxembourg, Mexico, Republic of the Philippines, U. S. S. R., and Yugoslavia, but production data are not available. No estimates for these countries are included in the total.
[2] Data not available; estimate by author of chapter included in total.
[3] Rail and river shipments.
[4] Estimate.
[5] Data represents areas designated as Free China during period of Japanese occupation.
[6] Exports.
[7] Russian zone only.
[8] Bizonal area.
[9] Includes 1,200 tons produced in Spanish Morocco.

Columbia Gypsum Products, Inc., Spokane, Wash., acquired a newly discovered gypsum property near Lake Winedmere in northeastern British Columbia and plans to begin working on it immediately. The property is reported to contain at least 40 million tons of high-grade gypsum. A processing plant to treat this material is being completed in Spokane.[19]

Ecuador.—In December 1947 the Minister of Economy and Mines of Ecuador was authorized to sign, on behalf of his Government, a contract granting a concession to La Cemento Nacional, C. A., and Canteras Nacionales, C. A.—affiliated cement producers—to exploit gypsum deposits in Guayas Province. The concession covers an area of approximately 3,970 hectares in the Parishes of General Villamil, Morro, and Progreso, of Guayaquil Canton, Guayas Province. The concessionaires are bound by the contract to exploit only the deposits of gypsum in the area. The material will be used solely for the manufacture of cement by the concessionaires.[20]

Ethiopia.—Gypsum occurs rather extensively on the Danakil salt plain in Ethiopia, in association with the salt. However, transportation difficulties have hindered its exploitation. The main source in this country is Dawale, on the railway between Diredawa and Jibuti. The production is believed to be about 1,000 tons per year and the chief use is as a retarding agent in cement. At Diredawa, gypsum is calcined separately and sold as plaster of paris. An alabaster variety occurs as a replacement in limestone in the Fiche area of Shoa Province and is used for ornamental carving.[21]

[19] Rock Products, vol. 51, No. 5, May 1948, p. 67.
[20] Bureau of Mines, Mineral Trade Notes: vol. 26, No. 3, March 1948, pp. 36–37.
[21] Mining Magazine (London), vol. 78, No. 5, May 1948, p. 309.

India.—Gypsum deposits are widespread in the Indian State of Bikaner, occurring at Jamsar, Khichian, Jalalsar, Jaimalser, Kaoni, Bearru, Harkasar, and Dholera, and at a few recently discovered deposits in the Surakgarh and Nohar tehsils. It is estimated that total reserves in the State are 25 million tons. Most of the deposits are at or near the surface in horizontal beds averaging 12 feet thick. Selenite is found at Kunkaransar. It is estimated that 500,000 tons can be obtained by working the first 20 feet of depth.[22]

It was reported that a reserve of about 40 million tons of gypsum was discovered in the latest geological survey of the Rajputana States of Cooch and Sirmur in the central Himalayas. It is also believed that a reserve of about 30 million tons is available in the States of Jodhpur and Jaipur.

The reconnaissance map of the Ministry of Industry and Supply, Government of India, shows nine areas in which gypsum resources are known to be extensive and capable of utilization as a result of the recent investigation. The principal areas are in Rajputana, Kathiawar, Cutch, Nellore district (Madras Province), and Trichinopoly district (Madras Province) and at several points in the Himalayan foothills from near Naini Tal (United Provinces) west to Simla. It is expected that the Rajputana and Kathiawar deposits will be the first to be developed for utilization by the fertilizer and cement industrial plants in northern India, and the Nellore and Trichinopoly districts deposits will be more extensively utilized than before to supply south Indian requirements.

Before the partition of the country, India relied greatly on the Salt Range (in West Pungab, now in Pakistan) as a source of gypsum for use in the country's fertilizer and cement industries, both of which it was planned should undergo expansion in the postwar period. Future requirements for gypsum are estimated at about 700,000 tons a year to satisfy the Indian cement and fertilizer industries.[23]

Iraq.—There are large deposits of gypsum throughout Iraq, many of which might be easily exploited. The mineral is sawed by hand in open quarries and is used for both ornamental and ordinary stone. It is also processed to form a plaster known as Juss, a type of mortar used as building material.[24]

Poland.—According to the Warsaw press in April, exploratory work by the Mineral Raw Materials Industry Combine of the Polish Government at Jelenia Gora has led to the discovery of important gypsum seams at Nowy Lad, near Lwowek, Lower Silesia. The importance of the new discovery lies in the fact that the known seams virtually have been exhausted and because the new seams yield an excellent quality of alabaster gypsum. A branch railway to the deposits has been built, and exploitation of the seams was said to be beginning.[25]

[22] Bureau of Mines, Mineral Trade Notes: vol. 27, No. 1, July 1948, pp. 51–52.
[23] Bureau of Mines, Mineral Trade Notes: vol. 27, No. 4, October 1948, pp. 50–52.
[24] Bureau of Mines, Mineral Trade Notes: vol. 26, No. 6, June 1948, p. 33.
[25] Bureau of Mines, Mineral Trade Notes: vol. 27, No. 1, July 1948, p. 52.

Poland has a rich area of mineral deposits in the Kielce Province, especially in the region of Kielce, Miechow, Nowy Karozyn, the Basin of the River Nida, and Opatow. This region will be developed industrially, including a building materails industry. Research by the Mining Academy at Cracow has shown that along the River Nida there are enormous deposits of crystalline gypsum of the highest quality, mostly near the surface. Provisional estimates assess these at about 200,000,000 tons.

A standard-gage railway line will be built between New Karczyn and Kielce, will connect the new industrial district with the rest of the country, and will shorten the route from Gdansk to the Balkan Peninsula. In the vicinity of the gypsum quarries, a factory for production of gypsum building materials and a chemical factory will be built, the latter to utilize gypsum byproducts. Work on all these industrial enterprises is expected to start early next year.[26]

[26] Cement, Lime and Gravel, vol. 23, No. 1, July 1948, p. 18.

Helium

By H. S. KENNEDY AND R. A. CATTELL

General Summary.—The preceding report in this series covered the period from July 1, 1941, to June 30, 1947, with some data extended to December 31, 1947. For security reasons, no reports of the production, distribution, or use of helium were published during the war. Beginning with this report for 1948, the series will cover calendar-year periods.

By act of Congress approved March 3, 1925, the Bureau of Mines was authorized to carry out the conservation, production, and exploitation of helium gas for national defense. The act of Congress approved September 1, 1937, directed the Bureau to administer regulations for the sale of helium for medical, scientific, and commercial purposes. Such sales had not been possible previously. Amended regulations governing such sales were approved by the President on January 2, 1947.

The Exell, Tex., helium plant continued to supply the total helium requirements in 1948 with a production of 63,143,513 cubic feet, a reduction from the 70,297,700 cubic feet produced in 1947. Total shipments to Federal agencies in 1948 were 34,877,490 cubic feet compared to 37,351,175 cubic feet in 1947. Sales to non-Federal users in 1948 increased to 16,037,856 cubic feet from the 1947 total of 14,971,175 cubic feet. Prices for sales for non-Federal use in 1948 continued at the levels set by the amended regulations of January 2, 1947.

Reserves.—The main helium reserves of the Nation are in the Cliffside gas field, near Amarillo, Tex., and the Rattlesnake gas field in San Juan County, N. Mex. The Government-owned Cliffside field still is the largest helium reserve known, capable of producing more than 2 billion cubic feet of helium. In addition, the Government owns full rights in the gas reserves of the Rattlesnake field, from which at least 800 million cubic feet of helium can be produced. Both these fields are shut in, and helium will be produced from them only in time of need. There are 11 gas wells in the Cliffside field and 2 wells in the Rattlesnake field.

Helium is produced at present from natural gas going to fuel markets from the Channing area of the Panhandle gas field in Texas, and this area contains enough gas reserves to supply 1½ billion cubic feet of helium. The Otis, Kans., helium plant, in standby status, is connected to gas reserves in the Otis area from which 400 million cubic feet of helium can be extracted. These reserves are entirely adequate for present needs for helium, but the Bureau of Mines continues to analyze gas samples from all parts of the United States, seeking new sources of helium-bearing gases in anticipation of all possible future requirements.

Domestic Production.—The Exell helium plant in the Texas Panhandle gas field near Amarillo, Tex., continued to be the only operating helium-production plant in the world. Total production for 1948 was 63,143,513 cubic feet. Since the beginning of production in March 1943, this plant has produced 340,541,593 cubic feet of helium. The table below indicates the total helium production by Government plants for the period 1921–48.

Helium production in the United States, 1921–48

Calendar year	Plant	Cubic feet
1921–January 1929	Fort Worth, Tex., plant	46,088,787
1929 (April)–1941	Amarillo, Tex., plant	131,887,380
1942	do	33,252,582
1943	All plants	116,307,437
1944	do	126,933,130
1945	do	94,733,744
1946	Amarillo and Exell, Tex., plants	58,236,385
1947	Exell, Tex., plant	70,297,700
1948	do	63,143,513
Total 1921–48		[1] 740,880,658

[1] Includes 81,475,525 cubic feet extracted at the Exell plant from gas from the Channing area and injected into the Cliffside gas reservoir for conservation in calendar years 1945–48.

Helium Plants.—The Amarillo, Tex., helium plant, which began operation in April 1929 and was the sole producing plant from that time until the Exell, Tex., plant began production in 1943, has produced to date a total of 252,451,982 cubic feet of helium. It is connected to the Cliffside gas field, and both plant and field now are in standby status. The Exell plant now supplies all helium requirements from natural gas produced for commercial use from the Panhandle gas field. A commercial pipe line carries the gas to fuel markets after it passes through the helium-extraction process; and, if this helium were not extracted, it would be lost forever.

The Otis, Kans., plant began operating in October 1943 and produced 56,633,755 cubic feet of helium before it was shut down and placed in standby status in August 1945. The Cunningham, Kans., plant began production in January 1944 and produced until July 1945. It since has been dismantled, because the reserve of helium-bearing natural gas supplying the plant was not large enough to warrant keeping it in standby condition. The Cunningham plant produced 43,049,000 cubic feet. The Navajo, N. Mex., plant, connected to the Rattlesnake gas field, was placed in operation in March 1944 for a trial period of 18 days, then was shut down and now is in standby status. At the time this plant was finished, the wartime helium demand was decreasing, and the other plants were able to supply all demands.

Shipments and Uses.—The Navy continues to use more helium than any other agency, although shipments for Navy use dropped about 5 million cubic feet in 1948. Shipments for commercial and scientific use increased 800,000 cubic feet for the year, and an encouraging increase of 250,000 cubic feet was purchased for medical use. The accompanying table lists yearly shipments to both Federal agencies and non-Federal users since 1941. The figures for medical use are approximate, because accounting for medical use is on a fiscal-year basis.

Shipments of helium in the United States, 1941–48 (calendar years), in cubic feet

Calendar year	Shipments to Federal agencies				Sales for non-Federal use			Grand total, shipments
	Navy	Weather Bureau	Army and other Federal agencies	Total	Scientific and commercial	Medical	Total	
1941	11, 187, 440	4, 408, 505	5, 313, 610	20, 909, 555	789, 396	442, 604	1, 232, 000	22, 141, 555
1942	25, 402, 000	5, 090, 715	4, 787, 550	35, 280, 265	359, 085	416, 392	775, 477	36, 055, 742
1943	107, 243, 085	5, 633, 950	2, 434, 695	115, 311, 730	806, 646	513, 282	1, 319, 928	116, 631, 658
1944	111, 075, 569	7, 035, 515	2, 443, 150	120, 554, 234	2, 445, 405	562, 990	3, 008, 395	123, 562, 629
1945	38, 091, 234	8, 010, 210	11, 759, 285	57, 860, 729	2, 362, 028	565, 477	2, 927, 505	60, 788, 234
1946	15, 735, 690	9, 705, 790	9, 287, 750	34, 729, 230	7, 960, 473	1, 233, 817	9, 194, 290	43, 923, 520
1947	26, 511, 005	6, 347, 670	4, 492, 500	37, 351, 175	12, 914, 075	2, 057, 100	14, 971, 175	52, 322, 350
1948	21, 531, 788	6, 478, 931	6, 866, 771	34, 877, 490	13, 735, 645	2, 302, 211	16, 037, 856	50, 915, 346

Helium is used both by Federal agencies and commercial concerns for the inflation of airships; in meteorology; for welding magnesium, aluminum, stainless steel, and other metals and alloys; in medicine for administering anaesthetics and in admixture with oxygen for the relief of severe respiratory ailments; and as a tracer for following the movement of gas in underground petroleum reservoirs. Also, helium is used to establish a neutral atmosphere in the reaction chamber in the Kroll process for producing titanium by powder metallurgy at the Boulder City, Colo., laboratory of the Bureau of Mines. Scientifically, progress continues in the development and production of apparatus for liquefying helium, and liquid helium is used in fundamental studies of importance in physics and thermodynamics.

The excess helium produced by the Exell plant continues to be conserved by injection into the Cliffside gas field through a pipe line connecting the plant to the field. Since 1945 more than 81 million cubic feet have been conserved by this practice.

Prices.—The Bureau of Mines continues to supply helium to Federal agencies at the cost of production, as required by the Helium Act. Prices for non-Federal use of helium are in accordance with the amended regulations of January 2, 1947, and are as follows: Helium sold for medical use and delivered in tank cars or trailers—$11 per thousand cubic feet; helium sold for medical use and delivered in standard cylinders containing about 200 cubic feet each—$13 per thousand cubic feet; helium sold for scientific and commercial use and delivered in tank cars or trailers—$13 per thousand cubic feet; and helium sold in standard cylinders for scientific and commercial use—$15 per thousand cubic feet. These prices are for delivery at the plant.

World Review.—The Helium Act sets up rigid standards governing the export of helium, and very little is used in foreign countries except for scientific purposes, largely within the field of cryogenics. As far as is known, helium is not produced from natural gas any place outside the United States. Some small amount may be extracted from air for scientific uses.

Iron Ore

By ROLAND D. PARKS [1]

GENERAL SUMMARY

PUBLIC concern over future supplies of iron ore for the steel-producing centers of the United States appeared to be rising in 1948. The iron-ore-mining industry itself, however, was able to report major progress toward making new supplies available. The over-all iron-ore situation at the end of 1948 brought recognition of the fact that new ores had been found to offset the trend toward depletion of ore bodies on which the Chicago-to-Pittsburgh iron- and steel-producing area has depended in the past. This came about as the result of several programs initiated in the late war and early postwar period. Prominent among these drives against depletion were the discovery and rapid proving of major tonnages of high-grade open-pit hematite in Quebec and Labrador, other explorations and developments abroad by United States capital (as in Venezuela and Liberia) and progress made in meeting the problems of concentrating Lake Superior region magnetic taconite. Without the St. Lawrence seaway there remains some question as to the extent to which these foreign ores can compete in the Lower Great Lakes region; but potential sources of supply, at least, are now known. Throughout the iron-ore industry recognition of the iron-ore supply problem of the future was reflected in the construction of new research facilities.

Salient Statistics.—In terms of crude ore, domestic production in 1948 set a peacetime record at 126,225,172 gross tons, only 0.25 percent less than the all-time peak established in the war year 1942. Shipments of crude ore approached the 1942 all-time peak of 126,794,970 tons. In terms of usable ore, however, the 1948 output of 101,003,492 gross tons, while 8 percent greater than for 1947, was 4 percent below the 1942 output and slightly below 1943. Crude ore is mine-run product before treatment. Usable ore includes direct-shipping ore (mine product requiring no treatment), washed ore, concentrates, sinter, and byproduct pyrites cinder and sinter.

Each of the major producing districts in the United States showed increased output in 1948, and imports of foreign ores were up 25 percent from 1947. Chile was again the major source of imports, Sweden replaced Canada as second source, and imports from Algeria increased notably.

[1] Consulting mining engineer, Bureau of Mines. Chapter prepared in cooperation with Norwood B. Melcher.

Salient statistics of iron ore in the United States, 1945–48

	1945	1946	1947	1948
Crude iron ore:				
Production by districts:				
Lake Superior ---- gross tons	85,451,692	67,014,550	[1] 88,420,140	[1] 94,465,955
Southeastern ---- do	9,616,593	9,278,832	11,031,102	13,292,770
Northeastern ---- do	7,686,338	5,136,313	8,698,983	10,379,799
Western ---- do	3,557,776	2,764,786	5,821,989	8,086,648
Total ---- do	106,312,399	84,194,481	113,972,214	126,225,172
Production by mining methods:				
Open pit ---- do	78,935,218	63,859,082	85,624,658	98,995,922
Underground ---- do	27,377,181	20,335,399	28,347,556	27,229,250
Total ---- do	106,312,399	84,194,481	113,972,214	126,225,172
Production by types of ore:				
Hematite ---- do	92,161,239	74,127,099	96,869,038	103,529,946
Brown ore ---- do	4,397,650	3,598,474	5,579,464	9,077,191
Magnetite ---- do	9,752,711	6,468,184	11,523,620	13,618,035
Carbonate ---- do	799	724	92	----
Total ---- do	106,312,399	84,194,481	113,972,214	126,225,172
Shipments ---- do	106,538,936	83,985,686	113,918,585	126,123,731
Iron ore (usable; less than 5 percent Mn):				
Production by districts:				
Lake Superior ---- gross tons	74,821,045	59,042,154	[2] 76,531,769	[2] 82,630,430
Southeastern ---- do	6,329,987	6,247,096	7,527,321	8,365,390
Northeastern ---- do	3,620,147	2,596,349	3,987,195	4,422,971
Western ---- do	3,087,774	2,450,611	4,502,512	5,104,703
Undistributed (byproduct ore) ---- do	517,440	506,903	542,723	479,998
Total ---- do	88,376,393	70,843,113	93,091,520	101,003,492
Production by types of product:				
Direct ---- do	67,768,993	54,014,466	71,121,676	76,882,338
Concentrates ---- do	16,812,961	13,799,046	17,058,162	19,055,357
Sinter ---- do	3,276,999	2,522,698	4,368,959	4,585,799
Byproduct material (pyrites cinder and sinter) ---- gross tons	517,440	506,903	542,723	479,998
Total ---- do	88,376,393	70,843,113	93,091,520	101,003,492
Production by types of ore:				
Hematite ---- do	81,294,688	65,728,172	84,535,465	90,686,138
Brown ore ---- do	942,910	686,402	1,201,408	2,176,149
Magnetite ---- do	5,620,810	3,920,986	6,811,876	7,661,207
Carbonate ---- do	545	650	48	----
Byproduct material (pyrites cinder and sinter) ---- gross tons	517,440	506,903	542,723	479,998
Total ---- do	88,376,393	70,843,113	93,091,520	101,003,492
Shipments ---- do	88,136,715	70,090,410	93,314,635	100,821,714
Value ----	$243,760,986	$215,006,427	$320,864,981	$394,460,751
Average value per ton at mine ----	$2.77	$3.07	$3.44	$3.91
Stocks at mines Dec. 31 ---- gross tons	4,431,970	5,339,147	[3] 6,036,244	6,284,773
Imports ---- do	1,197,925	2,754,216	4,903,484	6,108,754
Value ----	$4,113,583	$10,370,675	$22,095,876	$27,330,482
Exports ---- gross tons	2,063,125	1,505,854	2,806,894	3,080,666
Value ----	$6,688,156	$5,492,549	$10,011,476	$13,744,979
Consumption ---- gross tons	[3] 86,158,495	72,174,844	96,115,549	100,498,557
Manganiferous ore (5 to 35 percent Mn):				
Shipments ---- gross tons	1,359,691	1,045,699	1,048,531	1,196,933
Value ----	$3,513,666	$3,126,711	$3,447,149	(4)

[1] Includes production of brown crude iron ore from Fillmore County, Minn., which is not in the true Lake Superior district: 218,833 tons in 1947; and 512,987 tons in 1948.
[2] Includes production of concentrates from brown crude ore from Fillmore County, Minn.: 147,787 tons in 1947; and 352,979 tons in 1948.
[3] Revised figure.
[4] Bureau of Mines not at liberty to publish figure.

A trend showing the Lake Superior district becoming relatively less important in terms of the total domestic production continued during 1948. That district supplied 85 percent of the United States total in 1945, 83 percent in 1946, 82 percent in 1947, and 81 percent in 1948. The steady increase in imports during this period accentuates the indicated trend. Accordingly, including imported ores, the Lake Superior district furnished 83 percent of the total supply in 1945, 80 percent in 1946, 78 percent in 1947, and 77 percent in 1948.

Production of usable ore from the Western States (California, Missouri, Nevada, Texas, Utah, Washington, Wyoming), mainly from Utah, increased from 3 percent of the domestic total for 1945 and 1946 to 5 percent of the total for 1947 and 1948 and exceeded the tonnage output, not considering iron content, of the Northeastern States (Pennsylvania, New Jersey, and New York) for the latter 2 years.

In terms of the total United States supply for the postwar period, the decline, percentagewise, of the Lake Superior district has been offset by increased imports and by higher outputs from the Western and Northeastern States. The Southeastern States (Alabama, Georgia, Virginia) have maintained a fairly constant percentage of the total output during this period.

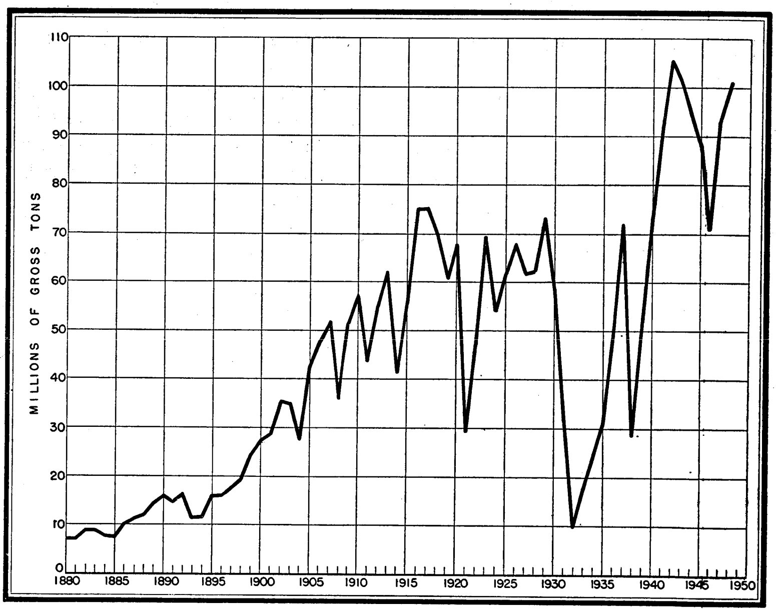

FIGURE 1.—Trends in production of iron ore in the United States, 1880–1948.

With the growth of iron- and steel-producing centers outside the Lower Great Lakes region, the decline of the Lake Superior district as a national source of supply may be expected to continue under normal transportation conditions because these outside centers, as in Utah, California, Texas, and Maryland, can be supplied more economically by local and imported ores. Local production, as from the Cedar City district, Utah, and the Eagle Mountain district, Calif., is immediately tributary to regional steel centers. Developments in Canada and Venezuela portend increasing imports. Expansion of production of iron ore from taconite will tend to retard if not arrest the decline of the Lake Superior district.

PRODUCTION AND SHIPMENTS

Domestic iron-ore mines produced crude ore totaling 126,225,172 gross tons and shipped 126,123,731 tons in 1948, increases of 11 percent in both cases from 1947. Of the 1948 shipments, 39 percent was sent to beneficiating plants, and 61 percent went direct to consumers, compared with 37 and 63 percent, respectively, in 1947. From the crude ores shipped to beneficiating plants, 19,055,357 tons of concentrates and 4,585,799 tons of sinter were produced. In addition, 479,998 tons of byproduct ore in the form of cinder and sinter were produced by the pyrites industry during the year. The ore from which this byproduct was produced is not included in the crude ore totals given above. In all, 101,003,492 gross tons of usable iron ore, including byproduct, were produced at mines and mills in 1948, an increase of 8 percent from 1947. Of this quantity, 76,882,338 tons were suitable for consumption as mined without requiring further treatment in the form of beneficiation.

The output in 1948, excluding byproduct material noted above, came from 215 mines, of which 36 mined over 1,000,000 tons of crude ore each. Minnesota, with 68,035,740 tons, and Michigan, second-largest producer, with 13,102,086 tons, again supplied, respectively, 67 and 13 percent of the total usable ore, as in the previous year. These two States and Wisconsin, with 1,492,604 tons, constitute the Lake Superior region, which supplied 81 percent of the domestic output.

Open-pit mines furnished 78 percent of the crude iron ore mined in 1948 compared with 75 percent in 1947. In production of crude ore, the Alabama, New York-Pennsylvania, and Texas-Utah areas showed gains in 1948, percentagewise, over 1947, whereas Minnesota and Michigan declined in percentage of total output.

Shipments of usable ore from mines and mills totaled 100,821,714 gross tons in 1948, an increase of 8 percent from 1947. Of this quantity, 76,610,537 tons (76 percent) were direct-shipping ore for use in iron and steel furnaces. Total shipments also include 43,693 tons of ore for cement manufacture, 8,490 tons for paint, and 10,022 tons for miscellaneous purposes. Shipments of byproduct ore for use in iron and steel included in the total shipments amounted to 546,749 tons in 1948, valued at $3,230,867.

Crude iron ore mined in the United States, by States and varieties, 1947–48, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	1947						1948					
	Number of mines	Hematite	Brown ore	Magnetite	Total	Rank	Number of mines	Hematite	Brown ore	Magnetite	Total	Rank
Alabama	[1] 24	6,973,550	2,604,922		9,578,472	3	[1] 22	8,237,409	3,681,648		11,919,057	3
California	3	530,434			530,434	11	2	153,684			153,684	12
Georgia	[1] 7		1,444,520		1,444,520	7	[1] 6		1,368,820		1,368,820	8
Michigan	37	12,657,407			12,657,407	2	35	13,102,086			13,102,086	2
Minnesota	116	74,082,509	218,833		74,301,342	1	123	79,358,278	512,987		79,871,265	1
Missouri	2	504,903	265		505,168	12	1	486,808			486,808	11
Nevada	1			5,452	5,452	14	2			8,945	8,945	13
New Jersey	4			938,404	938,404	9	4			857,444	857,444	9
New York	7	4,576		7,755,911	[2] 7,760,579	4	7	4,122		9,518,233	9,522,355	4
Pennsylvania	2						1					
Texas	4	529	1,302,814		1,303,343	8	4		3,508,843		3,508,843	5
Utah	5			2,823,853	2,823,853	5	3			3,233,413	3,233,413	6
Virginia	1		8,110		8,110	13	1		4,893		4,893	15
Washington	1	2,268			2,268	15	1	5,364			5,364	14
Wisconsin	2	1,461,391			1,461,391	6	2	1,492,604			1,492,604	7
Wyoming	1	651,471			651,471	10	1	689,591			689,591	10
Total	217	96,869,038	5,579,464	11,523,620	[2] 113,972,214		215	103,529,946	9,077,191	13,618,035	126,225,172	
Percent of total		85.0	4.9	10.1	100.0			82.0	7.2	10.8	100.0	

[1] Excludes an undetermined number of small pits. Estimated output of these pits included in tonnage given.
[2] Includes 92 tons of carbonate ore.

Crude iron ore mined in the United States, 1947–48, by States and mining methods, in gross tons

State	1947			1948		
	Open pit	Underground	Total	Open pit	Underground	Total
Alabama	2,820,800	6,757,672	9,578,472	4,782,270	7,136,787	11,919,057
California	530,434		530,434	146,341	7,343	153,684
Georgia	1,444,520		1,444,520	1,368,820		1,368,820
Michigan	1,191,118	11,466,289	12,657,407	2,846,204	10,255,882	13,102,086
Minnesota	71,110,817	3,190,525	74,301,342	77,475,098	2,396,167	79,871,265
Missouri	503,562	1,606	505,168	486,808		486,808
Nevada	5,452		5,452	8,945		8,945
New Jersey		938,404	938,404		857,444	857,444
New York Pennsylvania	3,880,381	3,880,198	7,760,579	5,151,263	4,371,092	9,522,355
Texas	1,303,343		1,303,343	3,486,503	22,340	3,508,843
Utah	2,823,853		2,823,853	3,233,413		3,233,413
Virginia	8,110		8,110	4,893		4,893
Washington	2,268		2,268	5,364		5,364
Wisconsin		1,461,391	1,461,391		1,492,604	1,492,604
Wyoming		651,471	651,471		689,591	689,591
Total	85,624,658	28,347,556	113,972,214	98,995,922	27,229,250	126,225,172
Percent of total	75.1	24.9	100.0	78.4	21.6	100.0

Crude iron ore shipped from mines in the United States, by States and disposition, 1947–48, in gross tons

State	1947			1948		
	Direct to consumers	To beneficiation plants	Total	Direct to consumers	To beneficiation plants	Total
Alabama	5,443,097	4,127,889	9,570,986	5,995,206	5,874,852	11,870,058
California	373,574		373,574	345,863		345,863
Georgia		1,444,520	1,444,520		1,368,820	1,368,820
Michigan	12,921,707	123,720	13,045,427	12,896,478		12,896,478
Minnesota	47,168,713	26,841,902	74,010,615	51,669,596	28,176,320	79,845,916
Missouri	265	504,903	505,168		486,808	486,808
Nevada	5,452		5,452	8,945		8,945
New Jersey	138,446	788,243	926,689	129,846	706,171	836,017
New York Pennsylvania	192,380	7,516,194	7,708,574	186,380	9,370,415	9,556,795
Texas	663	1,299,135	1,299,798	16,356	3,490,084	3,506,440
Utah	2,821,293		2,821,293	3,233,122		3,233,122
Virginia		9,651	9,651		4,561	4,561
Washington	2,268		2,268	5,364		5,364
Wisconsin	1,543,099		1,543,099	1,468,953		1,468,953
Wyoming	651,471		651,471	689,591		689,591
Total	71,262,428	42,656,157	113,918,585	76,645,700	49,478,031	126,123,731
Percent of total	62.6	37.4	100.0	60.8	39.2	100.0

Iron ore mined in the United States, by mining districts and varieties, 1947–48, 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 Southeast New York	Other	Total
1947							
Crude ore:							
Hematite	88,201,307	6,971,251	2,299			1,694,181	96,869,038
Brown ore		464,000	1,527,620			3,587,844	5,579,464
Magnetite				7,755,911	938,404	2,829,305	11,523,620
Carbonate						92	92
Total	88,201,307	7,435,251	1,529,919	7,755,911	938,404	8,111,422	113,972,214
Usable iron ore:							
Hematite	76,383,982	6,788,815	2,299			1,360,369	84,535,465
Brown ore		92,877	312,749			795,782	1,201,408
Magnetite				3,514,588	467,983	2,829,305	6,811,876
Carbonate						48	48
Total	76,383,982	6,881,692	315,048	3,514,588	467,983	4,985,504	92,548,797
1948							
Crude ore:							
Hematite	93,952,968	7,869,882	225			1,706,871	103,529,946
Brown ore		262,780	1,762,440			7,051,971	9,077,191
Magnetite				9,518,233	857,444	3,242,358	13,618,035
Carbonate							
Total	93,952,968	8,132,662	1,762,665	9,518,233	857,444	12,001,200	126,225,172
Usable iron ore:							
Hematite	82,277,451	7,350,623	225			1,057,839	90,686,138
Brown ore		47,442	352,438			1,776,269	2,176,149
Magnetite				3,978,160	436,567	3,246,480	7,661,207
Carbonate							
Total	82,277,451	7,398,065	352,663	3,978,160	436,567	6,080,588	100,523,494

Iron ore produced in the United States, by States and types of product, 1947–48, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	1947					1948				
	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	5,449,758	1,330,010	445,127	7,224,895	35.97	6,045,212	1,195,724	847,728	8,088,664	38.28
California	530,434			530,434	54.10	153,684			153,684	54.86
Georgia			295,992	295,992	43.88			273,735	273,735	42.26
Michigan	12,533,687		43,775	12,577,462	51.21	13,102,086			13,102,086	49.26
Minnesota	47,336,142	295,045	14,861,729	62,492,916	50.99	51,812,962	256,000	15,966,778	68,035,740	49.86
Missouri	265		171,091	171,356	53.55			165,326	165,326	52.11
Nevada	5,452			5,452	65.00	8,945			8,945	65.00
New Jersey	138,154		329,829	467,983	63.36	129,709		306,858	436,567	63.97
New York	188,272	2,743,904	587,036	3,519,212	62.65	186,330	3,041,639	758,435	3,986,404	62.50
Pennsylvania					58.68					56.00
Texas	529		317,149	317,678	40.87	22,438	92,436	733,506	848,380	41.19
Utah	2,823,853			2,823,853	53.34	3,233,413			3,233,413	53.93
Virginia			6,434	6,434	35.00			2,991	2,991	35.01
Washington	2,268			2,268	56.48	5,364			5,364	56.50
Wisconsin	1,461,391			1,461,391	52.74	1,492,604			1,492,604	52.84
Wyoming	651,471			651,471	49.20	689,591			689,591	47.00
Total mined ore	71,121,676	4,368,959	17,058,162	92,548,797	50.36	76,882,338	4,585,799	19,055,357	100,523,494	49.51
Byproduct ore: [2]										
Delaware		542,723		542,723	63.04		479,998		479,998	68.49
Tennessee					68.80					56.99
Virginia					57.00					62.59
Total byproduct ore		542,723		542,723	65.91		479,998		479,998	67.02
Grand total	71,121,676	4,911,682	17,058,162	93,091,520	50.44	76,882,338	5,065,797	19,055,357	101,003,492	49.59

[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, by States and varieties, 1947–48, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	1947				1948			
	Hematite	Brown ore	Magnetite	Total	Hematite	Brown ore	Magnetite	Total
Alabama	6,791,114	433,781		7,224,895	7,390,600	698,064		8,088,664
California	530,434			530,434	153,684			153,684
Georgia		295,992		295,992		273,735		273,735
Michigan	12,577,462			12,577,462	13,102,086			13,102,086
Minnesota	62,345,129	147,787		62,492,916	67,682,761	352,979		68,035,740
Missouri	171,091	265		171,356	165,326			165,326
Nevada			5,452	5,452			8,945	8,945
New Jersey			467,983	467,983			436,567	436,567
New York, Pennsylvania	4,576		3,514,588	[1] 3,519,212	4,122		3,982,282	3,986,404
Texas	529	317,149		317,678		848,380		848,380
Utah			2,823,853	2,823,853			3,233,413	3,233,413
Virginia		6,434		6,434		2,991		2,991
Washington	2,268			2,268	5,364			5,364
Wisconsin	1,461,391			1,461,391	1,492,604			1,492,604
Wyoming	651,471			651,471	689,591			689,591
Total	84,535,465	1,201,408	6,811,876	92,548,797	90,686,138	2,176,149	7,661,207	100,523,494
Byproduct ore:[2] Delaware, Tennessee, Virginia				542,723				479,998
Grand total	84,535,465	1,201,408	6,811,876	[2] 93,091,520	90,686,138	2,176,149	7,661,207	101,003,492

[1] Includes 48 tons of carbonate ore.
[2] Cinder and sinter obtained from pyrites treated in, but not necessarily mined in, States indicated.

Shipments of iron ore in the United States in 1948, 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	5,995,185	1,196,139	832,707			21	8,024,052	$32,543,713
California	329,158			16,705			345,863	(2)
Georgia			273,735				273,735	746,818
Michigan	12,896,478						12,896,478	53,246,591
Minnesota	51,669,596	256,000	15,997,641				67,923,237	249,523,078
Missouri			165,326				165,326	(2)
Nevada	8,945						8,945	(2)
New Jersey	129,729		292,794	12,146	1,377	326	436,372	3,739,985
New York, Pennsylvania	182,258	3,042,426	815,537	2,254	4,122	8,065	4,054,662	33,426,098
Texas	15,341	74,220	655,698			1,015	746,274	(2)
Utah	3,225,303			7,224		595	3,233,122	3,926,058
Virginia					2,991		2,991	(2)
Washington				5,364			5,364	(2)
Wisconsin	1,468,953						1,468,953	(2)
Wyoming	689,591						689,591	(2)
Undistributed								[2] 14,077,543
Total	76,610,537	4,568,785	19,033,438	43,693	8,490	10,022	100,274,965	391,229,884
Byproduct ore:[3] Delaware, Tennessee, Virginia		546,749					546,749	3,230,867
Grand total	76,610,537	5,115,534	19,033,438	43,693	8,490	10,022	100,821,714	394,460,751

[1] Exclusive of sinter produced at consuming plants.
[2] Values that may not be shown separately are combined as "Undistributed."
[3] Cinder and sinter obtained from pyrites treated in, but not necessarily mined in, States indicated.

PRINCIPAL MINES

Listed below in descending order and in some detail are the iron mines of the United States that produced over 500,000 gross tons of crude ore each in 1948. The order of listing is based on ore tonnage, not iron content of product, and thus mines producing low-grade crude ore that requires concentration are considered comparable in size to mines producing similar tonnages of direct-shipping ore.

Thirty-six mines, each producing more than 1,000,000 gross tons of crude ore, supplied 60 percent of the United States output in 1948. Of these, 22 were in Minnesota, 5 in Alabama, 4 in New York, and 1 each in Michigan, Pennsylvania, Texas, Utah, and Wisconsin; 24 were open-pit mines, 8 underground, and 4 combined operations. Except for 5 mines that produced magnetite, 1 producing semialtered magnetite, and 2 producing brown ore, all of the million-ton mines produced hematite in 1948. In 1947, 35 mines of more than 1,000,000 gross tons of crude ore each produced 59 percent of the United States output.

Iron-ore mines in the United States in 1948, 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	Minnesota	Hibbing	Mesabi	Open-pit	9,847,660	9,516,755
Rouchleau	do	Virginia	do	do	4,126,973	4,126,973
Mahoning	do	Hibbing	do	do	3,904,628	3,904,628
Mountain Iron	do	Virginia	do	do	3,163,064	3,163,064
Hill Annex	do	Calumet	do	do	2,863,739	1,720,581
Shaw 14 (stockpile)	do	Franklin	do	do	2,665,903	2,665,903
Leonard-Monroe	do	Chisholm	do	do	2,540,543	2,540,543
Benson	New York	Star Lake	Adirondack	do	2,390,363	809,587
Lone Star Steel Co	Texas	Lone Star	East Texas	do	2,347,917	548,336
Spruce	Minnesota	Eveleth	Mesabi	Combined	2,245,317	2,245,317
Warner Auxford	Alabama	Russellville	Russellville	Open-pit	2,110,730	422,146
MacIntyre	New York	Tahawus	Adirondack	do	2,096,472	569,095
Gross Marble	Minnesota	Marble	Mesabi	do	2,033,026	1,105,018
Pillsbury	do	Balkan	do	Combined	1,939,522	1,939,522
Iron Mountain	Utah	Cedar City	Iron Mountain.	Open-pit	1,929,040	1,929,040
Walker	Minnesota	Coleraine	Mesabi	do	1,891,566	1,132,996
Scranton	do	Hibbing	do	do	1,862,846	1,862,846
Canisteo	do	Coleraine	do	do	1,774,949	908,833
Wenonah	Alabama	Bessemer	Birmingham.	Underground	1,696,942	1,695,871
Ishkooda	do	do	do	do	1,633,162	1,634,710
Muscoda	do	do	do	do	1,617,988	1,617,511
Cornwall-Lebanon Conc.	Pennsylvania	Lebanon	Cornwall	Combined	2,996,519	1,950,711
New Bed, Harmony and Old Bed.	New York	Mineville	Adirondack	Underground		
Susquehanna	Minnesota	Hibbing	Mesabi	Open-pit	1,439,477	1,333,482
Holman Brown	do	Taconite	do	do	1,404,481	993,799
Hill-Trumbull	do	Marble	do	do	1,339,214	608,301
Chateaugay	New York	Lyon Mountain.	Adirondack	Underground	1,273,575	387,096
Embarrass	Minnesota	Biwabik	Mesabi	Open-pit	1,260,290	1,260,290
Hawkins	do	Nashwauk	do	do	1,205,139	657,812
Fayal	do	Eveleth	do	Combined	1,151,899	1,151,899
Pyne	Alabama	Bessemer	Birmingham.	Underground	1,147,702	1,147,702
Montreal	Wisconsin	Montreal	Gogebic	do	1,088,034	1,088,034
Mississippi	Minnesota	Keewatin	Mesabi	Open-pit	1,082,023	907,233
Argonne	do	Nashwauk	do	do	1,059,725	522,483
Kevin	do	Cooley	do	do	1,041,692	374,157
Mather	Michigan	Ishpeming	Marquette	Underground	1,001,001	1,001,001
Hartley	Minnesota	Fraser	Mesabi	Open-pit	965,493	965,493
Galbraith	do	Nashwauk	do	do	963,787	559,817

Iron-ore mines in the United States in 1948, by size of crude output—Con.

Name of mine	State	Nearest town	Range or district	Mining method	Production (gross tons) Crude ore	Production (gross tons) Usable ore
Bennett	Minnesota	Keewatin	Mesabi	Combined	956,736	880,567
Buckeye	do	Coleraine	do	Open-pit	950,443	647,191
Danube	do	Bovey	do	do	935,859	607,202
Portsmouth Group	do	Crosby	Cuyuna	do	879,178	678,618
Russellville No. 14	Alabama	Russellville	Russellville	do	878,073	142,565
Olson	Minnesota	Cooley	Mesabi	do	875,271	354,694
Fraser	do	Fraser	do	do	845,873	845,873
Missabe Mountain	do	Virginia	do	do	834,514	834,514
Webb	do	Hibbing	do	Combined	790,965	735,151
Longyear	do	do	do	Open-pit	789,610	732,840
Blowout	Utah	Cedar City	Iron Mountain.	do	777,804	777,804
Hodge Mining Co	Georgia	Taylorsville	Chattanooga	do	775,000	155,024
Buck-Zimmerman	Michigan	Iron River	Menominee	Underground	721,383	721,383
Wauseca	do	do	do	do	710,806	710,806
Pioneer	Minnesota	Ely	Vermilion	do	707,570	707,570
Sunrise	Wyoming	Sunrise	Hartville	do	689,591	689,591
Maas	Michigan	Negaunee	Marquette	do	673,126	673,126
Douglas	Minnesota	Chisholm	Mesabi	Open-pit	655,630	532,869
Mt. Haven	Texas	Jacksonville	Eastern Tex	do	638,964	155,845
Geneva	Michigan	Ironwood	Gogebic	Underground	635,344	635,344
Anvil-Palms-Keweenaw.	do	Bessemer	do	do	611,893	611,893
Cliffs Shaft	do	Ishpeming	Marquette	do	602,453	602,453
Plymouth	do	Wakefield	Gogebic	Open-pit	597,136	597,136
Newport	do	Ironwood	do	Underground	591,677	591,677
Hiawatha Nos. 1 and 2	do	Iron River	Menominee	do	582,366	582,366
Godfrey U. G	Minnesota	Chisholm	Mesabi	do	578,593	578,593
Sunday Lake	Michigan	Wakefield	Gogebic	do	564,135	564,135
Penokee	do	Ironwood	do	do	563,680	563,680
Maroco	Minnesota	Trommald	Cuyuna	Open-pit	551,675	346,233
Harrison	do	Cooley	Mesabi	do	529,803	229,150
Fisher Hill	New York	Mineville	Adirondack	Underground	523,304	137,824
Excelsior	Utah	Cedar City	Iron Mountain.	Open-pit	522,826	522,826
Columbia	Minnesota	Virginia	Mesabi	do	518,848	488,901
Spring Valley	do	Ostrander	Fillmore Cty.	do	512,987	352,979
Athens	Michigan	Negaunee	Marquette	Underground	506,600	506,600
Hewitt Contract Co	Alabama	Dolonah	Birmingham.	Open-pit	503,495	89,909
Output of 74 mines producing more than 500,000 tons of crude ore each					101,685,612	80,553,517
Output of 21 mines producing 400,000 to 500,000 tons of crude ore each					9,436,401	7,692,747
Output of 12 mines producing 300,000 to 400,000 tons of crude ore each					4,127,395	3,154,384
Output of 22 mines producing 200,000 to 300,000 tons of crude ore each					5,284,506	4,687,352
Output of 27 mines producing 100,000 to 200,000 tons of crude ore each					[1] 3,920,946	3,089,773
Output of 12 mines producing 50,000 to 100,000 tons of crude ore each					897,838	735,262
Output of 47 mines producing under 50,000 tons of crude ore each					872,474	610,459
Grand total United States (215 mines)					126,225,172	100,523,494

[1] Includes output from 1 plant treating tailings.

Thirty-eight mines producing 500,000 to 1,000,000 gross tons of crude ore each, supplied 21 percent of the United States total output of crude ore in 1948. Of these, 18 are in Minnesota, 12 in Michigan, 2 each in Alabama and Utah, and 1 each in Georgia, New York, Texas, and Wyoming. In summary, 81 percent of the total domestic output of crude ore came from the 74 mines listed in the accompanying table.

SINTER

Domestic sintering plants in 1948 used 13,091,069 gross tons of iron ore, 4,815,631 tons of flue dust, 580,204 tons of pyrites cinder, 227 tons of manganiferous ore, and 392,601 tons of mill cinder and roll scale to produce 17,210,555 gross tons of sinter—a conversion yield of 91 percent.

Sinter production in 1948 came from plants at mines, blast-furnace plants, and custom mills. Of the sinter produced in the United States, 29 percent was made at mine plants in 4 States, and 71 percent was produced at blast-furnace plants and custom mills in 13 States.

Production and consumption of sinter in the United States in 1948, by States, in gross tons

State	Sinter produced	Sinter consumed	
		In blast furnaces	In steel furnaces
Alabama	1,631,167	1,789,357	90,660
California			
Colorado	1,205,343	1,192,328	------------
Utah			
Delaware	92,539	------------	------------
Illinois	764,431	753,753	------------
Indiana	1,049,667	771,851	285,752
Maryland	------------		
Kentucky			
Tennessee	456,906	448,031	60,651
West Virginia			
Michigan	398,027	397,687	------------
Minnesota	256,000	------------	------------
New York	3,481,626	1,082,008	66,866
Ohio	3,538,384	3,808,479	296,478
Pennsylvania	4,244,029	4,099,776	194,264
Texas	92,436	74,221	------------
Total	17,210,555	14,417,491	994,671

REVIEW OF LAKE SUPERIOR DISTRICT

Production and Shipments.—Production of usable iron ore from mines and mills in the Lake Superior district in 1948 was 8 percent greater than in 1947, amounting to 81 percent of the United States total. This district—which includes the Marquette, Menominee, Gogebic, Vermilion, Mesabi, and Cuyuna ranges—has produced over half of the total domestic output each year for 60 years. The Mesabi range, which alone has produced over half the United States total each year since 1909 (except in 1932) supplied 78 percent of the district total and 63 percent of the United States total compared with percentages of 77 and 63, respectively, in 1947. A total of 82,277,451 gross tons of usable iron ore was reported produced from the six ranges of the Lake Superior district during 1948. In addition, 352,979 gross tons of brown ore concentrates were produced and shipped from Fillmore County in southeastern Minnesota, which is not considered part of the true Lake Superior district, and 1,093,359 tons of ore containing (natural) over 5 percent manganese (all from Minnesota) were produced, making the total output of all grades 83,723,789 gross tons. Shipments consisted of 1,070,110 tons of manganiferous ores and 81,935,689 tons of hematite from the six ranges of the Lake Superior district proper, plus 352,979 tons from brown ores in Fillmore County—total shipments from mines of 83-358,778 gross tons.

Production and shipments from Canadian mines in the Lake Superior region are not included in these statistics. Shipments from these mines in 1948 totaled 1,208,448 gross tons. Of this quantity, 522,063 tons came from the Helen mine in the Michipicoten district, and 686,385 tons were shipped from the Steep Rock mine in the Steep Rock district, Atikokan range.

The Lake Superior Iron Ore Association reported 81,739,165 gross tons of iron and manganiferous ores shipped to upper Lake ports from United States mines in 1948, an increase of 7 percent over 1947. All-rail shipments totaled 1,745,397 tons in 1948 compared with 1,722,739 tons in 1947. The 1948 shipping season was of longer duration than average, opening on April 5 and closing December 9.

The brown, bog-type limonite ore of the Spring Valley area, Fillmore County, southeastern Minnesota, is of different origin than the ores of the Lake Superior district. After washing, the Spring Valley product is shipped all-rail to Granite City, Ill.

Iron ore produced in the Lake Superior district, 1854–1948, by ranges, in gross tons

[Exclusive after 1905 of ore containing 5 percent or more manganese]

Year	Marquette	Menominee	Gogebic	Vermilion	Mesabi	Cuyuna	Total
1854–1943	225, 053, 662	201, 447, 840	237, 478, 238	74, 237, 762	1, 314, 036, 795	31, 390, 054	2, 083, 644, 351
1944	4, 720, 253	4, 288, 830	5, 224, 142	1, 466, 816	61, 994, 023	1, 417, 256	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
1947	5, 070, 631	3, 741, 217	5, 227, 005	1, 471, 879	58, 772, 404	2, 100, 846	76, 383, 982
1948	4, 830, 341	4, 259, 378	5, 504, 971	1, 580, 497	64, 071, 983	2, 030, 281	82, 277, 451
Total	247, 795, 664	220, 539, 812	261, 463, 087	81, 469, 969	1, 603, 909, 204	40, 102, 567	2, 455, 280, 303

Technologic Developments.—Iron ore, relatively, is a low-value material. Ordinarily it must be mined and moved in enormous quantities to be profitable. To be marketable, it must meet specifications, not only as to iron content, but also as to several minor constituents. Tolerances are narrow. A high degree of operational efficiency is essential to attain the low costs in iron-ore mining to meet competition.

With gradual depletion of the large high-grade open-pit deposits of the Mesabi range, two fields of development will confront the industry, particularly in the Lake Superior region. Underground mines will be called upon to provide an increasing share of the total output of high-grade crude ores; and the mining of taconite, whether by open-pit methods or underground, will present problems because of its hardness and abrasive qualities and because of the additional tonnage of crude taconite that will be needed to produce the required output of concentrate. Mining will tend to become less flexible unless means can be found to permit more rapid expansion of output from underground mines and from concentrating plants. Storage capacities at critical points may offer a partial solution to this problem. When called upon to do so, the large open pits could increase their production of direct-shipping ore very rapidly.

Efficient handling of iron ore and waste rock in the pits and in underground mines has been studied for many years. Recent developments in power shovels, conveyors, and mobile transportation equipment in the open-pit mines of the Lake Superior district were reviewed.[2] Possible transport of ore by water through pipe lines is being given consideration.[3]

Shaker conveyors have been applied underground at the Sherwood mine of Inland Steel Co., Iron River, Mich.,[4] where the ore, which is semihard, is mined by the sublevel-stoping method. Application of this type of equipment to the block-caving method of mining, which finds use in some underground iron mines, has been outlined.[5] A special belt-conveyor system [6] has been devised to aid in stock-piling concentrates.

Patents were issued early in 1948 on the equipment and processes used for jet-piercing hard-rock formation.[7]

Analyses.—The accompanying table shows the average analyses of all ores shipped from the Lake Superior district for the past 5 years. Since the analyses from year to year have been remarkably consistent in the past, despite an increasing percentage of concentrated product, the decline in iron content and the increase in silica in 1947 and 1948 are perhaps noteworthy.

Average analyses of total tonnages (bill-of-lading weights) of all grades of iron ore from all ranges of Lake Superior district, 1944–48

[Lake Superior Iron Ore Association]

Year	Gross tons	Content (natural), percent				
		Iron	Phosphorus	Silica	Manganese	Moisture
1944	81,039,404	51.72	0.088	8.42	0.74	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
1947	77,210,278	50.91	.093	9.09	.75	11.28
1948	82,655,757	50.49	.093	9.30	.76	11.35

Reserves.—The accompanying table shows reserves of iron ore in Michigan and Minnesota, by ranges. 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. 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, 1949.

A recent review[8] of iron mining in Wisconsin describes the several iron formations in the State and notes the exploratory work done in

[2] Johnson, J. A., and Cash, F. E., Transportation of Iron Ore, Open-cut Mines, Lake Superior District: Bureau of Mines Inf. Cir. 7458, 1948, 24 pp.

[3] University of Minnesota, Handling of Bulk Materials: 10th Ann. Mining Symposium, January 1949, p. 4.

[4] Pearson, P. D., and Marston, R. O., Underground Shaker and Conveyor Belt Operation: Min. Cong. Jour., vol. 34, No. 10, October 1948, pp. 18–22, 61.

[5] McWhorter, C. E., Shaker Conveyors Applied to the Caving Mining Method: Min. and Met., vol. 29, No. 500, August 1948, pp. 444–446.

[6] Skillings' Mining Review, Stock-Piling Iron-Ore Concentrates at Holman-Cliffs: Vol. 37, No. 16, July 31, 1948, p. 1.

[7] Gaines, John M. (assigned to Linde Air Products Co.), Process for Thermally Working Mineral and Lake Masses: U. S. Patent 2,436,001, Feb. 17, 1948.

Williams, Virgil C. (assigned to Linde Air Products Co.), Flux-Forming Fuel and Method for Thermally Working Minerals Therewith: U. S. Patent 2,436,002, Feb. 17, 1948.

[8] Bean, E. F., Iron Resources of Wisconsin: Paper presented at Minnesota Section, Am. Inst. Min. and Met. Eng., Duluth, Minn., Jan. 17, 1949; Skillings' Min. Rev., vol. 38, No. 6, June 4, 1949, pp. 1, 4, 11.

1943 by the Bureau of mines,[9] indicating that more than 100,000,000 tons of low-grade iron-bearing material was available for open-pit mining over a 2-mile representative length of the iron-bearing formations. Michigan iron reserves were estimated.[10]

Iron-ore reserves in Michigan, Jan. 1, 1945–49, in gross tons

[Michigan Department of Conservation]

Range	1945	1946	1947	1948	1949
Gogebic	32, 686, 550	31, 828, 392	31, 331, 775	31, 937, 142	30, 511, 502
Marquette	51, 357, 761	51, 648, 430	62, 228, 925	66, 636, 928	67, 101, 475
Menominee	50, 376, 403	48, 260, 784	49, 298, 678	51, 462, 819	55, 913, 371
Total Michigan	134, 420, 714	131, 737, 606	142, 859, 378	150, 036, 889	153, 526, 348

Unmined iron-ore reserves in Minnesota, May 1, 1944–48, in gross tons

[Minnesota Department of Taxation]

	1944	1945	1946	1947	1948
Mesabi	1, 020, 138, 504	962, 290, 748	924, 903, 098	922, 401, 348	915, 220, 248
Vermilion	12, 636, 820	12, 349, 903	11, 523, 341	10, 699, 576	10, 435, 800
Cuyuna	62, 059, 815	59, 659, 027	59, 061, 587	55, 756, 200	[1] 38, 040, 129
Total Lake Superior district (taxable)	1, 094, 835, 139	1, 034, 299, 678	995, 488, 026	988, 857, 124	963, 696, 177
Fillmore County	231, 393			186, 700	394, 248
State ore (not taxable)	13, 000, 996	19, 865, 715	19, 950, 255	11, 600, 524	3, 515, 084
Total Minnesota	1, 108, 067, 528	1, 054, 165, 393	1, 015, 438, 281	1, 000, 644, 348	967, 605, 509

[1] Excluding marginal properties formerly reported under Thwing decision.

Average costs, per gross ton, of mining iron ore at underground mines and at siliceous open pits in Michigan in 1948 [1]

Item	Underground				Siliceous open pits
	Gogebic	Marquette	Menominee	Average	
Cost of mining:					
Labor	$1. 8850	$2. 1825	$1. 3971	$1. 8290	$0. 5206
Supplies	. 8021	. 8469	. 6424	. 7641	. 3750
Deferred costs	. 1920	. 0705	. 1964	. 1480	. 0242
Taxes	. 2337	. 2210	. 1354	. 1952	. 0800
General overhead	. 2128	. 2046	. 1910	. 2033	. 1228
Transportation	2. 4189	1. 9459	2. 0573	2. 1439	2. 0004
Marketing	. 0634	. 0201	. 0893	. 0552	. 0149
Total ore cost	5. 8079	5. 4915	4. 7089	5. 3387	3. 1379
Lake Erie value per ton	6. 6679	6. 4905	5. 8544	6. 3267	3. 7275
Gross ore profit [2]	. 8600	. 9990	1. 1455	. 9880	. 5896
Other costs:					
Royalty	. 4630	. 2484	. 2389	. 3049	. 0787
Interest on borrowed money		. 0125	. 0051	. 0064	. 0030
Federal income and excess profits taxes	. 3318	. 1304	. 3461	. 2588	. 0216

[1] Pardee, F. G., and Kennedy, Bruce E., General Statistics Covering Costs and Production of Michigan Iron Mines: Michigan Dept. of Conservation, Geol. Survey Div., 1948, 9 pp.
[2] This figure does not represent true profit, as much ore is sold below the Lake Erie price.

[9] Zinner, P., and Holmberg, C. L., Investigation of the Iron-Bearing Formation of the Western Gogebic Range, Iron County, Wis.: Bureau of Mines Rept. of Investigation 4155, 1947, 48 pp.
[10] Pardee, F. G., Iron-Ore Reserves in Michigan: Min. and Met., vol. 29, No. 503, November 1948, pp. 613–614.

MINING BY STATES

Alabama.—Production of crude iron ore in Alabama, third largest producing State, increased 24 percent over 1947, twice the percentage increase for the country as a whole. Output of crude red ore, seven-eighths from underground mines, increased 18 percent while that of brown ore, all from open-pit operations, was up 41 percent for the year. All of the underground hematite mines in Alabama are in Jefferson County, centering around Birmingham. Tennessee Coal, Iron & Railroad Co., largest producer, shipped red hematite from its Red Mountain mines—the Muscoda, Ishkooda, and Wenonah groups. After crushing and blending, four-fifths of this ore was shipped direct; the balance was sintered before use. Woodward Iron Co. produced direct-shipping hematite from its Pyne, Red Ore, and Redding (Songo) underground mines. Sloss-Sheffield Steel & Iron Co. mined direct-shipping hematite from its Sloss and Ruffner underground properties and shipped concentrates from their La Grange open-pit operation, Colbert County, in the northwest corner of the State. Its Sadler Gap mine has been abandoned. Republic Steel Corp. shipped hema-

Iron ore mined in the United States in 1948, 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:			
Calhoun	[1] 1	187,780	37,535
Cherokee	[1] 1	176,905	35,381
Cleburne	[1] 1	8,785	1,757
Colbert	1	367,302	39,752
Franklin	[1] 2	3,013,173	569,585
Jackson	1	16,290	3,258
Jefferson	[1] 11	8,110,647	7,393,662
Macon	1	12,075	2,334
St. Clair	1	225	225
Shelby	1	22,015	4,403
Talladega	1	3,860	772
Total	22	11,919,057	8,088,664
California:			
Riverside	1	146,341	146,341
San Bernardino	1	7,343	7,343
Total	2	153,684	153,684
Georgia:			
Bartow	[1] 1	837,105	174,917
Cherokee	1	560	112
Muscogee	1	13,075	2,615
Polk	[1] 2	487,120	94,756
Walker	[1] 1	30,960	1,335
Total	6	1,368,820	273,735
Michigan:			
Dickinson	2	85,161	85,161
Gogebic	7	4,012,367	4,012,367
Iron	11	4,174,217	4,174,217
Marquette	15	4,830,341	4,830,341
Total	35	13,102,086	13,102,086
Minnesota:			
Crow Wing	10	2,500,811	2,030,281
Fillmore	1	512,987	352,979
Minnesota—Con.			
Itasca	[2] 33	24,035,856	14,140,576
St. Louis	79	52,821,611	51,511,904
Total	123	79,871,265	68,035,740
Missouri: St. Francois	1	486,808	165,326
Nevada: Pershing	2	8,945	8,945
New Jersey:			
Morris	3	856,246	435,601
Warren	1	1,198	966
Total	4	857,444	436,567
New York:			
Clinton	1		
Essex	3		
Oneida	1	9,522,355	3,986,404
St. Lawrence	2		
Pennsylvania: Lebanon	1		
Total	8	9,522,355	3,986,404
Texas:			
Cass	1		
Cherokee	2	3,508,843	848,380
Morris	1		
Total	4	3,508,843	848,380
Utah: Iron	3	3,233,413	3,233,413
Virginia: Pulaski	1	4,893	2,991
Washington: Stevens	1	5,364	5,364
Wisconsin: Iron	2	1,492,604	1,492,604
Wyoming: Platte	1	689,591	689,591
Grand total	215	126,225,172	100,523,494

[1] Excludes undetermined number of pits. Estimated output of these mines included in tonnage given.
[2] Includes output of 1 plant reprocessing tailings.

tite directly from its Edwards underground mine and produced concentrates from its combined open-pit and underground Spaulding mine. Hewitt Contract Co. produced concentrates from open-pit operations in Jefferson County. The unweighted average grade of hematite shipped from Alabama mines and mills during 1948 was 35.12 percent Fe (natural), 0.15 percent Mn, 0.30 percent P, 17.35 percent SiO_2, 15.83 percent CaO, and 1.77 percent H_2O.

All of the brown ore produced in Alabama in 1948 came from open-pit mines, and all was concentrated by washing.

The occurrence of these deposits and their productive history were summarized.[11]

Product as shipped during 1948 contained 42.31 percent Fe (natural) and 0.76 percent Mn, by unweighted average. Shook & Fletcher Supply Co. was the largest producer of brown ore from the Warner-Auxford pit near Russellville, Franklin County, northwest of the Birmingham district. Sloss-Sheffield Steel & Iron Co. operated its Russellville No. 14 mine in the same area. Hooper Construction Co. worked the Ruffner property, Jefferson County. Operations in Cherokee County, northeast of Birmingham, included the Sidhart mine of the Arrington Mining Co. and production by C. L. Erwin.

California.—The Eagle Mountain iron mine, Riverside County, Calif., was put into production [12] on November 10, 1948, by Kaiser Co., Inc., to supply ore to its Fontana steel plant 145 miles west and tributary to the Los Angeles area.

The Vulcan mine, San Bernardino County, a previous supplier, ceased production in mid-1947 but continued to ship from stocks throughout 1948.

The Eagle Mountain iron deposits, known for many years, were drilled and trenched by the Bureau of Mines and Geological Survey in 1941. Based on this work, reserves in the eastern part of the district were estimated [13] at 21,629,000 tons of positive ore averaging 51.2 percent iron with 0.40 percent sulfur and 15,000,000 tons additional of probable ore. Potential reserve for the entire district, considering numerous small deposits to the west, was placed at 70,000,000 tons of an iron content over 40 percent. Reserves of direct-shipping ore in the southern and Bald Eagle deposits of the eastern area have been given recently [14] at 7,071,000 tons containing 53.75 percent iron, 0.095 percent sulfur, 0.043 phosphorus, and less than 8 percent silica. This represents an increase of 2,000,000 tons over the earlier estimate on this class of ore.

Georgia.—Iron-ore production of Georgia consists entirely of brown ore mined by open-pit methods and concentrated by washing. Principal producers in 1948 included Hodge Mining Co., Taylorsville, Bartow County; Arrington Mining Co., Cartersville, Bartow County, and Cedartown, Polk County; E. L. Gammage, near Grady, and the Albea-York Mining Co., near Aragon, both in Polk County. These localities are in the northwestern part of the State. Much of the ore is loaded by power shovels without blasting. Mobile equipment,

[11] Reinholt, O. H., Alabama's Deposits of Brown Ore: Skillings' Min. Rev., vol. 37, No. 29, Oct. 30, 1948, pp. 1-7.

[12] Blast Furnace & Steel Plant, vol. 36, No. 2, December 1948, p. 1492.

[13] Bureau of Mines, Eagle Mountain Iron District, Riverside County, Calif.: War Minerals Rept. 97, 1943.

[14] Huttl, John B., Eagle Mountain, New Source of Iron Ore for Fontana: Eng. and Min. Jour., vol. 150, No. 5, May 1949, pp. 92-93.

such as power scrapers and trucks, is used to move the crude ore and concentrates.

Michigan and Minnesota.—See Review of Lake Superior District in this chapter.

Missouri.—The entire production of iron ore from Missouri in 1948 came from the Iron Mountain open-pit mine, St. Francois County, operated by the Ozark Ore Co. Crushing and jigging were used to concentrate the crude hematite before shipment. Grade of product shipped averaged 52.1 percent natural iron.

Nevada.—Magnetite was mined by open-pit methods in the Humboldt River Basin, Pershing County, during 1948 for direct shipment to customers. Roy S. Blair worked the Iron Horse and Iron Wonder mines near Woolsey, and Segerstrom & Heizer operated near Lovelock.

New Jersey.—Output of iron ore in New Jersey during 1948 came entirely from underground mines and very largely from Morris County, where the Alan Wood Steel Co. operated its Scrub Oaks mine, the Warren Pipe & Foundry Corp. its Mount Hope mine, and the Richard Ore Co. its Richard mine. The Alan Wood Steel Co. also worked the Washington mine, Morris County. One-sixth of the total mine output was shipped direct; the balance was concentrated by magnetic methods for all of the properties and also by gravity methods for the Scrub Oaks and Washington mines. Magnetite and some martite are the iron-bearing minerals. Shipments for the year averaged 63.3 percent iron content.

New York.—The Republic Steel Corp. shipped magnetite sinter and and concentrates and hand-sorted high-grade lump ore during 1948 from its New Bed-Harmony-Old Bed group at Mineville, Essex County. Shipments from the Fisher Hill mine in the same district and from the Chateaugay mine at Lyon Mountain, Clinton County, were almost entirely magnetite sinters. All mining was by underground methods. These operations were described.[15] Jones & Laughlin Ore Co. operated its Benson open-pit mine and its concentrator at Star Lake, St. Lawrence County, to ship sinter and some concentrates made from its magnetite and martite ores. Operating practices at this property were described and reserves estimated at 65,000,000 tons of crude magnetite ore and 38,000,000 tons of crude martite ore in the open-pit area.[16] Concentration ratio is approximately 3: 1 for each type of ore. National Lead Co. shipped magnetite sinter and concentrates from its MacIntyre development at Sanford Lake, Essex County. The ore, a titaniferous magnetite, is mined by open-pit methods. Hanna Coal & Ore Corp. worked its Clifton underground mine at Degrasse, St. Lawrence County, and shipped magnetite sinter. The average grade of shipments noted above was 63.14 percent iron. Except for the New Bed-Harmony-Old Bed group, all of the ores shipped were of Bessemer grade as to phosphorus content. Clinton hematite was mined in Oneida County for use as pigments.

Pennsylvania.—Bethlehem Steel Corp. produced crude magnetite

[15] Gillies, D. B., Adirondack Iron-Ore Mining: Steel, vol. 123, No. 9, Aug. 30, 1948, pp. 72–73, 77.
[16] Tillinghast, E. S., New York's Benson Mines: Min. World, vol. 10, No. 12, November 1948, pp. 27–30.

ore from its underground and open-pit mines at Cornwall, Pa., during 1948. All of the mine output was concentrated and sintered at Lebanon. The underground ore was mined by the block-caving method.

Texas.—Lone Star Steel Co., principal producer, worked its limonite open-pit in the Daingerfield area, Morris County, to make concentrates by a washing, sintering, and calcining process. Sheffield Steel Co. produced brown-ore concentrates by washing from two open-pit mines—the North Basin at Linden, Cass County, and the Mount Haven at Jacksonville, Cherokee County. Valencia Iron & Chemical Corp. mined brown ore underground near Rusk, Cherokee County. This ore was dried and screened before shipment. Average unweighted analysis of ores shipped was 45 percent Fe (natural), 0.08 percent Mn, 0.20 percent P, 11.3 percent SiO_2, 14 percent CaO, and 7 percent H_2O.

Utah.—All iron ore produced in Utah during 1948 consisted of direct-shipping semialtered magnetite from open-pit mines in the Cedar City district, Iron County, in the southwest part of the State. Columbia Iron Mining Co. worked the Iron Mountain mine; Colorado Fuel & Iron Corp., the Blowout mine; Utah Construction Co., the Excelsior; and Helene E. Beatty, the Great Western. Shipments averaged 53.9 percent Fe (natural), 0.06 percent Mn, 0.18 percent P, 8.8 percent SiO_2, 1.7 percent CaO, and 3.2 percent H_2O.

Potential reserves of Iron County, Utah, have been estimated by the Bureau of Mines [17] at 500,000,000 gross tons of iron-bearing material, of which 100,000,000 tons may be classed as measured and indicated reserves containing 45 to 50 percent iron.

Virginia.—Iron ore was mined by open-pit method in Pulaski County during 1948 for use as pigment.

Washington.—The Spokane Portland Cement Co. produced hematite by open-pit methods from the Napoleon mine during 1948 for use in making cement.

Wisconsin.—See Review of Lake Superior District in this chapter.

Wyoming.—Colorado Fuel & Iron Corp. produced direct-shipping hematite for its Pueblo furnaces from the Sunrise underground mine in the Hartville district, Platte County. Shipments averaged 47 percent natural iron content.

CONSUMPTION

A total of 100,498,557 gross tons of iron ore was reported consumed in 1948. Of this, 82 percent was consumed in iron blast furnaces, 13 percent in sintering plants, 4 percent in steel furnaces, and the remaining 1 percent in ferro-alloy furnaces and in the manufacture of cement, ballast blocks, paint, and other items. In addition to the iron ore used in blast and steel furnaces, blast furnaces consumed 14,417,491 tons of iron-ore sinter, and steel furnaces used 994,671 tons of sinter.

[17] Allsman, P. T., Investigation of Iron-Ore Reserves of Iron County, Utah: Bureau of Mines Rept. of Investigations 4388, (supp. to Rept. of Investigations 4076), 1948, p. 3.

Consumption of iron ore in the United States in 1948, by States and uses, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	Metallurgical uses				Miscellaneous uses			Total[2]
	Iron blast furnaces	Steel furnaces	Sintering plants	Ferro-alloy furnaces	Cement	Paint	Other[1]	
Alabama	6,820,979	42,748	1,266,415		66,858		(3)	8,197,000
California					38,062	(3)		
Colorado	2,480,497	223,967	1,259,073					4,005,841
Utah					3,647		595	
Illinois	8,452,407	306,770	404,017		408	(3)		9,163,602
Indiana	10,406,849	483,886	594,187		1,791			11,486,713
Kentucky	1,203,939	49,946						1,253,885
Maryland					230	(3)		
Massachusetts	5,753,238	499,311	231,778					6,484,557
Michigan								
Minnesota	945,481	84,881	347,125					1,377,487
New Jersey						(3)	(3)	
New York	4,947,532	302,136	3,070,221	150,005	6,871	(3)	(3)	8,476,765
Ohio	15,627,625	739,989	2,691,599	181,255	3,341	(3)		19,243,809
Pennsylvania	22,945,376	1,601,604	3,109,123	15,221	18,738	50,974	(3)	27,741,036
Tennessee	2,275				9,547			11,822
Texas	765,598	1,421	117,531		25,862		1,015	911,427
Virginia					2,025	(3)		2,025
West Virginia	2,024,574	13,937						2,038,511
Undistributed[4]					35,322	60,343	8,412	104,077
Total	82,376,370	4,350,596	13,091,069	346,481	212,702	111,317	10,022	100,498,557

[1] Shipments from domestic mines.
[2] Consumption for paint (except in Pennsylvania) and for "other" uses (except in Texas and Utah) excluded from State totals but included in United States total.
[3] Included with "Undistributed."
[4] Includes States indicated by footnote 3 plus the following: For cement—Arkansas, Florida, Kansas, Louisiana, Maine, Montana, Oklahoma, Oregon, South Carolina, and South Dakota. For paint—Georgia, North Dakota, and Wisconsin. For "other"—no additional.

STOCKS

Stocks of usable iron ore at mines on December 31, 1948, increased 4 percent over 1947. Of the quantity in stock piles, 52 percent was at mines in Minnesota, 29 percent in Michigan, and 11 percent in New York and Pennsylvania. Including Wisconsin, the Lake Superior district held 83 percent of the total stocks at the end of the year. Stocks of crude ore at mines totaled 4,662,648 gross tons on December 31, 1948, compared with a revised figure of 4,561,207 gross tons in 1947.

Stocks of iron ore, including sinter, at consuming plants totaled 37,144,933 gross tons on December 31, 1948, compared with 33,393,171 tons (adjusted figure) at the end of 1947.

Stocks at Lake Erie Ports.—On December 1, 1948, just before navigation stopped, the Lake Superior Iron Ore Association reported 5,689,828 gross tons of iron ore at Lake Erie ports, compared with 4,815,635 tons in 1947. At the opening of the 1949 season (May 1, 1949), 2,033,169 tons of ore were in stock at these ports, compared with 1,953,179 tons on May 1, 1948. Thus, withdrawals from stock during the 5-month period in 1948–49 were 28 percent more than during the previous year.

Stocks of usable iron ore at mines, Dec. 31, 1947–48, by States, in gross tons

State	1947	1948	State	1947	1948
Alabama	37,881	102,493	Texas	28,539	130,645
California	344,659	152,480	Utah	17,653	17,943
Michigan	1,597,695	1,803,304	Wisconsin	73,434	97,085
Minnesota	[1] 3,184,322	3,296,825			
New Jersey	1,335	1,530	Total	[1] 6,036,244	6,284,773
New York, Pennsylvania	[1] 750,726	682,468			

[1] Revised figure.

PRICES

Factors Affecting Price.—Iron ores vary widely in chemical composition and physical structure. These qualities affect the usefulness of an ore and its value or price. There is no uniform basis throughout the United States for selling iron ore; contracts are used widely, and in certain areas—notably the Lake Superior district—there are published schedules of prices. In general, the value of an ore is related to its chemical content of iron to other constituents (silica, moisture, phosphorus, sulfur, refractories, etc.) and to its structure, whether hard or soft, lump or fine. Moisture and silica reduce net iron content and add to freight costs. A minimum phosphorus content and lump structure are desirable; sulfur, refractory elements, and fine structure are undesirable qualities. Ores are sold on guaranteed analyses with price adjusted by freight and handling charges to point of delivery. Market prices are quoted [18] in terms of cents per unit of iron for some domestic eastern ores and foreign ores of specified iron content delivered at certain destinations.

In the Lake Superior region, where numerous producers forward a variety of ores of similar types to the many furnaces in the Lower Great Lakes area, standard specifications have been established; and published price schedules, known as Lake Erie base prices, are referred to in determining comparative prices of the various ores delivered at Lower Lake ports. Much ore is sold on contract below published prices.

Value at Mine.—The average value per gross ton of iron ore at mines was $3.91 in 1948 compared with $3.44 in 1947 and $3.07 in 1946.

The accompanying table gives the average value at mines of the different classes of iron ore in 1948 for each of the producing States or groups of States except where 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 plants 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.

Prices of Lake Superior Iron Ore.—Lake Erie base prices for Lake Superior iron ores were increased, effective March 27, 1948, by 65

[18] Steel Magazine, Market Summary: Vol. 124, No. 1, Jan. 3, 1949, p. 370.

Average value per gross ton of iron ore at mines in the United States, 1947–48

[Exclusive of ore containing 5 percent or more manganese]

State	1947							1948						
	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	$3.04			(1)	$2.88		(1)	$3.61			(1)	$3.22		(1)
Georgia					2.34							2.73		
Michigan	3.61			(1)				4.13			(1)			
Minnesota	3.17			$3.54	(1)		(1)	3.61			$3.88	(1)		(1)
New Jersey			(1)			$7.76							$8.38	
New York / Pennsylvania	(1)		(1)			6.39	$7.94	(1)		(1)			7.84	$8.66
Utah			$1.01							$1.21				
Other States [2]	3.17	$2.80	5.71	5.27	4.27			3.61	$3.00	6.43	6.43	5.14		
Average, all States	3.24	2.80	1.67	3.54	3.43	6.95	6.55	3.70	3.00	1.81	3.92	3.98	7.89	7.44
Byproduct ore: [3]														
Delaware / Tennessee / Virginia							5.02							5.91

[1] Included with average for all States.
[2] Includes California, Missouri, Nevada, Texas, Virginia, Washington, Wisconsin, and Wyoming.
[3] Cinder and sinter obtained from pyrites treated in, but not necessarily mined in, States indicated.

cents per gross ton.[19] Prices were then $6.20 for Mesabi non-Bessemer and $6.45 for Old Range non-Bessemer, with the respective Bessemer grades 15 cents higher. Prices were again increased by $1 per gross ton, effective December 30, 1948, making the prices as follows: Old Range Bessemer, $7.60; Old Range non-Bessemer, $7.45; Mesabi Bessemer, $7.35; Mesabi non-Bessemer, $7.20; and High-Phosphorus $7.20 per gross ton.

Lake Erie prices are based on 51.5 percent natural iron content with 0.045 percent phosphorus (dry) the dividing line between Bessemer and non-Bessemer grades. High-Phosphorus ores contain 0.18 percent phosphorus or more. Standard schedules[20] are used for determining the payment for iron content, including penalty deductions for iron below 50 percent natural and for premiums for phosphorus below 0.045 percent, dry basis. Premiums for lump structure and for high manganese content and deductions for high silica are negotiated between buyer and seller.

Freight Rates.—Upper Lake rail freight rates and dock handling charges were raised 11 and 2 cents, respectively, per gross ton, effective May 6, 1948, making the transportation costs from the Minnesota ranges to upper Lake ports $1.05 per ton—92 cents for rail movement, and 13 cents for dock loading. Boat rates were increased at the beginning of the 1948 season, with fractional cent adjustment effective May 6, to bring the charges from ports at the head of Lake Superior to lower Lake ports to $1.33 per gross ton, of which $1.15 was boat freight and 18 cents dock charge. These rates reflected increases of 15 and 2½ cents, respectively, over the 1947 season. Lower Lake rail freight rates, from ports to consuming districts, were raised 20

[19] Wade, H. H., Mining Directory of Minnesota, 1949: University of Minnesota, Mines Exper. Sta. Bull. vol. 52, No. 20, May 1, 1949, table 14, p. 234.
[20] Work cited in footnote 19, pp. 235–238.

cents per gross ton effective January 5, 1948, and an additional 8 cents per ton effective May 6. Further adjustments, but on an individual route basis, became effective August 21. These varied from a reduction of 8 cents per ton (to the May 6 level) for shipment from Lake Erie to the Mahoning and Shenango Valleys, Canton, and Massillon to an increase of 6 cents per ton for several routes from Lake Erie to specified points in southern Pennsylvania, Virginia, and Maryland. Total increases for the year thus ranged from 20 to 34 cents per ton. In addition, dock charges of 10 cents per ton in 1947 were increased to 11½ cents effective February 19, 1948, and to 12 cents per ton effective May 6. Certain rates for all-rail shipment to consuming districts were increased during the year; for instance, the rate from Fillmore County, Minn., to Granite City, Ill., was raised from $2.12 per ton in 1947, by three successive increases, to $2.46 per gross ton, effective August 21, 1948.

FOREIGN TRADE [21]

Imports of iron ore increased nearly 25 percent over 1947 and were double the quantity exported. Imports, by countries, are given in the accompanying table. Among the major sources, the drop in receipts from Canada was more than offset by increases from Chile and Sweden. Notable among minor sources were the increased receipts from Algeria and Brazil and the decline in imports from Cuba. Exports to Canada were three times imports, due in large measure to reduced shipments from the Steep Rock Lake district.

Iron ore imported for consumption in the United States, by countries, 1946–48, in gross tons

[U. S. Department of Commerce]

Country	1946		1947		1948	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Algeria	83,381	$291,873	30,733	$164,659	405,224	$2,066,463
Argentina	18	136				
Belgium-Luxembourg [1]	1,200	3,600	21	498	2	88
Brazil	3	24	85,534	421,621	295,926	1,524,539
British West Africa			22,970	191,718	18,528	171,199
Canada [1]	1,102,852	5,085,888	1,553,245	7,587,385	985,846	5,838,645
Chile	1,095,627	2,459,704	1,670,073	4,746,560	2,631,997	7,526,640
Cuba	158,268	749,654	153,050	773,722	34,500	101,775
Denmark	24,458	150,001				
France [1]	3,969	10,999	702	755	9,041	63,302
Greece	2,000	6,000				
Iran			1,500	42,000	3,000	162,000
Italy [1]	500	1,000	16	50	9,451	64,948
Liberia					4	85
Mexico	789	1,070	54,966	102,633	163,149	334,447
Morocco, French	5,550	17,600			8,690	60,830
Newfoundland and Labrador	15,500	62,000				
Norway			28,246	165,258	108,616	634,602
Philippines, Republic of					4,160	28,880
Spain	4	20			6,449	66,825
Spanish Africa					8,500	48,875
Sweden	232,887	1,384,993	1,286,896	7,756,413	1,358,962	8,317,362
Tunisia	26,873	121,233	6,000	50,100	56,358	297,748
Union of South Africa	2	100	8,932	49,455		
United Kingdom	335	24,780	600	43,049	351	21,229
Total	2,754,216	10,370,675	4,903,484	22,095,876	6,108,754	27,330,482

[1] Includes pyrites cinder.

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

Iron ore exported from the United States, 1946–48, by destinations

[U. S. Department of Commerce]

Destination	1946		1947		1948	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Argentina			1	$74		
Australia	1	$457				
Belgium-Luxembourg			2,361	13,409		
Canada	1,505,608	5,487,348	2,804,492	9,995,889	3,019,683	$13,192,918
Canal Zone			11	228		
Cuba	36	1,332				
France			20	1,183		
French Morocco					99	4,951
Japan					60,869	546,089
Mexico	44	397				
Netherlands			9	693	15	1,021
Netherlands Antilles	165	3,015				
Total	1,505,854	5,492,549	2,806,894	10,011,476	3,080,666	13,744,979

BENEFICIATION

About 60 percent of the iron ore mined in the United States is shipped directly to furnaces; the balance is treated before shipment to improve some quality, either chemical or physical. Such treatment is spoken of broadly as beneficiation. In the statistics given here, however, only those crude ores improved in chemical analysis are included.

The usual procedure in beneficiation is to separate and discard undesirable elements. Although the quantity of crude ore beneficiated has increased more or less steadily for the past 40 years or so, the types of crude treated and the problems of concentration have remained much the same. Beneficiation now, however, is entering a new phase brought about by the different structural and chemical qualities of the great bulk of low-grade iron formation that is being looked toward as the source of future iron supplies. Heretofore, the crude ores treated have been made up of iron and gangue constituents more or less readily separable as free pieces in relatively coarse sizes. Treatment, generally, has been by simple means, such as crushing, washing, and magnetic and gravity separation. This class of crude ore is often referred to as "intermediate" ore. By distinction, the crudes of the future, especially the taconites (unaltered iron formation) of the Mesabi range and similar formations elsewhere, have the iron associated more intimately with other constituents, even to chemical combinations as complex iron silicates in some cases. Fine grinding and agglomeration of the concentrate into a usable product are but two of the new problems.

In considering concentration methods, taconites are generally grouped into two types, magnetic and nonmagnetic, depending upon the preponderance or lack of magnetite as the iron-bearing mineral. Magnetic taconite is being given more attention at this time, since concentration of the magnetite, once liberated, can be effected by well-

Iron ore shipped from mines in the United States, 1925–29 (average) and 1930–48, 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	1939	9,425,809	54,827,100	17.2
1930	8,973,888	55,201,221	16.3	1940	12,925,741	75,198,084	17.2
1931	4,676,364	28,516,032	16.4	1941	19,376,120	93,053,994	20.8
1932	407,486	5,331,201	7.6	1942	23,104,945	105,313,653	21.9
1933	3,555,892	24,624,285	14.4	1943	20,117,685	98,817,470	20.4
1934	4,145,590	25,792,606	16.1	1944	20,303,422	94,544,635	21.5
1935	6,066,601	33,426,486	18.1	1945	19,586,782	87,580,942	22.4
1936	9,658,699	51,465,648	18.8	1946	15,588,763	69,494,052	22.4
1937	12,350,136	72,347,785	17.1	1947	21,407,760	92,670,188	23.1
1938	4,836,435	26,430,910	18.3	1948	23,629,265	100,274,965	23.6

known low-cost magnetic methods. A recent review [22] states that gravity methods flotation, magnetic roasting, and magnetic concentration will be needed for nonmagnetic taconite.

Reserves of taconite in Minnesota are given by Tartaron [23] at 60,000,000,000 tons of 30 percent iron content of which 5,000,000,000 tons are magnetic taconite at the eastern end of the Mesabi range. The Michigan ranges also contain substantial reserves of somewhat higher grade.

Three tons of taconite, approximately, will be mined to produce 1 ton of concentrate. Reserves of magnetic taconite, thus, add about 1,700,000,000 tons to present reserves of equivalent high-grade ore on the Mesabi range, enough to extend the mining life about 25 years at current rates, providing that mining and treatment of such enormous tonnages can be worked out economically. Mining will be by open-pit methods, using techniques well-established in the area except that the extreme hardness of the formation compared with the bulk of the ores now being mined will require significant changes in blast-hole drilling and blasting.

Significant progress was made during 1948 when Pickands, Mather & Co. began operating its new concentrator at Aurora, Minn., in the latter part of the year. Capacity of the plant is understood to be 2,000 tons of pellets per day from 6,000 tons of crude ore treated. Significant of the contemplated size of future taconite operations, this plant has been referred to as a pilot plant.[24]

Oglebay, Norton & Co. is in the preliminary stages of constructing a magnetic separation plant to produce 5,000,000 tons of concentrate per year. A 48-mile railroad and a new port at Beaver Bay, on Lake Superior, are included in the project.

[22] Ross, H. U., The Mesabi Taconite Problem: Canadian Min. Jour., vol. 69, No. 12, December 1948, pp. 57–61.

[23] Tartaron, F. X., Iron-Ore Beneficiation Shows Healthy Growth: Eng. & Min. Jour., vol. 149, No. 2, February 1948, pp. 110–113.

[24] Harbaugh, M. D., Iron Ore—Annual Review and Forecast: Min. Cong. Jour., vol. 35, No. 2, February 1949, pp. 76–80.

In the foreign field at Kirkenes, in the northeastern part of Norway on Varanger Inlet, the Sydvadranger firm is rebuilding [25] its war-destroyed plant for production of magnetite from taconite. The new plant is expected to process 2,000,000 tons of crude per year, about equivalent to the 1938 peak output for the old plant of 880,000 metric tons of concentrate from 1,982,600 tons of crude ore. Typical analysis of the concentrate is stated to be 66 percent iron, 6 percent silica, 0.01 percent phosphorus, and 0.01 percent sulfur. Reserves are given at some 200,000,000 tons, averaging 34 to 35 percent iron content.

Laboratories equipped for taconite research are either in final stages of construction or in use by Oliver Iron Mining Co., Duluth, Minn.; Jones & Laughlin Steel Corp., Negaunee, Mich.; and the M. A. Hanna Co., Hibbing, Minn. Cooperative research on taconite is being carried on by Battelle Memorial Institute, Columbus, Ohio.

EMPLOYMENT

Complete data on employment in iron mines are not yet available. Preliminary figures indicate a 1-percent increase in the number of workers over 1947. The average number employed is estimated at 30,200 men working 69,140,000 man-hours to produce 101,616,853 tons of usable iron and manganiferous ores, an average of 1.470 tons per man-hour. This compares with 1.442 tons per man-hour in 1947 and 1.422 in 1946. The above data and the table that follows include, in the Lake Superior district, manganiferous ore, which is considered by the trade as a special grade of iron ore.

[25] Mining World, Norwegians Conquer Taconite: Vol. 9, No. 11, October 1947, pp. 22-26.

Employment at iron-ore mines and beneficiating plants, quantity and tenor of ore produced, and average output per man in 1947, by districts and States [1]

District and State	Employment					Production									
	Average number of men employed	Time employed				Crude ore (gross tons)	Usable ore			Average per man (gross tons)					
		Average number of days	Total man-shifts	Man-hours			Gross tons	Iron contained		Crude ore		Usable ore			
				Average per shift	Total			Gross tons	Percent natural	Per shift	Per hour	Per shift	Per hour	Iron contained	
														Per shift	Per hour
Lake Superior: [1]															
Michigan Wisconsin	7,491	277	2,076,346	8.0	16,598,733	14,118,798	14,038,853	7,211,656	51.37	6.800	0.851	6.761	0.846	3.473	0.434
Minnesota	11,999	258	3,099,211	8.0	24,839,988	75,227,747	63,419,321	32,261,592	50.87	24.273	3.028	20.463	2.553	10.410	1.299
	19,490	266	5,175,557	8.0	41,438,721	89,346,545	77,458,174	39,473,248	50.96	17.263	2.156	14.966	1.869	7.627	.953
Southeastern States: [2]															
Alabama	5,874	277	1,628,552	8.1	13,164,260	9,578,472	7,224,895	2,598,795	35.97	5.882	.728	4.436	.549	1.596	.197
Georgia	83	294	24,368	10.2	249,490	1,444,520	295,992	129,881	43.88	59.279	5.790	12.147	1.186	5.330	.521
Total	5,957	277	1,652,920	8.1	13,413,750	11,022,992	7,520,887	2,728,676	36.28	6.668	.822	4.550	.561	1.651	.203
Northeastern States:															
New Jersey	695	248	172,167	8.7	1,492,309	938,404	467,983	296,514	63.36	5.451	.629	2.718	.314	1.722	.199
New York Pennsylvania	2,884	297	857,616	8.0	6,862,112	7,760,579	3,519,212	2,161,887	61.43	9.049	1.131	4.103	.513	2.521	.315
Total	3,579	288	1,029,783	8.1	8,354,421	8,698,983	3,987,195	2,458,401	61.66	8.447	1.041	3.872	.477	2.387	.294
Western States:															
California Nevada Washington	134	152	20,328	8.0	161,642	538,154	538,154	291,784	54.21	26.474	3.329	26.474	3.329	14.354	1.805
Missouri Texas Wyoming	485	269	130,595	8.1	1,054,942	2,459,982	1,140,505	542,116	47.53	18.837	2.332	8.733	1.081	4.151	.514
Utah	176	282	49,682	8.0	396,800	2,823,853	2,823,853	1,506,243	53.34	56.839	7.117	56.839	7.117	30.318	3.796
Total	795	252	200,605	8.0	1,613,384	5,821,989	4,502,512	2,340,143	51.97	29.022	3.609	22.445	2.791	11.665	1.450
Total 1947 [2]	29,821	270	8,058,865	8.0	64,820,276	114,898,619	93,475,202	47,000,468	50.28	14.257	1.773	11.599	1.442	5.832	.725

[1] Includes manganese-bearing ore from the Lake Superior district.
[2] Man-hour data for Virginia are not available and are therefore excluded from all totals; however, production data for Virginia (8,110 gross tons of crude ore and 6,434 tons of usable ore) are included with total production. In 1946, Georgia and Virginia combined showed 1.529 tons of usable ore per man-hour.

WORLD REVIEW

The accompanying table shows world production of iron ore, by countries, in recent years.

World production of iron ore, by countries, 1942–48, in metric tons [1]

[Compiled by Pauline Roberts]

Country [1]	1942	1943	1944	1945	1946	1947	1948
North America:							
Canada	494,691	581,769	501,899	1,030,052	1,405,696	1,741,210	1,228,384
Cuba	132,847	47,113	28,370	----------	----------	63,276	36,595
Mexico	160,286	252,437	301,550	282,524	275,445	332,446	229,077
Newfoundland	1,212,016	551,515	471,824	1,000,449	1,264,141	1,466,577	1,491,618
United States	107,219,890	102,872,863	95,628,294	89,794,834	71,980,145	94,585,639	102,624,598
South America:							
Argentina	890	150	1,921	43,353	55,400	60,500	(2)
Brazil	641,900	792,217	782,000	716,000	517,765	926,625	1,441,119
Chile [3]	408,587	299,411	674,529	944,863	1,352,886	1,607,929	2,545,381
Europe:							
Austria	2,996,912	3,188,459	3,014,909	323,189	462,016	884,856	1,269,100
Belgium	113,300	127,890	43,590	29,800	39,910	58,209	90,000
Czechoslovakia	2,040,000	1,944,000	1,584,000	276,000	1,116,074	1,363,491	1,428,000
France [4]	24,993,500	31,934,000	19,012,800	7,712,760	16,232,220	18,690,800	23,031,000
Germany [5]	13,223,456	10,763,000	(2)	(2)	4,140,100	[6] 4,463,000	[7] 6,533,900
Hungary	837,680	837,640	[8, 9] 427,660	[8, 10] 35,580	132,970	243,940	[11] 276,000
Italy	1,084,841	835,773	390,438	133,951	131,617	225,936	454,800
Luxembourg	5,110,050	5,253,025	2,912,500	1,405,877	2,246,908	1,992,167	3,399,274
Norway	284,498	219,000	264,426	78,538	59,972	127,798	287,992
Poland	808,776	717,331	680,754	93,600	423,723	544,113	602,000
Rumania	220,365	252,058	243,418	140,797	111,502	120,870	(2)
Spain	1,606,161	1,587,817	1,508,610	1,171,377	1,596,212	1,513,911	1,716,690
Sweden	9,727,250	10,819,997	7,253,359	3,929,662	6,867,208	8,894,544	[11] 12,061,000
Switzerland	304,673	276,959	214,499	17,436	18,000	45,000	[11] 75,000
U. S. S. R. [12]	(2)	(2)	(2)	[11] 18,000,000	[11] 21,000,000	(2)	(2)
United Kingdom:							
Great Britain [13]	20,225,085	18,790,524	15,720,021	14,425,878	12,368,377	11,260,882	13,320,000
Northern Ireland	4,825	6,660	579	(2)	----------	----------	----------
Yugoslavia	[9, 14] 256,000	(2)	(2)	(2)	(2)	(2)	(2)
Asia:							
China	17,633,149	[15] 6,929,461	[15] 8,128,400	1,441,325	15,310	100,000	[11] 246,600
India	3,269,070	2,697,813	2,401,576	2,300,524	2,446,325	2,538,559	(2)
Indochina, French	63,000	80,576	21,975	7,925	----------	(2)	----------
Japan [16]	[17] 2,532,108	[17] 3,057,177	[17] 4,367,879	[17] 1,356,260	566,468	498,084	556,000
Korea	2,278,000	2,359,000	3,387,000	832,953	[11] 75,000	[11] 93,000	(2)
Malaya, Federation of	92,233	49,137	10,621	13,590	205	1,668	641
Philippines, Republic of	(2)	(2)	(2)	(2)	----------	----------	18,289
Turkey [18]	19,135	91,751	90,430	125,708	112,210	145,620	185,434
U. S. S. R.	(2)	(2)	(2)	(12)	(12)	(2)	(2)
Africa:							
Algeria	329,000	183,492	783,928	1,202,648	1,671,244	1,558,055	1,871,522
Belgian Congo	9,000	23,964	----------	----------	----------	----------	----------
Morocco:							
French	3,329	10,670	6,600	104	124,870	153,650	301,300
Spanish	547,432	547,625	690,880	764,816	787,340	869,016	904,330
Rhodesia:							
Northern	394	624	212	76	162	1,528	149
Southern	182	182	----------	----------	----------	286	30,478
Sierra Leone	[19] 633,375	517,727	641,165	840,611	741,105	854,128	967,888
Tunisia	30,994	29,703	88,863	132,450	183,705	403,691	696,100
Union of South Africa	717,738	738,128	768,392	775,470	946,828	1,162,127	1,163,723

See footnotes at end of table.

World production of iron ore, by countries, 1942–48, in metric tons—Continued

Country [1]	1942	1943	1944	1945	1946	1947	1948
Oceania:							
Australia:							
New South Wales	185,041	205,691	154,326	43,358	(2)	(2)	(2)
Queensland	3,815	3,095	2,375	1,743	1,681	1,364	(2)
South Australia	2,156,111	2,217,865	2,061,810	1,543,983	1,847,398	2,179,965	[11] 2,088,000
Tasmania		7			5		
Western Australia	152	86					7,338
New Caledonia		36,280	60,406			(2)	(2)
New Zealand	2,472	5,068	6,133	6,164	7,525	6,326	4,853
Total (estimate)	235,000,000	227,000,000	199,000,000	159,000,000	154,000,000	184,000,000	211,000,000

[1] In addition to countries listed Bulgaria, Burma, Egypt, Eritrea, French West Africa, Greece, Madagascar, Portugal, and South-West Africa report production of iron ore, but quantity produced is believed insufficient to affect estimate of world total.
[2] Data not available; estimate by author of the chapter included in total.
[3] Production of Tofo mines.
[4] Including Moselle (Lorraine).
[5] Exclusive of manganiferous iron ore carrying 12 to 30 percent manganese.
[6] Excluding Russian zone.
[7] Bizonal area.
[8] Data represent Trianon Hungary subsequent to October 1944.
[9] January to June, inclusive.
[10] June to December, inclusive.
[11] Estimate.
[12] U. S. S. R. in Asia included with U. S. S. R. in Europe.
[13] Exclusive of bog ore, which is used mainly for purification of gas.
[14] Croatia only.
[15] Manchuria only.
[16] Includes iron sand production as follows: 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; 1946, 10,470 tons; 1947, 1,648 tons.
[17] Fiscal year ended March 31 of year following that stated.
[18] Data revised in some instances to cover production rather than shipments.
[19] Exports.

CANADA

British Columbia.—Magnetite deposits on Texada Island, in Georgia Strait, east of Vancouver Island, were being investigated late in 1948 for early production. Freyn Engineering Co., Chicago, is reported [26] to have estimated the proved reserves of the Prescott property at 5,136,000 tons with additional probable tonnage of 4,000,000. Other magnetite deposits are known at Upper Quemsaim Lake in the Campbell River region of Vancouver Island, nearby.

Ontario.—Steep Rock Iron Mines, Ltd., has exposed additional ore at the southeast end of its "B" ore body,[27] from which over 3,000,000 tons have been produced through 1948. To date, the "A" deposit, 1½ miles north of "B", has been drilled but not uncovered enough for mining. "C" deposit, 1½ miles east of "A", still covered by several hundred feet of water in East Bay, has been indicated only by scattered drill holes.[28] Reserves were estimated [29] by the operators as of May 1, 1947, at some 21,500,000 tons of proved ore and 51,000,000 tons of probable ore. Of this total the, "A" deposit area was estimated to contain over 7,000,000 tons proved and 46,000,000 probable, the "B" deposit area at 14,000,000 proved and nearly 5,000,000 probable.

Production declined in 1948; additional stripping was undertaken during the shipping season to permit higher output later.

[26] Mining Magazine (London), vol. 79, No. 4, October 1948, p. 226.
[27] Engineering and Mining Journal, vol. 149, No. 9, September 1948, p. 142.
[28] Goodwin, W. M., Steep Rock Iron Mine: Compressed Air Mag., vol. 53, No. 10, October 1948, pp. 244–246.
[29] Engineering and Mining Journal, vol. 149, No. 8, August 1948, pp. 84–85.

Algoma Ore Properties, Ltd., subsidiary of Algoma Steel Corp., Ltd., is enlarging its sinter plant at the Helen mine, Wawa, Michipicoten district, northeast of Lake Superior, to 1,000,000 gross tons annual sinter capacity.[30] Underground block-caving development, in the deep siderite deposits beneath the Helen open pit, neared completion in 1948. After primary crushing underground, belt conveyors will bring the siderite ore to the surface for further treatment. The Victoria pit, opened in 1948, will provide ore for the sinter plant until the underground mine reaches the necessary capacity.

Reserves of siderite in the Michipicoten district are known to be large. A recent review,[31] notes that 100,000,000 tons were indicated to moderate depth in the Helen mine before 1921. Substantial tonnages, undoubtedly, have been added by recent drilling, but exact data are not yet available.

The Britannia (formerly Bartlett) deposit of Algoma Ore Properties, Ltd., 9 miles northeast of the Helen mine, has shown increased width at depth and higher iron and manganese content than the Helen deposit. No work was done here in 1948. The Lucy and Ruth siderite deposits, held by Jones & Laughlin Steel Corp., lie midway along the range, some 5 miles northeast of the Helen. Drilling of the Ruth deposit was completed in 1948. The Josephine hematite mine, west of the Bartlett, remained flooded.

A typical analysis of the Helen siderite ore, as given by Bonham,[32] indicates that the natural iron content of 35 percent is improved to 51 percent by calcining. The treatment, which includes sintering, reduces sulfur from 1.76 percent to 0.06 and raises manganese from 2 percent to 3.

No further work was done by Algoma Ore Properties, Ltd., on its Goulais Magnetite deposits some 40 miles northeast of Sault Ste. Marie. Magnitude of these deposits has been given [33] at 150,000,000 tons.

Quebec.—Noranda Mines, Ltd., is testing possible production of iron and sulfur from pyrites. Deposits underlying present mine workings are reported [34] to contain 100,000,000 tons of material of 50 percent or more pyrite content. Scale of iron output contemplated is about 1,000 tons per day.

Iron will be a byproduct of the titanium-mining operations initiated in 1948 at Allard Lake, Quebec, by Kennecott Copper Corp. and New Jersey Zinc Co. Mine product is to be smelted in electric furnaces at Sorel, east of Montreal, to produce pig iron and titanium slag. Proved reserves of ore (known as the Lake Tio deposits) have been given at 125,000,000 tons averaging 35 percent iron and 40 percent titanium dioxide.

Quebec-Labrador.—Exploration of the Labrador trough continued throughout 1948. The Burnt Creek area, served by the airport at Knob Lake, was the center of prospecting activity extending northwest to the Koksoak River and southeast to the Hamilton River. The iron range is now considered to be some 350 miles long by 10 to

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[30] Goodwin, W. M., Iron Ore in 1948—Preliminary: Bureau of Mines, Ottawa, February 1949, 8 pp.
[31] Bonham, W. M., Iron Mines of Ontario: Canadian Min. Jour., vol. 69, No. 3, March 1948, pp. 75–78.
[32] Bonham, W. M., work cited in footnote 31.
[33] Northern Miner, vol. 34, No. 36, Nov. 25, 1948, p. 100.
[34] Northern Miner, vol. 34, No. 28, Sept. 30, 1948, p. 2.

60 miles wide.[35] Twenty-eight separate high-grade hematite deposits of economic size were reported [36] drilled and proved to the end of 1948, all on concessions held by subsidiaries of Hollinger Consolidated Gold Mines, Ltd., in association with The M. A. Hanna Co. Melcher [37] has described the district in detail in a recent economic report. Reserves estimated to the end of the 1948 season are given at 323,828,000 tons, including 38,394,000 tons of manganiferous ore averaging, on dry analysis, 50.23 percent iron, 7.68 percent manganese, and 7.75 percent silica content. Of the iron ore, 185,527,000 tons are listed as Bessemer grade, containing 60.69 percent iron, 0.028 percent phosphorus, and 8.58 percent silica on dry analysis. The balance of 98,907,000 tons is classed as non-Bessemer ore of 57.78 percent iron content, 0.112 percent phosphorus, and 7.84 percent silica. Reserves, as estimated, exclude all material of less than 50 percent iron content and ore at the bottom of deposits where the width is less than 125 feet. The largest deposit, Goodwood No. 1, contains 47,000,000 tons of iron ore and 4,500,000 tons of manganiferous ore.

A railroad location has been surveyed from the Burnt Creek area to Seven Islands, the port site selected on the St. Lawrence Gulf. A water-power site is reported to have been located within 25 miles of one of the deposits. A minimum annual production rate of 10,000,000 tons is considered necessary.

Iron occurrences in the Gilbert Bay area, southeastern shore of Labrador, are reported [38] being prospected by Westland Mining Co., Ltd., holder of a 500-square-mile concession.

OTHER COUNTRIES

Australia.—Iron deposits on Cockatoo Island, Yampi Sound, Western Australia, are being developed [39] by Australian Iron & Steel, Ltd., to provide increased ore supplies for steel plants at Newcastle, New South Wales, and Whyalla, South Australia, now supplied from mines at Iron Knob and Iron Monarch, near Whyalla.[40] The Cockatoo Island deposits, estimated from preliminary data at 20,000,000 tons of 66 percent iron content, [41] require no initial stripping in the area under development, while those on nearby Koolan Island, estimated at 76,000,000 tons of similar quality, are not so well exposed. H. A. Brassart & Co., Ltd., London, is assisting with the development.

The Yampi Sound iron deposits are being looked to as a base for establishment of an iron and steel industry in Western Australia. Three companies were reported late in 1948 to have been registered there for this purpose, that is, Western Steel Enterprises, Westeel, Pty., and W. A. Coal Mines.[42]

Shallow iron deposits in the Darling range near Wundowie, 41

[35] Retty, J. A., Labrador—North America's Newest Great Iron-Ore Field: Min. and Met., vol. 29, No. 501, September 1948, pp. 480–83.
[36] Goodwin, W. M., Iron Ore in 1948—Preliminary: Bureau of Mines, Ottawa, February 1949, 8 pp.
[37] Melcher, Norwood B., Quebec-Labrador as a Future Supply of Iron Ore for the United States: Bureau of Mines, Mineral Trade Notes, Spec. Suppl. No. 29 to vol. 27, No. 4, October 1948, 11 pp.
[38] Northern Miner, vol. 34, No. 36, Nov. 25, 1948, p. 117.
[39] Mining Magazine, (London), vol. 78, No. 6, June 1948, pp. 348–350.
[40] For map, *see* Chemical Engineering and Mining Review, vol. 40, No. 12, Sept. 10, 1948, p. 434.
[41] Mining Magazine (London), vol. 78, No. 4, April 1948, p. 203.
[42] Metal Bulletin, No. 3337, Oct. 29, 1948, p. 13.

miles east of Perth, Western Australia, are reported [43] supplying ore for local charcoal iron production.

Brazil.—Problems of finance confronting large-scale development of known iron deposits in the State of Minas Gerais have been under discussion [44] by the Joint United States-Brazil Technical Commission. Exports of 1,500,000 tons are looked for by 1950 by Brazilian authorities using the present narrow-gage railroad from Itabira to the port of Victoria. An additional 1,500,000 tons could be obtained by improvement of present mine, rail, and port facilities. Rebuilding of the railroad with broad-gage track and choice of a new port, it is said, would increase the capacity for export some tenfold.

Ceylon.—Iron deposits located in recent years in the southwest part of Ceylon are stated [45] to contain some 6,000,000 tons averaging 50 percent iron content. These occurrences of lateritic origin are in well-defined belts suitable for open-pit mining and, though not extensive, are thought sufficient for the island's needs for many years.

Chile.—With 18,000,000 tons, or 40 percent of the original reserve, yet to be mined in El Tofo, Bethlehem Chile Iron Mines is reported [46] to have acquired the Romeral iron deposit northeast of La Serena for early development.

Reserves at Romeral are given at 18,000,000 tons of grade and composition similar to the ores of El Tofo. New rail and port facilities will be needed.

Deposits of sedimentary magnetite and hematite of 30 to 40 percent grade are reported to have been discovered some 300 miles south of Santiago along the boundary between Aranco and Mallico Provinces. The deposits are stated [47] to cover some 300 square miles [48] and to consist of three horizontal beds close to the surface and some 20 meters thick, of which 11 meters represent the iron deposits.

Colombia.—The Colombian Government, together with Koppers Co., Pittsburgh, and Freyn Engineering Corp., Chicago, are reported [49] forming a new pig-iron concern at Bogota to be called Empresa Siderurgica Paz del Rio. Capacity of 500 tons per day is expected [50] by 1951. The Paz del Rio iron deposits in Boyaca Province, which will be drawn upon, are stated [51] to have about 45 percent iron content with 10 percent silica, 1 percent phosphorus, and less than 0.05 percent sulfur.

Cuba.—The Mayari open-pit mine of Bethlehem Steel Corp., in Oriente Province, produced direct-shipping ore during the first half of 1948 for experimental use.

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[43] Mining Magazine (London), vol. 78, No. 4, April 1948, p. 228.
[44] Engineering and Mining Journal, vol. 150, No. 1, January 1949, pp. 125–126.
[45] Mining Journal (London), vol. 230, No. 5884, May 29, 1948, p. 398.
[46] Engineering and Mining Journal, vol. 149, No. 10, October 1948, p. 142.
[47] Mining World, vol. 10, No. 13, December 1948, p. 31.
[48] Engineering and Mining Journal, vol. 149, No. 3, March 1948, p. 138.
[49] Metal Bulletin (London), No. 3347, Dec. 3, 1948, p. 16.
[50] American Metal Market, vol. 55, No. 191, Oct. 2, 1948, p. 7.
[51] Engineering and Mining Journal, vol. 148, No. 10, Oct. 1, 1947, p. 142.

Iron ore shipped from mines in the Province of Oriente, Cuba, 1884–1948, in gross tons

	Juragua, Daiquiri, and Estancia (hematite and magnetite)	Sigua (hematite)	Mayari (brown ore)	Guama (hematite)	El Cuero (hematite)	Total
1884–1946	22,651,554	20,438	3,989,940	41,241	903,103	27,606,276
1947	88,727		55,193			143,920
1948			34,025			34,025
Total	22,740,281	20,438	4,079,158	41,241	903,103	27,784,221

India.—M. S. Krishrian, of the Geological Survey of India, has estimated[52] reserves of good-grade iron ore in the Salem district, Madras, at some 600,000,000 tons. Another estimate[53] of the iron deposits in Salem and Trichinopoly, based on a survey conducted in 1940–44, places reserves at 304,650,000 tons to a depth of 100 feet. The Government of Madras is planning for an iron and steel plant to be located in the Salem district.

Japan.—Over 400,000 tons of iron ore was scheduled in the latter part of 1948 for shipment[54] from the United States to Japan; an additional 250,000 tons was expected from Brazil.[55] Contracts were announced earlier in the year for import of 250,000 tons of iron ore from the Chinese island of Hainan.[56]

Luxembourg.—Iron-ore reserves of Luxembourg, as of the end of 1947 have been estimated[57] at 405,000,000 metric tons; one-half is of the higher grades currently mined, one-quarter of lower grades usable without treatment, and one-quarter of lower grades requiring concentration before use. Reserves are thought to be completely outlined. The higher-grade ores (above 25 percent iron for calcareous ores and above 28 percent for siliceous ores) are expected to last 40 years at recent production levels. Plans are under way to extend the life by mining all grades, with provision for the necessary concentration treatment.

New Caledonia.—Iron deposits formerly exploited by Japanese companies and productive of 500,000 tons during the period 1938–44, are now idle.[58]

New Zealand.—An experimental electric furnace plant was scheduled to be set up at Onekaku, Nelson district, late in 1948 to test the feasibility of smelting the titaniferous iron sands occurring extensively on the west coast of the North Island.[59] In sponsoring this work, the Government of Onekaku is looking toward a possible future iron and steel industry to supply domestic needs.

52 Purushotham, M. P., Iron and Steel Plant for South India: Consulate General, Madras, India, Rept. 44, Mar. 3, 1948, 3 pp.
53 Liberator (Madras Daily), Mar. 2, 1948.
54 Western Industry, vol. 13, No. 9, September 1948, p. 86.
55 Metal Bulletin, No. 3328, Sept. 28, 1948, p. 13.
56 Skillings' Mining Review, vol. 36, No. 42, Jan. 31, 1948, p. 16.
57 Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 4, April 1948, pp. 11–27.
58 Chemical Engineering and Mining Review, vol. 40, No. 14, Nov. 10, 1948, p. 76.
59 Mining Journal (London), vol. 230, No. 5883, May 22, 1948, pp. 377–378.

Spain.—Export of iron ore, mainly to the United States and Great Britain, was resumed at the beginning of 1948. Shipments [60] for the first 3 months totaled 173,400 metric tons.

U. S. S. R.—Low-grade iron deposits of the Kola Peninsula and Karelio-Finnish Republic are being looked to as sources of supply for the 4,000,000-ton-per-year pig-iron capacity now in the planning stage for the Leningrad region.[61] The project is stated to be considered uneconomic by ordinary standards. Magnitude of the Kola Peninsula known deposits is of the order of a billion tons. The Yeno-Kovdar deposits, 50 miles west of Zasheyek, principal ones in the area, are said to average 33 percent iron, 2.7 percent phosphorus, and 0.08 percent sulfur. These deposits vary widely in composition and may be difficult to concentrate to the desired content of 63 percent iron with 0.5 percent phosphorus. Methods being tested include grinding, magnetic separation, and agglomeration. The Olenogorsk deposits in Primandrovsky district, 5 miles east of Oleneya on the railroad to Murmansk, are reported to average 35 percent iron and 45 percent silica, with low phosphorus and sulfur content. Both magnetite and hematite are present. The Kirivogorsk deposits in the same area are understood to have a greater proportion of magnetite and higher iron content, but analyses are not reported. The titaniferous magnetites in the Pudozhgora district on the west shore of Lake Onega, with 23 to 29 percent iron content, are a possible future source, as are the titaniferous magnetites of the Belimeki district with 30 to 45 percent iron content.

Venezuela.—Exploration and development of iron deposits in eastern Venezuela by mining subsidiaries of the two largest steel companies in the United States continued through 1948.

Development at El Pão by Iron Mines of Venezuela, subsidiary of Bethlehem Steel Corp., progressed to the point where at least small shipments to blast furnaces at Sparrows Point, Md., could be looked for before the end of 1949. Eventual rate from El Pão is forecast [62] at 1,700,000 tons of ore per year. The ore is known to be high-grade hematite carrying some magnetite. The best-quality ore averages close to 69 percent in iron content and is mostly of Bessemer grade with phosphorus content less than 0.045 percent. Mining will be by open-pit methods. Reserves at El Pão have been estimated [63] variously from preliminary work at upwards of 50,000,000 tons, with 68 percent average iron content.[64]

[60] Iron and Coal Trades Review, vol. 107, No. 4194, July 30, 1948, p. 215.
[61] Engineering and Mining Journal, Soviet Union Builds Large Northwestern Steel Center: Vol. 149, No. 6, June 1948, pp. 92–94.
[62] Iron Age, vol. 162, No. 17, Oct. 21, 1948, p. 118.
[63] Work cited in footnote 62, p. 118.
[64] Davey, J. C., Venezuela—the Guayana Highlands: Mining Mag. (London), vol. 73, No. 3, September 1945, pp. 137–151.

Rail facilities from the mine to the new river port, Palua, and an ocean-loading installation at Puerto Hierro were described in Minerals Yearbook, 1947 (p. 624) and Minerals Yearbook, 1946 (pp. 1602–1603).

Oliver Iron Mining Co., mining subsidiary of U. S. Steel Corp., has concessions covering, among others, the La Piacoa deposit (formerly known as Colon Mines), near the head of the Orinoco Delta and El Parido (Cerro Bolivar) deposit, south of Ciudad Bolivar. La Piacoa was classed by Davey [65] among the medium-grade deposits of Venezuela in referring to the previous estimate of reserves by Zuloaga and Tello [66] of 600,000,000 tons averaging 45.7 percent iron content. El Parido, at the western extremity of the known iron deposit area of Bolivar State, was discovered in 1948, reportedly, and data are not yet available as to its economic possibilities.

Zuloaga and Tello, from their field work of 1939, cited above, estimated the reserves of the Orinoco iron deposits in northern Bolivar State and the Amacuro Delta Territory to the east to be over 1,000,000,000 tons available above river level. There have been widespread discoveries since this estimate was made. Although known for iron occurrences since 1883, when the Orinoco Iron Co. was formed, and long recognized as a possible major source of open-pit iron ore close to water transportation, large-scale development of the Imataca region was delayed until the inroads of World War II demand on sources close to the steel centers made it apparent that new supplies would be needed within a relatively few years. Up to 1945, according to Davey, only a small part of the area had been prospected. La Represalia, a high-grade deposit reported [67] to contain 7,000,000 tons of 68-percent iron content in the exposed outcrops, was discovered in 1939 a few miles south of the Orinoco River in Delta Territory. Manoa, some 40 miles to the east and similar in grade and reported tonnage, was discovered in 1887 and was a producer, at times, from 1901 to 1913. The Iron Hat deposit, farthest east, was discovered in 1944.

[65] Work cited in footnote 64, p. 147.
[66] Zuloaga, G., Tello, M., Exploracion Preliminar de la Sierra Imataca 8th Am. Sci. Cong., vol. 4, 1940, pp. 717–735 (Dept. of State, Washington, D. C., 1942).
[67] Work cited in footnote 64, p. 150.

Iron and Steel

By NORWOOD B. MELCHER

GENERAL SUMMARY

THE steel industry in 1948 experienced its highest peacetime market demand. The industry operated at an average rate of 94 percent of capacity during the year, a rate above that for 1945–47 but lower than for any year, 1941–44, inclusive. The lower rate was partly explained, however, by production-capacity increases during 1948 approximating 3 million tons. The 88,640,470 net tons produced was exceeded only in the peak war years 1943–44. Moreover, the conversion loss from ingots to finished steel products was lower than in any previous year; and shipments of steel products, amounting to 65,973,138 net tons, set an all-time high. At no time in 1948 could the steel industry meet the full demand for steel products. The highest rate of steel production was attained during the fourth quarter. There were indications, however, during the latter months of the year that the demand for steel by desperate buyers, apparent in 1947 and early in 1948, was coming to an end. For example, conversion transactions, which prevailed in 1948 and earlier, had declined sharply at the end of the year. Under conversion agreements—a practice undertaken only during severe shortages—consumers buy steel ingots, at prices that early in 1948 reached $100 and more per net ton, and employ a company with rolling facilities only to roll the ingots into desired shapes. During recent experience, this practice cost consumers up to $250 per ton for steel products.

The gray market, where steel products were purchased at prevailing rates and resold at exorbitant prices, became relatively unimportant late in the year.

The automotive industry was the largest single consumer of steel products during 1948, as in 1947. That industry, with a production of 3,909,270 passenger cars and 1,376,155 trucks, used 10.2 million tons of steel products or more than 15 percent of the total consumed during the year. The demand for passenger automobiles during 1948 was phenomenal; and it was impossible, in most instances, for buyers to obtain immediate delivery on any but the highest-priced models. The production performance in 1948 was only slightly less than in the record year 1929. At the close of the year it appeared that the industry would experience this high demand for at least another year and thus would do much to maintain a high steel-production rate in 1949. In view of the easing of requirements for steel in some other industries, the automobile industry undoubtedly will use an even higher proportion of total steel than in 1948. The data on shipments of steel products to the automobile industry as well as those that follow are from the records of the American Iron and Steel Institute. The construction industry obtained more steel, as well as other construction materials, in 1948 than in 1947. This, plus increases in available labor, resulted in a 26-percent greater construction rate (in terms of dollars) and a substantial increase in physical volume. The value of new construction was 17.7 billion dollars during 1948, or 26 percent more than in 1947. This high rate, however, resulted from large construction activity during the first and second quarters of 1948, which were above the similar periods of 1947. After the second quarter of 1948, construction dropped progressively during the rest of the year, and in the fourth quarter it decreased considerably below that which would be expected as a seasonal decline. Many construction materials were available in adequate quantities by the end of 1948, but iron and steel products were still in short supply. Including contractors' products, such as plumbing and heating equipment, the construction industry obtained 9.8 million tons in 1948 or 15 percent of the total shipments. The container industry—the third largest—used slightly more steel in 1948 than in 1947, as did the railroads, the fourth largest consuming industry. Rails represented the largest tonnage of steel used by the railroads, with freight cars second in 1948—a reversal of the use pattern from 1947. The production of freight cars in 1948 totaled 114,204 compared with 80,711 in 1947.

Salient statistics of iron and steel in the United States, 1944–48, in net tons

	1944	1945	1946	1947	1948
Pig iron:					
Production	61,003,759	53,224,213	44,842,025	58,327,231	60,073,140
Shipments	60,995,977	53,265,353	45,075,890	58,367,510	60,051,350
Imports	5,778	[1] 21,433	14,091	32,624	219,253
Exports	162,478	90,833	95,698	40,202	7,032
Steel: [2]					
Production of ingots and castings:					
Open-hearth:					
Basic	79,168,294	71,069,876	60,112,300	76,209,268	78,714,852
Acid	1,195,659	869,726	599,663	664,525	625,305
Bessemer	5,039,923	4,305,318	3,327,737	4,232,543	4,243,172
Crucible	25	24	} 2,563,024	18	} 5,057,141
Electric	4,237,699	3,456,704		3,787,717	
Total	89,641,600	79,701,648	66,602,724	84,894,071	88,640,470
Capacity, annual	[3] 93,854,420	95,505,280	91,890,560	91,241,250	94,233,460
Percent of capacity	95.5	83.5	72.5	93.0	94.1
Production of alloy steel:					
Stainless	477,498	542,904	550,097	519,933	617,378
Other than stainless	10,155,588	8,104,807	5,527,098	6,908,298	7,863,736
Total	10,633,086	8,647,711	6,077,195	7,428,231	8,481,114
Shipments of steel products:					
For domestic consumption	59,267,961	53,448,897	45,763,761	58,850,458	62,728,250
For export	4,925,198	3,793,343	3,011,771	4,206,692	3,244,888
Total	64,193,159	57,242,240	48,775,532	63,057,150	65,973,138

[1] Corrected figure.
[2] American Iron and Steel Institute. Capacity figures Dec. 31 from A. I. S. I. Form 7.
[3] Average annual capacity as of Jan. 1 and July 1.

The first major change in the pricing structure of iron and steel was effected in 1948 in reverting from the multiple basing-point system, which had been in effect since 1924, to the f. o. b. mill price. This change was made as a result of a United States Supreme Court decision in 1948, ordering cement companies to abandon a similar pricing system. In March 1947 the Supreme Court agreed to review the Federal Trade Commission findings that numerous cement producers had conspired to restrict competition by the use of a delivered price system. On April 26, 1948, the Supreme Court ordered the cement companies to cease and desist quoting or selling cement on the multiple-basing-point delivered-price system or to discriminate among customers by charging different mill net prices on orders going to different destinations. The steel industry decided that the cement decision would also apply to it and was prompt in converting to an f. o. b. mill price system. Iron Age [1] pointed out that steel was sold exclusively on an f. o. b. mill basis, before 1880. During that year the Pittsburgh plus system of pricing was first introduced by the Carnegie Steel Co. Under this new system, all steel, regardless of the location of the producing plant, was sold at a price equivalent to the Pittsburgh price plus the equivalent freight rate from Pittsburgh to the point of consumption. This system continued until 1924 when it was outlawed. Thereafter, the multiple-basing-point system was introduced. Under this system, the consumer paid the quoted price at his nearest basing point, plus the equivalent freight rate from that point to his plant. This system continued until July 1948, when the present f. o. b. mill price was accepted by the industry. Many companies, both producers and consumers, dissatisfied with the new pricing system, have requested Congress to enact legislation that would authorize the steel industry to change back to the basing-

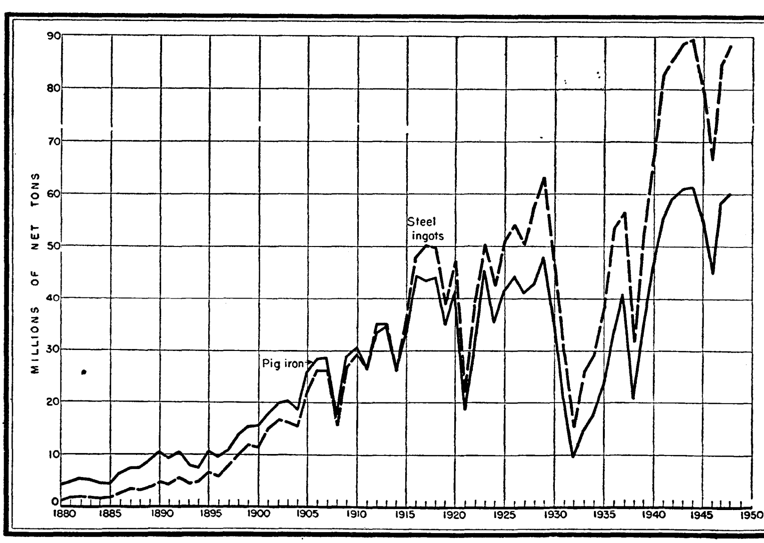

FIGURE 1.—Trends in production of pig iron and steel ingots in the United States, 1880–1948.

[1] Brown, D. I., F. O. B. Mill: Iron Age, vol. 163, No. 1, Jan. 6, 1949, p. 170.

point system. The Senate referred the problem for further study to a subcommittee of its Interstate and Foreign Commerce Committee.

Steel production was restricted somewhat during 1948 by work stoppages, particularly at coal mines, and by shortages of steel scrap. Approximately 1 million tons of steel production were lost owing to work stoppages at coal mines during April and July. Purchased scrap, although being used in record high tonnages throughout 1948, failed to meet total demands; and the composite price, as published by Steel, continued to increase during the year. An all-time high of $43.33 per long ton was reached in August, and this rate continued until October, when a slight decline to $43.25 was recorded; this price continued for the balance of the year. Receipts of iron ore at furnaces were limited by Great Lakes shipping capacity, and manganese ore became increasingly tight during the year. However, no substantial tonnage of steel production was lost owing to shortage of these materials. Imports of iron ore in 1948 were the largest in history.

The steel industry operated on a 40-hour-week basis during 1948, and the average weekly earnings for steel workers increased. Wages in January averaged $60.58 per week and reached a high of $67.02 in October but dropped to $65.73 in December.

PRODUCTION AND SHIPMENTS OF PIG IRON

Domestic production of pig iron, exclusive of ferro-alloys, increased 3 percent over 1947 but was nearly 1 million tons less than in 1944, the record year. Pennsylvania and Ohio retained the same relative position with respect to pig-iron production and for the fourth consecutive year, produced 30 and 21 percent, respectively, of the total. Of the pig iron manufactured in 1948, it is calculated that 2,358,000

Pig iron produced and shipped in the United States, 1947–48, by States

State	Produced		Shipped from furnaces			
	1947 (net tons)	1948 (net tons)	1947		1948	
			Net tons	Value	Net tons	Value
Alabama	3,928,785	4,013,771	3,928,007	$110,436,827	3,980,677	$145,358,582
California	459,148	361,659	453,376	72,511,626	375,113	121,033,803
Colorado, Texas, Utah	1,911,264	2,528,516	1,915,386		2,530,372	
Illinois	5,600,154	5,512,781	5,607,680	173,679,369	5,503,437	196,586,808
Indiana	6,400,254	6,493,268	6,385,503	195,211,140	6,496,421	245,945,553
Kentucky	661,925	799,287	661,925	(1)	799,287	(1)
Maryland	2,408,260	2,808,411	2,408,230	(1)	2,805,936	(1)
Massachusetts	205,234	140,830	203,844	(1)	140,575	(1)
Michigan	1,378,829	1,541,933	1,388,402	(1)	1,534,911	(1)
Minnesota	546,299	562,810	546,432	(1)	557,252	(1)
New York	3,663,581	3,734,321	3,675,217	101,204,575	3,744,341	122,440,520
Ohio	12,316,561	12,367,958	12,322,330	380,383,106	12,367,227	469,653,906
Pennsylvania	17,563,146	17,742,022	17,587,252	531,716,815	17,750,295	651,136,537
Tennessee, West Virginia	1,283,791	1,465,573	1,283,926	(1)	1,465,506	(1)
Virginia						
Undistributed [1]				205,515,205		279,966,128
Total	58,327,231	60,073,140	58,367,510	1,770,658,663	60,051,350	2,232,121,837

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

tons, valued at $87,647,000, were made from 4,634,416 tons of foreign ore from Africa, Brazil, Canada, Chile, Cuba, India, Mexico, Palestine, and Sweden. Domestic ore (88,684,594 tons) and sinter (16,139,976 tons) and 8,572,591 tons of miscellaneous materials were reported used in the manufacture of 57,715,140 tons of pig iron. In addition, 1,440,494 tons of home scrap and 142,743 tons of flue dust were consumed in making pig iron in 1948.

Shipments of pig iron increased 3 percent in quantity and 26 percent in value over 1947. The values given in the accompanying table represent the approximate amounts received for the pig iron, f. o. b. furnaces, and do not include freight costs, 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, 1947–48, by grades

Grade	1947			1948		
	Net tons	Value		Net tons	Value	
		Total	Average		Total	Average
Foundry	3,156,157	$95,147,407	$30.15	2,759,989	$110,686,035	$40.10
Basic	44,947,995	1,356,926,056	30.19	47,067,134	1,742,756,234	37.03
Bessemer	6,850,065	209,790,374	30.63	7,105,015	268,311,270	37.76
Low-phosphorus	361,806	12,607,016	34.84	389,119	17,250,121	44.33
Malleable	2,787,901	88,359,352	31.69	2,590,494	87,492,509	33.77
All other (not ferro-alloys)	263,586	7,828,458	29.70	139,599	5,625,668	40.30
Total	58,367,510	1,770,658,663	30.34	60,051,350	2,232,121,837	37.17

Metalliferous Materials Used.—The production of pig iron in 1948 required 109,458,986 short tons of iron ore, sinter, and manganiferous iron ore, 3,073,224 tons of mill cinder and roll scale, 3,997,172 tons of open-hearth and Bessemer slag, 1,460,096 tons of purchased scrap, and 42,099 tons of miscellaneous materials—an average of 1.965 tons of metalliferous materials (exclusive of home scrap and flue dust) per ton of pig iron made.

Alabama furnaces used red hematite from the Birmingham district, Alabama; brown ores from Alabama and Georgia; and some hematite from Missouri and the Lake Superior region. Pyrites cinder from Tennessee and Virginia and foreign iron ore from Brazil and Sweden were also used. Domestic manganese-bearing ores were used in addition to foreign material from Africa, Chile, India, and Mexico. 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 furnace at Fontana, Calif., used iron ore from the Eagle Mountain and Vulcan mines, California, and from the Excelsior mine, Utah. The manganese ore used came from Mexico.

The iron ore consumed in furnaces at Pueblo, Colo., originated from the Blowout mine, Iron County, Utah, and the Sunrise mine, Platte County, Wyo. Ferruginous manganese ore from the Boston Hill mine, Grant County, N. Mex., was also used.

The blast furnaces at Sparrows Point, Md., used domestic iron ore as well as ore from Africa, Chile, Cuba, and Sweden. Manganiferous ores from Africa, Palestine, and South Africa and domestic ore from the Cuyuna range in Minnesota were used.

Blast furnaces in Illinois, Indiana, Kentucky, Michigan, and Minnesota used Lake Superior iron ore and manganiferous iron ore exclusively. West Virginia furnaces used Lake Superior iron ore from mines in Canada and the United States.

The Everett, Mass., blast furnace used iron ore from Africa and Sweden as well as from the Lake Superior region.

In New York the blast furnaces in the Buffalo district used magnetite from the Mineville district in New York and hematite from the Lake Superior district (United States and Canada) as well as manganiferous ores from Minnesota. The Troy furnace consumed magnetite from the Chateaugay mine at Lyon Mountain, N. Y., and manganese ore from South Africa.

Blast furnaces (including ferro-alloy blast furnaces) in the United States, 1947–48

[American Iron and Steel Institute]

State	Dec. 31, 1947			Dec. 31, 1948		
	In blast	Out of blast	Total	In blast	Out of blast	Total
Alabama	19	1	20	19	1	20
California	1		1	1		1
Colorado	4		4	4		4
Illinois	20	1	21	21	1	22
Indiana	20	2	22	20	2	22
Kentucky	3		3	3		3
Maryland	7	1	8	8		8
Massachusetts	1		1	1		1
Michigan	5		5	6		6
Minnesota	3		3	3		3
New York	15	1	16	16		16
Ohio	46	1	47	49		49
Pennsylvania	72	2	74	72	4	76
Tennessee	2	1	3	2	1	3
Texas	2		2	2		2
Utah	4		4	5		5
Virginia	1		1	1		1
West Virginia	4		4	4		4
Total	229	10	239	237	9	246

Ohio blast furnaces consumed magnetite sinter from New York and domestic and Canadian hematite from the Lake Superior district.

Most 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 and some magnetite ore from New Jersey, New York, and Pennsylvania. Eastern Pennsylvania furnaces used iron ore from Africa, Chile, Cuba, and Sweden, and western Pennsylvania used foreign ores from Canada only; small quantities of pyrites cinder (both domestic and foreign) were used at eastern Pennsylvania furnaces.

Texas blast furnaces used brown iron ore from eastern Texas and manganese-bearing ores from both domestic and Mexican sources.

Utah furnaces used semialtered magnetite from the Iron Mountain mine near Cedar City, Utah; some of it was sintered before being used. Manganiferous ores from Nevada and Utah were also employed.

Iron ore and other metallic materials consumed and pig iron produced, 1947–48, by States in net tons

State	Metalliferous materials consumed					Pig iron produced	Materials consumed per ton of pig iron made			
	Iron and manganiferous iron ores		Sinter	Miscellaneous [1]	Total		Ores	Sinter	Miscellaneous	Total
	Domestic	Foreign								
1947										
Alabama	6, 038, 647	3, 104	2, 054, 009	172, 653	8, 268, 413	3, 928, 785	1. 538	0. 523	0. 044	2. 105
California	379, 279	4, 529	354, 833	66, 844	805, 485	459, 148	. 836	. 773	. 145	1. 754
Colorado, Texas, Utah	2, 788, 568	43, 766	739, 534	84, 168	3, 656, 036	1, 911, 264	1. 482	. 387	. 044	1. 913
Illinois	9, 857, 650		764, 587	674, 610	11, 296, 847	5, 600, 154	1. 760	. 137	. 120	2. 017
Indiana	11, 101, 185	12, 957	999, 662	893, 016	13, 006, 820	6, 400, 254	1. 736	. 156	. 140	2. 032
Kentucky	1, 141, 929		21, 330	138, 886	1, 302, 145	661, 925	1. 725	. 032	. 210	1. 967
Maryland	1, 224, 559	2, 345, 283	278, 243	534, 528	4, 382, 613	2, 408, 260	1. 482	. 116	. 222	1. 820
Massachusetts	289, 253	77, 529		7, 198	373, 980	205, 234	1. 787		. 035	1. 822
Michigan	2, 246, 278	75, 997	308, 516	110, 368	2, 741, 159	1, 378, 829	1. 684	. 224	. 080	1. 988
Minnesota	1, 059, 782	4, 723		72, 114	1, 136, 619	546, 299	1. 949		. 132	2. 081
New York	5, 464, 864	21, 814	1, 235, 788	484, 041	7, 206, 507	3, 663, 581	1. 498	. 337	. 132	1. 967
Ohio	16, 698, 607	455, 774	4, 455, 657	1, 962, 008	23, 572, 046	12, 316, 561	1. 393	. 362	. 159	1. 914
Pennsylvania	25, 824, 167	35, 561	4, 300, 688	3, 390, 721	33, 551, 137	17, 563, 146	1. 472	. 245	. 193	1. 910
Tennessee, West Virginia	1, 977, 638	194, 666	109, 682	138, 828	2, 420, 814	1, 283, 791	1. 692	. 086	. 108	1. 886
Total	86, 092, 406	3, 275, 703	15, 622, 529	8, 729, 983	113, 720, 621	58, 327, 231	1. 532	. 268	. 150	1. 950
1948										
Alabama	7, 568, 582	82, 414	2, 004, 080	172, 442	9, 827, 518	4, 013, 771	1. 906	. 499	. 043	2. 448
California	280, 776	2, 912	285, 267	70, 546	639, 501	361, 659	. 784	. 789	. 195	1. 768
Colorado, Texas, Utah	3, 347, 664	159, 354	1, 133, 268	111, 045	4, 751, 331	2, 528, 516	1. 387	. 448	. 044	1. 879
Illinois	9, 560, 354		8[illegible]4, 203	767, 893	11, 172, 450	5, 512, 781	1. 734	. 153	. 140	2. 027
Indiana	11, 660, 971		864, 473	791, 854	13, 317, 298	6, 493, 268	1. 796	. 133	. 122	2. 051
Kentucky	1, 352, 559		53, 880	167, 079	1, 573, 518	799, 287	1. 692	. 068	. 209	1. 969
Maryland	704, 638	3, 496, 308	322, 994	471, 402	4, 995, 342	2, 808, 411	1. 496	. 115	. 168	1. 779
Massachusetts	168, 500	68, 270		17, 561	254, 331	140, 830	1. 681		. 125	1. 806
Michigan	2, 303, 353		445, 410	105, 854	2, 854, 617	1, 541, 933	1. 494	. 289	. 068	1. 851
Minnesota	1, 063, 863			69, 819	1, 133, 682	562, 810	1. 890		. 124	2. 014
New York	5, 586, 899	26, 711	1, 204, 235	503, 068	7, 320, 913	3, 734, 321	1. 503	. 322	. 135	1. 960
Ohio	17, 369, 591	361, 566	4, 265, 497	1, 925, 878	23, 922, 532	12, 367, 958	1. 433	. 345	. 156	1. 934
Pennsylvania	25, 535, 084	348, 557	4, 591, 749	3, 239, 872	33, 715, 262	17, 742, 022	1. 459	. 259	. 182	1. 900
Tennessee, West Virginia	2, 181, 760	88, 324	124, 920	158, 278	2, 553, 282	1, 465, 573	1. 549	. 085	. 108	1. 7[illegible]2
Total	88, 684, 594	4, 634, 416	16, 139, 976	8, 572, 591	118, 031, 577	60, 073, 140	1. 553	. 269	. 143	1. 965

[1] Excludes recycled materials.

Foreign iron and manganiferous iron ore consumed in the manufacture of pig iron in the United States, 1947–48, by sources of ore, in net tons

Source	1947	1948	Source	1947	1948
Africa	88,045	342,354	Mexico	48,787	162,318
Australia	1,558		Newfoundland	14,141	
Brazil		49,870	Palestine		10,376
Canada	765,620	484,839	Sweden	323,016	904,215
Chile	1,898,732	2,677,610	Unclassified	10,392	665
Cuba	125,412	1,846			
India		323	Total	3,275,703	4,634,416

PRODUCTION OF STEEL

Steel production increased 4 percent in 1948 over 1947, while capacity increased 3 percent. Capacity, at the end of 1948, totaled 94,233,460 tons, second only to the peak reached in 1945. Of the total tonnage of steel ingots and castings produced in the United States in 1948, 89 percent was made in open-hearth furnaces compared with 91 percent in 1947. Five percent was made in Bessemer converters as during the previous year, and 6 percent was made in electric furnaces compared with 4 percent in 1947. Included in the electric furnace production is an extremely small quantity of steel made in crucible furnaces, which amounted to only 18 tons in 1947 but was not measured separately in 1948.

In 1948, 89.8 percent of domestic steel output was made in furnaces in the Northeastern district, 4.9 percent in the Southern district, and 5.3 percent in the Western district, compared with 90.3, 4.6, and 5.1 percent, respectively, in 1947.

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 production data.

Steel capacity, production, and percent of operations, 1944–48, 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
1944	[3] 93,854,420	80,363,953	5,039,923	25	4,237,699	89,641,600	95.5
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	(4)	2,563,024	66,602,724	72.5
1947	91,241,250	76,873,793	4,232,543	18	3,787,717	84,894,071	93.0
1948	94,233,460	79,340,157	4,243,172	(4)	5,057,141	88,640,470	94.1

[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] Average annual capacity as of Jan. 1 and July 1.
[4] Included with "Electric and all other."

Open-hearth steel ingots and castings manufactured in the United States, 1944–48, by States, in net tons [1]

[American Iron and Steel Institute]

State	1944	1945	1946	1947	1948
New England States	444,101	432,601	367,868	428,651	454,524
New York and New Jersey	4,365,108	3,813,333	3,242,138	4,213,369	4,277,040
Pennsylvania	24,677,513	21,194,721	17,495,219	22,911,984	23,648,314
Ohio	15,011,818	13,402,084	11,446,783	14,026,978	14,045,722
Indiana	10,925,049	10,237,621	8,359,305	10,128,496	10,453,975
Illinois	6,496,338	5,812,286	4,851,975	6,206,370	6,269,723
Other States	18,444,026	17,046,956	14,948,675	18,957,945	20,190,859
Total	80,363,953	71,939,602	60,711,963	76,873,793	79,340,157

[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, 1944–48, by States, in net tons [1]

[American Iron and Steel Institute]

State	1944	1945	1946	1947	1948
Ohio	2,207,176	1,930,956	1,447,825	1,981,428	1,936,873
Pennsylvania	1,645,247	1,388,284	1,143,388	1,345,412	1,355,934
Other States	1,187,500	986,078	736,524	905,703	950,365
Total	5,039,923	4,305,318	3,327,737	4,232,543	4,243,172

[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, 1944–48, in net tons [1]

[American Iron and Steel Institute]

Year	Ingots	Castings	Total	Year	Ingots	Castings	Total
1944	4,131,703	105,996	4,237,699	1947	3,680,500	107,217	3,787,717
1945	3,381,678	75,026	3,456,704	1948	4,973,611	83,530	[2] 5,057,141
1946	2,479,064	83,960	[2] 2,563,024				

[1] Includes only that portion of steel for castings produced in foundries operated by companies manufacturing steel ingots.
[2] Includes a very small quantity of crucible steel.

Alloy Steel.—The steel output for 1948 includes 8,481,114 net tons of alloy-steel ingots and castings, which represents 10 percent of the total compared with 9 percent in 1947. This figure includes steels in which the minimum of the range specified, in one or more of the elements named, exceeds the following percentages: Manganese, 1.65 percent; silicon, 0.60 percent; copper, 0.60 percent, or aluminum, boron, chromium, cobalt, columbium, molybdenum, nickel, titanium, tungsten, vanadium, zirconium, and other alloying elements, any percent. The output of alloy steels in 1948 increased 14 percent over 1947, whereas total steel increased only 3 percent. Of the alloy steel produced in 1948, 74 percent was made in basic open-hearth furnaces, 2 percent in acid open-hearths, and 24 percent in electric furnaces and crucibles. None was produced in Bessemer converters.

Electric furnaces produced proportionately less alloy steel in 1948 than in 1947; only 40 percent of the steel made in electric furnaces was alloy compared with 47 percent in the previous year. Typically, steels with higher alloy content are made in electric furnaces and steels with lower content by the open-hearth process.

Alloy-steel ingots and castings manufactured in the United States, 1944–48, by processes, in net tons [1]

[American Iron and Steel Institute]

Process	1944	1945	1946	1947	1948
Open hearth:					
Basic	6,494,627	5,572,353	4,325,657	5,520,540	6,285,054
Acid	515,662	274,889	115,711	128,754	128,915
Crucible	23	18	} 1,635,827	1,778,937	2,067,145
Electric	3,622,774	2,800,451			
Total	10,633,086	8,647,711	6,077,195	7,428,231	8,481,114

[1] Includes only that portion of steel for castings produced in foundries operated by companies manufacturing steel ingots.

Metalliferous Materials Used.—During 1948 steel furnaces used 3,808,155 net tons of domestic iron ore and 1,064,513 tons of foreign ore; the latter originated in Brazil, Canada, Chile, Spanish Morocco, and Sweden. Also used were 1,114,032 tons of sinter made from both foreign and domestic ores. Scrap and pig iron used in steel furnaces in 1948 totaled—99,757,885 net tons. Of this, 52 percent was pig iron, 25 percent home scrap, and 23 percent purchased scrap. Both charge ore and feed ore are employed 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 practice.

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 a charge ore because of the large quantity of slag resulting. Lump ore, which is preferred as a feed ore, is high-priced, and the supply is limited. The Vermilion range in Minnesota is the largest single source of this grade in the United States.

Metalliferous materials consumed in steel furnaces in the United States, 1944–48, in net tons

Year	Iron ore		Sinter	Manganese ore		Pig iron	Ferro-alloys	Iron and steel scrap	
	Domestic	Foreign		Domestic	Foreign			Home	Purchased
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
1947	3, 795, 886	809, 191	1, 134, 542	[1] 2, 080	3, 512	50, 177, 381	[1] 1,250, 000	23, 993, 919	20, 791, 449
1948	3, 808, 155	1, 064, 513	1, 114, 032	2, 698	4, 159	52, 177, 785	1, 300, 000	24, 689, 529	22, 890, 571

[1] Corrected figure.

CONSUMPTION OF PIG IRON

Consumption of pig iron in 1948 increased 3 percent over 1947. 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 1948, 87 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 9 percent was consumed in iron-making furnaces, of which the cupola is the most important. Gray-iron foundries used 3 percent less pig iron in 1948 than in 1947, but this was 9 percent of total pig iron in 1948, as in 1947.

Consumption of pig iron in the United States, 1945–48, by type of furnace

Type of furnace or equipment	1945		1946		1947		1948	
	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total
Open-hearth	41, 682, 581	78. 4	34, 608, 053	76. 8	45, 338, 462	77. 8	47, 267, 334	78. 8
Bessemer	4, 750, 817	8. 9	3, 722, 756	8. 3	4, 711, 581	8. 1	4, 778, 137	8. 0
Electric	163, 457	. 3	113, 125	. 3	127, 338	. 2	132, 314	. 2
Cupola	4, 084, 091	7. 7	4, 612, 704	10. 2	5, 438, 727	9. 3	5, 280, 957	8. 8
Air; Brackelsberg	433, 953	. 8	356, 436	. 8	413, 900	. 7	368, 003	. 6
Crucible	552	(1)	985	(1)	1, 312	(1)	1, 013	(1)
Puddling	22, 725	(1)	14, 506	(1)	16, 573	(1)	14, 979	(1)
Direct castings	2, 049, 001	3. 9	1, 641, 874	3. 6	2, 241, 789	3. 9	2, 183, 572	3. 6
Miscellaneous	-----------	--------	1, 191	(1)	1, 073	(1)	95	(1)
Total	53, 187, 177	100. 0	45, 071, 630	100. 0	58, 290, 755	100. 0	60, 026, 404	100. 0

[1] Less than 0.05 percent.

Plants using pig iron in 1948 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 the Southeastern States. These areas in 1948 used 95 percent of the pig iron; Pennsylvania (the leading consumer) took 29 percent of the total and Ohio (the second largest consumer) 19 percent.

Consumption of pig iron in the United States, 1945–48, by States and districts

State and district	1945 Consumers	1945 Net tons	1946 Consumers	1946 Net tons	1947 Consumers	1947 Net tons	1948 Consumers	1948 Net tons
Connecticut	61	104,676	55	88,307	58	92,114	59	73,173
Maine	16	6,692	16	10,267	15	14,111	15	14,882
Massachusetts	103	184,432	94	154,654	98	199,258	100	219,453
New Hampshire	16	8,908	15	5,992	16	5,771	16	4,178
Rhode Island	12	38,670	10	28,339	12	31,036	11	23,520
Vermont	12	11,133	12	9,411	14	10,007	14	7,687
Total New England	220	354,511	202	296,970	213	352,297	215	342,893
Delaware	8	331,639	7	292,498	7	312,845	7	374,384
New Jersey [1]	81		77		76		80	
New York	197	2,598,306	179	2,201,586	172	2,966,882	174	2,948,785
Pennsylvania [1]	434	16,047,518	354	13,120,922	349	17,287,166	401	17,667,350
Total Middle Atlantic	720	18,977,463	617	15,615,006	604	20,566,893	662	20,990,519
Alabama	69	2,884,295	66	2,568,276	69	3,356,612	74	3,500,614
District of Columbia	3		1		1		3	
Kentucky [1]	24	2,848,408	24	2,629,314	24	3,150,317	25	3,640,266
Maryland [1]	26		21		19		23	
Florida	18	88,111	17	63,613	14	37,525	15	38,565
Georgia	52		52		49		51	
Mississippi	6	1,023	8	2,256	8	2,596	8	2,271
North Carolina	48	22,886	50	28,423	47	27,466	44	20,482
South Carolina	17	5,355	17	7,348	16	9,169	14	9,404
Tennessee	55	176,736	52	197,055	53	254,202	53	265,838
Virginia	53		53		54		51	
West Virginia	25	1,433,478	25	1,115,785	25	1,379,112	26	1,585,755
Total Southeastern	396	7,460,292	386	6,612,070	379	8,216,999	387	9,063,195
Arkansas	5		4		4		4	
Louisiana	13	7,944	12	5,620	11	5,766	12	7,025
Oklahoma	12		10		9		9	
Texas	42	174,497	37	54,138	37	120,091	38	230,947
Total South Central	72	182,441	63	59,758	61	125,857	63	237,972
Illinois [1]	225	4,426,898	208	3,716,293	208	4,782,722	216	4,809,697
Indiana	142	6,543,439	126	5,356,288	128	6,810,122	137	7,075,885
Iowa	56	83,412	58	104,744	54	98,116	50	91,291
Kansas	24	13,532	24	16,901	22	14,041	25	24,410
Nebraska	13		11		11		11	
Michigan	189	2,228,616	173	2,275,887	167	2,737,764	167	2,979,528
Wisconsin	122		115		116		125	
Minnesota	63	426,666	61	443,861	59	445,584	58	458,139
Missouri	56	106,734	52	93,298	51	80,926	51	87,654
North Dakota	1	578	1	316	1	225	1	235
South Dakota	1		1		1		1	
Ohio [1]	339	10,803,564	297	9,162,118	299	11,674,075	327	11,633,581
Total North Central	1,231	24,633,439	1,127	21,169,706	1,117	26,643,575	1,169	27,160,420
Arizona								
Nevada	4	133	5	1,022	4	1,215	4	1,251
New Mexico								
Colorado	28	1,067,032	26	761,468	26	1,511,704	30	1,583,437
Utah								
Idaho							2	315
Wyoming	4	495	4	1,547	5	3,041	2	4
Montana							4	320
Total Rocky Mountain	36	1,067,660	35	764,037	35	1,515,960	42	1,585,327
Oregon	31	34,834	32	33,795	26	17,812	23	20,849
Washington	40		31		31		29	
California [1]	137	476,537	123	520,288	116	635,164	111	625,229
Total Pacific Coast	208	511,371	186	554,083	173	652,976	163	646,078
Undistributed [1]					7	216,198		
Total United States	2,883	53,187,177	2,616	45,071,630	2,589	58,290,755	2,701	60,026,404

[1] In 1947 some pig iron consumed in California, Illinois, Kentucky, Maryland, New Jersey, Ohio, and Pennsylvania—not separable—is included with "Undistributed."

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 $37.17 a net ton in 1948 compared with $30.34 in 1947.

Average value per net ton of pig iron at blast furnaces in the United States, 1944–48, by States

State	1944	1945	1946	1947	1948
Alabama	$17.34	$18.39	$21.15	$28.12	$36.52
California, Colorado and Utah	19.04	19.49	21.25	30.50	40.93
Illinois	20.92	22.98	25.17	30.97	35.72
Indiana	22.41	23.11	25.46	30.57	37.86
Michigan	17.21	17.60	27.19	(1)	(1)
New York	19.96	22.83	22.82	27.54	32.70
Ohio	21.96	22.99	24.90	30.87	37.98
Pennsylvania	21.48	22.37	24.70	30.23	36.68
Other States [2]	20.10	20.48	24.95	31.67	38.77
Average for United States	20.97	22.01	24.49	30.34	37.17

[1] Included with "Other States."
[2] Comprises Kentucky, Maryland, Massachusetts, Michigan (1947–48 only), Minnesota, Tennessee, Texas, Virginia, and West Virginia.

The average monthly prices of foundry, Bessemer, and basic pig iron at Valley furnaces and foundry pig iron at Birmingham furnaces, according to published market quotations, are summarized in the accompanying table.

Average monthly prices per net ton of chief grades of pig iron, 1947–48

[Metal Statistics, 1949]

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	
	1947	1948	1947	1948	1947	1948	1947	1948
January	$24.00	$32.28	$27.23	$35.06	$27.68	$35.51	$26.79	$34.62
February	24.00	32.48	27.23	35.27	27.68	35.71	26.79	34.82
March	26.06	32.48	29.91	35.27	30.36	35.71	29.46	34.82
April	26.68	32.48	29.91	35.27	30.36	35.71	29.46	34.82
May	26.68	33.77	29.91	35.27	30.36	35.71	29.46	34.82
June	26.68	35.16	29.91	35.27	30.36	35.71	29.46	34.82
July	27.88	37.34	31.36	38.29	31.80	38.73	30.91	37.84
August	29.80	38.73	32.59	38.84	33.04	39.29	32.14	38.39
September	29.80	38.73	32.59	38.84	33.04	39.29	32.14	38.39
October	29.80	38.73	32.59	40.66	33.04	41.11	32.14	40.21
November	29.80	38.73	32.59	41.52	33.04	41.96	32.14	41.07
December	29.80	38.73	32.59	41.52	33.04	41.96	32.14	41.07
Average annual	27.58	35.80	30.70	37.58	31.14	38.04	30.20	37.14

Composite prices of finished steel in the United States, 1941–48, by months, in cents per pound [1]

[Iron Age]

Month	1941	1942	1943	1944	1945	1946	1947	1948
January	2.396	2.396	2.396	2.396	2.412	2.464	2.877	3.193
February	2.396	2.396	2.396	2.396	2.427	2.555	2.884	3.125
March	2,396	2.396	2.396	2.396	2.432	2.719	2.884	3.241
April	2.396	2.396	2.396	2.396	2.433	2.719	2.884	3.241
May	2.396	2.396	2.396	2.396	2.436	2.719	2.884	3.214
June	2.396	2.396	2.396	2.396	2.464	2.719	2.884	3.211
July	2.396	2.396	2.396	2.396	2.464	2.719	2.914	3.293
August	2.396	2.396	2.396	2.396	2.464	2.719	3.193	3.720
September	2.396	2.396	2.396	2.396	2.464	2.719	3.193	3.720
October	2.396	2.396	2.396	2.396	2.464	2.719	3.193	3.720
November	2.396	2.396	2.396	2.396	2.464	2.719	3.193	3.720
December	2.396	2.396	2.396	2.396	2.464	2.747	3.193	3.720
Average annual	2.396	2.396	2.396	2.396	2.449	2.686	3.014	3.434

[1] Revised figures.

FOREIGN TRADE [2]

A resumption of imports of pig iron from European and trans-Pacific sources resulted in a sevenfold increase of imports into the United States during 1948. The largest supplier was Netherlands, followed in order by Belgium-Luxembourg, Australia, Germany, and Norway.

Pig iron imported for consumption in the United States, by countries, 1944–48, in net tons

[U. S. Department of Commerce]

Country	1944	1945	1946	1947	1948
North America:					
Canada	5,778	[1] 21,433	1,287	1,747	5,729
Mexico			11,248	1,004	
South America:					
Argentina					2
Brazil					551
Europe:					
Austria				281	19,145
Belgium and Luxembourg					33,147
France					17,876
Germany					24,558
Italy					5,001
Netherlands				2,711	45,020
Norway				9,482	23,920
Poland and Danzig				7,466	
Sweden			28		1,301
U. S. S. R.				1,357	
United Kingdom			1,528	8,576	
Asia: India					16,101
Oceania: Australia					26,902
Total: Net tons	5,778	[1] 21,433	14,091	32,624	219,253
Value	$116,408	[1] $440,283	$492,519	$1,738,812	$11,810,853

[1] Corrected figure.

[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.

Exports of pig iron from the United States in 1948, under strict control, were reduced to a token tonnage, most of which went to Canada.

Pig iron exported from the United States, by countries, 1946–48, in net tons

[U. S. Department of Commerce]

Country	1946	1947	1948
North America:			
Canada	11,789	9,523	6,520
Canal Zone	104	278	55
Cuba	122	47	7
Dominican Republic	214		
El Salvador	62	34	
Other North America	29	19	2
South America:			
Argentina	4,772	140	
Chile	904	500	140
Colombia	756		
Peru	854	224	228
Uruguay	3,366	3	
Venezuela	497		
Other South America	411	6	
Europe:			
Belgium-Luxembourg		29,262	
France	14,000		
Greece	695	3	30
Italy	16,856		
Portugal	2,316		
Sweden	24,082		
Other Europe	1,232		
Asia:			
China	12,155		
Philippines, Republic of	60	133	50
Other Asia	112		
Africa:			
Egypt	143	30	
Other Africa	167		
Total: Net tons	95,698	40,202	7,032
Value	$2,670,369	$1,011,502	$217,237

Imports and exports of iron and steel products are given in detail in the following tables. As in the case of pig iron, exports of most of these commodities were under control in 1948, and dropped sharply in quantity from 1947. Most of the imports of semimanufactures consisted of rolling stock in the form of ingots, blooms and slabs, and plates. Of the manufactures, the bulk of the tonnage consisted of structural shapes. The bulk of the exports consisted of tin plates, black sheet, other plates, and steel bars. In the manufactures the largest tonnage consisted of railroad rails, structural shapes, and tubular products for the petroleum industry.

Iron and steel imported for consumption in the United States, 1946–48, by products

[U. S. Department of Commerce]

Product	1946 Net tons	1946 Value	1947 Net tons	1947 Value	1948 Net tons	1948 Value
Semimanufactures:						
Steel bars:						
Concrete reinforcement bars	(1)	$23	2	$191	790	$79,008
Solid or hollow, n. e. s	863	183,311	687	161,230	5,007	527,480
Hollow and hollow drill steel	101	19,773	37	7,515	63	15,148
Bar iron	404	62,932	250	46,526	191	38,825
Wire rods, nail rods, and flat rods up to 6 inches in width	6,051	795,104	6,018	906,483	6,607	1,045,595
Boiler and other plate iron and steel, n. e. s	2,048	124,846	663	52,652	21,735	2,145,259
Steel ingots, blooms, and slabs	589	44,968	1,513	68,353	17,885	969,595
Billets, solid or hollow	603	43,124	4	798	5,399	441,416
Die blocks or blanks; shafting, etc	273	69,083	240	79,054	48	16,475
Circular saw plates	(1)	397	2	1,632	5	3,090
Sheets of iron or steel, common or black and boiler or other plate iron or steel	113	11,568	750	58,819	8,601	1,250,130
Sheets and plates and steel, n. s. p. f	91	20,092	431	48,941	3,988	409,026
Tin plate, terneplate, and taggers' tin	334	90,143	655	192,853	207	74,631
Total semimanufactures	11,470	1,465,364	11,252	1,625,047	70,526	7,015,678
Manufactures:						
Structural iron and steel	875	106,447	1,730	257,073	65,813	6,562,794
Rails for railways	5,771	113,678	8,859	211,223	5,063	266,032
Rail braces, bars, fishplates or splice bars, and tie plates	2,226	81,089	1,408	57,188	1,721	66,200
Pipes and tubes:						
Cast-iron pipe and fittings	215	42,959	59	10,155	1,981	341,206
Other pipes and tubes	203	26,045	6,228	1,519,443	2,561	290,966
Wire:						
Barbed			(1)	32	(1)	24
Round wire, n. e. s	207	40,341	97	25,423	25	14,482
Telegraph, telephone, etc., except copper, covered with cotton jute, etc	6	3,941	122	28,949	2	2,337
Flat wire and iron or steel strips	2,947	2,095,054	2,634	1,885,742	2,125	1,907,705
Rope and strand	294	89,483	312	92,438	280	107,963
Galvanized fencing wire and wire fencing	9	129	3	308	(1)	53
Hoop or band iron or steel, for baling					545	53,615
Hoop, band and strips, or scroll iron or steel, n. s. p. f	50	65,944	35	48,058	2,261	259,610
Nails	183	53,222	116	51,357	2,045	459,691
Castings and forgings, n. e. s	1,047	217,289	1,216	303,499	660	197,245
Total manufactures	14,033	2,935,621	22,819	4,490,888	85,082	10,529,923
Grand total	25,503	4,400,985	34,071	6,115,935	155,608	17,545,601

1 Less than 1 ton.

Iron and steel exported from the United States, 1946–48, by products

[U. S. Department of Commerce]

Products	1946 Net tons	1946 Value	1947 Net tons	1947 Value	1948 Net tons	1948 Value
Semimanufactures:						
Steel ingots, blooms, billets, slabs, and sheet bars	452,534	$21,316,011	491,215	$32,490,308	219,340	$16,737,092
Iron and steel bars and rods:						
Iron bars	25,572	2,059,874	34,752	3,948,426	3,659	533,323
Concrete reinforcement bars	199,651	12,624,758	248,373	23,191,211	130,298	12,804,067
Other steel bars	478,637	37,727,642	1 850,126	1 91,421,172	408,977	47,285,914
Wire rods	62,355	3,838,543	71,237	7,116,964	38,143	3,763,553
Iron and steel plates, sheets, skelp, and strips:						
Boiler plates	61,703	3,766,241	32,558	2,762,273	28,877	2,944,356
Other plates, not fabricated	470,904	29,655,835	529,922	45,086,679	318,820	30,503,504
Skelp iron or steel	56,563	2,609,715	67,403	3,451,166	57,920	3,370,867
Iron and steel sheets, galvanized	77,747	7,556,987	74,440	10,511,185	62,782	8,211,687
Steel sheets, black, ungalvanized	482,783	46,077,869	568,760	85,165,592	416,481	57,396,092

See footnote at end of table.

Iron and steel exported from the United States, 1946–48, by products—Continued

Products	1946 Net tons	1946 Value	1947 Net tons	1947 Value	1948 Net tons	1948 Value
Semimanufactures—Continued						
Iron and steel plates, sheets, skelp, and strips—Continued						
Iron sheets, black	31,177	$2,477,937	30,215	$3,753,982	17,773	$2,008,229
Strip band, and scroll iron or steel:						
Cold-rolled	64,626	9,323,516	89,618	[1] 17,507,117	59,483	12,405,506
Hot-rolled	84,376	6,323,882	107,149	10,963,981	69,094	7,569,374
Tin plate, terneplate, and taggers tin	398,490	43,568,821	620,198	86,917,802	613,785	97,102,604
Total semimanufactures	2,947,118	228,927,631	[1] 3,815,966	[1] 424,287,858	2,445,432	302,636,168
Manufactures—steel-mill products:						
Structural iron and steel:						
Water, oil, gas, and other storage tanks complete and knocked-down material	49,331	5,872,907	98,234	15,178,585	92,448	15,327,353
Structural shapes:						
Not fabricated	319,103	18,074,652	463,375	32,519,487	292,176	23,388,444
Fabricated	99,477	14,890,198	[1] 246,122	[1] 38,812,416	161,174	37,955,237
Plates, fabricated, punched, or shaped	34,856	2,629,060	[1] 36,876	[1] 4,199,751	23,551	3,728,580
Metal lath	3,538	679,016	5,717	1,216,971	7,233	1,661,125
Frames, sashes, and sheet piling	27,356	2,092,382	37,709	4,388,473	37,687	4,765,370
Railway-track material:						
Rails for railways	385,583	18,520,263	500,582	31,732,249	308,375	23,550,272
Rail joints, splice bars, fishplates, and tie plates	53,072	4,164,363	119,411	9,897,099	49,356	5,085,002
Switches, frogs, and crossings	6,763	1,216,754	7,249	1,651,127	5,467	1,430,134
Railroad spikes	12,045	1,214,087	23,459	2,684,325	9,268	1,283,138
Railroad bolts, nuts, washers, and nut locks	8,470	1,372,811	7,759	1,603,871	7,666	1,852,157
Tubular products:						
Boiler tubes	44,565	6,688,123	[1] 69,836	[1] 13,267,387	38,455	7,784,355
Casing and oil-line pipe	179,781	18,912,327	[1] 333,377	[1] 40,121,614	371,914	48,626,644
Seamless black pipe, other than casing and oil line	14,870	1,838,380	18,717	2,856,028	21,692	3,377,439
Welded black pipe	85,280	8,174,177	[1] 88,876	[1] 10,767,626	61,560	9,700,712
Welded galvanized pipe	61,062	7,100,025	70,219	11,577,836	41,761	7,944,365
Malleable-iron screwed pipe fittings	4,431	1,924,231	5,164	2,887,552	4,490	3,327,067
Cast-iron screwed pipe fittings	1,030	302,017	2,946	[1] 1,279,105	2,650	906,486
Cast-iron pressure pipe and fittings	43,724	3,154,665	41,040	3,575,451	32,066	3,823,795
Cast-iron soil pipe and fittings	2,727	286,013	5,602	849,972	4,568	904,290
Riveted-steel or iron pipe and fittings	72,985	17,617,034	101,850	30,914,371	68,938	29,075,781
Wire and manufactures:						
Barbed	52,509	5,613,481	84,346	12,093,216	76,827	11,818,185
Galvanized wire	65,218	10,019,634	101,026	19,428,575	50,314	9,426,895
Iron and steel wire, uncoated	46,800	4,862,386	78,862	12,322,992	39,789	6,096,728
Wire rope and strand	34,710	11,594,081	30,829	10,319,192	13,643	4,845,673
Woven-wire fencing and screen cloth	13,258	3,815,838	18,356	7,481,477	17,357	6,983,470
All other	35,564	10,116,336	67,443	18,513,762	57,352	15,733,926
Nails and bolts (except railroad):						
Wire nails	19,102	2,046,774	25,754	3,915,832	19,662	3,358,447
Horseshoe nails	2,080	676,421	1,025	368,679	428	148,924
All other nails, including tacks and staples	9,570	2,013,472	14,970	3,714,788	14,486	4,235,526
Bolts, nuts, rivets, and washers (except aircraft and railroad)	31,622	9,216,175	48,323	15,487,672	54,311	16,908,269
Castings and forgings:						
Horseshoes, mule shoes, and calks	1,859	274,969	897	178,977	582	112,854
Iron and steel, including car wheels, tires, and axles	121,396	15,202,594	191,292	24,307,976	116,763	19,531,742
Total manufactures	1,943,737	212,175,646	[1] 2,947,243	[1] 390,114,434	2,104,009	334,698,385
Advanced manufactures:						
House-heating boilers and radiators		527,680		1,898,479		854,207
Oil burners and parts		5,541,272		[1] 15,903,984		3,976,851
Tools:						
Axes		826,970		1,379,579		1,445,567
Shovels, spades, scoops, and drainage tools		844,529		1,404,422		823,711
Hammers and hatchets		1,033,422		1,665,521		1,496,997
Saws, wood and metal cutting		5,260,775		7,441,018		5,837,284
All other tools		34,383,214		57,877,807		42,942,880
Total advanced manufactures		48,417,862		[1] 87,570,810		57,376,497

[1] Revised figure.

WORLD PRODUCTION

World production of steel in 1948 set a peacetime high and ranked third largest on record. The increase over 1947 was due to some extent to an increase in the United States output, but more important were the increases in European as well as Japanese production. German output nearly doubled in 1948 over the previous year and exceeded 6,000,000 tons. Luxembourg increased nearly a million tons, United Kingdom 2,000,000, and Belgium 1,000,000, and substantial increases were reported from the smaller producing nations.

The following table shows pig-iron production from records of the Bureau of Mines and production of steel by most of the important producing nations as compiled by the American Iron and Steel Institute.

World production of pig iron (including ferro-alloys), by countries, 1942–48, in metric tons [1]

[Compiled by Pauline Roberts]

Country [1]	1942	1943	1944	1945	1946	1947	1948
Australia [2]	1, 582, 641	1, 421, 765	1, 326, 308	1, 135, 648	920, 829	1, 161, 479	1, 254, 622
Austria	783, 481	965, 000	926, 178	101, 549	57, 868	278, 505	613, 209
Belgium	1, 269, 450	1, 630, 570	718, 490	734, 580	2, 160, 830	2, 816, 780	3, 936, 909
Brazil	213, 619	247, 680	292, 169	259, 909	369, 254	480, 929	532, 394
Canada	1, 981, 309	1, 773, 866	1, 836, 088	1, 774, 497	1, 407, 285	1, 986, 698	2, 151, 439
Chile	4, 376	9, 256	5, 948	172, 242	365, 345	480, 638	([3])
China [4]	4, 743, 251	1, 867, 507	2, 121, 574	493, 575	31, 000	35, 733	[5] 47, 400
Czechoslovakia	1, 596, 000	1, 704, 000	1, 584, 000	576, 000	961, 000	1, 422, 466	1, 660, 000
Finland	28, 886	43, 277	100, 303	36, 798	77, 088	70, 637	[6] 75, 000
France	3, 837, 621	4, 920, 730	2, 892, 694	1, 197, 142	3, 494, 258	4, 885, 700	6, 573, 000
Germany	15, 441, 000	15, 972, 000	13, 370, 000	[6] [7] 1 123 000	[8] 2, 083, 400	[8] 2, 261, 200	[8] 5, 630, 399
Hungary	420, 470	420, 620	[9] 396, 260	[9] 43, 700	160, 180	299, 460	[5] 121, 000
India	1, 859, 108	1, 776, 941	1, 453, 713	1, 417, 309	1, 466, 542	1, 463, 112	1, 456, 778
Indochina, French	1, 146	2, 922	1, 926	----------	----------	([3])	([3])
Italy	974, 262	734, 207	279, 057	71, 355	199, 600	384, 000	524, 600
Japan	4, 423, 700	4, 112, 900	2, 794, 100	980, 800	217, 400	372, 000	832, 300
Korea	398, 428	543, 492	567, 856	141, 308	[5] 10, 000	[5] 20, 000	([3])
Luxembourg	1, 689, 121	2, 289, 740	1, 348, 096	316, 477	1, 364, 400	1, 818, 160	2, 626, 300
Mexico [10]	123, 761	126, 325	135, 157	218, 322	282, 243	235, 620	270, 391
Netherlands	151, 000	94, 000	67, 000	25, 000	186, 800	287, 990	442, 000
Norway	110, 838	144, 855	123, 745	50, 995	135, 410	165, 320	202, 184
Poland	741, 700	741, 700	690, 900	228, 249	725, 736	867, 121	1, 133, 000
Rumania	161, 014	172, 806	140, 736	53, 862	65, 867	89, 924	80, 000
Saar	2, 161, 000	2, 302, 000	1, 629, 000	([11])	234, 562	720, 720	1, 232, 000
Spain	549, 030	697, 318	564, 294	488, 414	509, 441	517, 180	530, 253
Sweden	771, 190	831, 769	888, 219	785, 359	719, 336	724, 569	754, 300
Switzerland	12, 400	15, 400	29, 400	2, 770	11, 500	5, 000	12, 000
Turkey	67, 350	55, 259	69, 795	69, 524	78, 886	99, 027	166, 467
Union of South Africa	362, 800	486, 800	471, 520	555, 700	560, 000	630, 000	651, 100
U. S. S. R. [5]	4, 280, 000	5, 500, 000	7, 210, 000	8, 730, 000	9, 780, 000	11, 200, 000	12, 770, 000
United Kingdom	7, 726, 000	7, 302, 250	6, 844, 621	7, 221, 474	7, 885, 564	7, 909, 543	9, 422, 848
United States	55, 316, 075	56, 969, 248	57, 059, 457	49, 855, 561	42, 023, 299	54, 558, 725	56, 214, 008
Yugoslavia	([3])	([3])	([3])	([3])	([3])	163, 000	172, 000
Total (estimate)	113, 900, 000	115, 900, 000	108, 000, 000	79, 000, 000	78, 700, 000	98, 500, 000	112, 700, 000

[1] Pig iron is also produced in Belgian Congo, New Zealand, and Republic of the Philippines, but quantity produced is believed insufficient to affect estimate of world total.
[2] Data for fiscal year ended June 30 of year stated.
[3] Data not available; estimate by author of chapter included in total.
[4] Figures for 1942–44 include Manchuria. Figures for Manchuria in 1945–48 are not available, but estimates are included in world total.
[5] Estimate.
[6] January, February, September–December inclusive, only.
[7] Excludes Russian Zone.
[8] Bizonal area.
[9] Data represents Trianon Hungary after October 1944.
[10] Excluding ferro-alloy production, for which data are not yet available.
[11] Included with Germany.

World production of steel, by major producing countries, 1944–48, in net tons

[American Iron and Steel Institute]

Country	1944	1945	1946	1947	1948
Austria		189,155	206,681	394,293	714,400
Belgium	701,063	812,395	2,517,653	[1] 3,179,728	4,317,709
Canada	2,930,174	2,803,097	2,293,005	2,901,670	3,158,828
Czechoslovakia	2,777,796	1,044,980	1,843,046	2,519,858	2,915,600
France	3,408,311	1,822,077	4,858,938	6,338,225	7,983,959
Germany	20,191,930	[2] 321,872	[2] 2,962,982	[2] 3,290,366	[2] 6,126,583
Hungary	765,878	141,535	388,891	657,853	818,300
Italy	1,137,574	436,511	1,269,850	1,874,000	2,342,498
Japan	[3] 7,031,572	1,177,256	608,470	1,040,571	1,889,342
Luxembourg	1,388,898	291,007	1,426,376	[1] 1,888,306	2,703,942
Poland	755,000	545,670	1,343,704	1,730,611	2,070,100
Saar	1,974,220		320,769	776,019	1,345,908
Spain	545,935	617,308	655,868	581,132	590,256
Sweden	1,319,936	1,326,560	1,334,885	1,310,635	1,384,489
U. S. S. R.	15,400,000	19,800,000	20,000,000	[1] 22,000,000	22,200,000
United Kingdom	13,599,264	13,243,328	14,219,520	14,246,400	16,662,240
United States	89,641,600	79,701,648	66,602,724	84,894,071	88,640,470
Total 17 countries	163,569,151	124,274,399	122,853,362	[1] 149,623,738	[4] 165,864,624

[1] Revised figure.
[2] American, British, and French Zones.
[3] Includes Korea and Manchuria.
[4] Author's note: Total world production was about 170,200,000 tons. This included the following outputs, as reported by the United Nations, in thousands of net tons: Australia 1,360; Brazil 508; India 1,346; Mexico 296; Turkey 109; and Union of South Africa 660. China produced a small unreported quantity.

Belgium.—At the beginning of 1948 Belgium had a total of 38 furnaces in blast.[3]

A strike of Belgian iron and steel workers during June 1948 reduced output of pig iron and steel sharply. Production of pig iron (including ferro-alloys) totaled only 231,000 metric tons in June compared with 320,000 tons in May. Steel ingots and castings decreased from 306,000 tons to 231,000 tons and rolled products from 260,000 tons to 204,000 tons during June. South America continued to be the most important foreign customer for Belgian steel products. However, financial problems restricted shipments; Argentina has large orders with the Belgian iron and steel industry, but reserves of Belgian francs in Argentina were low. Consequently, the fulfilment of orders will depend, to a large extent, on whether a new trade agreement can be concluded by the two countries.[4]

France.—A new company, Sollac, formed by eight French steel concerns, opened negotiations late in 1948 to purchase steel rolling-mill equipment in the United States worth $50,000,000, using ECA funds. The mills were planned to be erected at Hayange and Edange. Included were a blooming mill, a 10-stand, hot-strip mill, a 5-stand cold mill, and a 3-stand, tandem, cold-strip mill.

Germany.—The Governments of the United States, United Kingdom, and France have drawn up a statute establishing an international authority to control the Ruhr. This statute will be effective after ratification by these countries and the three Benelux countries. It will have power to allocate coal, coke, and steel from the Ruhr for German consumption and the export markets.[5]

[3] Metal Bulletin (London), No. 3260, Jan. 23, 1948, p. 12.
[4] Iron & Coal Trades Review, vol. 107, No. 4197, Aug. 20, 1948, p. 430.
[5] Metal Bulletin (London), No. 3354, December 1948, p. 19.

The steel-production rate in Germany at the close of 1948 was approximately 600,000 metric tons per month.

Poland.—Late in 1948 Poland announced a 6-year plan to begin in 1950 with a goal of doubling its prewar steel production.

Southern Rhodesia.—The first iron and steel plant in Southern Rhodesia was opened officially in April 1948 to produce pig iron and in June poured the first ingots from an open-hearth furnace. The plant, known as the Riscom Works (Rhodesian Iron and Steel Commission), is at Que Que, the geographic center of Southern Rhodesia. The blast furnace is small, having a daily capacity of only 75 tons; it is using iron ore produced from an open-pit mine at Que Que and coke which must be hauled 370 miles from Wankie. The iron ore used is a banded hematite said to be unusually low in silica.

Sweden.—The market for Swedish iron and steel attained a record high during 1948. Requirements during much of 1948 averaged 120,000 tons per month—50 percent higher than during the previous period and 33 percent more than the average for the previous 10-year period. A large domestic demand restricted exports greatly, but the steel industry expected that exports to European markets would increase on a barter basis. A shortage of charcoal and scrap in 1948 restricted production somewhat, and a switch from charcoal to coke as a fuel was progressing as rapidly as possible.[6]

Switzerland.—The only blast furnace in Switzerland, at Choindez, was blown in after having been idle for several years. The furnace was constructed in 1846.

U.S.S.R.—The Chelyabinsk Iron and Steel Works, under construction in the Urals during World War II, is reported already to have reached the production goal of the postwar 5-year plan, which ends in 1950. The plant produces electric steel and is said to be working on orders for ball-bearing steel. The second section of its power station began functioning recently, and the third was scheduled to begin operation in May. A new battery of coke ovens was scheduled for operation in future, and plans were being made for constructing an open-hearth furnace.[7]

Under the present 5-year plan Russia has a steel production goal of 25,400,000 tons in 1950.

United Kingdom.—The steel industry in the United Kingdom has not yet been nationalized, but a bill to bring the industry under public ownership was introduced in 1948. The bill covers iron mining, pig-iron smelting, steel production, and hot rolling.

Preliminary construction work was begun late in 1948 to construct a new steel plant at Margram, Wales, to be completed in 1951. The cost of the plant is estimated at the equivalent of $240,000,000; it will have a weekly capacity of 20,000 tons of pig iron and 15,000 tons of steel.[8]

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[6] Mining Journal (London), vol. 231, No. 5903, Oct. 9, 1948, p. 740.
[7] The Metal Bulletin (London), No. 3290, May 11, 1948, p. 10.
[8] Mining World, vol. 10, No. 13, Dec. 1948, p. 31.

Iron and Steel Scrap

By NORWOOD B. MELCHER AND JAMES E. LARKIN

GENERAL SUMMARY

A RECORD peacetime production of steel ingots and castings in 1948 resulted in a 5-percent increase in the use of ferrous materials (scrap and pig iron) over 1947 to establish an all-time record. In spite of this consumption rate, purchased iron- and steel-scrap stocks were 60-percent higher on December 31 than at the beginning of the year, equivalent to a 55-day supply at the 1948 average daily consumption rate of 88,919 short tons. Consumption of purchased scrap in 1948 established a new record; home-scrap consumption (representing 26-percent of the total melt) was the largest since 1944. Pig-iron consumption during 1948 showed a 3-percent increase over 1947 and reached a peacetime high. Work stoppages in coal mines occurred during March 15 through April 25, 1948, resulting in curtailment of the use of ferrous materials and loss of approximately 1,000,000 tons in steel production during April. During July there was a work stoppage for 9 days at the captive mines, but this did not curtail steel production to a large extent.

The proportions of scrap and pig iron used in 1948 were virtually unchanged from the previous year. The steel-furnace melt comprised 48 percent scrap and 52 percent pig iron during 1948, compared with 47 percent scrap and 53 percent pig iron during 1947. The charge of scrap and pig iron used in iron foundries (mainly cupola furnaces) comprised 67 percent scrap and 33 percent pig iron, compared with 64 and 36 percent, respectively, in 1947.

The continued increase in the use of purchased scrap during the year was effected by a record-breaking monthly consumption (March) and a record monthly average use of 2,700,000 short tons for the year. October and November were the peak steel-producing months, although less purchased scrap was used than in March; 23 percent of the total charge in steel-making furnaces for these months was purchased scrap, compared with 24 percent in March.

Salient statistics of ferrous scrap and pig iron in the United States, 1947–48

	1947 (short tons)	1948 (short tons)	Percent of change from 1947
Stocks, December 31: Ferrous scrap and pig iron at consumers' plants:			
Home scrap	1,400,719	1,598,673	+14
Purchased scrap	3,030,221	4,859,463	+60
Pig iron	988,435	1,606,160	+62
Total	5,419,375	8,064,296	+49
Consumption: Ferrous scrap and pig iron charged to—			
Steel furnaces:[1]			
Home scrap	23,993,919	24,689,529	+3
Purchased scrap	20,791,449	22,890,571	+10
Pig iron	50,177,381	52,177,785	+4
Total	94,962,749	99,757,885	+5
Iron furnaces:[2]			
Home scrap	7,509,888	7,656,258	+2
Purchased scrap	7,055,910	8,129,363	+15
Pig iron	8,112,301	7,848,524	−3
Total	22,678,099	23,634,145	+4
Miscellaneous uses[3] and ferro-alloy production:			
Home scrap	75,135	73,856	−2
Purchased scrap	1,438,060	1,524,298	+6
Pig iron	1,073	95	−91
Total	1,514,268	1,598,249	+6
All uses:			
Home scrap	31,578,942	32,419,643	+3
Purchased scrap	29,285,419	32,544,232	+11
Total ferrous scrap	60,864,361	64,963,875	+7
Pig iron	58,290,755	60,026,404	+3
Grand total	119,155,116	124,990,279	+5
Imports of scrap (including tin plate scrap):	70,683	461,086	+552
Exports of scrap:			
Iron and steel	164,276	205,321	+25
Tin plate, waste-waste, circles, strips, cobbles, etc	[4] 29,805	36,704	+23
Average prices per gross ton:			
Scrap:			
No. 1 Heavy-Melting, Pittsburgh[5]	$37.13	$41.36	+11
No. 1 Cast Cupola, Chicago[5]	$47.12	$70.48	+50
For export	$56.57	$57.92	+2
Pig iron, f. o. b. Valley furnaces:[5]			
Basic	$33.85	$41.62	+23
No. 2 Foundry	$34.35	$42.12	+23

[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] Revised figure.
[5] Iron Age.

During November, the Secretary of Commerce appointed a Scrap Drive Committee to assist the Office of Industry Cooperation in its efforts to increase the flow of ferrous scrap from industry, farms, and auto-wrecking yards to mills and foundries through a Nation-wide industrial iron- and steel-scrap drive. The committee was composed of leading trade-association executives representing industries that are potential sources of large quantities of obsolete iron and steel machinery and equipment. Unlike wartime scrap drives, this iron and steel drive did not extend to the Nation's households. Emphasis was placed on high-grade heavy scrap in the form of heavy pieces, such as obsolete industrial equipment, old tractors and plows, and junked automobiles.

An Industry-Government Scrap Mission to Germany, headed by John L. Haynes, Department of Commerce, made a study in Germany of potential scrap supplies there from December 30, 1947, to February 26, 1948, and recommended that "the collection, processing, and export of this material should be pursued under Military Government directives." This mission found that by far the largest scrap supply in Germany and the most difficult to assess in quantitative terms is rubble scrap. Estimates, not made by the mission but included in its report, placed rubble scrap at 3,000,000 to 10,000,000 tons, of which the most readily accessible portion is railway, bridge, and industrial type. The gathering of rubble scrap, however, was considered extremely difficult because of the problems involved in identifying or locating owners and then inducing them to sell, owing to the fact that the returns paid in reichsmarks had very little value. The mission also reported that dealers' yards contained large tonnages of unprepared scrap, but they were unable to prepare and ship more than 50,000 to 70,000 tons per month, because of currency and price problems, and inadequacy or bad state of repair of dealers' equipment.

Robert W. Wolcott, president, Lukens Steel Co., at the request of the Secretary of Commerce studied the German scrap market from June 29 to July 29, 1948, and upon his return said "there was enough scrap in Germany to support an extensive export program as well as to supply the needs of the German steel industry." He stated further that "a lack of understanding between the American and British Military Governors on several important points is one retardant to the immediate exportation of scrap from Germany." These points were the proper percentages of scrap that should go to the United States, consideration of future allocations, the definition of booty scrap, and the proper prices for scrap export sales. Upon settlement of these points there could be a substantial flow of scrap from Germany to the United States. Plans made to establish a private corporation under Government sponsorship to serve as a single buying agency for German scrap were abandoned in November.

Imports of iron and steel scrap in 1948 totaled 415,072 short tons, of which 179,725 short tons originated in Germany.

CONSUMPTION

A continued large use of scrap as compared with that of pig iron was noticeable in the New England, Southwestern, and Pacific Coast districts in 1948. These districts together, as in 1947, 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 3.8:1, whereas for the United States at large it was 1.1:1.

Open-hearth 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, although considerably less purchased scrap was used in 1948 than previously; open-hearth consumption accounted for 63 percent of the total scrap in 1948, 65 percent in 1947, and 66 percent in 1946; 68 percent of the home scrap in 1948 and 69 percent in both 1947 and 1946; and 57 percent of the purchased scrap in 1948, 60 percent in 1947, and 61 percent in 1946. Pig-iron consumption in open hearths accounted for 79 percent of the total pig iron consumed in 1948 and 78 percent in 1947.

Cupola-furnace consumption in 1948 was as follows: Home scrap, 16 percent of the total, compared with 17 percent in both 1947 and 1946; purchased scrap, 19 percent compared with 18 percent in both 1947 and 1946; pig iron, 9 percent in both 1948 and 1947 compared with 10 percent in 1946.

Bessemer converters consumed 8 percent of the pig iron for the past 3 years compared with 9 percent in 1945 and 1944, and 0.4 percent of the scrap in both 1948 and 1947 compared with 0.5 percent in 1946.

Electric furnaces consumed 10 percent of the total scrap compared with 9 percent in 1947 and 7 percent in 1946, and 0.2 percent of the pig iron in both 1948 and 1947 compared with 0.3 percent in 1946.

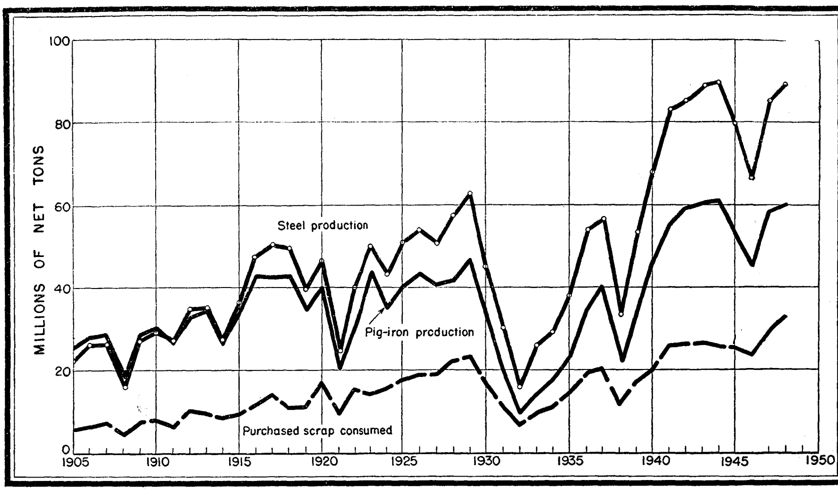

FIGURE 1.—Consumption of purchased scrap and output of pig iron and steel in the United States, 1905–48. Figures on consumption of purchased scrap for 1905–32 are from State of Minnesota vs. Oliver Iron Mining Co., et al., Exhibits, vol. 5, 1935, p. 328; those for 1933–34 are estimated by authors; and those for 1935–48 are based on Bureau of Mines reports. Data on output of steel are as given by the American Iron and Steel Institute.

Ferrous scrap and pig iron consumed in the United States and percent of total derived from home scrap, purchased scrap, and pig iron, 1947–48, by districts

District	1947					1948				
	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	1,373,904	33.5	40.9	74.4	25.6	1,434,132	30.9	45.2	76.1	23.9
Middle Atlantic [1]	39,294,390	25.7	22.0	47.7	52.3	40,957,933	25.8	23.0	48.8	51.2
Southeastern [1]	14,915,694	24.4	20.5	44.9	55.1	16,467,121	24.0	21.0	45.0	55.0
Southwestern	872,660	24.5	61.1	85.6	14.4	1,045,433	22.4	54.9	77.3	22.7
North Central [1]	56,455,556	27.5	25.3	52.8	47.2	58,760,287	26.7	27.1	53.8	46.2
Rocky Mountain	2,778,329	27.5	17.9	45.4	54.6	2,921,947	25.8	20.0	45.8	54.2
Pacific Coast [1]	3,049,266	22.0	56.6	78.6	21.4	3,403,426	22.6	58.4	81.0	19.0
Undistributed [1]	415,317	42.0	5.9	47.9	52.1					
Total	119,155,116	26.[illegible]	24.6	51.1	48.9	124,990,279	25.9	26.1	52.0	48.0

[1] In 1947, some scrap and pig iron consumed in the Middle Atlantic, Southeastern, North Central, and Pacific Coast districts—(not separable)—are included with "Undistributed."

Proportion of home and purchased scrap and pig iron used in furnace charges in the United States, 1947–48, in percent

Type of furnace	1947				1948			
	Scrap			Pig iron	Scrap			Pig iron
	Home	Purchased	Total		Home	Purchased	Total	
Open-hearth	25.7	20.7	46.4	53.6	25.1	21.1	46.2	53.8
Bessemer	4.3	1.2	5.5	94.5	3.9	1.1	5.0	95.0
Electric	38.4	59.2	97.6	2.4	34.9	63.2	98.1	1.9
Cupola	32.8	33.2	66.0	34.0	31.8	36.7	68.5	31.5
Air [1]	50.3	25.7	76.0	24.0	50.5	28.5	79.0	21.0
Crucible	24.1	39.2	63.3	36.7	25.0	31.8	56.8	43.2
Puddling		18.2	18.2	81.8	1.1	23.2	24.3	75.7
Blast	52.0	48.0	100.0		49.5	50.5	100.0	

[1] Includes data for 2 Brackelsberg furnaces.

Consumption of ferrous scrap and pig iron in the United States, 1947–48, by type of furnace, in short tons

Type of furnace or equipment	Active plants reporting [1]	Scrap			Pig iron
		Home	Purchased	Total	
1947					
Open-hearth	127	21,727,939	17,560,105	39,288,044	45,338,462
Bessemer	30	212,702	60,261	272,963	4,711,581
Electric	320	2,053,278	3,171,083	5,224,361	127,338
Cupola	2,495	5,240,692	5,316,947	10,557,639	5,438,727
Air	122	} 867,170	442,934	1,310,104	413,900
Brackelsberg	2				
Crucible	15	864	1,401	2,265	1,312
Puddling	3		3,691	3,691	16,573
Blast	71	1,401,162	1,290,937	2,692,099	
Direct castings	33				2,241,789
Ferro-alloy	19	9,058	307,916	316,974	
Miscellaneous	128	66,077	1,130,144	1,196,221	1,073
Total	3,365	31,578,942	29,285,419	60,864,361	58,290,755
1948					
Open-hearth	126	22,107,617	18,515,530	40,623,147	47,267,334
Bessemer	30	197,890	53,560	251,450	4,778,137
Electric	320	2,384,022	4,321,481	6,705,503	132,314
Cupola	2,453	5,323,049	6,143,958	11,467,007	5,280,957
Air	122	} 882,490	498,485	1,380,975	368,003
Brackelsberg	2				
Crucible	12	585	744	1,329	1,013
Puddling	3	224	4,578	4,802	14,979
Blast	74	1,449,910	1,481,598	2,931,508	
Direct castings	34				2,183,572
Ferro-alloy	18	9,818	342,108	351,926	
Miscellaneous	120	64,038	1,182,190	1,246,228	95
Total	3,314	32,419,643	32,544,232	64,963,875	60,026,404

[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

During 1948 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 1947, the largest consuming districts were the North Central, Middle Atlantic, and Southeastern. All districts increased over 1947 in total scrap; pig iron increased in all districts except New England and the Pacific Coast. The States having the largest consumption of scrap, with the percentage consumed, were: Pennsylvania 24, Ohio 18, Illinois 10, Indiana 9, Michigan-Wisconsin 8, New York 5, Alabama 4, Maryland 3, and California 3. This order is unchanged from 1947.

Consumption of ferrous scrap and pig iron in the United States, 1944–48, by districts

District and year	Active plants reporting[1]	Scrap: Home: Short tons	Scrap: Home: Change from previous year (percent)	Scrap: Purchased: Short tons	Scrap: Purchased: Change from previous year (percent)	Scrap: Total: Short tons	Scrap: Total: Change from previous year (percent)	Pig iron: Short tons	Pig iron: Change from previous year (percent)
New England:									
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
1947	245	460, 062	+17. 2	561, 545	+17. 5	1, 021, 607	+17. 4	352, 297	+18. 6
1948	241	442, 821	−3. 7	648, 418	+15. 5	1, 091, 239	+6. 8	342, 893	−2. 7
Middle Atlantic:									
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
1947[2]	807	10, 100, 971	+21. 4	8, 626, 526	+30. 4	18, 727, 497	+25. 4	20, 566, 893	+31. 7
1948	792	10, 564, 402	+4. 6	9, 403, 012	+9. 0	19, 967, 414	+6. 6	20, 990, 519	+2. 1
Southeastern:									
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
1947[2]	469	3, 639, 590	+15. 7	3, 059, 105	+20. 1	6, 698, 695	+17. 7	8, 216, 999	+24. 3
1948	471	3, 946, 494	+8. 4	3, 457, 432	+13. 0	7, 403, 926	+10. 5	9, 063, 195	+10. 3
Southwestern:									
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
1947	123	214, 063	+54. 0	532, 740	+32. 3	746, 803	+37. 9	125, 857	+110. 6
1948	120	233, 904	+9. 3	573, 557	+7. 7	807, 461	+8. 1	237, 972	+89. 1
North Central:									
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
1947[2]	1, 356	15, 553, 560	+19. 1	14, 258, 421	+23. 8	29, 811, 981	+21. 3	26, 643, 575	+25. 9
1948	1, 340	15, 708, 820	+1. 0	15, 891, 047	+11. 5	31, 599, 867	+6. 0	27, 160, 420	+1. 9
Rocky Mountain:									
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
1947	88	764, 317	+54. 0	498, 052	+16. 3	1, 262, 369	+36. 6	1, 515, 960	+98. 4
1948	85	753, 167	−1. 5	583, 453	+17. 1	1, 336, 620	+5. 9	1, 585, 327	+4. 6
Pacific Coast:									
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
1947[2]	270	671, 750	+14. 3	1, 724, 540	+26. 5	2, 396, 290	+22. 8	652, 976	+17. 8
1948	265	770, 035	+14. 6	1, 987, 313	+15. 2	2, 757, 348	+15. 1	646, 078	−1. 1
Undistributed:[2]									
1947	7	174, 629	-------	24, 490	-------	199, 119	-------	216, 198	-------
United States:									
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
1947	3, 365	31, 578, 942	+20. 8	29, 285, 419	+25. 4	60, 864, 361	+23. 0	58, 290, 755	+29. 3
1948	3, 314	32, 419, 643	+2. 7	32, 544, 232	+11. 1	64, 963, 875	+6. 7	60, 026, 404	+3. 0

[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.
[2] In 1947, some scrap and pig iron consumed in Middle Atlantic, Southeastern, North Central, and Pacific Coast districts—not separable—are included with "undistributed."

Consumption of ferrous scrap and pig iron in the United States in 1948, by States and districts

State and district	Active plants reporting [1]	Scrap: Home, Short tons	Scrap: Home, Percent of total	Scrap: Purchased, Short tons	Scrap: Purchased, Percent of total	Scrap: Total, Short tons	Scrap: Total, Percent of total	Pig iron: Short tons	Pig iron: Percent of total
Connecticut	64	144,712	0.5	191,055	0.6	335,767	0.5	73,173	0.1
Maine	19	18,101	.1	14,816	(2)	32,917	.1	14,882	(2)
Massachusetts	113	215,584	.7	349,705	1.1	565,289	.9	219,453	.4
New Hampshire	18	12,843	(2)	16,638	.1	29,481	(2)	4,178	(2)
Rhode Island	12	42,413	.1	60,468	.2	102,881	.2	23,520	.1
Vermont	15	9,168	(2)	15,736	(2)	24,904	(2)	7,687	(2)
Total New England	241	442,821	1.4	648,418	2.0	1,091,239	1.7	342,893	.6
Delaware	9								
New Jersey	106	390,757	1.2	659,919	2.0	1,050,676	1.6	374,384	.6
New York	209	1,538,953	4.8	1,518,720	4.7	3,057,673	4.7	2,948,785	4.9
Pennsylvania	468	8,634,692	26.6	7,224,373	22.2	15,859,065	24.4	17,667,350	29.5
Total Middle Atlantic	792	10,564,402	32.6	9,403,012	28.9	19,967,414	30.7	20,990,519	35.0
Alabama	90	1,472,196	4.5	973,850	3.0	2,446,046	3.8	3,500,614	5.8
District of Columbia	3								
Kentucky	27	1,654,820	5.1	1,127,416	3.5	2,782,236	4.3	3,640,266	6.1
Maryland	30								
Florida	17								
Georgia	62	57,803	.2	160,651	.5	218,454	.3	38,565	.1
Mississippi	11	1,963	(2)	2,154	(2)	4,117	(2)	2,271	(2)
North Carolina	50	17,593	.1	26,227	.1	43,820	.1	20,482	(2)
South Carolina	21	10,943	(2)	20,765	(2)	31,708	(2)	9,404	(2)
Tennessee	65								
Virginia	63	252,960	.8	364,547	1.1	617,507	1.0	265,838	.5
West Virginia	32	478,216	1.5	781,822	2.4	1,260,038	1.9	1,585,755	2.6
Total Southeastern	471	3,946,494	12.2	3,457,432	10.6	7,403,926	11.4	9,063,195	15.1
Arkansas	11								
Louisiana	26	31,274	.1	99,443	.3	130,717	.2	7,025	(2)
Oklahoma	17								
Texas	66	202,630	.6	474,114	1.5	676,744	1.0	230,947	.4
Total Southwestern	120	233,904	.7	573,557	1.8	807,461	1.2	237,972	.4
Illinois	245	2,929,099	9.1	3,780,374	11.6	6,709,473	10.3	4,809,697	8.0
Indiana	152	3,703,313	11.4	2,410,939	7.4	6,114,252	9.4	7,075,885	11.8
Iowa	56	188,205	.6	292,370	.9	480,575	.7	91,291	.1
Kansas	34								
Nebraska	15	41,488	.1	83,049	.3	124,537	.2	24,410	(2)
Michigan	187								
Wisconsin	135	2,634,885	8.1	2,550,239	7.8	5,185,124	8.0	2,979,528	5.0
Minnesota	71	237,829	.7	307,429	.9	545,258	.8	458,139	.8
Missouri	67	191,232	.6	720,263	2.2	911,495	1.4	87,654	.1
North Dakota	3								
South Dakota	2	1,281	(2)	1,101	(2)	2,382	(2)	235	(2)
Ohio	373	5,781,488	17.8	5,745,283	17.7	11,526,771	17.8	11,633,581	19.4
Total North Central	1,340	15,708,820	48.4	15,891,047	48.8	31,599,867	48.6	27,160,420	45.2
Arizona	10								
Nevada	3	4,680	(2)	80,673	.2	85,353	.1	1,251	(2)
New Mexico	4								
Colorado	27								
Utah	24	740,962	2.3	476,958	1.5	1,217,920	1.9	1,583,437	2.6
Idaho	6	1,096	(2)	5,666	(2)	6,762	(2)	315	(2)
Montana	9	6,427	(2)	20,148	.1	26,575	.1	320	(2)
Wyoming	2	2	(2)	8	(2)	10	(2)	4	(2)
Total Rocky Mountain	85	753,167	2.3	583,453	1.8	1,336,620	2.1	1,585,327	2.6
California	161	656,228	2.0	1,488,214	4.6	2,144,442	3.3	625,229	1.1
Oregon	44								
Washington	60	113,807	.4	499,099	1.5	612,906	1.0	20,849	(2)
Total Pacific Coast	265	770,035	2.4	1,987,313	6.1	2,757,348	4.3	646,078	1.1
Total United States:									
1948	[1] 3,314	32,419,643	100.0	32,544,232	100.0	64,963,875	100.0	60,026,404	100.0
1947	[1] 3,365	31,578,942	100.0	29,285,419	100.0	60,864,361	100.0	58,290,755	100.0

[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.
[2] Less than 0.05 percent.

CONSUMPTION BY TYPE OF FURNACE

Open-Hearth Furnaces.—Ferrous scrap and pig-iron consumption in open-hearth furnaces in 1948 totaled 87,890,481 short tons, an increase of 4 percent over 1947. This was the greatest quantity consumed in open-hearth furnaces during peacetime and has been exceeded only by 1944, a war year, when 89,089,225 short tons were used. The use of home scrap increased 2 percent, purchased scrap 5 percent, total scrap 3 percent, and pig iron 4 percent. The open-hearth furnace melt in 1948 consisted of 46 percent scrap and 54 percent pig iron, unchanged from 1947. Of the total scrap consumed, 46 percent was purchased compared with 45 percent in 1947 and 44 percent in 1946.

Consumption of ferrous scrap and pig iron in open-hearth furnaces in the United States in 1948, 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	77,358	245,093	322,451	102,403
Rhode Island	1				
Total: 1948	4	77,358	245,093	322,451	102,403
1947	4	127,441	231,235	358,676	96,752
Middle Atlantic:					
Delaware	1				
New Jersey	2	1,283,503	1,044,924	2,328,427	2,708,824
New York	8				
Pennsylvania	44	6,774,628	5,187,540	11,962,168	14,560,428
Total: 1948	55	8,058,131	6,232,464	14,290,595	17,269,252
1947	55	7,712,737	5,907,913	13,620,650	16,857,381
Southeastern and Southwestern:					
Alabama	2				
Georgia	1	1,037,510	762,506	1,800,016	2,889,501
Tennessee	1				
Texas	1				
Kentucky	2				
Maryland	1	1,793,004	1,525,668	3,318,672	4,454,862
Oklahoma	1				
West Virginia	2				
Total: 1948	11	2,830,514	2,288,174	5,118,688	7,344,363
1947	11	2,703,675	2,195,175	4,898,850	6,576,483
North Central:					
Illinois	10	1,754,609	1,918,404	3,673,013	3,516,473
Indiana	6	3,188,559	1,898,228	5,086,787	6,459,289
Michigan	3	696,783	639,151	1,335,934	1,744,402
Minnesota	1				
Missouri	2	258,023	668,765	926,788	445,095
Wisconsin	2				
Ohio	23	4,088,143	3,141,679	7,229,822	8,368,741
Total: 1948	47	9,986,117	8,266,227	18,252,344	20,534,000
1947	48	10,043,360	7,902,926	17,946,286	19,849,518
Rocky Mountain and Pacific Coast:					
California	6				
Colorado	1	1,155,497	1,483,572	2,639,069	2,017,316
Utah	1				
Washington	1				
Total: 1948	9	1,155,497	1,483,572	2,639,069	2,017,316
1947	9	1,140,726	1,322,856	2,463,582	1,958,328
Total United States: 1948	126	22,107,617	18,515,530	40,623,147	47,267,334
1947	127	21,727,939	17,560,105	39,288,044	45,338,462

Pennsylvania again led in the use of scrap in the open hearth in 1948, followed in order by Ohio, Indiana, and Illinois; this rank has remained unchanged since 1936. In 1935, the first year data were compiled on iron and steel scrap, Ohio consumed the largest quantity, followed by Pennsylvania, Indiana, and Illinois.

Bessemer Converters.—The 5,029,587 short tons of ferrous raw materials used in Bessemer converters in 1948 exceeded the use of these materials in this type of furnace during any previous peacetime year and represent a 1-percent increase over 1947. The proportion of scrap in the metal charges was 1 : 20, and of the scrap used, 79 percent was home scrap.

Following the usual pattern, Pennsylvania was the principal consumer of converter scrap in 1948.

Consumption of ferrous scrap and pig iron in Bessemer converters in the United States in 1948, 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	2,315	2,909	5,224	742
New York	1				
Pennsylvania	9	104,529	29,104	133,633	1,591,630
Total: 1948	13	106,844	32,013	138,857	1,592,372
1947	12	106,286	34,172	140,458	1,590,173
Southeastern and Southwestern:					
Alabama	1				
Louisiana	1				
Maryland	1	22,499	10,688	33,187	526,123
Texas	1				
West Virginia	1				
Total: 1948	5	22,499	10,688	33,187	526,123
1947	5	24,597	12,281	36,878	408,803
North Central and Pacific Coast:					
Illinois	2	2,401	4,368	6,769	220,058
Indiana	1				
Iowa	1	10,809	6,319	17,128	305,880
Michigan	1				
Minnesota	1				
Missouri	1	170	172	342	103
Washington	1				
Ohio	4	55,167		55,167	2,133,601
Total: 1948	12	68,547	10,859	79,406	2,659,642
1947	13	81,819	13,808	95,627	2,712,605
Total United States: 1948	30	197,890	53,560	251,450	4,778,137
1947	30	212,702	60,261	272,963	4,711,581

Electric Steel Furnaces.—The total melt of ferrous scrap and pig iron used in electric furnaces in 1948 amounted to 6,837,817 short tons, an increase of 28 percent over the 5,351,699 tons used in 1947 and the largest quantity used in a peacetime year, exceeded only by the 7,308,240 tons used in 1943. The use of scrap increased in all districts and of pig iron in all except Middle Atlantic and New England.

Consumption of ferrous scrap and pig iron in electric steel furnaces in the United States in 1948, by districts and States, in short tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut	4				
New Hampshire	1	8,163	6,141	14,304	358
Massachusetts	9	15,699	12,760	28,459	155
Total: 1948	14	23,862	18,901	42,763	513
1947	14	21,484	17,261	38,745	968
Middle Atlantic:					
Delaware	1				
New Jersey	11	15,174	21,708	36,882	954
New York	16	62,797	90,222	153,019	5,905
Pennsylvania	58	619,909	840,972	1,460,881	15,385
Total: 1948	86	697,880	952,902	1,650,782	22,244
1947	87	659,432	759,205	1,418,637	24,842
Southeastern:					
District of Columbia	1				
Kentucky	2				
Maryland	3	25,586	105,798	131,384	2,355
West Virginia	1				
Alabama	4				
Florida	1	16,095	33,867	49,962	368
Georgia	3				
North Carolina	1				
South Carolina	1				
Tennessee	4	12,841	17,048	29,889	1,097
Virginia	4				
Total: 1948	25	54,522	156,713	211,235	3,820
1947	24	46,766	98,123	144,889	1,583
Southwestern:					
Arkansas	1				
Louisiana	4				
Oklahoma	1	39,644	42,680	82,324	1,001
Texas	8				
Total: 1948	14	39,644	42,680	82,324	1,001
1947	14	32,555	36,817	69,372	451
North Central					
Illinois	25	395,254	780,524	1,175,778	9,267
Indiana	11	37,903	74,530	112,433	913
Iowa	1				
Kansas	1	10,983	14,657	25,640	118
Nebraska	1				
Michigan	21	213,967	366,283	580,250	3,840
Minnesota	4	6,960	8,912	15,872	118
Missouri	8	9,774	16,480	26,254	1,382
Ohio	36	661,645	1,315,489	1,977,134	81,552
Wisconsin	14	75,826	103,933	179,759	4,517
Total: 1948	122	1,412,312	2,680,808	4,093,120	101,707
1947	121	1,185,030	1,925,450	3,110,480	96,922
Rocky Mountain.					
Arizona	1				
Colorado	3				
Nevada	1	9,263	17,361	26,624	268
Utah	1				
Total: 1948	6	9,263	17,361	26,624	268
1947	6	7,336	13,748	21,084	262
Pacific Coast:					
California	28	97,562	230,502	328,064	2,135
Oregon	8	22,082	96,129	118,211	124
Washington	17	26,895	125,485	152,380	502
Total: 1948	53	146,539	452,116	598,655	2,761
1947	54	100,675	320,479	421,154	2,310
Total United States: 1948	320	2,384,022	4,321,481	6,705,503	132,314
1947	320	2,053,278	3,171,083	5,224,361	127,338

Cupolas.—Preliminary figures released by the Bureau of the Census, United States Department of Commerce, indicate that shipments of gray iron castings in 1948 exceeded 1947 by 2 percent. Accordingly, requirements for scrap and pig-iron cupola consumption increased in 1948 as in 1947. Scrap consumption in cupolas totaled 11,467,007 short tons, setting a new record for consumption in this type of furnace during any year since the beginning of the collection of these data by the Bureau of Mines in 1935. Cupola furnaces used 16,747,964 short tons (a record high) of scrap and pig iron, a 5-percent increase over the 15,996,366 tons used in 1947. The use of home scrap increased 2 percent, purchased scrap 16 percent, and total scrap 9 percent; pig iron decreased 3 percent.

Charges to cupolas consisted of 32 percent home scrap, 37 percent purchased scrap, and 31 percent pig iron compared with 33 percent for both home and purchased and 34 percent for pig iron in 1947.

As in 1947, Michigan continued to be the largest consumer of cupola scrap, followed in order by Ohio, Illinois, Pennsylvania, Alabama, Indiana, Wisconsin, New York, and New Jersey.

Consumption of ferrous scrap and pig iron in cupola furnaces in the United States in 1948, by districts and States, in short tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut	49	82,599	109,686	192,285	60,534
Maine	19	18,101	14,816	32,917	14,882
Massachusetts	94	145,783	147,530	293,313	115,328
New Hampshire	16	7,862	14,779	22,641	2,678
Rhode Island	10	24,539	28,408	52,947	17,018
Vermont	15	9,168	15,736	24,904	7,687
Total: 1948	203	288,052	330,955	619,007	218,127
1947	205	254,656	275,471	530,127	227,949
Middle Atlantic:					
Delaware	4	3,203	5,729	8,932	3,281
New Jersey [1]	75	181,704	285,068	466,772	233,565
New York	149	292,970	293,433	586,403	272,823
Pennsylvania [1]	281	435,475	513,308	948,783	513,457
Total: 1948	509	913,352	1,097,538	2,010,890	1,023,126
1947	521	839,633	982,129	1,821,762	998,866
Southeastern:					
Alabama	73	350,193	431,849	782,042	813,012
Maryland [1]	21	50,599	46,627	97,226	49,942
Florida	16	1,505	14,041	15,546	1,357
Georgia	56	24,800	35,251	60,051	34,682
Kentucky [1]	21	44,218	21,452	65,670	131,991
Mississippi	11	1,963	2,154	4,117	2,271
North Carolina	49	17,528	26,227	43,755	20,388
South Carolina	19	10,850	9,942	20,792	9,391
Tennessee	57	161,045	178,246	339,291	179,677
Virginia	57	78,701	137,940	216,641	84,618
West Virginia	20	9,392	20,732	30,124	7,647
Total: 1948	400	750,794	924,461	1,675,255	1,334,976
1947	402	685,072	705,600	1,390,672	1,211,895
Southwestern:					
Arkansas	10	599	2,177	2,776	625
Louisiana	20	2,875	7,598	10,473	1,850
Oklahoma	14	5,912	14,415	20,327	3,797
Texas	50	39,278	106,962	146,240	28,906
Total: 1948	94	48,664	131,152	179,816	35,178
1947	97	45,490	114,858	160,348	32,109

See footnote at end of table.

Consumption of ferrous scrap and pig iron in cupola furnaces in the United States in 1948, by districts and States, in short tons—Continued

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
North Central:					
Illinois [1]	175	558,859	491,136	1,049,995	392,931
Indiana	116	299,919	314,135	614,054	263,271
Iowa	52	169,338	159,862	329,200	84,952
Kansas	32	26,026	59,482	85,508	20,211
Michigan	153	1,063,649	983,829	2,047,478	945,993
Minnesota	59	68,365	113,518	181,883	45,374
Missouri	49	83,759	163,027	246,786	54,167
Nebraska	13	7,431	12,158	19,589	3,973
North Dakota	3	1,281	1,101	2,382	235
South Dakota	2				
Ohio [1]	250	529,878	661,663	1,191,541	502,634
Wisconsin	104	319,677	277,985	597,662	216,028
Total: 1948	1,008	3,128,182	3,237,896	6,366,078	2,529,769
1947	1,020	3,066,780	2,843,594	5,910,374	2,604,875
Rocky Mountain:					
Arizona	4	927	24,331	25,258	1,045
Colorado	20	20,216	49,336	69,552	34,978
Idaho	5	675	3,001	3,676	315
Montana	6	5,823	4,549	10,372	230
New Mexico	2	390	7,713	8,103	165
Utah	15	51,410	38,282	89,692	36,552
Wyoming	2	2	8	10	4
Total: 1948	54	79,443	127,220	206,663	73,289
1947	55	77,377	119,847	197,224	74,044
Pacific Coast:					
California [1]	113	91,661	211,204	302,865	57,086
Oregon	35	10,596	34,452	45,048	4,988
Washington	37	12,305	49,080	61,385	4,418
Total: 1948	185	114,562	294,736	409,298	66,492
1947	188	97,055	250,958	348,013	72,791
Undistributed: [1]					
Total 1947	7	174,629	24,490	199,119	216,198
Total United States: 1948	2,453	5,323,049	6,143,958	11,467,007	5,280,957
1947	2,495	5,240,692	5,316,947	10,557,639	5,438,727

[1] Some scrap and pig iron consumed during 1947 in California, Illinois, Kentucky, Maryland, New Jersey, Ohio, and Pennsylvania—not separable—are included with "Undistributed."

Air Furnaces.—Scrap and pig iron consumed in air furnaces (including 2 Brackelsbergs) in 1948 amounted to 1,748,978 short tons, an increase of 1 percent over the 1,724,004 tons melted in these furnaces in 1947. The use of home scrap increased 2 percent and of purchased scrap 13 percent; pig iron decreased 11 percent.

There was no change in the position of the principal consuming States; Ohio led in the use of scrap in air furnaces, followed in order by Illinois, Pennsylvania, Indiana, Michigan, Wisconsin, and New York.

Consumption of ferrous scrap and pig iron in air furnaces [1] in the United States in 1948, by districts and States, in short tons

District and State	Active plants reporting	Scrap: Home	Scrap: Purchased	Scrap: Total	Pig iron
New England:					
Connecticut	7				
Massachusetts	4				
New Hampshire	1	47,578	20,416	67,994	21,445
Rhode Island	1				
Total: 1948	13	47,578	20,416	67,994	21,445
1947	13	46,227	15,068	61,295	25,819
Middle Atlantic:					
Delaware	1				
New Jersey	2	12,423	3,424	15,847	6,278
New York	10	48,838	24,735	73,573	22,236
Pennsylvania	22	127,433	82,437	209,870	58,791
Total: 1948	35	188,694	110,596	299,290	87,305
1947	36	177,377	91,881	269,258	95,933
Southeastern and Southwestern:					
District of Columbia	1				
Texas	1	17,943	12,629	30,572	7,138
West Virginia	2				
Total: 1948	4	17,943	12,629	30,572	7,138
1947	3	17,330	13,051	30,381	7,334
North Central:					
Illinois	14				
Indiana	10	240,378	137,263	377,641	100,444
Michigan	6	82,278	48,033	130,311	24,423
Iowa	1				
Kansas	1				
Minnesota	1	12,401	5,421	17,822	9,427
Missouri	1				
Ohio	21	212,214	114,619	326,833	81,076
Wisconsin	12	78,199	48,315	126,514	33,829
Total: 1948	67	625,470	353,651	979,121	249,199
1947	68	623,315	321,777	945,092	282,014
Rocky Mountain and Pacific Coast:					
Colorado	1				
California	4	2,805	1,193	3,998	2,916
Total: 1948	5	2,805	1,193	3,998	2,916
1947	4	2,921	1,157	4,078	2,800
Total United States: 1948	124	882,490	498,485	1,380,975	368,003
1947	124	867,170	442,934	1,310,104	413,900

[1] Includes 2 Brackelsberg furnaces, 1 each in Indiana and Ohio.

Crucible and Puddling Furnaces.—Crucible furnaces used 1,329 short tons of scrap and 1,013 tons of pig iron in 1948 compared with 2,265 and 1,312 tons, respectively, in 1947. Puddling furnaces used 19,781 tons of scrap and pig iron, a decrease of 2 percent from 1947. Of the total puddling-furnace melt in 1948, 4,802 tons were scrap compared with 3,691 tons during the previous year. The bulk of the scrap and pig iron consumed in puddling furnaces was in Pennsylvania.

Consumption of ferrous scrap and pig iron in crucible and puddling furnaces in the United States in 1948, by districts and States, in short tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut	1	295	618	913	254
Massachusetts	1				
Total: 1948	2	295	618	913	254
1947	4	605	823	1,428	576
Middle Atlantic and Southeastern:					
District of Columbia	1	335	1,098	1,433	8,786
Kentucky	1				
Maryland	1				
New Jersey	1				
Pennsylvania	4	29	3,510	3,539	6,350
Total: 1948	8	364	4,608	4,972	15,136
1947	10	178	4,163	4,341	16,865
North Central:					
Ohio	1	(1)	(1)	(1)	(1)
Wisconsin	1				
Total: 1948	2	(1)	(1)	(1)	(1)
1947	2				
Southwestern and Pacific Coast:					
California	2	(1)	(1)	(1)	(1)
Oklahoma	1				
Total: 1948	3	(1)	(1)	(1)	(1)
1947	2				
Total United States: 1948	15	809	5,322	6,131	15,992
1947	18	864	5,092	5,956	17,885

[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 1948 consisted of 109,458,986 short tons of iron ore, sinter, and manganiferous ores; 3,073,224 tons of mill cinder and roll scale; 3,997,172 tons of open-hearth and Bessemer slag; and 42,099 tons of miscellaneous materials.

Total consumption of scrap in 1948 by 74 plants operating blast furnaces was 2,931,508 short tons, a 9-percent increase over 1947. The scrap charged to blast furnaces was 49 percent home and 51 percent purchased, compared with 52 and 48 percent, respectively, in 1947 and 51 and 49 percent, respectively, in 1946. The proportion of scrap used to pig iron produced was 4.9 percent compared with 4.6 percent in 1947; home scrap 2.4 percent and purchased scrap 2.5 percent in 1948.

Consumption of ferrous scrap in blast furnaces in the United States in 1948, by districts and States, in short tons

District and State	Active plants reporting	Scrap		
		Home	Purchased	Total
New England and Middle Atlantic:				
Massachusetts	1	28,405	108,159	136,564
New York	6			
Pennsylvania	17	536,746	431,433	968,179
Total: 1948	24	565,151	539,592	1,104,743
1947	24	575,359	439,896	1,015,255
Southeastern and Southwestern:				
Alabama	6	208,365	71,427	279,792
Kentucky	1	205,448	137,207	342,655
Maryland	1			
Tennessee	1			
Texas	3			
West Virginia	2			
Total: 1948	14	413,813	208,634	622,447
1947	11	295,789	168,440	464,229
North Central:				
Illinois	6	86,118	198,677	284,795
Indiana	3	46,105	66,861	112,966
Michigan	2	92,341	50,191	142,532
Minnesota	2			
Ohio	21	234,130	417,367	651,497
Total: 1948	34	458,694	733,096	1,191,790
1947	33	524,793	682,417	1,207,210
Rocky Mountain:				
Colorado	1	12,252	276	12,528
Utah	1			
Total: 1948	2	12,252	276	12,528
1947	3	5,221	184	5,405
Total United States: 1948	74	1,449,910	1,481,598	2,931,508
1947	71	1,401,162	1,290,937	2,692,099

USE OF SCRAP IN FERRO-ALLOY PRODUCTION

The production of ferro-alloys (by other than blast furnaces) in 1948 consumed 351,926 short tons of scrap, an 11-percent increase over 1947. Of this total, 471 tons were used in the aluminothermic process and the balance in electric furnaces. Scrap used in blast furnaces in the manufacture of ferro-alloys is included in this chapter with blast furnaces. Purchased scrap accounted for 97 percent of the quantity used and home scrap 3 percent; in 1947 the percentages were the same.

Eighteen ferro-alloy plants used ferrous scrap in 1948 compared with 19 in 1947. Of these plants, 17 operated electric furnaces. One of this group employed both the electric and aluminothermic process, and one additional plant used the aluminothermic process only.

Consumption of ferrous scrap by ferro-alloy producers in the United States in 1948, by districts and States, in short tons

District and State	Active plants reporting	Scrap		
		Home	Purchased	Total
Middle Atlantic:				
New York	5	254	81,600	81,854
Pennsylvania	3	----------	666	666
Total: 1948	8	254	82,266	82,520
1947	8	109	73,100	73,209
North Central:				
Iowa	1	9,564	142,577	152,141
Ohio	3			
Total: 1948	4	9,564	142,577	152,141
1947	4	8,949	142,271	151,220
Southeastern:				
Alabama	1	----------	109,244	109,244
South Carolina	1			
Tennessee	1			
West Virginia	1			
Total: 1948	4	----------	109,244	109,244
1947	4	----------	84,089	84,089
Pacific Coast:				
Oregon	1	----------	8,021	8,021
Washington	1			
Total: 1948	2	----------	8,021	8,021
1947	3	----------	8,456	8,456
Total United States: 1948	18	9,818	342,108	351,926
1947	19	9,058	307,916	316,974

MISCELLANEOUS USES

Scrap consumed in 1948 for miscellaneous purposes, such as rerolling, nonferrous metallurgy, and as a chemical agent, remained at slightly less than 2 percent of the total consumption. This percentage has been unchanged for the past 4 years. The quantity so used—1,246,228 short tons—was an increase of 4 percent over that used for these purposes in 1947. Of the quantity used, 95 percent was purchased and 5 percent home scrap.

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Consumption of ferrous scrap in miscellaneous uses in the United States in 1948, by districts and States, in short tons

District and State	Active plants reporting	Scrap: Home	Scrap: Purchased	Scrap: Total
New England:				
Connecticut	1	625	14,253	14,878
Massachusetts	2			
Total: 1948	3	625	14,253	14,878
1947	3	1,108	14,698	15,806
Middle Atlantic:				
New Jersey	15	2,719	120,864	123,583
New York	12	456	114,046	114,502
Pennsylvania	18	35,943	135,403	171,346
Total: 1948	45	39,118	370,313	409,431
1947	46	38,496	343,678	382,174
Southeastern:				
Alabama	3	50	51,445	51,495
Georgia	2	662	943	1,605
Tennessee	1			
Maryland	1			
Virginia	2	411	83,144	83,555
West Virginia	1			
Total: 1948	10	1,123	135,532	136,655
1947	10	1,334	122,261	123,595
Southwestern:				
Louisiana	1	547	9,984	10,531
Texas	2			
Total: 1948	3	547	9,984	10,531
1947	4	950	38,528	39,478
North Central:				
Illinois	9	3,468	305,405	308,873
Indiana	4	14,225	1,782	16,007
Michigan	1			
Nebraska	1	1,692	25,654	27,346
Wisconsin	2			
Minnesota	2	405	762	1,167
Missouri	6	----------	53,580	53,580
Ohio [1]	6	161	78,760	78,921
Total: 1948	31	19,951	465,943	485,894
1947	34	19,547	426,170	445,717
Rocky Mountain:				
Arizona	5			
Nevada	2	----------	45,725	45,725
New Mexico	2			
Colorado	1			
Idaho	1	1,052	20,568	21,620
Montana [1]	3			
Utah	4	1,087	29,821	30,908
Total: 1948	18	2,139	96,114	98,253
1947	20	4,102	98,610	102,712
Pacific Coast:				
California	7	535	88,966	89,501
Washington	3	----------	1,085	1,085
Total: 1948	10	535	90,051	90,586
1947	11	540	86,199	86,739
Total United States: 1948	120	64,038	1,182,190	1,246,228
1947	128	66,077	1,130,144	1,196,221

[1] In addition, 90 tons and 5 tons of pig iron were consumed in miscellaneous uses in Montana and Ohio, respectively, during 1948.

STOCKS

Complete iron- and steel-scrap stock figures covering 1948 year-end stocks are not available; producers (railroads and manufacturers) were not canvassed. Dealers and automobile wreckers reporting to the Bureau of Mines had 193,108 short tons of materials on hand December 31, 1948, compared with 228,614 short tons at the end of 1947, a decrease of 35,506 short tons or 16 percent. Shipbreakers reported having 34,368 short tons of material on hand December 31, 1948. Total stocks of iron and steel scrap on hand December 31, 1948 (exclusive of producers), totaled 6,685,612 short tons compared with 4,810,984 short tons on December 31, 1947, an increase of 1,874,628 short tons.

The increase in total stocks in 1948 reflected the 60-percent increase in consumers' stocks of purchased scrap. Home scrap stocks increased from 1,400,719 short tons on December 31, 1947, to 1,598,673 short tons on December 31, 1948.

Consumers' Stocks.—Consumers' stocks of home and purchased iron and steel scrap on December 31, 1948, totaled 6,458,136 short tons—an increase of 2,027,196 short tons or 46 percent from the beginning of the year. Stocks of home scrap (1,598,673 tons) increased 14 percent, and purchased scrap (4,859,463 tons) increased 60 percent. Stocks of pig iron on December 31, 1948, amounted to 1,606,160 short tons, an increase of 62 percent over the 988,435 short tons on hand December 31, 1947.

Consumers' stocks of ferrous scrap and pig iron on hand in the United States on Dec. 31, 1947 and Dec. 31, 1948, by States and districts, in short tons

State and district	Dec. 31, 1947				Dec. 31, 1948			
	Scrap			Pig iron	Scrap			Pig iron
	Home	Purchased	Total		Home	Purchased	Total	
Connecticut	5,060	11,376	16,436	10,478	5,163	16,076	21,239	15,714
Maine	1,234	3,045	4,279	2,630	2,764	5,300	8,064	4,939
Massachusetts	5,729	40,033	45,762	27,231	37,545	47,738	85,283	53,212
New Hampshire	375	1,854	2,229	611	678	4,397	5,075	1,606
Rhode Island	658	5,136	5,794	1,884	775	9,281	10,056	4,559
Vermont	473	5,507	5,980	1,280	493	5,278	5,771	1,417
Total New England	13,529	66,951	80,480	44,114	47,418	88,070	135,488	81,447
Delaware; New Jersey [1]	14,480	73,917	88,397	26,332	16,019	87,331	103,350	37,487
New York	107,736	130,248	237,984	55,340	47,644	266,799	314,443	53,111
Pennsylvania [1]	465,267	597,441	1,062,708	229,458	452,341	959,736	1,412,077	268,378
Total Middle Atlantic	587,483	801,606	1,389,089	311,130	516,004	1,313,866	1,829,870	358,976
Alabama	32,244	65,569	97,813	52,035	30,863	114,348	145,211	89,626
District of Columbia; Kentucky [1]; Maryland [1]	54,314	34,953	89,267	20,990	46,480	103,141	149,621	64,596
Florida; Georgia	1,094	9,371	10,465	4,178	1,501	10,496	11,997	5,911
Mississippi	129	447	576	288	172	655	827	385
North Carolina	176	1,639	1,815	1,444	282	2,881	3,163	2,008
South Carolina	130	1,635	1,765	1,783	201	2,520	2,721	2,479
Tennessee; Virginia	8,313	39,180	47,493	17,355	9,719	51,158	60,877	24,350
West Virginia	8,132	87,322	95,454	10,002	5,046	91,519	96,565	25,859
Total Southeastern	104,532	240,116	344,648	108,075	94,264	376,718	470,982	215,214

See footnote at end of table.

Consumers' stocks of ferrous scrap and pig iron on hand in the United States on Dec. 31, 1947, and Dec. 31, 1948, by States and districts, in short tons—Con.

State and district	Dec. 31, 1947				Dec. 31, 1948			
	Scrap			Pig iron	Scrap			Pig iron
	Home	Purchased	Total		Home	Purchased	Total	
Arkansas, Louisiana, Oklahoma	764	12,079	12,843	901	1,067	14,559	15,626	1,271
Texas	3,531	30,923	34,454	4,736	119,446	392,086	511,532	215,902
Total Southwestern	4,295	43,002	47,297	5,637	120,513	406,645	527,158	217,173
Illinois [1]	104,036	456,582	560,618	86,461	94,843	714,516	809,359	121,091
Indiana	130,571	149,955	280,526	64,693	214,198	375,903	590,101	82,215
Iowa	4,691	38,323	43,014	7,709	5,737	51,800	57,537	12,231
Kansas, Nebraska	725	11,998	12,723	1,160	589	12,600	13,189	3,461
Michigan, Wisconsin	108,199	223,223	331,422	139,125	145,619	258,060	403,679	184,991
Minnesota	8,965	69,966	78,931	5,748	13,988	136,821	150,809	11,829
Missouri	3,053	61,918	64,971	8,248	4,042	113,160	117,202	16,562
North Dakota, South Dakota	234	81	315	24	282	169	451	59
Ohio [1]	266,798	570,566	837,364	156,440	212,502	670,919	883,421	240,703
Total North Central	627,272	1,582,612	2,209,884	469,608	691,800	2,333,948	3,025,748	673,142
Arizona, Nevada, New Mexico	2,426	18,936	21,362	238	2,896	14,260	17,156	367
Colorado, Utah	9,672	61,167	70,839	11,066	10,327	77,007	87,334	10,640
Idaho		1,953	1,953	66		1,857	1,857	36
Montana	2,408	9,418	11,826	165	1,765	8,724	10,489	246
Wyoming	3	1	4	3	3	1	4	8
Total Rocky Mountain	14,509	91,475	105,984	11,538	14,991	101,849	116,840	11,297
Alaska, Oregon, Washington	4,371	53,716	58,087	3,148	3,788	76,111	79,899	5,734
California [1]	43,823	146,461	190,284	29,996	109,895	162,256	272,151	43,177
Total Pacific Coast	48,194	200,177	248,371	33,144	113,683	238,367	352,050	48,911
Undistributed [1]	905	4,282	5,187	5,189				
Total United States	1,400,719	3,030,221	4,430,940	988,435	1,598,673	4,859,463	6,458,136	1,606,160

[1] Some scrap and pig-iron stocks on Dec. 31, 1947, in California, Illinois, Kentucky, Maryland, New Jersey, Ohio, and Pennsylvania—not separable—are included with "Undistributed."

Suppliers' Stocks.—Stocks of iron and steel scrap in the hands of dealers (188,746 tons) and automobile wreckers (4,362 tons) totaled 193,108 short tons on December 31, 1948, compared with 228,614 tons on December 31, 1947—a drop of 16 percent. Stocks held by shipbreakers amounted to 3,244 short tons on December 31, 1948.

PRICES

The prices of iron and steel scrap continued to rise during 1948, despite industry efforts to curb the upward trend through a strong buyers' resistance during early months of the year. No. 1 Cast scrap at Chicago was selling at $68.00 per gross ton during January 1948, an increase of $24.62 per ton over January 1947; a peak price of $74.30 per ton was reached during August 1948. No. 1 Heavy-Melting steel at Pittsburgh and Chicago was quoted by Iron Age at $42.75 and $41.75 per gross ton, respectively, from August through December.

The previous high at Pittsburgh was $41.88 in November 1947, and at Chicago, $40.50 in October 1947. However, steel production continued at a rate of more than 7,000,000 short tons per month throughout the year, with the exception of February and April, and at the end of the year the scrap market appeared stronger than it had for some months. Shipments were moving in large tonnages, and mills were buying all the scrap offered at the current higher price levels.

FOREIGN TRADE [1]

Imports.—Imports of iron and steel scrap in 1948 increased 11-fold in quantity (415,072 short tons compared with 36,191 tons in 1947) and 16-fold in value ($10,453,480 compared with $668,790 in 1947). Of the 1947 imports, 179,725 tons came from Germany, 65,856 tons from Japan, 38,804 tons from the Netherlands, 31,567 tons from Cuba, and the remainder from other countries. In addition, 46,014 tons of tin-plate scrap were imported in 1948 compared with 34,492 tons in 1947, mostly from Canada.

Exports.—Exports of ferrous scrap from the United States in 1948 were 242,025 short tons valued at $12,515,668, a 25-percent increase in tonnage over 1947 and a 27-percent increase in value. Imports exceeded exports by 209,751 short tons (not counting 46,014 tons of imported tin-plate scrap). The tonnage exported amounted to 7 percent of the 5-year prewar average (for 1935–39) of 3,298,326 tons a year, compared with 6 percent during 1947. The 1948 exports included 36,704 tons of tin-plate scrap, circles, strips, cobbles, waste-waste, and terneplate clippings and scrap valued at $5,829,476. The same materials in 1947 amounted to 29,805 tons valued at $5,574,243. The accompanying table shows the principal countries to which scrap was exported during the period 1944–48.

Ferrous scrap exported from the United States, by countries, 1944–48, in short tons

[U. S. Department of Commerce]

Country	1944	1945	1946	1947	1948
Argentina	87	4,264	4,630	[1] 8,474	4,488
Brazil	271	1,088	787	1,165	1,252
Canada	71,518	47,465	82,346	119,394	168,072
Chile	72	7,447	1,334	5,719	376
China	----------	112	7,930	6,315	3,217
Colombia	1,819	955	22	587	1,173
Cuba	----------	687	521	845	906
Denmark	----------	----------	55	2,080	1,730
Hong Kong	----------	----------	649	2,572	3,034
India	----------	----------	----------	644	8,910
Mexico	17,509	27,471	48,194	33,978	37,759
Philippines, Republic of	----------	----------	240	429	739
Portugal	----------	----------	97	2,074	711
Sweden	----------	510	493	2,448	1,641
Turkey	----------	59	50	1,077	91
Union of South Africa	----------	168	393	477	1,271
United Kingdom	----------	199	435	141	----------
Uruguay	220	4,432	425	1,721	1,041
Other countries	4,186	877	505	3,941	5,614
Total: Short tons	95,682	95,734	149,106	[1] 194,081	242,025
Value	$1,910,226	$2,589,239	$3,384,514	[1] $9,854,401	$12,515,668

[1] Revised figure.

[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.

Lead[1]

By RICHARD H. MOTE AND EDITH E. DEN HARTOG

GENERAL SUMMARY

ACCENTUATED by the threat of possible lead shortages resulting from unpredictable work stoppages, an accelerated program of defense construction, and Government requirements for the strategic stock pile, consumer demand for lead remained high throughout 1948. As a result, the market quotation for lead advanced three times during the year to establish new record highs, and a sellers' market continued to prevail within the industry. With elimination of a 30,000-ton potential gain in domestic mine production in 1948 through work stoppages in certain mining areas which in turn limited domestic refinery output, there was increasing demand for lead from secondary and foreign sources. Recovery from secondary sources remained above 500,000 tons and surpassed domestic mine output for the third successive year. Total imports of lead were 52 percent greater in 1948 than in 1947 owing in part to the desire for American dollars abroad and to the suspension of lead import duties beginning July 1, 1948.

The total consumption of primary, antimonial, and secondary lead in the United States in 1948 was 1,115,995 tons. Lead stocks (physical inventory) at primary smelters and refineries rose 113 percent during 1948, and consumers' inventories at the end of the year were 30 percent greater than on January 1.

Government regulations requiring a license for the exportation of pig lead and lead semimanufactures remained operative throughout the year.

[1] This report deals primarily with the smelting, refining, and consuming phases of the industry. For details of mining operations, see various State chapters of this volume.

Salient statistics of the lead industry in the United States, 1939–43 (average) and 1944–48, in short tons

	1939–43 (average)	1944	1945	1946	1947	1948
Production of refined primary lead:						
From domestic ores and base bullion	439,692	394,443	356,535	293,309	381,109	339,413
From foreign ores and base bullion	85,234	70,320	87,050	44,888	59,901	67,281
Total	524,926	464,763	443,585	338,197	441,010	406,694
Recovery of secondary lead	312,871	331,416	363,039	392,787	511,970	500,071
Imports: [1]						
Lead in pigs, bars, and old	209,373	226,073	230,313	114,706	[2] 175,538	276,169
Lead in base bullion	28,333	58	8	125	[2] 1,580	7,186
Lead in ores and matte	74,713	93,570	70,005	44,407	50,752	63,907
Exports of refined pig lead [3]	31,381	15,523	1,784	700	1,616	399
Estimated consumption of primary and secondary lead	931,000	1,118,643	1,051,602	956,476	1,172,000	1,133,895
Prices (cents per pound):						
New York:						
Average for period	5.80	6.50	6.50	8.11	14.67	18.04
Quotation at end of period	5.97	6.50	6.50	12.55	15.00	21.50
London average for period	(4)	4.49	4.99	8.63	15.27	17.16
Mine production of recoverable lead	456,470	416,861	390,831	335,475	384,221	390,476
World smelter production of lead [2]	1,840,000	1,424,000	1,233,000	1,140,000	1,414,000	1,420,000

[1] Data include lead imported for immediate consumption plus material entering the country for storage under bond.
[2] Revised figures.
[3] Includes less than 1 ton of foreign lead reexported in 1944, 377 tons in 1945, 103 tons in 1946, 102 tons in 1947, and none in 1948, according to records of the U. S. Department of Commerce.
[4] Figure not available.

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 pertinent 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 owing to the lag between mine shipments and smelter consumption of ore and concentrates. These inequities, however, tend to balance over a period of years.

MINE PRODUCTION

Despite a continued high industrial demand for lead and an all-time high-record market price, domestic mine output of recoverable lead (including that made into pigments) in 1948 increased less than 2 percent over 1947. Work stoppages due to labor-management disputes curtailed lead outputs in certain areas and were the greatest single factor to impêde the obtaining of greater supplies from domestic mines in 1948. The work stoppage which shut down the St. Joseph Lead Co. mines, mills, and smelter in southeastern Missouri for 11 weeks was estimated to have been responsible for the loss of 25,000 tons of lead production. Work stoppages during the year curtailed lead outputs in other areas, notably the Tri-State district and northeastern Washington.

Of the total lead produced at United States mines in 1948, 63 percent came from the output of 25 properties. Missouri continued to rank first among the States in the production of lead, and the Southeastern Missouri district continued to be the largest lead-producing area, supplying 26 percent of the total domestic output. The St. Joseph Lead Co., as in the past, produced the bulk of the output from its Bonne Terre, Desloge, Federal, and Leadwood mine groups in St. Francois County and the Mine La Motte mine in Madison County. Each mine is equipped with a mill; the five have a combined daily capacity of about 24,000 tons. In the Tri-State district the production of lead concentrates, stimulated by the record high price, increased 11 percent over 1948 despite the loss of operating time caused by a labor strike in July and August. The Tri-State area produced 7 percent of the total domestic output in 1948 compared with 6 percent in 1947.

The combined Western States contributed 65 percent of the total domestic production and recorded a 14-percent gain over 1947. Idaho was again the largest producer of lead in the Western States and second only to Missouri in the United States. In 1948, 93 percent of the State total lead came from the Coeur d'Alene region. Six properties in Idaho produced 60 percent of the State total lead, and of the total more than 77 percent came from zinc-lead ore and old tailings. Lead production in Utah in 1948 responded strongly to the record high market price of lead, and the State output rose to the highest level since 1943. 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. Of the State total lead in 1948, 88 percent was recovered from zinc-lead ore. Uninterrupted operation of lead and zinc-lead mines in Arizona in 1948 resulted in an output of 29,899 short tons of recoverable lead, the largest in the history of the State, and 5 percent greater than the previous record production in 1947. The Copper Queen mine of the Phelps Dodge Corp. at Bisbee continued to be the largest Arizona lead producer in 1948; about 90 percent of the State total lead was recovered from zinc-lead ore. In Colorado the value of lead recovered from ores in 1948 was higher than in any previous year and exceeded that of gold for the first time since 1891. In quantity the mine production of lead increased 34 percent over 1947 and was the largest since 1928. The leading producer in the State in 1948 was the American Smelting & Refining Co. Kokomo unit in Summit County. Zinc-lead ore yielded 63 percent of the State total lead during the year. Lead production in Montana gained 14 percent over 1947 and was the largest yearly output since 1942. The four leading producers, which contributed 84 percent of the State total in 1948, were the Butte Hill mine and dumps, the Emma, Mike Horse, and Jack Waite mines. Of the Montana total output of lead in 1948, 89 percent was recovered from zinc-lead ore.

Mine production of recoverable lead in the United States, 1939–43 (average) and 1944–48, by States, in short tons

State	1939–43 (average)	1944	1945	1946	1947	1948
Western States and Alaska:						
Alaska	599	44	11	115	264	329
Arizona	13,635	16,707	22,867	23,930	28,566	29,899
California	3,346	5,682	7,224	9,923	10,080	9,110
Colorado	13,097	17,698	17,044	17,036	18,696	25,143
Idaho	102,219	83,530	68,447	59,987	78,944	88,544
Montana	19,445	13,105	9,999	8,280	16,108	18,411
Nevada	6,305	6,605	6,275	7,175	7,161	9,777
New Mexico	4,842	7,265	7,662	4,899	6,383	7,653
Oregon	27	4	1	2	12	7
South Dakota	27	34			8	16
Texas	162			47	78	170
Utah	70,022	52,519	40,817	30,711	49,698	55,950
Washington	4,010	5,825	3,802	2,987	5,359	7,147
Wyoming	1		3			
Total	237,737	209,018	184,152	165,092	221,357	252,156
West Central States:						
Arkansas	14		1	2	18	22
Kansas	11,758	9,394	7,370	6,445	7,285	8,386
Missouri	175,740	174,683	176,575	139,112	132,246	102,288
Oklahoma	23,304	13,944	12,664	13,697	14,289	16,918
Total	210,816	198,021	196,610	159,256	153,838	127,614
States east of the Mississippi River:						
Illinois	1,716	1,971	3,005	3,865	2,325	3,695
Kentucky	261	170	129	95	214	216
New York	2,250	1,644	862	1,073	1,496	1,231
Tennessee	310		54	125	22	
Virginia	2,629	4,622	4,243	4,381	3,803	4,703
Wisconsin	751	1,415	1,776	1,588	1,166	861
Total	7,917	9,822	10,069	11,127	9,026	10,706
Grand total	456,470	416,861	390,831	335,475	384,221	390,476

Mine production of recoverable lead in the United States, by districts that produced 1,000 tons or more during any year, 1944–48, in short tons

District	State	1944	1945	1946	1947	1948
Southeastern Missouri region	Missouri	169,622	173,005	135,796	129,516	100,654
Coeur d'Alene region	Idaho	76,813	63,430	56,548	73,060	82,587
West Mountain (Bingham)	Utah	31,169	22,723	12,343	26,163	30,672
Tri-State (Joplin region)	Kansas, southwestern Missouri, Oklahoma.	28,059	23,556	23,363	24,239	26,901
Summit Valley (Butte)	Montana	3,251	2,870	2,357	10,630	13,217
Park City region	Utah	11,660	8,916	8,373	10,987	12,670
Warren (Bisbee)	Arizona	3,497	9,400	10,889	13,422	11,253
Coso (Darwin)	California	2,609	5,214	7,708	6,551	6,078
Tintic	Utah	5,319	4,930	4,239	6,166	5,970
Pioche	Nevada	4,056	2,987	3,493	3,487	5,613
Old Hat	Arizona	4,161	5,216	4,790	4,603	5,406
California (Leadville)	Colorado	5,752	5,016	4,441	4,296	4,745
Austinville	Virginia	4,235	4,222	4,381	3,803	4,703
Metaline	Washington	5,278	3,506	2,224	3,450	4,297
Rush Valley & Smelter (Tooele County).	Utah	3,293	3,137	3,490	3,829	4,185
Ten Mile	Colorado	241	680	810	1,167	4,177
Pima (Sierritas, Papago, Twin Buttes).	Arizona	2,445	2,063	2,296	2,909	3,917
Upper San Miguel	Colorado	1,442	1,986	2,376	2,559	3,804
Central	New Mexico	4,428	5,379	3,199	3,450	3,740
Kentucky-southern Illinois	Kentucky, southern Illinois	2,048	2,649	3,687	1,889	2,965
Magdalena	New Mexico	1,620	1,243	1,273	1,987	2,826
Big Bug	Arizona	1,244	1,981	2,155	2,323	2,676
Pioneer (Rico)	Colorado	2,826	2,440	2,176	2,042	2,430
Harshaw	Arizona	2,212	1,066	692	1,393	1,999
Heddleston	Montana	2,436	3,175	2,648	2,087	1,946
Animas	Colorado	2,236	2,613	3,207	2,241	1,886
Bayhorse	Idaho	2,069	1,302	553	2,039	1,880
Upper Mississippi Valley	Iowa, northern Illinois, Wisconsin.	1,508	2,261	1,861	1,816	1,807

Mine production of recoverable lead in the United States, by districts that produced 1,000 tons or more during any year, 1944–48, in short tons—Continued

District	State	1944	1945	1946	1947	1948
Tomichi	Colorado	373	365	333	1,458	1,788
Northport (Aladdin)	Washington	233	28	39	508	1,426
Bossburg	do	5	158	428	1,010	1,394
Warm Springs	Idaho	3,333	2,347	1,649	1,879	1,304
St. Lawrence County	New York	1,644	862	1,073	1,496	1,231
Aravaipa	Arizona	181	291	467	794	1,142
Red Cliff	Colorado	1,444	572	690	924	1,120
Eureka	do	46	59	300	630	1,107
Modoc	California	26	862	279	139	1,061
Alder Creek	Idaho	32	38	136	1,103	776
Eagle	Montana	1,128	599	469	393	600
Smelter (Lewis and Clark County).	do	1,364	222	463	60	396
Resting Springs [1]	California	(2)	(2)	(2)	(2)	(2)

[1] Not listed in order of output.
[2] Bureau of Mines not at liberty to publish figures.

Mine production of recoverable lead in the United States, 1947–48, by months, in short tons

Month	1947	1948	Month	1947	1948
January	31,545	33,246	August	31,281	23,685
February	30,251	32,517	September	31,124	27,279
March	32,735	35,999	October	33,682	35,687
April	33,302	35,200	November	31,550	36,986
May	33,361	33,370	December	32,622	38,542
June	32,826	34,543			
July	29,942	23,422	Total	384,221	390,476

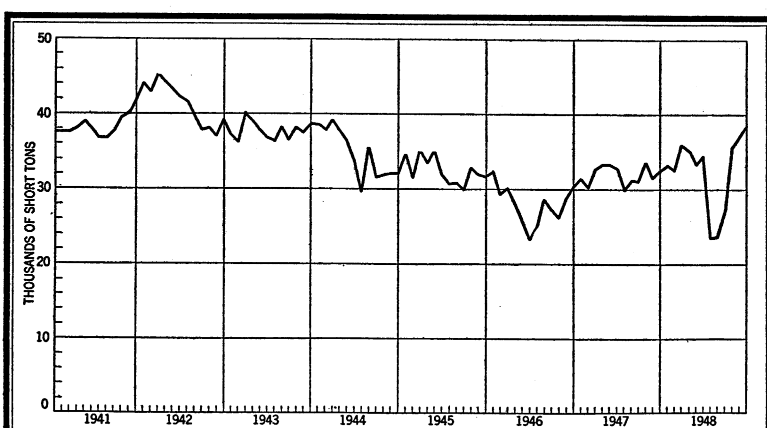

FIGURE 1.—Mine production of recoverable lead in the United States, 1941–48, by months.

The 25 leading lead-producing mines in the United States in 1948, listed in the following table, yielded 63 percent of the total domestic lead output; the 10 leading mines produced 45 percent, and the 4 leading mines 31 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.

Twenty-five leading lead-producing mines in the United States in 1948, in order of output

Rank	Mine	District	State	Operator	Type of ore
1	Federal	Southeastern Missouri	Missouri	St. Joseph Lead Co	Lead.
2	United States and Lark	West Mountain (Bingham)	Utah	U. S. Smelting, Refining & Mining Co	Zinc-lead.
3	Bunker Hill & Sullivan	Yreka	Idaho	Bunker Hill & Sullivan Mining & Concentrating Co.	Do.
4	Leadwood	Southeastern Missouri	Missouri	St. Joseph Lead Co	Lead.
5	Copper Queen	Warren (Bisbee)	Arizona	Phelps Dodge Corp	Zinc-lead.
6	Bonne Terre	Southeastern Missouri	Missouri	St. Joseph Lead Co	Lead.
7	Butte Mines	Summit Valley (Butte)	Montana	Anaconda Copper Mining Co	Zinc-lead.
8	Page	Yreka	Idaho	Federal Mining & Smelting Co	Do.
9	Mine La Motte	Southeastern Missouri	Missouri	St. Joseph Lead Co	Lead.
10	Star	Hunter	Idaho	Sullivan Mining Co	Zinc-lead.
11	Darwin group	Coso	California	Anaconda Copper Mining Co	Lead.
12	Madison	Southeastern Missouri	Missouri	St. Louis Smelting & Refining Co	Lead-copper.
13	Mammoth-Collins	Old Hat	Arizona	St. Anthony Mining & Development Co	Zinc-lead.
14	Chief, Gemini, etc	Tintic	Utah	Chief Consolidated Mining Co	Do.
15	Combined Metals group	Pioche	Nevada	Combined Metals Reduction Co	Do.
16	Silver King	Park City	Utah	Silver King Coalition Mines Co	Do.
17	Sherman	Lelande	Idaho	Day Mines, Inc	Lead.
18	Austinville	Wythe County	Virginia	New Jersey Zinc Co	Zinc-lead.
19	Desloge	Southeastern Missouri	Missouri	St. Joseph Lead Co	Lead.
20	Tamarack	Placer Center	Idaho	Day Mines, Inc	Zinc-lead.
21	Kokomo unit	Ten-Mile	Colorado	American Smelting & Refining Co	Do.
22	San Xavier	Pima	Arizona	Eagle-Picher Mining & Smelting Co	Do.
23	Morning	Hunter	Idaho	Federal Mining & Smelting Co	Do.
24	Osburn Tailings	Evolution	do	Hecla Mining Co	Do.
25	Park Utah	Uintah	Utah	Park Utah Consolidated Mining Co	Do.

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 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 14 primary smelters and refineries in operation in the United States in 1948 consumed 432,543 short tons (lead content) of ore and concentrates, 16 percent of which was of foreign origin, compared with 448,703 tons in 1947, 14 percent of which was foreign.

ACTIVE LEAD SMELTERS AND REFINERIES

Primary lead smelters and refineries operating in the United States in 1948 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, Bunker Hill & Sullivan Mining & Concentrating Co. (smelter and refinery).
Illinois: Alton—Federal plant, American Smelting & Refining Co. (smelter and refinery).
Indiana: 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).
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 1948 produced 411,646 short tons of refined lead, a decline of 10 percent from the 1947 output of 456,672 tons.

Of the 406,694 tons of primary lead produced in 1948, domestic ores and base bullion supplied 83 percent and foreign ores and imported base bullion 17 percent. In 1947 the origin was 86 percent domestic and 14 percent foreign. The quantity of refined lead produced from foreign base bullion, which has been negligible since 1942, advanced over one hundredfold in 1948. 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, 1944–48, in short tons

Source	1944	1945	1946	1947	1948
Refined lead:					
From domestic ores and base bullion	394,443	356,535	293,309	381,109	339,413
From foreign ores	70,225	86,932	44,790	59,838	60,829
From foreign base bullion	95	118	98	63	6,452
Total from primary sources	464,763	443,585	338,197	441,010	406,694
From scrap	11,368	18,525	8,013	15,662	4,952
Total refined lead	476,131	462,110	346,210	456,672	411,646
Average sales price per pound	$0.064	$0.064	$0.084	$0.143	$0.179
Total calculated value of primary refined lead [1]	$59,490,000	$56,780,000	$56,820,000	$126,130,000	$145,600,000

[1] Excludes value of refined lead produced from scrap at primary refineries.

Refined primary lead produced in the United States, by country of origin, 1944–48, in short tons

Source	1944	1945	1946	1947	1948
Domestic ore and base bullion	394,443	356,535	293,309	381,109	339,413
Foreign ore:					
Australia	22,210	22,087	7,534	5,952	6,729
Canada	7,461	11,151	5,026	3,548	3,608
Europe					43
Mexico	5,250	3,097	2,056	5,523	4,427
South America	13,434	25,701	11,344	17,096	24,589
Other foreign	21,870	24,896	18,830	27,719	21,433
Total	70,225	86,932	44,790	59,838	60,829
Foreign base bullion:					
Australia					466
Mexico	58	63	10	30	5,637
South America	37	55	88	33	52
Other foreign					297
Total	95	118	98	63	6,452
Total foreign	70,320	87,050	44,888	59,901	67,281
Grand total	464,763	443,585	338,197	441,010	406,694

ANTIMONIAL LEAD

Antimonial lead output at primary refineries in 1948 reached the highest level in history as production advanced 17 percent over 1947. Distribution of the lead according to source is shown in the following table. The average antimony content of antimonial lead produced in 1948 remained unchanged from 1947 at 5.7 percent. 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, 1944–48

Year	Production (short tons)	Antimony content		Lead content by difference (short tons)			
		Short tons	Percent	From domestic ore	From foreign ore	From scrap	Total
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
1947	86,075	4,933	5.7	14,836	9,850	56,456	81,142
1948	100,764	5,760	5.7	29,561	15,918	49,525	95,004

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 1944–48 is shown in the following table. Secondary lead recovery in 1948 exceeded the total domestic refined primary lead production by 23 percent and surpassed the domestic mine output of recoverable lead for the third successive year. Further details appear in the Secondary Metals—Nonferrous chapter of this volume.

Secondary lead recovered in the United States, 1944–48, in short tons

	1944	1945	1946	1947	1948
As refined metal:					
At primary plants	11,368	18,525	8,013	15,662	4,952
At other plants	43,678	42,598	65,691	95,843	126,951
Total	55,046	61,123	73,704	111,505	131,903
In antimonial lead:					
At primary plants	34,475	42,366	33,850	56,456	49,525
At other plants	146,343	151,713	159,834	209,479	194,027
Total	180,818	194,079	193,684	265,935	243,552
In other alloys	95,552	107,837	125,399	134,530	124,616
Grand total:					
Short tons	331,416	363,039	392,787	511,970	500,071
Value	$42,421,248	$46,468,992	$65,988,216	$146,423,420	$179,025,418

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

Domestic lead consumption (including lead in lead ore used directly in the manufacture of lead pigments and salts) totaled 1,133,895 short tons in 1948. Of the total consumed, 680,516 tons were refined soft lead, 280,952 tons antimonial lead, 55,426 tons unmelted white scrap, 52,719 tons percentage metals, 21,897 tons copper-base scrap, 24,485 tons drosses and residues, and 17,900 tons from lead ores used directly in the manufacture of lead compounds. During the year 77 percent of the total lead consumed was used in the manufacture of metal products. Production of the three largest lead-consuming items—batteries, cable covering, and tetraethyl fluid—used nearly 53 percent of all the lead consumed in 1948. Batteries took 31 percent of the total, cable covering 15 percent, and tetraethyl fluid 7 percent.

Consumption of lead in the United States in 1948

	Short tons
Metal products:	
Ammunition	49,635
Bearing metals	42,594
Brass and bronze	23,239
Cable covering	171,654
Calking lead	31,473
Casting metals	8,974
Collapsible tubes	11,071
Foil	3,203
Pipes, traps, and bends	39,843
Sheet lead	31,559
Solder	71,025
Storage batteries (antimonial lead)	203,869
Storage batteries (oxides)	150,536
Terne metal	3,278
Type metal	26,279
Total metal products	868,232
Pigments:	
White lead	30,970
Red lead and litharge	80,356
Pigment colors	10,832
Other [1]	20,230
Total pigments	142,388
Chemicals:	
Tetraethyl lead	83,809
Miscellaneous chemicals	10,280
Total chemicals	94,089
Miscellaneous uses:	
Annealing	6,132
Galvanizing	1,995
Lead plating	2,274
Weights and ballast	6,290
Total miscellaneous uses	16,691
Other uses unclassified	12,495
Grand total	1,133,895

[1] Includes lead content of leaded zinc oxide production.

Consumption of lead in the United States in 1948, by months [1]

Month	Short tons	Month	Short tons
January	97,451	August	96,102
February	92,451	September	94,638
March	102,601	October	106,106
April	95,094	November	98,935
May	86,203	December	98,741
June	89,847		
July	75,726	Total	1,133,895

[1] Includes lead content of leaded zinc oxide production.

Lead consumption in the United States in 1948, by class of products and type of material, in short tons

	Soft and antimonial lead	Scrap, percentage metal, drosses, etc.	Total
Metal products	715,183	153,049	868,232
Pigments	124,293	195	[1] 124,488
Chemicals	94,089		94,089
Miscellaneous	16,170	521	16,691
Unclassified	11,733	762	12,495
Total	961,468	154,527	[1] 1,115,995

[1] Excludes 17,900 tons of lead contained in leaded zinc oxide.

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. According to monthly reports released by the American Bureau of Metal Statistics, stocks of refined lead and antimonial lead declined in the first quarter of the year to a low of 14,837 tons at the end of March. Inventories gained sharply to 19,453 tons during April and continued to advance through May and June. Stocks on

Lead stocks at end of year at smelters and refineries in the United States, 1944–48, in short tons

[American Bureau of Metal Statistics]

	1944	1945	1946	1947	1948
Refined pig lead	15,602	37,584	40,870	13,634	29,050
Antimonial lead	3,934	7,283	6,717	7,694	9,594
Total	19,536	44,867	47,587	21,328	38,644
Lead in base bullion—					
At smelters and refineries	7,333	8,618	8,453	7,652	9,697
In transit to refineries	3,331	4,889	4,911	5,447	4,101
In process at refineries	14,473	15,097	16,042	16,328	17,939
Total	25,137	28,604	29,406	29,427	31,737
Lead in ore and matte and in process at smelters	80,461	89,462	111,836	77,199	76,373
Grand total	125,134	162,933	188,829	127,954	146,754

July 1 totaled 23,246 tons, declined slightly during the month, and dropped sharply in August to 18,971 tons on September 1. During the remainder of the year the inventories advanced steadily to the peak 1948 level of 38,644 tons—a net gain of 81 percent from January 1.

The Bureau of Mines annual survey of primary lead smelters and refiners indicated stocks of 13,634 tons (lead content) of refined lead at plants on January 1, 1948, and 29,048 tons on December 31, 1948. Primary antimonial lead stocks at these same plants increased from 7,009 short tons (lead content) at the beginning of 1948 to 9,258 tons at the end of the year. In terms of lead content, stocks of ore at the 14 operating smelters and refineries decreased 5 percent—from 46,313 tons to 44,038 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 4,912 tons at the beginning of January and 4,290 tons at the end of December 1948. 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.—Consumers' stocks of lead gained 30 percent during 1948. Inventories of refined lead and antimonial lead increased 20 percent and 57 percent, respectively, from the levels prevailing at the first of the year. Total stocks, which on January 1, 1948, were 91,344 tons, dropped to 80,897 tons by January 30 but showed a general upward trend thereafter and reached 119,198 tons on December 31, the highest point of the year.

Reconstruction Finance Corporation Stocks.—Refined-lead stocks (mostly corroding grade) of 4,996 short tons held by the RFC on January 1, 1948, were transferred during the year to the Treasury Department, Bureau of Federal Supply.

Consumers' stocks of lead at the end of 1947 and 1948, by types of materials, in short tons

Date	Refined soft lead	Antimonial lead	Unmelted white scrap	Percentage metals	Copper-base scrap	Drosses, residues, etc.	Total
Dec. 31, 1947	51,619	22,402	3,514	6,247	1,938	5,624	91,344
Dec. 31, 1948	62,077	35,088	4,828	7,932	2,301	6,972	119,198

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 0.2 cent a pound, an amount approximating the freight charges between the two points.

The market price for common lead, New York, was quoted at

$0.15 per pound until April 5, when the price advanced to $0.175. Continued heavy demands for lead from consumers and sales of foreign metal at premiums reportedly as high as 5 cents a pound resulted in a further advance on July 28 to $0.195 per pound. An additional increase on November 1 raised the quotation to an all-time record of $0.215 per pound at which level it remained the balance of the year.

The official London maximum price of £90 per long ton, duty paid, for Empire and foreign soft lead, fixed by the British Ministry of Supply March 31, 1947, was advanced to £112 on October 1, 1948, but remained unchanged the remainder of the year. Quotations of the London Metal Exchange, discontinued at the outbreak of the war in September 1939, were not resumed during 1948.

Average monthly and yearly quoted prices of lead at St. Louis, New York, and London, 1946–48, in cents per pound [1]

Month	1946			1947			1948		
	St. Louis	New York	London [2]	St. Louis	New York	London [2]	St. Louis	New York	London [2]
January	6.35	6.50	6.28	12.76	12.93	12.58	14.82	15.00	16.17
February	6.35	6.50	7.01	13.01	13.18	12.58	14.82	15.00	16.17
March	6.35	6.50	7.01	14.77	14.96	12.58	14.82	15.00	16.17
April	6.35	6.50	7.84	14.82	15.00	16.17	17.04	17.21	16.17
May	6.35	6.50	8.09	14.82	15.00	16.17	17.32	17.50	16.17
June	8.03	8.18	8.09	14.82	15.00	16.17	17.32	17.50	16.17
July	9.10	9.25	9.88	14.82	15.00	16.17	17.63	17.81	16.17
August	8.10	8.25	9.88	14.82	15.00	16.17	19.32	19.50	16.17
September	8.10	8.25	9.88	14.82	15.00	16.17	19.32	19.50	16.17
October	8.10	8.25	9.88	14.82	15.00	16.17	19.32	19.50	20.12
November	10.29	10.44	9.88	14.82	15.00	16.17	21.32	21.50	20.12
December	12.02	12.19	9.88	14.82	15.00	16.17	21.32	21.50	20.12
Average	7.96	8.11	8.63	14.50	14.67	15.27	17.87	18.04	17.16

[1] St. Louis: Metal Statistics, 1949, p. 499. New York: Metal Statistics, 1949, p. 493. 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; Apr. 8, 1946; July 1, 1946; Jan. 1, 1947; Mar. 31, 1947; and October 1, 1948.

FOREIGN TRADE [2]

Tariff.—The import duty set by the Tariff Act of 1930 on lead-bearing ores, flue dust, and mattes (lead content) was 1½ cents per pound, and on lead bullion, pigs, bars, scrap lead, antimonial lead, type metal, babbitt metal, solder, and alloys not specifically provided for, 2⅛ cents per pound. In accordance with the Mexican Trade Agreement of January 30, 1943, these rates were reduced to ¾ cent and 1 1/16 cents per pound, respectively. A provision of the agreement permits the increase in the tariff on lead-bearing ores, flue dust, and mattes to 1⅕ cents per pound (lead content) and lead bullion, pigs, bars, scrap lead, etc., to 1 7/10 cents per pound 30 days after the war emergency is officially terminated. The import duty of 1 1/16 cents per pound on pig lead and ¾ cent a pound on lead in ores and concentrates was suspended in June 1948 until June 30, 1949, by act of Congress.

Imports.—Imports of lead increased sharply in 1948 but remained well below the peak level established in 1942. As in previous years,

[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.

the greater part of the lead imported was in the form of pigs and bars, 40 percent of which came from Mexico, 22 percent from Canada, 12 percent from Australia, 9 percent each from Peru and Italy, and 8 percent from 20 other countries. Imports of lead in base bullion increased almost fivefold in 1948 to reach the highest level since 1942. Nearly 90 percent of the bullion originated in Mexico. Receipts of of lead in ore, concentrate, and matte—principally from Bolivia, Union of South Africa, Australia, Peru, Newfoundland, and Canada—increased 26 percent.

Total lead imported into the United States in ore, matte, base bullion, pigs, bars, and reclaimed, by countries, in short tons, 1944–48 [1]

[U. S. Department of Commerce]

Country	1944	1945	1946	1947	1948
Ore and matte:					
Africa	3,459	2,338	399	5,616	10,142
Argentina		4,716	2,112	6	
Australia	27,130	17,913	8,341	7,054	9,017
Bolivia	1,093	1,580	2,202	6,234	20,369
Canada	9,909	8,687	4,940	4,310	3,488
Chile	4,247	2,330	1,456	3,048	3,430
Mexico	3,693	667	376	3,065	2,702
Newfoundland and Labrador	32,273	17,046	19,037	10,523	4,800
Peru	11,295	14,524	5,192	10,477	8,548
Other countries	471	204	352	419	1,411
Total ore and matte	93,570	70,005	44,407	50,752	63,907
Base bullion:					
Korea				285	82
Mexico	11	8		1,255	6,455
Peru	47		125	[2] 40	619
Other countries					30
Total base bullion	58	8	125	[2] 1,580	7,186
Pigs and bars:					
Africa				78	510
Australia	560	13,747	8,190	10,639	30,469
Belgium-Luxembourg					8,911
Burma					2,343
Canada	8	19,389	22,822	59,079	53,940
Italy					21,349
Japan			12,126		24
Korea				1,659	
Mexico	167,704	160,179	53,534	85,783	98,233
Netherlands					1,826
Peru	54,486	34,153	15,568	1,151	23,559
Spain					1,653
Yugoslavia				1,120	2,889
Other countries		1	1	4	1,662
Total pigs and bars	222,758	227,469	112,241	159,513	247,368
Reclaimed, scrap, etc.:					
Africa				478	341
Australia	2,738	1,470	1,337	1,111	3,690
Belgium-Luxembourg					986
Canada	488	1,374	1,078	8,070	11,649
Canal Zone			9	202	447
Chile	15			62	
Italy				69	2,304
Japan				5,336	
Malta, Gozo, and Cyprus				78	155
Mexico					1,644
Netherlands					2,460
Panama, Republic of			12	41	223
Philippines, Republic of				[2] 433	2,341
Yugoslavia					652
Other countries	74		29	145	1,909
Total reclaimed, scrap, etc	3,315	2,844	2,465	[2] 16,025	28,801
Grand total	319,701	300,326	159,238	[2] 227,870	347,262

[1] Data include lead imported for immediate consumption plus material entering the country under bond.
[2] Revised figure.

Lead imported for consumption in the United States, 1944–48, by classes [1]

[U. S. Department of Commerce]

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
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value		
1944	100,846	$6,756,269	73	$7,045	223,379	$22,793,430	40	$39,572	$547	$29,895,575
1945	76,126	5,758,695	20	2,242	227,311	25,280,638	17	2,778	32,515	31,312,708
1946	28,377	3,056,111	20	2,302	100,820	14,205,992	24	10,251	21,517	17,491,086
1947	[2] 44,419	[2] 8,558,643	[2] 1,758	[2] 416,643	158,705	38,008,443	67	42,434	10,453	[2] 50,108,767
1948	33,932	8,350,507	10,922	3,239,135	244,998	81,061,505	181	100,519	35,554	101,069,746

[1] In addition to quantities shown (value included in total values), "reclaimed, scrap, etc." imported as follows—1944: 3,315 tons, $298,712; 1945: 2,848 tons, $235,840; 1946: 2,481 tons, $194,913; 1947: Revised figures. 15,963 tons, $3,072,151; 1948: 28,801 tons, $8,282,526. Figures for 1944–48 include lead received by the Government and held in stock piles.
[2] Revised figure.

Miscellaneous products, containing lead, imported for consumption in the United States, 1944–48

[U. S. Department of Commerce]

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
1944	50	43	$15,368	7,562	7,174	$954,255
1945	143	73	101,132	26,110	24,730	3,241,735
1946	157	72	211,122	1,740	1,494	220,645
1947	240	161	170,247	2,406	2,219	753,664
1948	257	184	213,614	14,346	12,797	5,162,168

Exports.—Total exports of pig lead (excluding reexports of foreign refined lead) declined from 1,514 tons in 1947 to 399 tons in 1948. Export restrictions imposed under the Export Control Act of 1940 remained in force throughout 1948.

Lead exported from the United States, 1944–48

[U. S. Department of Commerce]

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	
1944	15,523	$2,073,145	20,237	1947	1,514	$383,132	(1)
1945	1,407	202,754	14,846	1948	399	159,421	(1)
1946	597	106,457	(1)				

[1] Data not available.

Pig lead exported from the United States, by destinations, 1944–48, in short tons [1]

[U. S. Department of Commerce]

Destination	1944	1945	1946	1947	1948
Countries:					
Argentina				894	2
Brazil	450	406	281	63	1
Canada	5	8	40	6	7
Canal Zone			6	52	
Chile	23	215	2	52	42
China	1		8	6	21
Colombia	34	25	49	12	16
Cuba	18	156	58	38	40
Czechoslovakia			10		
Hong Kong				27	2
India			(2)	19	121
Madagascar				44	
Mexico	8	32	17	15	14
Netherlands			1	100	(2)
Netherlands Antilles	9	14	11		
Panama, Republic of	18	23	17	(2)	1
Philippines, Republic of			16	23	1
Portugal	542	257			
Saudi Arabia		13	11	3	24
Turkey		22		50	11
U. S. S. R.	14,314	66		5	
Uruguay	7	2	10	27	
Venezuela	17	75	34	30	63
Other countries	77	93	26	48	33
Total	15,523	1,407	597	1,514	399
Continents:					
North America	80	273	170	139	74
South America	541	761	381	1,078	125
Europe	14,867	323	11	118	9
Asia	30	44	35	133	189
Africa and Oceania	5	6	(2)	46	2

[1] In addition less than 1 ton of foreign lead was reexported in 1944, 377 tons in 1945, 103 tons in 1946, 102 tons in 1947, none in 1948.
[2] Less than 1 ton.

WORLD REVIEW

Lead is produced in many countries, but four—United States, Mexico, Australia, and Canada—have accounted for nearly three-quarters of the world output in recent years, as is apparent from the accompanying table, which shows world production by countries, 1942–48, insofar as statistics are available.

World smelter production of lead, by countries where smelted, 1942–48, in metric tons [1]

[Compiled by B. B. Mitchell]

Country	1942	1943	1944	1945	1946	1947	1948
Argentina	20,760	23,800	19,100	21,159	16,190	17,800	17,830
Australia	255,409	192,322	157,026	158,353	139,665	161,093	162,057
Austria	8,787	12,043	10,123	1,272	4,476	3,795	8,086
Belgium [2]	16,240	7,960	7,690	7,340	23,762	40,520	66,035
Burma	17,130						7,570
Canada	220,722	203,091	129,347	147,964	150,360	147,104	145,246
China	1,169	1,179	153	850	14	771	834
Czechoslovakia	(3)	(3)	(3)	645	2,800	4,460	5,770
France	12,462	12,428	1,923	2,765	32,010	36,623	34,813
Germany [4]	140,100	157,200	[5] 139,900	(6)	[2] 27,659	[2 7] 24,356	[2 7] 49,382
Greece	2,300	1,150	600	700	1,127	948	1,166
Guatemala	119	114	136	115	131	110	335
Hungary	4,810	6,370	[8 9] 3,230	[9] 10	10	60	(6)
India						234	554
Indochina, French	2	16	51				
Italy	28,996	17,715	2,229	2,826	14,010	17,543	26,427

See footnotes at end of table.

World smelter production of lead, by countries where smelted, 1942–48, in metric tons [1]—Continued

Country	1942	1943	1944	1945	1946	1947	1948
Japan	[10] 26,919	[10] 32,511	[10] 38,048	[10] 12,568	4,965	8,747	10,600
Korea:							
Northern	11,900	18,467	21,200	2,548	[5] 2,000	[5] 2,000	(6)
Southern					--------	250	
Mexico	192,989	212,452	178,270	201,078	137,742	217,827	187,067
Northern Rhodesia	1,118	1,265	1,047	1,748	8,371	15,891	13,229
Norway	--------	--------	--------	52	36	48	(6)
Peru	37,915	43,171	38,906	40,001	36,478	32,810	34,297
Poland	16,311	15,506	15,833	[5] 7,000	10,915	12,761	16,874
Rumania	154	187	261	3,363	3,225	3,316	(6)
South-West Africa	--------	--------	--------	--------	--------	64	82
Spain	41,149	36,760	30,978	31,922	32,346	34,382	20,926
Sweden	230	2,193	10,553	12,501	11,223	9,229	5,192
Tunisia	8,210	1,867	5,335	7,023	7,880	9,840	17,960
U. S. S. R.[5]	80,000	50,000	45,000	40,000	48,000	63,000	75,000
United Kingdom [5]	5,487	4,064	3,556	2,743	2,540	2,852	2,312
United States (refined) [11]	497,908	425,903	421,538	402,304	306,717	400,018	363,092
Total (estimate) [12]	1,665,000	1,492,000	1,292,000	1,119,000	1,034,000	1,283,000	1,288,000

[1] Data derived in part from Monthly Bulletin of the United Nations, The Mineral Industry of the British Commonwealth and Foreign Countries Statistical Summary, and the Yearbook of the American Bureau of Metal Statistics.
[2] Includes scrap.
[3] Included with Germany.
[4] Exclusive of secondary material. Includes Upper Silesia and Sudetenland through 1944.
[5] Approximate production.
[6] Data not yet available, estimate by author of chapter included in total.
[7] Bizonal area.
[8] January to June, inclusive.
[9] Data represent Trianon Hungary subsequent to October 1944.
[10] Preliminary data.
[11] Figures cover lead refined from domestic and foreign ores; refined lead produced from foreign base bullion not included.
[12] Includes estimate for Yugoslavia by author.

Argentina.—The chief lead-producing district in Argentina is the Aguilar, where the Compania Minera Aguilar, S. A., a subsidiary of the St. Joseph Lead Co., operates the Aguilar group of mines. Over 80 percent of the annual Argentine mine output of lead is produced at this property. Output in 1948 was at a rate approximately 40 percent under the installed mill capacity owing to extremely poor transportation facilities, which interrupted incoming shipments of machinery, Diesel oil, and mine timber, as well as shipments of concentrates to the smelter. The production of lead concentrates in 1948 totaled 24,068 metric tons compared with 25,834 tons in 1947. On December 31, 1948, 1,744 tons of lead concentrates and 84,496 tons of zinc concentrates were stock-piled at the mine awaiting shipment.

Australia.—Shortages of labor and material continued to hamper mining operations in Australia in 1948. Steel was in particularly short supply; as a result, deliveries of mining and milling machinery were being delayed 18 months to 2 years.

Lead and zinc production was emphasized during the year at the Mount Isa mines in northwest Queensland, the copper section of the mine being idle until the new copper milling and smelting plant is completed. Production of lead-zinc ore totaled 571,706 tons; ore reserves in the lead-zinc lodes were estimated at 9,608,400 tons assaying 6.4 ounces of silver per ton, 8.7 percent lead, and 7.3 percent zinc. During 1948 the Zinc Corp., Ltd., treated 454,717 tons of ore compared with 408,648 tons in 1947. At the New Broken Hill Consolidated property, adjoining the Zinc Corp. on the south and managed by that company, ore output was increased from 62,367 tons in 1947 to 103,567 tons in 1948, the grade of ore being silver 1.9 ounces per ton, lead 9 percent, and zinc 12.6 percent.

The Lake George Mining Corp., Ltd., at Captain's Flat, New South Wales, produced 12,644 tons of lead concentrates in the year ended June 30, 1948. Ore reserves on that date were estimated at 1,576,721 tons assaying 1.17 dwt. gold and 1.46 ounces of silver per ton, 6.65 percent lead, 11.85 percent zinc, and 0.65 percent copper. Mine output of Electrolytic Zinc Co. of Australasia in 1948, totaled 125,226 tons assaying 2.0 dwt. gold and 7.05 ounces of silver per ton, 19.5 percent zinc, 6.2 percent lead, and 0.48 percent copper.

A shortage of skilled miners and reduced working hours were named by North Broken Hill, Ltd., as the principal factors limiting mine production in 1948. The grade of ore mined was the lowest for many years, but recoveries of lead, silver, and zinc were the highest ever obtained. At Broken Hill South, Ltd., production for the year ended June 30, 1948, totaled 236,950 tons of ore assaying 7.8 ounces of silver per ton, 13 percent lead, and 12 percent zinc, from which 39,866 tons of lead concentrates containing 74.8 percent lead were recovered.

Burma.—Rehabilitation of the Burma Corp., Ltd., Bawdwin mine, which was severely damaged by Japanese occupation during the war, continued in 1948. The mine was unwatered to 40 feet below the 11th level—668 feet below the 6th level—and operations were continued in an effort to gain access to the 12th level. After this is accomplished, the electric pump on that level will be put into operation, and the prewar method of controlling mine water will have been reestablished. Additional electric power provided by three 400-kw. Diesel engines installed in May 1948 enabled resumption of smelting and refining operations. Production of refined lead began at the end of May and continued until early September, when it was discontinued because of shortage of essential mining supplies caused by interruption of traffic over the Burma Railway due to insurgent activities. Traffic and production were resumed early in October. A total of 4,890 tons of refined lead was produced before operations were suspended in September.

Chile.—Exceptionally high grade lead-zinc ore was reported occurring at the Compania Minera Aysen mine on the north shore of Lago Buenos Aires in Aysen Territory of southern Chile. Preliminary exploration has developed enough ore reserves to justify erection of a mill with the financial aid of the Chilean Miners' Credit Bank. Metallurgical tests conducted in the laboratories of the Credit Bank produced high-grade lead and zinc flotation concentrates with excellent separation and recoveries. Until Chilean roads are improved sufficiently to permit economical transportation to a Chilean port, concentrates will be shipped from Puerto Deseado, an Argentine port on the Atlantic coast.

French Morocco.—Mine output of lead in French Morocco increased in 1948 and surpassed the prewar production levels. Principal producing centers were Zellidja, Aouli, Touissit, Haut-Guir, and Bab Cedra. The Société Nord Africaine du Plomb, owned jointly by Société des Mines de Zellidja (51 percent), Newmont Mining Corp. (33 percent), and St. Joseph Lead Co. (16 percent) acquired ownership and conducted exploration of mineral lands formerly held by the Zellidja Co. in both Morocco and Algeria, adjacent to the main Zellidja property.

Greece.—Rehabilitation of the Laurium lead-zinc mine 35 miles south of Athens was in progress during the latter part of 1948 by the Mediterranean Mines, Ltd. The company plans to erect a 200-ton flotation mill to treat an indicated sulfide-ore reserve of 260,000 tons carrying 5 to 8 percent lead and an estimated 2,500,000 tons of tailings and slimes assaying 2.5 to 4.5 percent lead.

Greenland.—In the summer of 1948 a Danish Government geological survey party headed by Dr. Lange Koch discovered a lead deposit on the east coast of Greenland at Mesters Vig in the area around King Oscar Fjord and Davy Sound (73° 15′ N. Lat., 24° W. Long.). The deposit included 3 quartz veins 5 to 10 meters wide and 8 kilometers long extending from the coast to a mountain pass at an elevation of 600 meters. Ore samples taken from the outcrops assayed 80 percent lead and some samples contained as high as 300 grams of silver per ton. No zinc, bismuth, or other minerals were found which might complicate the recovery of the lead. On the basis of data obtained from exploration conducted in 1948 the area is thought to contain an estimated one million tons of lead. More detailed development and exploration are planned for the summer season of 1949.

Peru.—Lead production from Peru comes from a large number of mines, the most productive being the Cerro de Pasco, Casapalca, Huaron, Volcan, Atacocha, Cercapuquio, and Colquijirca mines. Lead output in 1948 at Cerro de Pasco was greater than in the previous year, due partly to the fact that throughout 1948 the Paragsha mill at Cerro de Pasco was used exclusively for lead-zinc ores, making possible expansion of mining operations in the Cerro de Pasco lead-zinc ore body. Production was halted at the Casapalca mine on April 19, 1948, by a fire which began in the underground hoist room of the Aguas Calientes shaft, killing 52 mine employees.

During the year the Compania Minero Atacocha began erecting the first of three 330-ton units of a new 1,000-ton flotation mill. The new plant is expected to be operating by the middle of 1950.

The Peruvian Government took action during 1948 to aid in expanding mineral production and early in the year made the first substantial reduction in tax load granted by any Latin American country by lowering the export tax.

South-West Africa.—The Tsumeb mine is the only important source of lead in South-West Africa. During 1948 shipments of lead-copper ores and concentrates totaled 74,837 short tons, containing 29,428 tons of lead and 7,483 tons of copper. Development included unwatering the mine to the twentieth level (1,900 feet below the surface), where mine workings of the former German owners were found to be in good condition. Diamond drilling below the twentieth level disclosed new and substantial ore tonnages. To provide additional productive capacity from the lower levels of the mine and to permit handling 1,800 to 2,000 tons of ore per day, the company plans to sink a new shaft at an estimated cost of $2,000,000. The new 1,200-ton-per-day selective flotation mill began producing in March 1948.

Tanganyika.—There were many conflicting reports during 1948 as to the importance of the lead deposit at Mpanda. Some releases indicated proved ore reserves of 25 million tons, containing 15.5 percent lead, in addition to copper, silver, gold, tungsten, nickel, and cobalt. Other more conservative reports indicate a much lower proved tonnage averaging 6.5 percent lead. Exploration and pilot-plant construction at the property proceeded under the supervision of Uruwira Minerals, Ltd., with technical direction by the Union Corp., Ltd. Late in the year the Union Corp. withdrew from participation in the development for the stated reason that the reserves disclosed did not indicate an ore body of enough magnitude to justify the expensive development that would be necessary before the deposit could be exploited.

Turkey.—Metallurgical tests on ore from the Bolkardag mine, owned by the Turkish Government agency—Etibank—were made during 1948. The property in the Taurus Mountains in the Province of Nigde, 257 kilometers from the Mediterranean port of Iskenderon, has a known ore reserve of 250,000 tons containing 6 percent lead 5 percent zinc, and some gold and silver.

A flotation plant, power plant, and repair shops were completed during 1948 at the Keban mine in the Province of Elazig, 548 kilometers from Iskenderon. The concentrator is designed to treat 18,000 tons of ore annually. Proved ore reserves total 100,000 tons, averaging 10 percent lead. It is planned to build a smelter at Iskenderon to treat concentrates from both the Keban and Bolkardag mines.

Lead and Zinc Pigments and Zinc Salts

By HELENA M. MEYER and ALETHEA W. MITCHELL

GENERAL SUMMARY

SMALLER quantities of all of the lead and zinc pigments covered by this report were shipped in 1948 than in 1947, declines ranging from a low of 6 percent for zinc oxide to a high of 33 percent for white lead (dry and in oil). Again, as in several immediately preceding years, the quantities shipped were not a true measure of demand. Large pigment users, such as the automobile, construction, storage battery, and rubber industries, operated at or above the high levels of 1947, so that requirements for pigments were unabated in 1948. The manufacture of passenger automobiles and trucks, for example, rose 9 percent following the sharp advance in 1947; new private and public construction was 26 percent larger in value, and the value of paint, varnish, and lacquer materials rose slightly over the previous all-time peak in 1947. Gains in unit values, of course, played an important part in raising total values for construction and paint. Consumption of natural rubber increased 11 percent, whereas that of the synthetic type dropped 20 percent, causing an over-all decrease. Natural rubber, however, requires considerably more zinc oxide than the synthetic type.

Shortages of crude materials used for pigment manufacture, notably pig lead, continued to be a limiting factor in the pigments picture. The inadequate supplies of pig lead in recent years and the inflationary trend of prices in general caused the price of pig lead to reach new peaks in 1947 and again in 1948. Lead-pigment prices responded by establishing new tops of their own in both years. These high prices played a part, no doubt, in reducing demand for some of the pigments covered by this report. The price for slab zinc gained markedly but did not exceed records set in World War I. Zinc-pigment prices in 1947 and 1948 were the highest in many years and in some instances may have reached new all-time heights.

Shipments of white lead (dry) dropped 32 percent and were the smallest since 1934. Those of the "in oil" variety fell 34 percent and were smaller even than the 1945 total, itself below all previous totals since considerably before the beginning of the present century. Red-lead shipments declined 15 percent and were the lowest since 1938. The total for litharge was 7 percent below the record performance in 1947 but second only to shipments in that year.

Salient statistics of the lead and zinc pigments industry of the United States, 1943–48

	1943	1944	1945	1946	1947	1948
Production (sales) [1] of principal pigments:						
White lead (dry and in oil)..........short tons..	76,167	85,726	51,170	[2] 66,501	68,787	46,070
Litharge..........do....	113,091	138,203	138,798	133,799	167,050	154,775
Red lead..........do....	53,378	53,972	47,381	32,526	36,064	30,787
Zinc oxide..........do....	143,402	140,675	127,955	157,851	160,771	150,958
Leaded zinc oxide..do....	43,828	64,395	62,598	67,971	81,459	67,441
Lithopone..........do....	135,723	142,905	136,161	147,001	165,024	140,033
Value of products:						
All lead pigments..........	$41,897,000	$46,601,000	$39,045,000	$43,595,000	[3] $90,199,000	[3] $90,915,000
All zinc pigments..........	36,260,000	39,288,000	36,644,000	44,195,000	63,891,000	65,547,000
Total..................	78,157,000	85,889,000	75,689,000	87,790,000	[3] 154,090,000	[3] 156,462,000
Value per ton received by producers:						
White lead (dry)..........	163	163	159	[2] 207	308	363
Litharge..................	152	146	148	175	313	387
Red lead..................	171	164	168	196	333	396
Zinc oxide................	137	139	138	144	186	218
Leaded zinc oxide.........	132	132	132	143	204	245
Lithopone.................	79	78	78	81	105	115
Foreign trade:						
Lead pigments:						
Value of exports......	1,439,000	1,387,000	1,427,000	851,000	1,041,000	970,000
Value of imports......	3,000	6,000	8,000	13,000	150,000	633,000
Zinc pigments:						
Value of exports......	2,737,000	2,017,000	2,279,000	2,911,000	6,554,000	5,229,000
Value of imports......	5,000	1,500	([4])	9,000	31,000	7,000
Export balance.....	4,168,000	3,396,500	3,698,000	3,740,000	7,414,000	5,559,000

[1] Reported as shipments, 1945–48.
[2] Data for basic lead sulfate in 1946 included under white lead; Bureau of Mines not at liberty to show separately.
[3] Excludes value of basic lead sulfate; Bureau of Mines not at liberty to publish.
[4] Less than $500.

Zinc oxide shipments were 6 percent under those for 1947 but lower than in only five other preceding years, 1946, 1925, and 1927–29, inclusive. Shipments of leaded zinc oxide fell 17 percent in 1948 but were smaller only than the previous peaks in 1947 and 1941; they were relatively the same as the 1946 tonnage. Lithopone shipments dropped 15 percent and were the smallest since 1945.

Zinc chloride evidently established a new high record in 1948, although there are a few gaps in the statistical record. Shipments of zinc sulfate approximated those for 1947 and lagged only behind the peak for 1946.

Titanium pigments were shipped in greater quantity than ever before in 1948, continuing the establishment of peak rates for the fifth successive year. Even greater heights would have been reached in recent years had production capacity permitted. Capacity was expanded again in 1948 to close to 10 percent above 1947. The record high tonnages made available, however, again failed to fill all demand, and further plant extensions were in prospect for 1949.

High lights in the distribution of pigments and salts covered by this report are outlined in the following discussion. Ceramics continued to make noteworthy gains as a consumer of pigments. The second-largest outlet for litharge, ceramics took more of this pigment than ever before, rising 9 percent over previous peaks in 1947 and 1941.

Zinc oxide was shipped for ceramic manufacture in new high record quantities for the third successive year, and red lead was shipped at a record high rate, except for 1941. The use of white lead by ceramic makers, on the other hand, has been gaining for several years but dropped, at least temporarily, in 1948. All pigments were shipped in smaller quantities for paint manufacture than in 1947; shipments of white lead for this purpose doubtless were the smallest since many years before the present century began. Shipments of red lead for paint manufacture, however, were 6 percent above the prewar (1935–39) average rate. Those of zinc oxide were relatively unchanged from that average, of leaded zinc oxide were 72 percent higher, and of lithopone were 11 percent lower than the prewar period. White-lead shipments for paint fell to considerably below half of the prewar average rate. Storage-battery manufacture took less litharge and red lead in 1948 as compared with 1947 but used more litharge than in any other year, or almost three times the prewar average quantity; red lead amounted to 27 percent less than the prewar average. The insecticidal use of litharge has been hardest hit of this pigment's uses, falling 17 percent from 1947, amounting to only 23 percent of the all-time high record in 1944, and falling 60 percent below the prewar average. Consumption of zinc sulfate for agricultural purposes likewise made a poor showing in 1948, falling 31 percent (dry basis) from 1947 and amounting to only about half of its peak tonnage in 1946. The manufacture of rubber took greater quantities of the pigments covered by this report in 1948 than in 1947 and also showed to advantage in relation to earlier years. Zinc oxide was used for rubber at a record rate except for 1941 and 1946, lithopone was the highest since 1937, and litharge the largest since 1944, being 53 percent above the prewar level. A new high record was established in 1948 by shipments of zinc sulfate for rayon manufacture. This use has climbed continuously since 1942.

Batteries.—There has been publicity [1] recently in connection with the nickel-cadmium battery, new to the United States but long-known in Europe. Arguments both in favor of and against the battery were contained in the literature.

Paints.—A lead-free exterior house paint, with a titanium base, was introduced [2] in 1948. Late in 1947 a new basic silicate white-lead pigment, which was said to contain 45 percent lead by weight as compared to 80 percent in basic carbonate white lead, was announced.[3] The characteristic of basic silicate white lead, it was said, results from pigment particles having a central core of silica so that whereas the pigment has the characteristics of lead compounds, less lead is required. Prospects for the development of improved finishes (paints, varnish, etc.) were outlined [4] briefly.

[1] Willihnganz, Eugene, Is There a Lifetime Battery: Pres. at convention of Association of American Battery Manufacturers, Inc., Chicago, Ill., Nov. 11–13, 1948.
The Nickel Cadmium Battery, a progress report: Consumers Reports, vol. 14, No. 5, May 1949, pp. 220–222 and 233–234.
Manchester, Harland, Nickel-Cadmium Battery Lasts as Long as the Car: Popular Science, vol. 153, No. 2, August 1948, pp. 113–118.
[2] Oil, Paint & Drug Reporter, vol. 154, No. 7, Aug. 16, 1948, p. 82.
[3] Oil, Paint & Drug Reporter, vol. 152, No. 20, Nov. 17, 1947, p. 82.
[4] Chemical Engineering, Improved Finishes, vol 54, No. 10, October 1947, p. 242.

PRODUCTION

The value of lead and zinc pigments in 1948 (exclusive of that for basic lead sulfate, which cannot be shown) was $156,462,000—an increase of 2 percent despite the 13-percent decline during 1948 in the total tonnage of the lead and zinc pigments covered. Higher average values in 1948, of course, made the foregoing situation possible. Lead pigments and zinc pigments comprised 58 and 42 percent, respectively, of the total value in 1948, compared with 59 and 41 percent, respectively, in 1947.

For many years, figures on sales were used in this series of reports as a better guide to activity in the pigments industry than production. Beginning with 1945, the base was changed to shipments to conform with data compiled on Bureau of Mines lead and zinc schedules. Available information for 1945 (the year of change) indicated that there was little difference between sales and shipments in that year. 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.

LEAD PIGMENTS

Lead pigments shipments dropped 15 percent in quantity but, owing to higher average values, rose 1 percent in total value as compared with 1947. (Shipments of basic lead sulfate, which the Bureau of Mines is not at liberty to publish, are excluded from the figures shown.) All lead pigments covered by the totals played a part in reducing the 1948 tonnage—white lead, dry, falling 32 percent; the "in-oil" variety, 34 percent; red lead, 15 percent; and litharge 7 percent.

Quoted lead pigment prices were higher than ever before, and average values reported by producers likewise showed gains. Total values for red lead and litharge were 1 and 15 percent, respectively, higher than in 1947 despite quantity losses already indicated.

Lead pigments [1] shipped by manufacturers in the United States, 1947–48

Pigment[1]	1947			1948		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Red lead	36,064	$12,022,585	$333	30,787	$12,190,258	$396
Litharge	167,050	52,345,941	313	154,775	59,952,202	387
White lead:						
Dry	39,075	12,036,554	308	26,551	9,643,402	363
In oil [2]	29,712	13,794,387	464	19,519	9,129,237	468

[1] Bureau of Mines not at liberty to publish figures for basic lead sulfate or sublimed lead.
[2] Weight of white lead only but value of paste.

Lead pigments shipped by manufacturers in the United States, 1944–48, in short tons

Year	White lead		Basic lead sulfate or sublimed lead		Red lead	Orange mineral	Litharge
	Dry	In oil	White	Blue			
1944 (sales)	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	[1] 41,892	24,609	(1)	(1)	32,526	123	133,799
1947	39,075	29,712	(2)	(2)	36,064		167,050
1948	26,551	19,519	(2)	(2)	30,787		154,775

[1] Basic lead sulfate included with white lead (dry); Bureau of Mines not at liberty to publish figure.
[2] Bureau of Mines not at liberty to publish figure.

ZINC PIGMENTS AND SALTS

Zinc-pigment shipments declined 12 percent in total quantity in 1948 from the record established in 1947, but increased 3 percent in total value to a new high peak. Higher average values for the three pigments covered accounted for the contrasting movements. Shipments of zinc oxide (lead-free) fell 6 percent from the high performance in 1947 but were smaller only than in 5 earlier years—1946, 1927–29, and 1925. Although shipments of the leaded variety decreased 17 percent, they failed to exceed only the previous peaks for 1947 and 1941, being relatively the same as the 1946 tonnage. Lithopone shipments dropped 15 percent and were the smallest since 1945.

Zinc chloride shipments, so far as can be ascertained, established a record in 1948, although the statistical picture for this product is somewhat incomplete. Zinc sulfate shipments were relatively unchanged from 1947 and second only to those for 1946.

Zinc pigments and salts shipped by manufacturers in the United States, 1947–48

Pigment or salt	1947			1948		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Zinc oxide [1]	160,771	$29,873,882	$186	150,958	$32,862,368	$218
Leaded zinc oxide [1]	81,459	16,634,516	204	67,441	16,548,636	245
Lithopone	165,024	17,382,592	105	140,033	16,135,976	115
Zinc chloride, 50° B	65,521	4,279,737	65	68,701	4,717,963	69
Zinc sulfate	21,547	2,235,683	104	21,513	2,443,869	114

[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 shipped by manufacturers in the United States, 1944–48, in short tons

Year	Zinc oxide	Leaded zinc oxide [1]	Lithopone	Zinc chloride (50° B.)	Zinc sulfate
1944 (sales)	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
1947	160,771	81,459	165,024	65.521	21,547
1948	150,958	67,441	140,033	68,701	21,513

[1] Includes a small quantity containing less than 5 percent lead.

CONSUMPTION BY INDUSTRIES

WHITE LEAD

The down trend in use of white lead, in progress for many years, was extended in 1948. Shipments of white lead (dry) fell 32 percent from 1947 and were the smallest since 1934; those of the "in-oil" variety were 34 percent below 1947 and less even than shipments in 1945, themselves the lowest since considerably before the beginning of the present century. Total white-lead shipments, likewise, hit a new bottom since many years before the present century began. Continued scarcity of pig lead and all-time record prices were chiefly responsible for the poor showing. Paint took at least 89 percent of total shipments in 1948; a more precise break-down of the "Other" class doubtless would add more to "paint" than to any other use. Progress and expansion in the use of white lead for ceramics were halted, at least temporarily, in 1948.

Production of white lead (dry) amounted to 25,955 tons and of white lead in oil to 17,672 tons, compared with 39,337 and 32,677 tons, respectively, in 1947.

Distribution of white lead (dry and in oil) shipments, by industries, 1944–48, in short tons

Industry	1944 [1]	1945	1946 [2]	1947	1948
Paints	79,948	46,418	60,943	61,265	40,892
Ceramics	946	839	1,367	1,665	1,369
Other	4,832	3,913	4,191	5,857	3,809
	85,726	51,170	66,501	68,787	46,070

[1] Reported as sales.
[2] Data for basic lead sulfate included with white lead; Bureau of Mines not at liberty to show separately.

BASIC LEAD SULFATE

The Bureau of Mines is not at liberty to publish figures on basic lead sulfate for 1946–48. Shipments in 1946 were included with those of "white lead" (dry), but 1947 and 1948 data are not shown in any way. Basic lead sulfate is used almost entirely in paints. Substantial quantities are used as an intermediate product in the manufacture of leaded zinc oxide. Such quantities have always been shown in this series under leaded zinc oxide rather than basic lead sulfate.

Distribution of basic lead sulfate shipments, by industries, 1944–48, in short tons

Industry	1944 [1]	1945	1946	1947	1948
Paints	5,496	3,009	(2)	(3)	(3)
Rubber	268	200			
Storage batteries	2	----------			
Other	567	686			
	6,333	3,895	(2)	(3)	(3)

[1] Reported as sales.
[2] Data for basic lead sulfate included with white lead; Bureau of Mines not at liberty to show separately.
[3] Bureau of Mines not at liberty to publish figures.

RED LEAD

Shipments of red lead dropped 15 percent from 1947 and were the smallest since 1938, exceeding that year by a narrow margin. The manufacture of storage batteries—the chief use of red lead—took 29 percent less than in 1947, when shipments were 31 percent below the all-time peak rate of 1944, but substantially the same as in late prewar years. Shipments for paint manufacture declined 4 percent, but this use about approximated prewar levels. Ceramics took 31 percent more red lead in 1948 and doubtless consumption was higher than in any previous year except 1941, being 20 percent below that year.

Production of red lead amounted to 29,698 tons in 1948 compared with 36,041 tons in 1947.

Distribution of red-lead shipments, by industries, 1944–48, in short tons

Industry	1944 [1]	1945	1946	1947	1948
Storage batteries	30, 211	26, 725	19, 115	20, 883	14, 854
Paints	18, 074	16, 438	9, 318	11, 362	10, 863
Ceramics	878	626	1, 228	977	1, 275
Other	4, 809	3, 592	2, 865	2, 842	3, 795
	53, 972	47, 381	32, 526	36, 064	30, 787

[1] Reported as sales.

ORANGE MINERAL

No shipments nor production of orange mineral was reported in 1948 and 1947.

Distribution of orange mineral shipments, by industries, 1942–48,[1] in short tons

Industry	1942 [2]	1943 [2]	1944 [2]	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] No shipments reported for 1947–48.
[2] Reported as sales.

LITHARGE

Litharge gave the best performance in 1948 of all pigments covered by this report. Although shipments dropped 7 percent, compared with 6 percent for zinc oxide, they were smaller only than the all-time peak in 1947, whereas zinc oxide shipments were lower than in five earlier years. Storage batteries, as always by far the leading use and responsible for the 1947 peak record, took 10 percent less than the record tonnage, or more than the average decline. In 1947 and 1948, two-thirds of total litharge shipments went to storage-battery manufacturers, compared with an average of 44 percent in the 5-year period 1935–39. 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 for 1948—69,000 tons—was unchanged from the high record established in 1947 and was 13 percent above the previous peaks in 1944 and 1941. Black oxide production required 66,000 tons of pig lead in both 1948 and 1947. The black oxide tonnages are not included in Bureau of Mines totals for litharge.

Ceramics, which have been taking increasing quantities since 1945, established a new peak in 1948, exceeding the previous peaks for 1947 and 1941 by 9 percent. The manufacture of chrome pigments has been falling since 1945 and had the sharpest percentage drop (19 percent) among the uses of litharge. This use took not much more than half of the peak established in 1941. The quantity of litharge shipped for oil-refining use decreased 6 percent as compared with 1947; the latter, however, was the largest since 1937. The insecticidal use of litharge has made the poorest showing in recent years of the various outlets. The 17-percent decline in this use in 1948, on top of successive drops since the all-time record for 1944, made the tonnage shipped for this purpose only 23 percent of the 1944 peak. Varnish and rubber manufacture both gained in 1948, the former 4 and the latter 29 percent. Sales to varnish makers were the largest ever, so far as it is possible to ascertain, and those to rubber manufacturers were the greatest since 1944.

Litharge production totaled 159,489 tons in 1948 compared with 174,341 tons in 1947.

Distribution of litharge shipments, by industries, 1944–48, in short tons

Industry	1944 [1]	1945	1946	1947	1948
Storage batteries	72, 342	79, 981	75, 836	111, 840	100, 645
Ceramics	12, 381	11, 511	13, 166	18, 360	19, 979
Chrome pigments	8, 233	11, 394	10, 877	9, 228	7, 455
Oil refining	5, 608	6, 419	6, 682	7, 688	7, 248
Insecticides	25, 957	18, 061	14, 259	7, 288	6, 033
Varnish	2, 988	2, 752	3, 302	4, 258	4, 424
Rubber	3, 023	1, 864	2, 131	2, 205	2, 835
Floor coverings	117	115	106	141	152
Other	7, 554	6, 701	7, 440	6, 042	6, 004
	138, 203	138, 798	133, 799	167, 050	154, 775

[1] Reported as sales.

ZINC OXIDE

Shipments of zinc oxide (lead-free) dropped 6 percent in 1948 but were greater than in all other earlier years except five, that is, 1946, 1927–29, and 1925. The manufacture of rubber took 55 percent of all shipments, slightly exceeded 1947, and except for 1941 and 1946 was probably the greatest on record; distribution data for years before 1929 are not available. Consumption of zinc oxide for paint manufacture declined for the second successive year. The tonnage for 1948 differed little from the average for the prewar period, 1935–39, inclusive. Use of zinc oxide for ceramics rose 9 percent to a new peak for the third successive year. This use did not maintain its proportionate importance during the war. Since the war-time low point was reached in 1942, however, shipments to ceramic manufacturers have been continuously upward. Coated fabrics and textiles dropped to fourth place among users of zinc oxide in 1947, having been displaced by ceramics, and continued below the latter use in 1948. Coated fabrics and textiles, chiefly the manufacture of rayon, took 4 percent more zinc oxide in 1948 than in 1947. Floor coverings, likewise, used 4 percent more zinc oxide in 1948.

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Production of lead-free oxide totaled 146,565 tons compared with 159,149 tons in 1947. Closing of the plant of the American Zinc Oxide Co. by a labor strike for several months in 1948 was principally responsible for the disparity between production and shipments. Of the 1948 total, 76 percent was made by the American process from ores and primary residues, 15 percent by the French process from metal and scrap, and 9 percent by other processes compared with 73, 17 (revised), and 10 (revised) percent, respectively, in 1947.

Distribution of zinc oxide shipments, by industries, 1944–48, in short tons

Industry	1944 [1]	1945	1946	1947	1948
Rubber	59,518	63,447	83,776	82,248	82,895
Paints	24,999	28,014	34,785	32,867	26,779
Ceramics	3,653	5,086	9,056	11,350	12,327
Coated fabrics and textiles [2]	9,563	12,177	10,022	9,100	9,474
Floor coverings			2,848	4,735	4,938
Chemical warfare	27,686	2,053	-	-	-
Other	15,256	17,178	17,364	20,471	14,545
	140,675	127,955	157,851	160,771	150,958

[1] Reported as sales. [2] Includes the following tonnages for rayon: 1946—9,363; 1947—7,302; 1948—8,209

The varied uses of zinc oxide recently were reported in Zinc Bulletin 5, published by the Zinc Development Assoc., Oxford, England. Purposes served by zinc oxide in natural and synthetic rubber production, as given in the aforementioned bulletin, were outlined in the technical press.[5]

LEADED ZINC OXIDE

The use of leaded zinc oxide has continued at high levels in recent years. Shipments established a new high record in 1941, were close to record levels in 1944–46, inclusive, and established a new peak in 1947. Shipments in 1948 were 17 percent less than the 1947 peak but were smaller only than in 1947 and 1941, being approximately the same as in 1946. Of the total shipments in 1948, 96 percent was reported for paint. Doubtless a better break-down of the "Other" class would add to the paint classification. Figures for basic lead sulfate used in blending to make leaded zinc oxide are included in tonnages for the latter pigment.

Leaded zinc oxide production totaled 67,480 tons in 1948 compared with 78,799 tons in 1947. The totals comprise grades as follows (1947 for comparison in parentheses): 53,915 (68,413) tons of 35 percent lead and under, and 13,565 (10,386) tons of over 35 percent lead.

Distribution of leaded zinc oxide shipments, by industries, 1944–48, in short tons

Industry	1944 [1]	1945	1946	1947	1948
Paints	62,223	58,852	64,816	77,994	64,912
Rubber	119	200	166	131	218
Other	2,053	3,546	2,989	3,334	2,311
	64,395	62,598	67,971	81,459	67,441

[1] Reported as sales.

[5] Chemical Age (London), Varied Uses of Zinc Oxide: Vol. 60, No. 1538, Jan. 1, 1949, p. 22.

LITHOPONE

Shipments of lithopone dropped 15 percent in 1948 and were the smallest since 1945; the 1948 tonnage was larger than in only 3 years (1945, 1943, and 1942) since 1938. Paint, varnish, and lacquer manufacturers took 23 percent less lithopone than the high quantity for 1947, which was smaller than in only two earlier years, that is 1928 and 1929. Paints, etc., which regularly use three-quarters or more of the total shipments, took 75 percent in 1948 compared with 82 percent in 1947. Other broad classifications of uses showed gains in 1948. Consumption for rubber, which has made sharp gains since 1944, rose 36 percent and was the largest since 1937. Floor coverings and coated fabrics and textiles together rose 19 percent to the highest total since 1941. The gain was due entirely to floor coverings, which took 12,423 tons compared with 9,048 tons in 1947, whereas the totals for coated fabrics were 8,436 and 8,421 tons, respectively. The use of lithopone by paper manufacturers was at the highest level since 1944; it was 4,814 in 1948, 4,069 in 1947, 3,011 in 1946, 3,086 in 1945, and 6,488 in 1944. Shipments for use in the manufacture of ink continued in 1948 at about the 1947 rate—727 and 720 tons, respectively. Sales for this use have been falling; the tonnages were 1,216 in 1944, 864 in 1945, and 830 in 1946. One manufacturer regularly includes tonnages for ink as not separable from those sold for paint, but the tonnages in the foregoing sentences are for identical companies. Exports are included mainly under "Other," but at least one company classifies part of its exports according to end use.

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 that always dominates the output of the high-strength product and has been the only producer in some years. In 1948, as in 1947, one company operating two plants produced high-strength lithopone.

Production of lithopone amounted to 151,005 tons in 1948 compared with 162,685 tons in 1947. Plant capacity for the manufacture of lithopone was reported to be 157,000 tons in 1948, or unchanged from 1947.

Distribution of lithopone shipments, by industries, 1944–48, in short tons

Industry	1944 [1]	1945	1946	1947	1948
Paints, varnishes, and lacquers [2]	108,800	109,398	123,279	134,830	104,441
Floor coverings and textiles	14,746	15,821	15,167	17,469	20,859
Rubber	726	977	1,607	3,085	4,192
Other	18,633	9,965	6,948	9,640	10,541
	142,905	136,161	147,001	165,024	140,033

[1] Reported as sales. [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. There was a further drop in 1948 to 1,700 tons or only 9 percent of the peak tonnage. 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, 1944–48, in short tons

Year	Titanated lithopone produced	Ordinary lithopone used	Year	Titanated lithopone produced	Ordinary lithopone used
1944	9,800	8,300	1947	2,600	2,200
1945	9,200	7,800	1948	2,100	1,700
1946	7,500	6,350			

ZINC SULFIDE

In 1948, as in several preceding years, only one company produced zinc sulfide; the Bureau of Mines is not at liberty to publish figures for this pigment.

ZINC CHLORIDE

A new high record doubtless was established by zinc chloride shipments (50° B. solution) in 1948; they were 5 percent higher than those in 1947, believed to have been the previous peak. The record for 1935–41 is somewhat incomplete, making a more precise statement impossible. The figures shown here 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 67,908 tons in 1948 compared with 67,475 tons in 1947.

ZINC SULFATE

Zinc sulfate shipments in 1948 continued at the high level of 1947, second only to the peak in 1946. Rayon, which was displaced by agriculture in the record year, continued in the first place regained in 1947 and required 19 percent more zinc sulfate (dry basis) than in that year. This use established a new top in 1948, whereas agriculture, in second place, dropped 31 percent from 1947 and took little more than half of its peak tonnage for 1946. Chemicals, regularly in third place, continued to decline in 1948, decreasing 17 percent from

Distribution of zinc sulfate shipments, by industries, 1944–48, in short tons

Industry	1944 [1]	1945		1946		1947		1948	
	Gross weight	Gross weight	Dry basis	Gross weight	Dry basis	Gross weight	Dry basis	Gross weight	Dry basis
Rayon	5,954	6,729	5,393	7,634	5,883	8,210	6,173	9,900	7,333
Agriculture	4,974	6,645	5,062	10,816	8,178	7,827	6,125	5,210	4,248
Chemicals	1,459	2,617	1,749	2,254	1,488	2,120	1,439	1,734	1,193
Flotation reagents	1,131	1,232	935	1,084	643	1,112	717	1,632	1,366
Glue	293	260	186	511	335	624	444	561	462
Electrogalvanizing	278	255	161	488	315	233	146	319	205
Paints and varnish processing	1,330	589	539	174	151	61	51	121	104
Textile dyeing and printing	-------	534	474	552	491	60	38	102	66
Other	1,737	1,993	1,342	1,418	943	1,300	864	1,934	1,191
	17,156	20,854	15,841	24,931	18,427	21,547	15,997	21,513	16,168

[1] Reported as sales.

1947. (The lowering of tonnages for chemicals reflects in part more precise separation of distribution data.) Shipments for the manufacture of flotation reagents nearly doubled in 1948 and probably established a new high record, although data on classification of shipments are somewhat incomplete. The other uses shown separately increased notably in 1948 but accounted for a relatively small part of total shipments.

In 1948, 20,125 tons of zinc sulfate were produced, compared with 23,423 tons in 1947.

RAW MATERIALS USED IN MANUFACTURE OF LEAD AND ZINC PIGMENTS AND ZINC SALTS

Figures covering the raw materials used in making pigments and salts in 1948 were not available when this report was prepared. Data for 1947 are given below, and those for 1948 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 1947, roughly 92 percent of the lead in pigments was derived from pig lead and the remainder from ore. Of the lead in ore used to make leaded zinc oxide, about 11 percent was from foreign sources. The proportion for zinc pigments in 1947 was 72 percent from ore and concentrates, 9 percent from slab zinc, and 19 percent from secondary materials; about 18 percent of the ore used was foreign.

The following tables give the source of the metal used in manufacturing 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 lithopone (63 percent in 1947) 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 the recent World War, 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 comparatively low in 1943–46, despite the fact that the percentage from metal and scrap rose in 1943 and continued upward in 1944–47. 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, 25 percent in 1945, 26 percent in 1946, and 28 percent in 1947.

Lead content of lead and zinc pigments produced by domestic manufacturers, by sources, 1946–47, in short tons

Pigment	1946: Lead in pigments produced from— Ore: Domestic	1946: Ore: Foreign	1946: Pig lead	1946: Total lead in pigments	1947: Lead in pigments produced from— Ore: Domestic	1947: Ore: Foreign	1947: Pig lead	1947: Total lead in pigments
White lead	------	------	49,825	49,825	------	------	57,791	57,791
Red lead	------	------	27,084	27,084	------	------	32,675	32,675
Litharge	------	------	123,698	123,698	------	------	161,823	161,823
Orange mineral	------	------	113	113	------	------	------	------
Basic lead sulfate	(1)	------	(1)	(1)	(1)	------	(1)	(1)
Leaded zinc oxide	17,412	1,434	170	19,016	18,669	2,355	------	21,024
	[2] 17,412	1,434	[2] 200,890	[2] 219,736	[2] 18,669	2,355	[2] 252,289	[2] 273,313

[1] Bureau of Mines not at liberty to publish figure.
[2] Excludes lead in basic lead sulfate, data for which Bureau of Mines not at liberty to publish.

Zinc content of zinc pigments and salts produced by domestic manufacturers, by sources, 1946–47, in short tons

Pigment or salt	1946: Zinc in pigments and salts produced from— Ore: Domestic	1946: Ore: Foreign	1946: Slab zinc	1946: Secondary material [1]	1946: Total zinc in pigments and salts	1947: Zinc in pigments and salts produced from— Ore: Domestic	1947: Ore: Foreign	1947: Slab zinc	1947: Secondary material [1]	1947: Total zinc in pigments and salts
Zinc oxide	68,113	15,799	17,991	12,050	113,953	72,639	19,164	17,332	18,106	127,241
Leaded zinc oxide	31,845	3,010	278	------	35,133	34,567	5,067	------	------	39,634
Lithopone	11,370	110	26	17,582	29,088	10,592	1,280	12	20,237	32,121
Total pigments [2]	111,328	18,919	18,295	29,632	178,174	117,798	25,511	17,344	38,343	198,996
Zinc chloride	------	------	------	12,559	12,559	------	------	7	14,863	14,870
Zinc sulfate	3,673	75	------	3,837	7,585	2,595	19	55	4,412	7,081

[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. For the second successive year, average values for lead pigments for 1948 were the highest ever recorded, and those for zinc pigments and salts were again the highest in many years and in some instances probably for all time.

Quoted prices for lead pigments repeated the 1947 performance. They were at all-time peaks at the beginning of the year, and all changes during the year were upward, the quotations following the movement of pig-lead prices. All price changes for the zinc pigments likewise were upward during 1948 as in 1947.

Range of quotations on lead pigments and zinc pigments and salts at New York (or delivered in the East), 1945–48, in cents per pound

[Oil, Paint and Drug Reporter]

Product	1945	1946	1947	1948
Basic lead sulfate, or sublimed lead, less than carlots, barrels	7.50– 7.75	7.50–13.50	13.25–15.75	15.75–21.25
White lead, or basic lead carbonate, dry, carlots, barrels	8.25	8.25–13.75	13.75–16.00	[1] 16.00–22.10
Litharge, commercial, powdered, barrels	8.00– 9.00	8.00–14.75	13.75–17.60	16.60–24.25
Red lead, dry, 95 percent or less, less than carlots, barrels	9.50–10.00	9.50–16.00	15.75–18.60	18.00–25.25
Orange mineral, American, small lots, barrels	12.00–12.50	12.00–18.25	17.75–21.00	20.50–27.60
Zinc oxide:				
American process, lead free, bags, carlots	7.25	7.25– 9.00	9.00–10.00	10.00–13.50
American process, 5 to 35 percent lead, barrels, carlots	7.25– 7.38	7.25–10.75	9.25–12.00	10.25–15.38
French process, red seal, bags, carlots	8.50	8.50–10.25	10.25–11.25	11.25–14.75
French process, green seal, bags, carlots	9.00	9.00–10.57	10.75–11.75	11.75–15.25
French process, white seal, barrels, carlots	9.75	9.75–12.00	11.50–12.50	12.50–16.00
Lithopone, ordinary, small lots, bags	4.50	4.50– 5.25	5.25– 6.25	6.25– 6.75
Zinc sulfide, less than carlots, bags, barrels	8.50– 8.75	8.50–10.00	10.00–11.00	10.75–14.00
Zinc chloride, works:				
Solution, tanks	2.50	2.50	2.50– 3.00	3.00– 3.25
Fused, drums	5.00– 6.50	5.00– 6.50	5.00– 7.40	6.25– 7.90
Zinc sulfate, crystals, barrels	3.65– 4.40	3.65– 4.40	3.65– 5.00	4.55– 6.85

[1] Quotations for bags.

FOREIGN TRADE [6]

Imports of lead and zinc pigments are insignificant in relation to domestic shipments of the items. The total value of the lead group more than quadrupled in 1948 owing to sharp gains in average prices for the various constituents, and to the more than doubling in receipts

Value of foreign trade of the United States in lead and zinc pigments and salts, 1947–48

[U. S. Department of Commerce]

	1947		1948	
	Imports	Exports	Imports	Exports
Lead pigments:				
White lead	$238	$334,631	$82,538	$294,527
Red lead	7,687	296,796	96,506	390,222
Litharge	127,375	409,417	421,595	285,473
Other lead pigments	15,060	(1)	32,689	(1)
	150,360	1,040,844	633,328	970,222
Zinc pigments:				
Zinc oxide	30,594	4,769,836	7,361	2,256,050
Lithopone	21	1,784,414		2,972,912
	30,615	6,554,250	7,361	5,228,962
Lead and zinc salts:				
Lead arsenate	20,700	591,299		433,779
Other lead compounds		(1)	448	(1)
Zinc sulfate	16,867	(1)	10,397	(1)
	37,567	591,299	10,845	433,779
Grand total	218,542	8,186,393	651,534	6,632,963

[1] Data not available.

[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.

of litharge, the chief item. Despite rising prices, zinc pigments fell to less than one-fourth of the small total for 1947.

Total values of exports of lead pigments, zinc pigments, and lead and zinc salts all dropped in 1948 despite higher prices characteristic of that year. All lead pigments except red lead were shipped abroad in smaller quantities in 1948 than in 1947. Of the two larger zinc-pigment classes, exports of the higher-valued zinc oxide were cut almost in half, while those of lithopone were more than half again as large as in 1947.

Lead pigments and salts imported for consumption in the United States, 1944–48

[U. S. Department of Commerce]

Year	Short tons					Total value
	Basic carbonate white lead	Red lead	Litharge	Suboxide of lead	Other lead compounds	
1944	(1)		1	10		$5,962
1945	1		8	10	(1)	7,801
1946	1	54	15	11		[2] 13,038
1947	1	22	416	33		[2] 171,060
1948	203	247	1,064	34	1	[2] 633,776

[1] Less than 1 ton.
[2] Includes also lead pigments, n. s. p. f., as follows: 1946, $97 (522 pounds); 1948, $13,257 (60,573 pounds); lead arsenate: 1946, $5 (552 pounds); 1947, $20,700 (120,000 pounds).

Lead pigments and salts exported from the United States, 1944–48

[U. S. Department of Commerce]

Year	Short tons						Total value
	White lead	Red lead	Litharge	Orange mineral	Sublimed lead	Lead arsenate	
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	2,162,548
1946	910	1,355	2,180	(1)	(1)	1,398	1,184,872
1947	863	787	1,212	(1)	(1)	1,552	1,632,143
1948	663	953	644	(1)	(1)	1,019	1,404,001

[1] Data not available.

Zinc pigments and salts imported for consumption in the United States, 1944–48

[U. S. Department of Commerce]

Year	Short tons						Total value
	Zinc oxide		Lithopone	Zinc sulfide	Zinc chloride	Zinc sulfate	
	Dry	In oil					
1944	(1)	5		(1)		542	$30,220
1945	(1)		(1)			421	16,806
1946	41		(1)	(1)	2	415	26,528
1947	117	1	(1)			295	47,482
1948	27	(1)				180	17,758

[1] Less than 1 ton.

Zinc pigments and salts exported from the United States, 1944–48

[U. S. Department of Commerce]

Year	Short tons		Total value [1]	Year	Short tons		Total value [1]
	Zinc oxide	Lithopone			Zinc oxide	Lithopone	
1944	5,511	11,551	$2,194,203	1947	19,082	13,652	$6,554,250
1945	7,102	11,576	2,554,177	1948	8,642	21,015	5,228,962
1946	10,955	9,651	2,911,457				

[1] Includes also—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, $62,119 (1,243,826 pounds); other zinc salts and compounds, $179,747 (750,108 pounds). Beginning January 1, 1946, none of the foregoing classes separately recorded.

WORLD REVIEW

Australia.—The Glidden Co. is said [7] to have licensed the Euston Lead Co., Ltd., of Australia, to use the Euston process for the manufacture of white lead. The Australian company was stated to have constructed a plant at Melbourne, expected to be in production by the end of the year or the beginning of 1949. An earlier report [8] said the plant was to have an initial capacity of 7,000 tons a year.

Canada.—A report of the Dominion Bureau of Statistics of Canada published in 1949 gave data on pigments consumed by the paint and varnish industry in Canada in 1946 and 1947. The figures for 1947 are as follows (1946 figures for comparison in parentheses): Basic carbonate white lead (dry) 3,264 (2,989) short tons, basic carbonate white lead in oil 1,741 (2,087) tons, basic sulfate white lead 7 (20) tons, red lead including orange mineral 625 (567) tons, litharge 312 (413) tons, zinc oxide (lead-free) 5,209 (4,923) tons, leaded zinc oxide 1,546 (700) tons, lithopone (30 percent zinc sulfide) 9,712 (8,078) tons, titanium dioxide 4,117 (3,416) tons, extended titanium dioxide pigments 7,199 (6,442) tons, and "other white pigments" 710 (1,354) tons.

Canada's imports of lithopone, 12,736 and 8,858 tons, respectively, in 1947 and 1946, were large enough to more than cover use in the 2 years. Imports of zinc white (zinc oxide) were 2,205 and 925 tons, respectively. Imports of the other items given in the preceding paragraph are very small, although titanium pigments are not shown separately. According to United States records for titanium dioxide and pigments, 13,274 tons were exported to Canada in 1947 and 12,020 tons in 1946.

Union of South Africa.—According to the February 14, 1949, issue of Foreign Commerce Weekly, a branch factory for the production of red lead, white lead, and litharge is being constructed at Durban, South Africa, by Associated Lead Manufacturers, Ltd., of the United Kingdom.

[7] Chemical Industries, vol. 63, No. 3, September 1948, p. 522.
[8] Chemical Engineering, vol. 55, No. 3, March 1948, p. 220.

Lime[1]

By G. W. JOSEPHSON AND F. D. GRADIJAN

GENERAL SUMMARY

ALL of the major industries—including chemicals, refractories, and construction—that are the principal markets for lime were operating at high rates in 1948; consequently, sales of lime increased to a record total of 7,263,976 short tons—7 percent greater than the previous record set in 1947.

Quicklime comprised 75 percent of the total sales and hydrated 25 percent. The output of quicklime increased somewhat more percentagewise than did hydrated—8 and 4 percent, respectively. Costs continued to rise, and the average value per short ton for quicklime increased from \$9.04 in 1947 to \$9.96 in 1948 and hydrated from \$10.50 to \$11.50. The declining trend in the number of active plants that has been noted in recent years was interrupted in 1948.

Salient statistics of the open-market lime industry in the United States, 1925–29 (average), 1935–39 (average), and 1946–48

	1925–29 (average)	1935–39 (average)	1946	1947	1948
Active plants	419	310	182	179	181
Sold by producers:					
By types:					
Quicklime short tons	2, 871, 236	2, 488, 269	4, 344, 331	5, 021, 156	5, 441, 313
Hydrated do	1, 585, 631	1, 204, 128	1, 648, 369	1, 757, 823	1, 822, 663
Total lime:					
Short tons	4, 456, 867	3, 692, 397	5, 992, 700	6, 778, 979	7, 263, 976
Value[1]	\$38, 548, 498	\$26, 592, 115	\$51, 032, 517	\$63, 826, 387	\$75, 162, 879
Per ton	\$8. 65	\$7. 20	\$8. 52	\$9. 42	\$10. 35
By uses:					
Agricultural short tons	318, 224	350, 535	384, 658	340, 363	323, 300
Building do	2, 096, 744	870, 335	845, 604	1, 008, 211	1, 140, 518
Chemical and industrial do	1, 623, 885	1, 929, 947	3, 684, 455	4, 035, 202	4, 255, 403
Refractory (dead-burned dolomite) short tons	418, 014	541, 580	1, 077, 983	1, 395, 203	1, 544, 755
Imported for consumption:					
Short tons	18, 683	14, 108	25, 275	27, 410	35, 624
Value	\$344, 887	\$240, 909	\$256, 849	\$298, 035	\$541, 243
Exported:					
Short tons	15, 752	10, 905	33, 540	50, 784	63, 088
Value	\$221, 177	\$123, 167	\$423, 948	\$713, 703	\$865, 157

[1] Selling value, f. o. b. plant, excluding cost of containers.

Lime is used so widely throughout the Nation's economy that its sales are affected by developments in a number of different fields. Figure 1 shows the correlation between the use of open-market lime and trends of activities in various markets. Sales of building lime generally follow the index of new construction; but there are exceptions, particularly during a war period in which temporary construction becomes an important factor. The quantity of refractory and chemical lime follows in general the curve in industrial production.

[1] Figures in this chapter pertain to open-market lime and exclude coverage of most captive lime operations.

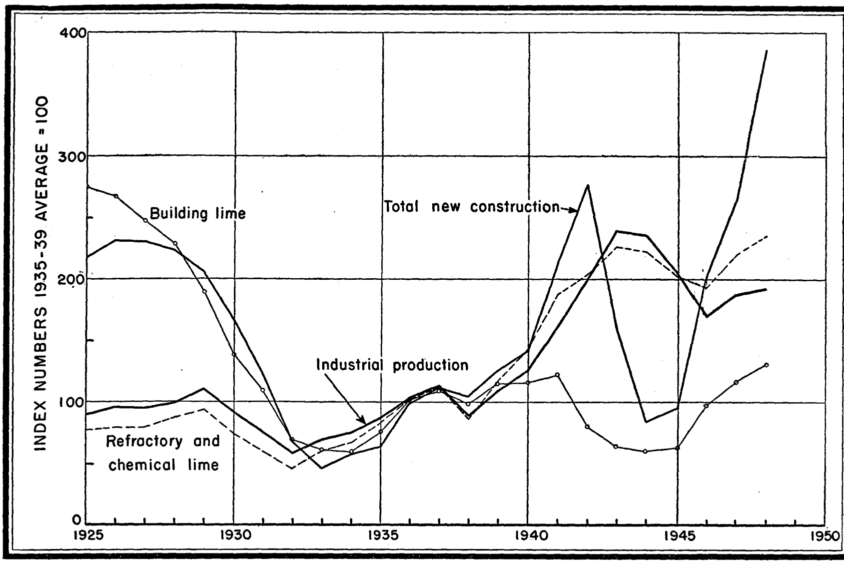

FIGURE 1.—Sales of refractory and building lime compared with total new construction and industrial production, 1925–48. Units are reduced to percentages of the 1935–39 average. Statistics on value of construction from the Bureau of Foreign and Domestic Commerce and on industrial production from the Federal Reserve Board.

Trends in sales of open-market lime sold for specified uses during the past 24 years are shown in figure 2. The growth in importance of the chemical market is noteworthy. The curve would, of course, show a much greater increase if all of the captive lime as well as the open-market were included.

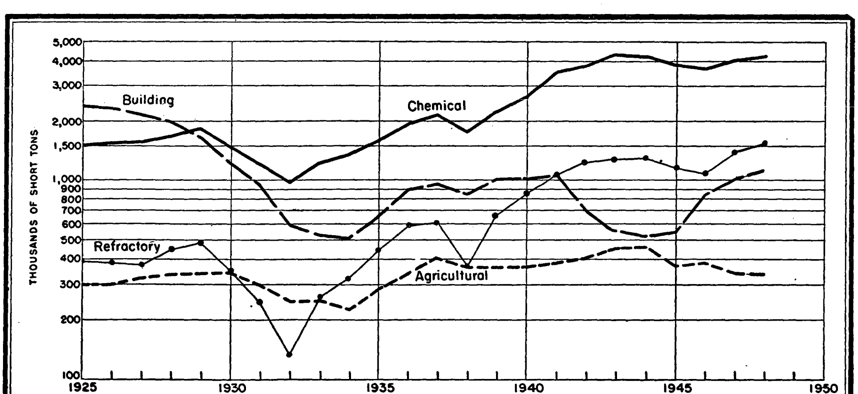

FIGURE 2.—Trends in major uses of lime, 1925–48.

DOMESTIC PRODUCTION

Production of open-market lime increased to a record total of 7,263,976 tons in 1948—7 percent above the previous high set in 1947. Production of lime for each of the major uses except agricultural advanced over the 1947 tonnages. Stocks reportedly are small and relatively constant, so in this chapter sales statistics are considered to be the equivalent of production of open-market lime.

Captive Tonnage.—Although the lime statistics included in this chapter are limited almost entirely to open-market lime, a relatively small quantity of captive tonnage is included in certain instances where it is particularly desirable to show complete figures for consumption by use. In 1948, 362,368 short tons of captive tonnage is included as follows: 14,528 tons for building, 242,074 for metallurgical uses, 61,478 for miscellaneous chemical uses, and 44,288 tons of refractory lime. If it is desired to obtain a more comprehensive view of lime production, a figure of approximately the proper order of magnitude can be obtained by calculations from limestone tonnages (shown in the Stone chapter of this volume) consumed in the uses in which limestone is generally calcined.

Lime sold by producers in the United States, 1947–48, by types and major uses

	1947				1948					
	Quantity		Value [1]		Quantity		Value [1]		Percent change from 1947 in—	
	Short tons	Percent of total	Total	Average	Short tons	Percent of total	Total	Average	Tonnage	Average value
By types:										
Quicklime	5,021,156	74	$45,377,205	$9.04	5,441,313	75	$54,200,000	$9.96	+8	+10
Hydrated lime	1,757,823	26	18,449,182	10.50	1,822,663	25	20,962,879	11.50	+4	+10
Total lime [2]	6,778,979	100	63,826,387	9.42	7,263,976	100	75,162,879	10.35	+7	+10
By uses:										
Agricultural:										
Quicklime	106,364	2	913,992	8.59	103,039	1	932,871	9.05	−3	+5
Hydrated lime	233,999	3	2,243,846	9.59	220,261	3	2,363,200	10.73	−6	+12
Total	340,363	5	3,157,838	9.28	323,300	4	3,296,071	10.20	−5	+10
Building:										
Quicklime	241,711	4	2,901,128	12.00	251,663	4	3,230,236	12.84	+4	+7
Hydrated lime	766,500	11	8,651,897	11.29	888,855	12	10,774,041	12.12	+16	+7
Total	1,008,211	15	11,553,025	11.46	1,140,518	16	14,004,277	12.28	+13	+7
Chemical and industrial:										
Quicklime	3,277,878	48	27,266,726	8.32	3,541,856	49	32,189,711	9.09	+8	+9
Hydrated lime	757,324	11	7,553,439	9.97	713,547	10	7,825,638	10.97	−6	+10
Total	4,035,202	59	34,820,165	8.63	4,255,403	59	40,015,349	9.40	+5	+9
Refractory (dead-burned dolomite)	1,395,203	21	14,295,359	10.25	1,544,755	21	17,847,182	11.55	+11	+13

[1] Selling value, f. o. b. plant, excluding cost of container.
[2] Includes lime used by producers (captive tonnage) as follows—1947: 392,223 tons, valued at $2,821,404; 1948: 362,368 tons, valued at $2,843,972.

Size of Plants.—In 1925 there were approximately 450 active lime plants in the United States, and in the intervening years there has been a general trend toward the elimination of smaller units and concentration of production in the larger, more efficient plants. However, there was a small increase in the total number of active open-market lime plants in 1948—181 as compared with 179 in 1947. During the past year 20 plants that each produced more than 100,000 tons supplied over half of the total output.

Distribution of open-market lime (including refractory) plants, 1946–48, according to size of production

Size group (short tons)	1946 Plants	1946 Production Short tons	1946 Production Percent of total	1947 Plants	1947 Production Short tons	1947 Production Percent of total	1948 Plants	1948 Production Short tons	1948 Production Percent of total
Less than 1,000	19	7,708	(1)	19	7,538	(1)	23	7,816	(1)
1,000 to less than 5,000	43	115,786	2	38	109,809	2	33	84,142	1
5,000 to less than 10,000	20	145,782	3	20	149,205	2	21	148,212	2
10,000 to less than 25,000	28	427,514	7	29	459,445	7	35	598,777	8
25,000 to less than 50,000	30	1,104,538	18	26	950,047	14	23	856,772	12
50,000 to less than 100,000	27	1,759,109	29	31	2,080,594	31	26	1,685,117	23
100,000 and over	15	2,432,263	41	16	3,022,341	44	20	3,883,140	54
Total	182	5,992,700	100	179	6,778,979	100	181	7,263,976	100

[1] Less than 1 percent.

PRODUCTION BY STATES

In 1948 open-market lime was produced in 32 States and 2 Territories. Ohio was again the principal producing State, followed by Pennsylvania and Missouri in that order. These three contributed about 56 percent of the Nation's output.

Lime (quick and hydrated) sold by producers in the United States, 1947–48, by States

State or Territory	1947 Active plants	1947 Short tons	1947 Value	1948 Active plants	1948 Short tons	1948 Value
Alabama	7	345,160	$2,727,464	8	388,197	$3,275,402
Arizona	3	54,562	582,074	4	54,608	763,296
Arkansas	1	(1)	(1)	1	(1)	(1)
California	10	181,296	2,615,599	8	179,257	3,026,941
Colorado	2	(1)	(1)	2	(1)	(1)
Connecticut	1	(1)	(1)	1	(1)	(1)
Florida	1	(1)	(1)	1	(1)	(1)
Georgia	1	10,141	110,983	1	6,141	58,150
Hawaii	1	9,130	228,370	1	8,767	236,799
Illinois	7	299,187	2,736,262	7	283,090	3,000,225
Indiana	1	(1)	(1)	1	(1)	(1)
Maine	2	(1)	(1)	2	(1)	(1)
Maryland	8	71,892	673,241	8	69,032	654,635
Massachusetts	4	113,420	1,276,693	4	112,271	1,302,251
Michigan	3	(1)	(1)	3	(1)	(1)
Minnesota	1	(1)	(1)	1	(1)	(1)
Missouri	9	889,090	7,006,426	8	1,009,993	8,998,691
Montana	2	(1)	(1)	2	(1)	(1)
Nevada	2	(1)	(1)	2	(1)	(1)
New Jersey	3	(1)	(1)	3	(1)	(1)
New York	3	(1)	(1)	2	(1)	(1)
Ohio	18	1,774,847	17,685,220	18	1,936,211	21,473,401
Oklahoma	1	(1)	(1)	1	(1)	(1)
Oregon	1	(1)	(1)			
Pennsylvania	29	1,045,566	9,861,812	34	1,085,807	11,319,685
Puerto Rico	4	(1)	(1)	5	(1)	(1)
South Dakota	2	(1)	(1)	2	(1)	(1)
Tennessee	6	181,039	1,533,737	5	163,098	1,442,906
Texas	6	134,530	1,274,095	8	168,738	1,583,726
Utah	5	47,096	366,127	4	40,635	352,859
Vermont	3	(1)	(1)	3	22,743	308,004
Virginia	14	260,663	2,138,707	13	382,734	3,271,053
Washington	2	(1)	(1)	2	(1)	(1)
West Virginia	7	471,914	4,050,950	6	490,803	4,610,157
Wisconsin	9	70,233	805,000	10	107,648	1,228,988
Undistributed [1]		819,213	8,153,627		754,203	8,255,710
Total	179	6,778,979	63,826,387	181	7,263,976	75,162,879

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

Hydrated Lime.—Hydrated lime in 1948 comprised 25 percent of the total lime output, which compares with 26 percent in 1947 and 20 percent in 1944. Hydrated-lime output was reported by 116 plants (same as in 1947) in 32 States and 2 Territories.

Hydrated lime sold by producers in the United States, 1947–48, by States

State or Territory	1947			1948		
	Active plants	Short tons	Value	Active plants	Short tons	Value
Alabama	5	37,152	$452,648	5	56,660	$569,539
California	7	47,611	706,482	6	35,309	559,084
Georgia	1	10,141	110,983	1	4,965	51,409
Hawaii	1	9,124	228,100	1	8,762	236,574
Illinois	4	37,463	343,706	3	33,980	362,377
Maryland	5	27,940	257,063	5	27,186	260,401
Massachusetts	4	48,038	483,668	4	44,274	507,832
Missouri	6	229,085	2,004,217	5	202,143	2,064,015
Ohio	14	570,079	6,066,483	14	658,602	7,723,528
Pennsylvania	11	310,677	3,274,507	13	316,340	3,653,510
Tennessee	6	47,043	451,043	5	45,323	434,193
Texas	5	48,652	540,040	6	49,111	551,833
Vermont	(1)	(1)	(1)	1	2,765	38,710
Virginia	10	47,155	508,909	11	55,252	607,374
West Virginia	4	53,311	439,937	4	42,042	364,669
Other States [2]	[2] 33	234,352	2,581,396	[2] 32	239,949	2,977,831
Total	116	1,757,823	18,449,182	116	1,822,663	20,962,879

[1] Included with "Other States."
[2] Includes the following States and numbers of plants in 1948 (1947 same as 1948 unless shown differently in parentheses): Arizona 2 (1), Arkansas 1, Colorado 1, Connecticut 1, Florida 1, Indiana 1, Maine 2, Michigan 1, Minnesota 1, Montana 1, Nevada 1, New Jersey 3, New York 2 (3), Oklahoma 1, Puerto Rico 3 (2), South Dakota 1, Utah 2, Washington 1, and Wisconsin 6; 1947 totals also include 2 plants in Vermont.

CONSUMPTION AND USES

Lime, which was once considered to be primarily a building material, is still used as such in substantial quantity but now finds its largest markets in the chemical and industrial field. As shown in the accompanying table, sales of lime to the chemical and other processing industries continued to increase in 1948. The boom in building was reflected in a 13-percent increase in demand for building lime. Dead-burned dolomite, used as a refractory, increased 11 percent, and agricultural lime decreased 5 percent, which compares with a 12-percent decline in 1947. Other important markets that expanded during the year are calcium carbide and cyanamide, paper mills, sewage and trade-wastes treatment, and water purification.

The accompanying table of lime sales classified by uses provides considerable additional data on current markets, and the table of sales by States and uses indicates the major markets of the lime produced in individual States.

Lime sold by producers in the United States in 1948, 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	([1])	([1])	63, 792	$547, 947	171, 991	$1, 249, 863	96, 487	$850, 092	([1])	([1])	13, 774	$170, 208	([1])	([1])	([1])	([1])	388, 197	$3, 275, 402
Arizona	([1])	([1])	([1])	([1])	33, 633	395, 597	-----	-----	-----	-----	([1])	([1])	([1])	([1])	-----	-----	54, 608	763, 296
Arkansas	-----	-----	([1])	([1])	([1])	([1])	([1])	([1])	([1])	([1])	([1])	([1])	([1])	([1])	-----	-----	([1])	([1])
California	3, 515	$37, 163	66, 111	1, 291, 952	30, 361	481, 057	([1])	([1])	747	$13, 160	6, 689	91, 316	([1])	([1])	([1])	([1])	179, 257	3, 026, 941
Colorado	-----	-----	([1])	([1])	([1])	([1])	-----	-----	-----	-----	([1])	([1])	([1])	([1])	([1])	([1])	([1])	([1])
Connecticut	([1])	([1])	([1])	([1])	-----	-----	([1])	([1])	-----	-----	-----	-----	([1])	([1])	-----	-----	([1])	([1])
Florida	([1])	([1])	([1])	([1])	-----	-----	-----	-----	-----	-----	-----	-----	([1])	([1])	-----	-----	([1])	([1])
Georgia	1, 176	6, 741	4, 965	51, 409	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	6, 141	58, 150
Hawaii	-----	-----	1, 066	28, 872	-----	-----	-----	-----	-----	-----	-----	-----	7, 701	$207, 927	-----	-----	8, 767	236, 799
Illinois	-----	-----	15, 310	154, 872	94, 231	905, 338	([1])	([1])	([1])	([1])	29, 527	303, 915	([1])	([1])	([1])	([1])	283, 090	3, 000, 225
Indiana	-----	-----	([1])	([1])	([1])	([1])	([1])	([1])	([1])	([1])	([1])	([1])	([1])	([1])	-----	-----	([1])	([1])
Maine	([1])	([1])	([1])	([1])	-----	-----	([1])	([1])	([1])	([1])	([1])	([1])	([1])	([1])	-----	-----	([1])	([1])
Maryland	58, 455	557, 931	10, 577	96, 704	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	69, 032	654, 635
Massachusetts	8, 089	83, 288	39, 199	433, 342	([1])	([1])	17, 527	199, 238	([1])	([1])	([1])	([1])	([1])	([1])	-----	-----	112, 271	1, 302, 251
Michigan	-----	-----	([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	-----	-----	67, 107	689, 381	211, 265	1, 749, 966	([1])	([1])	([1])	([1])	([1])	([1])	389, 591	3, 252, 743	([1])	([1])	1, 009, 993	8, 998, 691
Montana	-----	-----	([1])	([1])	([1])	([1])	-----	-----	-----	-----	([1])	([1])	([1])	([1])	-----	-----	([1])	([1])
Nevada	-----	-----	([1])	([1])	([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	47, 423	496, 877	544, 483	6, 546, 556	71, 988	663, 322	34, 922	297, 215	-----	-----	([1])	([1])	([1])	([1])	927, 715	$10,697,970	1, 936, 211	21, 473, 401
Oklahoma	-----	-----	-----	-----	([1])	([1])	([1])	([1])	-----	-----	([1])	([1])	([1])	([1])	-----	-----	([1])	([1])
Pennsylvania	133, 931	1,448,207	112, 217	1, 479, 089	259, 636	2, 517, 596	94, 524	878, 820	40, 527	377, 279	51, 710	520, 308	([1])	([1])	([1])	([1])	1, 085, 807	11, 319, 685
Puerto Rico	([1])	([1])	([1])	([1])	-----	-----	-----	-----	-----	-----	([1])	([1])	([1])	([1])	-----	-----	([1])	([1])
South Dakota	-----	-----	([1])	([1])	([1])	([1])	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	([1])	([1])
Tennessee	1, 449	12, 759	10, 152	106, 711	23, 813	207, 398	57, 331	498, 834	2, 178	19, 583	25, 793	224, 306	42, 382	373, 315	-----	-----	163, 098	1, 442, 906
Texas	([1])	([1])	43, 033	436, 681	19, 024	160, 656	([1])	([1])	-----	-----	40, 747	396, 120	([1])	([1])	-----	-----	168, 738	1, 583, 726
Utah	-----	-----	([1])	([1])	37, 274	295, 619	-----	-----	-----	-----	([1])	([1])	([1])	([1])	-----	-----	40, 635	352, 859
Vermont	2, 053	24, 738	180	2, 520	-----	-----	20, 510	280, 746	-----	-----	-----	-----	-----	-----	-----	-----	22, 743	308, 004
Virginia	19, 329	213, 920	12, 980	138, 024	42, 026	349, 516	64, 407	519, 288	([1])	([1])	14, 822	146, 391	([1])	([1])	-----	-----	382, 734	3, 271, 053
Washington	-----	-----	([1])	([1])	([1])	([1])	([1])	([1])	-----	-----	([1])	([1])	([1])	([1])	-----	-----	([1])	([1])
West Virginia	18, 934	146, 400	4, 753	43, 287	222, 899	1, 872, 232	([1])	([1])	([1])	([1])	9, 876	88, 294	([1])	([1])	([1])	([1])	490, 803	4, 610, 157
Wisconsin	([1])	([1])	20, 824	223, 074	([1])	([1])	([1])	([1])	([1])	([1])	([1])	([1])	9, 004	214, 846	-----	-----	107, 648	1, 228, 988
Undistributed[1]	28, 946	268, 047	123, 769	1, 733, 856	172, 614	1, 816, 686	312, 176	3, 190, 773	44, 877	462, 561	282, 349	2, 597, 817	1, 154, 470	11, 175, 408	617, 040	7, 149, 212	754, 203	8, 255, 710
Total	323, 300	3,296,071	1,140,518	14,004,277	1, 390, 755	12, 664, 846	697, 884	6, 715, 006	88, 329	872, 583	475, 287	4, 538, 675	1, 603, 148	15, 224, 239	1, 544, 755	17, 847, 182	7, 263, 976	75, 162, 879

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

Lime (quick and hydrated) sold by producers in the United States, 1947–48, by uses

Use	1947			1948		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Agricultural	340,363	$3,157,838	$9.28	323,300	$3,296,071	$10.20
Building:						
Finishing lime	467,527	5,430,925	11.62	564,163	7,330,833	12.99
Mason's lime	389,515	4,411,907	11.33	443,467	5,276,010	11.90
Prepared masonry mortars	50,330	470,803	9.35	58,977	556,751	9.44
Unspecified	100,839	1,239,390	12.29	73,911	840,683	11.37
Total	1,008,211	11,553,025	11.46	1,140,518	14,004,277	12.28
Chemical and industrial:						
Alkalies (ammonium, potassium, and sodium compounds)	3,945	36,586	9.27	(1)	(1)	(1)
Asphalts and other bitumens	(1)	(1)	(1)	381	6,100	16.01
Bleach, liquid and powder [2]	9,604	105,370	10.97	6,391	67,535	10.57
Brick, sand-lime and slag	18,272	191,022	10.45	25,414	281,208	11.07
Brick, silica (refractory)	16,955	174,088	10.27	13,419	139,938	10.43
Calcium carbide and cyanamide	354,104	2,791,244	7.88	569,643	4,829,752	8.48
Calcium carbonate (precipitated)	(1)	(1)	(1)	20,318	220,433.	10.85
Chromates and bichromates	25,267	199,736	7.91	(1)	(1)	(1)
Coke and gas (gas purification and plant byproducts)	27,466	230,725	8.40	29,972	276,430	9.22
Explosives	1,403	13,922	9.92	4,501	40,833	9.07
Food products:						
Creameries and dairies	3,849	42,082	10.93	735	12,253	16.67
Gelatin	10,188	91,581	8.99	8,390	87,585	10.44
Stock feed	15,753	171,945	10.92	26,353	289,325	10.98
Other [3]	2,091	21,843	10.45	3,125	37,269	11.93
Glassworks	244,043	2,086,323	8.55	235,866	2,064,382	8.75
Glue	4,909	41,006	8.35	11,039	102,845	9.32
Grease, lubricating	5,333	52,281	9.80	5,697	56,886	9.99
Insecticides, fungicides, and disinfectants	97,723	989,261	10.12	92,037	1,012,913	11.01
Medicines and drugs	9,744	80,980	8.31	12,350	109,303	8.85
Metallurgy:						
Nonferrous smelter flux	8,152	76,978	9.44	2,901	32,215	11.10
Steel (open-hearth and electric furnace flux)	1,130,613	9,021,853	7.98	1,131,098	10,177,450	9.00
Ore concentration [4]	251,663	2,035,905	8.09	208,233	1,918,021	9.21
Wire drawing	15,309	162,375	10.61	18,585	212,030	11.41
Other [5]	24,808	245,078	9.88	29,938	325,130	10.86
Paints	21,149	205,731	9.73	13,796	151,552	10.99
Paper mills [2]	645,665	5,717,372	8.86	697,884	6,715,006	9.62
Petroleum refining	48,720	501,091	10.29	51,737	550,698	10.64
Rubber manufacture	589	8,034	13.64	1,154	13,976	12.11
Salt refining	6,874	49,509	7.20	7,234	59,721	8.26
Sewage and trade-wastes treatment	84,870	840,543	9.90	101,917	1,061,200	10.41
Soap and fat	5,104	37,213	7.29	5,288	43,186	8.17
Sugar refining	28,412	430,929	15.17	24,510	403,393	16.46
Tanneries	89,029	804,137	9.03	88,329	872,583	9.88
Varnish	179	3,064	17.12	277	4,044	14.60
Water purification	454,339	4,060,039	8.94	475,287	4,538,675	9.55
Wood distillation	4,186	36,244	8.66	(1)	(1)	(1)
Undistributed [6]	81,439	927,225	11.39	93,090	1,023,660	11.00
Unspecified	283,453	2,336,850	8.24	238,514	2,277,819	9.55
Total	4,035,202	34,820,165	8.63	4,255,403	40,015,349	9.40
Refractory lime (dead-burned dolomite)	1,395,203	14,295,359	10.25	1,544,755	17,847,182	11.55
Grand total lime [7]	6,778,979	63,826,387	9.42	7,263,976	75,162,879	10.35
Hydrated lime included in above distribution	1,757,823	18,449,182	10.50	1,822,663	20,962,879	11.50

[1] Included with "Undistributed."
[2] Bleach used in paper mills excluded from "Bleach" and included with "Paper mills."
[3] Includes baking powders, citrates, fruit juices, tartrates, 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, magnesia (85 percent), polishing compounds, retarder, sulfur, tobacco, and miscellaneous industrial uses; in addition, asphalts and other bitumens and calcium carbonate (precipitated) in 1947 and alkalies, chromates and bichromates, and wood distillation in 1948.
[7] Includes lime used by producers (captive tonnage) as follows—1947: 392,223 tons, valued at $2,821,404; 1948: 362,368 tons, $2,843,972.

Hydrated lime sold by producers in the United States, 1947–48, by uses

Use	1947			1948		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Agricultural	233,999	$2,243,846	$9.59	220,261	$2,363,200	$10.73
Building	766,500	8,651,897	11.29	888,855	10,774,041	12.12
Chemical and industrial:						
Bleach, liquid and powder	2,283	21,645	9.48	2,458	23,742	9.66
Brick, sand-lime and slag	4,420	46,837	10.60	9,493	116,249	12.25
Brick, silica	14,461	152,939	10.58	11,813	125,134	10.59
Coke and gas	1,648	16,611	10.08	1,182	12,220	10.34
Food products	15,227	162,191	10.65	13,193	147,356	11.17
Insecticides, fungicides, and disinfectants	69,890	738,956	10.57	76,258	859,210	11.27
Metallurgy	56,365	561,842	9.97	65,565	744,177	11.35
Paints	10,331	112,168	10.86	9,712	111,370	11.47
Paper mills	51,176	484,351	9.46	46,807	480,802	10.27
Petroleum	33,584	386,682	11.51	28,131	347,141	12.34
Sewage and trade-wastes treatment	45,693	480,566	10.52	57,161	632,303	11.06
Sugar refining	19,261	328,630	17.06	16,957	315,022	18.58
Tanneries	47,357	455,023	9.61	45,022	470,485	10.45
Water purification	210,796	2,057,599	9.76	211,483	2,185,618	10.33
Undistributed [1]	18,739	184,568	9.85	25,026	258,335	10.32
Unspecified	156,093	1,362,831	8.73	93,286	996,474	10.68
Total	757,324	7,553,439	9.97	713,547	7,825,638	10.97
Grand total hydrated lime	1,757,823	18,449,182	10.50	1,822,663	20,962,879	11.50

[1] Includes glass, glue, grease (lubricating), magnesia (85 percent), medicines and drugs, rubber, and miscellaneous industrial uses.

The table of agricultural lime and other liming materials includes oystershells, limestone, and marl, as well as lime, to provide a more comprehensive picture.

Agricultural lime and other liming materials sold by producers in the United States, 1947–48, by kinds

Kind	1947				1948			
	Short tons		Value		Short tons		Value	
	Gross weight	Effective lime content [1]	Total	Average	Gross weight	Effective lime content [1]	Total	Average
Lime:								
Quicklime	106,364	90,410	$913,992	$8.59	103,039	87,580	$932,871	$9.05
Hydrated lime	233,999	163,800	2,243,846	9.59	220,261	154,180	2,363,200	10.73
Oystershells (crushed) [2]	46,447	21,830	189,164	4.07	48,505	22,800	333,787	6.88
Limestone	22,605,500	10,624,590	35,075,883	1.55	20,941,530	9,842,520	32,034,698	1.53
Calcareous marl	176,187	74,000	235,190	1.33	114,759	48,200	145,712	1.27
Total		10,974,630	38,658,075			10,155,280	35,810,268	

[1] Calculated upon basis of average percentages used by the National Lime Association, as follows: Quicklime (including lime from oystershells), 85 percent; hydrated lime, 70 percent; pulverized uncalcined limestone and oystershells, 47 percent; calcareous marl, 42 percent.
[2] Figures compiled by Fish and Wildlife Service.

Apparent Consumption.—Although the production of lime is widely distributed throughout the United States and most of it is used near the point of production, there is a considerable interstate trade in this commodity. The principal States that "export" to other States are Ohio, Missouri, Pennsylvania, and West Virginia. The pattern of the interstate movement of lime, as well as the consumption totals in each State, are indicated in the following three tables.

Apparent consumption of open-market lime in continental United States in 1948, by States, in short tons

State	Sales by producers	Shipments from State [1]	Shipments into State	Apparent consumption		
				Quicklime	Hydrated lime	Total
Alabama	388,197	109,059	42,403	291,290	30,251	321,541
Arizona	54,608	12,485	8,965	45,333	5,755	51,088
Arkansas	(2)	(2)	(2)	19,715	5,909	25,624
California	179,257	25,272	60,283	164,851	49,417	214,268
Colorado	(2)	(2)	(2)	20,313	6,973	27,286
Connecticut	(2)	(2)	(2)	24,382	19,392	43,774
Delaware			56,891	39,433	17,458	56,891
District of Columbia			14,717	149	14,568	14,717
Florida	(2)		(2)	57,380	46,473	103,853
Georgia	6,141	150	76,430	53,995	28,426	82,421
Idaho			5,790	4,043	1,747	5,790
Illinois	283,090	116,575	337,784	390,023	114,276	504,299
Indiana	(2)	(2)	(2)	165,472	42,017	207,489
Iowa			145,481	128,091	17,390	145,481
Kansas			38,597	21,641	16,956	38,597
Kentucky			219,494	196,660	22,834	219,494
Louisiana			149,494	112,093	37,401	149,494
Maine	(2)	(2)	(2)	76,243	7,473	83,716
Maryland	69,032	15,252	122,754	123,618	52,916	176,534
Massachusetts	112,271	64,876	48,850	52,049	44,196	96,245
Michigan	(2)	(2)	(2)	228,720	77,446	306,166
Minnesota	(2)	(2)	(2)	64,785	17,338	82,123
Mississippi			18,506	12,138	6,368	18,506
Missouri	1,009,993	826,454	30,953	131,748	82,744	214,492
Montana	(2)	(2)	(2)	19,855	2,975	22,830
Nebraska			10,306	3,395	6,911	10,306
Nevada	(2)	(2)	(2)	27,971	2,355	30,326
New Hampshire			13,916	6,075	7,841	13,916
New Jersey	(2)	(2)	(2)	59,593	118,806	178,399
New Mexico			6,428	1,036	5,392	6,428
New York	(2)	(2)	(2)	286,332	169,646	455,978
North Carolina			62,948	21,250	41,698	62,948
North Dakota			6,657	1,856	4,801	6,657
Ohio	1,936,211	1,320,323	370,325	825,221	160,992	986,213
Oklahoma	(2)	(2)	(2)	22,783	16,638	39,421
Oregon			38,304	33,674	4,630	38,304
Pennsylvania	1,085,807	499,094	637,407	977,212	246,908	1,224,120
Rhode Island			15,559	9,638	5,921	15,559
South Carolina			17,785	6,857	10,928	17,785
South Dakota	(2)	(2)	(2)	2,563	4,680	7,243
Tennessee	163,098	130,408	22,033	22,950	31,773	54,723
Texas	168,738	35,687	34,261	115,412	51,900	167,312
Utah	40,635	1,085	17,383	51,439	5,494	56,933
Vermont	22,743	21,250	1,383	1,583	1,293	2,876
Virginia	382,734	279,667	98,157	151,874	49,350	201,224
Washington	(2)	(2)	(2)	27,725	9,154	36,879
West Virginia	490,803	481,863	212,506	198,579	22,867	221,446
Wisconsin	107,648	52,013	80,757	98,626	37,766	136,392
Wyoming			1,679	224	1,455	1,679
Undistributed [2]	744,205	375,378	1,282,280			
Total	7,245,211	4,366,891	4,307,466	5,397,888	1,787,898	7,185,786

[1] Includes 59,425 tons exported or unclassified as to destination.
[2] Figures that may not be shown separately are combined as "Undistributed."

Apparent consumption of open-market lime in continental United States in 1948, 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, 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	1,060,293	315,725	1,376,018	145,951	9,458	155,409	67	323	390	65,747	2,040	67,787	1,553	3,090	4,643
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	453,287	195,774	649,061	1,035,986	394,717	1,430,703	35,335	23,141	58,476	135,953	15,816	151,769	5,287	3,915	9,202
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	1,684	26,163	27,847	80,369	10,529	90,898	85,515	48,865	134,380	2,251	465	2,716	--------	--------	--------
Florida, Georgia, North Carolina, South Carolina, Virginia	6,153	74,871	81,024	46,385	14,625	61,010	--------	--------	--------	124,116	47,694	171,810	111,616	38,488	150,104
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	69,029	40,008	109,037	783	1,230	2,013	--------	--------	--------	4,175	791	4,966	330,764	51,915	382,679
Arkansas, Kansas, Nebraska, Oklahoma, Texas	7,102	10,499	17,601	--------	--------	--------	--------	--------	--------	--------	--------	--------	92	--------	92
Iowa, Minnesota, Missouri, Wisconsin	59,793	45,003	104,796	100	--------	100	--------	--------	--------	--------	--------	--------	--------	--------	--------
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	14,332	4,951	19,283	755	--------	755	--------	--------	--------	65	--------	65	--------	70	70

Apparent consumption of open-market lime in continental United States in 1948, by region of origin and destination, in short tons—Con.

Destination	Origin											
	Arkansas, Oklahoma, Texas			Minnesota, Missouri, Wisconsin			Arizona, California, Colorado, Montana, Nevada, South Dakota, Utah, Washington			Total		
	Quick-lime	Hy-drated lime	Total	Quick-lime	Hy-drated lime	Total	Quick-lime	Hy-drated lime	Total	Quick-lime	Hy-drated lime	Total
Illinois, Indiana, Michigan, Ohio	-------	540	540	335,819	63,555	399,374	6	-------	6	1,609,436	394,731	2,004,167
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	3,418	-------	3,418	15,650	9,806	25,456	-------	-------	-------	1,684,916	643,169	2,328,085
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	-------	-------	-------	151	94	245	-------	-------	-------	169,970	86,116	256,086
Florida, Georgia, North Carolina, South Carolina, Virginia	292	15	307	2,794	1,182	3,976	-------	-------	-------	291,356	176,875	468,231
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	75,230	17,965	93,195	155,150	16,718	171,868	-------	-------	-------	635,131	128,627	763,758
Arkansas, Kansas, Nebraska, Oklahoma, Texas	138,172	64,982	203,154	37,580	22,663	60,243	-------	170	170	182,946	98,314	281,260
Iowa, Minnesota, Missouri, Wisconsin	9,978	269	10,247	353,379	109,966	463,345	-------	-------	-------	423,250	155,238	578,488
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	2,398	4,026	6,424	22,409	12,723	35,132	360,924	83,058	443,982	400,883	104,828	505,711

Apparent consumption of open-market hydrated lime from plants in Ohio and total continental United States in 1948, 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	280,553	43	71	394,731	22
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	195,617	30	30	643,169	36
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	26,163	4	30	86,116	5
Florida, Georgia, North Carolina, South Carolina, Virginia	74,831	11	42	176,875	10
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	34,116	5	27	128,627	7
Arkansas, Kansas, Nebraska, Oklahoma, Texas	9,599	1	10	98,314	5
Iowa, Minnesota, Missouri, Wisconsin	31,274	5	20	155,238	8
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	4,019	1	4	104,828	6
Undistributed and exports	2,430	(1)	14	17,911	1
Total	658,602	100	36	1,805,809	100

[1] Less than 1 percent.

A small quantity of lime is also shipped from the United States to various island Territories, as shown in the accompanying table.

Lime shipped to noncontiguous Territories of the United States, 1945–48

[U. S. Department of Commerce]

Territory	1945		1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Guam							1	$64
Hawaii	246	$4,555	406	$8,373	833	$17,330	(1)	(1)
Puerto Rico	1,458	20,144	365	5,276	2,698	27,844	1,912	30,508
Virgin Islands	80	2,100	142	3,160	57	1,603	100	2,313

[1] Figure not available.

PRICES

Lime prices continued to rise in 1948. In 1947 the average valuation of all lime sold was $9.42 per ton, and in 1948 it had increased to $10.35. Quicklime was valued at an average of $9.96 in 1948 ($9.04 in 1947) and hydrated lime at $11.50 ($10.50 in 1947).

FOREIGN TRADE [2]

Imports.—As shown in the accompanying tables, only a relatively small quantity of lime was imported into the United States. Most of this entered from Canada and served local needs in the border area. The largest tonnage enters through the Washington customs district.

[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.

Lime imported for consumption in the United States, 1944–48

[U. S. Department of Commerce]

Year	Hydrated lime		Other lime		Dead-burned dolomite [1]		Total	
	Short tons [2]	Value	Short tons [2]	Value	Short tons [2]	Value	Short tons [2]	Value
1944	380	$3,323	17,368	$147,406	40	$691	17,788	$151,420
1945	677	6,501	20,142	172,676	(3)	7	20,819	179,184
1946	611	8,538	24,664	248,311			25,275	256,849
1947	1,903	24,588	25,454	271,253	53	2,194	27,410	298,035
1948	2,861	48,157	30,336	401,473	2,427	91,613	35,624	541,243

[1] "Dead-burned basic refractory material consisting chiefly of magnesia and lime."
[2] Includes weight of immediate container.
[3] Less than 1 ton.

Lime imported for consumption in the United States, 1946–48, by countries and customs districts [1]

U. S. Department of Commerce]

Country of origin	Customs district of entry	1946		1947		1948	
		Short tons [2]	Value	Short tons [2]	Value	Short tons [2]	Value
Canada	Alaska			(3)	$12	(3)	$1
	Buffalo	3,559	$27,187	3,440	27,397	6,680	63,263
	Connecticut	(3)	1				
	Duluth and Superior	372	3,345			51	558
	Maine and New Hampshire	71	1,122	318	2,297	166	1,087
	Michigan					252	3,919
	Montana and Idaho			118	1,157	80	760
	St. Lawrence	(3)	1	(3)	2		
	Vermont	122	1,337			1,405	15,850
	Washington	21,151	223,848	23,474	264,614	24,563	364,192
Dominican Republic	Puerto Rico	(3)	8				
United Kingdom	Philadelphia			7	362		
Total		25,275	256,849	27,357	295,841	33,197	449,630

[1] Exclusive of dead-burned basic refractory material.
[2] Includes weight of immediate container.
[3] Less than 1 ton.

Exports.—Exports of lime have been increasing in recent years, but they are still relatively small in tonnage. Canada and Latin America constitute the major markets.

Lime exported from the United States, 1944–48

[U. S. Department of Commerce]

Year	Short tons	Value	Year	Short tons	Value
1944	22,689	$216,642	1947	50,784	$713,703
1945	24,276	268,875	1948	63,088	865,157
1946	33,540	423,948			

Lime exported from the United States, 1946–48, by countries

[U. S. Department of Commerce]

Country	1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value
Argentina	30	$1,145	89	$3,162	28	$983
Bahamas	19	598	63	3,069	65	1,850
Belgium and Luxembourg	185	8,746	95	6,156	59	3,840
Brazil	39	1,095	36	665	7	597
Canada	11,430	91,320	16,435	173,257	29,127	291,639
Canal Zone	50	1,441	59	1,390	738	13,675
Chile	3	518	529	8,435	100	2,096
Colombia	18	540	806	13,500	1,563	27,877
Costa Rica	4,117	48,173	7,486	90,281	7,736	108,338
Cuba	110	2,185	82	1,227	1,153	18,529
Dominican Republic	25	251	208	3,303	461	8,140
El Salvador	76	1,847	218	5,951	54	1,618
Haiti	130	2,025	307	4,640	622	9,661
Honduras	6,700	75,483	8,722	109,629	10,200	140,602
Liberia	43	1,190	46	1,499	39	902
Mexico	5,008	82,233	5,070	70,558	3,073	52,458
Netherlands Antilles	75	1,299	145	3,097	225	4,680
Nicaragua	115	2,741	465	9,338	35	1,740
Panama, Republic of	3,713	48,265	6,623	78,785	4,282	58,936
Peru	126	2,498	76	1,569	61	1,805
Philippines, Republic of	89	1,638	1,030	22,561	320	6,578
Saudi Arabia	20	500	96	2,023	264	7,159
Sweden	156	9,272	169	11,543	171	11,484
United Kingdom	733	34,197	1,098	56,903	913	55,640
Venezuela	3	50	253	3,088	1,508	26,420
Other countries	527	4,698	578	28,074	284	7,910
Total	33,540	423,948	50,784	713,703	63,088	865,157

TECHNOLOGY

The use of lime as a road-stabilizing agent has been receiving increasing attention recently, and the industry believes that the prospect of expansion in this market is promising. A report on the subject was published.[3]

Work on radioisotopes is beginning to throw more light on the processes by which liming of soil aids plant growth. Radioactive calcium is used as a tracer element.[4]

Whereas limestone is considered to be one of the most widely distributed and easily available minerals, industry is learning that properly located deposits having the magnitude and quality required for various high-specification uses are becoming harder to find. During the past few years, a number of firms have carried on extensive exploration programs and found the search surprisingly difficult. On the basis of such experience, the lime industry has proposed that depletion-allowance laws be liberalized.

The problems of stream and air pollution have become serious in the United States; consequently, widespread efforts are being made to improve the conditions. As it is one of the materials used in pollution control, lime is benefiting from this development. During 1948 Public Law 845 was passed, providing for Federal assistance in water-pollution control.

A description of the application of the Fluosolids method of calcination to the production of lime was described.[5]

[3] Aaron, Henry, Report of Committee on Lime-Soil Stabilization: Am. Road Builders Assoc. Tech. Bull. 147, 1948, 10 pp.
[4] Limeographs, vol. 14, No. 8, Feb. 16, 1948, p. 118.
[5] White, F. S., Operation of the Pilot-Size Fluosolids Lime Reactor: Pit and Quarry, vol. 40, No. 7, January 1948, pp. 110–112.

Magnesium

By RICHARD H. MOTE AND HORACE F. KURTZ

GENERAL SUMMARY

ALTHOUGH the apparent consumption of primary magnesium nearly doubled in 1948 owing to new and expanded uses of magnesium, the quantities required for these uses failed to create a demand for the metal large enough to stimulate production. As a result, the domestic outputs of primary and secondary magnesium dropped 19 and 18 percent, respectively, from 1947. As in 1947, the entire production of primary magnesium was obtained by undercapacity operation of the Dow Chemical Co. Magnesium Division plant at Freeport, Tex. Overshadowing the comparatively unimpressive record of production and consumption, however, were the important metallurgical and manufacturing advances in 1948 which served further to establish the practical usage of magnesium as a common commercial metal rather than a premium aircraft material.

Salient statistics of the magnesium metal industry in the United States, 1939–43 (average) and 1944–48

	1939–43 (average)	1944	1945	1946	1947	1948
Production of primary magnesium [1] short tons	51,691	157,100	32,792	5,317	12,344	10,003
Quoted price per pound [2] cents	23.9	20.5	20.5	20.5	20.5	20.5
Exports [3] short tons	8,837	21,001	518	207	315	274
World production do	103,500	[4] 231,000	54,900	12,900	[4] 21,800	20,900

[1] Ingot equivalent.
[2] Lowest nominal price (New York) for primary metal ingot, 99.8 percent pure, carlots.
[3] Magnesium metal and alloys, 1940 and 1943–45; metal, 1939, 1941–42, and 1946–48.
[4] Revised figure.

Domestic virgin ingot, commercially pure, was priced at 20.5 cents per pound throughout 1948. Estimated world production of magnesium totaled 20,900 short tons, a slight reduction from the 1947 output.

PRODUCTION

Primary.—The domestic output of primary magnesium in 1948 totaled 10,003 short tons, a decrease of 19 percent from the previous year. The rate of production declined from 883 short tons in January to a low level of 766 tons in June, but then increased to 932 tons per month by December. The entire 1948 output was produced from sea water by the electrolytic process at the Freeport, Tex., plant of the Dow Chemical Co. This plant has been the only primary magnesium metal producer in the United States since July 1946. The plant was operated at the minimum economic level, but output exceeded demand, as evidenced by sales. Total sales reached 8,489 tons, a gain of 61 percent over 1947, and the first increase since the wartime peak in 1943.

Production of primary magnesium (ingot equivalent), in the United States, 1942–48, by months, in short tons [1]

Month	1942	1943	1944	1945	1946	1947	1948
January	2,512	10,300	20,056	3,816	98	1,398	883
February	2,337	10,666	19,537	2,948	48	1,232	830
March	2,591	13,008	19,571	3,297	10	1,472	887
April	2,506	13,558	17,986	3,174	----------	1,153	801
May	2,635	15,093	16,217	3,171	----------	926	797
June	2,631	15,077	13,750	3,404	241	848	766
July	3,299	16,584	14,134	4,586	692	905	792
August	3,426	17,160	11,561	4,500	889	849	809
September	4,120	16,199	8,296	2,063	986	886	819
October	5,838	18,011	7,370	1,017	1,000	912	873
November	7,953	18,374	5,301	715	558	870	814
December	9,115	19,554	3,321	101	795	893	932
Total	48,963	[2] 183,584	[2] 157,100	32,792	5,317	12,344	10,003

[1] Producers' reports to War Production Board, January 1942–August 1945, thereafter to Bureau of Mines. Monthly figures have been adjusted to final annual totals.
[2] Excludes crystal equivalent of magnesium content of incendiary bomb mixture ("goop")—460 tons in 1943 and 6,473 tons in 1944.

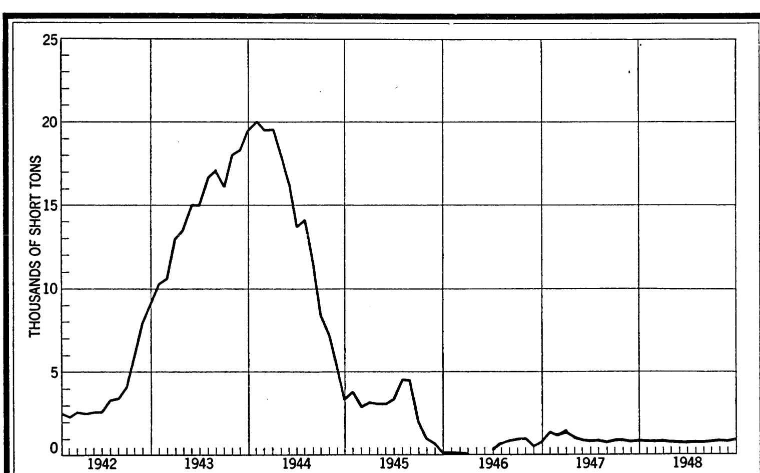

FIGURE 1.—Domestic production of primary magnesium, 1942–48.

Six primary magnesium plants, including two electrolytic reduction plants at Velasco, Tex., and Painesville, Ohio, and four ferrosilicon reduction plants at Luckey, Ohio, Canaan, Conn., Manteca, Calif., and Wingdale, N. Y., were being reconditioned by the Public Buildings Administration at the end of 1948. The object of this program was to put plants in stand-by condition, except for the replacement of missing equipment, and to provide for procurement of such equipment so that production could begin on 120 days' notice. Portions

Production, sales, exports, and apparent consumption of primary magnesium in the United States, 1944–48, in short tons

Year	Production		Sales	Exports [1]	Apparent consumption [2]
	Raw, crude, and pure ingot	Ingot equivalent			
1944	[3] 161,935	[3] 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
1947	12,344	12,344	5,264	315	4,949
1948	10,003	10,003	8,489	274	8,215

[1] Primary metal only. Alloy exports in addition: 16,171 tons in 1944, 22 tons in 1945, and none in 1946–48.
[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 10,515 tons in 1944, 7,080 tons in 1947, and 1,514 tons in 1948.
[3] Does not include magnesium content of incendiary mixture produced direct.

of the ferrosilicon reduction plant at Spokane, Wash., held by the War Assets Administration, were leased to the Chromium Mining & Smelting Co. and the Pend Oreille Mining Co. for experimental production of ferrosilicon, ferro-alloys, and metallic zinc.

In April 1948 the War Assets Administration announced disposal of its Basic Magnesium plant at Henderson to the State of Nevada. With a rated annual capacity of 56,000 tons, this electrolytic plant was the largest of the 13 plants constructed by the Government during World War II for the production of magnesium. At the end of the year it was indicated that the sale of the Government-owned half of the Freeport, Tex., plant to the Dow Chemical Co. might soon be consummated. Operating at full capacity, a production level of 20,000 tons per year could be attained at this plant.

Despite the fact that 1948 production totaled only 5 percent of the 1943 peak wartime year, output was sustained at a higher level than prewar, and the industry generally looked forward to long-term growth in use of the metal. A deterrent to the increased production of primary magnesium was the availability of scrap, also considerably greater than before the war. Classified as a strategic metal, magnesium presented problems to the Government which resolved chiefly into maintaining enough operable facilities for immediate expansion, rather than in the supply of raw material.

Secondary.—Recovery of secondary magnesium, including alloying ingredients and secondary magnesium incorporated in primary ingot, totaled 7,834 short tons in 1948 compared with 9,503 tons from the same sources in 1947. Of this quantity, 7,417 tons were recovered from 8,163 tons of magnesium-base scrap in 1948. Old scrap constituted about 54 percent of the scrap consumed compared with 42 percent (revised figure) in 1947 and 24 percent in 1946. Of the 1948 recovery, 4,604 tons were in ingot form, 1,301 tons in castings, 1 ton in magnesium-alloy shapes, 1,388 tons in aluminum-base alloys, 6 tons in zinc-base alloys, 450 tons in anodes and strip for cathodic protection, and 84 tons in chemicals and other nonrecoverable forms. Additional information on secondary magnesium may be found in the Secondary Metals—Nonferrous chapter of this volume.

CONSUMPTION AND USES

Since the close of World War II, the consumption pattern of magnesium has undergone radical changes. Magnesium was the first major metal removed from wartime priority controls. Following this action in October 1945, the use of scrap became an important source of the metal, and the quantities and types of products made from primary magnesium were severely altered, as indicated in the accompanying table. Actual consumption of primary magnesium declined steadily from 1944 until mid-1948. The use of magnesium increased thereafter, however, and total consumption in 1948 was 41 percent above that in the preceding year. Consumers expressed the opinion that the consumption trend was reversed as a result of the rearmament program and the increasing awareness of the advantages of magnesium for lightweight castings.

Actual domestic consumption of primary magnesium (ingot equivalent and magnesium content of magnesium-base alloys) in 1944–48, by uses, in short tons

Product	1944	1945 [1]	1946	1947 [2]	1948
Structural products:					
Castings:					
Sand	44,773	18,405	920	892	1,930
Die	1,165	803	341	182	213
Permanent mold	59,181	8,307	38	9	12
Sheet	1,543	1,517	1,990	1,053	1,122
Structural shapes, rods, tubing (extrusions)	4,784	2,452	2,689	1,619	2,529
Forgings	344	157	99	105	103
Total structural	111,790	31,641	6,077	3,860	5,909
Other products:					
Powder	9,080	4,769	192	9	(3)
Aluminum alloys	6,868	5,589	2,391	1,935	2,324
Other alloys	12	24	41	40	43
Scavenger and deoxidizer	159	228	248	427	418
Chemical	156	182	150	266	407
Cathodic protection	4,633	1,554	774	94	367
Other [4]				238	193
Total other products	20,908	12,346	3,796	3,009	3,752
Grand total	132,698	43,987	9,873	6,869	9,661

[1] Figures are incomplete owing to lack of returns from a number of wartime companies whose operations terminated during the year.
[2] Revised figures.
[3] Less than 1 ton.
[4] Includes primary metal consumed in making secondary alloy.

Consumption of magnesium in structural products in 1948 rose 53 percent, while use in all other products gained 25 percent. The most noteworthy advances were made in castings, extrusions, aluminum alloys, chemicals, and cathodic protection. Use of magnesium for sheet, forgings, other alloys, and scavenger and deoxidizer remained virtually unchanged, and consumption for magnesium powder was virtually nonexistent.

Sand castings, comparatively high priced, were largely confined to applications where lightness commanded a premium, but totaled 90 percent of the magnesium castings produced in 1948 and registered the greatest gain of all the items recorded. On the other hand, permanent mold and die castings, which were more competitive on a price basis, comprised only 10 percent of the total output of castings. Chief remedy for furthering magnesium's competitive position with aluminum and gray iron in the casting industry was thought to lie in demonstrations to manufacturers.[1] The Bureau of the Census, U. S. Department of Commerce, reported that shipments of magnesium castings and wrought products increased 7 and 22 percent, respectively, in 1948.

The aircraft industry remained the largest consumer of structural magnesium in 1948; the much discussed B–36 bomber probably required the greatest tonnage per plane, but new high-speed planes were also employing large quantities. Of the many other applications of magnesium in the transportation field, development of truck bodies and parts played a leading role during the year. The increased use of magnesium engraved plates to eliminate stereotype and electrolytic plates in printing was apparent in 1948. Magnesium was used in previous years as an anode to prolong the life of underground pipe lines where conditions leading to electrolytic corrosion were present, but the huge increase in its use for cathodic protection during 1948 resulted from its almost universal adoption as an anode in hot-water tanks. Other new uses for the metal included improvements in such consumers' goods as furniture, wheelbarrows, and small boats, and numerous items in which magnesium was substituted for aluminum.

As a result of the Air Force expansion program, the magnesium industry appeared to have a much larger market than at any time since the close of World War II. Enlargement of the industry for civilian consumption awaited reduction in fabrication costs. However, efforts of industry to inform consumers of the advantages of the metal in lightness, machinability, stability, strength, versatility, and availability apparently have brought some results.

STOCKS

Producer stocks at the Freeport, Tex., plant increased by the end of 1948 to nearly the equivalent of 1 year's production. Stocks at consumers' plants decreased slightly during the year.

About 50,000 tons of magnesium remained in the hands of Federal agencies at the close of 1948. Approximately half was in the form of incendiary bomb bodies made of low-zinc magnesium alloy.[2] Although regulations issued by the War Assets Administration did not permit release of this material in quantities greater than 375 tons per month, the fact that it was available constituted a threat to the magnesium market. Plans were discussed by interested Government agencies for demilitarizing the bomb bodies, but no action was taken during 1948. A stipulation that this metal, if used, must remain identifiable as magnesium, prevented aluminum companies from using it as an alloying ingredient. The remainder of the 50,000 tons of magnesium was held by the Bureau of Federal Supply in ingot form. Storage of the magnesium ingots in a manner that would prevent

[1] American Metal Market, American Magnesium Corp. Official Discusses Marketing of Castings: Vol. 56, No. 86, May 4, 1949, pp. 9, 12.

[2] Hartwell, G. V., The Government's Disposal Program Magnesium Plants and Facilities: Am. Metal Market, vol. 55, No. 58, Mar. 23, 1948, p. 3.

deterioration persisted as one of the foremost problems relative to stock-piling this material.

PRICES

Throughout 1948 the base price of standard virgin magnesium ingot remained unchanged at 20.5 cents a pound, the price established in January 1943. Reductions of approximately 10 percent on extrusions were announced early in 1948 as a result of processing improvements. Prices of principal primary casting alloys and secondary magnesium ingot, however, were virtually unchanged during the year.

The price of primary ingot in United Kingdom was quoted at 1s. 2d. per pound in 1948. In the latter part of the year, the French Price Directorate released magnesium from price control.

FOREIGN TRADE[3]

Imports.—Magnesium imports during 1948 increased 237 percent over the 201 tons received in 1947. Although statistics on magnesium imports were not recorded separately before 1918 and although the United States obtained all its magnesium from Germany prior to World War I, demand for the metal was so small in the earlier years that the 1948 total of 678 tons was probably an all-time record. Except for a negligible quantity of alloys and sheets from Canada, all of the 1948 receipts were reported as metal and scrap. Part of the tonnage consisted of high-purity ingot made by the Pidgeon process in Canada. Of the total imports, 270 tons were from United Kingdom, 253 tons from Canada, 98 tons from Egypt, 36 tons from Australia, 12 tons from Belgium and Luxembourg, and 9 tons from the Bahamas. The tariff rates on magnesium in 1948 were as follows: Metallic—20 cents per pound, scrap—20 cents per pound (duty suspended until June 30, 1949), and alloys, sheets, etc.—20 cents per pound on magnesium content and 10 percent ad valorem.

Magnesium imported for consumption in the United States, 1946–48

[U. S. Department of Commerce]

Magnesium content	1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value
Metallic and scrap [1]	241	$110,983	201	$87,499	678	$184,066
Alloys	(2)	3			(2)	57
Sheets, tubing, etc	(2)	621	1	11,902	(2)	943

[1] Gross weight.
[2] Less than 1 ton.

Exports.—Magnesium exports in 1948 totaled 444 tons, a gain of 25 percent over 1947. Mexico received 249 tons of the exports of metal in primary form; Canada received 18 tons; Germany, 6 tons; Brazil, 1 ton; and Netherlands and Finland, each less than 1 ton.

[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.

Increased shipments of powder and metal in other forms more than compensated for the decline in exports of metal in primary form, as 57 tons went to Venezuela, 54 to Saudi Arabia, 35 to Canada, 7 to Colombia, 7 to Finland, 6 to the Netherlands, and the remainder to 10 other countries.

Exports of magnesium from the United States, 1946–48

[U. S. Department of Commerce]

Magnesium	1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value
Metal in primary form	207	$85,382	315	$140,214	274	$122,374
Metal in other forms	87	48,892	40	80,210	170	149,891
Powder	12	6,104				

TECHNOLOGY

Many new metallurgical developments were revealed by the magnesium industry in 1948. Among the more outstanding was a new process for electroplating magnesium.[4] The method consists of preparing a reactive surface, immersing it in a solution that deposits a thin zinc coating, and plating with the usual finishes in a standard bath. The process involves the same number of steps used in electroplating other metals, and finished products proved satisfactory to physical tests. Notable advances were also made during the year in joining methods. Furnace, flux dip, and torch brazing were made applicable to magnesium by processes announced by the Dow Chemical Co. The method employs Dowmetal C as the filler and conventional gas-welding type fluxes and requires temperatures within the range of 1,075°–1,180° F. Another develpoment was the successful arc welding of heavy magnesium plates in one pass. The new welding procedure, which employs alternating current, enables single-pass butt welds to be made in plates over ½ inch thick without previous beveling.

The results of further experimental work on magnesium batteries was disclosed during 1948. Using magnesium in the negative electrode of dry cells patterned after the conventional Leclanché flashlight unit, greater voltages and higher capacities than comparable zinc batteries were reached. Acceptance of magnesium for such cells would mean lighter and smaller units or more powerful units of like sizes. Other significant advancements throughout the year were made in the fields of grain refinement, annealing, and rolling.

It was discovered that, by alloying small quantities of magnesium with gray cast iron, important gains in ductility and strength of the finished product could be achieved. Numerous experimentations were carried out on other alloys in 1948, with particular attention to cerium-, zirconium-, and lithium-containing magnesium-base alloys. Additions of zirconium or lithium tended to increase strength and

[4] Journal of Metals Technology Practice, Magnesium Industry: Vol. 1, No. 3, March 1949, pp. 86-87.

toughness, while cerium improved the properties of alloys at high temperatures. Early in the year, the American Society for Testing Materials drew up plans for revising the code designations of magnesium alloys, with the view toward eliminating small differences in classifications and devising a code applicable to all alloys currently in commercial production.

WORLD REVIEW

The world production of primary magnesium in 1948 was estimated at slightly less than 19,000 metric tons or about 4 percent below the 1947 total. Most of the decline was attributed to lower output in the United States, the world's largest producer. No appreciable gain in civilian demand was noted during the year, and, to a large extent, world markets continued to rely upon military consumption.

World production of magnesium metal, 1942–48, by countries, in metric tons

[Compiled by Pauline Roberts]

Country	1942	1943	1944	1945	1946	1947	1948
Australia	484	497	54				
Canada	367	3,245	4,799	3,338	145	136	(1)
China:							
Formosa	261	376	432	21			
Manchuria	8	251	450	200			
France	1,334	1,542	703	279	704	800	650
Germany	30,000	32,400	33,600	[2] 4,225			[3] 17
Italy	2,379	2,017	1,380	346	1,005	[4] 600	(1)
Japan	2,020	2,777	2,904	1,020			
Korea	240	532	1,628	1,014			
Norway (estimate)	2,000	2,000	2,000				
Switzerland (estimate)	1,500	1,500	1,000	500	300	500	
U. S. S. R. (estimate)	5,000	5,000	5,000	2,170	3,000	4,000	5,000
United Kingdom	14,865	19,096	13,094	[5] 6,900	[5] 1,700	[5] 2,500	[5] 3,500
United States	44,418	166,544	142,518	29,748	4,823	11,198	9,075
Total (estimate)	104,876	237,777	209,562	49,761	11,677	19,734	19,000

[1] Data not available; estimate by author of chapter included in total.
[2] January-February only. Planned production for March, 2,830 tons.
[3] Bizonal area.
[4] Estimated figure.
[5] Includes secondary metal.

Canada.—The ferrosilicon plant of Dominion Magnesium, Ltd., at Haley, Ont., produced calcium and small quantities of strontium and barium in 1948. The company had large enough stocks of magnesium, produced before the switch to calcium, to supply its markets during the year, but it appeared that magnesium production would have to be resumed in 1949 to replenish this inventory. Better market conditions were expected to follow, as a result of the installation of an extrusion press by the subsidiary, Light Alloys, Ltd. The Dominion Magnesium plant, constructed in 1942, utilizes the Pidgeon process, which produces magnesium of very high purity. The method is also unique in that it can readily be converted to production of several other base metals.

The Aluminum Co. of Canada continued to operate its magnesium plant at Arvida, Quebec, during 1948. The production process at this plant is a variation of the Dow electrolytic method. Brucite ore from the company mine in the Gatineau Valley is converted to magnesium chloride at Wakefield, Quebec, and shipped to Arvida for recovery of the metal.

China.[5]—It is believed that there has been no commercial production of magnesium in China since the close of the war. The Chinese National Government reported that it had no immediate plans for developing the industry because of the small demand for the metal. The Japanese are understood to have exploited deposits of magnesite in Liaoning Province and to have constructed plants at Yingkow and Shih-Ho for the production of magnesium ingot. Rated capacity for the two plants, which were believed to have been destroyed, was about 2,500 tons per year, but total output during 1939–44 did not exceed 700 tons.

France.—Production of magnesium in France declined about 19 percent in 1948. Because of large magnesia requirements in the steel industry and increasing demand for magnesium metal, consideration was given to the possibility of erecting an electrolytic magnesium plant for production from sea water. Construction of such a plant would eliminate the need for imports.

Japan.—During World War II, the annual magnesium productive capacity of the Japanse Empire was rated at 16,200 tons; but actually, output was never greater than 5,500 tons per year. Approximately half of the 1944 total came from Korea, Formosa, and Manchuria.

Japanese magnesium consumption in 1948 was estimated to be between 1,000 and 1,500 tons. The chief products were coins, telephone receivers, flashlights, printing blocks, portable tools, fireworks, and transportation equipment.

United Kingdom.—J. Freeman, Joint Parliamentary Secretary to the Ministry of Supply, stated that the three Government-owned plants that produced magnesium in 1945 were still Government property in 1948 but that production was considered uneconomical at current world prices. Existing stocks of metal were considered adequate for some time to come.

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[5] Kleinhans, Richard E., The Light-Metals Industries in China: Bureau of Mines, Mineral Trade Notes, vol. 26, No. 2, Spec. Suppl. 23, February 1948, 18 pp.

Magnesium Compounds[1]

By JOSEPH C. ARUNDALE AND F. M. BARSIGIAN

GENERAL SUMMARY

WITH the Nation's industry operating near capacity and expanding during 1948, consumer demand for such materials as refractory magnesia, dead-burned dolomite, and 85-percent magnesia insulation raised sales to new records.

Salient statistics of magnesite, magnesia, and dead-burned dolomite in the United States, 1944–48

	1944	1945	1946	1947	1948
Crude magnesite:					
Mined:					
Short tons	561,450	336,458	324,640	375,993	(1)
Value [2]	$4,407,461	$2,324,957	$2,225,850	$2,596,747	(1)
Caustic-calcined magnesia:					
Sold or used by producers:					
Short tons	139,243	43,270	45,178	[3] 26,831	33,209
Value	$6,481,963	$2,503,544	$2,854,538	[3] $2,508,624	$3,380,528
Average per ton [4]	$46.55	$57.86	$63.18	[3] $93.50	$101.80
Refractory magnesia:					
Sold or used by producers:					
Short tons	278,490	254,994	244,824	314,921	330,069
Value	$8,426,049	$7,414,218	$7,231,869	[3] $10,127,585	$13,444,587
Average per ton [4]	$30.26	$29.08	$29.54	[3] $32.16	$40.73
Dead-burned dolomite:					
Sold by producers:					
Short tons	1,290,790	1,187,334	1,007,983	1,395,203	1,544,755
Value	$11,441,612	$10,613,711	$10,101,707	$14,295,359	$17,847,182

[1] Bureau of Mines not at liberty to publish figure.
[2] Partly estimated; most of crude is processed by mining companies, and very little enters open market.
[3] Revised figure.
[4] Average receipts f. o. b. mine shipping point.

RESERVES

United States reserves of most of the magnesium minerals are large. Sea water and underground brines may be considered inexhaustible sources of magnesium. High-grade dolomite is available in enormous amounts, although no actual estimate of reserves is available. Reserves of high-grade magnesite in Washington and Nevada have been estimated at 8,000,000 tons, with probably 85,000,000 additional tons of lower-grade inferred ore as of 1944. Reserves of brucite in Nevada have been estimated at more than 70,000,000 tons. Although serpentine and olivine are not at present commercial sources of magnesia, they have been utilized to make other magnesium salts and are considered potential sources of refractory magnesia. When echnology makes this feasible, vast reserves are available.

[1] Former editions of this chapter included a section on miscellaneous salines, which now appears as a separate chapter titled "Salines—Miscellaneous."

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DOMESTIC PRODUCTION

Magnesite.—The tonnages of both caustic-calcined and refractory grades of magnesia sold or used by producers in the United States in 1948 were appreciably greater than in the previous year. Refractory magnesia was at an all-time high, whereas sales of caustic-calcined magnesia were less than in several past years. Statistics on output of crude magnesite during 1948 cannot be published by the Bureau of Mines, as they would reveal the production of individual companies.

Magnesia sold or used by producers in the United States, 1947–48, by kinds and sources

Magnesia	From magnesite, brucite, and dolomite [1]		From well brines, raw sea water, and sea-water bitterns [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1947						
Caustic-calcined	10,850	$1,005,920	[2] 15,981	[2] $1,502,704	[2] 26,831	[2] $2,508,624
Refractory	209,581	5,794,636	105,340	[2] 4,332,949	314,921	[2] 10,127,585
Total	220,431	6,800,556	[2] 121,321	[2] 5,835,653	[2] 341,752	[2] 12,636,209
1948						
Caustic-calcined	11,548	996,713	21,661	2,383,815	33,209	3,380,528
Refractory	214,628	7,954,089	115,441	5,490,498	330,069	13,444,587
Total	226,176	8,950,802	137,102	7,874,313	363,278	16,825,115

[1] Magnesia made from a combination of dolomite and sea water is included with that from sea water.
[2] Revised figure.

Dolomite.—The high level of industrial activity was reflected in record sales of dead-burned dolomite for use as a refractory in steel furnaces and other metallurgical furnaces.

The installation of a large kiln at the Maple Grove, Ohio, plant of Basic Refractories, Inc., was reported to have increased this company's capacity for burning dolomite by 40 percent.[2] A history and description of this operation were presented.[3]

Additional information on dolomite may be found in the Stone and Lime chapters of this volume.

Dead-burned dolomite sold in and imported into the United States, 1944–48

Year	Sales of domestic		Imports [1]		Year	Sales of domestic		Imports [1]	
	Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
1944	1,290,790	$11,441,612	40	$691	1947	1,395,203	$14,295,359	53	$2,194
1945	1,187,334	10,613,711	(2)	7	1948	1,544,755	17,847,182	2,427	91,613
1946	1,077,983	10,101,707							

[1] Reported as "Dead-burned basic refractory material."
[2] Less than 1 ton.

[2] Rock Products, vol. 51, No. 11, November 1948, p. 65.
[3] Pit and Quarry, vol. 40, No. 11, May 1948, pp. 82–85, 100.

Other Magnesium Compounds.—Production of both the light and heavy high-grade magnesias in 1948 was substantially greater than in the previous year. The heavy demand for 85-percent magnesia insulation, created by the large volume of industrial expansion, largely accounted for an increase in production of "technical carbonate."

An article was published describing a new sulfite pulping process being put into operation by the Weyerhaeuser Timber Co. at its Longview, Wash., plant. This process involved substitution of magnesium oxide for the calcium chemicals in the pulp mill digesters. A cyclic magnesia-base sulfite process eliminates the waste-liquor disposal problem.[4]

Specified magnesium compounds produced, sold, and used by producers in the United States, 1947–48

Product [1]	Plants [1]	Produced (short tons)	Sold [2]		Used (short tons)
			Short tons	Value	
1947 [3]					
Specified magnesias (basis 100 percent MgO), U. S. P. and technical:					
Extra-light and light	6	1,591	1,575	$792,026	(4)
Heavy	4	726	682	285,554	
Total	[5] 6		2,257	1,077,580	(4)
Precipitated magnesium carbonate	12	58,142	8,045	885,255	49,740
1948					
Specified magnesias (basis 100 percent MgO), U. S. P. and technical:					
Extra-light and light	6	1,826	1,837	909,697	(4)
Heavy	3	1,386	1,289	717,549	
Total	[5] 6		3,126	1,627,246	(4)
Precipitated magnesium carbonate	11	60,898	7,315	939,306	52,798

[1] In addition in 1947–48, magnesium chloride was produced by 4 plants and magnesium sulfate by 1 plant.
[2] Sales by a producer to an affiliated consumer for immediate use are not included with "Sold" but are with "Used."
[3] Revised figures.
[4] Bureau of Mines not at liberty to publish figure.
[5] A plant producing more than 1 grade is counted but once in arriving at total.

REVIEW BY STATES

The following review summarizes the activities of firms producing magnesium minerals (except dolomite) and compounds.

California.—Johns-Manville Products Corp., 22 East Fortieth Street, New York 16, N. Y., produced magnesium carbonate from purchased magnesium hydroxide at Redwood City, Calif., for use in 85-percent magnesia insulation. Marine Magnesium Products Corp., South San Francisco, Calif., recovered precipitated magnesium carbonate, magnesium hydroxide, and specialty magnesias, using lime, dolomite, and water from San Francisco Bay as raw materials. The Paraffine Co., Inc., 1550 Powell Street, Emeryville 8, Calif., produced magnesium carbonate from purchased magnesium hydroxide for use in 85-percent magnesia. The Permanente Metals Corp., Oakland, Calif., operated its magnesia-from-sea-water plant at Moss Landing, producing refractory and caustic-calcined magnesias. Westvaco

[4] Chemical Age (London), vol. 59, No. 1533, Nov. 27, 1948, pp. 724–725.

Chemical Division of Food Machinery & Chemical Corp., 405 Lexington Avenue, New York 17, N. Y., recovered magnesite from its Western mine near Livermore. At its Newark plant, the firm produced refractory- and caustic-grade magnesia from sea-water bitterns and dolomite and caustic-calcined magnesia from magnesite. It also recovered magnesium chloride from sea-water bitterns at Chula Vista.

Illinois.—Johns-Manville Corp., 22 East Fortieth Street, New York 16, N. Y., produced precipitated magnesium carbonate by the Pattinson process at its Waukegan, Ill., plant for use in 85-percent magnesia insulation.

Michigan.—The Dow Chemical Co., Midland, Mich., produced magnesium chloride and epsom salts from well brines, dolomite, and lime. Michigan Chemical Corp., St. Louis, Mich., produced magnesium carbonate, hydroxide, and magnesia from well brines, dolomite, and lime. The Morton Salt Co., 120 South LaSalle Street, Chicago 4, Ill., produced precipitated magnesium carbonate from well brines and lime at its Manistee, Mich., plant. Standard Lime & Stone Co., 2000 First National Bank Bldg., Baltimore 3, Md., at its plant at Manistee, produced refractory-grade magnesia from well brines and lime.

Nevada.—Basic Refractories, Inc., 845 Hanna Building, Cleveland 15, Ohio, produced brucite at its quarry at Gabbs. Most of this material was shipped to its plant at Maple Grove, Ohio, where it is processed into a line of refractories. Sierra Magnesite Co., Box 8–A, Newark, Calif., mined magnesite at Gabbs for caustic-calcined uses.

New Jersey.—The J. T. Baker Chemical Co., Phillipsburg, N. J., produced magnesia and magnesium chloride and nitrate from purchased magnesium carbonate. Johns-Manville Corp., at its Manville plant, produced precipitated magnesium carbonate by the Pattinson process for use in 85-percent magnesia insulation. Northwest Magnesite Co., 1916 Farmers Bank Building, Pittsburgh 22, Pa., recovered refractory-grade magnesia from sea water and dolomite at its Cape May, N. J., plant.

Ohio.—The Diamond Alkali Co., 300 Union Commerce Building, Cleveland, Ohio, produced refractory magnesia from dolomite at Fairport.

Pennsylvania.—Both The Philip Carey Manufacturing Co., Cincinnati 15, Ohio, plant at Plymouth Meeting, Pa., and Keasbey & Mattison Co., Ambler, Pa., produced magnesia and precipitated magnesium carbonate. Ehret Magnesia Manufacturing Co., Valley Forge, Pa., produced precipitated magnesium carbonate. All three firms used the Pattinson process, and the magnesium carbonate was for use in 85-percent magnesia insulation.

Texas.—The Dow Chemical Co., at Freeport, Tex., recovered magnesium chloride from sea water as an intermediate in the production of magnesium metal.

Washington.—Northwest Magnesite Co., 1916 Farmers Bank Building, Pittsburgh, Pa., produced refractory magnesite near Chewelah. This operation remained the largest magnesite producer in the United States.

West Virginia.—The Standard Lime & Stone Co., continued its recovery of refractory magnesia by leaching calcined dolomite at its Millville plant and produced magnesium carbonate from dolomite by the Pattinson process.

PRICES

According to E&MJ Metal and Mineral Markets, the price of dead-burned grain magnesite, per ton, f. o. b. Chewelah, Wash., in bulk, was increased to $31 during the year. The Westvaco Chemical Division of Food Machinery & Chemical Corp. quoted prices of its magnesias (carlots, f. o. b. California) as follows: Bulk and powdered caustic-calcined magnesite remained at $64 in bulk and $70 powdered in bags. No change occurred in the price of calcined sea-water magnesia, which remained at $64 per ton in bags, powdered. On April 1, 1948, kiln-run 90-percent sea-water periclase was advanced to $50.50 per ton.

According to the Oil, Paint and Drug Reporter, magnesium hydroxide, medicinal grade, was quoted at 29 to 30 cents per pound, as for the past few years; magnesium carbonate, technical grade, bags, carlots, freight equalized, was quoted at 9 cents per pound, and magnesium carbonate, U. S. P. grade, at 10¾ cents per pound at the end of 1948. Magnesium carbonate is quoted freight allowed to New Jersey (except to Atlantic, Burlington, Cape May, Cumberland, Gloucester, Ocean, and Salem Counties) and to Philadelphia County, Pa. Freight equalized with New York City on all other destinations. Magnesium chloride, flake, barrels, carlots, works, was quoted at $40 per ton in December. Epsom salts, technical, bags, carlots, remained at $2.30 per 100 pounds. At the end of the year, magnesia, calcined, technical cartons, works, was quoted at 32 cents per pound; synthetic, rubber grade, cartons, works, at 29 cents per pound; U. S. P. light, cartons, at 34 cents per pound; heavy, barrels, at 36 cents per pound.

FOREIGN TRADE [5]

The accompanying tables showing imports of the various grades and types of magnesite and magnesium compounds indicate the degree of self-sufficiency of the United States as regards these materials. In recent years imports have been very small compared with domestic consumption.

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[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.

Magnesite imported for consumption in the United States, by countries, 1946–48

[U. S. Department of Commerce]

Country	1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value
CRUDE MAGNESITE						
Canada					37	$4,372
India					59	1,037
Malta, Gozo, and Cyprus	(1)	$6				
Mexico	1	50				
Total	1	56			96	5,409
LUMP CAUSTIC-CALCINED MAGNESITE						
Canada			(1)	$10	17	$1,858
Greece			1	52	11	596
India	429	$11,318	498	19,479	713	24,824
Netherlands			15	1,198		
Total	429	11,318	514	20,739	741	27,278
GROUND CAUSTIC-CALCINED MAGNESITE						
Canada					17	$1,862
India					102	3,719
Netherlands	5	$475	2	$175	55	4,250
United Kingdom	7	1,192	10	1,542	7	1,375
Total	12	1,667	12	1,717	181	11,206
DEAD-BURNED AND GRAIN MAGNESITE AND PERICLASE						
Austria					(1)	$50
British Guiana					58	5,680
Canada	1,873	$182,574	1,745	$170,216	2,984	292,107
United Kingdom			2	216		
Total	1,873	182,574	1,747	170,432	3,042	297,837

[1] Less than 1 ton.

Magnesium compounds imported for consumption in the United States, 1944–48

[U. S. Department of Commerce]

Year	Oxide or calcined magnesia		Magnesium carbonate precipitated		Magnesium chloride (anhydrous and n. s. p. f.)		Magnesium sulfate (epsom salts)		Magnesium salts and compounds, n. s. p. f.[1]	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1944	30	$9,485	151	$26,703			22	$1,812	22	$12,799
1945			66	15,836	2	$222	(2)	2	23	18,938
1946	50	16,205	145	23,428	38	1,539	(2)	2	11	8,991
1947	(3)	20	136	34,799	3	348	(4)	5	6	4,335
1948			282	82,305	6	767			9	7,809

[1] Includes magnesium silicofluoride or fluosilicate, calcined magnesium sulfate, etc.
[2] 20 pounds. [3] 198 pounds. [4] 138 pounds.

WORLD REVIEW

Austria.—The accompanying table shows that the Austrian magnesite industry has made a substantial recovery from the postwar slump. A detailed report on the industry in recent years was issued by the Fuels and Mining Section, United States Element of the Allied Commission for Austria.[6]

World production of magnesite, by countries, 1942–48 in metric tons[1]

[Compiled by Pauline Roberts]

Country [1]	1942	1943	1944	1945	1946	1947	1948
Argentina					(2)	(2)	(2)
Australia:							
New South Wales	34,587	65,097	31,746	22,701	21,718	36,325	(2)
Queensland	(2)			(2)			
South Australia	876	804	467	752	657	1,003	[3] 900
Victoria	12						
Western Australia	25				11	74	977
Austria	486,000	494,400	480,500	93,200	97,300	220,289	411,627
Cyprus (exports)		2	144	288	3	30	
Germany: Prussia	25,407	39,937	[3][4] 20,000	(2)	(2)	(2)	(2)
Greece	2,890	680	950	1,650	4,500	13,700	12,168
India	48,547	49,858	42,609	5,573	45,394	52,363	(2)
Italy	13,686	5,670	1,490	494	(2)	(2)	(2)
Kenya			45	14	61	41	(2)
Korea	107,354	108,469	157,745	22,581	(2)	(2)	(2)
New Zealand		174	105	113	380	368	549
Norway	2,466	2,057	1,554	1,744	1,174	1,710	(2)
Poland	(2)	(2)	(2)	(2)	(2)	3,802	(2)
Southern Rhodesia	2,790	5,428	5,125	4,278	3,824	5,321	5,722
Spain	2,063	3,626	5,269	7,626	10,761	5,394	5,637
Turkey	115	137	797	798	100	860	3,407
Union of South Africa	16,685	12,694	5,433	7,079	7,003	8,415	10,660
United States	451,202	684,768	509,336	305,228	294,507	341,093	(5)
Venezuela		589	[3] 700	5,600	2,750	2,980	1,900
Total (estimate)	2,300,000	2,400,000	2,000,000	1,200,000	1,450,000	1,850,000	2,000,000

[1] Unless otherwise stated, quantities in this table represent crude magnesite mined. In addition to countries listed, magnesite is also produced in Anglo-Egyptian Sudan, Brazil, Canada, China, Cuba, Czechoslovakia, Egypt, U. S. S. R., and Yugoslavia, but data on tonnage of output are not available; estimates by senior author of chapter included in total.
The Canadian production was actually magnesitic dolomite and brucite, valued as follows: 1942: C$1,059,374; 1943: C$1,260,056; 1944: C$1,139,281; 1945: C$1,278,596; 1946: C$1,225,593; 1947: C$1,201,457 1948: C$1,722,341.
[2] Data not available; estimate by senior author of chapter included in total.
[3] Estimate.
[4] January to June, inclusive.
[5] Bureau of Mines not at liberty to publish figure, included in total.

U. S. S. R.—According to *Ogneupory* (February 1948), material progress was made in Russian output of refractories in 1947, and it was expected that production would be augmented during 1948. The production of "magnesite materials" during 1947 was said to have increased 17 percent over 1946 and calcined dolomite, 14 percent. Total refractory output during 1948 was expected to increase 14 percent.[7]

[6] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 6, June 1948, pp. 35–41.
[7] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 4, April 1948, p. 43.

Manganese

By NORWOOD B. MELCHER

GENERAL SUMMARY

HIGH requirements for manganese ore, coupled with dwindling supplies from some of the important world sources of this strategic commodity, caused increasing alarm in industry and Government during 1948. The demand was met only by reducing industry stocks by 27 percent. Without an early remedy to this situation, serious losses in steel production will result. All possible sources of manganese ore were reappraised during the year to determine what actions could be taken to increase supply to meet industrial demand, with a surplus large enough to permit the increase of industry inventories and accumulation in the National Strategic Stock Pile.

A review of the statistics for 1948 discloses that the total supply of manganese ore during 1948 was inadequate to meet industrial demands. Industry stocks of metallurgical ore, which were reduced by 239,705 short tons during the year, amounted to a bare 4-month supply on December 31, 1948. The seriousness of the diminishing supplies was emphasized when it was realized that 34 percent of receipts came from Russia, a nation that supplied none during several of the World War II years when the total receipts were considerably above the 1948 total. In most of the large producing nations of the world, transportation deficiencies constituted the chief obstacle to increasing exports of manganese ore during 1948. India, which has large reserves of manganese ore, was reorganizing its railroad transportation system, which had deteriorated owing to the heavy traffic of World War II; imports from India in 1943 totaled 575,839 short tons, whereas less than half as much was shipped to the United States during 1948. Exports of manganese ore from India were placed under a licensing system in 1948, and negotiations with that country resulted in a quota for 1949 of 400,000 gross tons, or twice the 1948 performance. At the close of 1948 it appeared that many years would elapse before exports to the United States exceeding 400,000 tons per year would be possible owing to domestic difficulties in India, particularly those connected with rail transportation.

The Union of South Africa, which shipped manganese ore to the United States at about the same rate as India in 1948, was also in a position to ship larger quantities if its railroad car capacity could be expanded. A program was undertaken in 1948 to supply 4,000 new railway cars to the Union from Canada, using steel from the United States allocated for that purpose. Further capacity would be realized in 1949 through shipments of wheel and axle sets from the United States. Ore shipments from Brazil are not expected to exceed 200,000 tons per year until large deposits in the State of Matto Grosso or the Territory of Amapa are put into production. Shipments from present sources, particularly Minas Gerais, are limited by transportation shortages, inadequate reserves, and a desire by the Brazilian Government to maintain production in that area for domestic use. Manganese-ore production facilities in Gold Coast operated at a high rate during 1948, but the bulk of the ore was shipped to the United Kingdom, Canada, and Norway. However, much of the manganese from the two latter countries was converted to ferromanganese for shipment to the United States. Of the Gold Coast ore shipped direct to the United States, approximately half was of battery grade. Cuba, which was a large supplier of metallurgical ore before 1947, has become relatively unimportant owing to exhaustion of reserves. Mexico supplied over 60,000 tons to the United States in 1948, but its reserve position will not support large increases of these exports.

Salient statistics of the manganese industry in the United States, 1944–48, gross weight in short tons

	1944	1945	1946	1947	1948
Manganese ore (35 percent or more Mn):					
Mine shipments:					
Metallurgical ore	241,170	174,295	134,381	125,428	119,828
Battery ore	6,224	8,042	[1] 8,295	6,189	10,845
Miscellaneous ore	222	----------	[1] 959	10	427
Total mine shipments	247,616	182,337	143,635	131,627	131,100
General imports	1,157,932	1,461,945	1,749,223	1,541,818	1,256,597
Consumption	1,593,098	1,485,859	1,136,687	[2] 1,419,131	1,538,398
Ferromanganese:					
Domestic production	702,632	619,760	491,973	614,626	647,617
Imports for consumption	4,199	35,521	32,130	81,307	98,220
Exports	600	836	2,951	20,168	19,696
Consumption	730,491	641,622	501,260	[2] 662,214	670,774
Spiegeleisen:					
Domestic production	165,530	139,039	111,696	134,329	112,610
Imports for consumption	3,761	3,146	[2] 321	----------	----------
Exports	202	2,393	7,513	305	51
Consumption	160,497	148,087	112,700	120,019	102,392

[1] A small quantity of miscellaneous ore is included with battery ore.
[2] Revised figure.

Shipments from domestic mines during 1948 were virtually unchanged from the previous year, although a slightly larger proportion was battery ore. As in 1947, nearly all of the production originated in Montana, while small shipments of metallurgical ore were made from Arizona, Arkansas, and Tennessee, and chemical ore was shipped from Virginia.

Prices of manganese ore in the United States increased only slightly in 1948 in spite of the high demand. The import duty continued unchanged throughout 1948 at one-fourth cent per pound of contained manganese, a rate established in October 1947 (effective January 1, 1948), as a result of the Geneva conference of the International Trade Organization, when the rate was cut in half.

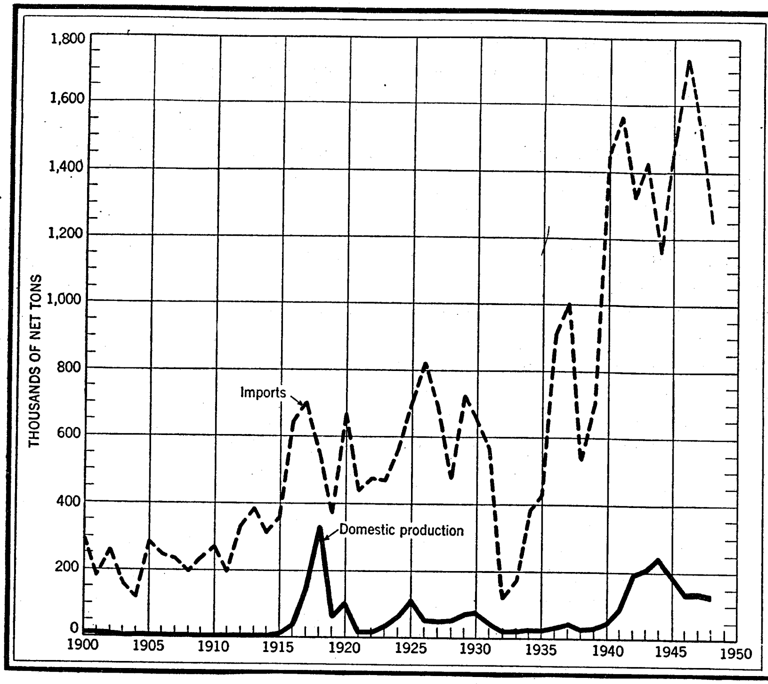

FIGURE 1.—General imports and domestic production (mine shipments) of manganese ore, 1900–48.

DOMESTIC PRODUCTION

The following table shows the various types of manganiferous materials shipped by domestic producers from 1944 to 1948.

Manganiferous raw materials shipped by producers in the United States, 1944–48, in short tons

Year	Metallurgical ore				Battery ore (35 percent or more Mn)	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		35 percent or more Mn	10 to 35 percent Mn
1944	241, 170	296, 981	1, 190, 476	247, 402	6, 224	222	155
1945	174, 295	114, 327	1, 408, 527	224, 331	8, 042		
1946	134, 381	100, 402	1, 070, 694	205, 786	[1] 8, 295	[1] 959	87
1947	125, 428	128, 562	1, 044, 961	227, 547	6, 189	10	832
1948	119, 828	139, 580	1, 198, 523	291, 383	10, 845	427	2, 462

[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 Montana, South Carolina, and Virginia, and manganiferous zinc residuum was produced from New Jersey zinc ores.

Metallurgical manganese ore shipped from mines in the United States, 1944–48, by States, in short tons

State	1944	1945	1946	1947	1948	State	1944	1945	1946	1947	1948
Ala.	49	32	-------	-------	-------	S. C.	1, 400	41	78	-------	-------
Ariz.	8, 519	1, 093	-------	133	240	Tenn.	418	-------	-------	39	37
Ark.	7, 109	6, 663	1, 101	841	212	Utah	30	-------	-------	-------	-------
Calif.	21, 540	1, 668	-------	-------	-------	Va.	20, 034	8, 566	321	-------	-------
Ga.	1, 135	1, 056	-------	-------	-------	Wash.	5, 199	6, 994	1, 424	-------	-------
Mont.	153, 665	143, 888	129, 227	123, 490	119, 339						
Nev.	21, 799	960	1, 064	67	-------	Total	241, 170	174, 295	134, 381	125, 428	119, 828
N. Mex.	273	3, 334	1, 166	858	-------						

Ferruginous manganese ore shipped from mines in the United States, 1944–48, by States, in short tons

State	1944	1945	1946	1947	1948	State	1944	1945	1946	1947	1948
Ariz.	320	56	-------	62	-------	Nev.	7, 492	2, 212	12, 468	13, 117	8, 707
Ark.	14, 755	14, 806	1, 964	2, 094	1, 165	N. Mex.	100, 683	85, 744	72, 299	97, 007	122, 879
Calif.	4, 598	12	-------	-------	-------	S. C.	171	-------	-------	-------	-------
Colo.	-------	47	-------	37	-------	Tenn.	6, 779	1, 000	-------	-------	-------
Ga.	2, 232	-------	-------	-------	-------	Utah	32, 141	5, 001	7, 903	7, 198	2, 694
Mich.	-------	-------	1, 952	-------	-------	Va.	4, 419	392	87	6, 208	2, 462
Minn.	122, 765	-------	-------	-------	-------						
Mont.	781	5, 057	3, 816	3, 671	4, 135	Total	297, 136	114, 327	100, 489	129, 394	142, 042

Manganiferous iron ore shipped from mines in the United States, 1944–48, by States, in short tons

State	1944	1945	1946	1947	1948
Michigan	45, 689	1, 680	-------	-------	-------
Minnesota	1, 144, 787	1, 406, 847	1, 070, 694	1, 044, 961	1, 198, 523
Total	1, 190, 476	1, 408, 527	1, 070, 694	1, 044, 961	1, 198, 523

Arizona.—The Denison Manganese Co. shipped manganese ore containing (natural) 48 percent Mn from the Long Valley and Heber mines in Coconino County.

Arkansas.—Manganese ore containing 49 percent Mn (natural) and ferruginous manganese ore containing less than 35 percent Mn were shipped by the Denison Manganese Co. from the Pfeiffer and Cushman mines during 1948.

Minnesota.—The Hanna Coal & Ore Corp. and Pickands, Mather & Co. shipped manganiferous iron ore from mines in Crow Wing County from the Cuyuna range. This ore, used mainly in the manufacture of manganiferous pig iron, averaged (natural) only 6.03 percent Mn during 1948.

Montana.—The Anaconda Copper Mining Co. shipped 91 percent of the total manganese ore from United States mines in 1948, and all but a fraction of 1 percent of the metallurgical ore. The product shipped by that company during the year consisted of nodules averaging 59.21 percent Mn from its operations at Anaconda, Mont. Much of this material was shipped to consuming plants in the eastern United States, but some was shipped to Great Falls, Mont., where Anaconda began the production of ferromanganese in electric furnaces.

Ore for the Anaconda operations came from the Alice, Anselmo, Emma, Badger State, and Travona mines—all in the Butte district.

The Taylor-Knapp Co. and the Trout Mining Division of American Machine & Metals, Inc., produced battery-grade concentrates from the Moorlight and Trout groups of mines, respectively, in the Philipsburg district. The battery material shipped from these properties averaged (natural) 66.23 percent MnO_2. The Trout mining division also produced a lower-grade middling to be used for metallurgical purposes.

Nevada.—The Charleston Hill National Mines shipped ferruginous manganese ore averaging 26 percent Mn from the Black Diablo mine in Pershing County to blast furnaces at Geneva, Utah.

New Mexico.—Ferruginous manganese ore averaging (natural) 10 percent Mn was shipped by the Luck Mining & Construction Co. from the Boston Hill mine in Grant County. This ore was shipped to blast furnaces at Pueblo, Colo.

Tennessee.—A small quantity of high-grade (57.96 percent Mn) ore was shipped by the Consolidated High-Grade Ore Co. from the Hambright mine in Bradley County. This ore was shipped to the Birmingham, Ala., area for consumption.

Utah.—Ferruginous manganese ore was shipped by the Blackbird Mining Co. from the Blackbird mine in Piute County and by Fred Staats from the Staats mine in Juab County during 1948. Other shipments from mines (names unreported) were made by Art Sessions from Grand County, American Mines from Juab County, and Manganese, Inc., from Piute County. All of the ore from Utah mines was shipped to blast furnaces at Geneva and Provo, Utah.

Virginia.—The manganese-bearing material shipped from Virginia in 1948 consisted mainly of products obtained from reworking tailings of the Dominion Manganese Corp. mine in Augusta County. Shipments consisted of manganese ore and ferruginous manganese ore for chemical purposes.

Manganese and manganiferous ores shipped from mines in the United States in 1948, by States

	Metallurgical			Battery			Miscellaneous			Total			
	Shippers	Short tons		Shippers	Short tons		Shippers	Short tons		Shippers	Short tons		Value
		Gross weight	Manganese content		Gross weight	Manganese content		Gross weight	Manganese content		Gross weight	Manganese content	
Manganese ore: [1]													
Arizona	1	240	115							1	240	115	(2)
Arkansas	1	212	104							1	212	104	(2)
Montana	1	119,339	70,664	2	10,845	4,540				3	130,184	75,204	$4,362,066
Tennessee	1	37	21							1	37	21	(2)
Virginia							1	427	172	1	427	172	(2)
Total	4	119,828	70,904	2	10,845	4,540	1	427	172	7	131,100	75,616	4,390,199
Ferruginous manganese ore: [3]													
Arkansas	1	1,165	349							1	1,165	349	(2)
Montana	1	4,135	992							1	4,135	992	(2)
Nevada	1	8,707	2,264							1	8,707	2,264	(2)
New Mexico	1	122,879	12,779							1	122,879	12,779	(2)
Utah	2	2,694	821							2	2,694	821	(2)
Virginia							1	2,462	610	1	2,462	610	(2)
Total	6	139,580	17,205				1	2,462	610	7	142,042	17,815	656,325
Manganiferous iron ore: Minnesota [4]	2	1,198,523	72,257							2	1,198,523	72,257	(5)

[1] Containing 35 percent or more manganese (natural).
[2] Value included in total.
[3] Containing 10 to 35 percent manganese (natural).
[4] Containing 5 to 10 percent manganese (natural).
[5] Bureau of Mines not at liberty to publish figure.

CONSUMPTION AND STOCKS

The consumption of manganese ore in 1948 increased 8 percent over the 1,419,131 tons used in 1947. In 1948, 92 percent was of foreign origin compared with 91 percent in 1947. Three percent was used in the manufacture of dry cells, 1 percent in the manufacture of chemicals, and 96 percent for metallurgical purposes. Industrial stocks of manganese ore decreased sharply during 1948 and totaled 640,842 tons on December 31 compared with 880,547 tons on December 31, 1947.

The following table shows ores available for consumption in the United States in 1948 without adjustment for changes in consumer or Government stocks.

Indicated consumption of manganiferous raw materials in the United States in 1948

	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	131,100	57.68	433,425	16.9	1,198,523	6.03
Imports for consumption	1,473,453	47.66	458	33.6	[1] 24,074	[2] 7.00
Total available for consumption	1,604,553	48.48	433,883	16.9	1,222,597	6.05

[1] Estimated from consumption. [2] Estimated.

The following table shows the actual tonnage of manganese ore (containing 35 percent or more manganese, natural) and manganese alloys consumed during 1947 and 1948, by type of consumer, together with stocks at the end of the year.

Consumption of manganese ore and manganese alloys in the United States, 1947–48, and stocks Dec. 31, 1948, gross weight in short tons

	Consumed		In stock Dec. 31, 1948 [1]	
	1947	1948	At plant, including bonded warehouses	In bonded warehouses only
Manufacturers of manganese alloys and manganese metal:				
Manganese ore:				
Domestic	116,217	112,746	69,471	
Foreign	1,216,807	1,302,133	513,217	315,210
Total manganese ore	1,333,024	1,414,879	582,688	315,210
Ferromanganese			32,609	20,707
Spiegeleisen			13,283	
Silicomanganese			(2)	(2)
Manganese briquets			(2)	(2)
Manufacturers of steel ingots and steel castings: [3]				
Manganese ore:				
Domestic	1,725	1,940	747	
Foreign	3,005	3,447	2,331	
Total manganese ore	4,730	5,387	3,078	
Ferromanganese:				
High-carbon	[4] 605,903	606,635	91,127	
Medium-carbon, Low-carbon	22,182	25,640	3,658	
Total ferromanganese	[4] 628,085	632,275	94,785	
Spiegeleisen	94,916	75,266	30,575	
Silicomanganese	61,273	64,110	8,561	

See footnotes at end of table.

Consumption of manganese ore and manganese alloys in the United States, 1947–48, and stocks Dec. 31, 1948, gross weight in short tons—Continued

	Consumed		In stock Dec. 31, 1948 [1]	
	1947	1948	At plant, including bonded warehouses	In bonded warehouses only
Manufacturers of steel castings: [5]				
Manganese ore:				
Domestic	355	758	423	
Foreign	507	712	1,064	
Total manganese ore	862	1,470	1,487	
Ferromanganese:				
High-carbon	24,095	27,236	6,961	
Medium-carbon, Low-carbon	1,155	1,316	535	
Total ferromanganese	25,250	28,552	7,496	
Spiegeleisen	9,135	13,412	2,340	
Silicomanganese	8,225	9,779	2,251	
Manufacturers of pig iron:				
Manganese ore:				
Domestic		828	516	
Foreign	14,997	50,695	8,636	
Total manganese ore	14,997	51,523	9,152	
Manufacturers of miscellaneous products:				
Ferromanganese:				
High-carbon	6,597	7,270	3,595	
Medium-carbon, Low-carbon	2,282	2,677	1,379	
Total ferromanganese	8,879	9,947	4,974	
Spiegeleisen	15,968	13,714	4,446	
Silicomanganese	1,035	1,537	295	
Manganese briquets	9,398	11,941	2,640	
Manufacturers of dry cells:				
Manganese ore:				
Domestic	6,727	5,747	2,350	
Foreign	39,629	42,253	24,696	8,665
Total manganese ore	46,356	48,000	27,046	8,665
Manufacturers of chemicals:				
Manganese ore:				
Domestic	70	686	679	
Foreign	19,092	16,453	16,712	
Total manganese ore	19,162	17,139	17,391	
Grand total:				
Manganese ore:				
Domestic	125,094	122,705	74,186	
Foreign	1,294,037	1,415,693	566,656	323,875
Total manganese ore	[6] 1,419,131	[6] 1,538,398	640,842	323,875
Ferromanganese:				
High-carbon	[4] 636,595	641,141	139,864 (High-, Medium-, and Low-carbon)	20,707
Medium-carbon, Low-carbon	25,619	29,633		
Total ferromanganese	[4] 662,214	670,774	139,864	20,707
Spiegeleisen	120,019	102,392	50,644	
Silicomanganese	70,533	75,426	[7] 11,107	
Manganese briquets	9,398	11,941	[7] 2,640	

[1] Excluding Government stocks.
[2] Data not available.
[3] Includes only that part of castings made by companies that also produce steel ingots.
[4] Revised figure.
[5] Excludes companies that produce both steel castings and steel ingots.
[6] 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.
[7] Excludes small tonnage of producers' stocks.

The use of manganese in steel making decreased from 13.2 pounds (revised figure) per short ton of steel ingots in 1947 to 12.7 pounds in 1948. Of the manganese used in steel during 1948, 11.3 pounds was in the form of ferromanganese, 0.3 pound as spiegeleisen, 1.0 pound as silicomanganese, and 0.1 pound as manganese ore used directly. In 1947 the consumption of manganese contained in ferromanganese, spiegeleisen, silicomanganese and manganese ore amounted to 11.7 pounds, 0.4 pound, 1.0 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. The companies reporting in this part of the survey are the same as those reporting production of ingots and castings to the American Iron & Steel Institute.

Electrolytic Manganese.—The Electro Manganese Corp., Knoxville, Tenn., was the only producer of electrolytic manganese in 1948. The Bureau of Mines continued its research on the production of electrolytic manganese using chloride as an electrolyte.[1]

Ferromanganese.—The domestic output of ferromanganese increased 5 percent over 1947 and totaled 647,617 short tons. This alloy was produced in the following plants during the year: Bethlehem Steel Co., Johnstown, Pa.; Anaconda Copper Mining Co., Black Eagle, Mont.; Electro Metallurgical Co., Niagara Falls, N. Y., Columbiana,

Ferromanganese and spiegeleisen imported into and made from domestic and imported ores in the United States, 1947–48, in short tons

	1947		1948	
	Alloy	Manganese content	Alloy	Manganese content
Ferromanganese:				
Imported	81,307	65,181	98,220	78,426
Domestic production	614,626	483,509	647,617	507,843
From domestic ore (estimated)	70,534	55,487	50,313	39,455
From imported ore (estimated)	544,092	428,022	597,304	468,388
Total	695,933	548,690	745,837	586,269
Ratio (percent) of Mn in ferromanganese of domestic origin to total Mn in ferromanganese made and imported		10.11		6.73
Number of plants making ferromanganese	12		10	
Spiegeleisen:				
Imported				
Domestic production	134,329	29,484	112,610	27,682
From domestic ore	133,532	29,309	112,610	27,682
From imported ore	797	175		
Total	134,329	29,484	112,610	27,682
Ratio (percent) of Mn in spiegeleisen of domestic origin to total Mn in spiegeleisen made and imported		99.41		100.0
Number of plants making spiegeleisen	5		3	
Total available supply of metallic manganese in ferromanganese and spiegeleisen		578,174		613,951
Percent of available supply of manganese in—				
Ferromanganese and spiegeleisen imported		11.27		12.77
Ferromanganese made from imported ore		74.03		76.29
Spiegeleisen made from imported ore		.03		
Ferromanganese made from domestic ore		9.60		6.43
Spiegeleisen made from domestic ore		5.07		4.51
Ferromanganese and spiegeleisen made from domestic ore		14.67		10.94
Spiegeleisen made and imported		5.10		4.51
Open-hearth, bessemer, and electric steel produced	84,894,071		88,640,470	

[1] Jacobs, J. H., and Churchward, P. E., Electrowinning of Manganese from Chloride Electrolytes: Jour. Electro-Chem. Soc. vol. 94, No. 3, September 1948, pp. 108–121.

Ohio, and Alloy, W. Va.; E. J. Lavino & Co., Reusens, Va., and Sheridan, Pa.; Sloss-Sheffield Steel & Iron Co., North Birmingham, Ala.; Tennessee Products & Chemical Corp., Rockwood, Tenn.; and Carnegie-Illinois Steel Corp., Clairton and Etna, Pa. Of the 1,287,951 short tons of manganese ore used in the production of ferromanganese during 1948, 6 percent was of domestic origin compared with 9 percent in 1947. However, on a basis of the relative manganese content of the foreign and domestic ore, 8 percent was made from domestic ore in 1948, compared with 11 percent in 1947. The recovery of manganese from ore in making ferromanganese was 84.60 percent in 1948 compared with 84.75 percent in 1947 and 85.01 percent in 1946.

Ferromanganese produced in the United States and metalliferous materials consumed in its manufacture, 1944–48

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	
		Percent	Short tons	Foreign	Domestic		
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
1947	614,626	78.67	483,509	1,075,043	109,987	1,340	1.928
1948	647,617	78.42	507,843	1,209,249	78,702	5,930	1.989

Manganese ore used in manufacture of ferromanganese in the United States, 1944–1948, by source of ore

Source of ore	1944		1945		1946		1947		1948	
	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	130,886	59.06	120,420	57.05	80,377	58.66	109,987	59.53	78,702	59.26
Foreign:										
Africa	290,684	46.19	280,264	46.15	323,225	47.18	313,027	47.35	386,503	46.69
Brazil	227,410	41.02	275,117	41.19	161,456	40.98	139,300	40.49	159,668	40.81
Chile	464	45.47	5,498	45.42	2,194	47.45	8,298	47.23	5,195	47.91
Cuba	241,582	47.45	257,521	45.37	165,951	46.53	74,102	44.00	35,328	42.87
India	409,563	49.05	258,432	48.77	207,769	48.33	369,101	49.94	304,607	47.82
Mexico	46,495	41.15	21,791	43.86	22,492	47.23	33,382	41.16	40,420	41.79
New Zealand	536	44.35	------	------	------	------	------	------	------	------
Philippines, Republic of	8,144	52.00	------	------	------	------	2,196	51.64	7,763	46.13
U. S. S. R.	------	------	12,452	44.49	296	44.59	135,637	47.71	269,765	46.08
Grand total	1,355,764	46.28	1,231,495	46.43	963,760	47.23	1,185,030	48.14	1,287,951	46.61

Shipments of ferromanganese from producing furnaces in 1948 increased 7 percent in quantity and 13 percent in value over 1947. The record of shipments for the past 5 years follows.

883326—50——50

Ferromanganese shipped from furnaces in the United States, 1944–48

Year	Short tons	Value	Year	Short tons	Value
1944	715,059	$91,406,229	1947	614,647	$79,972,673
1945	610,376	78,907,189	1948	659,193	90,126,657
1946	493,808	61,355,778			

Spiegeleisen.—Production of spiegeleisen in 1948 decreased 16 percent from 1947. Shipments decreased 12 percent in quantity but increased 6 percent in value over 1947. Spiegeleisen was produced in the following plants during 1948: New Jersey Zinc Co., Palmerton, Pa., and Carnegie-Illinois Steel Corp., Clairton, Pa., and Gary, Ind. All of the spiegeleisen manufactured in 1948 was made from domestic materials.

Spiegeleisen produced and shipped in the United States, 1944–48

Year	Produced (short tons)	Shipped from furnaces		Year	Produced (short tons)	Shipped from furnaces	
		Short tons	Value			Short tons	Value
1944	165,530	155,325	$4,851,490	1947	134,329	124,517	$4,980,030
1945	139,039	157,774	5,108,144	1948	112,610	108,960	5,261,650
1946	111,696	114,982	3,793,673				

Manganiferous Pig Iron.—Pig-iron blast furnaces used 9,852 short tons of manganiferous zinc residuum and 752,140 tons of manganese-bearing ores containing (natural) over 5 percent manganese in 1948. Of the ore used, 666,943 tons were domestic and 85,197 tons of foreign origin. Of the domestic material used, 526,979 tons contained (natural) 5 to 10 percent Mn, 139,136 tons contained 10 to 35 percent Mn, and 828 tons contained more than 35 percent manganese. Of the foreign material used, 24,074 tons contained less than 10 percent Mn, 10,428 tons contained 10 to 35 percent Mn, and 50,695 tons contained more than 35 percent.

Foreign ferruginous manganese ore and manganiferous iron ore consumed in the United States, 1945–48, in short tons

Source of ore	Ferruginous manganese ore				Manganiferous iron ore			
	1945	1946	1947	1948	1945	1946	1947	1948
Africa							44,227	24,074
Australia							1,558	
Mexico	800	257		52		5,854		
Palestine				10,376				
Total	800	257		10,428		5,854	45,785	24,074

Battery and Miscellaneous Industries.—During 1948 manufacturers of dry cells used 48,000 tons of manganese ore, of which 5,747 tons were of domestic origin and 42,253 were imported. Chemical plants used 686 tons of domestic ore and 16,453 tons of foreign ore containing (natural) more than 35 percent manganese. Most of this ore was used in the manufacture of manganese sulfate for fertilizer and in the manufacture of hydroquinone, a photographic chemical.

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, nickel, copper, and cobalt, which are electronegative to zinc.

PRICES

Manganese Ore.—Prices of manganese ore containing 48 percent Mn, as quoted by E&MJ Metal and Mineral Markets, at the beginning of 1948 ranged from 65.0 to 67.0 cents per long-ton unit, including duty, f. o. b. eastern and southern ports. At the end of the year comparable prices ranged from 70.6 to 72.6 cents per unit. 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-fourth cent per pound of contained manganese was imposed on all ores imported in 1948, except those from Cuba and the Republic of the Philippines, which entered duty-free.

Manganese Alloys.—The average value, f. o. b. producers' furnaces, for ferromanganese shipped during 1948 was $136.72 per short ton compared with $130.11 in 1947. According to Iron Age, the selling price of ferromanganese in car lots at eastern centers rose from $145.00 per gross ton, which had been in effect since October 1947, to $161.71 in October 1948; the average for the year was $149.18. The value of spiegeleisen, f. o. b. domestic furnaces, was $48.29 per short ton compared with $39.99 in 1947; and the quoted price, as given by Iron Age, rose uninterruptedly from $47.00 per gross ton at the beginning of the year to $62.00 in October, then remained unchanged during the balance of the year. The average quoted price per gross ton was $54.15 for 1948.

FOREIGN TRADE [2]

Imports of all grades of manganese ore are shown by countries in the accompanying table. These data include imports of battery-grade ore totaling 81,769 short tons in 1948. Of this quantity, 68,053 tons came from Gold Coast, 8,949 tons from U. S. S. R., 1,707 tons from India, 1,008 tons from Belgian Congo, 684 tons from Cuba, 672 tons from Chile, 560 tons from the Republic of the Philippines, and 136 tons from Mexico. This ore averaged 55.84 percent Mn, or 88.33 percent MnO_2. Imports for consumption of battery ore totaled 79,388 short tons, of which 63,566 tons came from Gold Coast, 11,055 tons from U. S. S. R., 1,707 tons from India, 1,008 tons from Belgian Congo, 684 tons from Cuba, 672 tons from Chile, 560 tons from the Republic of the Philippines, and 136 tons from Mexico. The value of these entries amounted to $2,130,006, or $26.83 per short ton, f. o. b. foreign ports.

Imports for consumption of ferromanganese in 1948 increased 21 percent over 1947; exports decreased 2 percent. Exports of manganese ore and concentrates amounted to 9,236 short tons valued at $687,314.

[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.

Manganese ore (35 percent or more Mn) imported into the United States, 1947–48, by countries

[U. S. Department of Commerce]

Country	General imports [1] (short tons)				Imports for consumption [2]					
					Short tons				Value	
	Gross weight		Mn content		Gross weight		Mn content			
	1947	1948	1947	1948	1947	1948	1947	1948	1947	1948
Belgian Congo	2,854	2,688	1,484	1,371	2,903	2,688	1,608	1,371	$42,257	$65,393
Brazil	184,050	143,917	74,971	57,954	157,804	160,479	70,234	71,561	1,957,910	1,933,867
British East Africa	530		267			530		281		9,187
Canada	257	348	138	177	257	348	138	177	7,425	11,025
Chile	43,450	10,843	20,523	4,873	42,078	10,303	19,930	4,927	1,341,484	164,471
Cuba	57,089	32,843	26,893	15,931	57,089	32,843	26,893	15,931	1,224,880	810,321
France		1		(3)		1		(3)		245
Gold Coast	192,277	132,971	99,563	70,306	217,317	218,164	112,102	112,503	3,316,990	3,269,203
India	421,121	213,445	206,705	103,217	284,535	314,799	140,007	152,852	3,497,822	4,331,225
Mexico	56,642	61,568	25,558	27,498	50,890	53,754	22,805	23,894	737,724	812,382
Morocco, French		300		166		300		166		12,696
Mozambique	567		283							
Peru	448		215		448		215		14,739	
Philippines, Republic of	2,376	10,120	1,141	5,099	2,376	10,120	1,141	5,099	37,800	219,774
Portuguese Asia		1,109		455						
Portuguese Guinea and Angola	448	2,607	229	1,408	448	1,630	229	880	8,052	43,214
Turkey		33		17						
Union of South Africa	248,703	216,575	109,838	98,514	192,871	283,376	87,154	130,114	2,205,279	3,394,517
U. S. S. R.	331,006	427,229	162,297	201,409	288,976	384,118	141,975	182,455	6,898,819	8,242,804
Total	1,541,818	1,256,597	730,105	588,395	1,297,992	1,473,453	624,431	702,211	21,291,181	23,320,324

[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.

Ferromanganese imported into and exported from the United States, 1944–48

[U. S. Department of Commerce]

Year	Imports for consumption [1]			Exports	
	Gross weight (short tons)	Mn content (short tons)	Value	Gross weight (short tons)	Value
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
1947	81,307	65,181	10,847,036	20,168	2,811,653
1948	98,220	78,426	14,516,593	19,696	2,990,645

[1] All from Canada in 1944–48 except—1944: 1,408 tons (1,076 content), $98,282 from India; 1946: 9,357 tons (7,595 content), $1,585,803 from Norway; 1947: 12,607 tons (10,372 content), $2,149,139 from Norway; 1948: 25,904 tons (20,949 content), $4,558,912 from Norway.

Spiegeleisen imported for consumption in the United States, 1943–48

[U. S. Department of Commerce]

Year	Short tons	Value	Year	Short tons	Value
1943	3,254	$140,247	1946	[1] 321	$17,512
1944	3,761	153,032	1947–48	----------	----------
1945	3,146	142,883			

[1] Revised figure.

WORLD REVIEW

The accompanying table shows, insofar as statistics are available, the world production of manganese ores from 1942 to 1948 and their average manganese content. Official statistics of the countries are used, supplemented by data from semiofficial and other sources.

World production of manganese ore, by countries, 1942–48, in metric tons

[Compiled by B. B. Mitchell]

Country [1]	Percent Mn	1942	1943	1944	1945	1946	1947	1948
North America:								
Canada (shipments)	--------	395	44	--------	--------	--------	204	227
Cuba	36–50+	249,255	[2] 311,214	[2] 257,864	198,243	130,764	48,678	29,073
Mexico	41–45	40,000	70,503	80,671	51,959	25,000	31,400	53,800
United States (shipments)	35+	173,043	186,129	224,632	165,412	130,303	119,409	118,931
South America:								
Argentina [3]	35–38	1,424	1,645	3,155	4,272	(4)	(4)	(4)
Bolivia (exports)	50	600	17	--------	--------	--------	--------	--------
Brazil (exports)	38–50	306,241	275,552	146,983	244,649	149,149	142,092	141,253
Chile	40–50	71,292	114,074	43,989	7,445	20,538	19,352	20,498
Europe:								
Germany	30+	2,100	985	(4)	[5] 19,000	[5] 35,000	[5] 89,000	(4)
Greece	60–62	43	290	--------	--------	15	--------	(4)
Hungary	35–48	31,880	33,580	[6] 21,050	[7] 6,600	14,780	33,470	(4)
Italy	34–37	59,971	45,070	23,909	3,297	7,919	26,815	[8] 26,000
Portugal	35–45	6,820	12,611	9,210	8,114	5,932	2,444	[9] 220
Rumania	30–36	29,021	37,417	(4)	(4)	18,807	(4)	(4)
Spain	40+	21,268	26,150	30,426	24,889	29,589	22,429	17,671
Sweden	30+	24,242	26,703	24,276	18,036	12,594	10,697	(4)
Switzerland	--------	5,772	8,138	5,778	2,757	(4)	--------	--------
U. S. S. R. (estimate)	41–48	[10] 1,823,000	1,000,000	461,000	2,251,000	1,700,000	1,800,000	(4)
United Kingdom	--------	10,599	20,558	17,890	11,480	--------	--------	--------
Asia:								
Burma (estimate)	35	762	762	762	(4)	(4)	(4)	(4)
China	41	500	4,364	(4)	16,400	[11] 9,600	20,000	[8] 22,000
India	47–52	769,423	604,922	376,934	213,963	256,975	456,512	[12] 318,220
Indochina, French	47–50	1,440	1,400	7,700	--------	--------	--------	--------
Indonesia	--------	39,600	39,600	39,600	(4)	--------	--------	--------
Japan	32–40	[13] 254,254	[13] 342,884	[13] 400,679	[13] 85,700	29,394	33,194	47,500
Korea	--------	(4)	(4)	32,377	(4)	(4)	(4)	(4)
Malaya, Federation of	30	2,540	2,540	2,540	--------	--------	--------	--------
Philippines, Republic of	35–48	(4)	(4)	(4)	(4)	--------	3,375	25,565
Portuguese India	42–50+	680	--------	--------	--------	(4)	[12] 100	[12] 4,728
Turkey	30–50	3,418	2,684	1,865	4,895	1,185	4,633	8,327
Africa:								
Belgian Congo	50+	28,984	17,411	2,983	2,561	12,231	17,646	[9] 10,000
Egypt	30+	8,169	7,079	30	47	25	29	(4)
Gold Coast	50+	691,016	[2] 534,362	[2] 479,499	[2] [12] 713,013	[2] [12] 777,583	[2] [12] 598,655	[2] [12] 640,088
Morocco, French	32–50	44,273	49,010	27,550	44,458	57,990	109,452	214,412
Northern Rhodesia	30–48	6,211	4,787	5,127	1,965	1,420	--------	3,961
Portuguese West Africa	50	(4)	4,000	2,000	--------	1,900	700	400
Tunisia	35–40	102	--------	313	--------	--------	25	--------
Union of South Africa	40–50	394,445	219,122	106,883	114,546	237,897	288,213	276,393
Oceania:								
Australia:								
New South Wales	--------	793	614	782	1,000	1,407	1,612	(4)
Queensland	--------	152	57	--------	--------	--------	--------	--------
South Australia	--------	9,477	5,680	1,219	--------	--------	192	(4)
Western Australia	--------	--------	--------	--------	--------	--------	--------	826
New Zealand	--------	326	518	--------	--------	408	--------	533
Papua	--------	352	365	176	174	44	83	(4)
Total (estimate)	--------	5,167,000	4,060,000	2,900,000	4,260,000	3,700,000	3,900,000	3,900,000

[1] In addition to countries listed, Belgium, Bulgaria, Costa Rica, Eritrea, Iran, Spanish Morocco, and Yugoslavia produce manganese ore, but data of output are not available. Czechoslovakia reports 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 by author of chapter included in total.

[5] Figures represent French zone only; no output in American-British zone or Saar.

[6] January to June, inclusive.

[7] June to December, inclusive.

[8] Estimate.

[9] January to September, inclusive.

[10] Estimate excludes Ukraine.

[11] Incomplete data.

[12] Exports.

[13] Fiscal year ended March 31 of year following that stated.

Australia.—A description of the manganese industry of Australia has been published recently.[3]

Belgian Congo.—Production was resumed at the Kasokelesa Mines in Katanga on February 17, 1947, after having been idle since 1944. Ore produced and transported by truck from the mine to Lufupa station on the Benguela Railroad amounted to 17,646 metric tons, of which 227 tons were shipped to the Sermikat foundry at Lubudi and 11,090 tons to Lobito for export.[4]

Chile.—The Department of Mines and Petroleum announced that recent studies have disclosed an estimated manganese ore reserve of 300,000 tons of 35 percent Mn, and 1,200,000 tons of 30 percent, the principal deposits occurring in the Provinces of Atacama and Coquimbo.[4]

Cuba.—Chemical-grade manganese ore is produced at about 24 mines in Oriente Province. The production of this grade ore during the first quarter of 1948 amounted to 985 long tons compared with a quarterly average of 1,192 tons during 1947. Virtually all of the metallurgical ore production comes from the Charco Redondo mine. The Canada and Lago mines of the Taranta group, which produced during 1947, were inactive during 1948 and have been closed indefinitely owing to exhaustion of reserves.[5] All of the production in Cuba is from the south coast of Oriente Province.

France.—French manganese ore requirements for 1948 were estimated at 240,000 metric tons based on a steel output of 8,000,000 tons, considerably under earlier estimates given in the 1947 chapter of this series. In 1947, when 5,700,000 tons of steel were produced, imports of manganese ore totaled 175,000 tons, of which 107,000 tons originated in Morocco.[6]

Hungary.—Hungary is virtually self-sufficient with respect to manganese. In 1947 reported production of all grades of ore totaled 112,310 metric tons, and consumption was 109,970 tons. Imports were 123 tons and exports only 9 tons.[7]

India.—At the opening of 1948, the Indian Government proposed an export duty on manganese ore of 20 rupees per ton, which in some cases would have exceeded 50 percent ad valorem. However, the government recognized immediately that such a rate virtually would stop exports of manganese ore, and the rate was promptly reduced to 25 percent ad valorem and on March 1 was reduced further to 15 percent. The latter rate, which prevailed during the balance of 1948, affected all contracts made after March 1, 1948. The cost of Indian manganese ore was also increased by a rise in freight rates effective January 1 which affected many commodities.[8] Manganese ore was placed on an export-licensing system during 1948.

Indonesia.—There are two manganese mines in Java, one in west and the other in central Java. The western mine is 50 kilometers south of Tasikmalaja, the other near Djocjakarta. When the owners of the western deposit returned after World War II, they found that

[3] Knight, C. L., and Ludbrook, M. H., Mineral Resources of Australia—Manganese: Australian Bureau of Mineral Resources, Geology and Geophysics Summary Rept. 7, 1947, 35 pp.
[4] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 6, June 1948, p. 18.
[5] Horn, Adolf B., Jr., Mineral Trade Notes, Fourth Quarter 1947: American Embassy Rept. 67, Havana, Cuba, Mar. 15, 1948, p. 2.
[6] Bureau of Mines, Mineral Trade Notes: Vol. 27, No. 2, August 1948, p. 17.
[7] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 6, June 1948, p. 18.
[8] Grady, Henry F., Reduction in Indian Export Duty on Manganese Ore: American Embassy Rept. 395, New Delhi, India, Apr. 20, 1948, 2 pp.

damage during the Japanese occupation was heavy. All buildings had been removed or destroyed. A report by the operating company on future production possibilities from this mine is expected in the near future. No details are yet available regarding the status of the mine in central Java. Some crude ore was found at the Port of Batavia after the Japanese withdrew. Former customers in the United States rejected the ore, as the quality was low, and the material was then shipped to the Netherlands. This ore presumably originated at the west Java mine, the only one operated by the Japanese during the war.[9]

Japan.—The Japanese reserves of high-grade manganese ore are inadequate to meet domestic needs. Consequently, Japan has turned to the production of metallic manganese to overcome, in part, dependence upon imported high-grade material. Processes for producing metallic manganese were described.[10]

Mexico.—The manganese deposits of Chihuahua were described.[11]

Republic of the Philippines.—Most of the manganese production in the Philippines in 1947 came from Busuanga Island, Palawan group. Development work and reconstruction were in progress in several islands of the Republic in 1948.[12]

Union of South Africa.—Problems of increasing exports of manganese ore from the Union of South Africa are discussed in the General Summary of this chapter. The two main companies producing manganese—Associated Manganese Mines of South Africa, Ltd., and South African Manganese, Ltd.,—are reported to employ 300 European supervisors and 3,500 native laborers.[13]

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[9] American Consular Rept. A-108, Batavia, Java, Netherlands East Indies, May 13, 1948, 2 pp.
[10] Dettmer, Philip P., Metallic Manganese Metallurgy in Japan: Bureau of Mines, Mineral Trade Notes, Special Supp. 22, vol. 26, No. 1, January 1948, 24 pp.
[11] Rocha, Victor S., and Wilson, Ivan F., Los Yacimientos de Manganeso de Talamantes, Municipio de Allende, Estado de Chihuahua: Comite Directivo para la Investigacion de los Recursos Minerales de Mexico, Bull. 18, 1948, 39 pp.
[12] Engineering and Mining Journal, vol. 149, No. 3, Mar. 1, 1948, p. 63.
[13] Engineering and Mining Journal, vol. 148, No. 5, May 1947, p. 129.

Mercury

By HELENA M. MEYER AND ALETHEA W. MITCHELL

GENERAL SUMMARY

FACTORS unfavorable to the domestic mercury-mining industry continued to accumulate in 1948 and culminated by the end of the year in virtual cessation of domestic mine production. Output for the year was 38 percent lower than in 1947, amounted to only 33 percent of the annual average for the 5-year period 1941–45, and in December was at a rate lower than that for any year since production records were begun 98 years ago. Only two of the larger producers—Mount Jackson and Bonanza mines—were in operation at the year end.

It has been pointed out in previous reports of this series that the world market shrank sharply after the defeat of Germany and Japan, two of the leading mercury-consuming nations before the end of World War II. During the war, producers everywhere had geared output to the record requirements for the metal. Postwar production exceeded total needs, and large stocks accumulated. Stocks were on hand also in the two defeated countries at the war's end, and these inventories sought a market. The attention of sellers focused on the United States as an outlet for their product. The need for dollar exchange, moreover, accentuated the desire to sell in this country. The world situation of oversupply in 1947 continued in 1948, and production over needs plus above-normal stocks were depressing factors. The resultant extension of the price drop was to be expected. The average price in New York—$76.49—was 9 percent below 1947, amounted to only 39 percent of the 1942–43 average, was the smallest since and approximately the same as in 1938, and (in terms of purchasing power) was equivalent to only about half of the prewar selling price. A mark-up approximating $14 took place in the latter part of December, following the Spanish-Italian cartel (Mercurio Europeo) price rise. Presumably the cartel did not anticipate that this rise would revive the domestic mining industry.

Imports for consumption rose 146 percent above those in 1947 and were the largest in times of peace in the entire history of the industry, falling below only those in 1945, 1943, and 1942. Exports and re-exports again were only a small fraction of imports.

Meanwhile, consumption, from the point of view of producers, was about the only cheering item in the picture. Thirty percent more mercury was used in 1948 than the relatively high rate for 1947, and only in 3 war years—1942, 1943, and 1945—was consumption greater. As explained in the Consumption and Uses section, equipping two new chlorine and caustic soda plants was an important factor in establishing the peacetime record. This use, of course, is nonrecurring. Mercury was accumulated in large quantities in 1948 for use in three mercury boilers. This metal, however, will not be utilized until 1949.

Salient statistics of the mercury industry in the United States, 1944–48

[Flasks of 76 pounds]

	1944	1945	1946	1947	1948
Production flasks	37,688	30,763	25,348	23,244	14,388
Number of producing mines	102	68	51	37	20
Average price per flask:					
New York	$118.36	$134.89	$98.24	$83.74	$76.49
London	$281.44	$242.45	$120.39	$73.02	$62.35
Imports for consumption:					
Pounds	1,486,025	5,214,890	1,055,956	[1] 988,614	2,428,248
Equivalent flasks	19,553	68,617	13,894	[1] 13,008	31,951
Exports:					
Pounds	57,007	78,877	68,932	67,148	59,713
Equivalent flasks	750	1,038	907	884	786
Consumption flasks	42,900	62,429	31,552	35,581	46,253

[1] Revised figure.

The improved reserve situation at mercury mines in 1948, assuming prewar price-cost relationships, and some problems involved in reopening shut mines, were outlined by S. H. Williston, vice president of the Cordero Mining Co., in testimony before the House Subcommittee on Mines and Mining of the Committee on Public Lands, May 20, 1948, as follows:

> * * * In spite of the fact that at the present time proven ore reserves on the basis of prewar grade, prewar prices, and prewar costs, are probably in a more favorable situation than at any time since 1890, the producing mines are being closed and allowed to fill. In the case of the largest producer, the New Idria mine, the present ore bodies are being extracted through considerable distances of old workings. Once maintenance ceases and these openings cave, it would take years to reopen the property. The Hermes mine in Idaho, with relatively large proven moderate grade reserves, is in an area of exceedingly bad ground. It takes constant watching to keep the haulage ways open. Even a short abandonment would cause extensive loss and require considerable time to be reopened, if at all. The industry's second largest mine, the Cordero mine in Nevada, is one of the deepest operating mines in the country at the present time. The water encountered has an average temperature of over 110 degrees. If this property is closed damage from hot water and the loss of the shaft would probably require 2 to 3 years to reopen. * * *

Both Williston and Schuette [1] recommended means of maintaining or reviving domestic mining.

[1] Schuette, C. N., Morituri Te Salutamus!: Min. Cong. Jour., vol. 34, No. 5, May 1948, pp. 31–33.

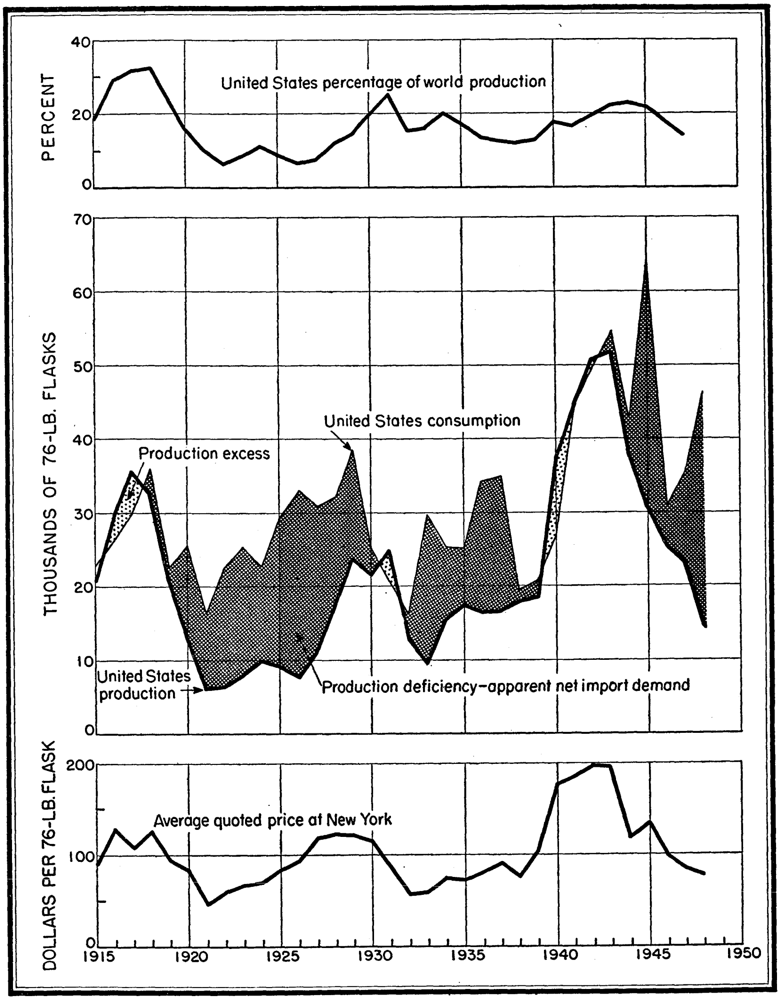

FIGURE 1.—Trends in production, consumption, and price of mercury, 1915–48.

Salient statistics of the mercury industry, 1910–48

Year	Production			Imports for consumption (flasks of 76 lb.)	Exports (flasks of 76 lb.)	Apparent consumption (flasks of 76 lb.)	Price	
	World (flasks of 76 lb.)	United States (flasks of 76 lb.)	United States (percent of world total)				Average price per flask of 76 lb. at New York	Index [1]
1910	107,053	20,330	19	9	1,898	18,441	[2] $47.69	68
1911	120,423	20,976	17	6,209	287	26,898	[2] 47.16	73
1912	120,650	24,734	21	1,088	306	25,516	[2] 43.03	62
1913	117,465	19,947	17	2,259	1,125	21,081	[2] 40.07	57
1914	108,601	16,330	15	8,090	1,427	22,993	[2] 48.95	72
1915	112,871	20,756	18	5,551	3,328	22,979	[2] 88.17	127
1916	101,544	29,538	29	5,585	8,763	26,360	[2] 127.16	149
1917	115,087	35,683	31	5,138	10,636	30,185	[2] 107.72	92
1918	99,256	32,450	33	6,631	3,057	36,024	[2] 125.12	95
1919	89,940	21,133	23	10,495	8,987	22,641	[2] 93.38	67
1920	84,470	13,216	16	13,982	1,533	25,665	[2] 82.20	53
1921	61,916	6,256	10	10,462	388	16,330	[2] 46.07	47
1922	91,819	6,291	7	16,697	287	22,701	[2] 59.74	62
1923	93,040	7,833	8	17,836	314	25,355	[2] 67.39	67
1924	89,138	9,952	11	12,996	205	22,743	[2] 70.69	72
1925	103,344	9,053	9	20,580	201	29,432	[2] 84.24	81
1926	115,969	7,541	7	25,634	114	33,061	[2] 93.13	93
1927	149,905	11,128	7	19,941	(3)	[4] 30,900	118.16	124
1928	149,083	17,870	12	14,562	(3)	[4] 32,300	123.51	128
1929	162,699	23,682	15	14,917	(3)	[4] 38,500	122.15	128
1930	108,985	21,553	20	3,725	(3)	[4] 25,200	115.01	133
1931	99,069	24,947	25	549	[5] 4,984	20,512	87.35	120
1932	82,644	12,622	15	3,886	[5] 214	16,294	57.93	89
1933	59,828	9,669	16	20,315	(3)	[4] 29,700	59.23	90
1934	76,939	15,445	20	10,192	(3)	[4] 25,400	73.87	99
1935	100,261	17,518	17	7,815	(3)	[4] 25,200	71.99	90
1936	123,878	16,569	13	18,088	263	34,400	79.92	99
1937	133,136	16,508	12	18,917	454	35,000	90.18	105
1938	150,000	17,991	12	2,362	713	19,600	75.47	96
1939	145,000	18,633	13	3,499	1,208	20,900	103.94	135
1940	215,000	37,777	18	171	9,617	[6] 26,800	176.87	225
1941	275,000	44,921	16	7,740	2,590	[6] 44,800	185.02	212
1942	265,000	50,846	19	[7] 38,941	[7] 345	[6] 49,700	196.35	199
1943	236,000	51,929	22	[7] 47,805	[7] 385	[6] 54,500	195.21	189
1944	163,000	37,688	23	19,553	750	[6] 42,900	118.36	114
1945	131,000	30,763	23	68,617	1,038	[6] 62,429	134.89	128
1946	144,000	25,348	18	13,894	907	[6] 31,552	98.24	81
1947	164,000	23,244	14	13,008	884	[6] 35,581	83.74	55
1948	120,000	14,388	12	31,951	786	[6] 46,253	76.49	46

[1] Quoted price divided by Bureau of Labor Statistics wholesale price index (1926=100).
[2] Quoted price for 75-pound flask calculated to equivalents for 76-pound flasks.
[3] Not separately classified for 1927–30 and 1933–35.
[4] Estimated by Bureau of Mines.
[5] From a special compilation, Bureau of Foreign and Domestic Commerce.
[6] Actual consumption.
[7] Large quantities reexported in 1942 and 1943 are included in imports but not exports

DOMESTIC PRODUCTION

Before 1948 and continuing in that year mercury prices had returned to low prewar levels, whereas costs of labor and supplies were at virtual postwar peaks. Under these conditions death of the mercury-mining industry was threatened. Complete closure of the mines did not eventuate in 1948, but the largest producer for many years—the New Idria mine, San Benito County, Calif.—was closed at the year end, as were almost all other large as well as small producers. The Mount Jackson (including Great Eastern) mine, Sonoma County, Calif., second-largest producer for the year and leading producer in the final quarter, and the Bonanza mine, Douglas County, Oreg., third largest producer in 1948, were the only important mines in operation as the year ended; it is doubtful that as many as a half-dozen mines altogether were active at that time.

Production of 14,388 flasks in 1948 was 38 percent below 1947, was only 28 percent of the war peak of 51,929 flasks in 1943, and was the smallest since 1933; output in the final quarter was at an annual rate in excess of only five years in the 98 years covered by production records, 1850, 1921, 1922, 1923, and 1926. The greatest drop was 69 percent in Nevada; Idaho declined 39 percent, California 35 percent, and Alaska 21 percent; Oregon recorded the only gain—14 percent.

The principal producing mines in 1948 were as follows:

Alaska—Decoursey Mountain mine.
California—Napa County, Knoxville mine; San Benito County, Juniper and New Idria mines; San Luis Obispo County, La Libertad mine; Sonoma County, Mount Jackson (including Great Eastern) mine; Yolo County, Reed mine.
Idaho—Valley County, Hermes mine.
Nevada—Humboldt County, Cordero mine.
Oregon—Douglas County, Bonanza mine.

In 1948, those 10 mines produced 98 percent of the total for the United States; in 1947, 16 mines supplied 99 percent; in 1946, 18 mines produced 98 percent; but in 1942, 34 mines produced only 89 percent.

Mercury produced in the United States, 1945–48, by States

Year and State	Producing mines	Flasks of 76 pounds	Value [1]
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
1947:			
Alaska	1	127	$10,635
California	26	17,165	1,437,397
Idaho	1	886	74,194
Nevada	6	3,881	324,995
Oregon	3	1,185	99,232
	37	23,244	1,946,453
1948:			
Alaska	1	100	7,649
California	13	11,188	855,770
Idaho	1	543	41,534
Nevada	4	1,206	92,247
Oregon	1	1,351	103,338
	20	14,388	1,100,538

[1] Value calculated at average price at New York.

Mercury produced in the United States, 1941–45, by months, and 1946–48, by quarters, in flasks of 76 pounds

Month	1941	1942	1943	1944	1945	1946	1947	1948
January	3,100	3,700	4,200	4,400	2,500			
February	2,900	3,400	3,900	3,800	2,700	5,550	6,100	5,300
March	3,500	4,100	4,600	3,800	3,000			
April	3,500	4,200	4,600	3,700	3,000			
May	3,600	4,800	4,200	3,400	3,300	7,000	5,700	3,600
June	4,000	4,900	4,100	3,000	3,000			
July	3,400	4,700	4,300	2,700	3,600			
August	4,100	4,500	4,500	2,500	3,300	6,500	5,850	3,150
September	4,200	4,200	4,500	2,500	2,050			
October	4,000	4,100	5,200	2,700	1,200			
November	3,800	4,100	5,000	2,300	1,350	6,150	5,550	2,050
December	3,900	4,400	4,200	2,500	1,600			
Total: Preliminary	44,000	51,100	53,300	37,300	30,600	25,200	23,200	14,100
Final	44,921	50,846	51,929	37,688	30,763	25,348	23,244	14,388

In recent years (before 1948) the trend in grade of mercury ore treated in the United States was upward, against the long-time trend. In 1948 the normal downtrend was resumed; and 10.2 pounds of mercury were recovered for each ton of ore treated, compared with 12.5 pounds in 1947, 12.0 in 1946, and 5.1 in 1942.

Mercury ore treated and mercury produced therefrom in the United States, 1927–48 [1]

[That material from old dumps which is not separable is included with ore]

Year	Ore treated (short tons)	Mercury produced: Flasks of 76 pounds	Mercury produced: Pounds per ton of ore	Year	Ore treated (short tons)	Mercury produced: Flasks of 76 pounds	Mercury produced: Pound per ton
1927	99,969	10,711	8.1	1938	199,954	17,816	6.8
1928	142,131	14,841	7.9	1939	191,892	18,505	7.3
1929	248,314	19,461	6.0	1940	449,940	37,264	6.3
1930	288,503	18,719	4.9	1941	652,141	43,873	5.1
1931	260,471	22,625	6.6	1942	733,360	49,066	5.1
1932	108,118	11,770	8.3	1943	613,111	50,761	6.3
1933	78,089	8,381	8.2	1944	300,385	37,333	9.4
1934	126,931	13,778	8.2	1945	209,009	29,754	10.8
1935	135,100	15,280	8.6	1946	157,469	24,929	12.0
1936	141,962	14,007	7.5	1947	[2] 139,311	22,823	12.5
1937	186,578	16,316	6.6	1948	103,220	13,891	10.2

[1] Excludes mercury produced from placer operations and from clean-up activity at furnaces and other plants.
[2] Corrected figure.

In addition to mercury produced at the mines in 1948, at least 2,170 flasks were reported as produced from battery plates, scrap, and calomel, compared with 3,500 in 1947. Additional unreported quantities are believed to have been recovered.

REVIEW BY STATES

Alaska.—The Decoursey Mountain mine, 24 miles from Crooked Creek, was the only producer of mercury in Alaska in 1948 as in 1947. A total of 50 tons of ore was treated in two D retorts, and 100 flasks of metal were recovered. About 450 feet of development drift were driven, with low-grade showings along most of the distance. Backs of 140 to 190 feet, all unmined, exist above this development drift.

A report [2] on the Rainy Creek mercury prospect, which lies at the western base of the Kilbuck Mountains, about 80 miles southeast of Bethel, in southwestern Alaska, was published in 1948. According to Rutledge the deposits are believed to have been discovered between 1910–20. Production of mercury from the area has been solely from cinnabar concentrates recovered as a result of gold placer operations. About 2,000 pounds of high-grade concentrate were said to have been shipped.

California.—The 35-percent drop in output of mercury was slightly smaller than the average decline for the United States, and California bettered its position as the leading mercury-producing State by a substantial margin, supplying 78 percent of the country's total compared with 74 percent in 1947. As in 1947, eight counties contributed to California output—Del Norte, Lake, Napa, San Benito, San Luis Obispo, Santa Clara, Sonoma, and Yolo. San Benito County and the New Idria mine were again leading mercury-producing county and leading mercury-producing mine, respectively, in the United States. The New Idria mine likewise was preeminent in the entire Western Hemisphere. This property closed at the end of the year, the shut-down having been threatened for several months.

Shults Bros. produced 5 flasks of mercury near Crescent City in a newly installed 30-ton Lacy rotary furnace. The plant, which uses oil for fuel, was completed in August and replaced a wood-burning retort at the property.

A small quantity of mercury was produced from clean-up operations at two properties in Lake County.

Mercury was produced in a furnace at the Knoxville mine, Napa County, by lessees.

The New Idria, Juniper, and Aurora mines produced in San Benito County, the first in furnaces and the last two in retorts. The New Idria mine, again the largest producer in the Western Hemisphere, has four Gould rotary furnaces. Production was from newly mined ore and dumps. The property was closed at the year end, but by the end of the first quarter the company announced that it was withdrawing from the market because of the price-cost relationship and that the mine was being prepared for a shut-down.

Production of mercury at the La Libertad and Buena Vista (Mahoney) mines, San Luis Obispo County, was in furnaces. The Moapa Mining Co. operated the former property.

The Almaden Dumps were drawn on for Santa Clara County's relatively small output.

At the end of 1948 two substantial producers continued in operation. These were the Mount Jackson (including Great Eastern) mine, of the Sonoma Quicksilver Mines, Inc., Sonoma County, and the Bonanza mine, of the Bonanza Mines, Inc., Douglas County, Oreg. The Mount Jackson mine was the second largest mercury producer in 1948 and stood first in the final quarter of the year. Ore is treated in a Gould rotary furnace. No other property in Sonoma County reported production in 1948, but H. G. Walker announced that an extension of the drainage tunnel for the Riley Contact (Old Contact)

[2] Rutledge, F. A., Investigation of the Rainy Creek Mercury Prospect, Bethel District, Kuskokwim Region, Southwestern Alaska: Bureau of Mines Rept. of Investigations 4361, 1948, 7 pp.

and Socrates mines was planned, with operation of the mines in prospect. A 50- by 4-foot rotary furnace is on the Contact property.

Clean-up operations at the Reed mine yielded the mercury credited to Yolo County.

Idaho.—The Hermes mine of Bonanza Mines, Inc., Yellow Pine district, Valley County, was again the only producer of mercury in the State. Owing to the low price for mercury, the property was closed on July 16; but the mine, nonetheless, became the fifth largest producer in the United States for the year as a whole compared with sixth in 1947.

Nevada.—The sharpest drop in output among mercury-producing States occurred in Nevada in 1948; the decline was 69 percent. Closing of the Cordero mine, third largest producer in the United States in 1947, during the first quarter of 1948 accounted very largely for the poor showing for the State Three counties—Esmeralda, Humboldt, and Pershing—shared in production for the State in 1948.

W. F. Dunnigan produced mercury in retorts at the Red Rock mine, Fish Lake Valley district, Esmeralda County, in 1948. He was the only producer in the county as in 1947.

The Cordero mine of the Cordero Mining Co., Opalite district, Humboldt County, was the second-largest producer of mercury in the United States in the first quarter of 1948, as in the preceding quarter; it was nonproductive in the final three quarters of 1948, ranking, nonetheless, as the fourth largest producer in the country for the year as a whole. A total of 1,155 flasks of mercury was produced from 5,771 tons of ore, indicating a tenor of ore of 0.76 percent recovered mercury. The ore was treated in the 80-ton Nichols-Herreshoff furnace at the mine. Early in 1949 the company stated:

> We have been maintaining a small maintenance crew to prevent complete loss of the underground workings but we cannot continue this expense for long without some evidence that it will again be profitable to produce mercury in the United States.

A small output came from another property in Humboldt County.

A small production came from a property in Pershing County in 1948.

Oregon.—Contrary to the trend in all other mercury-producing States, Oregon produced 14 percent more mercury in 1948 than in 1947. The Bonanza mine of Bonanza Mines, Inc., Sutherlin district, Douglas County, is the only property known to have produced in 1948 and, consequently, is entirely responsible for the gain. Output of 1,351 flasks of mercury, from treatment of 8,119 tons of ore in a Gould rotary furnace, indicated a tenor of 0.63 percent recovered mercury. Bonanza ranked third among mercury-producing properties in 1948 and was one of only two large mines operating at the year end.

The Amity Mining Co., operator of the Amity mine, Ochoco district, Crook County, reported completion during the year of a 25-ton Nichols-Herreshoff furnace but no production of mercury.

CONSUMPTION AND USES

Consumption of mercury increased 30 percent in 1948 to a record high peacetime rate; in only three war years—1942, 1943, and 1945—was use of the metal greater. Features of the mercury market were the construction late in 1947 and early in 1948 of two chlorine and caustic soda plants and the withdrawal from supplies of large quantities of metal for these plants during the second quarter of 1948. The mercury for these installations—at Syracuse, N. Y., and Wyandotte, Mich.—is covered by "Other" in the tabulation that follows. During 1948 mercury was accumulated for use in three boiler plants under construction at Portsmouth, N. H., Pittsfield, Mass., and Hartford, Conn. (a replacement plant). The accumulated mercury for the two new plants will remain a part of industry inventories until the latter part of 1949. Much of the metal for the Hartford plant was reclaimed from the earlier plant at that location. The part of the metal that was reclaimed will not be considered as consumption in the records for 1949 to avoid duplication. This Hartford plant was put into operation in January 1949. Other than the new chlorine and caustic soda plants, the greatest expansion in use of mercury in 1948 was for agricultural purposes. The rise of 25 percent in 1948 followed a gain of 79 percent in 1947. The new mercury cell failed to require anticipated expanded quantities of metal, and the total for electrical manufactures, which includes the new cell, declined 4 percent compared with 1947. Makers of the mercury cell continued their efforts to perfect manufacturing techniques, to develop improved structures, and to reduce costs. As stated in previous reports of this series, a low price for mercury is claimed to be essential if the cell is to establish and maintain a place as one of the important uses of mercury.

The Hartford installation, in the South Meadow Station of the Hartford Electric Light Co., is the first mercury-unit power-plant equipment placed in operation since before World War II. Designed and supplied by the General Electric Co., the equipment uses mercury vapor at 113 pounds per square inch gage at 945° F. to drive a mercury turbine at 720 r. p. m. The unit generates 15,000 kw. while also supplying about 200,000 pounds of steam per hour at 400 p.s.i.g. at 700° F. to drive existing steam turbines. The system combines the mercury-vapor cycle and a steam cycle into a binary system for producing power from fuel with greater thermal economy than is possible with the steam cycle alone. The mercury-steam cycle consists of a mercury boiler, in which liquid mercury is vaporized at a comparatively low pressure; a mercury turbine, powered by the vaporized mercury; a generator, driven by the mercury turbine; and a mercury-condenser boiler, where the heat given up by the condensing mercury is used to convert water to steam, which is used to drive the existing steam turbines. The new installation replaces a smaller unit that had been in service 20 years, the first large mercury unit installed in this country.

A new organic mercury compound, a combination of phenyl mercury chloride and acetate in a completely soluble dry, powdered form, suggested for insecticidal and fungicidal uses, is said [3] to be stable, to

[3] Oil, Paint & Drug Reporter, vol. 155, No. 8 Feb. 21, 1949, p. 56.

Mercury consumed in the United States, 1947–48, in flasks of 76 pounds

Use	1947	1948	Use	1947	1948
Pharmaceuticals	3,047	3,382	Electrical apparatus	[1] 6,763	[1] 6,47[illegible]
Dental preparations	785	994	Industrial and control instruments	[1] 5,394	[1] 5,653
Fulminate for munitions and blasting caps	523	441	Amalgamation	138	143
Agriculture	5,617	7,048	General laboratory	333	442
Antifouling paint	760	996	Redistilled	[1] 4,689	[1] 6,499
Electrolytic preparation of chlorine and caustic soda	693	806	Other	1,761	10,116
Catalysts	5,078	3,262		35,581	46,253

[1] A partial break-down of the "redistilled" classification showed 52 percent was for instruments, 10 percent for dental preparations, and 22 percent for electrical apparatus in 1947 and 53, 16 and 16 percent, respectively, in 1948.

Mercury consumed in the United States, 1941–45, by months, and 1946–48, by quarters, in flasks of 76 pounds

Month	1941	1942	1943	1944	1945	1946	1947	1948
January	2,900	3,800	4,500	3,400	5,200			
February	4,700	3,000	4,700	3,700	5,100	6,800	9,000	10,000
March	4,000	3,500	4,900	3,600	6,100			
April	3,200	3,600	5,500	3,200	7,500			
May	3,500	4,200	5,600	3,100	8,900	8,100	8,500	15,700
June	3,300	3,700	4,700	3,400	8,500			
July	3,300	3,200	4,700	3,000	6,600			
August	3,600	3,700	4,900	3,900	5,300	7,400	7,700	9,400
September	3,700	4,100	4,100	3,900	3,100			
October	4,800	6,200	3,800	3,900	3,100			
November	3,900	6,200	3,900	3,900	2,500	8,900	9,900	10,300
December	3,900	4,500	3,200	3,900	2,000			
Total: Preliminary	44,800	49,700	54,500	42,900	63,900	31,200	35,100	45,400
Final					62,429	31,552	35,581	46,253

be amenable to indefinite storage, to be easy to handle, and to be unaffected by climatic conditions.

A new type of mercury manometer which, according to report,[4] can operate at 1,500 pounds per square inch working pressure and is available in ranges of 10–400 inches of water. It is built for use on indicating, recording, or controlling instruments. Two manometers can be mounted on a single case for recording two flows or ratio flow control.

A new method of transforming bluish-white mercury light into a warmer color without sacrificing high efficiency was recently disclosed.[5] It was predicted that the lamp would expand the use of high-intensity mercury lighting, since in most places warmer colors of light are desirable. Lighting television and movie studios and general lighting of certain factories, sports areas, and other places were given as prospective uses.

A number of other articles regarding the use of mercury in lamps were published [6] during the year, some of which are listed.

According to a recent report,[7] the Monsanto Chemical Co. made a

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[4] Chemical Industries, vol. 63, No. 6, December 1948, p. 998.
[5] American Metal Market, vol. 55, No. 237, Dec. 11, 1948, p. 3.
[6] Beggs, E. W., Applications of Mercury-Vapor Lamps: Westinghouse Eng., vol. 8, March 1948, pp. 52–56.
Rowten, D. W., Evolution of Mercury Vapor Street Lighting: Illuminating Eng., vol. 43, March 1948, pp. 290–313. New Lamps Reduce Costs: Elec. World, vol. 129, Apr. 10, 1948, pp. 112–113.
Carlson, F. E., New Developments in Mercury Lamps for Studio Lighting: Jour. Soc. Mot. Pic. Eng., vol. 50, February 1948, pp. 122–138.
[7] Oil, Paint & Drug Reporter, vol. 154, No. 15, Oct. 11, 1948, p. 45.

tentative arrangement with an Italian company for the use and sale of the De Nora mercury cell for the manufacture of chlorine, caustic soda, and hydrogen.

A discussion of diaphragm and mercury cells was recently published.[8]

STOCKS

Industry inventories of mercury expanded sharply in 1948. Much of the gain was caused by accumulation of metal for use in new mercury boiler plants, and the anticipated completion of these plants—one in January and two in the latter part of 1949—will cause a noteworthy reduction in the stocks. Data on mercury held in the Government strategic stock pile are confidential; consequently, such stocks are not covered by the accompanying table.

Stocks of mercury in hands of producers, consumers and dealers, and Office of Metals Reserve, 1944–48, in flasks of 76 pounds

End of year	Producers [1]	Consumers and dealers	Office of Metals Reserve	Total
1944	2,714	10,400	67,812	80,900
1945	3,243	17,000	63,638	83,900
1946	2,599	16,400	20,884	39,900
1947	3,084	16,200		19,284
1948	5,165	25,000		30,165

[1] Operators that account for roughly 95 percent of output.

PRICES

The downtrend in mercury quotations generally in progress since March 1945 continued through May, when the monthly average was $74.16 a flask, or the lowest in almost 10 years. Gradual strengthening took place after May and continued until the latter part of December, when the Spanish-Italian cartel boosted its price $14 a flask and the New York quotation was raised similarly. In the final week of the year, the domestic quotation was $90–93 a flask, or about the level that prevailed in November 1946. The cartel price advance came at a time when the domestic mining industry virtually had collapsed. More than one market commentator remarked that evidently the amount of the price rise was what the market was expected to bear without reviving the United States mining industry.

The report of this series for 1947 pointed out that the downtrend in mercury prices was in contrast to price movements in general. The average price for mercury in 1948 was the lowest since 1938. The Bureau of Labor Statistics index price for all commodities, meanwhile, including many items affecting cost of producing mercury, has more than doubled, causing the $76.49 average price for 1948 to represent closer to $38 in terms of prewar purchasing power. Early in 1948, S. H. Williston, vice president of the Cordero Mining Co., in commenting on the unfavorable price-cost relationship before

[8] Industrial and Engineering Chemistry, Modern Production of Chlorine and Caustic Soda, A staff-industry collaborative report: Vol. 40, No. 11, Nov. 1948, pp. 2002–2010.

the National Resources Subcommittee of the Senate Interior and Insular Affairs Committee, Denver, Colo., February 3, 1948, stated:

> * * * It is quite safe to say that the industry as a whole is losing money. It is equally safe to say that no individual mine could show a profit if it were to carry on anything approaching normal exploration and development work. It is my opinion, although I cannot be certain, that no mercury mine in operation in the United States today is making a profit. * * *

There is a tariff on mercury of 25 cents a pound, or $19 a flask of 76 pounds. Normally, therefore, there is a price differential favoring the New York market as compared with foreign markets. During World War II, however, the differential almost invariably favored foreign markets. In December 1946 a small excess of New York over London was resumed; and since May 1947 the differential in favor of the New York market has been similar to the prewar years, at no time, however, amounting to the full tariff.

Average monthly prices per flask (76 pounds) of mercury at New York and London, and excess of New York price over London price, 1946–48

Month	1946			1947			1948		
	New York [1]	London [2]	Excess of New York over London	New York [1]	London [2]	Excess of New York over London	New York [1]	London [2]	Excess of New York over London
January	$104.81	$126.06	[3] $21.25	$88.00	$83.61	$4.39	$78.31	$64.49	$13.82
February	102.73	126.06	[3] 23.33	86.86	83.57	3.29	76.41	64.50	11.91
March	103.92	126.06	[3] 22.14	86.85	83.57	3.28	76.00	64.50	11.50
April	102.46	126.05	[3] 23.59	85.77	83.57	2.20	75.46	64.50	10.96
May	101.00	126.04	[3] 25.04	84.46	77.81	6.65	74.16	63.69	10.47
June	99.40	126.05	[3] 26.65	84.00	69.17	14.83	76.00	60.47	15.53
July	98.31	126.05	[3] 27.74	84.00	69.17	14.83	75.42	60.47	14.95
August	97.56	126.05	[3] 28.49	84.00	67.28	16.72	75.00	60.47	14.53
September	96.00	126.04	[3] 30.04	81.64	64.48	17.16	75.04	60.47	14.57
October	95.19	126.00	[3] 30.81	80.69	64.50	16.19	76.00	60.47	15.53
November	89.39	100.57	[3] 11.18	79.64	64.49	15.15	77.91	60.47	17.44
December	88.12	83.61	4.51	79.00	64.50	14.50	82.15	63.75	18.40
Average	98.24	120.39	[3] 22.15	83.74	73.02	10.72	76.49	62.35	14.14

[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 recorded by Federal Reserve Board.
[3] London excess.

The British quotation was £16 0s. 0d. from the latter part of August 1947 through the third week in May 1948, falling thereafter to £15 0s. 0d. and remaining at that level until the last days of December, when it was raised to £18 5s. 0d.

The year-end price mark-up of the cartel was $14 a flask to $70 a flask ex European ports, or about $72.50 in bond in the United States. With the $19 tariff the quoted price was equivalent to about $91.50.

FOREIGN TRADE [9]

Imports.—Receipts of mercury for consumption in the United States in 1948 were almost 2½ times those in 1947 and were slightly more than 3½ times the average annual entries in the 10-year period 1930–39; in only three earlier years (1945, 1943, and 1942) had imports

[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.

been larger. Much more metal was received from abroad in 1948 than was required to supplement the reduced domestic production in filling consumption (which was substantially above prewar rates), resulting in augmented inventories. This situation indicates that need for United States currency in foreign countries was a greater motive in the expanded shipments of metal to the United States than United States demand for mercury.

General imports, which are a better measure of metal actually arriving in the country in a given period than imports for consumption, amounted to 41,732 flasks in 1948, or more than four times the 10,228 flasks received in 1947. Of the 1948 imports (comparisons with 1947 in parentheses), 27,114 (2,161) flasks came from Spain, 4,994 (1,516) from Italy, 4,063 (1,824) from Mexico, 3,746 (3,107) from Japan, 1,691 (1,500) from Yugoslavia, 75 (none) from Sweden, 49 (none) from the United Kingdom, and none (120) from Chile. Doubtless the quantities credited to Sweden and the United Kingdom are reexports.

Of "imports for consumption"—31,951 (13,008) flasks—which include imports for immediate consumption plus withdrawals from warehouse for consumption, 19,384 (3,498) were from Spain, 3,947 (2,900) from Italy, 3,675 (3,107) from Japan, 3,489 (1,783) from Mexico, 1,256 (1,400) from Yugoslavia, 200 (none) from Czechoslovakia, none (270) from Chile, and none (50) from Canada.

Mercury imported for consumption in the United States, 1944–48

[U. S. Department of Commerce]

Country	1944		1945		1946	
	Pounds	Value	Pounds	Value	Pounds	Value
Canada	118,906	$337,177	130,720	$237,175	2	$6
Chile	74,627	152,309	36,285	55,995	28,064	27,978
Czechoslovakia						
Honduras			1,748	3,621		
Italy					382,880	325,274
Japan						
Mexico	1,288,548	2,012,873	824,789	1,307,402	407,334	378,235
Peru	3,944	9,397	11,628	19,570		
Spain			4,209,720	7,386,167	237,676	201,783
Yugoslavia						
Total: Pounds	1,486,025	2,511,756	5,214,890	9,009,930	1,055,956	933,276
Flasks	19,553		68,617		13,894	

Country	1947		1948	
	Pounds	Value	Pounds	Value
Canada	[1] 3,801	$2,783	2	$4
Chile	20,536	17,504		
Czechoslovakia			15,212	9,920
Honduras				
Italy	220,352	180,336	299,983	205,735
Japan	236,161	251,899	279,326	175,460
Mexico	135,521	103,015	265,140	179,266
Peru				
Spain	265,843	201,766	1,473,137	931,201
Yugoslavia	106,400	71,400	95,448	65,273
Total: Pounds	[1] 988,614	828,703	2,428,248	1,566,859
Flasks	[1] 13,008		31,951	

[1] Revised figure.

Imports of mercury compounds generally are insignificant; none was reported in 1948.

Exports.—Of the exports of 786 flasks (884 in 1947), 259 (28) went to Austria, 230 (92) to Canada, 81 (25) to Venezuela, 32 (less than ½) to Belgian Congo, 31 (31) to Colombia, 28 (53) to Brazil, 17 (10) to Cuba, 15 (none) to Korea, and the remainder in smaller quantities to 22 other countries.

Mercury exported from the United States, 1944–48

[U. S. Department of Commerce]

Year	Pounds	Flasks of 76 pounds	Value	Year	Pounds	Flasks of 76 pounds	Value
1944	57,007	750	$123,481	1947	67,148	884	$90,659
1945	78,877	1,038	121,713	1948	59,713	786	121,420
1946	68,932	907	113,817				

Reexports amounted to 921 flasks in 1948 (a drop from 3,095 in 1947) and were destined chiefly as follows: 416 (1,405) to Canada, 349 (71) to Brazil, 45 (22) to Curacao, 33 (51) to Belgium, 27 (31) to Colombia, and 19 (12) to Saudi Arabia; the remainder went to seven other countries.

WORLD REVIEW

Available data for 1948 indicate that production declined markedly in that year owing to lower outputs in all leading mercury-producing areas. Despite the fact that less metal was produced, more mercury than needed was available owing to large stocks on hand at the beginning of the year.

Germany.—One of the chief world consumers before the end of World War II, Germany not only ceased to purchase after the war but added some metal on hand to world markets. According to the Metal Bulletin of January 21, 1949, the first Spanish delivery to Germany, amounting to 150 metric tons (nearly 4,400 flasks), had just left Barcelona. The delivery was being made, it was stated, under the trade agreement, concluded recently, between Spain and Western Germany.

Italy.—Unsatisfactory conditions for the sale of Italian mercury caused the Italian Government to take steps aimed at alleviating the problem.[10] The reports stated that the Treasury duty of 500 lire per flask on quicksilver and of 13 lire per kilogram on ore, to which levels it was reduced in July 1947, had been abolished. The Government was said to have promised to represent fully the industry's interests within existing trade agreements, as well as at all forthcoming foreign trade negotiations. Efforts were made to obtain credits for the mines and more favorable treatment as regards taxes and transportation fees.

Production in Italy was reduced sharply as the year progressed.

Spain.—The history of the Almaden mine was summarized recently.[11] The author said that, after more than 20 centuries of exploitation,

[10] Metal Bulletin (London), No. 3313, Aug. 6, 1948, p. 17. Mining Journal (London), Italian Mercury Crisis: Vol. 231, No. 5903, Oct. 9, 1948, p. 740.

[11] Bennett, Evan, Almaden, World's Greatest Mercury Mine: Min. and Met., vol. 29, No. 493, January 1948, pp. 6–9.

World production of mercury, 1941–48, by countries, in flasks of 34.5 kilograms (76 pounds) [1]

[Compiled by B. B. Mitchell]

Country [1]	1941	1942	1943	1944	1945	1946	1947	1948
Algeria	147	121	146	165	326	340	348	377
Australia:								
New South Wales	1	(2)	--------	--------	--------	--------	--------	(3)
Queensland	34	15	15	12	3	--------	(3)	(3)
Austria	(3)	(3)	(4)	(4)	(3)	(3)	(3)	(3)
Bolivia (exports)	--------	--------	51	2	3	--------	(3)	(3)
Canada	7,057	13,630	22,240	9,682	--------	--------	--------	--------
Chile	1,305	2,256	2,563	1,181	862	827	445	359
China	2,756	4,293	3,133	3,510	1,828	1,189	290	290
Czechoslovakia	(3)	(3)	(3)	(3)	(3)	(3)	[5] 768	800
Germany	899	493	[6] 73,480	[6] 73,480	(3)	--------	(3)	(3)
Italy	94,161	75,921	58,004	28,704	25,410	50,822	53,984	39,000
Japan [8]	4,323	5,197	6,706	7,096	3,139	1,361	1,619	1,526
Mexico	23,137	32,443	28,321	26,063	16,443	11,661	9,700	4,786
New Zealand	73	150	93	90	30	--------	--------	(3)
Peru	--------	145	326	152	209	5	--------	--------
Rumania	--------	21	176	(3)	(3)	(3)	(3)	(3)
Southern Rhodesia	2	3	(2)	--------	(2)	--------	--------	--------
Spain	86,473	72,288	47,756	34,349	40,694	41,801	55,608	(3)
Sweden	59	11	--------	21	1	--------	--------	(3)
Tunisia	88	3	(2)	--------	--------	--------	--------	(3)
Turkey [9]	354	271	186	97	158	--------	98	(3)
Union of South Africa	204	579	1,189	1,192	852	764	--------	--------
United States	44,921	50,846	51,929	37,688	30,763	25,348	23,244	14,388
Yugoslavia [10]	--------	--------	--------	--------	--------	(3)	(3)	(3)
Total [7]	275,000	265,000	236,000	163,000	131,000	144,000	164,000	120,000

[1] Mercury is also produced in Korea (Chosen) and U. S. S. R., but production data are not available; estimates by senior author of chapter included in the total.
[2] Less than 1 flask.
[3] Data not yet available; estimates by senior author of chapter included in the total.
[4] Included with Germany.
[5] Byproduct of pyrites production in Slovakia only.
[6] Includes Austria.
[7] Estimate.
[8] Preliminary.
[9] Data revised in some instances to represent production rather than shipments.
[10] Output of Idria mine included with Italy through 1945.

intensive throughout the last 4, ore from Almaden is about five times as rich as that of its closest competitor. Over 228,000 tons of metal, not allowing for production of the Romans, Visigoths, and Moors, is estimated to have been produced. Ore occurrence and reserves were described as follows:

* * * The ore-bearing veins are three; the principal and most productive is the San Pedro-San Diego, seven to nine meters wide; the San Francisco, four meters; and the San Nicolas, three meters, where seen on the lower levels. They are separated by ten to twenty meters of barren slate. The strike is west northwest and the dip ranges from vertical to 70° N. Vein material is massive recemented quartzite breccia.

Silicification and movement along the fault preceded and accompanied deposition of ore, which followed the fresh fracture planes and penetrated the less silicified sandstones in their process of becoming quartzites. Rich zones of one to three meters' width, of a deep red hue, occur in mid-vein, tapering in values toward the walls. Mining activity, and apparently the richer mineral, is confined to a zone between two cross faults, of which the easterly one is well defined, with a twenty-meter horizontal throw. The west fault is irregular, echeloned, and in places is rather a sharp bend in the vein. Both are pre-mineral. This zone was about 200 m long at the surface, but extended to 300 m at 200-m depth, and is only 110 m long on the fourteenth, or lowest working level, 400 m below the shaft collar.

The great stopes of the middle levels are caved and inaccessible. Records show that ore hoisted was 20 to 25 percent grade, which must have entailed sorting in the stopes. It is likely, therefore, that these stope fills contain a great deal of now valuable ore. From the twelfth down to the fourteenth levels, a distance of 50 m, there is notable diminution of grade and vein width and the three veins converge. It appears probable that the oreshoot will bottom 50 m or so below the fourteenth level. The ore mineral is invariably cinnabar, rather coarsely crystalline, with free mercury in the richer ores oozing out and forming pools in the stopes. Pyrite, calcite, sericite, and barite are also found.

In 1945, the visible proved reserves were enough for twenty years' operation at the current rate. Recent exploration beyond the end faults has disclosed considerable ore. During the Fuggar lease, shallow workings extended some 6000 m beyond the east fault, in the fracture zone, so it is likely that a great deal of ore will be found adjoining these old workings beyond these faults. In the process of extracting it, the old stope fills may also be drawn.

At Almadenejos, 11 km east of the mine, on the strike, an eight-meter vein is being explored with promising results. At Las Minetas, eighteen kilometers east of Almaden, is an old working with ruins of Bustamante furnaces, also on the strike. The Almaden reserve extends over a circle of 25 km radius with the San Teodoro shaft as a center. The mine is by no means depleted except as regards the fabulously rich ores once worked. On the other hand, statements that there are millions of tons are likewise inaccurate. The program of systematic exploration and development of new ore, recently undertaken by the Council, is definitely to assure a future ore supply. * * *

United Kingdom.—Foreign trade data for the United Kingdom for 1947 indicated that consumption of mercury was returning to prewar levels, and figures for 1948 marked continuation of the 1947 condition. Imports of mercury were 30,627 flasks in 1948 compared with 25,665 flasks in 1947, reexports were 7,146 and 2,276 flasks, respectively, and net imports (a measure of consumption) were 23,481 and 23,389, flasks, respectively.

The British quotation was £16 0s. 0d. from the latter part of August 1947 through the third week in May 1948, falling thereafter to £15 0s. 0d. It remained at the lower level until the last days in December, when it was raised to £18 5s. 0d.

The Belfast, Ireland, mercury battery plant of P. R. Mallory & Co., Inc., was said to have made progress during 1948.

Mica

By JOSEPH C. ARUNDALE AND E. M. TUCKER

GENERAL SUMMARY

DOMESTIC production of sheet mica continued to decline during 1948. The output of ground mica again reached a new record volume, and there was a shortage of high-grade scrap. The consumption of sheet, punch, film, and splittings declined. Reports were current of the development of several materials which are alternates or substitutes for mica in some uses. The synthesis of a fluorine-phlogopite type of mica advanced to the pilot-plant stage of production in a coordinated research program, and investigation of the commercial possibilities continued.

A cooperative investigation of mica deposits in South Carolina was conducted by the State Research, Planning and Development Board and the Tennessee Valley Authority.[1] Reports on mica deposits in Georgia [2] and North Carolina [3] and a report on methods for recovering scrap mica [4] were published during the year.

Import duties on mica and certain mica products were reduced as a result of the General Agreement on Tariffs and Trade at Geneva.

A mica-splitting machine was described by the National Bureau of Standards.

Important new mica deposits in the Northern Territory of Australia were described.

DOMESTIC PRODUCTION

Sheet Mica.—The production of sheet and punch mica in the United States continued to decline in 1948, and a total of only 270,042 pounds was reported for the year. Of this total, North Carolina produced 257,926 pounds. In compiling the statistics on domestic production of sheet mica, the Bureau of Mines must depend largely on reports by purchasers because many small producers fail to report. The high cost of extracting and processing sheet mica is the ultimate cause of the depressed condition of the domestic sheet mica producing industry.

The problems of the mica industry were discussed.[5]

[1] Ceramic Industry, vol. 51, No. 2, August 1948, p. 30.
[2] Beck, W. A., Georgia Mica Spots: Bureau of Mines Rept. of Investigations 4239, 1948, 29 pp.
[3] Dahners, L. A., and McIntosh, F. K., North Carolina Mica Spots: Bureau of Mines Rept. of Investigations 4241, 1948, 16 pp.
[4] Munson, G. A., and Clarke, F. F., Studies on Methods for Recovering Scrap Mica from Pegmatite of the Black Hills, South Dakota: Bureau of Mines Rept. of Investigations 4190, 1948, 26 pp.
[5] Sharp, J. Wray, Mica Industry Problems: Min. Cong. Jour., vol. 34, No. 8, August 1948, pp. 48-51.

Salient statistics of the mica industry in the United States, 1944–48

	1944	1945	1946	1947	1948
Domestic mica sold or used by producers:					
Total uncut sheet and punch:					
Pounds	1,523,313	1,298,587	1,078,867	415,589	270,042
Value	$3,262,711	$737,342	$217,955	$116,110	$45,940
Average per pound	$2.14	$0.57	$0.20	$0.28	$0.17
Scrap: [1]					
Short tons	51,727	41,060	53,602	49,797	52,157
Value	$1,089,072	$812,322	$1,041,423	$1,095,578	$1,091,698
Average per pound	$21.05	$19.78	$19.43	$22.00	$20.93
Total sheet and scrap: [1]					
Short tons	52,489	41,709	54,141	50,005	52,292
Value	$4,351,783	$1,549,664	$1,259,378	$1,211,688	$1,137,638
Total ground: [1]					
Short tons	52,713	51,806	62,113	64,540	64,642
Value	$1,914,709	$1,995,969	$2,516,018	$2,967,713	$3,232,632
Consumption of splittings:					
Pounds	8,816,965	7,897,402	7,815,989	9,309,981	7,917,365
Value	$4,657,730	$3,415,696	$4,259,478	$6,680,753	$6,300,581
Imports for consumption:					
Total uncut sheet and punch:					
Pounds	5,032,983	4,208,130	4,499,672	1,754,419	2,829,335
Value	$3,921,078	$4,148,737	$2,288,897	$1,150,958	$2,477,598
Scrap:					
Short tons	2,412	3,612	6,207	5,109	7,124
Value	$32,688	$41,950	$75,846	$66,408	$107,540
Total sheet and scrap:					
Short tons	4,929	5,716	8,457	5,986	8,539
Value	$3,953,766	$4,190,687	[2] $2,364,743	$1,217,366	$2,585,138
Manufactured:					
Short tons	2,314	3,695	5,487	5,699	9,357
Value	$3,707,718	$2,173,133	$4,754,583	$6,251,613	$12,960,918
Total imports:					
Short tons	7,243	9,411	13,944	11,685	17,896
Value	$7,661,484	$6,363,820	[2] $7,119,326	$7,468,979	$15,546,056
Exports (all classes of mica):					
Short tons	619	981	1,542	1,493	1,403
Value	$526,824	$377,473	$709,109	$970,326	$720,359

[1] Includes mica recovered from kaolin and mica schists as follows: 1944, 22,107 tons, $485,567; 1945, 15,046 tons, $324,515; 1946, 15,197 tons, $290,540; 1947, 14,598 tons, $385,833. The Bureau of Mines is not at liberty to publish the corresponding figure for 1948.
[2] Revised figure.

Scrap Mica.—Domestic production of scrap mica in 1948 totaled 52,157 short tons valued at $1,091,698. This figure includes mine scrap, mica reclaimed as a byproduct of kaolin washing, and mica recovered from schist. A shortage of domestic high-grade scrap from which the better grades of ground mica are produced made it necessary for grinders to import large quantities of scrap, principally from India.

An article was published summarizing the history of the mica industry in New Mexico and describing the mining and milling methods being tested. This new procedure involves underground mining of a pegmatite from wall to wall, and the material is milled for the recovery of scrap mica only.[6]

[6] Jahns, Richard H., Milling Improves Northern New Mexico Scrap-Mica Outlook; Eng. and Min. Jour., vol. 149, No. 5, May 1948, pp. 96–100.

Mica sold or used by producers in the United States, 1935–39 (average) and 1942–48

Year	Sheet mica: Uncut punch and circle mica, Pounds	Sheet mica: Uncut punch and circle mica, Value	Sheet mica: Uncut mica larger than punch and circle, Pounds	Sheet mica: Uncut mica larger than punch and circle, Value	Sheet mica: Total uncut sheet mica [1], Pounds	Sheet mica: Total uncut sheet mica [1], Value	Scrap mica and mica recovered from kaolin and schist, Short tons	Scrap mica and mica recovered from kaolin and schist, Value	Total, Short tons	Total, 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
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	1, 166, 858	166, 116	131, 729	571, 226	1, 298, 587	737, 342	41, 060	812, 322	41, 709	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 [2]	633, 010	69, 207	3, 666	4, 811	636, 676	74, 018	11, 696	89, 830	12, 014	163, 848
Total	986, 891	126, 039	91, 976	91, 916	1, 078, 867	217, 955	53, 602	1, 041, 423	54, 141	1, 259, 378
1947:										
North Carolina	169, 647	22, 601	41, 169	61, 674	210, 816	84, 275	38, 655	844, 086	38, 761	928, 361
South Dakota	162, 380	22, 464	26, 000	6, 240	188, 380	28, 704	1, 499	37, 225	1, 593	65, 929
Other States [2]	11, 805	2, 034	4, 588	1, 097	16, 393	3, 131	9, 643	214, 267	9, 651	217, 398
Total	343, 832	47, 099	71, 757	69, 011	415, 589	116, 110	49, 797	1, 095, 578	50, 005	1, 211, 688
1948:										
North Carolina	204, 713	22, 699	53, 213	21, 979	257, 926	44, 678	44, 428	992, 303	44, 557	1, 036, 981
South Dakota	-----	-----	-----	-----	-----	-----	988	28, 515	988	28, 515
Other States [2]	12, 081	1, 229	35	33	12, 116	1, 262	6, 741	70, 880	6, 747	72, 142
Total	216, 794	23, 928	53, 248	22, 012	270, 042	45, 940	52, 157	1, 091, 698	52, 292	1, 137, 638

[1] Includes small quantities of splittings in certain years.
[2] Includes Alabama (1946–47), Arizona (1947), California (1946–47), Colorado, Connecticut (1946 and 1948), Georgia, Maine, New Hampshire, New Mexico (1948), New York (1946), South Carolina (1946), and Virginia (1946–47).

Scrap and reclaimed mica sold or used by producers in the United States, 1935–39 (average) and 1944–48

	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
1944	29,620	603,505	22,107	485,567	51,727	1,089,072
1945	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
1947	35,199	709,745	14,598	385,833	49,797	1,095,578
1948	(1)	(1)	(1)	(1)	52,157	1,091,698

[1] Bureau of Mines is not at liberty to distribute total because of too few producers of reclaimed.

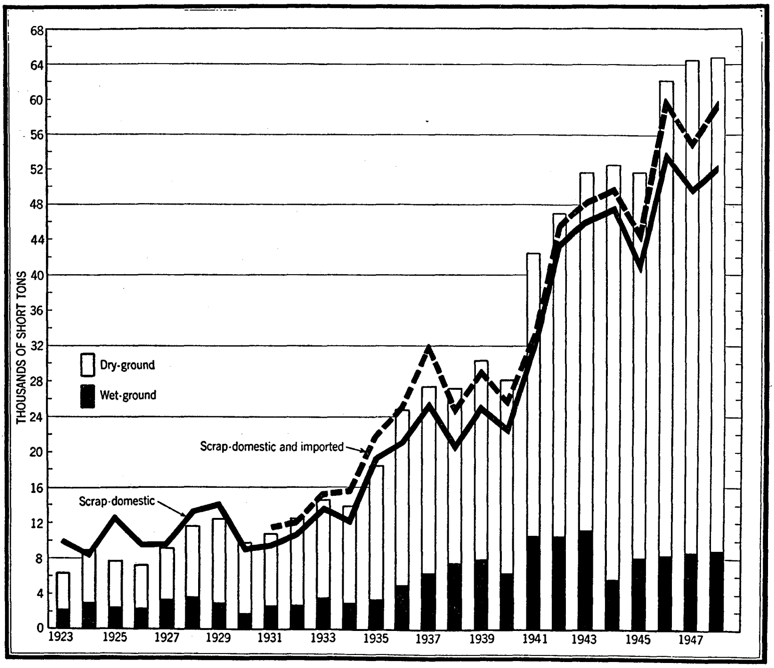

FIGURE 1.—Scrap and ground mica sold in the United States, 1923–48.

Ground Mica.—Domestic production of 64,642 short tons of ground mica valued at $3,232,632 was a new record. In the accompanying table, production is shown for both wet and dry processes.

The Wet Ground Mica Association, Inc., 420 Lexington Avenue, New York 17, N. Y., is reported to have retained the Centro Research Laboratories, Inc., Briarcliff Manor, N. Y., to conduct a research program to develop new and improved methods of utilizing the special characteristics of wet-ground mica.[7]

The Diamond Mica Co. began production of wet-ground mica at its new modern grinding plant at Spruce Pine, N. C., utilizing local scrap mica. The process was described in considerable detail.[8]

[7] Chemical and Engineering News, vol. 26, No. 32, Aug. 9, 1948, pp. 2363-2364.
[8] Engineering and Mining Journal, vol. 149 No. 6, June 1948, pp. 86-88.

National Grinding Corp. procured a permit to erect a plant near Lawrence, Colo. The mica to be ground probably will be obtained from mines being developed between Grand Junction and Glade Park, Colo.[9] Consolidated Feldspar Corp. completed a new plant at Parkdale, Colo., where mica will be recovered as a byproduct in the flotation of feldspar.[10]

The Mica Co. of Canada announced the transfer of its operations at Massena, N. Y., to Newport News, Va. The move was made to bring the plants closer to seaport facilities, as much of the material used comes from India and Madagascar.[11]

The Rubber Asphalt Co., Los Angeles, Calif., announced plans to erect a mill in which mica from company mines in New Mexico will be both wet- and dry-ground.[12]

Ground mica (including mica from kaolin and schist) sold by producers in the United States, 1944–48, by methods of grinding

	Dry-ground		Wet-ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1944	47,023	$1,382,147	5,690	$532,562	52,713	$1,914,709
1945	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
1947	55,731	1,852,768	8,809	1,114,945	64,540	2,967,713
1948	55,494	2,035,618	9,148	1,197,014	64,642	3,232,632

CONSUMPTION

Sheet, Punch, and Film Mica.—The consumption of sheet, punch and film mica continued to decline, as the accompanying table shows. Some of the decrease may be ascribed to reduced demand for household electrical appliances and other electrical equipment, of which this material is a component, but increasing use of alternate or substitute insulating materials, such as fiber glass, ceramics, and plastics, undoubtedly accounts for a portion. Certain grades and classes of block and film were acquired for the National Strategic Stock Pile.

Production of sheet and punch mica and apparent consumption of sheet and punch mica and mica splittings in the United States, 1937–48, in pounds

Year	Production	Apparent consumption	Year	Production	Apparent consumption
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
1941	2,666,453	12,040,476	1947	415,589	11,302,644
1942	2,761,844	12,888,273	1948	270,042	11,009,970

9 Rock Products, vol. 51, No. 12, December 1948, p. 81.
10 Engineering and Mining Journal, vol. 149, No. 9, September 1948, p. 122.
11 Rock Products, vol. 51, No. 9, September 1948, p. 65.
12 Engineering and Mining Journal, vol. 149, No. 6, June 1948, p. 133.

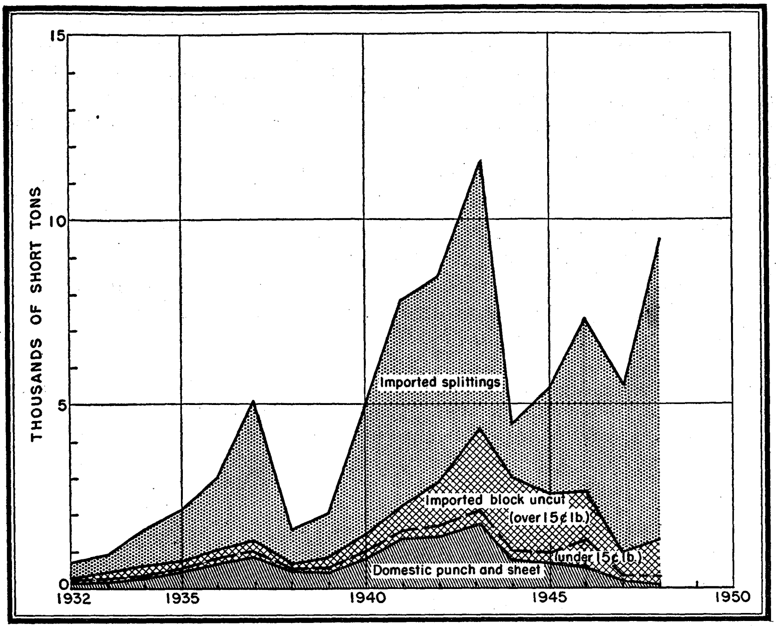

FIGURE 2.—Block mica and splittings imported for consumption in the United States and sales of domestic sheet and punch mica, 1932–48.

Consumption of block and film muscovite and phlogopite mica in the United States in 1948, in pounds [1]

Type	Block	Film	Total
Muscovite:			
Clear and slightly stained	1,620	100	1,720
Fair stained	5,538	30,865	36,403
Good stained	41,257	37,619	78,876
Stained	845,783		845,783
Heavy stained	285,680		285,680
Other	120,649	40,859	161,508
Total muscovite	1,300,527	109,443	1,409,970
Phlogopite (all qualities)	2,081		2,081
Grand total	1,302,608	109,443	1,412,051

[1] Partly estimated.

Mica Splittings.—Consumption of mica splittings in the United States in 1948, as reported by consumers, totaled 7,917,365 pounds valued at $6,300,581. This was a decrease from the previous year of approximately 15 percent in pounds consumed, but the increase in price of splittings left the total value of consumption only slightly less than the previous year. A sharp reduction in stocks was reported, most of which was in muscovite splittings and apparently indicates the determination of domestic consumers to resist the prevailing high prices of Indian splittings. Splittings also were being acquired during the year for the National Strategic Stock Pile.

Consumption and stocks of mica splittings in the United States, 1944–48, by sources, as reported by consumers

	1944		1945		1946		1947		1948	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Consumption:										
Domestic	58,350	$23,862	94,716	$46,731	7,220	$1,651	81,800	$66,020	[1] 75,395	[1] $33,106
Canadian	601,661	324,631	321,216	163,658	292,212	152,969	[2] 254,135	[2] 139,504	237,350	150,487
Indian	7,708,253	4,002,010	7,085,316	2,970,013	7,243,835	3,939,595	8,424,625	6,074,465	7,228,660	5,866,441
Madagascan	371,972	251,945	324,383	188,530	217,309	130,040	549,421	400,764	375,960	250,547
Mexican	76,729	55,282	71,771	46,764	55,413	35,223	(2)	(2)	(1)	(1)
Total	8,816,965	4,657,730	7,897,402	3,415,696	7,815,989	4,259,478	9,309,981	6,680,753	7,917,365	6,300,581
Stocks in consumers' hands Dec. 31:										
Domestic	3,694	1,365	7,000	3,430	4,541	1,390	50,700	23,818	147,297	78,992
Canadian	141,427	95,850	143,102	91,115	275,685	166,786	[2] 110,162	[2] 64,561		
Indian	3,578,885	1,749,011	2,684,848	1,145,176	5,727,615	3,039,429	5,846,763	4,470,649	3,168,801	2,723,175
Madagascan	184,970	121,307	193,763	130,661	535,185	378,174	339,220	224,615	402,217	283,170
Mexican	86,001	57,632	35,876	21,235	45,906	29,952	(2)	(2)		
Total	3,994,977	2,025,165	3,064,589	1,391,617	6,588,932	3,615,731	6,346,845	4,783,643	3,718,315	3,085,337

[1] Mexican included with domestic.
[2] Mexican included with Canadian.

Built-Up Mica.—Built-up mica products in 1948 were characterized by a substantial decrease in consumption and a sharp increase in value. This decrease in consumption reflected the softening of demand for many types of industrial electrical equipment of which these products are components, and the use of alternate materials. Since mica is the component of chief value in built-up mica products, the increased value is attributable to the increased cost of splittings.

Built-up mica produced in the United States, 1946–48, by kinds of product

Product	1946		1947		1948	
	Pounds	Value	Pounds	Value	Pounds	Value
Molding plate	1,742,835	$2,061,588	1,660,883	$1,832,779	1,545,401	$2,435,709
Segment plate	1,860,173	2,460,860	1,920,875	2,513,205	2,008,924	3,614,521
Heater plate	685,580	1,283,908	1,248,461	2,351,901	1,033,995	2,126,367
Flexible (cold)	553,274	746,600	677,801	973,247	339,509	575,066
All other (tape, etc.)	1,644,693	3,732,906	1,388,094	3,741,913	1,020,989	3,792,278
Total	6,486,555	10,285,862	6,896,114	11,413,045	5,948,818	12,543,941

Ground Mica.—The roofing industry continued to be the largest consumer of ground mica, utilizing dry ground mica principally as a coating material. The paint industry consumes largely the finer and purer grades of both wet- and dry-ground mica. Growing acceptance of ground mica as a filler and binder in rubber products and as a mold dust in their manufacture has made the rubber industry an increasingly important consumer—more than one-fifth of the total went to this industry in 1948. Increased tonnages were used in oil-well drilling and pipe-line enamels during the year.

Ground mica (including mica from kaolin and schist) sold by producers in the United States to various industries, 1947–48

Industry	1947			1948		
	Short tons	Percent of total	Value	Short tons	Percent of total	Value
Roofing	40,012	62	$1,228,972	25,066	39	$775,297
Wallpaper	1,724	3	205,454	1,256	2	148,311
Rubber	3,900	6	429,570	12,275	19	773,319
Paint	8,151	13	560,336	9,172	14	703,558
Plastics	1,374	2	72,836	590	1	63,428
Miscellaneous [1]	9,379	14	470,545	16,283	25	768,719
Total	64,540	100	2,967,713	64,642	100	3,232,632

[1] Includes mica used for molded electric insulation, house insulation, Christmas-tree snow, manufacture of axle greases and oil, annealing, pipe-line enamel, oil-well drilling, welding, and other purposes.

PRICES

Prices received for domestic sheet and punch mica vary widely and are generally determined by direct negotiation between buyer and seller after agreement as to quality of particular lots. Hence, the following quotations from E&MJ Metal and Mineral Markets are largely nominal and represent the range of prices during 1948: North Carolina district, punch, 6 to 22 cents per pound, according to size and quality; sheet, 1½ by 2 inches, 60 to 75 cents per pound; 2 by 2 inches, 95 cents to $1.20; 2 by 3 inches, $1.35 to $1.65; 3 by 3 inches, $1.80 to $2.10; 3 by 4 inches $2.25 to $2.65; 3 by 5 inches, $2.75 to $3.25; 4 by 6 inches, $3.50 to $4; 6 by 8 inches, $4 to $6.

Prices for scrap ranged from $25 to $35 per short ton. Wet-ground mica sold at prices between $90 and $175 per ton and dry-ground between $32.50 and $80, depending on mesh size and quantity.

FOREIGN TRADE [13]

Imports.—In 1948 imports of mica of all types totaled 17,896 short tons valued at $15,546,056 compared with 11,685 short tons valued at $7,468,979 in 1947. The largest single item imported was muscovite splittings from India, which comprised nearly half the total tonnage and represented three-fourths of the total value. The trade in nearly every type of mica increased over the previous year, with the exception of films from India. Brazil assumed the leading role in films and, as for several years, was the leading supplier of muscovite block.

The competition of the Brazilian mica industry has been the subject of a controversy in India for some time. For several years Brazilian block mica has been shipped to India for splitting and reexportation. During 1948 the Mica Advisory Committee established by the Indian Government recommended continuance of this practice.[14] However, on September 1, the Indian Ministry of Commerce announced that no licenses for the imports of mica from Brazil or any other country would be issued in future.[15]

Substantial reduction of import duties on mica and mica manufactures resulted in 1948 from the General Agreement on Tariffs and Trade, concluded at Geneva, Switzerland, October 30, 1947. The effective date regarding Indian mica was July 9, 1948, and for Brazilian mica July 31, 1948.

[13] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.
[14] Engineering and Mining Journal, vol. 149, No. 10, October 1948, p. 147.
[15] Mine and Quarry Engineering, vol. 14, No. 10, October 1948, pp. 294–295.

Mica imported for consumption in the United States, by kinds and by countries, in 1948 [1]

[U. S. Department of Commerce]

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 by 2 inches may be cut		Other			
	Phlogopite		Other				Valued not above 15 cents per pound n. e. s.		Valued above 15 cents per pound	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Argentina							143,078	$13,796	355,564	$210,520
Austria									56	671
Belgian Congo	96,252	$375								
Brazil							179,786	20,760	1,325,306	1,159,831
British East Africa									16,416	35,234
Canada	1,874,980	20,073			434,429	$77,167	6,000	700	6,294	8,087
India	2,688,427	16,413	7,600,453	$58,016					268,005	712,116
Madagascar									66	500
Mexico									18,639	15,764
Norway									97	84
Peru							373	37		
Portuguese Guinea and Angola			162,211	905					8,016	30,822
Southern Rhodesia									5,029	30,502
Union of South Africa	230,045	1,496	1,596,354	10,262					22,713	13,372
United Kingdom							1,218	61	38,031	147,387
Uruguay									219	187
Total: 1948	4,889,704	38,357	9,359,018	69,183	434,429	77,167	330,455	35,354	2,064,451	2,365,077
1947	3,229,691	23,355	6,987,900	43,053	305,688	57,066	186,631	21,149	1,262,100	1,072,743

Country	Manufactured—films and splittings							
	Not cut or stamped to dimensions				Cut or stamped to dimensions		Total films and splittings	
	Not above 12/10,000 of an inch in thickness		Over 12/10,000 of an inch in thickness					
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Argentina	61	$122					61	$122
Brazil	43,795	39,555	220,960	$121,678	2,615	$2,870	267,370	164,103
Canada	8,478	5,832	150	225			8,628	6,057
Ceylon	288	87					288	87
Egypt	1,500	597					1,500	597
France	27,951	12,281					27,951	12,281
India	15,253,547	11,691,390	137,874	271,803	24,735	33,074	15,416,156	11,996,267
Madagascar	756,037	381,470	2,545	749			758,582	382,219
Mexico	26,529	88,703	5,499	23,446	1,421	23,238	33,449	135,387
Pakistan	1,875	1,045					1,875	1,045
Union of South Africa	8,002	2,864					8,002	2,864
United Kingdom	19,985	7,792	24	30	134	4,038	20,143	11,860
Total: 1948	16,148,048	12,231,738	367,052	417,931	28,905	63,220	16,544,005	12,712,889
1947	9,075,818	5,460,243	467,548	611,995	11,128	39,714	9,554,494	6,111,952

See footnote at end of table.

Mica imported for consumption in the United States, by kinds and by countries, in 1948 [1]—Continued

Country	Manufactured—cut or stamped to dimensions, shape, or form		Manufactured—other: Mica plates and built-up mica		Manufactured—other: All mica manufactures of which mica is the component material of chief value		Manufactured—other: Ground or pulverized	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Brazil	62,927	$63,483	453	$712			165	$339
Canada							1,978,795	50,439
India	92,827	87,370	2,600	1,427	16,421	$15,633		
Italy					1	3		
Mexico	6,785	11,030			9,276	17,568		
United Kingdom	1	34						
Total: 1948	162,540	161,917	3,053	2,139	25,698	33,204	1,978,960	50,769
1947	131,776	103,118			1,976	3,128	1,710,090	33,415

[1] Changes for tables in Minerals Yearbook are as follows—Other: Valued above 15 cents per pound—1946, p. 793, Argentina, 452,872 pounds, $285,882; total, 2,652,929 pounds, $2,048,029. 1947, p. 789, British East Africa, 3,720 pounds, $16,763; United Kingdom, none.

Exports.—The quantity of mica products exported from the United States in 1948 continued to decrease, although exports of ground mica were only slightly less than the previous year. A slight increase in exports of unmanufactured block and sheet is attributed to a marked increase in shipments to Canada.

Mica and manufactures of mica exported from the United States in 1948, by countries

[U. S. Department of Commerce]

Country	Unmanufactured		Manufactured: Ground or pulverized		Manufactured: Other	
	Pounds	Value	Pounds	Value	Pounds	Value
North America:						
Canada	262,518	$5,641	1,142,102	$62,954	56,123	$164,715
Cuba			11,100	655	4,902	9,287
Mexico	6,694	5,556	41,700	3,658	14,287	32,666
Panama, Republic of			80,000	1,800	205	355
Other North America					735	2,397
South America:						
Argentina			186,100	7,443	3,240	5,100
Brazil	4,500	293	56,150	2,558	8,350	22,251
Chile			6,600	495	1,374	7,487
Colombia					1,361	3,107
Peru					875	2,662
Venezuela			99,451	6,926	1,727	4,230
Other South America					144	498
Europe:						
Austria					11,697	59,125
Belgium and Luxembourg			184,600	14,204	13,442	54,877
France					9,798	28,474
Greece	500	50			436	1,015
Italy	36	153	5,000	350	12,300	43,959
Netherlands			101,000	7,554	1,112	4,994
Portugal					3,877	1,704
Spain			8,800	572	1,553	4,049
Sweden			111,100	2,392	3,223	9,832
Switzerland			22,000	1,403	1,920	1,095
United Kingdom					6,831	28,789
Other Europe					850	3,502

Mica and manufactures of mica exported from the United States in 1948, by countries—Continued

Country	Unmanufactured		Manufactured			
			Ground or pulverized		Other	
	Pounds	Value	Pounds	Value	Pounds	Value
Asia:						
China					6,350	$10,961
India and Pakistan	64,207	$55,600	117,500	$6,523	26,014	5,840
Indonesia			16,500	1,339	941	2,139
Philippines, Republic of					1,242	3,140
Other Asia	313	1,339			1,119	2,668
Africa:						
Algeria					102	758
Belgian Congo					225	464
Madagascar			8,300	300		
Union of South Africa			57,900	3,304	1,548	3,804
Other Africa					160	857
Oceania: New Zealand			12,500	496		
Total: 1948	338,768	68,632	2,268,403	124,926	198,063	526,801
1947	330,900	76,695	2,343,657	129,091	311,097	764,540

TECHNOLOGY

The quality classification of mica long has depended mainly on visual tests and therefore is largely a matter of personal judgment of the examiner. Inadequate descriptions of impurities and imperfections and the lack of standard techniques and methods of examining mica have caused considerable wastage of mica, monetary risk, and confusion to miners, dealers, fabricators, and users of mica. To meet the urgent need for universal standardization acceptable to all concerned, the American Society for Testing Materials was engaged in a project designed to provide sets of reference standards in the form of color negatives for use in classifying mica.[16]

The National Bureau of Standards made available plans for a mechanical mica splitter that represents an important step forward in mica splitting. It is reported that an untrained operator can produce 60 films per minute with this machine, whereas the average rate of hand splitting is 15 to 20 films per minute.[17]

It was announced that synthetic mica of the fluorine-phlogopite type is being produced on a pilot-plant scale under a coordinated research program involving the Federal Bureau of Mines, Colorado School of Mines, Signal Corps, Owens-Corning Fiberglass Corp., and the Office of Naval Research.[18] Technical data are available from the Office of Naval Research.

[16] Bulletin of the American Society for Testing Materials, No. 151, March 1948, pp. 26–27.
[17] Pit and Quarry, vol. 40, No. 11, May 1948, p. 152.
[18] Mining Congress Journal, vol. 34, No. 9, September 1948, p. 108.

WORLD REVIEW

Available statistics on world production of mica are shown in the accompanying table.

World production of mica by countries, 1942–48, in metric tons [1]

[Compiled by Helen L. Hunt]

Country [1]	1942	1943	1944	1945	1946	1947	1948
North America:							
Canada (sales)	2,731	3,651	3,032	3,195	3,956	3,773	2,079
Guatemala	[2] 3	5	1	[3] 1	[3] 4	(4)	(4)
Mexico	44	104	[2] 111	[2] 409	[2] 81	[2] 231	(4)
United States (sold or used by producers):							
Block	1,253	1,564	691	589	489	189	122
Scrap	39,246	41,855	46,926	37,249	48,627	45,175	47,316
South America:							
Argentina	625	402	594	719	430	(4)	(4)
Bolivia (exports)	4	2	2			(4)	(4)
Brazil (exports)	866	796	941	984	1,148	866	987
Peru	5	9	113	491	207	2	
Uruguay			3		6	14	2
Europe:							
Italy	256	415	(4)	42	(4)	(4)	(4)
Norway	1,391	981	[2] 724	[2] 564	[2] 224	[2] 169	[2] 90
Portugal	11	1,200	[5] 1,200	(4)	(4)	(4)	(4)
Rumania	116	628	(4)	(4)	(4)	(4)	(4)
Spain	334	387	239	18	4	12	10
Sweden	494	327	335	126	69	155	(4)
Asia:							
Ceylon		2	2	1	(6)	(6)	
India (exports)	8,671	10,242	3,670	4,859	10,675	9,788	17,383
Korea	111	146	422	95	(4)	(4)	(4)
Africa:							
British East Africa:							
Kenya			(6)	(4)			(4)
Tanganyika	12	41	[2] 128	[2] 250	[2] 342	[2] 71	[2] 75
Uganda			12	6	(6)		2
Eritrea			(4)		(4)	3	(4)
Madagascar	320	343	493	620	468	540	507
Portuguese East Africa	1		4	2	2	20	1
Portuguese West Africa	(6)	1	4	20	31	89	108
Rhodesia:							
Northern	4	10	16	7	(6)		
Southern	12	54	250	196	335	296	293
Union of South Africa	1,265	1,274	1,127	1,131	1,785	2,008	1,599
Oceania:							
Australia	206	88	146	134	230	329	[7] 16
New Zealand	(4)	(6)	(6)	(6)			
Total (estimate) [1]	58,000	64,500	62,000	52,000	70,000	65,000	72,500

[1] In addition to countries listed mica is also produced in Austria, China, Colombia, Ethiopia, and U. S. S. R., but data on production are not available; no estimates for these countries are included in total.
[2] Exports.
[3] Imports into United States.
[4] Data not available; estimate by senior author of chapter included in total.
[5] Estimate.
[6] Less than 1 ton.
[7] Northern Territory only.

Australia.—A Government survey of the Hart's Range mica field of Northern Territory of Australia indicates that mica is an important national resource awaiting development. The field includes, in addition to the Hart's Range area, the Plenty River, Undippa, and Bundey areas. It has been reported that this field is comparable in size, concentration of mica-bearing pegmatites, and grade and quality of mica with the Indian deposits. Much of the area is rugged, and access is difficult. At present, most of the mines are relatively small, mining methods are crude, and output is limited. Mica production from mines operating in the Hart's Range and Plenty River areas from July 1, 1945, to March 31, 1948, totaled 230,296 pounds. Prices are controlled by the Commonwealth Prices Commission. The National Security Regulations administered by the Controller of Minerals Production, Department of Supply and Development, empowers the Commonwealth Government to purchase and distribute all mica produced.

India.—The International Organization for Standardization entrusted the Indian Standards Institution with the responsibility of devising international standards for grade and class of mica. The scope of this work includes preparing an agreed set of standard samples of mica which could be duplicated and supplied to all interested parties.[19]

The grant of additional wages, attendance bonus, annual bonus, housing and water-supply facilities, and free rations was announced by the Central Government's Industrial Tribunal, Dhanbad (Bihar), in its decision regarding the industrial dispute between workers in the mica mines of Bihar and their employers. The ruling was effective July 1, 1948.[20]

Madagascar.—Near the beginning of 1948 the Director of Mines estimated the monthly production of phlogopite block and splittings at about 35 to 40 tons and stocks at about 250 to 300 tons, either at the port of Fort Dauphin or at the mines. The producers reported a steady demand for splittings, either ordinary trimmed or book form, from the United States. A new classification system for phlogopite and new minimum export prices were announced. New regulations concerning the granting of prospecting and mining permits were summarized.[21] An order of the High Commissioner, February 27, 1948, slightly increased the basic value of mica, on which a 5-percent ad valorem mining tax is levied.[22]

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[19] Mining Journal (London), vol. 231, No. 5909, Nov. 20, 1948, p. 856.
[20] Bureau of Mines, Mineral Trade Notes: Vol. 27, No. 1, July 1948, pp. 53–54.
[21] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 2, February 1948, pp. 29–31, 39–41.
[22] Bureau of Mines, Mineral Trade Notes: Vol. 27, No. 2, August 1948, p. 49.

Molybdenum

By HUBERT W. DAVIS

GENERAL SUMMARY

PRODUCTION of molybdenum concentrates was 1.3 percent smaller in 1948 than in 1947, but shipments were 34 percent larger. The decline in output resulted chiefly from a strike (beginning October 24 and continuing the remainder of the year, by employees of the railroad serving the mines and concentrators, which were closed during this period) of the Utah Copper Division of Kennecott Copper Corp., and partly from a strike of much briefer duration by employees of the Questa mine of the Molybdenum Corp. of America in New Mexico. Colorado regained first place as a molybdenum-producing State, and California ascended from sixth to fourth place.

The high rate of operations in the steel industry, which utilizes about 70 percent of the total molybdenum consumed in the United States, was partly reflected in gains of 20 and 22 percent, respectively, in production and shipments of molybdic oxide, calcium molybdate, and ferromolybdenum in 1948 over 1947. Also partly responsible for the gains were greater export demand and increased purchases in the last quarter, following the announced price advance effective January 1, 1949. Output and shipments of ammonium molybdate and sodium molybdate were less in 1948 than in 1947, as also were shipments of molybdenum metal. Production of metal, however, was slightly greater. As a consequence of the greater demand for molybdenum products in 1948, the quantity of molybdenum concentrates converted to oxide was 24 percent larger than in 1947.

No molybdenum concentrates were imported into the United States in 1947 and 1948. Exports, however, were 38 percent greater in 1948 than in 1947.

Salient statistics of molybdenum concentrates in the United States, 1944–48

	Molybdenum contained, thousands of pounds				
	1944	1945	1946	1947	1948
Production	38,679	30,802	18,218	27,047	26,706
Shipments (including exports)	39,423	33,683	16,787	22,190	29,669
Exports	5,985	2,863	565	2,989	4,132
Imports for consumption [1]	2,354	204	(2)	----------	----------
Consumption	31,520	32,696	14,994	20,221	25,156
Stocks (industry), Dec. 31 [3]	19,321	16,883	19,275	23,661	21,206

[1] Excludes imports for conversion and reexport as follows: 1944, 1,145,440 pounds; 1945, 460,416 pounds, 1946, 276,465 pounds; 1947–48, none.
[2] 10 pounds.
[3] At mines and at plants making molybdenum products.

Reversing an upward trend that had persisted for two consecutive years, industry stocks of molybdenum concentrates turned downward in 1948 and were 10 percent less at the end of 1948 than at the close of 1947. Stocks of molybdenum products held by producers declined 7 percent.

The published prices of molybdenum concentrates and molybdenum products remained unchanged throughout 1948.

DOMESTIC PRODUCTION—HISTORICAL REVIEW

Molybdenum ores were produced sporadically in the United States before 1915, but few data are available as to quantity of output. In 1898, 16,000 pounds of molybdenite assaying 42 to 56 percent molybdenum were mined in New Mexico and Arizona, and about 12 short tons of wulfenite assaying 90 percent $PbMoO_4$ were shipped from the Mammoth mine, Pinal County, Ariz.[1] From the Castleman mine in the Mount Baker district, Whatcom County, Wash., occasional shipments of molybdenite ore were made.[2] In 1901 and 1902 production of molybdenum ores, presumably from a deposit worked by the Crown Point Mining Co. in Chelan County, Wash., was 10 to 15 tons a year.[3] In 1903, 795 short tons of wulfenite concentrates (estimated to contain 10 percent molybdenum) valued at $60,865 were produced at the Mammoth mine, Pinal County, Ariz.[4] In 1904, 1905, and 1906, production was about 15 tons annually. The 1906 output included one lot of crude ore mined at Homestake, Mont., and a small quantity of comparatively pure molybdenite shipped from Lucerne, Wash. There was no reported production of molybdenum in the United States from 1907 until 1914, when 1,297 pounds of molybdenum were produced in Arizona, New Mexico, and Washington. The total output of molybdenum in the United States to 1914 probably did not exceed 350,000 pounds.

During the next decade developments were undertaken that were eventually to establish the United States as the premier producer of molybdenum in the world.

In 1917 active exploration was begun by the Climax Molybdenum Co. and the Molybdenum Products Corp. on different parts of the same large molybdenite deposit at Climax, Lake County, Colo. During 1918 the two companies made rapid strides in developing their holdings; mills were built, and toward the end of the year the Climax Molybdenum Co. had increased the capacity of its plant to 250 tons of ore a day. Meanwhile, the Primos Chemical Co. began developing the molybdenite deposit at Camp Urad on Red Mountain in Clear Creek County, Colo. Chiefly as a consequence of these developments, the center of molybdenum production moved from Arizona to Colorado, where production jumped to 663,386 pounds in 1918 and the State supplied 77 percent of the United States total. However, the end of World War I and the consequent break in the market made it necessary to suspend production at the Climax mine April 1, 1919, and at the Urad mine July 1. The Molybdenum Products Corp. ceased

[1] Mineral Industry, vol. 7, 1898, p. 514.
[2] Geological Survey, Twenty-first Annual Report, 1899–1900: Part 6, p. 307.
[3] Geological Survey, Mineral Resources of the United States, 1901, p. 268, and 1902, p. 286.
[4] Geological Survey, Mineral Resources of the United States, 1903, p. 308.

operations in the latter part of 1918. Operations were resumed at the Climax mine in 1924.

The Questa mine of the Molybdenum Corp. of America near Questa, Taos County, N. Mex., was opened in 1919, and made small outputs in that year and in 1920, after which production was suspended. Operations were resumed in 1923, since which time it has been an annual producer.

The results of the Climax Molybdenum Co. research campaign to develop the use of molybdenum began to show results in 1925, when output in the United States exceeded 1 million pounds for the first time. As the demand for molybdenum was growing constantly, additional milling facilities were needed to pace requirements; and, as a consequence, by 1942 the new constructions by the Climax Molybdenum Co. had raised the daily milling and treating capacity of its plant to 18,000–20,000 tons of ore. Despite labor shortages and curtailment of operations at the end of 1943, molybdenum production of the Climax Molybdenum Co. rose to an all-time high of 46,133,715 pounds. Meanwhile, operation at the Questa mine of the Molybdenum Corp. of America was greatly expanded, and in 1930 production of molybdenum reached a peak of 639,852 pounds.

The Climax and Questa mines have been consistent producers of molybdenum since 1924 and were the only producers in 1924–26. Since the beginning of operations through 1948 these mines have yielded 356,474,000 pounds of molybdenum or 72 percent of the United States total.

Previous to 1936 by far the greater part of the production of molybdenum in the United States had come from mines operated solely for their molybdenum content. In 1936, however, recovery of molybdenum as a byproduct of copper ores was begun in the United States by the Utah Copper Division of the Kennecott Copper Corp. from the Bingham deposit in Utah. The following year the Nevada Consolidated Copper Corp., now the Chino Mines Division of the Kennecott Copper Corp., became a producer of molybdenum from the Chino copper property in New Mexico; in 1938 the Miami Copper Co. began recovering molybdenum as a byproduct of its copper operations at Miami, Ariz.; and in 1941 the Nevada Mines Division of the Kennecott Copper Corp. inaugurated the recovery of molybdenum as a byproduct of its Ruth and Copper Flat operations and custom copper ore from the Emma Nevada group of Consolidated Copper Mines Corp. Meanwhile, the Bagdad Copper Corp. and the Squaw Peak Copper Mining Co. recovered small quantities of molybdenum as byproducts of their copper operations at Bagdad and Camp Verde, Ariz., respectively. However, molybdenum recovery by the former company was discontinued in 1945 and by the Squaw Peak Copper Mining Co. in 1946. In 1939 the United States Vanadium Corp. began the recovery of molybdenum as a byproduct of its tungsten operation at the Pine Creek mine in Inyo County, Calif.

From 1936 through 1948 byproduct molybdenum production in the United States has totaled 124,890,000 pounds and has comprised 29 percent of the total.

The spectacular growth of the molybdenum industry in the United States is shown in the accompanying table. Of the total production through 1948, it is estimated that 73 percent has come from mines operated solely or almost solely for molybdenum, 25 percent as a byproduct of copper and tungsten operations, and 2 percent from wulfenite deposits.

Production and shipments of molybdenum ore and concentrates in the United States through 1948, in pounds of contained molybdenum

Year	Production	Shipments	Year	Production	Shipments
Previous to 1914	[1] 350,000	[1] 350,000	1932	2,431,000	2,373,000
1914		1,297	1933	5,682,000	5,761,000
1915		181,769	1934	9,362,000	9,377,000
1916	[1] 1,602,000	206,740	1935	11,512,000	10,892,000
1917		350,200	1936	17,186,000	17,959,000
1918		861,637	1937	29,419,000	30,122,000
1919	397,200	297,926	1938	33,297,000	25,727,000
1920		34,900	1939	30,324,000	32,415,000
1921		----------	1940	34,313,000	25,329,000
1922		----------	1941	40,363,000	38,377,000
1923	[1] 2,000,000	22,667	1942	56,942,000	66,437,000
1924		297,174	1943	61,667,000	53,955,000
1925		1,154,050	1944	38,679,000	39,423,000
1926	1,393,000	1,431,830	1945	30,802,000	33,683,000
1927	2,299,000	2,286,075	1946	18,218,000	16,786,600
1928	3,428,000	3,329,214	1947	27,047,000	22,189,800
1929	4,021,000	3,904,648	1948	26,706,000	29,669,000
1930	3,723,000	3,759,269			
1931	3,133,000	3,157,000	Total	496,296,200	482,102,000

[1] Estimate

Arizona.—Arizona was the principal producer of molybedenum ores in the United States before 1918, when it was surpassed by Colorado. The State has many deposits of molybdenite and wulfenite. Despite the fact that more deposits have been worked there than in any other State, Arizona has produced a relatively small proportion of total output. For example, during the 35 years 1914–48, shipments of molybdenum contained in molybdenite and wulfenite from Arizona were 13,425,000 pounds or 2.8 percent of the United States total. Of this total (13,425,000 pounds), about 95 percent was contributed by the wulfenite deposits (Mammoth, Mohawk, and adjoining claims) in Pinal County, the Childs molybdenite property also in Pinal County, and the copper operation of Miami Copper Co. in Gila County, where since 1938 molybdenite has been recovered as a byproduct. The remaining output was mined at a number of widely scattered properties, including the Leviathan, Helvetia, Grand Reef, Rowley, Total Wreck, Santo Niño, Kullman McCool, Garnet Group, Squaw Creek, and Bagdad Copper.

California.—Except for 666 pounds of molybdenum contained in molybdenite hand-picked from a deposit near Bishop, Inyo County, in 1916, 499 pounds by Amigo & Maclean in Mono County, and 2,652 pounds from the Parker & Loftus property in Shasta County in 1917, and 634 pounds recovered from slime middlings of the Pine Creek mine in Inyo County in 1933, output of molybdenum in California has come from the Pine Creek tungsten mine, where both molybdenite and powellite are molybdenum minerals accessory to scheelite.

Colorado.—In 1918–19, 1924–46, and 1948 Colorado was the premier molybdenum-producing State. In 1947, however, it yielded first place to Utah, where output of molybdenite is a byproduct of copper operations; consequently, production is governed largely by the rate of copper mining, whereas in Colorado production is almost solely for the content of molybdenite and in general is geared to world molybdenum demand. From 1914 through 1948 Colorado has contributed about 70 percent of the total molybdenum shipped from mines in the United States. Colorado output has come chiefly from the Climax deposit in Lake County; virtually all of the remainder has been produced at the Urad mine in Clear Creek County.

Idaho.—A small quantity (1,044 pounds of molybdenum) of molybdenite was produced (but not shipped) at a property in Boundary County in 1938.

Nevada.—Except for a small quantity of high-grade molybdenite concentrates produced near Lovelock in 1915, a smaller quantity mined near Golconda in 1917, and 77,779 pounds of molybdenum contained in wulfenite mined at the Shenandoah claim at Goodsprings in 1934–36, molybdenum in Nevada has been recovered since 1941 as a molybdenite concentrate at the McGill mill of the Nevada Mines Division of Kennecott Copper Corp., treating copper ore mined at its Ruth and Copper Flat mines, and custom copper ore from the Emma Nevada group of Consolidated Coppermines Corp.

New Mexico.—In 1918 the Stephenson-Bennett mine at Organ produced 43,328 pounds of molybdenum contained in wulfenite. Since 1919 the entire New Mexico output has come from the mine near Questa, Taos County, and as a byproduct of mining copper ore at the Chino mines at Santa Rita, Grant County. The Questa mine, which is mined for molybdenum only and is outstanding in the richness of the ore, was opened in 1919, has been an annual producer since 1923 and was the only producer in New Mexico from 1919–36. In 1937 the recovery of molybdenite as a byproduct of mining copper ore at the Chino mines was begun and since 1939 the output of molybdenite from this operation has exceeded that at Questa.

Utah.—Except for several hundred pounds of molybdenum contained in molybdenite mined near Alta in 1916 and a few hundred pounds produced near Gold Hill in 1917, the output of molybdenum in Utah has come from the mining of copper ore at Bingham, where commercial recovery of molybdenite as a byproduct was inaugurated in 1936. From 1937 through 1946 and in 1948 Utah ranked second as a producer of molybdenite concentrates in the United States. In 1947, however, it ascended to first place, temporarily displacing Colorado.

Washington.—In the latter part of the nineteenth century and the early part of the present century, sporadic shipments of molybdenite were reported made from the Crown Point mine in Chelan County, the Castleman mine in Whatcom County, and a property near Lucerne, Chelan County. The Deertrail Monitor mines in Stevens County made small outputs between 1936 and 1941.

Wisconsin.—The only reported production of molybdenite in Wisconsin was in 1939, when 3 short tons of concentrates averaging 79.78 percent MoS_2 and containing 2,917 pounds of molybdenum were produced at a property in Marinette County.

DOMESTIC PRODUCTION IN 1948

The total production of molybdenum concentrates was 26,706,000 pounds (contained molybdenum) in 1948, a decrease of 1.3 percent from 1947. The loss in output resulted chiefly from a strike at the

Utah Copper Division of the Kennecott Copper Corp. and partly from a strike by employees of the Questa mine of the Molybdenum Corp. of America in New Mexico. The chief mineral of molybdenum is molybdenite (MoS_2), which comprised virtually the entire output in 1948; powellite [$Ca(Mo,W)O_4$] contributed a relatively small quantity. Wulfenite ($PbMoO_4$), once mined from several deposits in southwestern United States, has not been produced since 1944.

Molybdenum was produced in six States in 1948; Colorado led, followed in order by Utah, New Mexico, California, Arizona, and Nevada. Output of concentrates at mines operated solely or almost solely for molybdenum was 13,387,000 pounds in 1948, an increase of 15 percent over 1947, whereas byproduct concentrates from copper and tungsten operations totaled 13,319,000 pounds, a decrease of 13 percent. Byproduct molybdenum represented nearly 50 percent of the total concentrates produced in 1948 compared with 57 percent in 1947.

Shipments of molybdenum concentrates were 29,669,000 pounds (contained molybdenum) in 1948, an increase of 34 percent over 1947. The shipments in 1948 comprised 26,144,100 pounds to domestic consumers and 3,524,900 pounds for export.

Molybdenum in ore and concentrates produced and shipped from mines in the United States, 1939–48

Year	Production (pounds)	Shipped from mines		Year	Production (pounds)	Shipped from mines	
		Pounds [1]	Value [2]			Pounds [1]	Value [2]
1939	30,324,000	32,415,000	$22,157,000	1944	38,679,000	39,423,000	$27,999,000
1940	34,313,000	25,329,000	17,189,000	1945	30,802,000	33,683,000	23,976,000
1941	40,363,000	38,377,000	25,996,000	1946	18,218,000	16,786,600	11,529,000
1942	56,942,000	66,437,000	47,275,000	1947	27,047,000	22,189,800	15,178,000
1943	61,667,000	53,955,000	38,500,000	1948	26,706,000	29,669,000	20,418,000

[1] Figures for 1939–44 represent shipments from mines, plus concentrates converted to oxide by producer at Miami, Ariz.; those for 1945–48 represent shipments to domestic and foreign customers, plus concentrates converted to oxide at Miami, Ariz., and Langeloth, Pa.

[2] Largely estimated by Bureau of Mines.

REVIEW BY STATES IN 1948

Arizona.—The Miami Copper Co. was the sole producer of molybdenum in Arizona in both 1947 and 1948. Since 1938 the company has been a regular producer of molybdenite, which is recovered as a byproduct of its copper operations at Miami, Ariz. The concentrates are converted to molybdic oxide at Miami; output declined for the second consecutive year and was 28 percent less in 1948 than in 1947.

California.—California ascended from last to fourth place as a producer of molybdenum in 1948. The only producer in California was the United States Vanadium Corp. at Bishop, where the metal is recovered as a byproduct of tungsten production. The treatment plant of the company was operated at a greatly increased rate in 1948; as a consequence, recovery of molybdenum was four times that of 1947. Molybdenum occurs as molybdenite and powellite, which comprised 77 and 23 percent, respectively, of the output in 1948.

Colorado.—Colorado, which after 23 consecutive years lost the lead to Utah in 1947 as the largest molybdenum-producing State, regained its premier rank in 1948. The ore deposits of Colorado are exploited chiefly for their molybdenum content; and, in general, production is geared to demand, whereas in Utah output of molybdenum is a byproduct of copper operations and consequently is governed largely by the rate of copper mining.

The Climax Molybdenum Co., operating the world-famous deposit at Climax, Colo., was the sole producer of molybdenum concentrates in Colorado in both 1947 and 1948; output was 14 percent greater in 1948 than in 1947. The Climax deposit heretofore has been exploited solely for molybdenum, but in 1948 recovery of tungsten as a byproduct was inaugurated. Most of its 1948 output of molybdenite concentrates was shipped to its processing plant at Langeloth, Pa., where the company produces ferromolybdenum, calcium molybdate, molybdic oxide, and other molybdenum products, as well as ferrotungsten.

A shortage of manpower in 1947 and 1948 prevented carrying out of adequate mine repair and development at the Climax mine. To meet the development problem the driving of a level, situated 300 feet below the Phillipson Level, was begun in November 1948.

Montana.—A report on the Big Ben molybdenum deposit has been published.[5] There has been no commercial production of molybdenum from this deposit.

Nevada.—Since 1941 the Nevada Mines Division of the Kennecott Copper Corp. has been the lone producer of molybdenite concentrates in Nevada. The concentrates are recovered as a byproduct of the McGill concentrator, where copper ores from the company Ruth and Copper Flat operations and from the Emma Nevada group of Consolidated Coppermines Corp. are milled. Output of concentrates was 39 percent less than in 1947 and was the smallest since recovery was inaugurated in 1941.

New Mexico.—The Chino Mines Division of the Kennecott Copper Corp., Hurley, and the Molybdenum Corp. of America, Questa, continued to be the only producers of molybdenite in New Mexico in 1948. The output of these producers was 64 and 36 percent, respectively, greater than in 1947; State output was 58 percent larger. A strike of employees from March 23 to May 15 resulted in some delay in output at the Questa mine. The Questa mine, which is operated for molybdenum only, was opened in 1919 and since 1923 has been a regular producer. Discovery of a vein of ore averaging 5 to 6 percent MoS_2 on the lowest level of the Questa mine was reported. The concentrates produced at Questa are shipped to the processing plant of the Molybdenum Corp. of America at Washington, Pa., where the company produces ferromolybdenum, calcium molybdate, molybdic oxide, and other molybdenum products. At Hurley molybdenite has been recovered as a byproduct of copper operations since 1937.

Utah.—Utah dropped to second place as a producer of molybdenum in 1948. The sole producer in Utah is the Utah Copper Division of the Kennecott Copper Corp., which since 1936 has been recovering molybdenite as a byproduct of copper at its Arthur and Magna concentrators. Output of molybdenite concentrates in Utah was 19 percent less in 1948 than in 1947. The loss in output resulted chiefly

[5] Herdlick, J. A., Investigation of Big Ben Molybdenum Deposit, Neihart District, Cascade County, Mont.: Bureau of Mines Report of Investigations 4406, 1949, 22 pp.

from a strike by employees of the railroad serving the mine and concentrators, which were closed from October 24, 1948, to February 5, 1949.

RESERVES

Information on reserves of molybdenum in the United States, prepared by the Bureau of Mines and Geological Survey, was published in hearings before a Subcommittee of the Committee on Public Lands, United States Senate, Eightieth Congress, first session, 1947, pp. 267–269. An abstract is contained in the Molybdenum chapter of Minerals Yearbook, 1947 (p. 796).

CONSUMPTION AND USES

Consumption (as measured by shipments to domestic consumers) of molybdenum products in the United States was 20 percent greater in 1948 than in 1947. The largest single use for molybdenum is as an alloying element in the manufacture of steels, to which it is added as molybdic oxide, calcium molybdate, or ferromolybdenum. In general, when an entire open-hearth heat is to be alloyed to a degree not exceeding 0.8 percent molybdenum, the addition is in the form of molybdic oxide or calcium molybdate; ferromolybdenum is used when higher percentages of molybdenum are desired. Of the total molybdenum used in the United States, it is estimated that about 70 percent is in steels. The addition of molybdenum to various grades of stainless steel increases resistance to most chemical attacks. Molybdenum is finding an expanding market in the high-temperature alloys developed for various components of gas turbines, as well as in jet aircraft engines and turbosuperchargers. The development of high-temperature ceramic coatings for molybdenum has been described.[6]

Much smaller quantities (about 20 percent of the total) of molybdenum, chiefly in the form of ferromolybdenum and molybdic oxide, are employed in gray iron and malleable castings. Molybdenum in various forms finds limited employment in the chemical, electrical, and ceramic industries, which account for about 10 percent of the total. A relatively small quantity of concentrates (50,000 to 75,000 pounds of contained molybdenum annually) is used by a few steel companies as an addition to the molten metal in the ladle to raise the sulfur content to improve machinability, in addition to gaining the benefit of the contained molybdenum. Molybdenum has been tested as a fertilizer for deficient soils.

The following information concerning the research and development program of the Climax Molybdenum Co. has been quoted from its annual report: [7]

Metallic molybdenum.—A large proportion of current research effort has been devoted to the development of methods of fabricating molybdenum and molybdenum-base alloys. The potential new applications for these materials depend largely upon the exceptionally high melting point of molybdenum which is about 4,750° F. as compared, for example, with a melting point of 2,800° F. for pure iron. Considerable progress was made during 1948 in the production of larger size

[6] Steel, High-Temperature Ceramic Coatings Developed for Molybdenum: Vol. 124, No. 4, January 24, 1949, p. 59.

[7] Climax Molybdenum Co., Annual Report: 1948, p. 3.

ingots and harder alloys. Field tests are under way for developing new uses for these materials.

Molybdenum steel for springs.—A substantial proportion of alloy steel production is used for vehicle springs. During 1948 our research work has been continued on the development of improved molybdenum alloy steels, and the efforts of our engineers have contributed to the more extensive use in this field. Special attention is being directed toward the European market where until recently there has been little use of molybdenum for this purpose.

Molybdenum sulfide.—There has been increased interest in the use of molybdenite as a lubricant. Our field engineers are continuing their efforts in this field and a program of research has been started.

Ceramics.—The use of molybdenum in vitreous enameling, on which we have been working for several years, has commenced in a small way, especially in "low-temperature" enamels.

Production and shipments of molybdenum products [1] in the United States, 1944–48, in pounds of contained molybdenum

Year	Production	Shipments		
		To domestic consumers	Exports [2]	Total
1944	30, 579, 800	31, 138, 500	1, 577, 500	32, 716, 000
1945	32, 406, 300	26, 977, 200	1, 327, 000	28, 304, 200
1946	15, 039, 100	16, 501, 700	442, 400	16, 944, 100
1947	20, 659, 700	19, 878, 500	866, 400	20, 744, 900
1948	24, 445, 300	23, 808, 900	1, 215, 800	25, 024, 700

[1] Comprises ferromolybdenum, molybdic oxide, and molybdenum salts and metal.
[2] Reported by producers to the Bureau of Mines.

STOCKS

The accompanying table shows industry stocks of molybdenum concentrates and products, 1944–48.

Industry stocks of molybdenum concentrates and products, Dec. 31, 1944–48

[Thousands of pounds]

Year	Molybdenum content			
	Concentrates [1]	Products [2]		Total
		Producers	Consumers	
1944	19, 321	6, 069	2, 671	28, 061
1945	16, 883	10, 176	2, 653	29, 712
1946	19, 275	8, 211	2, 582	30, 068
1947	23, 661	8, 126	2, 695	34, 482
1948	21, 206	7, 547	(3)	[4] 28, 753

[1] At mines and at plants making molybdenum products.
[2] Comprises ferromolybdenum, molybdic oxide, and molybdenum salts and metal.
[3] Figure not available.
[4] Excludes stocks of molybdenum products at consumers' plants.

PRICES

Since 1938 the published price, f. o. b. mines, of molybdenite in concentrates containing 90 percent MoS_2 has been 45 cents a pound (equivalent to 75 cents a pound of molybdenum contained). Molybdenite concentrates are shipped largely to processing plants for conversion to molybdic oxide, the form in which most molybdenum is employed in iron and steel plants. Some oxide, however, is employed in making ferromolybdenum and calcium molybdate, which are also used in the manufacture of iron and steel. The prices of the principal molybdenum products are based on a pound of contained molybdenum, f. o. b. producer's plant. Throughout 1948 molybdic oxide and calcium molybdate were quoted at 80 cents a pound and ferromolybdenum at 95 cents. Effective January 1, 1949, the price of molybdenite concentrates was increased to 54 cents a pound of MoS_2 (equivalent to 90 cents a pound of molybdenum contained); molybdic oxide and calcium molybdate were raised to 95 cents a pound of contained molybdenum and ferromolybdenum to $1.10.

FOREIGN TRADE [8]

Imports of molybdenum ore and concentrates into the United States for consumption are normally small, and in 1947 and 1948 none was received. Some molybdenum ore and concentrates are occasionally imported for conversion to molybdenum products, which are exported; no ore or concentrates were so imported in 1947 and 1948.

Exports of molybdenum concentrates were 4,132,341 pounds (contained molybdenum) in 1948 compared with 2,989,251 pounds in 1947. Taking 46 and 38.5 percent, respectively, the United Kingdom and France were the chief foreign markets in 1948.

Exports of ferromolybdenum were 1,188,949 pounds (gross weight) in 1948 compared with 953,034 pounds in 1947, and those of molybdenum metal and alloys were 56,303 pounds compared with 133,106 pounds in 1947.

Tariff.—The duty on molybdenum ores and concentrates continued to be 17½ cents a pound on the metallic molybdenum contained; and on ferromolybdenum, molybdenum metal and powder, calcium molybdate, and other compounds and alloys of molybdenum it was 50 cents a pound of molybdenum contained plus 15 percent ad valorem.

Molybdenum ore and concentrates exported from the United States, 1946–48, by countries

[U. S. Department of Commerce]

Country	1946		1947		1948	
	Molybdenum content (pounds)	Value	Molybdenum content (pounds)	Value	Molybdenum content (pounds)	Value
Argentina			2,050	$1,808		
Austria			6,589	5,502	10,000	$4,968
Canada	30,000	$24,000	101,650	81,320	159,230	104,336
Cuba	1,940	815				
Czechoslovakia			21,820	15,422		
France			555,840	418,509	1,591,210	1,161,353
Germany					131,060	74,945
Italy			392,378	294,433	63,201	48,945
Netherlands					13,384	10,567
Sweden	301,031	172,109	105,915	84,895	262,570	195,721
United Kingdom	231,153	173,365	1,803,009	1,330,296	1,901,686	1,397,898
Venezuela	800	735				
Total	564,924	371,024	2,989,251	2,232,185	4,132,341	2,998,733

[8] 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.

WORLD REVIEW

Despite the fact that molybdenum is produced in many parts of the world, the combined output of all countries other than the United States is less than 15 percent of the world total, and most of that comes from a few countries.

World production of molybdenum in ores and concentrates, by countries, 1940–48, in metric tons [1]

[Compiled by B. B. Mitchell]

Country [1]	1940	1941	1942	1943	1944	1945	1946	1947	1948
Australia	20	24	7	15	9	(2)	4	2	2
Austria	-------	-------	4	5	7	(2)	20	(3)	(3)
Canada	5	47	43	178	509	228	184	207	79
Chile	267	229	580	680	1,051	841	560	402	532
China:									
Manchuria [4]	(3)	75	384	516	516	30	(3)	(3)	(3)
Other Provinces [5]	7	5	3	(3)	(3)	(3)	(3)	(3)	(3)
Finland	47	148	126	108	110	92	99	(3)	-------
France	-------	-------	2	11	7	-------	(3)	(3)	(3)
Indochina, French	-------	-------	2	2	(2)	(3)	(3)	(3)	-------
Italy	21	26	17	9	(2)	-------	(3)	(3)	(3)
Japan	[6] 13	[6] 41	[6] 56	[6] 87	[6] 189	[6] 108	52	18	1
Korea, South	83	122	217	291	394	54	-------	5	2
Mexico	310	522	855	1,138	717	468	818	136	-------
Morocco, French	35	31	6	7	-------	-------	39	32	-------
Norway	287	229	368	227	248	76	10	103	79
Peru	166	146	154	85	62	29	4	3	3
Sweden	-------	-------	-------	12	20	3	-------	-------	(3)
United States	15,564	18,309	25,829	27,972	17,545	13,972	8,264	12,268	12,114
Total (estimate)	17,200	20,300	29,000	31,400	21,400	15,900	10,800	14,000	13,600

[1] Molybdenum is also produced in Greece, Rumania, Turkey, U. S. S. R., and Yugoslavia, but production data are not available. Estimates by author of chapter are included in total.
[2] Less than 1 ton.
[3] Data not yet available; estimate by author of chapter included in total.
[4] Exports to Japan proper.
[5] Data represent areas designated as Free China during the period of Japanese occupation.
[6] Preliminary data for fiscal year ended Mar. 31 of year following that stated.

Canada.—According to the Dominion Bureau of Statistics, production of molybdenite in Canada was 291,150 pounds in 1948 compared with 759,795 pounds in 1947. The output in both years came from Quebec, presumably from the La Corne mine.

Chile.—Since 1939 Chile has been a regular producer of molybdenite concentrate. Output of molybdenite in Chile was 887 metric tons in 1948 compared with 669 tons in 1947.

Finland.—Operations at the Mätäsvaara molybdenum mine in Pielisjarvi were discontinued in July 1947 and the equipment has been sold and moved to the Aijala copper mine of Outokumpu Oy.[9] Presumably the Mätäsvaara mine was the only producer of molybdenum ore in Finland.

French Morocco.—French Morocco had a small but regular annual production of molybdenite in 1929–30 and from 1933 through 1941, but from 1942 through 1945 there was little or no output. Operation was resumed in 1946, when 79 metric tons of concentrates were produced; output was 60 tons averaging 88 percent MoS_2 in 1947. The deposits are in the Atlas Mountains, Azegour district, 12 miles from Amismiz.

[9] Kaukokallio, Elvi, American Legation, Helsinki, Finland, June 7, 1948.

Japan.[10]—Production of molybdenum in Japan reached a peak in 1944, when an average monthly output of 26.2 metric tons of concentrates containing 80 percent MoS_2 was recorded. Mining of molybdenum was temporarily suspended at the end of the war but was resumed on a small scale in October 1945, and 113 tons of concentrates were produced in 1946. The average monthly output dropped to 2.1 tons in 1947, and in February and in March 1948 production was only 0.7 ton. The Japanese molybdenum deposits are small and of low grade, and high Government subsidies have been paid in the past.

Mexico.—During 1947 mining of the deeper ores, in which molybdenum is a constituent, was discontinued by the Greene Cananea Copper Co., Cananea, Sonora, which had been recovering molybdenite concentrate since 1933. Consequently, there was no production of molybdenite by this company in 1948 compared with 344,668 pounds in 1947.

Norway.—Production of molybdenite in Norway was 132 metric tons in 1948 compared with 172 tons in 1947. The Knaben deposits, 40 miles east of Stavanger, are the principal sources of production.

United Kingdom.—Imports of molybdenum concentrates into the United Kingdom were 2,287 long tons in 1948 compared with 2,309 tons in 1947.

[10] Mining Journal (London), vol. 231, No. 5908, November 13, 1948, p. 842.

Natural Gas

By F. S. LOTT, J. G. GROSSMAN and H. BACKUS

GENERAL SUMMARY

RESPONDING to an ever-growing demand, marketed production of natural gas expanded 12 percent to an all-time high of 5,148 billion cubic feet in 1948. These figures are estimated to include gas stored and gas lost in transmission and reflect the sale at wells rather than at points of ultimate consumption, as in past practice. All major classes of consumers except carbon-black manufacturers used more gas during 1948. Domestic sales soared 12 percent to 896 billion cubic feet, influenced by record sales of gas ranges, refrigerators, and near-record sales of water heaters. At the same time that the Federal Reserve Board index of industrial production rose 3 per-

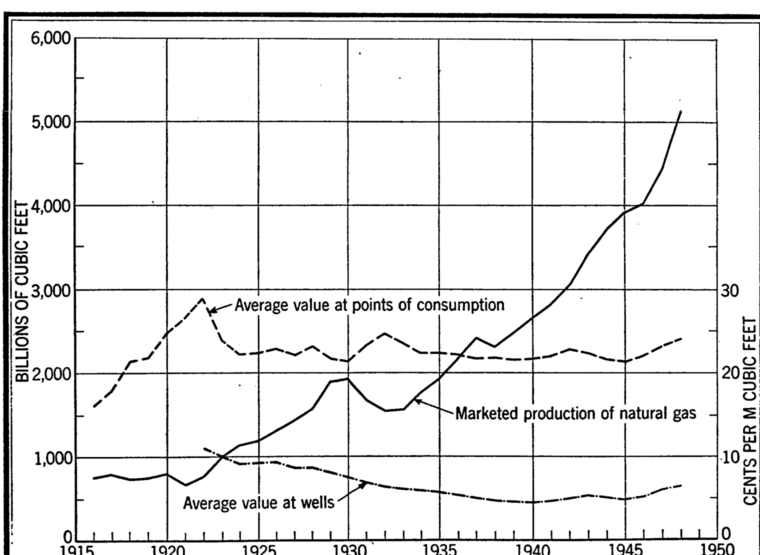

FIGURE 1.—Production and value of natural gas in the United States, 1916–48.

Salient statistics of natural gas in the United States, 1944–48

	1944	1945	1946	1947	1948
Supply:					
Marketed production:[1]					
California .... millions of cubic feet	502,017	502,442	487,904	560,510	570,954
Louisiana .... do	534,688	542,789	525,178	581,398	686,061
Oklahoma .... do	310,888	357,530	380,938	419,010	480,573
Texas .... do	1,525,515	1,711,401	1,776,148	1,992,704	2,289,923
West Virginia .... do	181,452	160,225	178,958	192,233	203,681
Other States .... do	656,479	644,299	681,479	836,318	916,828
Total production[1] .... do	3,711,039	3,918,688	4,030,605	4,582,173	5,148,020
Total withdrawn from storage .... do	33,585	36,167	56,138	86,643	79,035
Total supply .... do	3,744,624	3,954,853	4,086,743	4,668,816	5,227,055
Disposition:					
Consumption:					
Domestic .... do	562,183	607,400	660,820	802,150	896,348
Commercial .... do	220,747	230,099	241,802	285,213	323,054
Industrial:					
Field .... do	855,180	916,952	897,809	933,761	1,021,513
Carbon-black plants .... do	355,770	431,830	478,349	484,882	480,646
Petroleum refineries .... do	315,311	338,458	331,520	363,892	441,470
Portland-cement plants .... do	35,588	38,349	58,004	60,499	72,139
Other industrial .... do	1,351,684	1,337,391	1,344,626	1,496,147	1,709,979
Total consumption .... do	3,696,463	3,900,479	4,012,930	4,426,544	4,945,149
Used at electric public-utility power plants[2] .... millions of cubic feet	359,745	326,190	306,924	373,037	478,097
Exports .... do	14,576	18,207	17,675	18,149	18,704
Total stored .... do	43,502	61,502	75,458	96,316	136,406
Lost in transmission, etc .... do	(3)	(3)	(3)	127,807	126,796
Total disposition .... do	3,754,541	3,980,188	4,106,063	4,668,816	5,227,055
Number of consumers:					
Domestic .... thousands	10,669	10,959	11,472	12,204	13,508
Commercial .... do	845	889	965	1,039	1,145
Industrial[4] .... do	43	46	50	50	59
Number of producing gas wells	58,780	60,660	62,740	63,670	(3)
Value (at wells) of gas produced:					
Total .... thousands of dollars	189,809	191,006	212,251	274,709	333,173
Average per M cubic feet .... cents	5.1	4.9	5.3	6.0	6.5
Value of gas consumed at point of consumption:					
Domestic .... thousands of dollars	388,359	415,122	447,018	526,355	585,188
Commercial .... do	92,137	97,572	102,566	125,844	142,170
Industrial .... do	313,775	321,501	332,772	376,119	466,201
Total value .... do	794,271	834,195	882,356	1,028,318	1,193,559
Average per M cubic feet:					
Domestic .... cents	69.1	68.3	67.6	65.6	65.3
Commercial .... do	41.7	42.4	42.4	44.1	44.0
Industrial .... do	10.8	10.5	10.7	11.3	12.5
Domestic and commercial .... do	61.4	61.2	60.9	60.0	59.6
Domestic, commercial, and industrial .... cents	21.5	21.4	22.0	23.2	24.1
Treated for natural gasoline:					
Quantity .... millions of cubic feet	3,300,000	3,653,870	3,663,760	4,070,150	4,267,500
Ratio to total consumption	.89	.94	.91	.92	.86

[1] Figures exclude in 1944–46 and include in 1947–48 gas stored and lost in transmission.
[2] This statistical series, compiled by the Federal Power Commission, includes manufactured gas and is therefore shown separately. However, the natural gas portion is assumed to be included with "Other industrial" consumption shown above.
[3] Figure not available.
[4] Exclusive of oil- and gas-field operators

cent over the 1947 performance, commercial and industrial consumption of natural gas increased 13 and 12 percent, respectively. Gas used in the manufacture of carbon black was 1 percent below the 1947 record, the first decline since 1943. Gas used as fuel at petroleum refineries, electric-public utility power plants, and portland-cement plants was 21, 28, and 19 percent, respectively, over the 1947 volumes.

The average value of natural gas at the wells is estimated to have risen from 6.0 cents per thousand cubic feet in 1947 to 6.5 cents in 1948. The strong market for natural gas resulted in gains in field prices in many areas.

The number of domestic meters increased from 12,204,000 in 1947 to 13,508,000 in 1948 and commercial customers from 1,039,000 to 1,145,000. The small movement of natural gas to Canada continued, amounting to 193 million cubic feet in 1948 compared with 207 million in 1947. Deliveries to Mexico increased from 17,942 million cubic feet in 1947 to 18,511 million in 1948.

OUTLOOK

The trend toward relatively lower prices of natural gas compared with other fuels and the concomitant increase in public demand forecast continuance of the vigorous growth of the natural-gas industry in the immediate future. Although the amount spent on construction in 1948 (chiefly for interstate transmission lines) was more than eight times the combined amount spent for natural, manufactured, and mixed gas 10 years ago, pipe-line construction will not have its full effect on 1949 consumption because of the 3 or 4 years required for completing projects. Planned expenditures will gradually taper off; but shortages, particularly of large-diameter steel pipe, are still expected to delay completion of expanded distribution and production projects.

The present importance of the natural-gas industry is attested to by the fact that its pipe-line system exceeds railroad mileage in the Nation and far exceeds oil-pipe-line mileage. Although sales and number of customers gained materially in 1948, reserves increased faster than gas consumed or lost. Much of this gain was due to the record exploration and development under way in the oil industry, which had an important auxiliary result in the discovery of more gas. The accumulation of increased stocks of petroleum in 1948, followed by the curtailment of production, may affect exploration and incidental discovery of gas.

A factor tending to conserve existing supplies is the interest shown in certain quarters—particularly by the Texas Railroad Commission—in ending all gas flaring where economically possible. Gas-transmission companies are working with producers to tie more casinghead production into their lines.

Change-overs to straight natural gas resulted in decreases in sales and number of consumers of manufactured and mixed gas. In view of the continuation of high construction costs, this tendency to convert from manufactured to natural or mixed gas rather than to expand existing plants to meet increased demands may be expected to continue.

Another factor tending to increase gas consumption is the continued expansion of use in appliances and equipment. The sale of water heaters and central heating units, which declined in 1948, should gain as the steel shortage eases.

Some price changes may be expected as a result of several factors. Higher costs of materials and labor have already resulted in raises in field prices by a few producers. Transmission-line construction costs are almost double the prewar level. The Supreme Court decision holding that the Federal Power Commission could not regulate the disposal of a natural-gas company's field properties may facilitate the upward revision of gas rates. Some of the higher costs for labor and materials have been met by extending the trend toward automatic control devices to every phase of the gas industry.

Underground storage has already proved its usefulness in expanding effective peak-load capacity, and new process equipment with considerably increased capacity will likewise help to augment winter capacity. New domestic applications of natural gas, recently developed, promise sustained demand at high levels. In the industrial field, the savings in labor cost and processing time likewise insure further progressive development in the applications of natural gas as a source of heat. Completion of unfinished and planned long-distance pipe lines will consolidate the position of Texas and contiguous States as the heart of the natural-gas arteries of the Nation.

GOVERNMENT REGULATIONS

The United States Department of the Interior announced in 1948 the first agreement under legislation enacted in 1946, authorizing it to permit the subsurface storage of oil or gas on Federal land. Though covering but a small portion of the Michigan gas fields, this established an important precedent, and several other applications are pending.

In May 1948, the United States Supreme Court dismissed Republic Natural Gas Co.'s appeal from a decision of the Oklahoma Supreme Court requiring it to take gas ratably from a well owned by the Peerless Oil & Gas Co. in the Hugoton field. The Oklahoma commission found that Republic, which has a pipe line, was draining gas from underneath the section where the Peerless well was drilled, thus preventing Peerless, which has no pipe line or market, from taking its proportionate share. The commission, sustained by the court, said

Oklahoma law required Republic to buy gas from Peerless under such circumstances.

The Texas Railroad Commission continued its efforts to reduce flaring by ordering operators in 17 Texas oil fields to shut-in all wells where the produced gas was not being put to "lawful use," effective in December 1948. The commission cited operators in 26 more fields for hearing January 25, 1949. Operators obtained injunctions for a court test in fields previously ordered closed in.

The United States Circuit Court of Appeals set aside an order of the Federal Power Commission making the Border Pipe Line Co. of Texas subject to regulations of the commission, ruling that the FPC did not have power to regulate natural-gas companies which sell intrastate or for export. The FPC continued to find it necessary to allocate inadequate pipe-line capacities. It also issued new and amended regulations effective December 1, 1948. In December 1948, the FPC stated that the statutes of Missouri do not confer jurisdiction upon the Missouri Public Service Commission in cases involving Missouri sales by an interstate pipe-line company.

In June 1948, a United States Court of Appeals upheld a FPC order rejecting a company's claim that it had exclusive rights to service the Detroit and Ann Arbor markets under the grandfather clause of the Natural Gas Act and under well-established public utility law. The court held that nothing in the Natural Gas Act suggests that the Congress preferred monopoly to competition.

The Senate Commerce Committee rejected the Moore-Rizley bill, which would have changed the Natural Gas Act of 1938 by limiting the powers of the Federal Power Commission.

In June 1949 the Supreme Court, in an important decision, ruled that the Federal Power Commission could not regulate disposal of a natural-gas company's reserve fields.

RESERVES

The Committee on Natural Gas Reserves of the American Gas Association reported reserves of 173,869,340 million cubic feet at the end of 1948. This represented a 4.8-percent increase over the 1947 figure in spite of a record production year. The proved reserves of natural gas in the United States have increased more than 700 percent since 1925 and more than 230 percent in the past 10 years. The following table lists the committee's estimates of changes during 1948 and totals as of December 31, 1948, by States.

American Gas Association estimates of the proved reserves of natural-gas liquids (including condensate, natural gasoline, and liquefied petroleum gases) in the United States total 3,540,783,000 barrels as of December 31, 1948. This represents a gain of 286,808,000 over the 1947 year-end figure of 3,253,975,000 barrels.

Estimated proved recoverable reserves of natural gas in the United States, 1947–48, in millions of cubic feet [1]

[Committee on natural gas reserves, American Gas Association]

State	Reserves as of Dec. 31, 1947	Changes in reserves during 1948 [2]				Reserves as of Dec. 31, 1948 [2]				
		Extensions and revisions	Discoveries of new fields and new pools in old fields	Net change in underground storage [3]	Net production [4]	Total	Nonassociated [5]	Associated [6]	Dissolved [7]	Underground storage [8]
Arkansas	890, 149	73, 969	3, 484	−10	65, 754	901, 838	457, 906	161, 919	280, 568	1, 445
California	10, 164, 356	498, 673	111, 257	−2, 699	578, 994	10, 192, 593	2, 911, 991	3, 052, 802	4, 215, 775	12, 025
Colorado	331, 866	621, 577	408, 148	----------	12, 412	1, 349, 179	586, 757	40, 939	721, 483	----------
Illinois	221, 131	43, 310	----------	----------	36, 637	227, 804	7, 967	20, 000	199, 837	----------
Indiana	13, 000	14, 104	----------	----------	5, 504	21, 600	6, 000	----------	15, 600	----------
Kansas	14, 556, 916	124, 304	2, 385	1, 213	276, 986	14, 407, 832	13, 959, 636	210, 292	211, 035	26, 869
Kentucky	1, 379, 480	69, 775	9, 000	7, 896	88, 000	1, 378, 151	1, 295, 122	----------	73, 000	10, 029
Louisiana	23, 481, 233	532, 638	722, 859	----------	759, 210	23, 977, 520	18, 909, 691	3, 490, 004	1, 577, 825	----------
Michigan	168, 469	14, 490	11, 705	10, 461	22, 138	182, 987	121, 502	----------	45, 876	15, 609
Mississippi	2, 452, 760	54, 413	52, 423	----------	55, 260	2, 504, 336	1, 743, 948	464, 632	295, 756	----------
Montana	700, 510	189, 244	1, 966	1, 575	40, 690	852, 605	485, 030	337, 121	28, 879	1, 575
New Mexico	5, 990, 283	−214, 670	108, 930	989	279, 171	5, 606, 361	2, 824, 102	1, 991, 862	786, 557	3, 840
New York	64, 900	4, 098	----------	3, 073	4, 456	67, 615	59, 720	----------	725	7, 170
Ohio	611, 200	57, 780	7, 880	13, 325	60, 732	629, 453	542, 608	----------	38, 500	48, 345
Oklahoma	11, 350, 864	447, 543	208, 636	−283	674, 315	11, 332, 445	7, 660, 624	1, 125, 136	2, 534, 088	12, 597
Pennsylvania	483, 063	182, 967	12, 000	13, 972	74, 592	617, 410	530, 721	----------	45, 750	40, 939
Texas	90, 025, 566	6, 563, 060	1, 830, 349	----------	2, 710, 422	95, 708, 553	68, 663, 367	16, 725, 023	10, 320, 163	----------
Utah	66, 670	----------	10, 000	----------	6, 872	69, 798	69, 798	----------	----------	----------
West Virginia	1, 780, 735	123, 462	37, 000	1, 970	206, 000	1, 737, 167	1, 622, 235	----------	89, 500	25. 432
Wyoming	1, 191, 788	363, 063	588, 067	----------	49, 178	2, 093, 740	927, 796	257, 308	908, 636	----------
Other States [9]	1, 975	5, 683	3, 000	----------	305	10, 353	7, 993	----------	2, 360	----------
Total	165, 926, 914	9, 769, 483	4, 129, 089	51, 482	6, 007, 628	173, 869, 340	123, 394, 514	27, 877, 038	22, 391, 913	205, 875

[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] Excludes shrinkage caused by recovery of natural gas liquids.
[3] The net difference between gas stored in and gas withdrawn from underground storage reservoirs.
[4] Net production equals gross withdrawals less gas injected into underground reservoirs; changes in underground storage are excluded.
[5] Nonassociated gas is free gas not in contact with crude oil in the reservoir.
[6] Associated gas is free gas in contact with crude oil in the reservoir.
[7] Dissolved gas is gas in solution with crude oil in the reservoir.
[8] Gas held in underground reservoirs for storage purposes only.
[9] Alabama, Florida, Missouri, Nebraska, and Virginia.

PRODUCTION

GROSS PRODUCTION

The estimated gross production of natural gas in the United States in 1947 increased 9 percent over 1946—from 6,190,200 million to 6,733,230 million cubic feet. Continuing an earlier trend, straight gas-well production declined 1 percent from 3,807,500 million cubic feet in 1946 to 3,769,768 million in 1947, while gas obtained from oil wells increased 24 percent to 2,963,462 million feet in 1947. The States with the greatest total production in 1947 were Texas, Louisiana, California, and Oklahoma. Mississippi experienced the largest proportionate gain, 65,980 million cubic feet compared with 22,700 million in 1946. Texas made the largest gain in 1947. A few States, mainly in the Appalachian area (including New York, Pennsylvania, and West Virginia), showed declines. Much of the production from the Gulf States was transported to the east and to California.

Gross production and disposition of natural gas in the United States in 1947, by States, in millions of cubic feet

State	Production [1]			Disposition		
	From gas wells	From oil wells	Total	Marketed production [2]	Repressuring	Losses and waste [3]
Arkansas	34,000	40,000	74,000	50,630	11,890	11,480
California	209,700	494,600	704,300	560,510	135,363	8,427
Colorado	5,400	5,900	11,300	8,392	300	2,608
Illinois	400	48,000	48,400	17,023	5,200	26,177
Indiana	630	1,460	2,090	877	1,200	13
Kansas	151,000	92,500	243,500	209,321	1,814	32,365
Kentucky	87,860	10,150	98,010	96,459	1,491	60
Louisiana	466,100	386,500	852,600	581,398	164,934	106,268
Michigan	14,000	24,300	38,300	18,812	133	19,355
Mississippi	27,840	38,140	65,980	40,037	10,813	15,130
Missouri	38		38	38		
Montana	31,560	3,440	35,000	34,282	270	448
New Mexico	27,590	208,570	236,160	142,740	3,741	89,679
New York	4,480	250	4,730	4,600	130	
Ohio	68,860	4,000	72,860	68,946	3,914	
Oklahoma	282,060	367,620	649,680	419,010	16,500	214,170
Pennsylvania	87,070	5,000	92,070	91,971	67	32
Texas	2,038,000	1,204,000	3,242,000	1,992,704	710,302	538,994
Utah	6,040		6,040	6,040		
West Virginia	190,310	7,500	197,810	192,233	3,579	1,998
Wyoming	36,240	21,500	57,740	45,550	11,478	712
Other States [4]	590	32	622	600		22
Total	3,769,768	2,963,462	6,733,230	4,582,173	1,083,119	1,067,938

[1] Marketed production plus quantities used in repressuring, lost, and wasted (see footnote 3).
[2] New basis; includes gas stored and lost in transmission.
[3] Includes gas (mostly residue) blown to the air but does not include direct waste on producing properties, except where data are available.
[4] Florida, North Dakota, South Dakota, Tennessee, and Virginia.

An aggregate of 5,640,438 million cubic feet was withdrawn from reserves and consumed or lost in 1947. This figure was obtained by subtracting from estimated gross production the amounts returned to underground reservoirs for repressuring, pressure maintenance, and storage. The increase in withdrawals of 10 percent over 1946 indicates the rate at which the Nation's reserves of gas are being depleted.

Underground storage of natural gas increased 28 percent from 75,458 million cubic feet in 1946 to 96,316 in 1947. In the Eastern States, increasing reliance on gas from interstate pipe lines continued. In West Virginia large quantities of gas were stored in old pools for peak-load delivery, and three underground storage projects were completed or planned. Several liquefied-petroleum-gas storage plants were built to store some of the heavier and richer fractions of natural gas, such as propane and butane, in liquid form to be regassified as the need occurs. Expanded transportation facilities brought increased quantities of Texas gas directly to consuming centers in Ohio, New York, and Pennsylvania.

Natural gas stored underground in and withdrawn from storage fields, by States of location, 1946–47, in millions of cubic feet

State	1946			1947		
	Total stored	Total withdrawn	Net stored	Total stored	Total withdrawn	Net stored
Arkansas	1,189		1,189	7		7
California	14,173	9,731	4,442	9,297	11,291	−1,994
Illinois	451		451	294	5	289
Indiana	345	67	278	544	433	111
Kansas	7,527	7,866	−339	11,323	8,790	2,533
Kentucky	1,361	914	447	1,149	1,932	−783
Michigan	1,118	2,481	−1,363	4,712	8,804	−4,092
Montana	621	186	435	1,377	608	769
New Mexico	1,417	83	1,334	261	87	174
New York	2,293	780	1,513	2,668	2,702	−34
Ohio	14,534	10,571	3,963	18,136	15,979	2,157
Oklahoma	4,098	1,314	2,784	4,987	3,776	1,211
Pennsylvania	12,147	9,667	2,480	19,230	15,297	3,933
Texas		425	−425	4,012	27	3,985
West Virginia	14,180	12,053	2,127	17,692	16,907	785
Wyoming	4		4	627	5	622
Total	75,458	56,138	19,320	96,316	86,643	9,673

Total gas withdrawn from storage increased 54 percent from 56,138 million cubic feet in 1946 to 86,643 million in 1947. The figures show steady growth in storage and withdrawal, and there is little doubt that the practice of storing gas to assure steady supplies during peak seasonal periods will continue to expand.

Losses and waste other than gas lost in transmission totaled 1,067,938 million cubic feet in 1947. Although casinghead-gas conservation projects saving millions of cubic feet daily were completed, under construction, or planned in Texas, that State still led the Nation in gas waste with 538,994 million cubic feet, followed by Oklahoma with 214,170 million.

After decreasing 23,709 million cubic feet in 1946 (2 percent), the amount of gas used for repressuring and pressure maintenance increased 4 percent to 1,083,119 million in 1947, mainly due to gains in Louisiana and Texas. Texas accounted for 65.6 percent, Louisiana

15.2, and California 12.5 percent of the total volume of gas used for repressuring.

The growth in repressuring and pressure maintenance is closely related to cycle-plant operation. Texas, California, and Louisiana (where 93.3 percent of all gas returned to formations was reported in 1947) were also leading in natural-gasoline and cycle-plant production during that year.

MARKETED PRODUCTION

Marketed production in 1947 is reported on a new basis and includes gas stored and lost in transmission, in order to reflect more accurately actual field conditions. Figures therefore are not comparable with 1946 and earlier records, which include only gas used by the ultimate consumer. In all 4,582,173 million cubic feet of gas were marketed in 1947. Texas, Louisiana, California, and Oklahoma being the four leading producing States.

The average wellhead value of natural gas in the United States increased from 5.3 cents per thousand cubic feet in 1946 to 6.0 cents in 1947, reflecting sustained demand. The average in the Gulf States was 3.7 cents in 1947 compared with 3.3 cents in 1946. California experienced a sharper increase from 7.4 to 10.2 cents in the same period, and the combined average for New York, Ohio, Pennsylvania, and West Virginia declined from 21.3 to 20.8 cents.

Marketed production of natural gas in the United States, by States, 1943–47, in millions of cubic feet

Year	Arkansas	California	Colorado	Illinois	Indiana	Kansas	Kentucky	Louisiana	Michigan	Mississippi	Montana	New Mexico
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	1,352	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
1946	45,177	487,904	6,728	17,166	1,094	165,725	70,396	525,178	20,879	7,225	30,713	119,262
1947 [1]	50,630	560,510	8,392	17,023	877	209,321	96,459	581,398	18,812	40,037	34,282	142,740

Year	New York	Ohio	Oklahoma	Pennsylvania	Texas	West Virginia	Wyoming	Other States	Total	Value at wells: Total (thousands of dollars)	Value at wells: Average (cents per M)
1943	8,062	52,001	285,045	93,543	1,323,885	223,787	34,351	4,858	3,414,689	176,893	5.2
1944	7,052	51,724	310,888	92,987	1,525,515	181,452	34,521	6,660	3,711,039	189,809	5.1
1945	9,210	49,967	357,530	82,188	1,711,401	160,225	35,282	6,946	3,918,686	191,006	4.9
1946	5,084	61,570	380,938	92,443	1,776,148	178,958	33,266	4,751	4,030,605	212,251	5.3
1947 [1]	4,600	68,946	419,010	91,971	1,992,704	192,233	45,550	6,678	4,582,173	274,709	6.0

[1] New basis: includes gas stored and lost in transmission.

Natural gas produced and consumed in the United States in 1947, by States

State	Marketed production [1]				Consumption (including receipts from other States)			
	Quantity [1]		Estimated value at wells		Quantity		Value at points of consumption	
	Millions of cubic feet	Percent of total	Total (thousands of dollars)	Average per M (cents)	Millions of cubic feet	Percent of total	Total (thousands of dollars)	Average per M (cents)
Alabama					50,713	1.1	$11,759	23.2
Arizona					27,768	.6	8,242	29.7
Arkansas	50,630	1.1	1,818	3.6	102,779	2.3	14,562	14.2
California	560,510	12.2	57,284	10.2	548,382	12.4	171,552	31.3
Colorado	8,392	.2	660	7.9	49,027	1.1	14,372	29.3
District of Columbia					8,474	.2	7,831	92.4
Florida	8	(2)	(3)	3.2	7,891	.2	1,617	20.5
Georgia					41,368	.9	14,046	34.0
Illinois	17,023	.4	1,565	9.2	132,153	3.0	65,480	49.5
Indiana	877	(2)	80	9.1	42,528	1.0	24,641	57.9
Iowa					40,948	.9	16,313	39.8
Kansas	209,321	4.6	10,598	5.1	191,952	4.3	38,195	19.9
Kentucky	96,459	2.1	14,430	15.0	36,938	.8	15,564	42.1
Louisiana	581,398	12.7	21,221	3.6	375,206	8.5	38,906	10.4
Maryland					3,402	.1	3,413	100.3
Michigan	18,812	.4	2,386	12.7	80,571	1.8	53,893	66.9
Minnesota					43,198	1.0	15,886	36.8
Mississippi	40,037	.9	1,989	5.0	52,461	1.2	12,063	23.0
Missouri	38	(2)	5	13.2	78,101	1.8	32,542	41.7
Montana	34,282	.8	1,560	4.6	30,919	.7	8,431	27.3
Nebraska					39,699	.9	15,034	37.9
New Mexico	[4] 142,740	3.1	2,526	1.8	102,766	2.3	8,922	8.7
New York	[5] 4,600	.1	1,118	24.3	41,572	.9	31,112	74.8
North Dakota	442	(2)	14	3.2	2,608	.1	1,153	44.2
Ohio	68,946	1.5	13,548	19.7	221,571	5.0	117,222	52.9
Oklahoma	419,010	9.1	16,509	3.9	254,522	5.7	34,000	13.4
Pennsylvania	[6] 91,971	2.0	21,816	23.7	175,906	4.0	78,453	44.6
South Dakota	6	(2)	(3)	6.0	8,016	.2	3,077	38.4
Tennessee	80	(2)	5	6.3	33,986	.8	11,303	33.3
Texas	[7] 1,992,704	43.5	73,331	3.7	1,444,422	32.6	114,394	7.9
Utah	6,040	.1	324	5.4	20,919	.5	6,206	29.7
Virginia	64	(2)	6	9.4	3,055	.1	3,438	112.5
West Virginia	192,233	4.2	29,643	15.4	106,105	2.4	29,400	27.7
Wisconsin					267	(2)	329	123.2
Wyoming	45,550	1.0	2,273	5.0	26,351	.6	4,967	18.8
Total 1947	4,582,173	100.0	274,709	6.0	4,426,544	100.0	1,028,318	23.2

[1] New basis; includes gas stored and lost in transportation.
[2] Less than 0.05 percent.
[3] Less than $500.
[4] Includes 3,077 million cubic feet piped to Mexico.
[5] Includes 28 million cubic feet piped to Canada.
[6] Includes 179 million cubic feet piped to Canada.
[7] Includes 14,865 million cubic feet piped to Mexico.

NUMBER OF WELLS

Gas-well completions dropped from 3,353 in 1947 to 2,897 in 1948, with sharp drops in Michigan, Ohio, Pennsylvania, and West Virginia. Declines also occurred in some of the Rocky Mountain States, including Montana, Wyoming, and New Mexico. Casing and line-pipe shortages at the Bowdoin and Cedar Creek fields caused most of the decline in Montana. Texas continued to lead in number of completions, with 542. California drilled only 21 wells, compared to 45 in 1947.

The number of producing gas wells increased during 1947 from 62,740 to 63,670 at the close of the year. States with large total increases included Kansas and Oklahoma (550), West Virginia (500), Texas (200), and Louisiana (100).

The total number of gas wells (net) abandoned or shut-in during 1947 was 2,423. Of this number 1,400 were in the Ohio-Pennsylvania-New York area, and 337 were in Texas.

Gas wells in the United States, 1946–48, by States

State	Producing Dec. 31, 1946	Drilled during 1947 [1]	Producing Dec. 31, 1947	Drilled during 1948 [1]
Arkansas	180	10	160	5
California	310	45	350	21
Colorado	20	7	20	10
Illinois	90	9	100	11
Indiana	840	35	830	40
Kansas	2,400	400	2,700	382
Kentucky	[2] 3,390	110	[2] 3,350	151
Louisiana	2,000	105	2,100	133
Michigan	750	150	760	30
Mississippi	30	29	60	16
Missouri	110	2	100	3
Montana	650	93	700	69
New Mexico	170	63	220	44
New York	1,830	10	1,700	----------
Ohio	7,200	580	7,190	407
Oklahoma	3,000	269	3,250	258
Pennsylvania	19,500	270	19,100	228
Tennessee	(2)	----------	(2)	1
Texas	4,800	537	5,000	542
West Virginia	15,300	610	15,800	535
Wyoming	140	19	150	7
North Dakota, South Dakota, Utah, and Virginia	30	----------	30	4
Total	62,740	3,353	63,670	2,897

[1] From Oil and Gas Journal and State sources.
[2] Tennessee included with Kentucky.

DEVELOPMENT AND PRODUCTION BY STATES

Arkansas.—Data supplied by J. W. Saunders, Arkansas Oil and Gas Commission, indicate that the increased gas production in 1948 was due primarily to additional development in established fields. The output of the controlled oil and condensate fields in south Arkansas declined slightly from 65,984 million cubic feet in 1947 to 65,636 million in 1948. About 6,000 million cubic feet were vented. In the dry-gas fields of north Arkansas, where the White Oak field was extended in 1948, 4,812 million cubic feet of gas were produced in 1947 and 5,703 million in 1948. The Columbia pool remained shut-in during 1948 because of the lack of a market for the gas. No dry-gas discoveries were reported.

California.—According to the California State Department of Natural Resources, total withdrawals of gas in California for 1948 were 571,643 million cubic feet compared with 551,145 for 1947, a gain of 4 percent. Production totaled 189,682 million cubic feet of gas from dry-gas fields, 415,735 million cubic feet of wet gas from oil fields, and 26,480,000 barrels of natural-gas liquids (including condensate). Losses due to processing at gasoline plants aggregated 33,774 million cubic feet.

In northern California, during 1948, the Pacific Gas & Electric Co. added approximately 30 miles of high-pressure transmission mains. Its gathering system in the Rio Vista field is connected to a total of 145 active gas wells. In southern California, the Southern California Gas Co. completed approximately 73 miles of transmission mains in

Riverside and Imperial Counties, extending from the 30-inch Texas-California line to the United States-Mexico border. This service will reach several communities not heretofore supplied with utility gas, some of which have converted to natural gas from liquefied petroleum gas. Other pipe lines constructed included 14 miles of 30-inch in the Pasadena area and 6 miles of expanded gathering lines in the Trico field area to connect with recently developed production in the northwest extension of the field.

A 1,000-horsepower compressor unit was installed in Playa del Rey underground storage field, where a maximum withdrawal of about 100 million cubic feet per day was attained—an increase over the 1945 rate of 72 million. Owing to the strategic location of this storage structure near the heart of the Los Angeles load center, it has been used to a great degree in hourly load equation in addition to daily and seasonal equation, for which it was originally planned. Another storage reservoir, in Santa Barbara County, operated for the purpose of daily and seasonal load equation only, is in the La Goleta field. It has increased its maximum daily delivery capacity from 215 million in 1945 to 222.5 million cubic feet as of January 10, 1949.

The great demand for natural gas in southern California during the severe winter of 1948–49 caused increased withdrawal from storage. Measures are being taken to provide additional pipe lines to the San Diego area to preclude a recurrence of the shortages experienced during the past winter. Utilization of natural gas by domestic and commercial consumers increased 17 percent and by industrial users 19 percent.

The California subcommittee on statistics of exploratory drilling, Graham B. Moddy, chairman, recorded nine new fields and pools discovered in 1948, none rated as a major discovery. Together with extensions, these added 8 million barrels to natural-gas-liquids reserves and 240 billion cubic feet to gas reserves. Of 488 completions in 1948, only 33 were drilled primarily to find gas. Of these, eight were successful, including two wildcats. Three outposts were finished as discovery wells of new pools. Wildcats discovered three gas fields and one gas pool.

Among the new field wildcats, a Solano County discovery had a rated initial production of 7 million cubic feet a day in the Denverton field. Another, in Yolo County, rated 6.45 million cubic feet from the Martinez. A successful new-pool wildcat in Santa Barbara County showed an initial production of 2,155 thousand cubic feet per day from the Seape formation. Among the deeper and shallower pool tests, one Cretaceous well in Solano County yielded an initial production of 4.7 million cubic feet.

Estimated natural-gas-liquids reserves totaled 307,908,000 barrels on December 31, 1948, a decrease of 4,243,000 barrels during 1948. Gas reserves at the end of the year were 10,192,593 million cubic feet, an increase of 28,237 million over 1947.

Rio Vista led in activity among dry-gas fields, with 9 completions out of a total of 23 completions for all dry-gas fields.

Colorado.—New discoveries increased in Colorado in 1948, according to J. R. Schwabrow, Federal Geological Survey. An 8,286-foot well at Dove Creek produced 5,200,000 cubic feet of gas and 528 barrels of condensate per day from the Hermosa or Paradox sand at

5,910–5,934 feet. Another (an extension of a New Mexico field) at Barker Creek produced 113,000,000 cubic feet after acidizing in the Paradox. An old McElmo well, deepened, flowed 40,000,000 cubic feet of carbon dioxide gas from the Devonian at 6,805–6,965 feet. A 4,902-foot well at Pagoda, which had an initial production of 7,700,000 cubic feet in the Shinarump at 3,957–4,047 feet, was shut in for the winter. Drill-stem tests in the Dakota and Entrada formations indicated 7 to 8 million cubic feet, with a CO_2 content of 57 percent in the Entrada. Further tests are planned.

Development wells were completed at the Douglas Creek (2), Hiawatha, West Hiawatha, and Powder Wash fields. The combined open flow of nine wells, exclusive of the McElmo well, was 183,780,000 cubic feet. At North Callum, 9,709,634,000 cubic feet of carbon dioxide gas were returned to the oil-producing sand, and the loss was reduced to 110,537,000 cubic feet. At Wilson Creek 371,277,000 cubic feet of gas were recycled, 106,839,000 used in the field, and 102,787,000 lost.

Marketed production in Colorado (exclusive of CO_2 gas and field use) increased from 6,030,492,000 cubic feet in 1947 to 6,489,621,000 in 1948. All fields except Powder Wash shared the gain. Production by fields in thousands of cubic feet was: Powder Wash, 2,678,850; East Hiawatha (Colorado side only) 2,530,303; West Hiawatha, 910,469; Thornburg, 331,790; Berthoud, 34,064; and Craig, 4,145. The Piceance Creek, White River, and Douglas Creek fields remained shut in for lack of pipe-line connections to markets.

Gross production (other than marketed) was divided as follows (in thousands of cubic feet): Repressured and recycled, 371,277; field use, 1,118,262; and losses 1,394,415. Field use declined 34 percent owing mainly to completion of drilling operations in the Rangely field. A gasoline plant was under construction there. Stripped gas will be returned to the producing formation in 1949 for pressure maintenance.

Illinois.—A. H. Bell and D. H. Swann of the Illinois State Geological Survey reported 10 gas completions in Illinois in 1948. Nine of these were drilled in the Waverly, Dubois, Herald, and Roland pools. These were shut-in during 1948.

Almost 16 billion cubic feet of casinghead gas were processed in gasoline plants during the year, compared with 18.23 billion in 1947. In addition, approximately 45 billion cubic feet of unmetered gas were produced during 1948.

Estimated total lease utilization of the unmetered gas was 7 to 15 billion cubic feet. The unused excess was flared.

Of the 13 billion cubic feet of residue gas remaining after extraction, approximately half served as plant fuel or in generating electricity for field use, about 4.1 billion cubic feet were injected for pressure maintenance or repressuring, and approximately 2 billion cubic feet were used for lease fuel. Minor amounts were sold and flared.

It is estimated that approximately 61 billion cubic feet of gas were produced in Illinois in 1948, an increase of 12.6 billion over the 1947 figure. Distributing companies marketed 9 million cubic feet of gas from the Ayers gas field, 49 million from the Russellville gas field, 110 million from the Storms gas-cap field plus 14 million from residue gas, and 136 million from the gas wells of the Louden field. These figures indicate a decline of 465,000 million cubic feet from 1947 figures.

Indiana.—Figures obtained from the Bulletin of the American Association of Petroleum Geologists show that five gas discovery wells were drilled in 1948, including two Pennsylvanian extensions in Posey County. Wells drilled in new fields include two in Harrison County and one in Martin County (all Devonian). The combined production for these five wells was 3,952 thousand cubic feet. R. E. Esarey and B. E. Brooks reported that a gas well flowing 3 million cubic feet daily was drilled in the Devonian New Albany shale. Three new gas wells were also drilled in Jay County.

Kansas.—Earl K. Nixon of the State Geological Survey reported that gas-well completions numbered 351 in 1948 compared with 417 in 1947. A total of 325 gas wells was drilled in the Hugoton field, a decline of 45 from 1947. These resulted in a slight enlargement of the field along the western boundary.

A new gas pool, the Richfield, was discovered in Morton County, within the general area of the Hugoton field, with a production of 3.9 million cubic feet per day and 20 barrels of condensate from the basal Pennsylvanian Atoka horizon.

Two other new pools were reported in 1948 as follows: Producing from the Arbuckle dolomite, the Bradbridge field in Stafford and Edwards Counties; and producing from the Simpson, the Cottonwood Creek field in Barber County.

Gas production increased 17 percent from 205 billion cubic feet in 1947 to 240 billion cubic feet in 1948. The Hugoton field increased production 18 percent to 186 billion cubic feet in this period. Producing wells in the Kansas portion of this field increased to 1,134 in 1948 from 928 at the end of 1947.

Kentucky.—New gas wells declined in number from 316 in 1947 to 195 in 1948. No new pools were discovered during the year. In eastern Kentucky, completions in the Big Sandy field numbered 158, compared to 228 in 1947. The total open-flow capacity of 226 million cubic feet, of which 166 million were obtained from the Silurian Big Six sand, exceeded the 1947 total by 5,428 million.

In the South Central area, four wells in Pulaski County encountered gas in amounts ranging from 100 to 200 thousand cubic feet with a rock pressure of 50 pounds. Gas was shut-in awaiting a market. Producing wells drilled in this area dropped from 40 in 1947 to 6 in 1948.

In western Kentucky, drilling activity declined and gas completions fell to 7. In Magoffin County a well which came in at 10 million cubic feet extended an earlier Big Six field to the head of Bee Tree Creek. Six wells totaled almost 75 million cubic feet. Production is expected to be spotty and characterized by large initial flows. Exhaustion of Bee Tree field gas is expected in a comparatively short time.

Louisiana.—Arnold Chauviere, Louisiana Geological Survey, reported 250 gas and condensate completions in 1948, including 163 in the northern part of the State and 87 in the south. Fourteen of the 18 discoveries were in south Louisiana. Those showing promise of developing into major fields are Cote Blanche Island in St. Mary Parish; Pointe-a-la Hache in Plaquemines Parish; and, in the Gulf of Mexico, Breton Island Block 38, Vermillion Area Block 71, Ship Shoals Area Block 72, and Eugene Island Area Block 45. Other new gas and condensate fields (with parish locations) are Downsville in Union, Milhaven and Calhoun in Ouachita, Castor in Bienville, Lottie in Pointe Coupee, Bell City and East Bell City in Calcasieu, Holly Beach in Cameron, Edna in Jefferson Davis, Melville in St. Landry, and West Bivens and North Gordon in Beauregard.

In the Hico-Knowles field, Lincoln Parish, a considerable gas reserve was discovered by the extension of Jurassic production approximately 1 mile northwest and 2½ miles northeast.

During 1948, a total of 972,992 million cubic feet of natural gas was produced, a 16-percent increase over 1947.

Michigan.—Information on gas developments in Michigan was furnished by G. E. Eddy, State geologist. Gas completions declined from 191 in 1947 to 108 in 1948, owing to a decrease in the number of wells drilled in older fields for underground storage. Five gas fields were discovered, of which only the Newark in Gratiot County added important reserves. A second, the Jennings pool in Missaukee County, holds some promise.

The Howell field had a total production of 3,362,694 thousand cubic feet of gas and 12,357 barrels of condensate at the end of 1948. The limits of this Salina-Guelph discovery of 1947 are not defined.

Expansion of storage featured developments at the Austin, Goodwell, Reed City, Cranberry Lake, and Marion fields. These accounted for 71.4 billion cubic feet, or 93 percent of the total State sales of gas.

Before May 1948, all gas stored in the State was Michigan gas. Since then, all stored gas has come from Texas, Kansas, and Oklahoma through a 24-inch line from Detroit to the Austin field. A projected 22-inch line will also deliver gas to the Austin reservoir. The Michigan Gas Storage Co. is constructing a 20-inch line to connect with Panhandle's 20-inch line in southwestern Washtenaw County.

A unique dry-gas storage project at the Cranberry Lake and Winterfield reservoirs involved mixing 12 million gallons of butane with dry gas and air and injection under pressure to furnish supplies during the peak winter months and to prevent avoidable bottom and edgewater advance.

A total of 21,369,587 thousand cubic feet of gas was produced from reserves in place in 1948. This 10-percent decline from 1947 reflects the influence of larger imports from midcontinent sources through newly constructed pipe lines and the unusually mild fall and winter weather.

Mississippi.—A communication from H. M. Morse, supervisor, Mississippi State Oil and Gas Board, discloses increased production at the Gwinville field from 26,699,327 thousand cubic feet in 1947 to 35,310,842 thousand in 1948. A new gas field, Sandy Hook, was discovered in Marion County, where no pipe line was available. Two companies have applied to take gas from the Baxterville field to points east of the State. Several other gas fields still lacked facilities for marketing. The Carthage Point field, however, marketed 7,779,526 thousand cubic feet in 1948.

Gross production in Mississippi soared to 90,307,901 thousand cubic feet in 1948, almost three times the 1947 total of 32,810,564 thousand cubic feet.

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Missouri.—Frank C. Greene geologist, Missouri Geological Survey, reported that production increased slightly from 30,035,000 cubic feet in 1947 to 31,110,000 in 1948.

A new pool was discovered in Platte County, but the discovery well had an initial open flow of only 98,000 cubic feet. A second well, completed early in January 1949, yielded 1,108,000 cubic feet. The Platte County Gas Co., discoverers of the new pool, has a pipe line in this area, and further development is anticipated.

Montana.—Information from J. R. Schwabrow, Federal Geological Survey, indicates that about 48 gas wells with a combined open flow of 123,660,000 cubic feet were completed in 1948 compared with 92 wells with 141,816,000 cubic feet in 1947. Casing and line-pipe shortages reduced drilling to 22 wells in the Bowdoin field and one at Cedar Creek. Completions by fields were: Cut Bank (11), Kevin-Sunburst (4), Bowes (3), Utopia (2), Hardin (2), and Apex, Cassady, and Reagan (1 each). No new discoveries were made. Gas storage to meet winter demands continued at Cedar Creek and Cut Bank, and field use increased at Cut Bank and Kevin-Sunburst.

A pipe line was laid from the Reagan field to a sweetening plant under construction at Cut Bank to utilize the flared gas from the two fields.

Total marketed production of major fields, in thousands of cubic feet, was: Bowdoin, 7,149,977; Cedar Creek (Montana side only), 3,464,820; Cut Bank, 17,323,809; Dry Creek, 1,703,714; Kevin-Sunburst, 2,179,153; and Whitlash, 1,037,106.

Gross production was 40,616,918 thousand cubic feet (38,234,656 in 1947) divided as follows: Marketed production, 34,724,670; repressuring, 411,568; field use, 3,676,350; and losses 1,804,330.

New Mexico.—Information furnished by R. E. Canfield, Federal Geological Survey, reveals no major gas-field discoveries in southeastern New Mexico in 1948. There were 35 gas-well completions in Lea County and 5 in Eddy County as compared with the same number for Lea and 2 in Eddy in 1947.

Gas wells drilled in the San Juan Basin in northwestern New Mexico numbered 16 in 1948, a decline from 22 in 1947, distributed as follows: Kutz Canyon field (5), Fulcher Basin field (8), Rattlesnake field (Indian) (1), and Ute Dome field (Indian) (2).

Permission was requested by the El Paso Natural Gas Co. to construct a pipe line from this area to the Arizona-California border. Such a development would undoubtedly stimulate future drilling and exploration in this region.

In central and east-central New Mexico, 73 million cubic feet of natural carbon dioxide were produced from the Bueyeros field in Harding County. The only carbon dioxide completion, in Colfax County, was shut-in because no solidified carbon dioxide plant was in operation as yet.

In southeastern New Mexico an estimated 1947 production of 151,675 million cubic feet rose to 207,852 million in 1948. Of this amount, 53,270 million cubic feet were dry gas and 154,582 million casinghead gas. Natural-gasoline and repressuring plants handled 152,902 million cubic feet of gas (including 17,652 million cubic feet of dry gas) in 1948. Residue gas from these plants was distributed as follows: Domestic, commercial, and industrial, 87.27 billion cubic feet; carbon-black manufacture, 27.75 billion; plant and lease fuel, 11.56 billion; shrinkage, 6.77 billion; vented at plants, 17.47 billion; returned to ground, 2.097 billion.

In northwestern New Mexico, 9.3 billion cubic feet of natural gas were delivered to domestic, commercial, and industrial markets in 1948 compared to 8.2 billion in 1947.

New York.—Information supplied by Philip Donnerstag, New York State Geological and Natural History Surveys, indicates that 24 wells were completed to the Oriskany or below and 3 additional wells were still being drilled at the end of 1948. This compares with 21 and two additional abandoned wells for 1947. Of the 24, 6 were storage wells, 8 extensions, and 10 wildcats. Three of the extension wells, in Erie and Chautauqua Counties, had a combined open flow of 810 thousand cubic feet from the Medina sandstone. None of the wildcats was productive.

Total estimated production for 1948 was 4.5 billion cubic feet, of which 2,185,102,000 were from deep Oriskany wells.

Increased geophysical prospecting for gas included an airborne magnetic survey over the east-central part of the State and seismic shooting along the Pennsylvania border from the Hudson River westward to Allegany County. Several wells to test the results of this work are expected in the near future.

North Dakota.—A report from Wilson M. Laird, State geologist of the North Dakota Geological Survey, indicated a 45-percent gain in the total volume of gas produced from 442,213,000 in 1947 to 642,687,000 cubic feet in 1948. Production was from the Eagle sand in Bowman County. The number of wells (25) remained the same as in 1947, and no new permits to drill for gas were issued. A well being drilled near Carpio encountered appreciable quantities of gas, but drilling for oil continued.

Ohio.—K. C. Cottingham, chief geologist, Ohio Fuel Gas Co., supplied the following information on gas developments in 1948:

Gas-well completions decreased from 582 in 1947 to 428 in 1948. Of these, 262 were in the Clinton, 86 in the Berea, 38 in the Shallow sands, 21 in the Oriskany, and 21 in other sands. No unusually large gas wells were completed. The largest, the Pfeiffer-Guspyt, had an initial open flow of 6,018,000 cubic feet from the Clinton sand at 4,205 feet. Perry County was the most active, with 68 gas wells completed, followed by Stark, with 62, and Muskingum, with 34.

About 2,000 acres were proved in new gas pools compared with 1,850 acres in 1947. Another 7,500 acres were added to proved acreage in older pools, chiefly from Clinton territory. The depth of average drilling (oil and gas) was 2,382 feet compared to 2,751 feet in 1947. For gas wells the average daily initial production declined to 708 thousand cubic feet. Production was 60,732,000 thousand cubic feet, and natural-gas reserves at the end of 1948 amounted to 581,108,-000 thousand cubic feet; an additional 48,345,000 thousand cubic feet was held in underground reservoirs for storage purposes only.

Oklahoma.—Information was furnished by Elmer Capshaw, gas engineer, Oklahoma Corporation Commission. Casinghead-gas production increased 8 percent in 1948 to a total of 178,751,567 thousand cubic feet. Dry-gas output increased 3 percent to 276,542,084 thousand cubic feet. Residue gas decreased 29,085,648 thousand cubic feet to 27,307,846 thousand. This decline is not certain because of irregularities in reporting such gas.

The Texas County portion of the Hugoton field, which is the greatest single source of gas in the State, expanded production 11 percent to an aggregate of 120,354,134 thousand cubic feet in 1948. Wells tied in to pipe lines numbered 114, bringing the number of connected wells up from 564 to 678 as of January 1, 1949. Virtually all the gas from Texas County is consumed outside the State. Production in the rest of the State has paced local consumption. No new reserves of great importance were opened up during the year, although the Elk City-Sayre area shows some promise. Gas completions declined slightly from 269 in 1947 to 258 in 1948.

Estimates published by the American Gas Association indicate that total reserves of natural gas at the end of 1948 were 11,332,445 million cubic feet, about the same as the 1947 figure.

Pennsylvania.—Of 802 completions in the shallow-sand fields in 1948, 481 were producers, according to J. G. Montgomery, Jr., vice president, United Natural Gas Co.

The combined initial daily open-flow capacity of 102,615,000 cubic feet compares with 71,667,000 for 502 shallow-sand producers in 1947. Shallow drilling in the west-central district resulted in 245 producers, Armstrong County leading with 105. In the southwestern area, 110 wells were drilled, Washington County contributing 38. The northwest, with a total of 122 producers, was paced by McKean County with 56.

Five small pools were discovered, one each in Cambria, Clearfield, Elk, Jefferson, and Potter Counties.

Oriskany-sand developments centered in the East Fork-Wharton field, where 8 wells yielded daily initial flows ranging from 2,100,000 to 10,600,000 cubic feet. Six tests in Potter County and three in Tioga were dry holes. There were four dry holes in Fayette County and one producer with a daily initial flow of 1,500,000 cubic feet.

Six deep tests in Erie County, including three through the Medina sands, failed to locate new reserves. A deep Cambro-Ordovician test being drilled in Bedford County, east of the Allegheny Front, attracted interest.

Storage continued to be important, and at least 51 wells were drilled for underground storage purposes. The increasing supply of gas brought into the Appalachian area by large pipe-line companies resulted in intensive programs of pipe-line and compressor-station construction and improvement.

South Dakota.—J. R. Schwabrow, Federal Geological Survey, reported that no new developments occurred in 1948. An estimated 8,140,000 cubic feet were marketed and 4,092,000 lost from gas-water wells at Pierre compared with 9,061,000 cubic feet marketed and 4,531,000 lost in 1947.

Tennessee.—The following information is from a report by H. C. Milhous, assistant geologist, Tennessee Department of Conservation: Total gas production for 1948 was 157,500,000 cubic feet, of which 145,000,000 were from Scott and Morgan Counties and the remainder from Fentress County. No new commercial gas wells were brought in during the year, and none was abandoned.

Tennessee's 1947 estimated production of 80,000,000 cubic feet came from 14 wells, 8 in Morgan and 6 in Fentress County fields.

Texas.—Total production of natural gas approximated 3,277,845 million cubic feet in 1948, including 2,519,410 million cubic feet of dry and 758,435 million of wet gas. Residue gas aggregated approximately 2,734 billion cubic feet, including: Repressured, 191.8 billion; pipe line, 546 billion; and vented, 102.3 billion. The following information was obtained from the Bulletin of the American Association of Petroleum Geologists (Vol. 33, No. 6):

In the Panhandle district, gas production increased 48 billion cubic feet over 1947. Drilling activities declined slightly to 154 wells, and no new fields were discovered.

Four gas discoveries in West Texas in 1948 included two in Pecos County and one each in Crockett and Winkler Counties. One Pecos wildcat had an initial production of 6.4 million cubic feet plus 186 barrels of distillate from the Ellenburger limestone.

Discoveries drilled in north and west-central Texas numbered 12, including 4 in Stephens and 3 in Jack County. A Wise County well made over 4 million cubic feet and 174 barrels of distillate initially.

There were 36 gas discoveries in south Texas in 1948. Liquids recovered from casinghead gas and free gas totaled 12,296,755 barrels. The number of oil wells connected with casinghead-gas processing systems increased to 36 percent at the close of 1948, and the percentage is expected to increase as additional transmission lines are extended.

A total of 585.8 billion cubic feet of gas was produced in south Texas in 1948, of which 54 percent was returned to the formation for pressure maintenance or cycling purposes and 26 percent was delivered to transmission lines. Twelve gas-producing areas were found in the lower Eocene. Another large gas reserve was uncovered in the Wilcox formation in the Government Wells-Wilcox field. Field development resulted in 41 gas producers and 4 new gas reserves.

Wells drilled in south Texas in 1948 included 243 gas producers and 93 dual completions. Sixty-five new gas pools were found. In the upper Eocene 593 tests resulted in 38 gas wells and 4 reservoirs. In the lower Oligocene, 41 new reservoirs were found by tests in proved areas. In the upper Oligocene-lower Miocene, 17 wildcats resulted in the discovery of 3 gas fields, none a major reserve as yet.

East Texas recorded 88 gas completions. A reworked test in Harrison County had an initial production of 1,270 thousand cubic feet. This indicates a new field and is evidence of productive stratigraphic traps along the flanks of the Sabine uplift, thus opening a large area for exploration. A Beckville-field well was completed through lower Pettit perforations for an initial potential of 36 million cubic feet of gas per day, with 32 barrels of distillate per million. A Marion County completion had an initial potential of 10 million cubic feet from Travis Peak sand at 7,984 feet.

Ten gas-condensate fields and 3 gas fields, all of minor importance, were discovered in southeast Texas in 1948. Condensate production amounted to 14,792,000 barrels. In new sands, new reservoirs, and extensions were 20 gas wells, including 1 perforated at 7,556–7,580 feet in Newton County with initial production of 5.9 million cubic feet from a new sand and 38 condensate completions, 1 of which, in

Orange County, had an initial production of 5 million cubic feet per day.

More casinghead conservation projects to reduce the volume of gas flared or lost were planned or were already under construction.

Utah.—New discoveries of gas increased in 1948, according to J. R. Schwabrow, Federal Geological Survey. A well rich in carbon dioxide in the Bar-X field had an initial open flow of 4,700,000 cubic feet. Two completions in southeastern Boundary Butte field showed initial flows of 25,000,000 and 9,000,000 cubic feet, respectively, from the Hermosa formation.

Dry-ice manufacture utilized 156,105,000 cubic feet of carbon dioxide gas in 1948 compared with 183,309,000 cubic feet (including liquid CO_2) for 1947. (These figures are not included in the natural-gas statistics.) No drilling occurred in the Clay Basin or Farnham fields, the only commercial producing areas. A deep test at South Last Chance and a wildcat at North Last Chance were unsuccessful. The only well at South Last Chance was depleted and the area ready for abandonment. Metered production from the Clay Basin field was 6,609,774 thousand feet. In addition, 22,250,000 cubic feet were used in the field, and 500,000 were lost. Comparable figures for 1947 are 6,036,372, 28,000,000, and zero, respectively.

Virginia.—Prospecting in southwestern Virginia uncovered a small gas field in Scott and Washington Counties and scattered indication of possible production in Buchanan and Wise Counties, according to David B. Reger, consulting geologist.

An upper Mississippian Maxton sand completion with a capacity of 14,000,000 cubic feet at a depth of 2,301 feet was reported near Dwight. Prospecting on 1,000,000 acres in Buchanan, Dickenson, and Wise Counties was planned, and drilling progressed in Tazewell County. In the early Grove field seven wells continued to supply gas to the city of Bristol.

West Virginia.—David B. Reger, consulting geologist, Morgantown, W. Va., reported that new gas pools discovered or brought into assured production in 1948 included two in Wayne County and one each in Barbour, Kanawha, McDowell, Mason, Jackson, Raleigh, and Upshur Counties. Of 37 wildcats drilled, 20 discovered gas. Deep-drilling operations extended the Charleston gas field northward into Wirt and Wood Counties, enlarged the Terra Alto pool, and assured extension of the Blackwater pool by an early 1949 well. Approximately 42,600 acres of new territory were proved. In all, 888 new wells were drilled in the State, resulting in 561 gas wells with 475,798,000 cubic feet of daily open flow and 180 dry holes. Sixty-three which were drilled deeper yielded 21,382,000 cubic feet. The daily average capacity of the new wells was 848,125 cubic feet per well, initial production increasing 21 percent over 1947. Estimated marketed production in 1948 was 203,681 million cubic feet as compared with 192,233 million (the Federal Bureau of Mines figure for 1947).

Approximately 139 billion cubic feet of Texas gas were received in 1948 at an average rate of about 380 million per day.

Exploration in the lower Devonian and deeper horizons declined somewhat from 1947, with 28 wells drilled in the Oriskany sand or overlying Huntersville chert. In the Charleston field, 26 completions produced 120,338,000 cubic feet and extended proved acreage northward about 10,000 acres. At the end of 1948 there had been 24 White Clinton sand tests in the State, of which only two (in Kanawha) were producers.

United Fuel Gas Co. completed a Girbotol gas-purification plant at Frame, Kanawha County, with a capacity of 15,000,000 cubic feet per 24 hours.

Wyoming.—J. R. Schwabrow, Federal Geological Survey, reported 10 gas wells completed in 1948 with a combined open flow of 84,000,000 cubic feet. Newly discovered fields included the Heart Mountain (two wells) and North Danker (one). Old fields with completions (one each) were: Beaver Creek, Big Sand Draw, Church Buttes, Little Buffalo Basin, Pine Mountain, Sand Creek, and South Sand Draw. The Heart Mountain wells had an initial capacity of about 12,000,000 cubic feet from Frontier sands at 1,970 and 2,492 feet. The North Danker discovery was drilled to the Madison limestone at 6,306 feet and plugged back to a Frontier sand at 2,810–2,840 feet, with an initial capacity of 2,946,000 cubic feet. The field is just north of the Polecat gas field but may have separate closure. Gas from these new areas may supplement supply for local markets when connected to pipe lines. The large Church Buttes field had four completions, which were connected to a pipe-line system for a testing period.

Fields producing over a billion cubic feet in 1948 were (in thousands of cubic feet): Baxter Basin, 8,909,166; Beaver Creek, 7,314,628; Big Sand Draw, 3,939,400; Elk Basin, 1,330,178; Garland, 1,804,359; Hiawatha (Wyoming side only), 1,230,066; Lance Creek, 3,118,872; Little Buffalo Basin, 2,970,627; Oil Springs, 1,808,264; Salt Creek, 3,692,796; and South Elk Basin, 1,793,501. Baxter Basin field declined 10 percent from 1947, while Beaver Creek advanced from 4,766,784,000 to 7,314,628,000 cubic feet. South Elk Basin was added to the list of large gas-producing areas.

Metered production increased from 39,511,874 thousand cubic feet in 1947 to 44,233,041 in 1948. Gross production was 72,071,725 thousand cubic feet (57,739,666 in 1947), gas returned to sands totaled 11,008,777, field use accounted for 983,479, and losses were 15,846,428 (5,824,539 in 1947).

In spite of the reduction of waste at Oregon Basin, the more complete development of new fields with increased oil production (especially at Worland) resulted in increased losses of natural gas exceeding the large gain in marketed production. It is expected that these will be reduced as soon as new gas-handling and sulfur-extraction plants are completed in 1949.

INTERSTATE SHIPMENTS AND EXPORTS

The growth in interstate and export movements of natural gas continued in 1947. Figures for the year include gas stored or lost in transportation and therefore are not comparable with 1946 records. The total for 1947 aggregated 1,402,157 million cubic feet, over one-third of the total marketed production in the United States.

By far the greatest proportion of the total interstate movements came from the Gulf coast and midcontinent areas in 1947. Texas

(39 percent of the total interstate shipments), Louisiana (18 percent), Oklahoma (12 percent), Kansas (9 percent), and West Virginia (9 percent) were the principal exporters of natural gas in 1947.

States using the largest amounts of gas from outside sources during the year, with the quantities involved in billions of cubic feet, were: Ohio 163.4; Kansas 122.1; Illinois 116.9; Pennsylvania 113.6; and Missouri 79.3.

Exports to Mexico increased from 17,475 million cubic feet in 1946 to 17,942 million in 1947. Exports to Canada were 207 million cubic feet in 1947 compared with 200 million in 1946.

Interstate transportation of natural gas in 1947 [1] [2]

Producing State	Consuming State [1]	Millions of cubic feet [2]
Arkansas	Louisiana	220
Colorado	Utah	5,629
	Wyoming	64
		5,693
Indiana	Illinois	19
Kansas	Colorado	4,537
	Illinois	5,155
	Indiana	8,453
	Iowa	20,369
	Michigan	16,501
	Minnesota	28,111
	Missouri	7,105
	Nebraska	27,999
	Ohio	7,063
	Oklahoma	1,237
	South Dakota	3,233
		129,763
Kentucky	District of Columbia	6,209
	Illinois	23
	Indiana	1,103
	Maryland	1,398
	New York	366
	Ohio	19,896
	Pennsylvania	19,527
	Virginia	1,240
	West Virginia	14,596
		64,358
Louisiana	Alabama	33,475
	Arkansas	40,394
	Florida	5,500
	Georgia	30,868
	Illinois	21,271
	Indiana	72
	Kentucky	386
	Maryland	38
	Mississippi	27,404
	Missouri	26,260
	New York	1,060
	Ohio	13,830
	Pennsylvania	4,730
	Tennessee	30,521
	Texas	14,712
	Virginia	57
	West Virginia	6,723
		257,301
Mississippi	Alabama	9,166
	Florida	2,664
	Georgia	5,182
	Louisiana	5,710
		22,722

See footnotes at end of table.

Interstate transportation of natural gas in 1947 [1] [2]—Continued

Producing State	Consuming State [1]	Millions of cubic feet [2]
Montana	North Dakota	3,165
	South Dakota	3,046
		6,211
New Mexico	Arizona	27,877
	California	3,490
	Colorado	581
	Mexico	3,077
	Texas	8,170
		43,195
New York	Canada	28
	Pennsylvania	126
		154
North Dakota	South Dakota	442
Ohio	West Virginia	579
Oklahoma	Arkansas	4,270
	Illinois	4,506
	Indiana	7,422
	Iowa	31
	Kansas	82,692
	Michigan	14,437
	Minnesota	43
	Missouri	29,610
	Nebraska	910
	Ohio	5,565
	South Dakota	63
	Texas	12,639
		162,188
Pennsylvania	Canada	179
	Maryland	404
	New York	18,314
	Ohio	111
	West Virginia	992
		20,000
Texas	Alabama	9,477
	Arkansas	9,153
	Colorado	41,806
	Georgia	6,482
	Illinois	85,959
	Indiana	26,043
	Iowa	21,605
	Kansas	39,436
	Kentucky	7,939
	Louisiana	43,996
	Maryland	564
	Mexico	14,865
	Michigan	29,108
	Minnesota	16,502
	Mississippi	7,711
	Missouri	16,361
	Nebraska	10,365
	Nex Mexico	2,926
	New York	6,124
	Ohio	66,087
	Oklahoma	17,939
	Pennsylvania	32,306
	South Dakota	1,854
	Tennessee	4,403
	Virginia	852
	West Virginia	27,593
	Wisconsin	267
	Wyoming	1,165
		548,888
Utah	do	68
Virginia	Tennessee	28

See footnotes at end of table.

Interstate transportation of natural gas in 1947 [1] [2]—Continued

Producing State	Consuming State [1]	Millions of cubic feet [2]
West Virginia	District of Columbia	2,629
	Maryland	1,095
	New York	12,366
	Ohio	50,858
	Pennsylvania	56,906
	Virginia	957
		124,811
Wyoming	Montana	3,735
	Nebraska	1,939
	Utah	9,843
		15,517
Total United States		1,402,157

[1] Includes:
Exports to Canada—207 million cubic feet.
Exports to Mexico—17,942 million cubic feet.
[2] Includes gas stored and lost in transmission.

PIPE LINES

The continuing steel shortage, especially in large-diameter pipe, hampered natural-gas pipe-line expansion but not plans for further development. Of 89 pipe-line projects under Federal Power Commission jurisdiction, 48 were delayed by various shortages as of September 1, 1948.

The Federal Power Commission authorized the construction of approximately 8,500 miles of new pipe line during the year, and pending applications call for 14,600 miles additional. The largest new authorization was for construction of an 1,840-mile pipe line from Texas to New York City, consisting of 1,210 miles of 30-inch, 558 miles of 26-inch, and 71 miles of 20-inch, which, with 411 miles of 6- to 16-inch lateral lines, would have an ultimate capacity of 500 million cubic feet daily. Estimated to be the largest and costliest (almost $200,000,000) natural-gas pipe line in the world, its initial capacity of 340 million cubic feet daily will supply metropolitan markets in New York, New Jersey, and Pennsylvania. Other important authorizations include an addition of 1,400 miles to the Texas Eastern Transmission Corp. system and a 1,387-mile Texas-to-Pittsburgh line.

An application to the Federal Power Commission for a 20-inch line from upper Gulf coast gas fields in Texas and southwest Louisiana to Danville, Va., was based on plans to achieve a capacity of 215 million cubic feet per day for sale in North Carolina, South Carolina, and Virginia.

East Tennessee Natural Gas Co. received Federal Power Commission approval to lay 186 miles of 16-inch line from the Tennessee Gas Transmission Co. system to Chattanooga and 112 miles of 12-inch line to Knoxville, Tenn. Work progressed on a Michigan-Wisconsin pipe line which will run from the Hugoton field near the Texas-Oklahoma border to Wisconsin and Michigan. Begun at the end of 1947, the first phase of the project, costing $88,000,000 and permitting sales at the rate of 75 billion cubic feet annually, is to be completed by the spring of 1950. Underground storage in the depleted fields of Michigan is planned, and sales are expected to reach 108 billion cubic feet during 1952. Several other pipe lines over 400 miles in length and reaching into every corner of the Nation are on the planning boards.

The total construction expenditure for 1948 was $675,000,000 compared to $623,612,000 in 1947. The 1947 figure showed $423,537,000 for transmission, including $143,127,000 for the Big Inch system. An American Gas Association survey indicates that a total of about $1,900,000,000 will be spent on natural-gas construction during the next 4 years.

Throughout the Nation, 251,330 miles of pipe line (including authorized construction) serve, or will serve consumers in 34 States and District of Columbia with natural gas originating in 22 States.

CONSUMPTION

Consumption of natural gas in the United States increased 10 percent from 4,012,930 million cubic feet in 1946 to a record 4,426,544 in 1947. All the major classes of consumers in the United States participated in the increase.

Domestic (residential) consumption expanded 21 percent, commercial 18 percent, and industrial 7 percent, the latter owing chiefly to large gains in the miscellaneous industrial group.

Natural gas consumed in the United States, 1943–47

Year	Domestic and commercial consumption							
	Consumers (thousands) [1]			Billion cubic feet			Average M cubic feet used per consumer	Average value at point of consumption (cents per M)
	Domestic	Commercial	Total	Domestic	Commercial	Total		
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
1946	11,472	965	12,437	661	242	903	72.6	60.9
1947	12,204	1,039	13,243	802	285	1,087	82.1	60.0

Year	Industrial consumption							Total consumption		Electric public-utility power plants (billion cubic feet) [3]
	Billion cubic feet						Average value at point of consumption (cents per M)	Billion cubic feet	Average value at point of consumption (cents per M)	
	Field	Carbon-black manufacture	Petroleum refineries	Portland-cement plants [2]	Other industrial	Total industrial				
1943	781	315	244	52	1,277	2,669	11.3	3,403	22.3	306
1944	855	356	315	35	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
1946	898	478	331	58	1,345	3,110	10.7	4,013	22.0	307
1947	934	485	364	60	1,496	3,339	11.3	4,426	23.2	373

[1] Includes consumers served with mixed gas.
[2] Chapters on Cement in Minerals Yearbook.
[3] Federal Power Commission: Figures include gas other than natural, impossible to segregate; therefore shown separately from main table.

Natural gas consumed in the United States, by States, 1943–47, in millions of cubic feet

State	1943	1944	1945	1946	1947
Alabama	40,123	44,323	43,417	45,445	50,713
Arizona	24,048	23,908	22,488	24,198	27,768
Arkansas	82,825	94,783	91,198	87,668	102,779
California	457,757	502,017	502,442	487,904	548,382
Colorado	31,424	33,101	34,877	40,418	49,027
District of Columbia	6,754	6,782	6,883	7,428	8,474
Florida	4,033	6,545	7,331	7,065	7,891
Georgia	33,280	35,603	35,915	36,679	41,368
Illinois	122,340	123,325	121,366	124,284	132,153
Indiana	39,227	38,581	40,274	40,185	42,528
Iowa	28,687	27,307	27,794	33,163	40,948
Kansas	129,173	143,814	160,406	175,820	191,952
Kentucky	23,409	24,399	26,802	29,494	36,938
Louisiana	290,651	310,127	325,888	331,364	375,206
Maryland	2,395	2,491	2,584	2,830	3,402
Michigan	53,010	56,077	59,594	69,251	80,571
Minnesota	33,501	35,229	35,930	37,624	43,198
Mississippi	30,113	33,111	38,297	41,778	52,461
Missouri	59,577	65,046	72,059	74,257	78,101
Montana	28,815	29,019	29,575	28,212	30,919
Nebraska	20,462	24,699	28,235	33,572	39,699
New Mexico	52,126	55,284	71,459	85,662	102,766
New York	27,787	27,057	29,577	32,892	41,572
North Dakota	2,030	2,267	2,640	2,519	2,608
Ohio	162,371	166,785	172,258	188,527	221,571
Oklahoma	230,423	249,996	249,927	245,981	254,522
Pennsylvania	159,004	148,675	149,092	158,587	175,906
South Dakota	7,483	7,688	7,158	7,526	8,016
Tennessee	24,252	24,693	24,419	24,344	33,986
Texas	1,059,329	1,221,383	1,348,140	1,366,457	1,444,422
Utah	20,303	20,275	20,264	15,733	20,919
Virginia	1,610	1,694	1,791	2,101	3,055
West Virginia	94,315	88,953	88,757	100,733	106,105
Wisconsin				86	267
Wyoming	20,842	21,426	21,642	23,143	26,351
Total United States	3,403,479	3,696,463	3,900,479	4,012,930	4,426,544

The three leading consuming States took more than half of the United States total in 1947 as follows: Texas, 33 percent; California, 12 percent, and Louisiana, 9 percent.

Treated for Natural Gasoline.—The quantity of natural gas processed at natural-gasoline and cycle plants increased 11 percent from 3,663,760 million cubic feet in 1946 to 4,070,150 in 1947, again setting a new record. States with the largest gains in this period were Texas, California, Louisiana, Oklahoma, and Kansas in the order named. Only Kentucky, Michigan, Illinois, and Wyoming registered declines. Mississippi began processing for the first time, with 8,079 million cubic feet treated.

After declining from 0.94 to 0.91 in 1946, the ratio of gas treated to total natural-gas consumption rose slightly to 0.92 in 1947. The number of cycling plants increased from 36 to 38 in the same period, but natural-gasoline production increased at a slower rate than gas treated.

Domestic and Commercial.—The use of natural gas for household purposes expanded 21 percent in 1947, or from 660,820 million cubic feet in 1946 to 802,150 million cubic feet. At the same time, the number of domestic users increased 6 percent, from 11,472,000 to 12,204,000. Domestic meters added (net) have averaged 403,722 to lines of distributors of natural and mixed gas annually during the past 9 years. The average amount of gas used per consumer increased from 57,605 cubic feet in 1946 to 65,730 cubic feet in 1947.

Natural gas treated at natural-gasoline and cycle plants in the United States, by States, 1943–47, in millions of cubic feet

State	1943	1944 [1]	1945	1946	1947
Arkansas	43,309	53,539	55,725	53,246	60,474
California	349,383	397,860	420,482	414,881	460,046
Illinois	32,200	32,000	27,690	25,161	22,720
Kansas	196,043	158,524	165,538	189,834	216,644
Kentucky	46,149	48,746	41,562	41,447	38,717
Louisiana	236,286	307,912	310,614	308,723	345,975
Michigan	835	3,330	4,271	3,253	2,255
Mississippi					8,079
Montana	11,950	11,630	12,000	10,000	12,066
New Mexico	94,194	103,277	116,539	123,234	130,693
New York	4	4	3	10	12
Ohio	39,106	40,482	35,210	31,898	32,869
Oklahoma	188,029	191,610	193,744	207,139	236,673
Pennsylvania	53,616	53,672	42,565	38,084	52,437
Texas	1,520,043	1,682,738	2,039,983	2,012,357	2,235,185
West Virginia	198,636	195,000	166,037	181,903	193,044
Wyoming	18,217	19,676	21,907	22,590	22,261
Total	3,028,000	3,300,000	3,653,870	3,663,760	4,070,150
Ratio to total consumption	.89	.89	.94	.91	.92

[1] Partly estimated.

Commercial consumption totaled 285,213 million cubic feet in 1947, a gain of 18 percent over the 1946 figure of 241,802. At the same time, the number of commercial consumers increased 8 percent to 1,039 thousand, and consumption per meter increased from 250,000 to 274,000 cubic feet.

Field.—Reversing a brief decline, gas consumed in field operations of the petroleum and natural-gas industry increased from 897,809 million cubic feet in 1946 to 933,761 million in 1947. The principal gains were (in the order named) in Texas, Louisiana, New Mexico, and California. With the exception of Louisiana, all of these States showed gains in natural-gasoline production. Oklahoma declined again, with a drop of 4.6 billion cubic feet accompanied by a fall of 34.5 million gallons in liquefied-petroleum-gas production.

Carbon-Black Manufacture.—A record total of 484,882 million cubic feet of gas was used in carbon-black manufacture in 1947, 6,533 million cubic feet over the comparable 1947 figure. Continuing a 10-year trend, the average value of gas at these plants increased from 3.02 cents in 1946 to 3.57 in 1947. The growing use of the high-yield furnace process has resulted in a steady increase in the yield of carbon black per thousand cubic feet of gas consumed from 1.63 pounds in 1941 to 2.44 in 1946 and 2.51 pounds in 1947. In addition to gas, over 31 million gallons of liquid hydrocarbons were used in 1947.

Petroleum Refineries.—A 10-percent increase in the volume of gas used as fuel at petroleum refineries was reported, from 331,520 million cubic feet in 1946 to 363,892 million in 1947. The greatest gains (in billions of cubic feet) were in Texas, 14.9; California, 8.1; Louisiana, 6.7; and Oklahoma, 2.1.

Electric Public-Utility Power Plants.—The Federal Power Commission reported that gas consumption at electric public-utility power plants expanded from 306,924 million cubic feet in 1946 to 373,037 million in 1947. These figures—which include, as usual, a small percentage of manufactured gas—reversed a 2-year downward trend.

Domestic and commercial consumption of natural gas in the United States in 1947, 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	76,350	5,605	3,784	67.5	7,910	2,137	958	44.8	84,260	7,742	4,742	61.3
Arizona	64,590	3,264	2,678	82.0	8,140	2,472	1,011	40.9	72,730	5,736	3,689	64.3
Arkansas	120,440	12,361	5,926	47.9	19,690	6,254	2,205	35.3	140,130	18,615	8,131	43.7
California	2,186,510	133,939	84,171	62.8	183,620	59,694	23,406	39.2	2,370,130	193,633	107,577	55.6
Colorado	132,330	15,319	7,787	50.8	16,710	6,024	2,561	42.5	149,040	21,343	10,348	48.5
Florida	8,350	481	482	100.2	980	235	131	55.7	9,330	716	613	85.6
Georgia	126,520	10,384	7,299	70.3	13,740	5,385	1,911	35.5	140,260	15,769	9,210	58.4
Illinois	1,489,110	38,735	39,442	101.8	84,540	10,462	7,374	70.5	1,573,650	49,197	46,816	95.2
Indiana	277,840	13,124	13,367	101.9	18,240	3,313	2,658	80.2	296,080	16,437	16,025	97.5
Iowa	189,110	12,659	9,344	73.8	18,340	4,235	2,562	60.5	207,450	16,894	11,906	70.5
Kansas	290,790	32,136	16,930	52.7	36,810	15,320	5,313	34.7	327,600	47,456	22,243	46.9
Kentucky	212,820	16,597	9,258	55.8	22,780	6,060	2,342	46.3	235,600	21,657	11,600	53.6
Louisiana	298,550	18,915	11,164	59.0	33,380	11,110	3,406	30.7	331,930	30,025	14,570	48.5
Maryland, Virginia, and District of Columbia	264,180	10,897	11,558	106.1	19,950	2,471	2,276	92.1	284,130	13,368	13,834	103.5
Michigan	880,980	44,065	37,714	85.6	40,240	7,406	5,336	72.0	921,220	51,471	43,050	83.6
Minnesota	175,010	14,943	9,710	65.0	9,580	3,874	1,564	40.4	184,590	18,817	11,274	59.9
Mississippi	92,220	7,452	5,182	69.5	13,520	5,097	1,907	37.4	105,740	12,549	7,089	56.5
Missouri	481,540	25,786	19,548	75.8	39,260	8,626	4,009	46.5	520,800	34,412	23,557	68.5
Montana	54,950	9,844	4,577	46.5	6,240	5,814	1,781	30.6	61,190	15,658	6,358	40.6
Nebraska	157,090	11,908	8,743	73.4	14,010	5,254	2,353	44.8	171,100	17,162	11,096	64.7
New Mexico	50,870	4,625	2,944	63.7	6,480	3,731	1,219	32.7	57,350	8,356	4,163	49.8
New York	579,690	29,142	23,164	79.5	42,500	6,013	4,367	72.6	622,190	35,155	27,531	78.3
North Dakota, South Dakota, Utah, and Wisconsin	85,930	8,444	6,248	74.0	6,000	3,665	1,470	40.1	91,930	12,109	7,718	63.7
Ohio	1,548,110	119,063	72,508	60.9	122,570	26,153	14,598	55.8	1,670,680	145,216	87,106	60.0
Oklahoma	343,590	32,958	14,951	45.4	43,120	16,750	5,098	30.4	386,710	49,708	20,049	40.3
Pennsylvania	734,000	61,297	37,600	61.3	53,200	12,383	6,419	51.8	787,200	73,680	44,019	59.7
Tennessee	93,170	7,768	5,616	72.3	12,680	4,200	2,056	49.0	105,850	11,968	7,672	64.1
Texas	928,340	67,267	41,880	62.3	118,610	32,508	12,331	37.9	1,046,950	99,775	54,211	54.3
West Virginia	230,750	28,400	10,435	36.7	21,820	6,451	2,213	34.3	252,570	34,851	12.648	36.3
Wyoming	29,970	4.772	2,345	49.1	4,420	3,116	1,009	32.4	34,390	7,888	3,354	42.5
Total: 1947	12,203,700	802,150	526,355	65.6	1,039,080	285,213	125,844	44.1	13,242,780	1,087,363	652,199	60.0
1946	11,471,640	660,820	447,018	67.6	964,990	241,802	102,566	42.4	12,436,630	902,622	549,584	60.9

[1] Includes natural gas used with manufactured gas.

Industrial consumption of natural gas in the United States in 1947, 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)
	Millions of cubic feet (estimated)	Value at point of consumption (estimated; thousands of dollars)	Millions of cubic feet	Value at point of consumption		Millions of cubic feet				Value at point of consumption		Millions of cubic feet	Value at point of consumption		
				Total (thousands of dollars)	Average (cents per M)	Petroleum refineries	Portland cement plants	Other industrial	Total	Total (thousands of dollars)	Average (cents per M)		Total (thousands of dollars)	Average (cents per M)	
Alabama							(2)	[2] 42,971	42,971	7,017	16.3	42,971	7,017	16.3	6,366
Arizona								22,032	22,032	4,553	20.7	22,032	4,553	20.7	2,500
Arkansas	18,710	960				8,210	(2)	[2] 57,244	65,454	5,471	8.4	84,164	6,431	7.6	10,461
California	132,737	13,770	(3)	(3)	(3)	55,937	12,397	[3] 153,678	[3] 222,012	[3] 50,205	[3] 22.6	354,749	63,975	18.0	39,918
Colorado	2,363	369				150	(2)	[2] 25,171	25,321	3,655	14.4	27,684	4,024	14.5	4,428
Florida	8	(4)						7,167	7,167	1,004	14.0	7,175	1,004	14.0	2,675
Georgia							(2)	[2] 25,599	25,599	4,836	18.9	25,599	4,836	18.9	12,655
Illinois	15,910	1,190				(5)		67,046	67,046	17,474	26.1	82,956	18,664	22.5	3,254
Indiana	164	20				841		25,086	25,927	8,596	33.2	26,091	8,616	33.0	244
Iowa							(2)	[2] 24,054	24,054	4,407	18.3	24,054	4,407	18.3	10,048
Kansas	20,197	1,306	(3)	(3)	(3)	11,092	8,925	[3] 104,282	[3] 124,299	[3] 14,646	[3] 11.8	144,496	15,952	11.0	27,144
Kentucky	3,731	559				85		11,465	11,550	3,405	29.5	15,281	3,964	25.9	
Louisiana	107,611	4,802	25,977	961	3.7	62,067	(2)	[2] 149,526	211,593	18,573	8.8	345,181	24,336	7.1	48,668
Maryland, Virginia, and District of Columbia								1,563	1,563	848	54.3	1,563	848	54.3	1
Michigan	1,480	200						27,620	27,620	10,643	38.5	29,100	10,843	37.3	5
Minnesota								24,381	24,381	4,612	18.9	24,381	4,612	18.9	8,976
Mississippi	10,074	761						29,838	29,838	4,213	14.1	39,912	4,974	12.5	5,044
Missouri	106	12				813	(2)	[2] 42,770	43,583	8,973	20.6	43,689	8,985	20.6	9,452
Montana	1,844	154				1,541		11,876	13,417	1,919	14.3	15,261	2,073	13.6	773
Nebraska						36	(2)	[2] 22,501	22,537	3,938	17.5	22,537	3,938	17.5	9,545
New Mexico	38,162	800	31,510	889	2.8	586		24,152	24,738	3,070	12.4	94,410	4,759	5.0	9,729
New York	142	36				10		6,265	6,275	3,545	56.5	6,417	3,581	55.8	878
North Dakota, South Dakota, Utah, and Wisconsin						380	(5)	19,321	19,701	3,047	15.5	19,701	3,047	15.5	2,830
Ohio	1,243	280				2		75,110	75,112	29,836	39.7	76,355	30,116	39.4	1,611
Oklahoma	100,490	3,631	17,628	904	5.1	29,687	(2)	[2] 57,009	86,696	9,416	10.9	204,814	13,951	6.8	27,615
Pennsylvania	5,165	1,648				414		96,647	97,061	32,786	33.8	102,226	34,434	33.7	3

See footnotes at end of table.

Industrial consumption of natural gas in the United States in 1947, by States and uses—Continued

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)
	Millions of cubic feet (estimated)	Value at point of consumption (estimated; thousands of dollars)	Millions of cubic feet	Value at point of consumption		Millions of cubic feet				Value at point of consumption		Millions of cubic feet	Value at point of consumption		
				Total (thousands of dollars)	Average (cents per M)	Petroleum refineries	Portland cement plants	Other industrial	Total	Total (thousands of dollars)	Average (cents per M)		Total (thousands of dollars)	Average (cents per M)	
Tennessee								22,018	22,018	3,631	16.5	22,018	3,631	16.5	6,796
Texas	449,574	16,058	387,876	13,647	3.5	185,298	17,398	304,501	507,197	30,478	6.0	1,344,647	60,183	4.5	120,179
West Virginia	14,220	2,712				1,226		55,808	57,034	14,040	24.6	71,254	16,752	23.5	589
Wyoming	9,830	567				5,517		3,116	8,633	1,046	12.1	18,463	1,613	8.7	650
Unclassified by States			[3] 21,891	[3] 915	[3] 4.2		[2] 21,779								
Total: 1947	933,761	49,835	484,882	17,316	3.6	363,892	60,499	1,496,147	1,920,538	308,968	16.1	3,339,181	376,119	11.3	373,037
1946	897,809	41,317	478,349	14,470	3.0	331,520	58,004	1,344,626	1,734,150	276,985	16.0	3,110,308	332,772	10.7	306,924

[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] Less than $500.

[5] Less than 500 M cubic feet.

California, which had suffered heavy declines for 2 years, gained 21,340 million cubic feet to lead the national gain of 22 percent.

Scattered decreases, mainly in a few Western and Midwestern States, were outweighed by gains in Texas, Louisiana, Arkansas, Oklahoma, and Tennessee. Three leading States—Texas, Louisiana, and California—alone accounted for 56 percent of the United States total in 1947.

Portland-Cement Plants.—A 14-percent growth in cement production in 1947 contributed to the 4-percent increase in the volume of natural gas used in that industry. The aggregate of 60,499 million cubic feet consumed in 1947 represents a gain of 2,495 million feet over the corresponding figure for 1946.

Other Industrial.—The increase in gas used by miscellaneous industrial plants in 1946 continued in 1947. Some 1,496,147 million cubic feet were consumed in 1947 compared to 1,344,626 million in 1946, a 11-percent gain. California, Texas, and Louisiana—all States that use large amounts—showed the greatest gains over 1946, offsetting smaller losses mainly centered in the Missouri-Illinois-Indiana area.

Mixed Gas.—Natural gas sold in mixtures with manufactured gas totaled 124,265 million cubic feet in 1947 compared with 105,863 in 1946. This gain of 17 percent compares with the 11-percent gain in 1946. The main growth, both in total volume and in number of consumers, was in the domestic field. Domestic consumption gained 11.8 billion, industrial 3.7 billion, and commercial 2.9 billion cubic feet in 1947. Illinois and New York continued their lead of several years standing. Together these two States consumed approximately 49 percent of all the mixed gas in the United States in 1947.

Consumption of natural gas used with manufactured gas in the United States in 1947, 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	157,320	3,857	13,000	800	516	5,173	3,563
Illinois	1,087,170	25,089	55,150	6,695	10,061	41,845	32,738
Indiana	62,540	2,649	3,450	637	2,125	5,411	4,651
Iowa	28,810	708	2,780	214	341	1,263	961
Kentucky	89,880	5,015	8,800	2,095	1,923	9,033	4,684
Maryland	34,620	199	1,060	12	4	215	164
Michigan	5,340	85	210	16	32	133	143
Minnesota	134,770	9,902	5,660	871	859	11,632	7,485
Missouri	281,080	7,719	10,070	1,421	1,112	10,252	9,375
Nebraska	62,060	2,235	450	139	214	2,588	2,391
New York	410,090	14,006	24,610	2,699	2,003	18,708	14,417
Ohio	321,460	8,087	26,900	2,731	2,278	13,096	7,447
Pennsylvania	43,780	3,665	2,920	575	629	4,869	2,869
Tennessee	140	15	120	11	2	28	30
Virginia	740	8	140	7	4	19	14
Total: 1947	2,719,800	83,239	155,320	18,923	22,103	124,265	90,932
1946	2,655,010	71,436	147,670	16,064	18,363	105,863	79,429

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TECHNOLOGY

Recently developed gas appliances broadened sales of gas in such domestic fields as automatic laundry drying, incineration, and all-year air conditioning. A gas heat pump using latent heat in earth or water as a source for house heating has been developed.

Recent adaptations of the Fischer-Tropsch synthesis permit the use of dry natural gas as a starting chemical raw material in the manufacture of liquid fuels and chemicals. A plant now under construction at Brownsville, Tex., will be in operation by 1950.

Catalytic cracking of propane, butane, and lower grades of gasoline, already in commercial use by at least one gas company, may provide added flexibility for meeting seasonal demand patterns. Enrichment of gas to produce any desired B. t. u. content results, in effect, in greatly increasing the capacity of the delivering natural-gas line. It is reported that the relatively low production cost may extend its use to supply the base load in plants built for new areas. Additional catalytic re-forming plants are already being installed in Pennsylvania.

Centrifugal compressors were used for the first time to move large volumes of gas under high pressure over long distances through the Big Inch and Little Big Inch lines. Studies indicate that, excluding fuel or power, the operating costs will be about one-half of the corresponding costs for reciprocating equipment.

Detailed studies of physical and chemical means of removing nitrogen from natural gas have been made with a view to increasing transmission capacity of natural-gas pipe lines and improving the marketability of natural gas containing incombustible nitrogen. A nitrogen-removal pilot plant has been completed, permitting test runs. Prospective means for solution of the problem involve liquefaction and fractionation.

Several types of gas-fired lumber kilns have been developed which greatly shorten the seasoning of green lumber. Bureau of Mines research on direct reduction and distillation of zinc ores by the use of natural gas resulted in the first use of this method for the salvage of zinc residue and scrap in 1948. Utility companies have been helped by research in the removal of nitrogen and sulfur from gas and by studies of corrosion and pipe-line coatings.

Natural Gasoline

and Liquefied Petroleum Gases[1]

By G. W. CALE, E. M. SEELEY, A. T. COUMBE, AND I. F. AVERY

GENERAL SUMMARY

PRODUCTION in 1948 of light liquid products totaled an all-time high of 6,110 million gallons, equivalent to a 10-percent gain over the previous year. The increment was uniform throughout the year, as each month showed a substantial increase over the corresponding period of 1947. Notwithstanding a heavy product demand, total stocks of light hydrocarbons increased 53.9 million gallons in 1948 to reach 234 million gallons.

Export sales declined nearly 40 million gallons during 1948 to 216 million gallons, reversing the trend established during the past few years. Nearly half of the natural-gasoline shipments went to the United Kingdom; Canada received approximately a third. Canada was the largest importer of LP-gases,[2] with 59 percent of total exports, while Mexico was second with 34 percent.

The total value of all light products at plants soared to a record high of $463,618,000 in 1948 contrasted with $294,994,000 in 1947, an increase of 57 percent. Reflecting an unusually strong market, the average price of all light hydrocarbons jumped to 7.6 cents per gallon compared with 5.3 cents in 1947.

[1] Data for 1948 are preliminary.
[2] Liquefied petroleum gases.

Salient statistics of the natural-gasoline industry in the United States, 1944–48, in thousands of gallons

	1944	1945	1946	1947	1948 [1]
Production:					
Natural gasoline and natural-gasoline mixtures	2,188,284	2,498,741	2,691,001	2,743,731	2,950,925
LP-gases:					
Isobutane	209,412	162,756	164,015	206,184	206,449
Other LP-gases	961,212	1,250,468	1,245,330	1,685,634	1,974,249
Other products	843,024	792,208	760,687	915,718	978,504
Total	4,201,932	4,704,173	4,861,033	5,551,267	6,110,127
Receipts from outside sources	112,182	120,074	118,850	122,705	172,333
Stock change at plants and terminals	+798	+24,139	+33,996	−26,481	+49,924
Total supply	4,313,316	4,800,108	4,945,887	5,700,453	6,232,536
Shipments to refineries:					
Natural gasoline and natural-gasoline mixtures	2,060,985	2,384,216	2,438,416	2,554,494	2,729,193
LP-gases	534,274	657,018	381,175	407,206	457,908
Other products	629,949	496,895	412,905	477,001	495,715
Shipments to jobbers and trade outlets:					
Natural gasoline	118,608	94,155	157,523	177,848	172,579
Condensate		6,511	11,205	7,131	8,407
Finished gasoline and naphtha	134,610	229,948	265,819	361,182	371,333
Sales of LP-gases:					
For fuel	608,881	668,698	860,619	1,212,648	1,441,233
For chemical manufacture	96,558	170,386	209,394	242,280	285,165
Transfers of cycle products	76,482	35,658	52,990	71,576	80,402
Exports from plants	28,351	31,453	121,781	156,114	153,238
Losses	24,618	25,170	34,060	32,973	37,363
Total demand at plants and terminals	4,313,316	4,800,108	4,945,887	5,700,453	6,232,536
Stocks at plants, terminals, and refineries:					
Natural gasoline	114,702	101,726	138,667	118,346	151,571
LP-gases	46,452	39,517	32,264	30,225	44,147
Other products	17,430 [2] 25,788	40,270	38,278	31,847	38,614
Total	178,584 [2] 186,942	181,513	209,209	180,418	234,332
Value at plants:					
Natural gasoline ......thousands of dollars	[3] 110,000	112,018	111,798	171,057	263,141
LP-gases ......do	[3] 34,300	41,994	36,079	66,820	112,042
Other products ......do	[3] 38,200	33,552	34,404	57,117	88,435
Average per gallon ......cents	[3] 4.3	4.0	3.7	5.3	7.6
Natural gas treated ......millions of cubic feet	[3] 3,300,000	3,653,870	3,663,760	4,070,150	4,400,000
Average yield, light products except LP-gases per M cubic feet ......gallons	0.92	0.90	0.94	0.90	0.89
Average yield, all light products ......do	1.27	1.29	1.33	1.36	1.39
Sales to consumers for fuel and chemical uses:					
LP-gases	703,786	839,084	1,039,688	1,448,807	1,766,017
LR-gases [4]	356,370	437,682	664,574	760,990	970,784
Total	1,060,156	1,276,766	1,704,262	2,209,797	2,736,801
Total exports of natural gasoline and LP-gases	42,702	62,971	177,875	256,160	216,294

[1] Subject to revision.
[2] For comparison with 1945.
[3] Estimated.
[4] Liquefied refinery gases.

The production of all light hydrocarbons in 1948 was equivalent to approximately 7 percent of the total domestic crude-oil output. Demand for both natural gasoline and LP-gases continued strong at the end of the year. The expansion program of the industry continued satisfactorily during 1948, with Texas accounting for the greatest number of new cycling plants. California increased capacity of its plants principally by installing additional facilities at existing plants. The total capacity of the industry at the year's end for light liquid products was nearly 20 million gallons daily. Based on current information, it is evident that this accelerated building program will extend through 1949.

During 1948 natural gasoline represented 48 percent of the gallonage of light hydrocarbons, with a value of 57 percent of the total. The relative position of natural gasoline remained practically the same as in 1947, when it represented 49 percent of total production and 58 percent of the value. LP-gases were responsible for 36 percent of total output in 1948 compared to 34 percent in 1947, while the percent of the value of this product increased to 24 percent compared to 23 percent the previous year. Other products (including finished gasoline, condensate, kerosine, distillate fuel, "special naphtha," etc.) maintained a relatively important position. During 1948 these products contributed 16 percent of the total output, identical to the 1947 proportion; likewise the percentage of value remained the same for both years at 19 percent.

A total of 4,400 billion cubic feet of natural gas was processed in 1948 at natural-gasoline and cycle plants, an increase of 8 percent over 1947. The average yield of all light products per thousand cubic feet of gas treated rose from 1.36 gallons in 1947 to 1.39 gallons in 1948. Although the average yield of natural gasoline remained unchanged at 0.67 gallon per thousand cubic feet in 1948 compared with 1947, the average yield of LP-gases increased to 0.50 gallon from 0.46 gallon. Continuing the trend of recent years, production of propane increased 35 percent in 1948 over the previous year, while commercial butane-propane mixture gained 8 percent and normal butane 6 percent.

Sales to consumers of liquefied gases produced in oil refineries (LR-gases) totaled 971 million gallons in 1948 compared with 761 million gallons in 1947 and 665 million in 1946. However, a large volume of LR-gas fractions is utilized by the refineries in processing other products, in addition to the sales for consumption outside the petroleum-refining industry.

It is apparent that the uses for LP-gases will continue to expand in the foreseeable future. Already many industrial firms are utilizing LP-gases as stand-by fuel, while others use it to supplement their normal supply during peak load periods. LP-gases are also used to a great extent to augment both natural- and manufactured-gas supplies during peak loads.

RESERVES

A report compiled by the American Petroleum Institute and the American Gas Association indicates total proved reserves of natural-gas liquids in the United States of 3,540,783,000 barrels as of December 31, 1948. This figure includes condensate, natural gasoline, and LP-gases, and is an increase of 286,808,000 barrels over 1947.

Arkansas, California, Kentucky, Mississippi, New Mexico, Ohio, and West Virginia showed declines in reserves totaling 15,137,000 barrels. The largest increases in reserves were reported in Colorado, Louisiana, Oklahoma, Texas, and Wyoming. Texas led all States with an addition of 117,611,000 barrels to reserves; Louisiana was second with 61,282,000 barrels.

Natural-gas reserves are estimated at 173,869,340 million cubic feet as of December 31, 1948, an increase of 7,942,426 million cubic feet over the previous year. The comparable reserve of 3,540,783,000 barrels of natural gas liquids would therefore indicate an average yield of 0.86 gallon per thousand cubic feet of gas reserves.

Estimated proved recoverable reserves of natural-gas liquids [1] in the United States, in thousands of barrels

[Committee on Natural Gas Reserves, American Gas Association]

State	Reserves as of Dec. 31, 1947	Changes in reserves during 1948			Reserves as of Dec. 31, 1948			
		Extensions and revisions	Discoveries of new fields and new pools in old fields	Net production	Nonassociated	Associated	Dissolved	Total
Arkansas	58,259	3,220	249	4,271	36,468	7,926	13,063	57,457
California	312,151	20,088	2,149	26,480	--------	103,259	204,649	307,908
Colorado	7,942	27,834	537	14	537	--------	35,762	36,299
Illinois	17,920	10,152	--------	3,910	40	100	24,022	24,162
Indiana	65	71	--------	28	30	--------	78	108
Kansas	88,812	15,621	17	2,106	97,695	2,539	2,110	102,344
Kentucky	15,344	410	206	1,559	[2] 14,401	--------	--------	14,401
Louisiana	462,814	67,206	16,113	22,037	382,319	95,908	45,869	524,096
Michigan	1,065	53	59	111	607	--------	459	1,066
Mississippi	58,659	721	942	2,758	24,563	27,641	5,360	57,564
Montana	1,360	2,840	--------	200	--------	4,000	--------	4,000
New Mexico	85,922	-5,756	4,342	4,261	23,879	30,902	25,466	80,247
Ohio	1,736	70	9	151	[2] 1,664	--------	--------	1,664
Oklahoma	155,003	53,685	8,225	16,525	95,869	16,436	88,083	200,388
Pennsylvania	2,236	467	233	291	[2] 2,645	--------	--------	2,645
Texas	1,957,063	180,126	31,204	93,719	1,314,800	297,052	462,822	2,074,674
Utah	200	--------	30	21	209	--------	--------	209
West Virginia	17,521	1,076	359	3,742	[2] 15,214	--------	--------	15,214
Wyoming	9,900	27,971	--------	1,564	12,191	--------	24,116	36,307
Alabama, Florida, Missouri, Nebraska, New York, and Virginia	3	19	9	1	24	--------	6	30
Total	3,253,975	405,874	64,683	183,749	2,023,155	585,763	931,865	3,540,783

[1] Includes condensate, natural gasoline, and LP-gases.
[2] Not allocated by types, but occurring principally in column shown.

PRODUCTION

The production of light products reached the record total of 6,110,127 thousand gallons in 1948. The daily average output for December was 18,200 thousand gallons, a record for the industry. Total gain for the year was 10 percent over 1947.

This gain represented a material increase each month in 1948 over the comparable 1947 month. Natural-gasoline production totaled 2,950,925 thousand gallons, an 8-percent increase over 1947. The output of LP-gases continued to shatter all former records, with a production of 2,180,698 thousand gallons in 1948—an increase of 15 percent over the previous year. Other light hydrocarbons made a moderate increase of 7 percent for the year, with a production of 978,504 thousand gallons.

Texas continued to lead all States in production of light products with California second and Louisiana third.

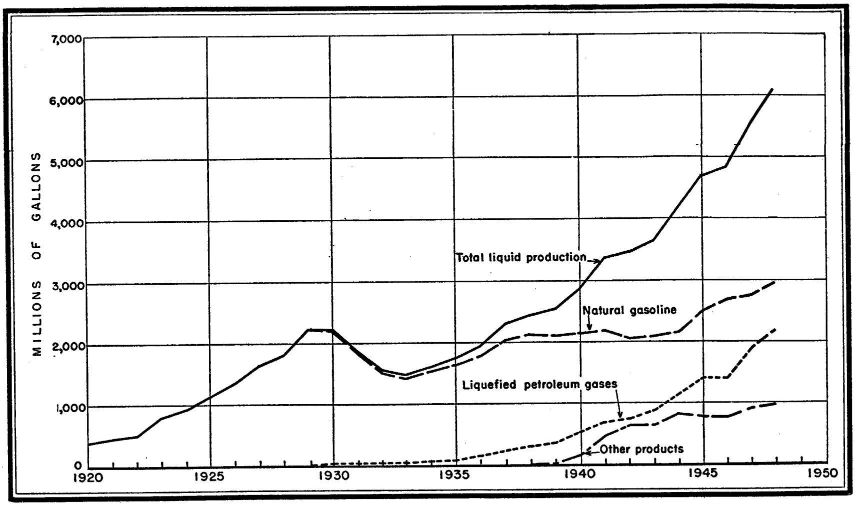

FIGURE 1.—Annual production of the natural-gasoline industry, 1920–48.

Natural gasoline and allied products produced and natural gas treated in the United States, 1947–48, by States

State	Number of operators [2]	Production								Natural gas treated		
		Natural gasoline		LP-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 LP-gases	All light products
1947												
Arkansas	8	51,165	3,320	37,279	1,271	5,622	348	94,066	4,939	60,474	0.94	1.56
California	29	689,998	38,323	230,635	7,901	143,475	7,979	1,064,108	54,203	460,046	1.81	2.31
Colorado	------	997	68	------	------	------	------	997	68	------	------	------
Illinois	9	47,180	4,008	115,324	5,043	------	------	162,504	9,051	22,720	2.08	7.15
Kansas	8	71,532	3,826	27,648	978	15	1	99,195	4,805	216,644	.33	.46
Kentucky	3	9,577	656	50,136	1,304	------	------	59,713	1,960	38,717	.25	1.54
Louisiana	20	298,136	17,049	147,097	7,090	183,612	9,728	628,845	33,867	345,975	1.39	1.82
Michigan	2	3,658	248	629	17	------	------	4,287	265	2,255	1.62	1 90
Mississippi	1	4,752	256	3,207	159	11,983	659	19,942	1,074	8,079	2.07	2.47
Montana	1	2,768	216	2,988	208	------	------	5,756	424	12,066	.23	.48
New Mexico	7	92,297	6,020	20,748	703	6	6	113,051	6,729	130,693	.71	.87
New York	1	11	1	------	------	------	------	11	1	12	.92	.92
Ohio	5	5,775	414	144	5	1,165	85	7,084	504	32,869	.21	.22
Oklahoma	37	272,078	17,822	165,602	5,700	8,813	868	446,493	24,390	236,673	1.19	1.89
Pennsylvania	18	12,420	831	593	51	------	------	13,013	882	52,437	.24	.25
Texas	87	1,098,779	72,168	984,860	32,724	555,795	37,129	2,639,434	142,021	2,235,185	.74	1.18
Utah	------	685	47	------	------	------	------	685	47	------	------	------
West Virginia	16	47,106	3,025	88,935	2,975	5,232	314	141,273	6,314	193,044	.27	.73
Wyoming	5	34,817	2,759	15,993	691	------	------	50,810	3,450	22,261	1.56	2.28
Total	213	2,743,731	171,057	1,891,818	66,820	915,718	57,117	5,551,267	294,994	4,070,150	.90	1.36
1948 [3]												
Arkansas	8	49,306	4,364	39,092	2,260	6,102	635	94,500	7,259	60,094	.92	1.57
California	29	704,745	58,564	269,644	16,961	137,680	11,014	1,112,069	86,539	466,189	1.81	2.39
Colorado	------	944	94	------	------	------	------	944	94	------	------	------
Illinois	8	45,793	5,605	103,202	7,864	------	------	148,995	13,469	19,534	2.34	7.63
Kansas	8	73,343	6,051	28,617	1,731	------	------	101,960	7,782	231,019	.32	.44
Kentucky	3	10,182	953	56,407	1,683	------	------	66,589	2,636	44,629	.23	1.49
Louisiana	23	329,390	28,064	179,442	11,215	197,346	17,939	706,178	57,218	402,866	1.31	1.75
Michigan	1	2,471	238	46	3	------	------	2,517	241	1,586	1.56	1.59
Mississippi	1	27,167	1,687	18,339	922	------	------	45,506	2,609	30,840	.88	1.48

Montana	1	3,403	370	5,046	350	----------	----------	8,449	720	13,748	.25	.61
New Mexico	7	99,980	9,798	31,396	1,234	202	14	131,578	11,046	166,115	.60	.79
New York	1	11	1	----------	----------	----------	----------	11	1	12	.92	.92
Ohio	5	5,500	569	203	11	652	67	6,355	647	24,400	.25	.26
Oklahoma	37	267,109	24,788	197,131	10,980	5,901	643	470,141	36,411	229,122	1.19	2.05
Pennsylvania	16	11,320	1,105	919	66	14	(4)	12,253	1,171	46,751	.24	.26
Texas	85	1,235,072	112,392	1,123,225	50,433	626,092	57,914	2,984,389	220,739	2,445,457	.76	1.22
Utah	----------	640	64	----------	----------	----------	----------	640	64	----------	----------	----------
West Virginia	15	49,415	4,699	103,412	4,778	4,515	209	157,342	9,686	194,260	.28	.81
Wyoming	5	35,134	3,735	24,577	1,551	----------	----------	59,711	5,286	23,378	1.50	2.55
Total	209	2,950,925	263,141	2,180,698	112,042	978,504	88,435	6,110,127	463,618	4,400,000	.89	1.39

[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] Subject to revision.
[4] Less than $500.

REVIEW BY STATES

California.—The total production of light products increased 5 percent in 1948 over 1947, to 1,112,069 thousand gallons. The increase in natural gasoline was 2 percent and in liquefied petroleum gas 17 percent; however, other products declined 4 percent.

Louisiana.—The combined production of all light hydrocarbons rose to 706,178 thousand gallons in 1948, a gain of 12 percent over the previous year. Production in the Louisiana Gulf dropped slightly, but output in the rest of the State showed a phenomenal increase and outstripped the Gulf production. For Louisiana as a whole, natural-gasoline output gained 10 percent, LP-gases were up 22 percent, and other products increased 7 percent in 1948 as compared to 1947.

Oklahoma.—In Oklahoma the general trend was similar to 1947; that is, an over-all increase of 5 percent in the production of light hydrocarbons. Natural-gasoline output was off nearly 2 percent, whereas LP-gases gained 19 percent.

Texas.—Texas continues to expand rapidly in the manufacture of light liquid products, as evidenced by an output of 2,984,389 thousand gallons in 1948, almost half of the entire domestic production. Natural gasoline gained 12 percent over 1947, and LP-gases increased 14 percent to a record total of 1,123,225 thousand gallons. The over-all gain was 13 percent for all allied products for the year.

Other States.—Mississippi led all States, with a gain of 128 percent in 1948 over the previous year due to the addition of a large new plant. West Virginia and New Mexico likewise made substantial gains in production of light hydrocarbons in 1948 compared to 1947. Illinois had a moderate decline, whereas Kansas and Arkansas maintained the same position they established in 1947.

Monthly production of natural gasoline and allied products in the United States, 1947–48, by States and districts, in millions of gallons

Field	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1947													
West New York and West Pennsylvania	1.3	1.2	1.3	1.3	1.2	0.8	0.8	0.7	0.8	1.0	1.3	1.3	13.0
West Virginia	10.8	11.8	13.1	11.2	11.0	9.9	9.7	10.8	10.7	12.6	14.1	15.6	141.3
Ohio	.8	.7	.8	.6	.5	.4	.4	.4	.4	.6	.7	.8	7.1
Illinois	13.9	12.9	14.2	13.6	14.1	13.4	13.9	13.3	13.3	13.5	13.2	13.2	162.5
Kentucky	5.5	3.2	4.6	5.2	4.8	4.7	4.9	4.7	4.5	5.3	6.1	6.2	59.7
Michigan	.4	.3	.4	.4	.4	.4	.5	.4	.3	.3	.3	.2	4.3
Kansas	9.0	9.1	8.8	8.7	8.2	7.8	7.3	7.2	7.5	7.8	8.6	9.2	99.2
Oklahoma	36.7	34.8	39.3	36.8	37.2	34.0	35.7	36.6	36.5	38.8	39.2	40.9	446.5
Texas:													
Gulf	57.1	53.7	58.4	57.3	55.3	53.1	58.1	58.1	56.5	62.2	63.0	66.0	698.8
East Texas	27.8	28.4	30.7	31.4	33.6	33.1	34.0	34.1	33.2	34.7	30.6	29.2	380.8
Panhandle	51.5	50.4	54.6	52.7	27.8	45.4	47.0	44.4	50.7	53.1	55.8	58.1	591.5
Rest of State	74.1	69.8	78.5	76.4	79.6	81.2	84.6	86.5	83.4	85.3	83.1	85.8	968.3
Total Texas	210.5	202.3	222.2	217.8	196.3	212.8	223.7	223.1	223.8	235.3	232.5	239.1	2,639.4
Arkansas	8.3	8.0	8.6	7.6	7.4	7.1	7.6	7.6	7.6	7.6	8.1	8.6	94.1
Louisiana:													
Gulf	30.5	23.8	32.9	28.6	30.5	27.2	29.7	29.3	27.2	26.9	30.1	27.9	344.6
Inland	21.3	19.0	19.6	19.3	20.8	19.9	21.4	28.5	25.7	28.5	29.4	30.8	284.2
Total Louisiana	51.8	42.8	52.5	47.9	51.3	47.1	51.1	57.8	52.9	55.4	59.5	58.7	628.8
Mississippi	-----	-----	-----	-----	-----	-----	-----	-----	1.0	2.1	7.3	9.5	19.9
New Mexico	8.2	7.7	8.7	8.8	9.6	10.0	10.7	11.3	10.3	9.9	8.8	9.1	113.1
Montana	.4	.4	.4	.4	.4	.4	.4	.4	.5	.6	.7	.8	5.8

Monthly production of natural gasoline and allied products in the United States, 1947–48, by States and districts, in millions of gallons—Continued

Field	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1947—Continued													
Colorado, Utah, and Wyoming	4.3	4.2	4.6	3.6	3.9	3.7	3.8	4.0	4.5	5.1	5.0	5.8	52.5
California	85.2	77.8	83.6	84.1	88.0	86.5	90.1	92.1	90.2	94.7	94.1	97.7	1,064.1
Total United States	447.1	417.2	463.1	448.0	434.3	439.0	460.6	470.4	464.8	490.6	499.5	516.7	5,551.3
Daily average	14.4	14.9	14.9	14.9	14.0	14.6	14.9	15.2	15.5	15.8	16.7	16.7	15.2
1948 [1]													
West New York and West Pennsylvania	1.3	1.2	1.1	1.1	1.1	.9	.8	.8	.8	1.1	1.0	1.1	12.3
West Virginia	13.9	13.2	14.8	13.7	13.5	11.4	11.4	11.6	12.0	13.8	13.9	14.1	157.3
Ohio	.6	.6	.6	.6	.5	.5	.5	.5	.5	.5	.5	.5	6.4
Illinois	12.5	11.0	12.3	12.1	13.0	12.5	12.5	12.2	12.7	13.2	12.6	12.4	149.0
Kentucky	6.0	5.5	5.9	5.3	5.8	4.9	4.8	4.9	4.8	6.0	5.8	6.9	66.6
Michigan	.2	.2	.2	.3	.3	.2	.2	.2	.2	.2	.2	.1	2.5
Kansas	9.6	9.5	9.2	8.5	8.1	7.6	7.5	7.6	7.4	8.3	8.9	9.7	101.9
Oklahoma	38.4	37.0	40.2	37.4	37.0	34.9	36.7	38.0	39.1	42.3	43.1	46.0	470.1
Texas:													
Gulf	66.2	61.7	67.7	66.0	65.3	61.8	63.4	66.9	67.2	71.8	72.1	73.3	803.4
East Texas	27.3	27.4	31.2	29.9	30.7	31.1	31.4	33.2	33.1	33.6	30.8	29.4	369.1
Panhandle	60.3	56.2	56.8	56.2	56.7	48.5	46.3	51.7	53.0	61.0	61.6	66.6	674.9
Rest of State	86.0	82.3	86.3	86.9	90.4	94.4	98.6	99.5	99.1	102.1	104.2	107.2	1,137.0
Total Texas	239.8	227.6	242.0	239.0	243.1	235.8	239.7	251.3	252.4	268.5	268.7	276.5	2,984.4
Arkansas	8.4	8.0	8.3	7.2	7.4	6.9	7.6	7.5	8.0	8.1	8.3	8.8	94.5
Louisiana:													
Gulf	28.6	28.1	29.0	26.7	29.6	27.6	30.3	27.5	27.4	30.8	27.9	28.8	342.3
Inland	26.4	23.0	32.5	27.2	29.9	28.2	30.5	31.1	30.7	35.2	33.1	36.1	363.9
Total Louisiana	55.0	51.1	61.5	53.9	59.5	55.8	60.8	58.6	58.1	66.0	61.0	64.9	706.2
Mississippi	3.8	3.6	3.9	3.7	3.6	3.1	3.6	3.8	3.9	4.1	4.1	4.3	45.5
New Mexico	8.8	8.4	9.6	10.2	10.8	11.1	11.1	11.6	12.4	12.5	12.1	13.0	131.6
Montana	.8	.7	.8	.7	.6	.6	.4	.5	.6	.7	.9	1.1	8.4
Colorado, Utah, and Wyoming	6.3	5.9	5.7	4.5	4.5	4.2	4.4	4.9	4.9	5.4	5.3	5.3	61.3
California	98.5	93.0	99.1	92.2	97.1	93.5	95.4	95.4	65.8	87.1	94.9	100.1	1,112.1
Total United States	503.9	476.5	515.2	490.4	505.9	483.9	497.4	509.4	483.6	537.8	541.3	564.8	6,110.1
Daily average	16.3	16.4	16.6	16.3	16.3	16.1	16.0	16.4	16.1	17.3	18.0	18.2	16.7

[1] Subject to revision.

YIELDS, PROCESSES, AND NUMBER OF PLANTS

Cycle Plants.—During 1948 cycle plants produced approximately 1,659,245 thousand gallons of light hydrocarbons from 1,040,000 million cubic feet of processed natural gas, an indicated yield of 1.60 gallons per thousand cubic feet. This compares with 1.60 gallons per thousand cubic feet in 1947 and 1.50 gallons in 1946.

Yields.—The average yield of all light products in 1948 increased slightly over the previous year. The 1948 yield was 1.39 gallon per thousand feet of natural gas treated compared to 1.36 gallon per thousand cubic feet in 1947. The yield of natural gasoline in 1948 remained unchanged from the previous year at 0.67 gallon per thousand cubic feet.

The average yield of LP-gases in 1948 increased to 0.50 gallon per thousand cubic feet in contrast to a yield of 0.46 in 1947. The average yield of all light products except LP-gases was 0.89 in 1948 as against 0.90 for the previous year. The production of propane established a record in 1948 of 750,503 thousand gallons, indicating a gain of 35 percent compared to 1947. Commercial butane-propane mixture and normal butane made moderate increases of 8 and 6 percent, respectively, in 1948 over the previous year.

The average value of light products recovered per 1,000 cubic feet of natural gas processed increased to 10.5 cents per gallon in 1948 compared to 7.2 cents in 1947. The increase was due primarily to much higher product prices. Extending the trend established in 1947, natural gasoline continued to be the most valuable of all products recovered, contributing 6 cents per 1,000 cubic feet of gas processed. LP-gases accounted for 2.5 cents and other products 2 cents in 1948 compared to 1.6 and 1.4 cents, respectively, the previous year.

Production by Processes.—During 1947 the number of natural-gasoline plants and cycle plants declined to 546, indicating a net loss of 22 plants for the year. Compression-type plants were reduced by 24, although there was no change in the number of absorption plants, which totaled 373. Cycle plants increased from 36 to 38. The huge plant at Katy, Tex., is an example of the trend both in construction and operation of present industry technique. This plant is adjacent to an enormous gas field, and although there are many individual operators of the gas wells, the plant is operated by one company acting for and responsible to the others. Much of the stripped gas is returned to producing sands for repressuring. Cotton Valley, La., is another example of unitized operation on a large scale. The net result of present technique is to increase materially the average daily output per operating plant. This has risen from 27,900 gallons daily in 1947 to 30,600 gallons in 1948.

Natural gasoline and allied products produced in the United States in 1947, 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		8		8		94,066		94,066
California	1	73	2	76	50	854,831	209,227	[5] 1,064,108
Colorado						[6] 997		997
Illinois	9	6		15	371	162,133		162,504
Kansas	2	12		14	1,157	98,038		99,195
Kentucky	1	3		4	797	58,916		59,713
Louisiana	4	24	5	33	31,384	143,820	453,641	628,845
Michigan		2		2		4,287		4,287
Mississippi			1	1			19,942	19,942
Montana		1		1		5,756		5,756
New Mexico	2	7		9	5,391	107,660		113,051
New York	1			1	11			11
Ohio	2	7		9	2	7,082		7,084
Oklahoma	14	71		85	10,331	436,162		446,493
Pennsylvania	30	8		38	780	12,233		13,013
Texas	21	125	30	176	113,309	1,699,949	826,176	2,639,434
Utah						[6] 685		685
West Virginia	46	22		68	64,513	76,760		141,273
Wyoming	2	4		6	1,238	49,572		50,810
Total: 1947	135	373	38	546	229,334	3,812,947	1,508,986	5,551,267
1946	159	373	36	568	238,595	3,304,592	1,317,846	4,861,033

[1] Figures for 1948 not yet available.
[2] Includes 15 plants manufacturing LP-gases.
[3] Includes combination of absorption process with compression and charcoal processes. Includes 202 plants manufacturing LP-gases; and 3 charcoal plants in Ohio and West Virginia with 1,586,000 gallons produced in 1947 and 3 charcoal plants with 1,638,000 gallons in 1946.
[4] Includes 29 plants manufacturing LP-gases.
[5] Includes 24,444,000 gallons, of field condensate.
[6] Drip gasoline.

Technologic Trends.—In 1948, 506 natural-gasoline plants and 41 cycling plants were in operation. The capacity of these plants was nearly 20 million gallons daily. In addition, about 50 large-scale projects for new plants or expansion of existing facilities were under construction or planned. Completion of this program will increase present production by approximately 12 percent. There has been a definite trend in the industry toward producing more LP-gases. Due to the higher prices for propane and butane as well as the expanding markets for these products, many plants which heretofore produced only natural gasoline have been modernized to manufacture LP-gas fractions.

New plants being erected average considerably larger than the older ones, and some installations will have capacity to handle 500,000,000 cubic feet daily. New technique is being developed to extract more propane and where possible to design new plants for almost complete propane extraction.

An article in Oil and Gas Journal (March 25, 1948), entitled "Modern Process Methods to Improve LP-Gas Recovery," states:

> It is predicted that the present trend toward deep extraction of propane and eventually ethane will alter future plant processes from the absorption-oil types to low-temperature liquefaction.
>
> The original purpose of the natural-gasoline plant was to remove the "wet" or heavy gasoline ends, but the present-day trend is to make the separation not at the bottom but at the top, removing the light gases from the liquefiable hydrocarbons. This objective, it seems, should be accomplished more efficiently by straight low-temperature fractionation of the inlet gas.

MARKET DEMAND—SHIPMENTS

The total demand for light products processed at natural-gasoline and cycle plants reached the huge total of 6,232,536 thousand gallons, an increase of 9 percent over 1947 and an all-time record. Deliveries of natural gasoline gained 6 percent in 1948 over the previous year, and LP-gases increased 17 percent. Deliveries of condensate dropped 12 percent in 1948, but finished gasoline and naphtha showed an 18-percent gain. It is to be noted that the figures for LP-gases in the table do not include LR-gases.

Supply and distribution at plants of natural gasoline and allied products in the United States, 1947–48, by months, in thousands of gallons

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1947													
Production:													
Natural gasoline and natural-gasoline mixtures	216,462	195,040	219,153	221,015	235,219	235,903	242,686	241,852	237,846	242,356	225,536	230,663	2,743,731
Raw condensate	31,490	27,271	33,258	31,002	31,700	29,809	33,417	33,696	35,382	37,074	43,862	43,575	411,545
LP-gases:													
Commercial butane-propane mixture	43,744	43,756	44,465	37,081	32,886	29,781	32,888	37,721	38,080	43,167	45,538	50,019	479,126
Normal butane	36,284	41,157	41,369	38,966	30,011	30,660	29,042	33,534	35,627	39,080	44,590	42,213	442,533
Propane	45,402	43,507	45,643	40,141	36,811	36,615	40,602	46,111	45,854	50,922	59,635	66,712	557,955
Other mixtures (LP-gases)	11,781	9,984	14,762	14,772	12,665	13,216	13,541	13,931	13,273	14,340	16,055	17,432	165,752
Isobutane	14,470	13,569	18,345	20,943	13,581	22,765	24,169	17,134	15,861	16,859	13,919	14,569	206,184
Isopentane	3,886	2,183	3,359	2,551	2,718	2,690	3,187	2,727	3,736	3,546	5,586	4,099	40,268
Finished gasoline and naphtha	37,524	35,542	36,937	35,681	32,421	31,497	34,592	37,172	33,507	37,068	38,806	40,996	431,743
Other products	6,026	5,229	5,823	5,852	6,236	6,028	6,441	6,553	5,647	6,226	5,977	6,392	72,430
Total	447,078	417,238	463,114	448,004	434,248	438,964	460,565	470,431	464,813	490,638	499,504	516,670	5,551,267
Receipts from outside sources	10,574	9,563	10,961	13,253	4,116	10,856	8,577	9,223	13,628	12,231	6,302	13,421	122,705
Stock change at plants and terminals	−3,597	5,817	−3,628	19,189	−12,008	−8,124	−271	−6,269	−9,743	−10,496	7,990	−5,341	−26,481
Total supply	461,249	420,984	477,703	442,068	450,372	457,944	469,413	485,923	488,184	513,365	497,816	535,432	5,700,453
Shipments to refineries:													
Natural gasoline and natural-gasoline mixtures	208,888	179,617	201,510	198,246	206,369	214,309	215,969	230,927	234,101	236,047	212,803	215,708	2,554,494
Condensate	30,988	25,740	31,977	28,968	30,419	29,041	32,677	32,631	35,128	35,828	42,500	42,413	398,310
Normal butane	6,257	9,760	8,147	6,078	6,222	7,165	8,819	8,964	10,197	12,962	11,368	12,346	108,285
Isobutane	11,619	10,772	14,670	20,633	13,238	21,346	23,327	15,255	15,648	15,702	11,734	15,104	189,048
Isopentane	3,034	2,000	2,910	2,511	3,392	2,517	3,540	3,925	2,856	3,776	5,477	3,003	38,941
Other LP-gases	5,637	3,133	3,477	5,597	4,893	6,102	6,171	5,878	7,817	6,365	7,307	8,555	70,932
Finished gasoline and naphtha	5,879	5,775	6,514	5,251	5,714	6,022	6,377	6,356	6,151	6,586	5,123	12,943	78,691
Shipments to jobbers and trade outlets:													
Natural gasoline	11,840	11,156	16,072	12,630	17,548	16,147	14,371	15,048	14,811	15,466	15,056	17,703	177,848
Condensate	379	456	758	1,620	1,154	313	430	349	325	203	567	577	7,131
Finished gasoline and naphtha	31,350	29,704	32,918	26,457	31,836	33,543	27,427	29,755	28,278	31,528	29,784	28,602	361,182
LP-gases:													
For fuel [1]	113,202	107,078	117,209	96,452	83,826	81,262	87,182	95,113	96,370	105,798	119,913	137,351	1,240,756
For chemical manufacture	19,737	16,738	20,067	20,800	16,812	19,150	21,086	20,463	19,919	22,037	22,151	23,320	242,280
Transfers of cycle products	6,682	4,979	6,266	5,649	5,949	5,118	6,159	6,753	5,587	6,155	5,496	6,783	71,576
Exports and losses [1]	5,757	14,076	15,208	11,176	23,000	15,909	15,878	14,506	10,996	14,912	8,537	11,024	160,979
Total demand at plants and terminals	461,249	420,984	477,703	442,068	450,372	457,944	469,413	485,923	488,184	513,365	497,816	535,432	5,700,453

1948 [2]													
Production:													
Natural gasoline and natural-gasoline mixtures	227, 610	212, 556	235, 229	244, 652	257, 300	256, 339	261, 395	261, 961	233, 633	257, 545	248, 914	253, 791	2, 950, 925
Raw condensate	33, 263	31, 020	30, 841	28, 025	31, 523	28, 667	31, 402	29, 046	23, 301	27, 998	33, 613	34, 905	363, 604
LP-gases:													
Commercial butane-propane mixture	51, 992	46, 413	47, 824	44, 050	39, 263	33, 615	38, 189	40, 312	41, 975	43, 437	43, 148	46, 099	516, 317
Normal butane	38, 304	42, 654	41, 629	34, 808	35, 245	36, 280	30, 275	35, 406	40, 569	43, 175	45, 754	46, 057	470, 156
Propane	66, 188	61, 877	67, 370	53, 389	53, 187	47, 674	50, 151	57, 400	61, 401	71, 098	76, 371	84, 397	750, 503
Other mixtures (LP-gases)	15, 788	15, 059	16, 002	14, 326	15, 720	14, 550	14, 459	13, 130	13, 436	15, 526	14, 841	17, 664	180, 501
Isobutane	17, 378	15, 456	18, 699	19, 045	19, 275	15, 202	18, 292	18, 490	14, 019	16, 750	16, 533	17, 310	206, 449
Isopentane	4, 446	4, 058	4, 132	3, 994	5, 467	4, 593	4, 779	4, 276	4, 970	5, 420	4, 976	5, 661	56, 772
Finished gasoline and naphtha	42, 376	40, 982	46, 124	41, 474	41, 769	40, 461	41, 605	42, 834	43, 529	49, 263	49, 536	50, 751	530, 704
Other products	6, 542	6, 369	7, 390	6, 647	7, 103	6, 535	6, 853	6, 579	6, 771	7, 621	7, 609	8, 177	84, 196
Total	503, 887	476, 444	515, 240	490, 410	505, 852	483, 916	497, 400	509, 434	483, 604	537, 833	541, 295	564, 812	6, 110, 127
Receipts from outside sources	15, 629	12, 790	17, 590	15, 483	13, 503	11, 460	12, 856	14, 504	17, 925	12, 632	11, 102	16, 859	172, 333
Stock change at plants and terminals	4, 956	7, 386	8, 673	18, 416	7, 458	10, 859	1, 873	8, 388	−307	3, 188	−11, 766	−9, 200	49, 924
Total supply	514, 560	481, 848	524, 157	487, 477	511, 897	484, 517	508, 383	515, 550	501, 836	547, 277	564, 163	590, 871	6, 232, 536
Shipments to refineries:													
Natural gasoline and natural-gasoline mixtures	210, 622	195, 707	216, 234	210, 967	248, 028	225, 593	239, 273	229, 417	224, 166	241, 822	242, 340	245, 024	2, 729, 193
Condensate	32, 503	30, 059	29, 350	27, 885	29, 528	28, 507	30, 927	29, 338	21, 961	25, 410	30, 727	32, 356	348, 551
Normal butane	8, 897	7, 493	10, 229	7, 846	8, 620	9, 445	10, 564	10, 146	11, 230	12, 966	15, 205	16, 180	128, 821
Isobutane	16, 141	15, 224	17, 656	17, 652	18, 017	16, 900	17, 681	17, 898	13, 522	14, 918	15, 467	16, 372	197, 448
Isopentane	4, 023	3, 268	4, 311	5, 227	5, 545	4, 772	3, 997	3, 994	5, 239	4, 885	4, 772	5, 177	55, 210
Other LP-gases	7, 835	7, 235	7, 102	6, 513	6, 006	5, 716	6, 113	6, 253	5, 251	5, 783	6, 269	6, 353	76, 429
Finished gasoline and naphtha	12, 459	12, 290	12, 135	12, 228	12, 084	11, 753	12, 562	11, 068	12, 106	12, 809	12, 575	13, 095	147, 164
Shipments to jobbers and trade outlets:													
Natural gasoline	16, 675	15, 163	14, 570	13, 696	14, 749	9, 821	15, 849	17, 966	14, 168	14, 034	13, 189	12, 699	172, 579
Condensate	412	455	616	897	634	452	218	215	409	1, 449	1, 767	883	8, 407
Finished gasoline and naphtha	28, 433	26, 834	34, 975	29, 581	25, 976	31, 526	28, 393	28, 672	30, 907	31, 347	37, 741	36, 948	371, 333
LP-gases:													
For fuel [1]	137, 214	131, 075	130, 872	110, 130	102, 176	93, 213	103, 515	116, 823	119, 768	131, 121	136, 754	153, 424	1, 466, 085
For chemical manufacture	22, 891	22, 590	24, 970	23, 535	23, 929	22, 158	22, 700	19, 953	23, 679	26, 495	26, 149	26, 116	285, 165
Transfers of cycle products	6, 997	6, 701	7, 067	5, 768	6, 282	6, 019	5, 846	6, 408	6, 065	7, 711	7, 548	7, 990	80, 402
Exports and losses [1]	9, 458	7, 754	14, 070	15, 552	10, 323	18, 642	10, 745	17, 399	13, 365	16, 527	13, 660	18, 254	165, 749
Total demand at plants and terminals	514, 560	481, 848	524, 157	487, 477	511, 897	484, 517	508, 383	515, 550	501, 836	547, 277	564, 163	590, 871	6, 232, 536

[1] Exports from plants and terminals totaling 28,108,000 gallons in 1947 and 24.852,000 gallons in 1948 are included with shipments of LP-gases for fuel and are excluded from "Exports and losses." This portion of the exports is not separable by months.

[2] Subject to revision.

Natural gasoline and allied products utilized at refineries in the United States, 1947–48, by districts and months, in thousands of gallons

District	January	February	March	April	May	June	July	August	September	October	November	December	Total
1947													
East Coast	6,216	5,082	3,402	3,528	756	714	3,276	420	1,344	3,948	4,662	3,738	37,086
Appalachian	2,394	1,848	2,226	1,890	1,722	1,806	1,764	1,512	1,806	1,638	1,638	2,016	22,260
Indiana, Illinois, Kentucky, etc	27,678	23,982	24,444	26,376	25,662	28,182	27,678	31,122	30,156	31,920	32,088	30,408	339,696
Oklahoma, Kansas, Missouri	25,410	21,798	20,916	17,262	17,514	18,312	17,010	19,656	23,688	24,738	23,520	22,260	252,084
Texas:													
Gulf Coast	55,440	43,386	53,256	52,752	59,976	57,582	69,300	64,596	64,260	61,404	65,100	63,798	710,850
Inland	37,968	32,172	41,622	46,536	29,358	49,434	40,572	47,166	47,544	44,436	42,378	41,076	500,262
Total Texas	93,408	75,558	94,878	99,288	89,334	107,016	109,872	111,762	111,804	105,840	107,478	104,874	1,211,112
Louisiana, Arkansas:													
Louisiana Gulf Coast	12,600	9,366	9,450	11,718	11,802	9,828	11,256	12,474	12,306	10,332	10,248	8,820	130,200
Arkansas, Louisiana Inland	3,864	3,948	3,402	3,276	2,982	3,360	3,402	3,360	3,108	3,402	2,982	2,814	39,900
Total Louisiana, Arkansas	16,464	13,314	12,852	14,994	14,784	13,188	14,658	15,834	15,414	13,734	13,230	11,634	170,100
Rocky Mountain	3,948	3,528	3,444	3,528	2,814	2,016	1,806	2,478	4,368	3,192	3,318	4,116	38,556
California	70,560	61,026	59,220	69,090	70,014	76,482	83,328	89,250	84,966	81,900	79,632	72,702	898,170
Total United States	246,078	206,136	221,382	235,956	222,600	247,716	259,392	272,034	273,546	266,910	265,566	251,748	2,969,064
1948 [1]													
East Coast	2,688	3,822	2,142	2,436	3,192	2,142	714	2,268	1,848	3,192	6,426	6,174	37,044
Appalachian	2,100	2,142	2,226	1,890	1,974	1,932	2,058	2,016	2,100	2,016	2,184	3,360	25,998
Indiana, Illinois, Kentucky, etc	31,206	28,728	29,190	30,744	30,030	29,442	28,476	29,022	29,736	30,576	29,358	27,258	353,766
Oklahoma, Kansas, Missouri	24,150	25,914	21,126	22,344	23,268	23,352	25,620	27,300	28,518	31,542	30,366	32,508	316,008
Texas:													
Gulf Coast	62,706	51,786	69,342	63,672	63,630	63,168	67,242	65,268	64,596	64,344	68,292	64,680	768,726
Inland	49,098	40,740	40,152	43,008	60,186	45,276	36,036	45,444	55,482	56,406	52,878	56,700	581,406
Total Texas	111,804	92,526	109,494	106,680	123,816	108,444	103,278	110,712	120,078	120,750	121,170	121,380	1,350,132
Louisiana, Arkansas:													
Louisiana Gulf Coast	9,492	8,946	10,416	8,568	8,568	7,812	10,248	11,466	11,214	14,490	14,868	17,808	133,896
Arkansas, Louisiana Inland	2,688	1,890	3,234	3,276	2,730	2,520	2,394	2,982	2,730	2,646	2,772	2,814	32,676
Total Louisiana, Arkansas	12,180	10,836	13,650	11,844	11,298	10,332	12,642	14,448	13,944	17,136	17,640	20,622	166,572
Rocky Mountain	4,116	3,612	3,318	4,242	3,024	2,184	2,394	2,226	3,864	3,696	4,662	5,334	42,672
California	81,984	71,610	78,708	74,256	78,540	73,290	81,984	86,478	50,316	69,006	80,220	83,370	909,762
Total United States	270,228	239,190	259,854	254,436	275,142	251,118	257,166	274,470	250,404	277,914	292,026	300,006	3,201,954

[1] Subject to revision.

Shipments to Refineries.—Total shipments of light hydrocarbons to refineries equaled 3,682,816 thousand gallons, which is equivalent to 59 percent of total demand in 1948. This continues the downward trend of the refinery market in relative importance established over recent years, as shipments to refineries represented 60 percent of total demand on the industry in 1947 and 65 percent in 1946. Shipments of natural gasoline to refineries totaled 2,729,193 thousand gallons in 1948, a 7 percent increase over the previous year. LP-gases shipped to refineries equaled 457,908 thousand gallons in 1948, a 12-percent gain over 1947. However, shipments of condensate declined to 348,551 thousand gallons or 12 percent.

Shipments of isopentane to refineries in 1948 represented a 42-percent increase over the previous year, while normal butane gained 19 percent and isobutane 4 percent.

Natural gasoline and allied products utilized at domestic refineries in 1948 equaled 3,201,954 thousand gallons compared to 2,969,064 thousand gallons in 1947.

Percentage of natural gasoline and allied products in refinery gasoline in the United States, 1944–48, by districts

Year	East Coast	Appalachian	Indiana, Illinois, Kentucky	Oklahoma, Kansas, Missouri	Texas Inland	Texas Gulf Coast	Louisiana Gulf Coast	Arkansas, Louisiana Inland	Rocky Mountain	California	Total
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	1.2	1.9	5.0	7.9	22.7	8.8	5.1	16.6	4.7	15.4	8.4
1947	.8	2.0	5.5	7.7	22.6	8.8	5.3	10.3	3.9	17.4	8.7
1948 [1]	.8	2.4	5.0	8.9	25.0	8.3	4.8	7.1	3.8	17.2	8.5

[1] Subject to revision.

The percentage of natural gasoline and allied products used in refinery gasoline in the United States equaled 8.5 percent in 1948, 8.7 percent in 1947, and 8.4 percent in 1946. There is wide variation in the use of these products in different areas. For instance, the Texas Inland refining district utilizes 25 percent and California 17.2 percent, whereas Oklahoma-Kansas-Missouri consumes 8.9 percent and Louisiana Gulf Coast 4.8 percent.

"Direct" Sales.—Jobbers and other trade outlets purchased 172,579 thousand gallons of natural gasoline in 1948, a decline of 3 percent compared with 1947. However, finished gasoline and naphtha purchases totaled 371,333 thousand gallons, a 3-percent gain. Sales of LP-gases for fuel amounted to the record total of 1,466,085 thousand gallons in 1948, an increase of 18 percent over the previous year. Likewise sales of LP-gases to chemical plants gained 18 percent in 1948 totaling 285,165 thousand gallons. There is every indication that the sales of LP-gases to jobbers will continue the upward trend in the future.

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SALES OF LP-GASES

During 1948 LP-gas sales continued the steady growth they have consistently shown during the past decade. There were 2,736,801,000 gallons of LP-gases delivered to consumers in the United States during 1948, a total representing a 24-percent increase over sales of 2,209,797,000 gallons in 1947. The increase in 1948 in marketed LP-gas over that sold in 1947 was greater than the total quantity of LP-gases delivered during 1941. Records compiled by the Bureau of the Census, United States Department of Commerce, show exports of 45,520,000 gallons of LP-gases in 1948 compared with 53,233,000 gallons in 1947.

The tendency toward the greater use of propane gas shows a remarkable increase, as 1,279,744,000 gallons were delivered in 1948, comprising 47 percent of total sales. Comparing 1948 sales of propane with propane sales in 1944, the first year in which LP-gas was widely used as a synthetic rubber component, the proportion of propane sales was 32 percent of the 1944 total of 335,884,000 gallons. Using the same year as a comparison, the proportions for butane declined from 26 percent in 1944 to 19 percent in 1948, and those for butane-propane mixture also decreased from 43 percent in 1944 to 35 percent in 1948.

Sales of LP-gases in the United States, 1944–48

Year	Butane		Propane		Butane-propane mixture		Total	
	Thousand gallons	Percent of total	Thousand gallons	Percent of total	Thousand gallons	Percent of total	Thousand gallons	Percent increase over previous year
1944	273, 116	25.8	335, 884	31.7	451, 156	42.5	1, 060, 156	(1)
1945	325, 140	25.5	444, 581	34.8	507, 045	39.7	1, 276, 766	20
1946	441, 418	25.9	551, 250	32.3	711, 594	41.8	1, 704, 262	34
1947	398, 635	18.0	863, 686	39.1	947, 476	42.9	2, 209, 797	30
1948	512, 615	18.7	1, 279, 744	46.8	944, 442	34.5	2, 736, 801	24

[1] No comparable figure for 1943.

With the cooperation of the LP-gas industry, distribution of the sales of LP-gas is shown by five marketing districts for the first time in 1948. Forty-one percent of the national sales (1,122,870,000 gallons) were made in States comprising district 3, where the largest proportion of LP-gas was marketed. Sales in district 2 followed, with 788,142,000 gallons (29 percent). Sales in district 1 amounted to 454,555,000 gallons or more than 16 percent of the total, while in district 5 sales were 12 percent of the total deliveries. Only less than 2 percent of the total was marketed in district 4.

Sales of LP-gases in the United States in 1948, by district and use, in thousands of gallons

Use	District [1]					Total		Percent increase 1948
	1	2	3	4	5	1948	1947	
Butane:								
Domestic and commercial	17,159	22,419	58,986	7,595	6,842	113,001	62,092	82
Gas manufacturing	20,521	36,445	2,206	2,588	1,812	63,572	58,424	9
Industrial plants	7,042	43,414	13,352	--------	2,678	66,486	61,901	7
Synthetic rubber	563	19,311	159,197	--------	15,706	194,777	187,733	4
Chemical plants	178	--------	44,005	--------	10,203	54,386	18,796	189
Internal combustion	380	16,491	49	6	3,093	20,019	9,662	107
All other uses	1	54	319	--------	--------	374	27	(2)
Total butane	45,844	138,134	278,114	10,189	40,334	512,615	398,635	29
Propane:								
Domestic and commercial	193,515	317,068	138,260	28,643	88,467	765,953	503,448	52
Gas manufacturing	45,156	69,890	1,802	--------	16,227	133,075	77,110	73
Industrial plants	48,135	40,095	12,270	1,033	10,757	112,290	83,108	35
Synthetic rubber	870	1,267	785	--------	1,203	4,125	4,558	−10
Chemical plants	4,915	785	209,256	--------	34,697	249,653	182,388	37
Internal combustion	52	7,514	1,004	41	5,521	14,132	12,595	12
All other uses	283	232	1	--------	--------	516	479	8
Total propane	292,926	436,851	363,378	29,717	156,872	1,279,744	863,686	48
Butane-propane mixture:								
Domestic and commercial	35,670	119,667	351,852	4,325	82,821	594,335	584,998	2
Gas manufacturing	3,906	20,990	3,775	1,243	11,077	40,991	33,798	21
Industrial plants	1,336	8,785	11,156	--------	13,851	35,128	28,592	23
Synthetic rubber	--------	2	26,737	--------	--------	26,739	9,244	189
Chemical plants	74,873	44,706	67,346	--------	--------	186,925	213,083	−12
Internal combustion	--------	18,754	19,231	453	20,352	58,790	77,529	−24
All other uses	--------	253	1,281	--------	--------	1,534	232	(2)
Total butane-propane mixture	115,785	213,157	481,378	6,021	128,101	944,442	947,476	-------
Total:								
Domestic and commercial	246,344	459,154	549,098	40,563	178,130	1,473,289	1,150,538	28
Gas manufacturing	69,583	127,325	7,783	3,831	29,116	237,638	169,332	40
Industrial plants	56,513	92,294	36,778	1,033	27,286	213,904	173,601	23
Synthetic rubber	1,433	20,580	186,719	--------	16,909	225,641	201,535	12
Chemical plants	79,966	45,491	320,607	--------	44,900	490,964	414,267	19
Internal combustion	432	42,759	20,284	500	28,966	92,941	99,786	−7
All other	284	539	1,601	--------	--------	2,424	738	229
Total sales for U. S. use	454,555	788,142	1,122,870	45,927	325,307	2,736,801	2,209,797	24
Exports	--------	--------	--------	--------	--------	45,520	53,233	−15
Grand total sales	--------	--------	--------	--------	--------	2,782,321	2,263,030	23

[1] The States in each district are as follows:
DISTRICT 1.—Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, and Florida.
DISTRICT 2.—North Dakota, South Dakota, Minnesota, Nebraska, Iowa, Wisconsin, Illinois, Indiana, Michigan, Ohio, Kentucky, Tennessee, Missouri, Kansas, and Oklahoma.
DISTRICT 3.—New Mexico, Texas, Arkansas, Louisiana, Mississippi, and Alabama.
DISTRICT 4.—Idaho, Montana, Wyoming, Utah, and Colorado.
DISTRICT 5.—California, Oregon, Washington, Arizona, and Nevada.
[2] Over 500 percent.

Domestic and Commercial Sales.—The volume of LP-gas sold for domestic and commercial purposes was 1,473,289,000 gallons in 1948. This represents 54 percent of the total LP-gas marketed and is an increase of 28 percent over the 1,150,538,000 gallons delivered for the same purpose in 1947.

The total quantity sold for domestic and commercial uses in 1948 is greater than the total quantity of LP-gas sold for all purposes in 1945, just 3 years before. The large demand for this product for homes, farms, institutions, and commercial establishments located beyond the gas mains is clearly indicated. According to a report by K. W. Rugh and E. O. Mattocks entitled "LP-Gas Sales Continue to Gain in 1948", released by the Phillips Petroleum Co., more than 25 percent of the gas ranges produced in 1948 went into the LP-gas market. Also, the demand for LP-gas automatic water heaters and refrigerators continued to increase along with LP-gas space heaters. They also estimated that about 5½ million homes are now using LP-gas and that one-third of these use LP-gas for space heating as well as for other household purposes. The report adds that there are at present more than 3,000 bulk plant installations, a number about equal to the counties in the United States.

The greatest relative increase in domestic sales was for butane, as the 113,001,000 gallons sold in 1948 were an 82-percent gain over the 62,092,000 marketed for domestic use in 1947. However, propane sold for domestic purposes comprise 52 percent of the LP-gas used in domestic trade, and 765,953,000 gallons of propane were sold for the domestic and commercial uses in 1948, which is 52 percent above 1947 sales of 503,448,000 gallons. Butane-propane mixture increased only 2 percent, as 594,335,000 gallons were marketed in 1948 compared with 584,998,000 sold for domestic and commercial purposes in 1947. District 3 is reported as having the largest market for LP-gas in the domestic trade, as 37 percent of the national demand for LP-gas for domestic and commercial use was sold in that area. There was 31 percent in district 2; 17 percent in district 1; 12 percent in district 5; and 3 percent in district 4. However, in district 4 over 88 percent of all LP-gas sold was for domestic use.

Sales of LP-gases in the United States, by uses, 1940–48, in thousands of gallons

Year	Domestic	Chemical	Synthetic rubber	Industrial	Gas manufacturing	Internal combustion	All other	Total
1940	134,018	34,671		69,892	20,285	53,918	672	313,456
1941	220,722	44,206		98,728	25,255	66,871	7,070	462,852
1942	299,559	53,038		114,132	31,366	82,456	4,889	585,440
1943	339,380	55,356	(1)	149,429	37,519	87,834	5,715	675,233
1944	445,617	151,985	162,085	162,018	45,879	92,495	77	1,060,156
1945	533,262	224,291	208,787	163,121	53,849	93,340	116	1,276,766
1946	758,466	311,499	293,892	159,115	86,660	94,592	38	1,704,262
1947	1,150,538	414,267	201,535	173,601	169,332	99,786	738	2,209,797
1948	1,473,289	490,964	225,641	213,904	237,638	92,941	2,424	2,736,801

[1] Included in "All other."

Gas-Manufacturing-Plant Use, for Distribution Through Mains.—The use of LP-gas in gas-manufacturing installations continues to increase rapidly. It is reported that 237,638,000 gallons were sold for this purpose in 1948, an increase of 40 percent over the sales of 169,332,000 gallons in 1947. The wider distribution of natural gas throughout the country has, in many instances, resulted in excessive space-heating demands during the winter months. LP-gas is used to a great extent to augment both natural and manufactured gas supplies during peak loads. The largest proportion of LP-gas used in the gas-manufacturing installations is reported in district 2, amounting to 127,325,000 gallons, or 54 percent of the total demand for LP-gas for this purpose. District 1 follows with 29 percent, and 12 percent was reported in district 5. Less than 5 percent was used by gas-manufacturing companies in districts 3 and 4. The total sales of LP-gas used by gas-manufacturing companies represent about 9 percent of the total LP-gas marketed.

Data regarding the distribution of LP-gases by manufactured-gas companies, according to the American Gas Association, are as follows: Liquefied gas, as of June 1, 1949, was being delivered through mains in 476 communities by 195 companies in 41 States. During 1948, an average of 318,100 customers were served with LP-gas by utilities. Butane-air gas and propane-air with heating value ranging from 525 to 1,600 B. t. u. per cubic foot were supplied to 399 communities in 38 States.

A mixture of undiluted butane and propane gases with a heating value of 2,800 to 3,500 B. t. u. per cubic foot was supplied to 18 communities in Arizona, California, Iowa, Nevada, New Mexico, and North Carolina. Undiluted propane gas with a heating value of 2,515 to 2,550 B. t. u. per cubic foot was supplied to 59 communities in Connecticut, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Jersey, New Mexico, South Carolina, Virginia, and Wisconsin.

Industrial-Plant Use.—The volume of LP-gas marketed for industrial use during 1948 was 213,904,000 gallons, an increase of 23 percent over the 1947 sales of 173,601,000 gallons. The total sales of LP-gas for industrial use represents 8 percent of the total LP-gas marketed.

One of the most rapid-growing uses for LP-gas by industrial plants is as a standby for other fuels, generally manufactured or natural gas. Greatly increased domestic and commercial space-heating requirements have resulted in demands that frequently exceed the capacity of the natural-gas transmission lines or that of manufactured-gas producing plants. To meet the increased demand, it has been necessary to force more industrial-gas consumers to accept a smaller volume of gas during peak-load periods. To insure against interruption of gas supply, a large number of industries have installed LP-gas as a standby fuel.

The quantity of propane sales for this purpose increased 35 percent in 1948 over 1947 sales, and the proportion of propane amounted to over 50 percent of the total demand for LP-gas sold for industrial use. Butane-propane mixture, used by industrial plants, increased about 23 percent in 1948 over the same period in 1947, and the butane increase was only 7 percent. Industrial plants in district 2 purchased more than 43 percent of the total and district 1's proportion was 26 percent, followed by district 3 with 17 percent, district 5 with 13 percent, and district 4 with less than 1 percent.

Synthetic Rubber Components.—LP-gas sold for synthetic rubber components in 1948 totaled 225,641,000 gallons. This represents an increase of 12 percent over that marketed for the same purpose in 1947. Butane gas is principally used for this purpose, and the sales of this gas amounted to 86 percent of the total LP-gas sold for synthetic rubber manufacture. Butane sales increased from 187,733,000 gallons in 1947 to 194,777,000 gallons in 1948, an increase of 4 percent.

Synthetic rubber plants in district 3 purchased 83 percent of the Nation's demand for this purpose, followed by district 2 with 9 percent and district 5 with almost 8 percent. A small amount was reported in district 1.

Raw Material and Solvents for Chemical Plants.—LP-gas is an intermediate for producing finished chemicals. The volume used amounted to 490,964,000 gallons in 1948, which was 19 percent above the 1947 delivery of 414,267,000 gallons. Sales of LP-gases for chemical raw material rank second among the principal uses, using 18 percent of the national demand for all LP-gases. Large quantities of LP-gases in gaseous form are furnished to chemical companies through pipe lines direct from the source of production. Propane sold for chemical use amounts to 51 percent of the total demand of LP-gas for this purpose. Sales in 1948 of 249,653,000 gallons increased 37 percent over the 182,388,000 gallons purchased in 1947.

Butane-propane mixtures delivered for chemical raw material decreased about 12 percent in 1948, from 213,083,000 gallons in 1947 to 186,925,000 in 1948. The butane sales more than doubled in 1948, rising from 18,796,000 gallons in 1947 to 54,386,000 in 1948. The sales of LP-gas for chemical solvents, by districts, show 65 percent in district 3, 16 percent in district 1, and about 9 percent in district 2 and in district 5.

Used as Fuel in Internal-Combustion Engines and Other Uses.—The quantity of LP-gases sold for these purposes is almost 4 percent of the national demand. The volume sold for internal-combustion engines dropped 7 percent in 1948 compared with 1947, and the sales reported for all miscellaneous rose from 738,000 gallons in 1947 to 2,424,000 gallons in 1948. The largest proportion of engine fuel is reported in district 2 as 46 percent, while 31 percent was reported in district 5.[3]

STOCKS

Total stocks of light hydrocarbons increased nearly 54 million gallons or approximately 30 percent in 1948 over the previous year. However, at the year end, total stocks were reduced 30 million gallons from the maximum in August. LP-gases represented the largest gain with 46 percent over 1947, while natural-gasoline stocks increased 28 percent and other products were up 21 percent. Notwithstanding the large increase in consumption of light liquid products during 1948, it is evident that stocks on hand at the end of 1948 were adequate.

[3] The survey covering sales of LP-gases in the Pacific Coast marketing area (district 5) was made by E. T. Knudsen, supervising economist, Bureau of Mines, Los Angeles, Calif.

Stocks of natural gasoline and allied products in the United States, 1944–47, and 1948, by months, in thousands of gallons

Date	Natural gasoline		LP-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:									
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	97, 339	41, 328	20, 882	11, 382	28, 282	9, 996	146, 503	62, 706	209, 209
1947	75, 338	43, 008	24, 723	5, 502	19, 961	11, 886	120, 022	60, 396	180, 418
1948									
Jan. 31	79, 831	39, 396	24, 475	7, 266	20, 672	9, 912	124, 978	56, 574	181, 552
Feb. 29	84, 539	43, 764	25, 559	7, 896	22, 266	12, 222	132, 364	63, 882	196, 246
Mar. 31	89, 019	46, 074	30, 082	8, 778	21, 936	5, 964	141, 037	60, 816	201, 853
Apr. 30	107, 254	50, 652	31, 538	6, 174	20, 661	6, 552	159, 453	63, 378	222, 831
May 31	103, 551	53, 592	37, 522	7, 224	25, 838	8, 400	166, 911	69, 216	236, 127
June 30	117, 099	61, 152	38, 038	9, 408	22, 633	6, 888	177, 770	77, 448	255, 218
July 31	125, 117	63, 168	30, 580	8, 610	23, 946	7, 980	179, 643	79, 758	259, 401
Aug. 31	134, 274	58, 212	27, 712	7, 518	26, 045	11, 172	188, 031	76, 902	264, 933
Sept. 30	132, 521	60, 522	27, 738	8, 526	27, 465	7, 266	187, 724	76, 314	264, 038
Oct. 31	127, 094	54, 390	30, 912	7, 014	32, 906	6, 930	190, 912	68, 334	259, 246
Nov. 30	115, 172	51, 408	32, 497	8, 316	31, 477	7, 140	179, 146	66, 864	246, 010
Dec. 31	106, 589	44, 982	31, 421	12, 726	31, 936	6, 678	169, 946	64, 386	234, 332

PRICES

The Mid-Continent (group 3) price of 26–70 natural gasoline remained constant at 8.5 cents per gallon f. o. b. refineries or natural gasoline plants throughout 1948. This was an increase of 2.515 cents per gallon above the average price of 5.985 cents per gallon in 1947.

Likewise for shipments of this material f. o. b. Breckenridge, Tex., the price remained unchanged at 8.0 cents per gallon. The average price of 26–70 natural gasoline in 1947 was 5.483 cents per gallon. This indicates an increase of 2.517 cents per gallon in 1948 over the previous year.

The Oklahoma spot price for 73–75 octane motor gasoline moved in a narrow range during 1948. The highest monthly average price prevailed in June and the lowest in December—11.6875 and 10.6006 cents per gallon, respectively. It is apparent that the demand for gasoline as well as the price held unusually firm throughout the year. In fact, these were the highest prices paid in nearly 25 years.

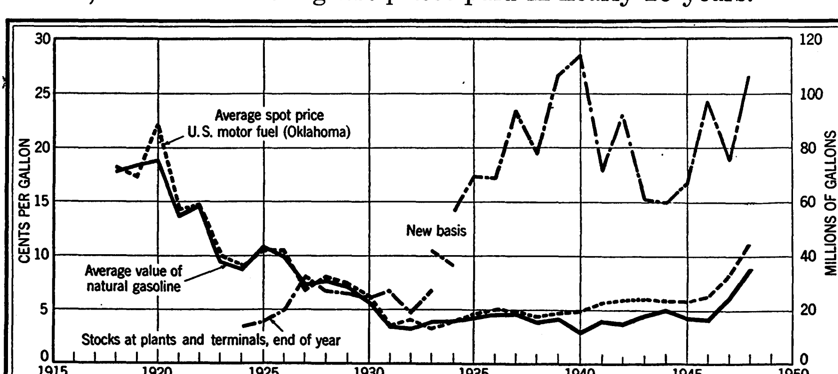

FIGURE 2.—Trends in average value of natural gasoline, spot price of gasoline, and stocks of natural gasoline, 1918–48.

With respect to LP-gases, the market was exceedingly strong during 1948. The average price for commercial propane and industrial propane in tank cars or transport trucks f. o. b. New York Harbor was 9 cents per gallon. Likewise, the prices for commercial butane and industrial butane held firm at New York Harbor. The price range for these products remained between 8.0 cents per gallon and 9.0 cents per gallon during 1948. At New Orleans, La., the average price for commercial propane was 6.12 cents per gallon for the year; moreover the price range was narrow, the low being 5.375 cents and the high 6.5 cents per gallon. The price of butane continued to advance, while propane remained fairly constant during 1948.

Average monthly refinery price quotations for commercial grades of LP-gases for several important distribution centers are shown in the accompanying table. After a slight increase early in the year, prices for LP-gases changed little through the remainder of 1948.

Monthly average price of LP-gases at refineries in the United States in 1948, in cents per gallon

[Platt's Oil Price Handbook]

	Dec. 31, 1947	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average 1948
New York harbor:														
Commercial propane	8.70	8.96	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
Industrial propane	8.70	8.93	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	8.99
Commercial and/or industrial butane	8.70	8.93	9.00	9.00	8.91	8.00	8.00	8.00	8.00	8.00	9.00	9.00	9.00	8.57
Philadelphia, Pa.: Commercial propane	7.95	8.61	8.75	8.96	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	8.94
Baltimore, Md.: Commercial propane	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
New Orleans, La.: Commercial propane	6.50	6.50	6.50	6.50	6.50	6.50	6.50	5.38	5.38	5.38	5.57	6.38	6.38	6.12
Hastings, W. Va.:														
Commercial propane	8.25	8.25	8.25	8.25	8.25	8.25	8.25	82.5	8.25	8.25	8.25	8.25	8.25	8.25
Commercial butane	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	8.00	8.25	7.60
Toledo, Ohio:														
Commercial propane	7.25	8.50	8.50	8.91	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	8.91
Commercial butane	7.50	8.75	8.75	9.16	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.16

FOREIGN TRADE [4]

Shipments of natural gasoline to foreign countries in 1948 totaled 170,774,142 gallons valued at $20,126,140. This compares with exports of 202,927,494 gallons valued at $17,111,425 in 1947 and 128,-784,432 gallons valued at $7,506,921 in 1946. This is a decline of 32 million gallons in 1948 from the previous year. Almost half of the shipments were made to the United Kingdom, while Canada received 33 percent, Curaçao 15 percent, and Australia 7 percent.

Exports of LP-gases originating at natural-gasoline plants and refineries were 45,520,181 gallons valued at $5,259,048, in 1948. This is a decrease of nearly 8 million gallons in 1948 compared to 1947. Canada received 59 percent of these products, while Mexico received 34 percent and Brazil 4 percent. Shipments were made in smaller

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

quantities to 48 other countries, reaching virtually every corner of the globe.

LP-gases exported from the United States, 1944–48, by countries, in thousands of gallons[1]

[U. S. Department of Commerce]

Country	1944	1945	1946	1947	1948
Bermuda	86	103	147	198	269
Brazil	----------	63	289	1,570	1,720
Canada	7,507	15,044	30,379	31,591	26,681
Cuba	----------	----------	----------	59	259
France	----------	----------	1,941	2,082	(2)
Guatemala	----------	----------	----------	----------	131
Mexico	6,743	10,615	15,955	16,471	15,497
Philippines, Republic of	----------	12	101	402	568
United Kingdom	1	----------	----------	446	(2)
Other countries	220	222	279	414	395
Total	14,557	26,059	49,091	53,233	45,520

[1] Converted from pounds to gallons at 4.5 pounds per gallon.
[2] Less than 500 gallons; included with "Other countries."

Nickel

By HUBERT W. DAVIS

GENERAL SUMMARY

CONSUMPTION of nickel in the United States established a peacetime record in 1948 and was 16 percent larger than in 1947. This unprecedented peacetime demand for nickel was met largely by accelerated operations in Canada, where output was 10 percent greater than in 1947. Although demand for nickel in 1948 put pressure on the supply available, it is believed that the supply of all forms of nickel, except nickel salts, met actual consumption needs. At times, however, the supply of nickel salts was inadequate to satisfy requirements. Imports of nickel into the United States reversed a 4-year downward trend in 1948; they were 20 percent more than in 1947. Because of the closing on March 31, 1947, of the United States Government-owned nickel mining and processing facilities in Cuba, Canada supplied about 96 percent of the total imports in 1948 compared with 91 percent in 1947. However, receipts of nickel from Norway and the United Kingdom were also much larger than in 1947. Shortage of coal continued seriously to hamper production of nickel in New Caledonia. Domestic output of nickel was, as heretofore, small in 1948.

Salient statistics for nickel, 1944–48

	1944	1945	1946	1947	1948
United States:					
Production:					
Primary .... short tons..	988	1,155	352	646	883
Secondary .... do....	4,321	6,483	8,248	9,541	8,850
Imports (gross weight) [2] .... do....	134,932	122,528	104,734	88,408	106,939
Exports (gross weight) [3] .... do....	7,931	3,876	7,977	12,037	8,184
Consumption .... do....	(1)	96,252	80,105	80,757	93,558
Price per pound [4] .... cents..	31½	31½	31½–35	35	33¾–40
Canada:					
Production .... short tons..	137,299	122,565	96,062	118,627	131,075
Imports .... do....	424	762	(1)	(1)	(1)
Exports .... do....	133,599	108,222	111,422	117,056	131,840
World production .... do....	173,000	160,000	136,000	153,000	165,000

[1] Figure not available.
[2] Excludes "All other manufactures of nickel"; weight not recorded.
[3] Excludes "Manufactures"; weight not recorded.
[4] Price quoted to United States buyers by International Nickel Co., Inc., for electrolytic nickel in carlots f. o. b. Port Colborne, Ontario; price includes duty of 2½ cents a pound 1944–47 and 1¼ cents 1948.

The steel industry continued to be the chief consumer of nickel in the United States. Usage of nickel in stainless steels was 6 percent more in 1948 than in 1947, but that for other steels was 25 percent greater. Consumption of nickel in high-temperature and electrical-resistance alloys was up 20 percent, and that for anodes gained 58 percent.

The use of nickel in cast irons increased 7 percent over 1947. Most of the nickel consumed in 1948 was in the form of new metal, but proportionately more oxide and oxide sinter were used than in 1947.

Effective July 22, 1948, the contract price to United States buyers for electrolytic nickel in carlots f. o. b. Port Colborne, Ontario, was increased to 40 cents a pound, including duty of 1¼ cents a pound; the former price was 33¾ cents a pound.

Effective January 1, 1948, the rate of duty on refined nickel imported into the United States was reduced 50 percent to 1¼ 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. Domestic primary nickel production totaled 1,765,000 pounds in 1948 and comprised both crude and refined nickel sulfate recovered as a byproduct of copper refining at Baltimore, Md.; Carteret and Perth Amboy, N. J.; Laurel Hill, N. Y.; and Tacoma, Wash. Shipments were 1,879,000 pounds, the bulk of which was crude nickel sulfate sold to refiners for use as an intermediate in the manufacture of refined nickel salts. Although all the nickel recovered as a byproduct of copper refining is credited to domestic production, some is recovered from imported blister copper. There has been no production of nickel from ore or as a byproduct of talc production since 1945.

In addition to the nickel recovered as a byproduct of copper refining in 1948, 4,075,000 pounds (nickel content) of refined nickel salts (chiefly sulfate) were produced in the United States from Canadian cobalt-nickel ore and nickel residues, from domestic crude nickel sulfate, and from nickel shot and nickel scrap.

The total production of refined nickel salts in the United States was 4,492,000 pounds (nickel content) in 1948; shipments to consumers for electroplating, catalysts, and ceramics were 4,673,000 pounds.

Nickel produced in the United States, 1944–48

Year	Primary (short tons) [1]		Secondary [2]	
	Byproduct of copper refining [3]	Other [4]	Short tons	Value
1944	697	291	4,321	$3,024,700
1945	719	436	6,483	4,538,100
1946	352		8,248	5,801,600
1947	646		9,541	7,188,189
1948	883		8,850	6,966,720

[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.

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, matte, and oxide. The figures for nickel salts, however, fall short of the total and probably represent only 43 percent of the total in 1948.

Nickel (exclusive of scrap) consumed and in stock in the United States, 1947–48, by forms, in pounds of nickel

Form	1947			1948		
	Consumption	Stocks at consumers' plants Dec. 31 [1]	In transit to consumers' plants Dec. 31	Consumption	Stocks at consumers' plants Dec. 31	In transit to consumers' plants Dec. 31
Primary [2]	117,120,883	11,263,442	1,052,069	130,911,216	15,060,130	1,340,622
Matte	23,711,215	1,280,670	2,267,131	21,238,604	2,119,330	312,115
Oxide and oxide sinter	19,331,904	2,441,088	105,274	33,052,564	3,898,439	281,888
Salts	1,349,857	477,939	5,930	1,914,134	521,773	3,344
Total	161,513,859	15,463,139	3,430,404	187,116,518	21,599,672	1,937,969

[1] Revised figures (except for matte).
[2] Includes secondary nickel (ingot or shot remelted from scrap nickel and scrap-nickel alloys).

Nickel (exclusive of scrap) consumed in the United States, 1947–48 by uses

Use	Pounds of nickel	
	1947	1948
Ferrous:		
Stainless steels	30,700,270	32,487,815
Other steels	34,758,963	43,564,600
Cast irons	7,905,576	8,431,667
Nonferrous (comprises copper-nickel alloys, nickel-silver, brass, bronze, beryllium, magnesium, and aluminum alloys, and Monel, Inconel, and malleable nickel)	[1] 54,747,667	56,067,736
High-temperature and electrical-resistance alloys	10,249,545	12,336,123
Electroplating:		
Anodes	17,975,335	28,425,717
Solutions	1,218,268	1,327,396
Catalysts	[1] 878,664	1,190,851
Ceramics	385,112	370,708
Other	2,694,459	2,913,905
Total	161,513,859	187,116,518

[1] Revised figure.

FOREIGN TRADE [1]

Imports of nickel into the United States in 1948 reversed a 4-year downward trend and were 20 percent more than in 1947. Imports in 1948 comprised chiefly metallic nickel, matte, oxide, and nickel residues. As heretofore, Canada was the chief source of the imports; it supplied 134,974,975 pounds of metallic nickel (pig, ingot, and shot), 25,681 pounds of bars, rods, etc., 27,708,041 pounds of roasted and sintered matte (averaging about 68 percent nickel), 43,028,224

[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.

pounds of oxide and oxide sinter (averaging about 74 percent nickel), and an undetermined quantity of nickel residues. The matte is refined to "Monel" metal at the plant of the International Nickel Co., Inc., Huntington, W. Va. In 1948, 2,185 short tons of nickel pig were refined at Huntington from Canadian oxide sinter. In 1948 Norway furnished 6,225,281 pounds of metallic nickel, the United Kingdom 1,665,247 pounds, and the U. S. S. R., Union of South Africa, Italy, India, and the Netherlands 114,483, 56,384, 28,532, 20,342, and 18,474 pounds, respectively. The United Kingdom supplied 1,508 pounds of bars, rods, etc., Germany 3,719 pounds, the Netherlands 97 pounds, and Sweden 7 pounds in 1948.

The nickel content of the unmanufactured nickel products imported into the United States is estimated at 193,760,000 pounds in 1948, compared with 161,435,000 pounds in 1947.

Effective January 1, 1948, the rate of duty on refined nickel imported into the United States was reduced 50 percent to 1¼ cents a pound. Nickel ore, matte, and oxide entered the United States duty free.

Exports of nickel comprise largely products manufactured from imported raw materials. Exports of alloys and scrap (including Monel metal), which comprise the bulk of the foreign shipments, were 31 percent less in 1948 than in 1947; those of metallic nickel, nickel-chrome electric-resistance wire, and nickel-silver were 0.3, 46, and 60 percent, respectively, smaller.

The United Kingdom (10,353,894 pounds) and Canada (2,612,241 pounds) were the chief foreign markets for nickel, Monel metal, alloys, and scrap in 1948.

Nickel products imported for consumption in the United States, 1926–48, in pounds

Year	Gross weight				Total	
	Ore and matte	Pigs, ingots, shot, bars, rods, tubes, etc.	Oxide	Nickel-silver	Gross weight	Nickel content (estimated)
1926	14,635,651	29,408,950	1,485,386	6,476	45,536,463	38,600,000
1927	10,744,474	29,219,779	1,013,332	16,754	40,994,339	35,800,000
1928	18,589,032	49,118,737	1,743,218	25,553	69,476,540	60,600,000
1929	28,981,343	64,710,054	3,265,425	14,434	96,971,256	83,000,000
1930	20,593,361	38,323,029	1,353,096	16,557	60,286,043	50,600,000
1931	11,629,709	23,633,754	304,991	10,211	35,578,665	30,200,000
1932	5,917,770	15,023,813	687,597	2,193	21,631,373	18,800,000
1933	19,220,399	31,621,203	2,019,155		52,860,757	43,800,000
1934	11,845,865	45,799,511	950,236	75	58,595,687	42,000,000
1935	15,924,300	58,858,726	912,907		75,695,933	68,400,000
1936	23,194,329	80,537,245	2,550,073		106,281,647	95,200,000
1937	25,085,947	81,229,414	2,044,395		108,359,756	95,768,000
1938	14,579,441	43,956,363	555,181	296	59,091,281	52,400,000
1939	28,433,530	99,526,058	1,631,558		129,591,146	116,400,000
1940	34,889,970	141,059,797	8,986,834	153	184,936,754	167,519,000
1941	79,892,400	149,986,922	18,377,937	2,800	248,260,059	212,363,000
1942	80,378,120	161,575,130	23,954,909		265,908,159	228,550,000
1943	86,971,459	185,157,444	10,368,220	1,017	282,498,140	244,983,000
1944	72,828,746	186,105,235	10,929,012	291	269,863,284	236,586,000
1945	50,077,170	156,804,217	38,174,845	408	245,056,640	214,866,000
1946	38,092,080	142,325,035	29,041,940	9,762	209,468,817	185,000,000
1947	29,272,226	117,374,447	30,147,686	21,799	176,816,158	161,435,000
1948	27,708,041	143,134,730	43,028,224	7,754	213,878,749	193,760,000

Nickel products (excluding residues) imported for consumption in the United States, 1946–48, by classes

[U. S. Department of Commerce]

Class	1946		1947		1948	
	Pounds	Value	Pounds	Value	Pounds	Value
Unmanufactured:						
Nickel ore and matte	38,092,080	$5,263,584	29,272,226	$3,750,870	27,708,041	$3,576,268
Nickel pigs, ingots, shot, etc	142,324,523	38,657,205	117,372,931	35,368,075	143,103,718	47,423,584
Nickel bars, rods, tubes, etc	512	960	1,516	1,455	31,012	30,290
Nickel oxide	29,041,940	5,927,731	30,147,686	6,458,240	43,028,224	10,000,860
Manufactured:						
Nickel-silver or German silver in sheets, strips, rods, and wire	9,762	4,697	21,799	11,095	7,754	3,467
All other manufactures of nickel	(1)	3,529	(1)	5,834	(1)	5,082
Total		49,857,706		45,595,569		61,039,551

[1] Quantity not recorded.

Nickel products exported from the United States, 1946–48, by classes

[U. S. Department of Commerce]

Class	1946		1947		1948	
	Pounds	Value	Pounds	Value	Pounds	Value
Ore, concentrates, and matte	21,083	$12,832	1,510	$861	1,500	$1,725
Alloys and scrap containing nickel (including Monel metal)	11,194,004	4,005,090	16,848,166	6,287,395	11,652,796	4,718,518
Metal in ingots, bars, sheets, etc	1,883,881	994,470	2,712,787	1,528,451	2,705,777	1,494,350
Manufactures	(1)	647,736	(1)	1,119,984	(1)	745,916
Nickel-chrome electric resistance wire	817,003	1,247,861	1,386,457	2,021,879	747,082	1,197,348
Nickel-silver or German silver, crude, scrap, or bars, rods, etc	2,037,788	500,132	3,125,017	1,197,860	1,260,330	591,858
Total		7,408,121		12,156,430		8,749,715

[1] Quantity not recorded.

WORLD REVIEW

The accompanying table shows world production of nickel by countries, 1940–48, 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.—have furnished about 96 percent of the world output since 1943, and one country—Canada—has supplied about 77 percent of the total.

Canada.—Virtually all the Canadian nickel output is derived from the copper-nickel ores of the Sudbury district, Ontario. Some nickel is also recovered as a byproduct from silver-cobalt ores of Cobalt. Two companies—International Nickel Co. of Canada, Ltd., and Falconbridge Nickel Mines, Ltd.—are the principal producers. Nickel production in Canada was 131,075 short tons in 1948 compared with 118,627 tons in 1947. Exports of nickel from Canada were 131,840 short tons in 1948 compared with 117,056 tons in 1947.

Sales of nickel in all forms by the International Nickel Co. of Canada, Ltd., in 1948 were the highest in any peacetime year; they were 240,098,274 pounds compared with 205,278,868 pounds in 1947 and with 207,700,943 pounds in 1937, the previous peacetime high.[2]

[2] International Nickel Co. of Canada, Ltd., Annual Report: 1948, 15 pp.

World production of nickel (content of ore), by countries, 1940–48, in metric tons

[Compiled by B. B. Mitchell]

Country	1940	1941	1942	1943	1944	1945	1946	1947	1948
Brazil	(1)	(1)	1	-------	6	(1)	(1)	(1)	(1)
Burma	745	[2] 471	-------	-------	-------	-------	-------	-------	(1)
Canada	111,383	128,029	129,369	130,642	124,555	111,189	87,146	107,616	118,909
Cuba	-------	-------	(1)	2,430	4,679	10,900	11,241	2,014	-------
Finland	(1)	97	1,630	8,970	313	900	622	(1)	(1)
Germany	729	674	577	951	(1)	(1)	-------	-------	-------
Greece	575	185	706	495	-------	-------	-------	-------	-------
Indonesia	2,222	[3] 1,200	[3] 1,200	[3] 1,200	(1)	(1)	-------	-------	-------
Italy [3]	87	91	74	43	14	12	(1)	(1)	(1)
Japan [4]	825	2,311	1,252	1,613	1,720	650	-------	-------	-------
Morocco, French	(1)	(1)	(1)	45	47	-------	-------	-------	-------
New Caledonia	10,535	10,395	9,415	7,374	8,115	4,328	2,779	3,345	4,882
Norway	1,007	907	911	577	529	516	55	-------	-------
Sweden	-------	101	377	702	698	390	-------	-------	(1)
Union of South Africa	416	581	449	343	481	499	497	529	458
U. S. S. R.[3]	8,650	13,600	(1)	11,160	(1)	13,400	20,000	25,000	25,000
United States [5]	503	599	555	582	896	1,048	319	586	801
Total (estimate)	140,000	162,000	158,000	167,000	157,000	145,000	123,000	139,000	150,000

1 Data not available; estimate by author of chapter included in total.
2 Data cover 9 months ended March 31, 1942.
3 Estimate.
4 Preliminary data for year ended March 31 of year following that stated.
5 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.

Over 90 percent of the 1948 total was sold in the United States, Great Britain, and Canada; sales outside these three countries were only a small fraction of prewar volume. To continue a large and steady supply of nickel, the company has been forced to mine ores of lower grade during the past decade; this is illustrated by the fact that 43 pounds of nickel were obtained from each ton of ore mined in 1938, whereas in 1948 this figure had dropped to 27 pounds. As a consequence of the heavy demands on its ore reserves in the war and postwar years, the company has been forced to give more detailed attention to the mining of lower-grade underground ores; and it has decided upon a mine-development program that will make possible, with improved mining, concentrating, and smelting methods, the economic recovery and use of lower-grade ore. Ore mined was 10,866,862 short tons in 1948 compared with 10,406,644 tons in 1947. Underground development totaled 84,152 feet in 1948, bringing the total footage to 1,323,660 or 251 miles at the year end. Proved ore reserves at the end of 1948 were 246,177,000 short tons containing 7,503,000 tons of nickel-copper compared with 221,843,000 tons containing 7,171,000 tons of nickel-copper at the end of 1947. The new process plant at Copper Cliff for the production of nickel in the form of oxide sinter for the market and for intermediate refinery products was completed and put into operation in 1948.

Concerning virtual replacement of the Orford process of copper-nickel separation by the matte casting and flotation operations in the new nickel oxide sinter plant, R. C. Stanley, chairman of the board of directors of the International Nickel Co. of Canada, Ltd., reported to stockholders as follows on April 27, 1949:

Our Orford process served well for many years in the production of the major portion of the world's nickel requirements. However, we have developed a better process. A plant has been built for the separation of copper, nickel and platinum metals in matte by subjecting the matte to controlled cooling, flotation and magnetic separation. The matte flotation operations in the new oxide sinter plant commenced in September and are rapidly approaching full-scale production, practically replacing the Orford process. This has been a process change of major significance. The transfer of sintering operations from Port Colborne to Copper Cliff will soon be completed.

Falconbridge Nickel Mines, Ltd.,[3] reported an unprecedented peacetime demand for nickel in 1948; and operations were pushed to the maximum permitted by power, equipment, supplies, and labor. During 1948 one blast furnace operated 5½ months and two furnaces operated 6 months. As a result of the increased operations, 821,259 short tons of ore were treated in 1948 compared with 731,925 tons in 1947. Ore hoisted and treated in 1948 was only slightly below that in the peak year 1944 (830,254 tons). At the Falconbridge mine exploration attention was focused mainly on preparation for and beginning the internal shaft for depth development, drifting and drilling on the 3,150-foot level, and drilling on upper levels for extensions of the footwall ore bodies found on the bottom levels. At the McKim mine the shaft was completed to 1,421 feet by August, and at year end all major buildings and installations were either in use or nearing completion. Drifting toward the ore zone was in progress on four levels. In December 1948 the Rexora nickel prospect, 32 miles north of Minaki, was optioned and exploration work begun. Ore reserves of the company were 14,007,500 short tons averaging 1.74 percent nickel on December 31, 1948. Since February 4, 1930, when the smelter was blown in, through 1948 Falconbridge Nickel Mines, Ltd., has treated 9,261,692 short tons of ore, and the smelter has produced 285,575,301 pounds of nickel and 145,194,178 pounds of copper in matte.

The Sherritt Gordon Mines, Ltd.,[4] continued its program of exploration and development of nickel-copper ores in the Lynn Lake area of northern Manitoba in 1948. A total of 36,408 feet of diamond drilling in 89 holes was done. Shaft sinking of the "A" shaft was started in June and at the year end 567 feet had been sunk. A total of 47,510 cubic feet of station had been cut in four main stations and three smaller substations. The mining plant at the "A" shaft was completed. All concrete foundation work was completed for the pilot mill, including the foundation for the Diesel-electric generator to supply power for the pilot mill operation. This Diesel and generator were also set up. At the "EL" shaft one 33,000-gallon fuel-storage tank was erected, and concrete foundations were completed for the hoist, Diesel and compressor, shaft collar and head-frame piers, and base for the boilers. During 1948 laboratory investigations were continued at the University of British Columbia and at Sherridon with a view to finding the most economical method of reducing the nickel concentrate to a salable product. As a result of this work, a chemical process using oxygen and ammonia was invented which shows considerable promise. The process will be developed further in 1949 on a larger scale in a pilot plant, as soon as concentrates can be obtained from underground development. Some other reduction methods are also being tested.

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[3] Falconbridge Nickel Mines, Ltd., 20th Annual Report: 1948, 16 pp.
[4] Sherritt Gordon Mines, Ltd., Annual Report: 1948, pp. 16–18.

Cuba.—The United States Government-owned nickel-mining and processing facilities in Cuba, which were closed on March 31, 1947, remained inactive throughout 1948. The facilities were declared surplus and transferred to the War Assets Administration on July 11, 1947, but they had not been disposed of on December 31, 1948. A report, PB 97271, Review of the Nicaro Nickel Project, Nicaro, Oriente, Cuba, Plancor 690, 159 pages, is available at $20 a copy in photostat or $6 in microfilm from the Library of Congress, Photoduplication Service, Publication Board Project, Washington, D. C.

Egypt.—The history and geologic features of the ancient "Ab Swayel" copper mine, in which the presence of nickel was discovered, has been described.[5]

New Caledonia.[6]—Only two nickel concessions—Pin-Pin at Moindah, 130 miles north of Noumea, and the Thio Group at Thio, on the east coast, both belonging to La Société le Nickel—were in production in 1948. Output of ore was 96,415 metric tons and comprised 59,465 tons averaging 3.55 percent nickel at the Thio Group and 36,950 tons averaging 7.5 percent nickel at the Pin-Pin concession.

The hydroelectric plant of La Société le Nickel at Yate was worked throughout 1948, except for a few weeks when the water level was too low, keeping four electric furnaces in operation which produced 4,049 metric tons of ferronickel averaging 41.5 percent nickel, of which 1,235 tons were exported to France, 1,891 tons were shipped to the smelters at Noumea, and 923 tons remained in stock at Yate.

The smelters at Noumea were worked irregularly during 1948 because of lack of coal and as a consequence production of matte was only 2,208 metric tons averaging 77 percent nickel. Exports of matte, all to France, were 2,435 tons in 1948. Stocks of matte at Noumea were 60 tons on December 31, 1948.

Much progress was made during 1948 on the construction of the Yate-Noumea power line. All the pylons were set in place, the three lines were strung, and a trial transmission of electricity was made. Work on installing the new electric furnaces at the Noumea plant was well under way by the end of the year.

Norway.[7]—The Falconbridge Nickel refinery at Kristiansand continued to be hampered by shortage of power, materials, and supplies and during the summer by insufficient skilled and unskilled labor. Despite these difficulties, the refinery operated at a rate of 92 percent of its peak production in 1939. Nevertheless, refinery operations failed to pace smelter production, but it was possible to sell the surplus nickel matte produced by the smelter. Good progress was achieved in 1948 on the modernization and expansion program. Erection of the new roaster building was completed, and the foundations for other additions were mostly completed.

U. S. S. R.—The U. S. S. R. is the second-largest producer of nickel in the world, but precise figures on production are not available.

[5] Nassim, G. L., The Discovery of Nickel in Egypt: Econ. Geol., vol. 44, No. 2, March–April 1949, pp. 143–150.
[6] Loubert, R. E., American Consulate, Noumea, New Caledonia, Developments in the Mineral Industry of New Caledonia, Mar. 24, 1949.
[7] Falconbridge Nickel Mines, Ltd., 20th Annual Report: 1948, pp. 1, 5, 6.

Output is variously estimated at 20,000 to 40,000 metric tons annually. Nickel is produced at Petsamo, which was ceded by Finland to the Soviet Government in 1944, and at Ufalei, Chelyabinsk region; Orsk, Chalhov region; and Monchegorsk, Kola Peninsula.

The development of the nickel deposits in the Petsamo district has been described[8] as follows:

> Finland received the Petsamo area in the Treaty of Dorpat after World War I. In the Geological Survey of this district conducted as early as 1921, traces of ores containing considerable contents of nickel and copper were found on the Petsamo mountain. The Finnish Geological Commission investigated the deposit and localized several ore lenses, the most important of which was on the Kaulatunturi mountain, and subsequent drilling showed that the mining of this ore would be profitable.
>
> On the other hand, the Petsamo region was thinly populated and the ore lay in a barren mountain with no communication with what is known as the "Arctic Highway" which leads from Rovaniemi to the Arctic port of Lünahamari, the nearest railway being several hundred miles to the south. Lünahamari, however, is a harbour situated on a fjord on the Arctic Ocean and is ice-free for most of the year. It lacked, however, any heavy handling equipment.
>
> In view of the fact that a considerable amount of capital was required to exploit the Petsamo nickel-copper ores in such a remote locality, an agreement was concluded with the Mond Nickel Company in London (the European subsidiary of the International Nickel Company of Canada). This led to the formation of a subsidiary Finnish company, Petsamon Nikkeli O/Y, which was responsible for exploiting the concession area in Petsamo.
>
> During the years 1935–36 initial development work was in progress including the prospecting and mapping of the deposit in the Kaulatunturi mountain. Living quarters for the staff were built and a small diesel-electric D. C. set was installed for the power supply.
>
> In 1936 it was decided to construct an adit into the mountain. Adjoining the entrance to the adit was an area of level ground where it was decided to build the smelter and auxiliary plant. The erection of buildings for the personnel was begun on a large scale in 1937 at Kolosjoki which adjoined the site for the smelter plant.
>
> The need for electricity and compressed air for the buildings as well as for the operations on the mine led to the erection of a small power station which included four diesel sets having a total capacity of 610 h. p.
>
> During 1938 it was decided that the ore which proved difficult to concentrate by flotation, should be smelted direct in electric furnaces and for this purpose alone a demand of 26,000 kv. a. would be required. There were several water power potentialities in the district and after a detailed examination was made of these, it was decided to erect a power station at Jäniskoski, some 53 miles to the south-west of the smelter plant and about 2 miles from the "Arctic Highway."
>
> This involved the building of a dam 1,640 yd. long with a head of 71 ft. This dam created a lake 1,200 yd. wide with an upstream length of 5½ miles. Two Kaplan vertical turbines were installed running at 187 r. p. m. with a nominal output of 20,000 hp. each. Power was generated at 6.6 kv. and transformed up to 110 kv. for transmission to the smelter plant at Kolosjoki.
>
> The power plant was well under construction in 1939 but was not put into commission until 1942. During 1943–44 the German Todt organization installed a huge air-raid bunker over the power station constructed of reinforced concrete averaging 15 ft. thick.
>
> The smelting plant consisted of two electric furnaces which consumed 85 to 90 per cent of the whole of the electricity consumed at Kolosjoki. The furnaces were similar in form to the rectangular reverberatory furnaces in use for nickel smelting at Copper Cliff, Ontario, but they were heated by six electrodes of the Soderberg type 41 in. in diameter and located at 9 ft. 10 in. centres. The internal dimensions

[8] Nordin, W., Petsamo Nickel: Metal Ind. (London), vol. 73, No. 10, Sept. 3, 1948, pp. 183–185.

of the furnaces were 70 ft. 6 in. long and 18 ft. wide, and 10 ft. 6 in. high to the crown of the arch.

From an electrical point of view they were resistance furnaces, the generation of heat taking place in the semi-molten slag. Some current, however, flowed through the refractory hearth which became impregnated with the matte and formed a good conductor. The heat developed in the hearth, therefore, was small owing to the low electrical resistance.

Each furnace was supplied with a 12,000 kv. a. transformer bank consisting of three 4,000 kv. a. single-phase units. The primary of the transformers was connected to a 10 kv. supply while the secondary gave a series of low tension voltages variable on a tapping switch so that the most suitable tapping could be selected for the furnace electrodes.

These latter were of the continuous Soderberg type which were built up from sheet steel and carbon paste which was rammed in from an upper platform. Each electrode weighed approximately 30 tons and was suspended from chains and raised and lowered by means of winches which were controlled from the furnace control station.

The power input to the furnaces was controlled manually from a desk type control panel from which the electrode voltage could be regulated and the electrodes raised and lowered. This panel was fully instrumentated to indicate the power input, power factor, current, voltage, as well as the kilowatt hours consumed.

There was also a temperature-measuring panel which recorded the temperature at various points of the furnace by means of built-in thermocouples.

The starting of the first furnace at the smelter plant was accompanied by an unfortunate mishap. In the first place the operators were unaccustomed to working a furnace of this type and difficulties arose when tapping the furnace. In order to reduce the pressure on tapping the slag level was kept low and the furnace operated with electrodes very close to the hearth. This had disastrous consequences; it was found after a time that deep channels had been worn in the magnesite bottom bricks. This was due to a very heavy concentration of current underneath the electrodes causing over-heating of the hearth, while excessive turbulence of the matte was produced by the electromagnetic effect of the current. It was found that with the furnace operating with electrodes in a raised position, obtained by raising the level of the slag, this difficulty was overcome, and it was also found that with a higher operating voltage of 210 and the electrodes in a raised position, the furnace worked satisfactorily and no difficulties were encountered in starting up the second furnace.

Some interesting operating data are given in the accompanying table, and it was found from the experience over the period recorded (one year) that the power consumption could be reduced on further operation.

Operating Data for Electric Furnaces

Total power consumption	180,000 million w-hr.
Mean load per furnace	10,400 kw.
Charge smelted per day per furnace, approx.	310 tons (metric).
Consumption electrical energy:	
Per ton charge	806 kw-hr.
Per ton ore	870 kw-hr.
Per ton stone (as mined)	2,000 kw-hr.
Per ton crushed stone	15,000 kw-hr.
Per ton nickel	26,000 kw-hr.
Consumption of electrode material:	
Per ton charge	8 lb.
Per million w-hr	9.5 lb.
Consumption of sheet metal electrode casing:	
Per ton charge	0.38 lb.
Per million w-hr	0.44 lb.

The matte produced in the electric smelting furnaces was transferred by ladle to large converters which were served by a high-speed overhead crane of 40 tons capacity with a 10-ton auxiliary hoist. All the cranes and converter controls were operated from a 220-volt D. C. supply with a series of motors of the robust rolling mill type. The converters were supplied with air from two electrically driven turbo-compressors. These turbo-compressors operated at 585 r. p. m. through gear boxes from 1,700 kv. a. synchronous motors. The blast pressure was 14 lb./in.[2] These compressors were also used for heating purposes in the smelter as the blast was delivered at 80° C.

The slag from the smelting furnaces was granulated with the result that a large volume of water was required and a pump-house was installed capable of delivering 10,800 L/min. of water.

Compressed air was supplied to the mine by electrically driven reciprocating compressors of Bellis & Morcom manufacture. They compressed the air in two stages to a pressure of 7 atmospheres, and each compressor was capable of delivering 2,000 cu. ft./min. of free air.

Both the vertical and the inclined shafts in the mine had winding machinery, the former being served by two balanced skips running between guide rails. There were two winding drums 9 ft. 10 in. in diameter and these were driven by a 150 kw. synchronous motor. The winch for the inclined shaft was a temporary one and was equipped with a single drum.

The haulage on the plant was carried out by electric locomotives of which there were two 8-ton locos, two 7-ton locos and four smaller accumulator locos.

It is interesting to note that for the hardening and forging of the drill steel required in the mine, two high frequency furnaces were installed and the smithy was built in the mine itself between the main shafts.

Nitrogen Compounds

By BERTRAND L. JOHNSON

GENERAL SUMMARY

THE United States is the largest producer and importer of nitrogen in the world. Some is exported. The 1948–49 allotment for the United States set the export requirements at 61,000 short tons—the same as the previous year. Public Law 606 (80th Congress), which amended the Second Decontrol Act of 1947 (Public Law 188), extended the expiration date to June 30, 1949. It also provided that the Army supply at least 50 percent of the nitrogen in the nitrogenous fertilizer materials that go into the fertilizer export program. This nitrogen, amounting to about 30,000 short tons, is to be diverted from the amount now going to occupied areas or made up from increased production at Army ordnance plants.

The supply of nitrogen in the United States in 1948 was inadequate to meet the demand. The only United States controls over nitrogen in 1948, however, were those on exports in accordance with the world allocations of the International Emergency Food Committee. There was no allocation of nitrogen fertilizers for domestic agriculture.

Ammonia solutions (including liquid anhydrous ammonia), ammonium sulfate, ammonium nitrate, and sodium nitrate constitute the principal part of our domestic production of ammonia and its compounds. In recent years a trend favoring the domestic use of solutions is reported. Export nitrogen is mostly in the form of ammonium sulfate and ammonium nitrate, with much smaller amounts of ammonium phosphate and nitrogenous solutions.

DOMESTIC PRODUCTION

Ammonium Compounds.—At the beginning of 1948 the Army nitrogen fertilizer program was based upon (1) the output of three anhydrous ammonia plants: Cactus Ordnance Works, Etter, Tex., in the Texas Panhandle; Morgantown Ordnance Works, Morgantown, W. Va., and the Ohio River Ordnance Works, West Henderson, Ky.; (2) four other plants used for converting the ammonia into ammonium nitrate solutions, at Lawrence, Kans.; Joliet, Ill.; Radford, Va.; and Charlestown, Ind., and (3) five plants processing the ammonium nitrate solution into solid ammonium nitrate at Grand Island, Nebr.; Burlington, Iowa; Carbondale, Ill.; Fremont, Nebr.; and Apco, Ohio. No part of the commercial supply was taken by the Army. Later the Cactus Ordnance Works was leased by the Army to the Phillips Chemical Co., a wholly owned subsidiary of the Phillips Petroleum Co., and on August 16, 1948, this company took possession of the plant under the terms of the lease. The Army, late in 1948, made arrangements to transfer two lines of anhydrous-ammonia production equipment at the Louisiana Ordnance Works, Louisiana, Mo., to its San Jacinto Ordnance Depot, on the ship channel near Houston, Tex., where the plant will be operated for the Army by the Hercules Powder Co., with a production of 2,000 tons of anhydrous ammonia per month.

Nitrogen compounds produced in the United States, 1945–48, in short tons

	1945	1946	1947	1948
Ammonia (NH_3):				
Synthetic plants: Anhydrous ammonia [1]	548,655	725,537	1,117,212	1,089,786
Byproduct coking plants (NH_3 content):				
Aqua ammonia	27,607	24,991	25,718	24,753
Ammonium sulfate	191,073	160,938	202,360	207,671
Total	218,680	185,929	228,078	232,424
Ammonium sulfate:				
Synthetic plants [1]	88,863	156,653	197,027	205,531
Byproduct coking plants [2]	764,293	643,752	809,440	830,683
Total	853,156	800,405	1,006,467	1,036,214
Ammonium nitrate, original solution 100 percent NH_4NO_3 [1]	421,487	724,899	1,047,792	988,342

[1] Data from Bureau of the Census monthly Facts for Industry series.
[2] Does not include ammonium sulfate produced at byproduct coking plants from purchased anhydrous ammonia as follows: 1945–46 (no data); 1947—11,070 short tons; 1948—30,749 short tons.

Late in 1948 the Mathieson Chemical Corp. (formerly the Mathieson Alkali Works) officially received title to the Government-owned Lake Charles, La., ammonia plant from the War Assets Administration, acting for the Reconstruction Finance Corporation. This plant, built and operated by Mathieson for the Government during World War II, had been leased by the company before its purchase.

The sale of the war-surplus synthetic-ammonia producing Jayhawk Ordnance Works, Galena, Kans., to the Spencer Chemical Co., Kansas City, Mo., was approved on May 12, 1948, by the War Assets Administration. The synthetic ammonia plant formerly known as the Ozark Ordnance Works, El Dorado, Ark., was purchased on March 3, 1948, from the War Assets Administration, by the Lion Oil Co., which had previously been operating the plant under a long-term lease.

The Government-owned war-surplus synthetic ammonium sulfate plant at Salem, Oreg., was offered for sale to the highest bidder on December 9, 1948, by the War Assets Administration.

Sodium Nitrate.—The synthetic nitrate of soda consumed in the United States in 1948 was produced domestically. None is known to have been imported. The sole commercial producer was the Hopewell, Va., plant of the Allied Chemical & Dye Corp. It is reported that in 1947 the industry operated at less than half capacity, the domestic production being limited in that year by a shortage of soda ash. A step-up in the production of the domestic synthetic sodium nitrate was expected late in the year, with a total production in excess of that in 1947, when 210,000 tons was reported.

Deposits of soluble nitrate minerals, none of present economic importance, are scattered throughout the United States. (See Minerals Yearbook 1942, p. 1522.)

CONSUMPTION AND USES

Anhydrous ammonia was in wide demand throughout 1948, and general shortages existed for both agricultural and industrial uses. The commercial supply available for agriculture was augmented by some from Army ordnance plants. By Public Law 793, 80th Congress, approved June 28, 1948, the Army was directed to make available 10 percent of its anhydrous ammonia production to the fertilizer industry to relieve the shortage. This would amount to about 27,000 tons, or a nitrogen equivalent about equal to what private industry would have to export. Congress stated that this supply of anhydrous ammonia was to be made available to those producers of ammonium sulfate who have been forced to shut down because of lack of the material or face imminent shut-down for the same reason. Any balance was to be distributed to the rest of the industry.

Ammonium nitrate is reported forging ahead of all other types of nitrogenous fertilizers now being used on American farms. It is said to have been used first in mixed fertilizers about 1930 and was first applied as a top dressing for crops in the 1942–43 season. In the 1947 season, 374,613 tons are stated to have been used for top dressing alone.

The shortage of synthetic sodium nitrate continued into the first part of 1948. Later in the year, however, the supply became more abundant and at about the end of the year was easily available. A considerable portion of the production is said to go to industrial uses.

PRICES

Chilean Nitrate.—On December 17, 1947, prices for imported Chilean nitrate of soda at the usual ports of importation had been fixed at $44.50 per ton for bulk material, carlots at port warehouse, plus loading and terminal charges and charges for fertilizer tags and attaching if required. The bagged material was set at $48 per ton. These prices held over into 1948 until early in August 1948, when an increase of $3.50 per ton was applied to both bulk and bagged material, bringing the base rate to $48 per ton for the bulk product and $51.50 per ton for the bagged material. No further price change occurred during the rest of the year.

Synthetic Nitrate.—Price for domestic synthetic "Arcadian" nitrate of soda in bulk on January 1, 1948, was $37 per ton and for the bagged material $40.50 for carlot shipments f. o. b. Hopewell, Va., according to the Oil, Paint and Drug Reporter. In July 1948 the contract prices were advanced $5 per ton, establishing the market at $42 per ton for bulk sodium nitrate and $45.50 for shipments in bags in carlots. The prices of this domestic product were again advanced, this time $3 per ton, effective October 1, 1949, making the new price $45 per ton for bulk and $48.50 for the bagged nitrate of soda. These prices were in effect for the balance of the year.

FOREIGN TRADE [1]

Chilean Nitrate.—Imports of natural sodium nitrate from Chile still bulk large in the domestic economy. The amount brought into the United States in 1948—720,764 short tons—was much larger

[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.

than in 1947 and larger than in any year since 1945. In spite of this increase, however, domestic demand is reported to have greatly exceeded the material available, and the market was tight throughout the year. The total value of the imports reached $23,400,075, a much greater value than in recent years. Imports of sodium-potassium nitrate into the United States in recent years have been small and irregular. In 1947 only 2,500 tons entered, and in 1948 there were no known imports of this commodity. The accompanying tables show the imports of these commodities in 1944–48.

Nitrogen compounds imported into and exported from the United States, 1945–48, in short tons

	1945	1946	1947	1948
Imports:				
Industrial chemicals:				
Anhydrous ammonia	4	7		209
Ammonium nitrate	(1)		27	80
Fertilizer materials:				
Ammonium sulfate	118,890	101,558	114,398	105,887
Calcium cyanamide	141,057	163,093	153,764	116,504
Ammonium nitrate mixtures:				
Containing less than 20 percent nitrogen			92	250
Containing 20 percent or more nitrogen	655	1,105	[3] 99,322	100,314
Nitrogenous materials, n. s. p. f.	135,010	126,029	9,687	5,304
Ammonium phosphates	92,757	91,113	105,189	108,228
Potassium nitrate, crude			(1)	(1)
Sodium nitrate	849,888	529,677	556,525	720,963
Sodium-potassium nitrate		4,400	2,500	
Exports:				
Industrial chemicals:				
Anhydrous ammonia	4,312	6,159	6,062	3,407
Aqua ammonia	2,715	(2)	(2)	(2)
Ammonium nitrate	9,845	(2)	(2)	(2)
Fertilizer materials:				
Ammonium sulfate	20,752	25,256	88,601	210,486
Calcium cyanamide	(1)	(2)	(2)	(2)
Nitrogenous chemical materials, n. e. s.	83,974	(2)	(2)	(2)
Sodium nitrate	12,229	16,180	19,920	17,100

[1] Less than 1 ton.
[2] Beginning January 1, 1946, not separately classified by U. S. Department of Commerce.
[3] Revised figure.

Sodium nitrate and sodium-potassium nitrate imported for consumption in the United States, 1944–48 [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
1944	713,004	$15,346,426	9,407	$278,534	1947	556,525	$15,153,889	2,500	$64,968
1945	849,888	18,558,959			1948	720,963	23,411,132		
1946	529,677	11,448,232	4,400	146,312					

[1] All from Chile except sodium nitrate as follows: Canada, 1947: 42 tons, $2,542; 1948: 199 tons, $11,057.

WORLD REVIEW

The critical world shortage of nitrogen continued throughout 1948. A gradually increasing demand for nitrogen in that year continued to outrun an increased supply. Shortages existed in the supply available for both agriculture and industry. The world production of fertilizer nitrogen in the fiscal year 1948–49 (exclusive of the U. S. S. R.) was estimated by the International Emergency Food Committee (IEFC) at 3,353,000 metric tons compared with 2,918,000 tons in 1947–48. World requirements are much greater than this: requests for nitrogen submitted by participating governments to the IEFC were nearly a million tons more than production. The deficiency is said to have been nearly as great as during the past 3 years. Control of world nitrogen exports continued during 1948 under the auspices of IEFC of the Food and Agricultural Organization of the United Nations. All of the above production will be distributed under allocation to more than 100 countries or areas. Most of the nitrogen distributed by the 1948–49 allocations was produced within countries using it. Supplementing this, more than a million tons were imported by claimants from recommended sources, principally Belgium, Canada, Chile, Italy, Norway, United Kingdom, and the United States. Not included in the distributions referred to above are the Allied occupation areas, to which the United States War Department shipped large tonnages.

World production and consumption of nitrogen compounds, by principal countries, fiscal years 1947–49, in metric tons of contained nitrogen [1]

[United Nations International Emergency Food Committee]

Country	Production			Consumption		
	1946–47	1947–48	1948–49 [2]	1946–47	1947–48	1948–49 [2]
Belgium and Luxembourg	126,500	146,520	167,500	88,600	89,000	82,600
Canada	176,200	160,570	167,000	26,200	24,680	30,000
Chile	261,000	274,080	280,030	6,000	6,080	8,000
China [3]		5,330	8,890	37,000	42,870	44,600
Egypt				46,700	64,890	119,270
France [4]	143,800	169,700	188,000	202,000	236,820	264,000
Germany:						
Soviet Zone [5]	107,000	120,000	155,000	107,000	120,000	130,000
Western Zones	168,000	230,000	310,500	212,300	311,120	358,770
India and Pakistan	4,000	7,280	11,000	39,100	37,840	49,820
Italy	48,300	100,000	150,000	62,300	99,300	110,000
Japan and Ryukyus	161,900	200,520	265,320	[6] 241,500	310,460	347,140
Korea:						
North [5]	5,000	10,000	20,000	5,000	5,000	5,000
South	(7)	(7)	(7)	(6)	73,200	84,780
Netherlands	40,000	65,000	80,000	92,800	103,320	104,790
Norway	93,800	82,850	107,500	21,100	20,400	22,000
Poland	39,900	41,140	55,080	49,100	42,060	58,440
United Kingdom [4]	230,700	258,000	275,000	173,400	216,670	229,990
United States [4]	674,230	905,260	936,000	711,240	805,590	865,830
Other countries	102,000	142,000	176,000	279,000	312,000	377,000
Total [8]	2,382,000	2,918,000	3,353,000	2,400,000	2,921,000	3,292,000

[1] Includes quantities produced in ordnance or other government plants for fertilizer purposes.
[2] Preliminary figures.
[3] Figures for production exclude Manchuria.
[4] Figures for consumption include overseas territories.
[5] Estimated figures.
[6] South Korea included with Japan.
[7] Data not available.
[8] Exclusive of U. S. S. R.

Chile.—Experiments are in progress in Chile looking to extraction of a million tons of sodium nitrate in the waste dumps of the nitrate plants by leaching and subsequent solar evaporation, a process reportedly not hitherto tried out in Chile. An experimental evaporation pond at Maria Elena has been built by the research departments of the Lautaro Nitrate Co. and the Anglo-Chilean Nitrate Co. If the results are favorable, it is expected that 70 ponds—each 410,000 square feet in area, but only 1.5 feet deep—will be constructed. Water which has flowed through the now useless waste would be used to fill the ponds, and the heat of the sun would concentrate the resultant solution to a point suitable for extracting the salts.

Conveyor belts are being installed at one Chilean port to decrease the present high cost of loading the nitrate.

Peat

By J. A. CORGAN AND GOLDEN V. CHIRIACO

PRODUCTION

PEAT production in the United States dropped about 5 percent in 1948, when a total of 129,581 short tons valued at $929,560 was reported to the Bureau of Mines, as compared with 136,232 tons valued at $868,979 in 1947.

Forty-one producers operating in 19 States accounted for the 1948 production. Eleven plants active in 1947 were designated inactive in 1948; one was reported closed permanently, whereas the others indicated temporary inactivity, several expressing plans for reopening in 1949.

The average value per ton in 1948 was $7.17, a 12-percent increase over the 1947 value of $6.38.

Peat produced in the United States, 1944–48

Year	Short tons	Value	
		Total	Average per ton
1944 (estimated)	97,000	$878,000	$9.05
1945 (estimated)	107,000	821,000	7.67
1946	140,707	1,006,231	7.15
1947	136,232	868,979	6.38
1948	129,581	929,560	7.17

Florida, New Jersey, and Ohio, respectively, retained the position established in 1947 as the highest peat-producing States. The following States ranked next highest in the order named: Michigan, Illinois, California, Pennsylvania, Connecticut, Iowa, Minnesota, Wisconsin, Georgia, Indiana, Colorado, Alabama, Texas, Maine, Washington, and Massachusetts.

Peat humus, produced in 12 States, comprised about 69 percent of the total production in 1948; reed or sedge, produced in 12 States, 21 percent; and moss peat and other, produced in 11 States, 10 percent.

Peat produced in the United States in 1948, by kinds

Kind	Short tons	Value	
		Total	Average per ton
Moss peat	12,685	$128,960	$10.17
Reed or sedge	27,566	262,475	9.52
Peat humus	88,949	536,993	6.04
Other	381	1,132	2.97
Total	129,581	929,560	7.17

Reserves.—Peat 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.

USES

In 1948, as in preceding years, the most prevalent use for peat in this country was for soil improvement. Of the total sales reported for 1948, 67 percent was for soil improvement, 28 percent for mixed fertilizers, and 5 percent for other purposes, including litter for barns and poultry yards, 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 1948. Although some European countries utilize peat for fuel and power purposes, it is not used in this country for fuel purposes because of the competition of higher-grade fuels.

Peat sold in the United States in 1946–48, by uses

Year	Soil improvement		Mixed fertilizers		Other uses		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1946	99,733	$664,565	32,471	$263,542	6,684	$66,286	138,888	$994,393
1947	105,796	584,012	28,354	266,359	1,561	17,593	135,711	867,964
1948	86,991	578,615	36,012	309,259	6,000	36,000	129,003	923,874

IMPORTS[2]

Imports of moss peat continued to increase, totaling 91,073 short tons in 1948, an increase of 16 percent over the 1939 prewar figure of 78,611 tons and 15 percent more than the quantity imported in 1947 (79,567 short tons). As no exports of peat were reported, the quantity available for domestic consumption in 1948 totaled 220,654 tons.

Peat moss imported for consumption in the United States in 1948, by kinds and by countries

[U. S. Department of Commerce]

Country	Poultry and stable grade		Fertilizer grade		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Canada	31,328	$1,130,686	54,700	$1,928,087	86,028	$3,058,773
Denmark	25	830	488	15,856	513	16,686
Germany	23	587	334	7,583	357	8,170
Ireland	63	2,207	668	25,797	731	28,004
Netherlands	70	2,049	2,555	52,409	2,625	54,458
Poland			512	18,385	512	18,385
Sweden	1	49	19	733	20	782
United Kingdom	55	1,846	232	7,552	287	9,398
Total	31,565	1,138,254	59,508	2,056,402	91,073	3,194,656

[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.
[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

The latest available statistics on the world production of peat are given in the accompanying table.

World production of peat, by countries, 1942–48, in metric tons [1]

[Compiled by P. Roberts]

Country	1942	1943	1944	1945	1946	1947	1948
Canada:							
Fuel	156	709	584	107	132	86	77
Peat moss	48,540	58,386	72,979	76,170	87,850	72,592	67,361
Denmark	4,800,000	6,200,000	5,800,000	5,684,723	3,705,180	5,168,139	3,616,860
Finland	8,659	2,364	2,840	7,280	6,846	(2)	(2)
France	209,740	190,210	112,619	95,842	84,621	85,800	(2)
Germany	(2)	[3] 640,000	(2)	[3, 4] 20,000	[3, 5] 500,000	[5] 1,800,000	[5] 2,038,000
Hungary	16,710	28,640	(2 6)	(2 6)	3,720	8,550	(2)
Iceland	(2)	11,560	11,973	11,000	[3] 10,500	[3] 6,600	(2)
Ireland [7]	4,312,738	4,954,895	5,302,477	5,086,734	4,826,238	4,809,879	(2)
Italy	134,463	[8] 59,204	72,152	156,069	(2)	(2)	(2)
Netherlands	712,935	648,800	535,550	386,050	571,940	(2)	(2)
Norway	323,300	334,688	296,974	269,648	(2)	378,600	343,130
Portugal	(2)	(2)	(2)	2,322	2,456	2,715	1,502
Sweden:							
Fuel	637,568	978,269	774,612	1,049,089	703,000		
Litter, baled	112,400	110,000	105,310	101,420			
Litter and "Mull," unbaled	2,060	1,395	1,303	1,075	106,000	450,000	375,000
"Mull," baled	14,987	15,948	16,600	14,629			
Switzerland	[3] 200,000	[3] 430,000	[3] 310,000	497,429	100,000	40,000	(9)
United States [10]	65,000	54,000	88,000	97,000	127,647	123,587	117,553
Total (estimate) [1]	12,251,000	14,746,000	14,026,000	13,660,000	11,286,000	13,604,000	12,141,000

[1] In addition to countries listed, Argentina, Australia, Poland, and U. S. S. R. produce peat, but data of production are not available; estimates for these are not included in total. U. S. S. R. produced approximately 20,000,000 tons in 1945.
[2] Data not available, estimate included in total.
[3] Estimate.
[4] United States zone only.
[5] Bizonal area.
[6] Data represent Trianon Hungary subsequent to October 1944.
[7] Figures for 1942 relate to production by holders of agricultural land only; those for 1943–47 cover tota production.
[8] January to June, inclusive.
[9] Negligible.
[10] Data for 1942–43 are as reported to the Bureau of Mines by producers and probably represent only about ⅔ of total production. Data for 1944–48 believed to represent reasonably complete coverage.

Petroleum and Petroleum Products

By A. G. WHITE, F. S. LOTT, A. T. COUMBE, AND A. L. CLAPP

GENERAL SUMMARY

THE outstanding feature of the oil situation in 1948 was a transition from tight supply and local product shortages at the beginning of the year to abnormally high stocks of refined products and oversupply at the end of the year. Additions to refinery capacity and a flattening in the rate of increased demand restored the essential flexibility to adjust operations to abnormal seasonal changes in demand. With the expansion in the heating-oil market, weather has become a more dominant factor in the seasonal fluctuations in demand. The cold winter of 1947–48 resulted in an unexpectedly large demand for heating oils and necessitated the use of refinery capacity to the limit, with maximum yields of light fuel oils, and a strain on distribution facilities from the refinery to the consumer that caused serious temporary shortages in the east coast and parts of the Middle West. The abnormally mild winter of 1948–49 cut the expected demand for heating oils by possibly 10 percent. Before this situation had become apparent, supply had exceeded requirements in the last quarter of 1948, and stocks of heating oils were far above normal seasonal levels. The whole pattern of subsequent operations in the first half of 1949 had to be adjusted to meet this abnormal situation. Refinery operations were sharply reduced below the level of 1948, the yields of fuel oils were cut to a minimum, and the seasonal yield of gasoline was increased by about 3 percent, as that product was the only one for which demand continued to increase at the anticipated rate.

During each of the past 3 years, the annual and seasonal patterns of oil demand have varied sharply. In 1946 the transition from war requirements to civilian demand took place without the substantial decline in demand that had been expected. The total demand for all oils in 1946, compared with 1945, declined only 0.5 percent owing to a sharp drop in exports, while domestic demand showed a small increase of 1 percent.

In 1947, both the total demand and the domestic demand for all oils gained 11 percent compared with 1946. To supply this high demand, refinery and transportation facilities were used to capacity, and there was a small reduction of about 5 million barrels in total stocks of refined oils.

Both demand and supply exceeded all previous records in 1948. Compared with 1947, the total demand for all oils increased about 4 percent with a decline of 18 percent in exports and a gain of about 6 percent in domestic demand.

Demands for all oils in the United States, 1939–48

[Millions of barrels]

Year	Domestic demand	Exports	Total demand	Year	Domestic demand	Exports	Total demand
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	1,792.8	153.1	1,945.9
1942	1,449.9	116.9	1,566.8	1947	1,989.8	164.5	2,154.3
1943	1,521.4	150.0	1,671.4	1948 [1]	2,108.4	134.9	2,243.3

[1] Subject to revision.

Total exports and shipments to noncontiguous Territories declined from 164.5 million barrels in 1947 to 135 million in 1948. Exports of crude oil decreased 6.5 million barrels or 14 percent and exports of refined products 23.0 million barrels or 20 percent during the year. Exports of refined products were restricted in the early part of 1948 during the period of domestic shortage and were later affected by increases in outside world supply and problems of monetary exchange. A net export of about 5 million barrels in 1947 changed to a net import of about 53 million in 1948.

Domestic demand in continental United States rose from 1,989.8 million barrels in 1947 to a record level of 2,108.4 million in 1948, exceeding 2 billion barrels for the first time. Compared with 1947, domestic demand increased 6 percent in 1948—including gains of 9 percent in motor-fuel demand, 14 percent in distillate fuel-oil demand, 9 percent in kerosine demand, and 3 percent in the demand for miscellaneous products and a 4-percent decline in the demand for residual fuel oil. The increase in domestic demand in 1948 was considerably less than had been expected and resulted in an excess of supply in the latter half of the year.

Stocks of all oils increased 106.5 million barrels in 1948—including gains of 25.6 million in crude stocks, 1.3 million in natural-gasoline stocks, and 79.6 million barrels in stocks of refined products.

The supply of all oils in 1948 totaled 2,349.8 million barrels, a total increase of 9 percent on a daily average basis compared with 1947. Production of crude oil set a new record of 2,016.3 million barrels, or 5,509,000 barrels daily—a gain of 8 percent compared with 1947. The production of light oils from natural gas, including a small amount of motor benzol, amounted to 145.8 million barrels in 1948, a daily average increase of 9 percent. The total imports of all oils rose from 159.4 million barrels in 1947 to 187.7 million in 1948—a daily average gain of 18 percent, including an increase of 32 percent in imports of crude oil and a decline of 5 percent in imports of refined oils.

Salient statistics of crude petroleum, refined products, and natural gasoline in the United States, 1944–48

	1944	1945	1946	1947	1948 [1]
Crude petroleum:					
Domestic production..thousands of barrels [2]	1,677,904	1,713,655	1,733,939	1,856,987	2,016,282
World production..do	2,592,514	2,594,959	2,745,667	3,021,668	3,425,283
United States proportion of world production, percent	65	66	63	61	59
Imports [3]..thousands of barrels [2]	44,805	74,337	86,066	97,532	129,093
Exports [4]..do	34,238	32,998	42,436	46,355	39,840
Stocks, end of year:					
Gasoline-bearing crude..do	220,663	218,763	224,473	224,929	246,199
California heavy crude..do	6,107	4,496	5,703	5,725	10,055
Runs to stills..do	1,665,684	1,719,534	1,730,197	1,852,246	2,030,670
Total value of domestic production at wells, thousands of dollars	2,032,960	2,094,250	2,442,550	3,577,890	[5] 5,196,034
Average price per barrel at wells	$1.21	$1.22	$1.41	$1.93	$2.58
Total producing oil wells in the United States, Dec. 31	412,220	415,750	421,460	426,280	(6)
Total oil wells completed in the United States during year	13,029	14,297	15,851	17,999	22,585
Refined products:					
Imports [7]..thousands of barrels [2]	47,506	39,282	51,610	61,857	58,616
Exports [7]..do	173,378	149,985	110,687	118,122	95,114
Stocks, end of year..do	245,868	235,998	271,937	[8] 265,850	345,469
Output of motor fuel..do	739,340	798,194	776,583	839,998	921,902
Yield of gasoline..percent	39.4	40.9	39.6	40.2	40.3
Completed refineries, end of year	413	393	399	390	375
Daily crude oil capacity of refineries, thousands of barrels [2]	5,301	5,316	5,569	6,034	6,439
Average dealers' net price (excluding tax) of gasoline in 50 United States cities, cents per gallon [9]	10.49	10.33	10.40	12.33	14.55
Natural gasoline:					
Production..thousands of barrels [2]	100,046	112,004	115,739	132,173	145,479
Stocks, end of year..do	4,451	4,322	4,981	4,296	5,579

[1] Subject to revision.
[2] 42 gallons per barrel.
[3] Bureau of Mines.
[4] Bureau of Mines, 1944–46; U. S. Department of Commerce, 1947–48. Exports include shipments to noncontiguous Territories.
[5] Estimated.
[6] Figure not available.
[7] U. S. Department of Commerce. Exports include shipments to noncontiguous Territories.
[8] Figure on new basis and comparable with succeeding years. Figure for 1947 on old basis and comparable with preceding years—267,103,000 barrels.
[9] American Petroleum Institute.

Supply and demand of all oils in the United States in 1947–48, by months

[Thousands of barrels]

	1947													1946 (total)
	January	February	March	April	May	June	July	August	September	October	November	December	Total	
New Supply:														
Domestic production:														
Crude petroleum	144, 823	134, 696	152, 178	149, 410	156, 055	153, 058	159, 366	160, 448	157, 665	165, 032	158, 701	165, 555	1, 856, 987	1, 733, 939
Natural gasoline	10, 645	9, 934	11, 026	10, 667	10, 339	10, 451	10, 966	11, 201	11, 067	11, 682	11, 893	12, 302	132, 173	115, 739
Benzol	80	80	80	50	50	50	50	50	50	50	50	50	690	2, 070
Total production	155, 548	144, 710	163, 284	160, 127	166, 444	163, 559	170, 382	171, 699	168, 782	176, 764	170, 644	177, 907	1, 989, 850	1, 851, 748
Imports:														
Crude petroleum [1]	7, 763	8, 444	9, 263	7, 276	8, 703	7, 628	7, 294	8, 242	8, 658	7, 761	7, 688	8, 812	97, 532	86, 066
Refined products [2]	6, 207	5, 596	6, 146	5, 913	5, 625	3, 711	4, 624	3, 825	3, 902	4, 563	5, 619	6, 126	61, 857	51, 610
Total new supply	169, 518	158, 750	178, 693	173, 316	180, 772	174, 898	182, 300	183, 766	181, 342	189, 088	183, 951	192, 845	2, 149, 239	1, 989, 424
Change in stocks	−13, 958	−10, 579	−1, 289	+2, 036	+7, 800	+5, 557	+3, 223	+10, 772	+2, 665	+920	+1, 838	−14, 026	−5, 041	+43, 515
Demand:														
Total demand	183, 476	169, 329	179, 982	171, 280	172, 972	169, 341	179, 077	172, 994	178, 677	188, 168	182, 113	206, 871	2, 154, 280	1, 945, 909
Exports: [2]														
Crude petroleum	2, 481	2, 585	3, 257	3, 999	4, 789	3, 758	5, 184	4, 139	4, 087	3, 712	3, 844	4, 520	46, 355	42, 436
Refined products	7, 558	10, 964	10, 753	11, 248	9, 523	10, 810	11, 606	10, 352	9, 787	10, 181	8, 337	7, 003	118, 122	110, 687
Domestic demand:														
Motor fuel	57, 114	50, 602	60, 005	63, 325	70, 862	71, 201	73, 438	72, 086	71, 399	73, 331	64, 146	67, 506	795, 015	735, 417
Kerosine	12, 325	10, 533	10, 079	8, 082	6, 068	5, 910	5, 348	5, 447	6, 580	8, 163	11, 070	12, 914	102, 519	89, 088
Distillate fuel oil	35, 298	31, 687	29, 279	21, 321	19, 262	16, 977	16, 355	16, 093	19, 414	23, 106	28, 997	40, 484	298, 273	242, 894
Residual fuel oil	48, 299	43, 308	45, 852	42, 140	40, 057	38, 188	40, 412	39, 864	40, 678	43, 995	43, 532	52, 185	518, 510	480, 029
Lubricating oil	2, 879	2, 684	2, 929	3, 066	3, 104	2, 873	3, 003	3, 051	3, 219	3, 437	2, 911	3, 325	36, 481	34, 891
Miscellaneous	17, 522	16, 966	17, 828	18, 099	19, 307	19, 624	23, 731	21, 962	23, 513	22, 243	19, 276	18, 934	239, 005	210, 467
Total domestic demand	173, 437	155, 780	165, 972	156, 033	158, 660	154, 773	162, 287	158, 503	164, 803	174, 275	169, 932	195, 348	1, 989, 803	1, 792, 786
Stocks:														
Gasoline-bearing crude	223, 848	225, 121	228, 981	235, 710	237, 768	237, 278	230, 974	228, 523	225, 258	226, 666	225, 462	224, 929	224, 929	224, 473
Heavy crude petroleum in California	5, 584	5, 790	5, 999	5, 953	5, 825	5, 429	5, 208	5, 320	5, 194	5, 275	5, 623	5, 725	5, 725	5, 703
Natural gasoline	4, 794	5, 010	5, 265	5, 604	5, 566	5, 452	5, 269	5, 017	4, 456	4, 221	4, 266	4, 296	4, 296	4, 981
Refined products	258, 910	246, 636	241, 023	236, 037	241, 945	248, 502	258, 433	271, 796	278, 413	278, 079	280, 728	267, 103	267, 103	271, 937
Total stocks	493, 136	482, 557	481, 268	483, 304	491, 104	496, 661	499, 884	510, 656	513, 321	514, 241	516, 079	502, 053	502, 053	507, 094

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	1948 [3]													1947 (total)
	January	February	March	April	May	June	July	August	September	October	November	December	Total	
New supply:														
Domestic production:														
Crude petroleum	163, 781	155, 224	167, 593	164, 509	170, 574	166, 330	171, 196	172, 886	163, 037	174, 581	170, 242	176, 329	2, 016, 282	1, 856, 987
Natural gasoline	11, 997	11, 344	12, 268	11, 676	12, 044	11, 522	11, 843	12, 129	11, 515	12, 805	12, 888	13, 448	145, 479	132, 173
Benzol	50	28	28	28	28	28	28	28	28	28	28	28	358	690
Total production	175, 828	166, 596	179, 889	176, 213	182, 646	177, 880	183, 067	185, 043	174, 580	187, 414	183, 158	189, 805	2, 162, 119	1, 989, 850
Imports:														
Crude petroleum [1]	8, 427	8, 354	8, 682	9, 757	10, 293	9, 749	11, 478	10, 883	11, 428	12, 572	12, 923	14, 547	129, 093	97, 532
Refined products [2]	5, 479	6, 288	5, 966	5, 048	4, 519	4, 011	4, 425	4, 597	4, 402	3, 876	4, 555	5, 450	58, 616	61, 857
Total new supply	189, 734	181, 238	194, 537	191, 018	197, 458	191, 640	198, 970	200, 523	190, 410	203, 862	200, 636	209, 802	2, 349, 828	2, 149, 239
Change in stocks	−10, 029	−575	+1, 275	+8, 068	+13, 722	+10, 358	+14, 040	+14, 935	+15, 290	+19, 636	+15, 376	+4, 406	+106, 502	−5, 041
Demand:														
Total demand	199, 763	181, 813	193, 262	182, 950	183, 736	181, 282	184, 930	185, 588	175, 120	184, 226	185, 260	205, 396	2, 243, 326	2, 154, 280
Exports: [2]														
Crude petroleum	2, 992	2, 626	3, 138	3, 538	3, 362	3, 419	3, 661	4, 078	3, 362	3, 404	3, 192	3, 068	39, 840	46, 355
Refined products	6, 633	5, 646	7, 052	8, 748	9, 209	8, 935	10, 270	8, 936	7, 873	7, 501	6, 632	7, 679	95, 114	118, 122
Domestic demand:														
Motor fuel	61, 308	56, 487	68, 171	72, 183	77, 186	78, 044	81, 428	80, 348	76, 159	75, 164	72, 560	72, 162	871, 200	795, 015
Kerosine	16, 198	12, 608	10, 884	7, 774	6, 508	6, 351	6, 561	6, 193	6, 365	9, 411	10, 928	12, 384	112, 165	102, 519
Distillate fuel oil	42, 056	38, 648	33, 779	25, 498	22, 809	20, 896	18, 305	20, 210	20, 364	25, 595	30, 645	41, 243	340, 048	298, 273
Residual fuel oil	48, 853	45, 565	47, 808	42, 831	39, 819	38, 987	38, 255	38, 400	35, 026	38, 807	39, 108	47, 300	500, 759	518, 510
Lubricating oil	3, 056	3, 044	3, 231	3, 096	2, 956	3, 007	2, 803	2, 957	2, 843	3, 178	3, 229	2, 985	36, 385	36, 481
Miscellaneous	18, 667	17, 189	19, 199	19, 282	21, 887	21, 643	23, 647	24, 466	23, 128	21, 166	18, 966	18, 575	247, 815	239, 005
Total domestic demand	190, 138	173, 541	183, 072	170, 664	171, 165	168, 928	170, 999	172, 574	163, 885	173, 321	175, 436	194, 649	2, 108, 372	1, 989, 803
Stocks:														
Gasoline-bearing crude	223, 430	224, 880	227, 408	227, 278	223, 820	223, 481	223, 124	224, 211	228, 401	234, 615	240, 083	246, 199	246, 199	224, 929
Heavy crude petroleum in California	6, 412	6, 539	6, 756	7, 228	7, 498	7, 931	7, 831	7, 743	8, 901	9, 357	9, 983	10, 055	10, 055	5, 725
Natural gasoline	4, 323	4, 673	4, 806	5, 305	5, 622	6, 077	6, 176	6, 308	6, 287	6, 173	5, 857	5, 579	5, 579	4, 296
Refined products	256, 506	254, 104	252, 501	259, 728	276, 321	286, 130	300, 528	314, 332	324, 295	337, 375	346, 973	345, 469	345, 469	[4] 265, 850
Total stocks	490, 771	490, 196	491, 471	499, 539	513, 261	523, 619	537, 659	552, 594	567, 884	587, 520	602, 896	607, 302	607, 302	500, 800

[1] Bureau of Mines.
[2] U. S. Department of Commerce.
[3] Subject to revision.
[4] New basis, excluding distributors' stocks in California.

In considering the general relation between supply and demand in 1948, the increase of 106.5 million barrels in total stocks represented an excess supply of about 4.5 percent over actual requirements. While part of this gain in stocks can be considered a normal increase incident to the larger demand, a very substantial part of the increment represented excess stocks that would require subsequent readjustments in supply to return to a normal seasonal balance. As originally estimated, the same supply in 1949 would have met most of the expected gain in demand, but actually the indications for 1949 indicate an increase considerably less than 4.5 percent in total demand and consequently will result in a substantial reduction in total new supply below the record levels of 1948.

In the following sections of this general review, the position of the major products is discussed, and the trends of demand in 1948 are indicated by quarters. A brief review of the four major products—motor fuel, residual fuel oil, distillate fuel oil, and kerosine—will indicate the principal changes in demand and stocks of refined products that occurred in 1948. These four products represented almost 85 percent of the total demand for all oils in 1948.

The record demand for motor fuel in 1948 amounted to 908.6 million barrels, including exports of 37.4 million and a domestic demand of 871.2 million barrels. Compared with 1947, total demand increased 66.1 million barrels, including a decline of 10.1 million in exports and a gain of 76.2 million in domestic demand or 9 percent on a daily average basis. Stocks of finished gasoline increased 12.3 million barrels in 1948 with a gain of 15.1 million in areas east of California and a decline of 2.8 million in the California district. According to the Public Roads Administration, the highway demand for motor fuel amounted to 725.3 million barrels in 1948 or 8 percent greater than in 1947. This highway demand represented 83.3 percent of total domestic demand, as computed by the Bureau of Mines, in 1948 compared with 84.5 percent in 1947—the relative decline being due primarily to the gain of about 15 million barrels in the domestic demand and for aviation gasoline in 1948.

The total demand for residual fuel oil in 1948 amounted to 513.3 million barrels, including exports of 12.5 million and a domestic demand of 500.8 million barrels. Compared with 1947, total demand decreased 15.8 million barrels, including a gain of 1.9 million in exports and a decline of 17.7 million in domestic demand or a loss of 4 percent on a daily average basis. Stocks of residual fuel oil increased 29.8 million barrels in 1948, with a gain of 13.5 million barrels in areas east of California and an increase of 16.3 million in the California district. Current reports available indicate a decline in railroad consumption of 7.0 million barrels in 1948, a decline in the bunkering of ships in the foreign trade of 8.1 million barrels, and a decline in the consumption by public-utility electric plants of 3.3 million barrels.

The record demand for distillate fuel oil in 1948 amounted to 361.9 million barrels, including exports of 21.8 million and a domestic demand of 340.1 million barrels. Compared with 1947, total demand increased 33.7 million barrels, including a decline of 8.1 million in exports and a gain of 41.8 million in domestic demand or 14 percent on a daily average basis. Stocks of distillate fuel oil increased 24.9 million barrels in 1948, with almost all the gain occurring in areas east

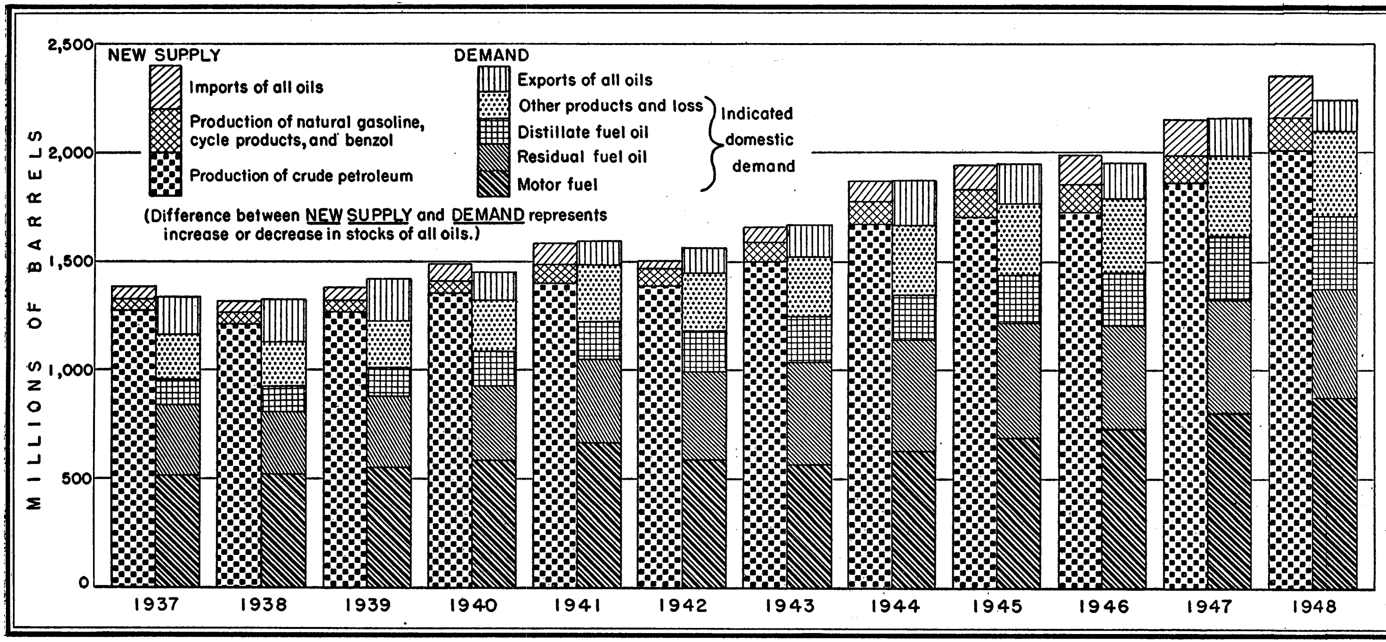

FIGURE 1.—Supply and demand of all oils in the United States, 1938–48.

of California, including 9.6 million in the East Coast district and 7.3 million in the Gulf Coast districts. Part of the increase in stocks was essential restocking, but a material excess in seasonal stocks resulted from the mild weather at the end of the year. Current figures available indicate an increase in 1948 of 9.7 million barrels in Diesel-oil demand by railroads.

The total demand for kerosine in 1948 amounted to 115.7 million barrels, including exports of 3.5 million and a domestic demand of 112.2 million barrels. Compared with 1947, total demand increased 5.9 million barrels, with a decline of 3.7 million in exports and an increase in domestic demand of 9.6 million or a gain of 9 percent on a daily average basis. Stocks of kerosine increased 6.3 million barrels in 1948, including an increase of 3.2 million in the East Coast district. A considerable part of the demand for kerosine is in small space-heating units where it competes with No. 1 distillate fuel oil.

Excluding the four major products already reviewed, the total demand for all other products in 1948 amounted to 343.9 million barrels in 1948 compared with 344.8 million in 1947, a decline of 0.4 percent on a daily average basis. Exports included in this group declined from 69.3 million barrels in 1947 to 59.7 million in 1948, including declines of 6.5 million in crude oil exports and 3.1 million barrels in the exports of other refined products. The domestic demand for these other products increased from 275.5 million barrels in 1947 to 284.2 million in 1948—a daily average gain of 3 percent. Of the total increase of 8.7 million barrels in 1948, the principal gains were 11.4 million barrels for liquefied gases, 2.8 million for asphalt, 1.6 million for coke, 1.4 million for other miscellaneous products, and 1.0 for road oil. The principal declines in domestic demand were 4.8 million barrels for losses (refinery shortage and crude losses) and 4.4 million for still gas.

Review of the trends of 1948 by quarters will clarify the most important changes in supply and demand during the year.

The first quarter of 1948 was characterized by cold weather, heavy demands for heating oils, local shortages of distillate fuel oil and kerosine, emergency transportation arrangements, and restrictions in export licenses for the products in critical supply. The situation was particularly acute in the East Coast States, where products are moved by boat and where the stocks of distillate fuel oil had declined sharply in 1947 in the refinery district serving this area. Crude runs to stills were maintained at a high level, the yield of gasoline from crude oil was reduced, and yields of distillate fuel oil and kerosine were raised to a maximum. Compared with 1947, the total demand for all oils in 1948 increased almost 7 percent on a daily average basis, total exports declined 26 percent, and domestic demand was 9 percent greater. Increases in domestic demand by product showed gains of 19 percent for kerosine, 18 percent for distillate fuel oil, almost 10 percent for motor fuel, and about 5 percent for all other products.

In the second quarter of 1948, crude runs were at record levels, averaging 5,614,000 barrels daily in the effort to meet demand and to replenish heating-oil stocks that has been reduced to minimum levels at the end of March. A total of 33.6 million barrels was added to stocks of refined oils during the quarter. Compared with the second quarter of 1947, total demand gained almost 7 percent, exports decreased about 16 percent, and domestic demand gained about 9 percent. Increases in domestic demand by products included 20 percent for distillate fuel oil, 11 percent for motor fuel, 3 percent for kerosine, 1 percent for residual fuel oil, and 9 percent for other products. Early restocking of light heating oils by distributors and consumers was indicated.

A slowing in the upward trends of demand was evident in the third quarter of 1948. Total demand, compared with the third quarter of 1947, increased less than 3 percent, total exports were about 15 percent lower, and domestic demand gained less than 5 percent. Domestic demand by products showed gains of over 13 percent for distillate fuel oil, 10 percent for gasoline and kerosine, and 2 percent for miscellaneous products, while the domestic demand for residual fuel oil was almost 8 percent less. Total crude runs to stills averaged 5,544,000 barrels daily and were reduced by a strike that lasted through September and part of October in California. Total stocks of refined products increased 38.2 million barrels in the third quarter.

A combination of abnormally warm weather, earlier seasonal stocking of heating oils by distributors and consumers, and a sharp drop in the demand for residual fuel oils resulted in an unexpectedly small demand in the fourth quarter of 1948. Compared with the same period in 1947, total demand declined 0.4 percent, exports were reduced over 16 percent, and domestic demand gained only 0.7 percent. Although the domestic demand for motor fuel gained over 7 percent, the increase for distillate fuel oil was only 5 percent and for kerosine 2 percent, while the domestic demand for residual fuel oil declined over 10 percent and the demand for miscellaneous oils was reduced about 3 percent. In spite of the relative decline in demand, crude runs to stills reached an all-time record of 5,662,000 barrels daily in the fourth quarter; and stocks of refined oils, instead of declining, increased 21.2 million barrels during the quarter.

With a total increase of almost 80 million barrels in refined stocks during 1948 and continuation of an abnormally mild winter, supply greatly exceeded demand in the first quarter of 1949. Compared with the first quarter of 1948, total demand was down 1.4 percent, exports gained about 13 percent, and domestic demand was 2 percent less. The domestic demand for motor fuel was 5.5 percent higher, but distillate fuel oil and residual fuel oil demands were about 4 percent less. The demand for kerosine declined 15 percent and for other miscellaneous products dropped 10 percent. As a result of the low demand for heating oils combined with excessive inventories, yields of gasoline were much above normal, and fuel-oil yields were reduced to a minimum.

Demand in Noncontiguous Territories.—In order to compute domestic demand in continental United States, the shipments from the United States to the Territories are included in exports, and any imports from foreign countries to the Territories are deleted from total imports. The major part of such shipments from the United States goes to Hawaii, Alaska, and Puerto Rico, and Puerto Rico is normally the chief Territorial importer of foreign oils.

The accompanying table has been prepared to show shipments to the Territories from the United States and the foreign imports received by them. No crude oil is involved in these movements. The receipts of products from the United States plus the imports indicate the total supply available in the Territories and, minus some minor reexports, indicate their total demand.

Imports and exports of crude petroleum and petroleum products

[Thousands of barrels]

Product [1]	Imports					
	1947			1948		
	Continental United States	Noncontiguous Territories	Total	Continental United States	Noncontiguous Territories	Total
Gasoline	358	21	379	302	125	427
Kerosine				135	12	147
Distillate fuel oil	4, 175	135	4, 310	2, 546	5	2, 551
Residual fuel oil	54, 244	2, 547	56, 791	53, 161	2, 363	55, 524
Lubricating oil	38		38	101		101
Wax	4		4	27		27
Coke						
Asphalt	1, 159	5	1, 164	1, 362	25	1, 387
Other unfinished oils	1, 879		1, 879	982		982
Total	61, 857	2, 708	64, 565	58, 616	2, 530	61, 146
Crude petroleum [2]	97, 532		97, 532	129, 093		129, 093

Product [1]	Exports					
	1947			1948		
	Foreign	Noncontiguous Territories	Total	Foreign	Noncontiguous Territories	Total
Motor fuel	42, 472	4, 977	47, 449	32, 601	4, 809	37, 410
Kerosine	6, 689	563	7, 252	2, 929	606	3, 535
Distillate fuel oil	25, 844	4, 033	29, 877	18, 760	3, 048	21, 808
Residual fuel oil	8, 082	2, 541	10, 623	8, 998	3, 541	12, 539
Lubricating oil	14, 055	207	14, 262	12, 848	142	12, 990
Wax	1, 107		1, 107	994		994
Coke	2, 088	14	2, 102	2, 506	15	2, 521
Asphalt	3, 056	206	3, 262	1, 484	134	1, 618
Miscellaneous	2, 161	27	2, 188	1, 684	15	1, 699
Total	105, 554	12, 568	118, 122	82, 804	12, 310	95, 114
Crude petroleum [1]	46, 355		46, 355	39, 840		39, 840

[1] United States Department of Commerce: 1947 final data; 1948 preliminary data.
[2] Bureau of Mines data.

The figures for 1948 indicate that shipments to the Territories from the United States totaled 12,310,000 barrels and that total direct imports from foreign countries were 2,530,000 barrels, making a total new supply of 14,840,000 barrels. Reexports to foreign countries amounted to 234,000 barrels (see table of exports, by countries of destination, in the next to the last section of this chapter). There is indicated a total set demand for oil products in the noncontiguous Territories of about 14.6 million barrels in 1948 compared with 15.1 million barrels in 1947. If these figures are added to the domestic demand figures for continental United States, the sum will show the total domestic demand within the political boundaries of the United States.

World Oil Supply.—World production of crude petroleum in 1948 again exceeded all previous records, increasing from 3,022 million barrels in 1947 to 3,425 million in 1948. The total increase of 403 million barrels represents a gain of 159 million for the United States and 244 million for the rest of the world, including gains of 55 million for Venezuela, 53 million for Saudi Arabia, 35 million for Iran, 31 million for Russia, 30 million for Kuwait, and 24 million for Indonesia. The United States produced 61 percent of the world total in 1947 and 59 percent in 1948.

According to Bureau of Mines data for 1948, exports of all oils from continental United States totaled 135 million barrels and imports about 188 million, resulting in a net import of about 53 million barrels in 1948. As total stocks of all oils increased almost 107 million barrels in 1948, the production of all oils (including crude oil and liquid products from natural gas) exceeded domestic demand in continental United States by about 54 million barrels.

RESERVES

The Committee on Petroleum Reserves, American Petroleum Institute, estimated proved reserves of crude oil in the United States on December 31, 1948, at 23,280 million barrels, compared with 21,488 million on December 31, 1947. These estimates refer solely to proved or blocked-out reserves, including only oil recoverable under existing economic and operating conditions.

The increase in total net crude reserves in 1948 was 1,792 million barrels. In arriving at this net figure, the total of estimated new reserves added in 1948 was 3,795 million barrels—including an upward revision of 3,399 million of reserves due to extensions and revisions during 1948 and an estimate of 396 million for new reserves discovered in new fields or in new pools in old fields during 1948. From this estimate of total reserves added in 1948 was deducted an estimated production of 2,002 million barrels of crude oil during 1948 to determine the net gain in total reserves.

The principal changes in net crude reserves in 1948 were gains of 707 million barrels for Texas, 469 million for California, 297 million for Oklahoma, 111 million for Kansas, 78 million for Louisiana, 61 million for Mississippi, 38 million for Illinois, 37 million for Wyoming, and 22 million for New Mexico. The principal declines were 16 million barrels for Colorado and 13 million for Pennsylvania.

As of December 31, 1948, Texas had 54 percent of the total estimated reserves, California 16 percent, Louisiana 8 percent, and Oklahoma 5 percent—83 percent of the total for the four States combined.

The total proved reserves of natural-gas liquids, not included in the crude-oil reserves, were 3,541 million barrels on December 31, 1948. This figure, combined with the crude-oil reserves, made a proved reserve for all liquid hydrocarbons of 26,821 million barrels on December 31, 1948.

Estimates of proved oil reserves in the United States on December 31, 1942–48, by States [1]

[Millions of barrels]

State	1942	1943	1944	1945	1945 [2]	1946	1947	1948
Eastern States:								
Illinois	307	295	321	350	350	351	355	393
Indiana	32	31	31	41	41	44	46	49
Kentucky	35	35	41	57	57	59	65	59
Michigan	64	55	65	64	64	69	70	69
New York	54	90	86	81	81	76	71	67
Ohio	35	33	32	30	30	29	29	29
Pennsylvania	153	137	123	110	110	98	123	110
West Virginia	47	44	41	39	39	36	36	37
Total	727	720	740	772	772	762	795	813
Central and Southern States:								
Arkansas	300	297	293	304	288	267	297	300
Kansas	687	646	602	542	542	545	563	674
Louisiana	1,442	1,484	1,573	1,690	1,559	1,652	1,791	1,869
Mississippi	41	39	209	267	257	270	304	365
New Mexico	677	654	563	512	512	544	530	552
Oklahoma	969	909	970	890	889	898	953	1,250
Texas	11,546	11,325	11,375	11,470	10,835	11,647	11,777	12,484
Total	15,662	15,354	15,585	15,675	14,882	15,823	16,215	17,494
Mountain States:								
Colorado	39	45	89	260	260	300	382	366
Montana	86	108	112	108	108	104	115	119
Wyoming	371	499	582	600	600	589	679	716
Total	496	652	783	968	968	993	1,176	1,201
Pacific Coast States: California	3,196	3,337	3,344	3,410	3,318	3,294	3,295	3,764
Other States	2	1	1	2	2	2	7	8
Total United States	20,083	20,064	20,453	20,827	19,942	20,874	21,488	23,280

[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.

CRUDE PETROLEUM

SUPPLY AND DEMAND

The total demand for crude petroleum in 1948 set another new record amounting to 2,119.8 million barrels, an average of 5,792,000 barrels daily, that was 8 percent greater than in 1947. The demand for domestic crude oil rose to 1,994.8 million barrels, an average of 5,450,000 barrels daily and an increase of 7 percent compared with 1947. The demand for foreign crude oil amounted to 125.0 million barrels in 1948—a daily average of over 341,000 barrels and an increase of 28 percent compared with 1947.

The new supply of crude petroleum in 1948 included a record domestic production of 2,016.3 million barrels and imports of 129.1 million barrels. The average production of 5,509,000 barrels daily represented a gain of 8 percent compared with 1947 and imports of 353,000 barrels daily, an increase of 32 percent compared with 1947. Stocks of domestic crude petroleum increased by 21.5 million barrels during the year, and stocks of foreign crude gained 4.1 million.

The gain of 25.6 million barrels in total crude stocks in 1948 and the increase in total stocks of refined products of 79.6 million barrels indicate that the new supply of crude oil in 1948 was almost 5 percent greater than the total demand for all oils. In other words, the new supply of crude oil in 1948 was adequate to take care of a 5-percent increase in total demand in 1949 with no changes in stocks. If demand in 1949 should increase less than 5 percent or if stocks were substantially reduced, a sharp decline in new requirements of crude would be indicated.

The total increase in the indicated demand for crude oil (consumption plus export) of 165.8 million barrels in 1948 represented a gain of 178.5 million in total runs to stills and a decline of 12.7 million in the other demands for crude, including declines of 6.5 million in exports, 3.0 million in transfers to fuel oil, and 3.2 million in losses and unaccounted-for crude oil.

Supply of and demand for crude petroleum in the United States, 1944–48

[Thousands of barrels]

	1944	1945	1946	1947	1948 [1]
Production	1,677,904	1,713,655	1,733,939	1,856,987	2,016,282
Imports [2]	44,805	74,337	86,066	97,532	129,093
Changes in stocks [3]	−22,435	−3,511	+6,917	+478	+25,600
Total supply	1,745,144	1,791,503	1,813,088	1,954,041	2,119,775
Runs to stills:					
Domestic	1,622,514	1,645,862	1,645,845	1,754,987	1,906,656
Foreign	43,170	73,672	84,352	97,259	124,014
Exports [4]	34,238	32,998	42,436	46,355	39,840
Transfers to fuel oil:					
Distillate	3,242	3,047	3,123	3,263	3,543
Residual	28,515	20,727	23,142	27,091	23,847
Other fuel and losses	13,465	15,197	14,190	25,086	21,875
Total demand	1,745,144	1,791,503	1,813,088	1,954,041	2,119,775

[1] Subject to revision.
[2] Bureau of Mines data.
[3] Inclusive of heavy crude in California.
[4] Bureau of Mines, 1944–46: U. S. Department of Commerce, 1947–48.

PRODUCTION

GENERAL

Production of crude petroleum in the United States set a new record of 2,016.3 million barrels in 1948. Crude production first reached the 1-billion-barrel mark in 1929, and 1948 is the first year in which it has amounted to 2 billion barrels or more.

The increase of 159.3 million barrels in crude production in 1948 compared with 1947 represented gains in every important producing State except Illinois, Pennsylvania, Kentucky, and New York. The principal gains were 83.1 million barrels for Texas, 21.1 million for Louisiana, 13.0 million for Oklahoma, 10.9 million for Mississippi, 9.2 million for Wyoming, 7.0 million for New Mexico, and 5.7 million barrels for Kansas. The chief declines were 1.8 million barrels for Illinois, 0.8 million for Kentucky, and minor decreases in New York and Pennsylvania.

There were 13 States that produced over 10 million barrels in 1948. Six States produced 87.0 percent of the total crude output in 1948 compared with 87.6 percent in 1947 and 88.0 percent in 1946. Texas ranked first with 45 percent of the total in 1948, California second with 17 percent, Louisiana third with 9 percent, Oklahoma fourth with nearly 8 percent, Kansas fifth with over 5 percent, and Illinois sixth with 3 percent.

The next seven States in importance produced a total of 225.8 million barrels in 1948 or 11.2 percent of the total production compared with 10.5 percent in 1947 and 9.8 percent in 1946. Mississippi, Wyoming, New Mexico, Arkansas, Colorado, and Michigan increased their production, while production in Pennsylvania was static.

The production of all other States has been comparatively unchanged and represents a relative decline from 1.8 percent of the total production in 1948, 1.9 percent in 1947, and 2.2 percent in 1946.

Petroleum produced in the United States, 1944–48, and total, 1859–1948, by States [1]

[Thousands of barrels]

	1944	1945	1946	1947	1948 [2]	1859–1948 (total)
Production:						
Alabama	43	181	380	396	466	1,466
Arkansas	29,418	28,613	28,375	29,948	31,675	735,001
California	311,793	326,482	314,713	333,132	340,089	7,959,064
Colorado	3,083	5,036	11,856	15,702	16,827	99,069
Florida	12	30	57	259	290	652
Illinois	77,413	75,094	75,297	66,459	64,669	1,379,648
Indiana	5,118	4,868	6,726	6,095	6,710	180,064
Kansas	98,762	96,415	97,218	105,132	110,833	[3] 1,916,349
Kentucky	9,621	10,325	10,578	9,397	8,551	[4] 232,812
Louisiana	129,645	131,051	143,669	160,128	181,181	2,160,948
Michigan	18,490	17,267	17,074	16,215	16,870	[5] 289,903
Mississippi	16,337	19,062	24,298	34,925	45,809	207,905
Montana	8,647	8,420	8,825	8,742	9,380	151,022
Nebraska	417	305	293	229	240	5,532
New Mexico	39,555	37,351	36,814	40,926	47,969	[6] 587,383
New York	4,697	4,648	4,863	4,762	4,621	[7] 158,033
Ohio	2,937	2,828	2,908	3,108	3,300	613,833
Oklahoma	124,616	139,299	134,794	141,019	154,032	5,918,427
Pennsylvania	14,118	12,515	12,996	12,690	12,667	1,112,340
Texas	746,699	754,710	760,215	820,210	903,318	12,147,971
West Virginia	3,070	2,879	2,929	2,617	2,687	435,308
Wyoming	33,356	36,219	38,977	44,772	54,004	805,249
Other States [8]	57	57	84	124	94	1,692
Total	1,677,904	1,713,655	1,733,939	1,856,987	2,016,282	37,099,671
Value at wells:						
Total (thousands of dollars)	2,032,960	2,094,250	2,442,550	3,577,890	5,196,034	48,541,553
Average per barrel	$1.21	$1.22	$1.41	$1.93	$2.58	$1.31

[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 1925–48 production only; earlier years included under "Other States."
[6] Figures represent 1924–48 production only; earlier years included under "Other States."
[7] Early production in New York included with Pennsylvania.
[8] Includes Alaska, 1912–33; Arkansas, 1920; Michigan, 1900–19; Missouri, 1899–1911, 1913–16, 1919–23, 1932–48; New Mexico, 1913, 1919–23; Tennessee, 1916–48; Utah, 1907–11, 1920, 1924–41; Virginia, 1943–48.

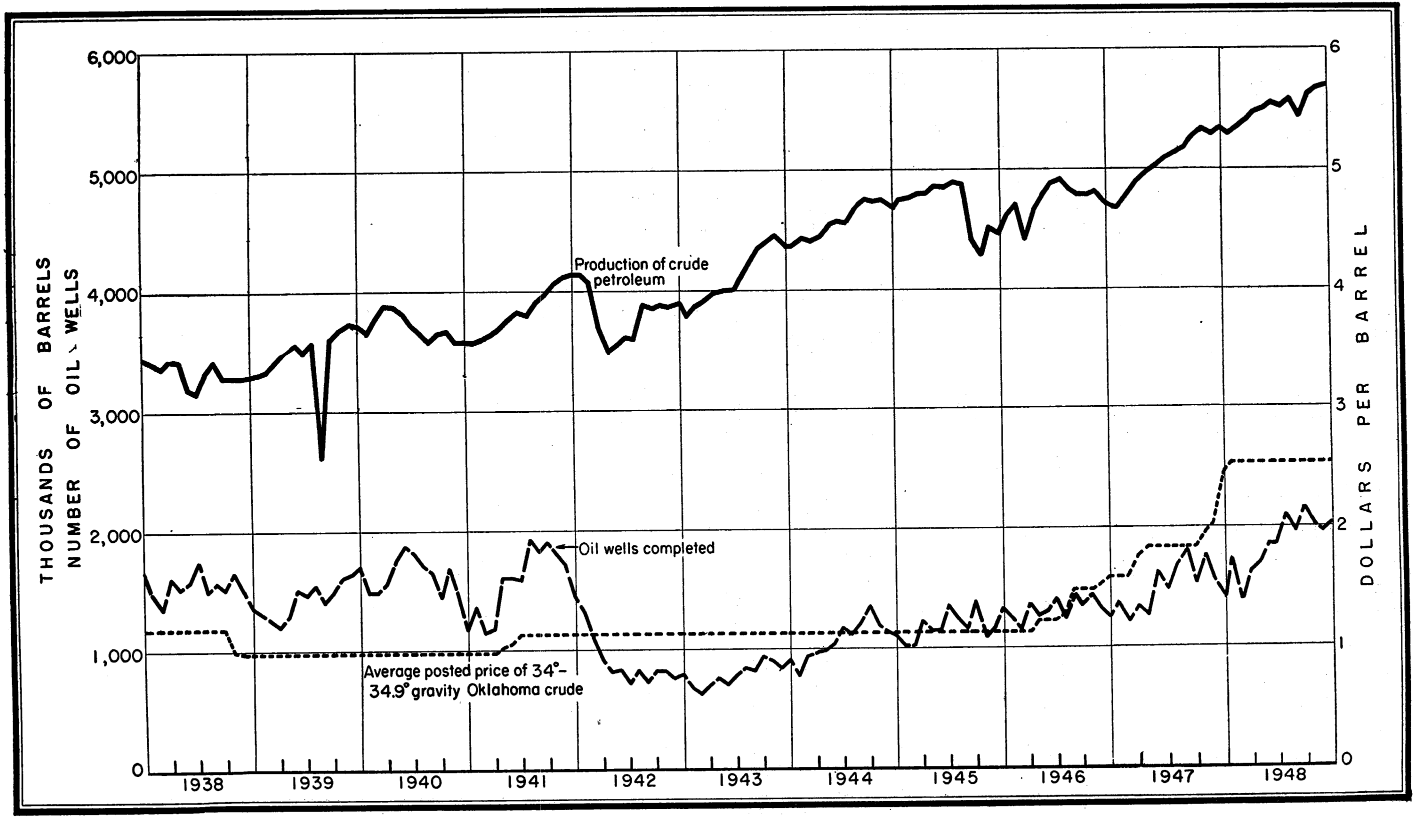

FIGURE 2.—Daily average production of crude petroleum, total number of wells completed, and average posted price per barrel of a selected grade of Oklahoma crude petroleum in the United States, 1938–48, by months.

Production of crude petroleum in the United States in 1947,[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	1,903	1,573	1,775	1,833	1,853	1,835	1,928	1,831	1,875	1,974	1,722	1,925	22,027
Other Appalachian [2]	894	760	882	896	895	871	940	895	926	964	877	935	10,735
Lima, Northeastern Indiana, Michigan	1,335	1,218	1,304	1,317	1,338	1,314	1,416	1,394	1,408	1,482	1,378	1,475	16,379
Illinois, Southwestern Indiana	6,521	5,776	6,306	6,108	6,175	5,845	6,092	5,922	5,866	6,104	5,729	6,086	72,530
Mid-Continent:													
North Louisiana, Arkansas, Alabama, Mississippi	8,062	7,336	8,269	7,971	8,400	8,178	8,585	8,668	8,642	9,131	8,980	9,467	101,689
West Texas, Southeastern New Mexico	18,757	17,272	19,534	19,232	21,056	21,362	23,305	24,396	23,857	24,944	24,277	25,432	263,424
East Texas	9,345	9,250	9,620	10,070	10,565	10,074	10,139	10,036	9,643	10,040	9,120	9,210	117,112
Oklahoma, Kansas, North Texas, etc	36,570	34,120	38,974	38,127	39,265	38,547	39,760	39,710	39,382	41,545	39,705	41,620	467,325
Gulf Coast	28,777	27,320	32,072	31,183	32,446	31,995	32,797	33,056	32,492	33,877	32,853	34,145	383,013
Rocky Mountain	5,258	4,859	5,415	5,480	5,752	5,622	5,943	6,083	6,117	6,400	6,170	6,522	69,621
California [3]	27,401	25,212	28,027	27,193	28,310	27,415	28,461	28,457	27,457	28,571	27,890	28,738	333,132
Total 1947	144,823	134,696	152,178	149,410	156,055	153,058	159,366	160,448	157,665	165,032	158,701	165,555	1,856,987
STATE													
Alabama	31	26	32	21	37	34	35	32	32	40	36	40	396
Arkansas	2,432	2,214	2,560	2,395	2,502	2,420	2,536	2,510	2,516	2,615	2,567	2,681	29,948
California [3]	27,401	25,212	28,027	27,193	28,310	27,415	28,461	28,457	27,457	28,571	27,890	28,738	333,132
Colorado	1,151	1,010	1,148	1,151	1,256	1,256	1,449	1,491	1,444	1,498	1,412	1,436	15,702
Florida	7	5	20	15	21	31	31	31	28	23	24	23	259
Illinois	5,985	5,302	5,776	5,588	5,657	5,346	5,578	5,421	5,376	5,602	5,247	5,581	66,459
Indiana	538	476	532	522	520	501	516	503	492	504	484	507	6,095
Kansas	8,328	7,590	8,639	8,610	8,919	8,723	9,143	9,140	8,898	9,321	8,827	8,994	105,132
Kentucky	800	679	774	787	781	752	814	777	803	842	772	816	9,397
Louisiana	12,830	11,747	13,045	12,818	13,374	12,945	13,612	13,742	13,322	14,124	13,941	14,628	160,128
Michigan	1,322	1,204	1,292	1,302	1,326	1,298	1,398	1,379	1,394	1,469	1,367	1,464	16,215
Mississippi	2,720	2,352	2,655	2,613	2,829	2,832	2,976	3,073	3,082	3,326	3,158	3,309	34,925
Montana	694	642	680	720	735	719	743	772	754	775	737	771	8,742
Nebraska	23	18	18	17	17	18	19	17	21	20	20	21	229
New Mexico	3,165	2,955	3,261	3,201	3,284	3,243	3,376	3,628	3,592	3,773	3,582	3,866	40,926
New York	419	349	384	395	400	400	424	393	402	416	359	421	4,762
Ohio	236	201	244	266	256	264	282	259	274	291	250	285	3,108
Oklahoma	11,272	10,406	11,766	11,432	11,753	11,374	12,074	11,884	11,806	12,541	11,992	12,719	141,019
Pennsylvania	1,110	920	1,017	1,069	1,081	1,057	1,110	1,056	1,072	1,120	994	1,084	12,690
Texas	60,740	58,017	66,524	65,503	69,047	68,597	70,846	71,868	70,777	73,807	70,840	73,644	820,210
West Virginia	227	183	220	202	211	209	218	219	229	253	208	238	2,617
Wyoming	3,379	3,176	3,552	3,576	3,727	3,613	3,715	3,787	3,885	4,092	3,988	4,282	44,772
Other States	13	12	12	14	12	11	10	9	9	9	6	7	[4] 124
Total: 1947	144,823	134,696	152,178	149,410	156,055	153,058	159,366	160,448	157,665	165,032	158,701	165,555	1,856,987
1946	143,660	132,263	136,869	140,180	148,229	146,989	152,541	149,859	143,703	148,325	144,659	146,662	1,733,939
Daily average, 1947	4,672	4,811	4,909	4,980	5,034	5,102	5,141	5,176	5,256	5,324	5,290	5,340	5,088

[1] Final figures. [2] Includes Florida, Kentucky, Tennessee, and Virginia. [3] American Petroleum Institute. [4] Missouri (55), Tennessee (8), and Virginia (61).

Production of crude petroleum in the United States in 1948,[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	1,763	1,667	1,949	1,887	1,849	1,907	1,894	1,885	1,840	1,810	1,842	1,793	22,086
Other Appalachian [2]	833	788	899	758	841	825	838	827	829	854	820	858	9,970
Lima, Northeastern Indiana, Michigan	1,411	1,314	1,407	1,365	1,360	1,386	1,416	1,470	1,447	1,450	1,453	1,516	16,995
Illinois, Southwestern Indiana	5,767	5,449	5,849	5,619	5,922	5,884	6,077	6,183	6,013	6,318	6,069	6,205	71,355
Mid-Continent:													
North Louisiana, Arkansas, Alabama, Mississippi	9,570	9,357	10,046	9,816	10,175	9,946	10,411	10,456	10,090	10,618	10,375	10,558	121,418
West Texas, Southeastern New Mexico	25,406	24,009	26,128	25,930	27,066	26,284	27,151	27,653	27,032	28,803	27,881	29,030	322,373
East Texas	9,091	9,175	9,992	9,581	9,578	9,528	9,495	9,506	9,471	9,413	9,074	9,104	113,008
Oklahoma, Kansas, North Texas, etc.	40,663	38,483	41,222	41,423	43,009	41,871	42,798	43,365	42,319	43,904	42,681	45,240	506,978
Gulf Coast	33.823	31,924	34,366	33,391	34,608	33,618	34,737	35,004	34,056	35,206	34,729	35,962	411,424
Rocky Mountain	6,594	5,983	6,597	6,439	6,831	6,615	7,029	7,092	6,946	7,113	6,721	6,626	80,586
California [3]	28,860	27,075	29,138	28,300	29,335	28,466	29,350	29,445	22,994	29,092	28,597	29,437	340,089
Total 1948	163,781	155,224	167,593	164,509	170,574	166,330	171,196	172,886	163,037	174,581	170,242	176,329	2,016,282
STATE													
Alabama	39	38	36	34	43	41	39	41	39	41	37	38	466
Arkansas	2,583	2,545	2,689	2,575	2,632	2,568	2,691	2,691	2,624	2,744	2,646	2,687	31,675
California [3]	28,860	27,075	29,138	28,300	29,335	28,466	29,350	29,445	22,994	29,092	28,597	29,437	340,089
Colorado	1,433	1,274	1,384	1,354	1,444	1,412	1,459	1,443	1,418	1,471	1,410	1,325	16,827
Florida	24	23	26	23	22	24	25	24	23	27	21	28	290
Illinois	5,335	5,042	5,408	5,113	5,377	5,336	5,509	5,608	5,380	5,641	5,412	5,508	64,669
Indiana	434	409	443	508	547	550	570	577	635	679	659	699	6,710
Kansas	8,966	8,311	8,450	9,179	9,686	9,400	9,482	9,621	9,323	9,593	9,075	9,747	110,833
Kentucky	728	686	781	643	716	712	718	708	706	721	710	722	8,551
Louisiana	4,560	13,821	14,883	14,598	15,246	14,809	15,403	15,616	15,064	15,524	15,514	16,143	181,181
Michigan	1,401	1,308	1,397	1,354	1,350	1,372	1,405	1,458	1,437	1,441	1,443	1,504	16,870
Mississippi	3,526	3,419	3,730	3,652	3,817	3,760	4,027	4,021	3,856	4,069	3,976	3,956	45,809
Montana	750	678	760	748	773	805	826	832	799	822	788	799	9,380
Nebraska	17	17	18	23	23	20	21	20	14	20	23	24	240
New Mexico	3,840	3,712	4,026	3,921	3,992	3,832	4,054	4,109	3,977	4,200	4,074	4,232	47,969
New York	375	351	410	387	386	397	396	390	389	368	386	386	4,621
Ohio	244	236	284	277	273	292	287	294	284	275	273	281	3,300
Oklahoma	12,117	11,613	12,601	12,579	12,952	12,713	12,988	13,143	12,876	13,387	13,106	13,957	154,032
Pennsylvania	1,021	961	1,115	1,089	1,071	1,093	1,083	1,073	1,048	1,047	1,046	1,020	12,667
Texas	72,933	69,498	75,349	73,608	76,072	74,128	75,915	76,750	75,221	78,393	76,313	79,138	903,318
West Virginia	210	199	234	230	222	224	230	231	225	230	232	220	2,687
Wyoming	4,378	4,000	4,421	4,305	4,582	4,370	4,711	4,785	4,700	4,788	4,495	4,469	54,004
Other States	7	8	10	9	13	6	7	6	5	8	6	9	[4] 94
Total: 1948	163,781	155,224	167,593	164,509	170,574	166,330	171,196	172,886	163,037	174,581	170,242	176,329	2,016,282
1947	144,823	134,696	152,178	149,410	156,055	153,058	159,366	160,448	157,665	165,032	158,701	165,555	1,856,987
Daily average, 1948	5,283	5,353	5,406	5,484	5,502	5,544	5,523	5,577	5,435	5,632	5,675	5,688	5,509

[1] Subject to revision. [2] Includes Florida, Kentucky, Tennessee, and Virginia. [3] American Petroleum Institute. [4] Missouri (53), Tennessee (8), and Virginia (33).

Percentage of total crude petroleum produced in the United States, 1939–48, by principal States

State	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948 [1]
Texas	38.2	36.4	36.1	34.8	39.5	44.5	44.0	43.8	44.2	44.8
California	17.7	16.6	16.4	17.9	18.9	18.6	19.1	18.2	17.9	16.9
Louisiana	7.4	7.7	8.3	8.3	8.2	7.7	7.7	8.3	8.6	9.0
Oklahoma	12.7	11.5	11.0	10.2	8.2	7.4	8.1	7.8	7.6	7.6
Kansas	4.8	4.9	5.9	7.0	7.0	5.9	5.6	5.6	5.7	5.5
Illinois	7.5	10.9	9.4	7.7	5.5	4.6	4.4	4.3	3.6	3.2
Wyoming	1.7	1.9	2.1	2.4	2.3	2.0	2.1	2.2	2.4	2.7
New Mexico	3.0	2.9	2.8	2.3	2.6	2.4	2.2	2.1	2.2	2.4
Mississippi		.3	1.1	2.1	1.2	1.0	1.1	1.4	1.9	2.3
Arkansas	1.7	1.9	1.9	1.9	1.8	1.8	1.7	1.6	1.6	1.6
Colorado	.1	.1	.2	.1	.2	.2	.3	.7	.8	.8
Michigan	1.8	1.5	1.2	1.6	1.4	1.1	1.0	1.0	.9	.8
Pennsylvania	1.4	1.3	1.2	1.3	1.0	.8	.7	.8	.7	.6
Other States	2.0	2.1	2.4	2.4	2.2	2.0	2.0	2.2	1.9	1.8
Total	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, 1947–48, and total production since discovery, in thousands of barrels

[Oil and Gas Journal]

Field	State	1947	1948	Total since discovery [1]
East Texas	Texas	118,643	111,829	2,586,215
Wilmington	California	47,698	48,583	417,225
Coalinga	do	30,575	32,369	593,096
Panhandle	Texas	31,443	31,687	629,938
Wasson	do	26,121	28,884	178,285
T-X-L	do	16,768	24,089	46,920
Hastings	do	21,391	21,648	168,906
Huntington Beach	California	18,318	20,825	417,153
Webster	Texas	21,112	20,768	125,638
Conroe	do	22,018	20,440	269,604
Slaughter	do	18,485	19,184	129,781
Yates	do	16,559	18,103	349,874
Ventura Avenue	California	17,713	17,786	355,654
Hawkins	Texas	17,083	17,621	96,396
Thompson	do	15,673	16,958	130,985
Buena Vista	California	17,257	16,610	364,014
Fullerton	Texas	13,290	16,011	50,733
Midway-Sunset	California	15,667	15,167	736,026
Bradford-Allegany [2]	Pennsylvania-New York	15,151	14,965	572,917
Keystone	Texas	14,742	14,586	65,601
Rangely	Colorado	11,680	13,412	36,658
Velma	Oklahoma	8,153	13,225	32,927
Kettleman-North Dome	California	13,475	12,887	350,208
Seeligson	Texas	15,027	12,269	58,404
Van	do	10,446	12,124	195,465
Goldsmith	do	9,076	11,128	93,208
Anahuac	do	10,693	10,758	87,172
McElroy	do	10,489	10,629	185,544
Trapp	Kansas	11,371	10,404	105,675
West Edmond	Oklahoma	14,936	9,322	82,500
North Cowden	Texas	8,939	8,978	75,481
Talco	do	8,896	8,795	110,647
Oklahoma City	Oklahoma	9,670	8,543	660,743
Long Beach	California	8,605	8,268	734,684
Elk Basin	Wyoming-Montana	5,877	8,168	43,426
Seminole	Texas	7,316	8,124	48,075
Lake St. John	Louisiana	6,092	8,094	21,598
Baxterville	Mississippi	4,960	7,925	14,292
Coles Levee	California	8,902	7,809	57,901
Levelland	Texas	970	7,637	10,527
Santa Maria Valley	California	9,560	7,407	91,519
Coyote	do	7,271	7,395	216,817
West Ranch	Texas	7,060	6,986	54,313
Foster	do	7,320	6,980	51,160
Monument	New Mexico	6,541	6,902	93,857
Cranfield	Mississippi	5,540	6,836	19,439

See footnotes at end of table.

Production of crude petroleum in leading fields and districts in the United States, 1947–48, and total production since discovery, in thousands of barrels—Con.

Field	State	1947	1948	Total since discovery [1]
Delta Farms	Louisiana	5,574	6,754	23,918
Louden	Illinois	7,385	6,715	143,575
La Gloria	Texas	4,296	6,656	23,683
Drinkard	New Mexico	3,332	6,236	10,366
Cymric	California	5,572	6,182	17,162
Mallalieu	Mississippi	2,078	6,141	8,575
Tinsley	do	6,749	6,054	107,034
Old Ocean	Texas	6,853	5,954	50,687
Cat Canyon	California	4,403	5,917	40,912
Santa Fe Springs	do	5,896	5,513	522,886
K-M-A	Texas	6,346	5,439	122,929
Eunice	New Mexico	5,796	5,360	101,106
Heidelberg	Mississippi	5,052	5,230	18,702
Bayou Sale	Louisiana	4,438	5,220	22,178
Greeley	California	4,288	5,132	37,431
Todd	Texas	5,259	5,052	13,975
Katy	do	4,674	5,020	23,559
Brookhaven	Mississippi	4,419	5,013	10,641

[1] Includes revisions.
[2] Bureau of Mines data.

PRODUCTION BY STATES [1]

Alabama.—Crude production in Alabama in 1948 totaled 466,000 barrels, which represents an increase of 70,000 barrels over 1947. Twenty wildcat wells were drilled during the year; all were abandoned. One oil well was completed in the Gilbertown field, bringing the total number of producers to 34. The majority of the wells produce from the Eutaw at 3,300 feet, although there is some production from the Selma chalk at 2,700 feet. The Humble Oil & Refining Co. discovered the State's first piercement-type salt dome in Washington County.

Arkansas.—Production of nearly 31.7 million barrels in Arkansas in 1948 compared with approximately 30 million barrels during the previous year indicates a gain of 6 percent. During 1948, 301 wells were drilled, a moderate decline from the previous year. However, the number of wildcat wells drilled increased from 76 in 1947 to 106 in 1948.

Production of crude petroleum in Arkansas, 1944–48, by fields

[Thousands of barrels]

Year	Atlanta	Buckner	Dorcheat-Macedonia	Fouke	McKamie	Magnolia	Midway	Schuler	Smackover	Stephens	Village	Wesson	Other fields [1]	Total
1944	1,164	666	2,345	600	1,107	5,592	2,382	5,105	4,280	1,828	568	------	3,781	29,418
1945	1,329	614	1,759	878	1,064	4,951	2,641	4,733	4,146	2,035	816	9	3,638	28,613
1946	1,578	544	1,446	957	1,062	4,718	2,646	4,419	4,092	1,866	1,230	622	3,195	28,375
1947	1,472	654	1,503	985	1,175	4,648	2,703	4,022	3,983	1,475	1,791	1,793	3,744	29,948
1948 [2]	1,383	861	1,263	1,037	1,084	4,622	2,851	3,820	3,901	1,278	2,086	3,084	4,405	31,675

[1] Includes oil consumed on leases and net change in stocks held on leases for entire State.
[2] Subject to revision.

[1] Exploration data are largely from the Bulletin of the American Association of Petroleum Geologists, June 1949.

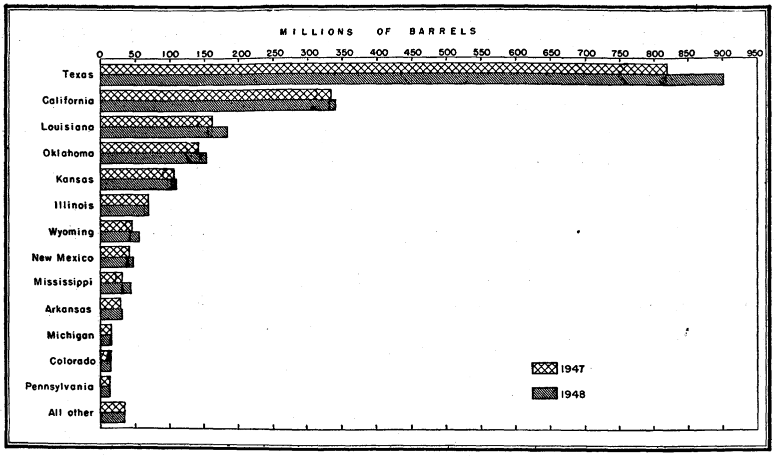

FIGURE 3.—Production of crude petroleum in the United States, 1947-48, by States.

No new gas or distillate fields were discovered; but four new oil fields were found, namely, Felsenthal in Ashley County, College Hill in Columbia County, and Cairo and Bear Creek in Union County. It is believed that Cairo and Bear Creek offer the best possibilities of the four fields. Drilling activity was greatest in the Wesson, Smackover, and Village fields, with 67 oil wells.

California.—All California production records were shattered in 1948, with a crude total of 340 million barrels, an increase of 7 million barrels over 1947. San Joaquin Valley gained over 0.9 million barrels, Los Angeles Basin increased over 2.7 million barrels, and the Coastal district made the largest gain, with approximately 3.3 million barrels.

The accelerated drilling program continued unabated during 1948, with 2,876 wells completed, contrasted with 2,053 the previous year. Oil-well completions totaled 2,395—an increase of 46 percent compared with 1947—and 488 exploratory wells were drilled contrasted with 352 in 1947. Kern County continued to lead in the number of exploratory wells with 201, while Los Angeles County was second with 58 and Santa Barbara County third with 49.

Production of crude petroleum in California, 1944–48, by districts and fields, in thousands of barrels

[American Petroleum Institute]

District and field	1944	1945	1946	1947	1948 [1]
San Joaquin Valley:					
Belridge	6,340	6,959	5,862	4,488	4,019
Buena Vista	6,896	15,772	14,756	17,264	16,596
Canal	1,297	1,244	867	739	635
Coalinga	35,410	31,681	32,105	33,755	35,818
Coles Levee [2]	6,692	7,030	6,335	7,225	6,591
Edison	1,051	2,166	5,316	4,124	4,107
Elk Hills	7,719	15,805	3,668	2,334	2,118
Fruitvale	3,043	3,096	2,723	2,391	2,383
Greeley	5,219	5,062	3,923	4,288	5,100
Helm	499	1,211	1,580	1,553	1,264
Kern	8,440	8,210	6,826	6,979	8,240
Kettleman Hills-North Dome	15,133	14,357	13,849	13,480	12,832

See footnotes at end of table.

Production of crude petroleum in California, 1944–48, by districts and fields, in thousands of barrels—Continued

District and field	1944	1945	1946	1947	1948 [1]
San Joaquin Valley—Continued					
Lost Hills	1,284	1,228	1,315	1,922	2,750
McKittrick	1,851	2,043	5,409	9,959	10,606
Midway-Sunset	15,169	14,334	15,318	15,660	15,165
Mountain View	1,156	1,024	1,369	1,890	1,307
Mount Poso	8,025	6,717	5,930	5,151	4,567
Raisin City	936	1,163	988	963	1,093
Rio Bravo	5,920	5,743	4,883	4,576	4,430
Riverdale	1,517	1,540	1,481	1,546	1,155
Round Mountain	3,932	3,507	3,352	3,085	2,700
Tejon Ranch	60	161	487	1,188	1,133
Ten Section	4,624	4,095	3,229	2,829	2,379
Other San Joaquin Valley	5,281	6,983	7,625	[2] 8,508	9,872
Total San Joaquin Valley	147,494	161,131	149,196	[3] 155,897	156,860
Coastal district:					
Aliso Canyon	1,100	1,156	1,098	1,219	1,226
Capitan	1,079	794	1,265	1,091	909
Del Valle	1,481	1,969	2,355	3,069	3,516
Elwood	2,133	2,172	2,454	2,576	2,682
Gato Ridge	1,777	1,615	1,421	1,314	1,279
Newhall-Potrero	1,906	1,996	2,111	2,397	2,726
Padre Canyon	474	753	904	1,179	2,092
Rincon	1,501	1,689	1,627	1,344	1,158
San Miguelito	2,111	1,940	1,835	1,874	1,832
Santa Maria	4,892	5,038	4,921	7,938	10,276
Santa Maria Valley	11,358	13,489	11,929	9,518	7,269
Ventura Avenue	17,504	17,701	16,906	17,754	17,738
Ventura-Newhall	2,227	2,285	2,542	3,369	4,016
Other Coastal	460	1,242	1,154	1,489	2,681
Total Coastal	50,003	53,839	52,522	56,131	59,400
Los Angeles Basin:					
Brea Olinda	4,304	4,195	3,945	4,449	5,286
Coyote	6,434	7,105	7,315	7,273	7,381
Dominguez	7,879	6,726	5,875	5,436	4,818
Huntington Beach	17,162	17,587	17,084	18,313	20,821
Inglewood	6,467	5,624	4,720	4,330	4,420
Long Beach	10,862	9,851	9,055	8,596	8,159
Montebello	3,932	3,665	3,129	2,696	2,467
Newport	7	[4] 385	1,894	2,630	2,412
Richfield	2,564	2,741	2,595	2,413	2,272
Rosecrans	2,238	2,095	1,840	1,684	1,695
Santa Fe Springs	6,838	6,278	6,117	5,914	5,512
Seal Beach	2,835	3,426	3,693	4,042	4,150
Torrance	3,186	3,241	3,126	2,938	2,862
Wilmington	36,929	36,192	40,171	47,674	48,317
Other Los Angeles Basin	2,659	2,401	2,436	2,716	3,257
Total Los Angeles Basin	114,296	111,512	112,995	121,104	123,829
Total California	311,793	326,482	314,713	333,132	340,089

[1] Subject to revision.
[2] Includes Tupman.
[3] Includes a revision of 30,000 barrels not yet distributed by fields and districts.
[4] Includes Costa Mesa.

Wildcat wells resulted in the discovery of 13 oil fields in 1948 compared with 11 during the previous year. Moreover, 19 oil pools, 3 gas fields, and 1 gas pool were opened during 1948. The Russell Ranch field in Cuyama Valley with 43 producing wells was the most important field discovered during the year. This discovery revealed large reserves in a district that had for many years been regarded as unpromising territory for commercial oil production. Other promising discoveries included the Guijarral Hills field in Fresno County and the Campbell pool in the San Ardo field in Salinas Valley. According to estimates of the American Petroleum Institute, 58 million barrels of crude were added to the State's reserves in 1948 by new fields and new pools and 149 million barrels from extensions.

Colorado.—Crude production in Colorado in 1948 totaled 16.8 million barrels compared with 15.7 million barrels in 1947, an increase of 1.1 million barrels. As in other recent years, this gain was due to increased production in the Rangely field. The second-largest field, Wilson Creek, registered a small decline in production for the year. Changes in other fields were comparatively small, the Moffat and Hiawatha fields making slight gains whereas the Iles, Price, and Walden fields showed losses.

Production of crude petroleum in Colorado, 1944–48, 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
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	135	45	441	93	239	24	8,128	39	188	2,381	143	11,856
1947	133	51	541	91	195	29	11,600	39	179	2,705	139	15,702
1948[2]	127	62	534	112	164	35	12,864	41	129	2,602	157	16,827

[1] Includes crude oil consumed on leases and net change in stocks held on leases for entire State.
[2] Subject to revision.

During 1948 oil-well completions totaled 149 compared with 152 the previous year. Drilling activity continued at approximately the same rate as in 1947. During the year two oil fields and two gas fields were discovered in the State, surpassing the two discoveries made in 1947. The most interesting well was drilled by Western Natural Gas Co. and Byrd-Frost at Dove Creek, Montezuma County, which made 200 barrels of high-gravity oil and 5 million cubic feet of gas on a production test.

Florida.—Crude production of Florida equaled 290,000 barrels in 1948 contrasted with 259,000 barrels in 1947, a gain of 12 percent. All production came from the State's only field, Sunniland, in Collier County, where three producers and one dry hole were completed. Exploration activity continued at approximately the same rate in 1948, with 24 dry holes compared to 25 failures the previous year.

Illinois.—Production in Illinois continued to decrease in 1948, with a total of 64.7 million barrels in contrast with 66.5 million barrels in 1947. Declines were largest in the Bridgeport, Centralia, Louden, Patoka, and Salem fields, while the biggest gains were made in the Bible Grove, Clay City, Johnsonville, Phillipstown, Roland, Rural Hill, and Sailor Springs fields.

Twenty-eight new pools were discovered in 1948, identical to the number located in the previous year. Extensions to pools totaled 47 in contrast with 69 in 1947, and the number of oil wells completed in the State rose from 1,054 in 1947 to 1,262 in 1948. Wildcat wells drilled during the year totaled 628 compared with 536 in 1947, an increase of 17 percent. The largest number of wells were drilled in Wayne, Wabash, Clay, Gallatin, and White Counties, a continuation of the trend established over the past few years.

Except for the Assumption pool in Christian County, virtually all of the new oil pools were found close to established pools. In the northern part of the Illinois Basin, the Rosiclare sandstone in the Ste.

Genevieve formation of the Lower Mississippian appears to have excellent possibilities for good producers of about 400 barrels initial capacity, according to industry reports.

Production of crude petroleum in Illinois, 1944–48, by fields, in thousands of barrels

[Oil and Gas Journal]

Field	1944	1945	1946	1947	1948
Albion	858	1,234	898	663	595
Benton	1,655	1,217	927	773	664
Bible Grove	985	1,757	1,491	1,069	1,335
Boyd	135	1,372	1,497	1,313	1,210
Bridgeport	1,932	2,144	2,272	2,267	1,905
Centralia	1,785	1,729	1,887	1,456	1,251
Clay City	4,890	5,104	5,309	4,383	[1] 8,585
Dale-Hoodville	3,160	2,022	1,479	1,341	1,323
Dundas	780	873	935	1,022	(2)
Johnsonville	1,460	1,119	1,206	936	1,173
Keensburg	873	757	663	723	635
Louden	11,175	9,463	8,243	7,385	6,715
Marine	(2)	799	1,208	1,057	1,080
New Harmony	4,395	3,429	2,866	2,494	2,283
Patoka	940	1,574	1,651	1,345	769
Phillipstown	985	1,244	1,038	829	1,032
Robinson	1,078	1,095	1,118	1,100	1,236
Roland	760	936	752	641	1,154
Rural Hill	925	679	510	786	1,020
Sailor Springs	(2)	512	418	688	1,320
Salem	8,310	6,637	5,967	5,239	4,706
Woodlawn	960	950	792	686	649
Other fields	27,781	26,814	31,486	27,264	23,392
Total Illinois	75,822	73,460	74,613	65,460	64,032

[1] Includes Noble.
[2] Included in "Other fields."

Indiana.—In 1948 Indiana petroleum production totaled 6.7 million barrels compared with 6.1 million barrels in 1947, a gain of 10 percent. Drilling activity was greatly accelerated during the year, with 518 wells completed as oil producers in contrast with 312 in 1947. Discovery of new fields increased over twofold, totaling 23 compared with 11 new fields the previous year. Wildcat wells drilled during the year totaled 307, a large increase compared with 1947. With respect to noteworthy developments during 1948, R. E. Esarey and B. E. Brooks, writing in the June 1949 Bulletin of American Association of Petroleum Geologists, report as follows:

The most significant development in Indiana was the opening of three new Devonian fields in Sullivan and Vigo Counties. Two of the fields, Wilfred and Marts in Sullivan County, were discovered on the basis of surface structure determined from coal drilling, and the Spring Hill field in Vigo County was located by non-technical means. Oil in these fields is produced from three zones in the Devonian limestones and dolomites at depths between 1,800 and 2,300 feet.

Production of crude petroleum in Indiana, 1944–48, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
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	482	504	599	605	611	577	578	568	545	580	519	558	6,726
1947	538	476	532	522	520	501	516	503	492	504	484	507	6,095
1948 [1]	434	409	443	508	547	550	570	577	635	679	659	699	6,710

[1] Subject to revision.

Kansas.—The upward trend in Kansas crude production continued in 1948 with a total of 110.8 million barrels, a gain of 5.7 million barrels over the previous year. The State continued to rank fifth among the oil-producing States of the country. Drilling activity was accelerated materially, with 3,252 wells completed in comparison with 2,667 in 1947. During 1948, 69 new oil and gas fields were discovered, classified as follows: 59 new oil fields, 5 revivals of old pools, and 5 new gas discoveries. Rooks County led the State, with 11 new pools or fields compared with 9 in 1947. The Hugoton field, largest gas field in the State, accounted for 77 percent of total gas produced during 1948.

Of the 69 new fields discovered in 1948, 58 were opened up in western Kansas and 11 in eastern Kansas. The greatest drilling activity centered in Rooks County, where the strikes were unusually successful; the 11 discovery wells averaged 948 barrels of oil per day. Of particular significance was the discovery well in the Northampton pool, with a maximum potential of 3,000 barrels daily. Important discoveries were also made in the following counties—Barton, Barber, Sedgwick, Nemaha, Kiowa, Morton, and Seward.

Production of crude petroleum in Kansas, 1944–48, by fields, in thousands of barrels

[Oil and Gas Journal]

Field	1944	1945	1946	1947	1948
Bemis-Shutts	4,885	5,160	5,305	6,057	5,748
Bloomer	[1] 2,724	2,902	2,749	3,045	3,161
Bornholdt	[2] 1,591	1,412	1,057	1,022	796
Burnett	3,715	3,189	2,873	3,120	4,996
Burrton-Haury [3]	1,525	1,351	1,209	1,073	1,024
Carmi	2,067	1,161	986	945	946
Chase	3,702	3,076	2,766	2,644	2,583
Genesco-Edwards	3,268	3,181	3,220	3,733	3,519
Gorham	2,286	2,068	1,891	1,880	1,667
Hall-Gurney	3,750	3,410	3,455	3,414	3,485
Kraft-Prusa [4]	4,086	4,590	5,257	6,425	6,871
Morel	912	1,076	1,098	1,641	1,717
Peace Creek	1,638	1,305	1,419	1,287	967
Ray	1,172	1,147	1,213	1,397	1,390
Ritz Canton	864	742	721	657	579
Silica-Raymond	7,834	6,422	5,691	5,783	5,387
Stoltenberg [5]	2,818	2,740	2,747	2,804	2,483
Trapp [6]	9,347	10,631	11,042	11,371	10,404
Zenith	3,624	2,912	1,521	849	583
Other fields	38,049	38,021	40,359	45,181	49,507
Total Kansas	99,857	96,496	96,579	104,328	107,813

[1] Includes Breford.
[2] Includes Welch.
[3] Haury excluded before 1945.
[4] Includes Feltes before 1946.
[5] Included Wilkins before 1946.
[6] Includes Sellens before 1946.

Kentucky.—Production of 8.6 million barrels in Kentucky during 1948 indicated a 9-percent decline from the 1947 total of 9.4 million barrels. Twelve new fields and 17 new pools were discovered during 1948, and 903 wells were drilled compared with 660 the previous year, according to the Oil and Gas Journal.

The total included 349 oil wells, 151 gas wells, and 403 dry holes drilled during 1948. There was a noticeable increase in the number of deep tests drilled. One of the most promising deep horizons is the St. Peter sandstone in the Furnace field, where 8 gas wells have been completed.

Although drilling activity declined during the year in Western Kentucky, the area remains by far the most important in the State, accounting for 9 new fields, 11 new pools, 8 new producing horizons in old fields, and 4 extensions.

South Central Kentucky witnessed a marked decline in drilling activity during 1948, with only 152 wells drilled in contrast with 222 in 1947. Exploration resulted in the discovery of 3 new fields, 5 new pools, and one new horizon. Likewise, drilling operations decreased in eastern Kentucky from 355 in 1947 to 330 in 1948, and only 1 new pool was discovered during the year.

Production of crude petroleum in Kentucky, 1944–48, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
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	866	835	929	907	940	897	922	906	866	875	812	823	10,578
1947	800	679	774	787	781	752	814	777	803	842	772	816	9,397
1948 [1]	728	686	781	643	716	712	718	708	706	721	710	722	8,551

[1] Subject to revision.

Louisiana.—Production in Louisiana in 1948 soared to a new record of 181.2 million barrels, an increase of 21.1 million barrels compared with the previous year. Largest gain was made in the Gulf Coast—an increase of 14 million barrels—whereas the rest of the State increased 7 million barrels. In Northern Louisiana individual fields that made the largest gains were Caddo, Haynesville, Lake St. John, and Ora. In all, 33 new fields and new producing horizons in old fields were discovered in 1948 contrasted with 35 in 1947. The new strikes included 3 new oil fields, 1 distillate field, and 4 gas fields. The total number of wells drilled increased to 1,550 compared with 975 in 1947, and oil wells completed increased from 593 to 1,095 in 1948. Drilling was extensive and very successful in such old fields as the Caddo and Haynesville; however, none of the new discoveries appeared to have major importance. The number of wildcat wells drilled in northern Louisiana declined from 161 in 1947 to 114 in 1948.

Production of crude petroleum in Louisiana, 1944–48, by districts and fields

[Thousands of barrels]

District and field	1944	1945	1946	1947	1948 [1]
Gulf Coast:					
Anse la Butte	2,620	2,481	2,448	2,423	2,385
Avery Island	582	928	1,223	1,601	2,137
Barataria	1,135	1,367	1,523	1,932	3,255
Bay St. Elaine	66	227	380	817	1,495
Bayou Sale	3,112	2,903	3,479	4,445	5,221
Black Bayou	1,019	686	723	919	991
Bosco	1,046	1,000	1,068	960	900
Caillou Island	1,939	1,917	2,054	2,699	3,549
Charenton	1,040	1,048	1,200	1,580	1,514
Delta Farms	2,218	3,372	4,510	5,539	6,818
East White Lake	1,044	1,219	1,427	1,357	1,333
Egan	48	417	1,453	2,054	2,441
Eola	3,158	2,467	1,721	1,370	1,156
Erath	358	1,193	1,204	1,194	1,233
Garden Island	1,256	1,139	1,168	1,295	1,353

See footnotes at end of table.

Production of crude petroleum in Louisiana, 1944–48, by districts—Continued

[Thousands of barrels]

District and field	1944	1945	1946	1947	1948[1]
Gulf Coast—Continued					
Gibson	3,542	3,384	2,555	2,161	2,089
Golden Meadows	2,796	2,494	2,400	2,666	3,493
Good Hope	26	770	1,745	2,178	2,351
Grand Bay	2,724	3,033	3,122	3,433	3,729
Gueydan	1,963	2,071	2,200	2,008	2,072
Hackberry	4,057	3,776	3,794	4,000	4,264
Iowa	3,309	2,731	2,486	2,489	2,478
Jennings	2,840	2,442	2,025	1,809	1,492
Lafitte	4,452	4,139	4,374	4,362	4,107
Lake Chicot	770	773	922	1,349	1,201
Lake Pelto	645	913	1,302	1,429	1,558
Lake Salvador	1,554	1,595	1,632	1,623	1,665
Leeville	1,421	1,575	1,381	1,580	1,811
Neale	2,342	2,301	1,501	1,280	1,153
New Iberia	2,615	2,152	1,744	1,526	1,548
North Crowley	1,624	1,648	1,526	1,521	1,696
Paradis	4,013	3,652	3,688	3,728	3,936
Pine Prairie	1,944	1,942	1,821	1,546	1,409
Port Barre	1,176	1,008	1,103	1,375	1,636
Quarantine Bay	2,877	2,977	3,227	3,421	3,745
St. Gabriel	1,957	1,911	1,741	1,786	1,709
Tepetate (including north and west)	901	1,931	2,936	3,402	3,935
University	2,338	1,982	1,884	1,976	2,097
Venice	3,334	3,315	3,030	3,638	4,174
Ville Platte	3,642	2,502	2,588	2,238	2,106
Vinton	1,942	2,703	3,372	3,654	3,578
West Bay	1,055	1,222	1,246	1,691	2,108
West Cote Blanche	657	796	971	1,040	1,280
West Lake Verrett	1,015	1,004	1,136	1,357	1,379
White Castle	1,437	1,250	1,013	1,229	1,597
Other Gulf Coast[2]	20,022	21,025	22,759	26,028	30,536
Total Gulf Coast	105,631	107,381	112,805	123,708	137,713
Northern:					
Big Creek		35	908	1,892	1,963
Caddo	2,129	1,950	1,944	2,328	3,392
Delhi	2	1,054	5,525	8,041	8,576
Haynesville	3,816	2,356	3,321	3,500	4,405
Holly Ridge	749	1,429	1,254	1,162	1,025
Homer	1,019	976	926	924	893
Lake St. John	623	1,882	4,381	5,544	7,357
Nebo[3]	3,466	3,191	2,805	2,798	2,623
Olla[4]	4,221	3,636	3,109	2,921	2,794
Ora				674	2,997
Rodessa	2,930	2,515	1,978	1,727	1,509
Urania	678	632	615	675	854
Other Northern[2]	4,381	4,014	4,098	4,234	5,080
Total Northern	24,014	23,670	30,864	36,420	43,468
Total Louisiana	129,645	131,051	143,669	160,128	181,181

[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.

In the Gulf Coast area the fields that made the biggest increases in production were Avery Island, Barataria, Bay St. Elaine, Bayou Sale, Caillou Island, Delta Farms, Golden Meadows, and Venice. During the year 769 wells were drilled, an increase of 18 percent over 1947. The results from wildcat wells were highly successful, as 129 wildcats opened up 28 new fields, which included 13 oil fields, 11 condensate fields, and 4 gas fields. Seven new fields were discovered in the Gulf of Mexico (three oil fields, two condensate fields, and two gas fields). Discovery of these seven fields in open water was the outstanding drilling feat of the year. Although the crude reserves found offshore are generally believed to be of considerable extent, no exact estimate of the total quantity of oil is possible at this time. Owing to the large outlay of capital involved in such complex drilling operations, development of these fields will necessarily be slow. The picture is complicated further by the legal battle being waged with respect to ownership of the tidelands.

Michigan.—A moderate increase of 655,000 barrels in Michigan's production reversed the trend of the past 5 years, as total crude output for 1948 equaled nearly 16.9 million barrels compared with approximately 16.2 million barrels in 1947. The Deep River field continued to lead in output with approximately 2.9 million barrels with no appreciable change from 1947. The Coldwater, Kawkawlin, and Kimball Lake fields gained in production, while the Reed City and Adams fields declined.

A total of 820 wells was drilled in the State during 1948 in comparison with 769 the previous year; of 330 wildcats completed, 22 were productive in contrast with 15 in 1947. A break-down of the 22 successful wildcats discloses the discovery of 10 new oil fields, 4 new gas fields, and 8 oil-field extensions. The most significant field discovered during 1948 was the Pentwater field in Oceana County, where 52 oil wells were completed, including 44 producing from the Dundee horizon. Of major importance is the discovery of production from the Dundee in western Michigan, as this strike opens up a large area of potential production.

Production of crude petroleum in Michigan, 1944–48, by fields, in thousands of barrels

[Michigan Department of Conservation]

Year	Adams	Coldwater	Deep River	Fork	Headquarters	Kawkawlin	Kimball Lake	Porter	Reed City	Stony Lake	Other fields	Total
1944	1,177	68	736	1,436	1,212	724	------	626	5,194	------	7,317	18,490
1945	1,196	958	1,460	1,566	461	654	------	521	4,267	------	6,184	17,267
1946	1,299	1,598	2,409	1,354	226	697	------	462	3,250	3	5,776	17,074
1947	988	1,746	2,872	752	169	725	868	412	2,209	419	5,055	16,215
1948 [1]	400	2,212	2,885	422	117	804	1,614	381	1,282	849	5,904	16,870

[1] Subject to revision.

Mississippi.—Petroleum production of Mississippi soared to 45.8 million barrels in 1948, surpassing the record year of 1947 by 10.9 million barrels. The leading producing fields, in order of their importance, are Baxterville, Cranfield, Mallalieu, Tinsley, and Heidelberg.

In all, 250 oil wells were completed in 1948 in proved fields compared to 319 the previous year. The number of dry holes totaled 161, and wildcats drilled totaled 109 in contrast with 81 in 1947. Five new fields were discovered, and four shallow piercement salt domes found compared with three new fields and five salt domes in 1947. None of the discoveries appeared to have major importance, although more intensive drilling will be required to determine whether the salt domes have important possibilities.

Production of crude petroleum in Mississippi, 1944–48, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
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	1,697	1,554	1,663	1,707	1,918	1,921	1,981	2,220	2,207	2,384	2,425	2,621	24,298
1947	2,720	2,352	2,655	2,613	2,829	2,832	2,976	3,073	3,082	3,326	3,158	3,309	34,925
1948 [1]	3,526	3,419	3,730	3,652	3,817	3,760	4,027	4,021	3,856	4,069	3,976	3,956	45,809

[1] Subject to revision.

Montana.—The Montana crude production in 1948 totaled almost 9.4 million barrels contrasted with 8.7 million barrels the previous year.

Largest production was recorded in the Cut Bank field, which totaled over 4 million barrels, although production declined moderately from the 1947 level. The best gain was registered in the Montana portion of the Elk Basin field, with 2.4 million barrels in 1948 in comparison with 1.7 million barrels the previous year. The production in the Kevin-Sunburst field remained virtually unchanged. Declines were recorded in the Cat Creek, Dry Creek, and Gage fields.

In all, 57 wildcats were drilled during 1948 which resulted in the discovery of 3 new fields, 1 new pool, and 10 outposts. The most interesting discoveries were made in Musselshell County, and these strikes were responsible for considerable leasing activity in the central part of the State. These discoveries were the Texas Co. basal Amsden production at Big Wall and the Amerada Petroleum Corp. strike at Melstone. Later in the year, the Texas Co. extended the Big Wall discovery one-half mile northeast and three-quarters of a mile southwest.

Production of crude petroleum in Montana, 1944–48, by fields

[Thousands of barrels]

Year	Cat Creek	Cut Bank	Dry Creek	Elk Basin	Frannie	Gage	Kevin-Sunburst	Pondera	Other fields [1]	Total
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	480	4,546	160	1,355	16	104	1,772	306	86	8,825
1947	586	4,246	130	1,728	18	51	1,625	317	41	8,742
1948 [2]	510	4,074	105	2,415	26	25	1,623	361	241	9,380

[1] Includes crude oil consumed on leases and net change in stocks held on leases for entire State.
[2] Subject to revision.

Nebraska.—Crude production in Nebraska increased slightly from 229,000 barrels in 1947 to 240,000 barrels in 1948. Nine dry holes were drilled in the State during the year.

Production of crude petroleum in Nebraska, 1944–48, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
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	28	22	25	27	29	26	27	26	22	23	20	18	293
1947	23	18	18	17	17	18	19	17	21	20	20	21	229
1948 [1]	17	17	18	23	23	20	21	20	14	20	23	24	240

[1] Subject to revision.

New Mexico.—An all-time production record of nearly 48.0 million barrels of crude oil was established in New Mexico in 1948 compared with approximately 41.0 million barrels the previous year. The principal oil fields, with production in millions of barrels, were: Monument 6.9, Drinkard 6.2, Eunice 5.4, Vacuum 4.5, Hobbs 3.8, and Maljamar 2.0.

In Southeast New Mexico, 456 development tests were drilled, of which 404 were successful. Wildcat wells opened up 10 new fields, 7 new pools, and 7 outposts. Of major significance was the discovery of Devonian oil in northern Lea County, where the Mid-Continent Petroleum Co. opened up the Crossroad field. This discovery was responsible for a large new area becoming prospective territory for wildcatting.

Another important strike was discovery of the Cary field, where oil was found for the first time in the area in the Montoya horizon of Ordovician age.

In western and northern New Mexico virtually all drilling activity was in the San Juan Basin, where 11 fields produced approximately 370,000 barrels of oil in 1948. A total of 28 wildcats was drilled in this area during the year, 5 of which were small gas wells.

Production of crude petroleum in New Mexico, 1944–48, by districts and fields, in thousands of barrels

[Oil and Gas Journal]

Year	Southeast										North-west	Total
	Arrow-head	Drink-ard	Eu-nice	Gray-burg-Jack-son	Hobbs	Malja-mar	Monu-ment	Pad-dock	Vac-uum	Other		
1944	1,946	-------	6,470	1,983	4,120	2,117	7,570	-------	5,080	10,017	448	39,751
1945	1,839	148	5,707	1,952	3,874	[1] 2,086	7,139	65	4,585	9,836	[2] 455	37,686
1946	1,691	650	6,007	1,811	3,569	2,033	6,565	655	4,054	9,203	[2] 466	36,704
1947	1,547	3,332	5,796	1,935	3,562	2,119	6,541	1,298	4,099	10,319	[2] 422	40,970
1948	1,460	6,236	5,360	1,869	3,841	2,033	6,902	1,584	4,504	13,443	[2] 375	47,607

[1] World Oil. [2] Bureau of Mines.

New York.—Crude production in New York declined slightly in 1948 from the previous year, as the total dropped from approximately 4.8 million barrels to 4.6 million. Approximately 95 percent of the year's production was from secondary-recovery operations, and 5 percent was natural production. In all, 18 shallow wildcats were drilled in 1948. All were dry holes. In proved oil fields 675 oil wells were completed during 1948, and active geophysical work was carried on in the southwestern, central, and eastern parts of the State. There was a noticeable increase in leasing activity related to the possibilities of deeper production.

Production of crude petroleum in New York, 1944–48, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
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	418	370	398	416	424	405	404	416	397	428	383	404	4,863
1947	419	349	384	395	400	400	424	393	402	416	359	421	4,762
1948 [1]	375	351	410	387	386	397	396	390	389	368	386	386	4,621

[1] Subject to revision.

Ohio.—A slight gain in Ohio oil production was reported during the year, as the total output increased to 3.3 million barrels in 1948 contrasted with 3.1 million barrels in 1947. No important oil discoveries were made during the year, although drilling activity continued about normal, with 1,522 wells completed, exclusive of wells for gas storage.

Oil-well completions equaled 416 compared with 307 during 1947. In addition, 407 gas wells and 481 dry holes were drilled in 1948. The greatest activity in shallow drilling continued to be in Meigs County, while the largest number of deep tests was drilled in Muskingum and Perry Counties.

Production of crude petroleum in Ohio, 1944–48, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
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	234	214	242	248	260	245	238	243	242	260	235	247	2,908
1947	236	201	244	266	256	264	282	259	274	291	250	285	3,108
1948 [1]	244	236	284	277	273	292	287	294	284	275	273	281	3,300

[1] Subject to revision.

Oklahoma.—A sizable gain of 13 million barrels in production was made in Oklahoma during 1948, with a total crude output of 154 million barrels compared with 141 million barrels the previous year. Gains in production were reported from the following fields: Apache, Cement, Healdton, Sholem-Alechem-Tatums-Tussy, and Velma; the Velma field increased output by 5.0 million barrels, whereas losses were noted in Burbank, Cache Creek, Oklahoma City, Pauls Valley, South Burbank, and West Edmond. The West Edmond field declined 5.6 million barrels during 1948 compared with 1947; however, the many smaller fields in the State showed a total increase of 11.5 million barrels.

In Oklahoma 4,263 wells were drilled during 1948, the largest number in any State except Texas. Of the 713 wildcats drilled, 94 were successful, resulting in a discovery ratio of 13 percent. The intensive drilling campaign resulted in the discovery of significant crude reserves, although no new field of paramount importance was indicated. However, the posted price for Oklahoma crude was attractive enough to warrant drilling many wells in old fields, which heretofore would not have been profitable.

The largest number of successful wildcats was in the north central, central, and south central parts of the State. Of particular significance was successful completion of the Union Producing Co.'s well in the Elk City field area on the southwest flank of the Anadarko Basin. This well was located 2 miles southeast of a Shell Oil Co. discovery well, and these two wells were responsible for the largest leasing and exploration activity in the State. Another important discovery well was drilled by Gulf Oil Co. in the southeastern embayment of the Anadarko Basin, extending production 5 miles northwest. This well shattered all previous records for depth by producing from the Bromide and

Tulip Creek sandstones at 12,855 to 13,611 feet, with an initial daily potential of 1,068 barrels.

The discovery well of Carter Oil Co., which opened the North Foster pool, and the Carter and Continental Oil Cos.' wildcat, which opened up the Southwest Panther Creek pool by finding production in the Deese sand, contributed materially to the addition of crude reserves in the area.

The strike of Superior Oil Co., 20 miles northwest of the West Edmond field, was especially significant. This well had a total depth of 9,026 feet and was a dual completion, producing through perforations opposite the Hunton group from 8,050 to 8,080 feet, and the Simpson dolomite from 8,565 to 8,640 feet. Initial production was 81 barrels of distillate in 9 hours and 4,665,000 cubic feet of gas per day from the Hunton, and 43 barrels of distillate in 15 hours and 3,854,000 cubic feet of gas per day from the Simpson dolomite. This discovery is in the center of Kingfisher County and opened up possibilities for future production in the northern part of the Anadarko Basin.

Production of crude petroleum in Oklahoma, 1944–48, by fields, in thousands of barrels

[Oil and Gas Journal]

Field	1944	1945	1946	1947	1948
Allen	1,285	1,256	[1] 1,120	[1] 1,075	[1] 1,129
Apache	2,245	2,308	1,591	1,803	2,181
Beebe	840	723	661	619	601
Billings	1,490	1,296	820	543	377
Burbank	3,140	3,128	2,927	2,615	2,432
Cache Creek			668	2,328	1,945
Cement	4,190	5,165	4,801	4,442	4,552
Coon Creek			561	1,652	1,731
Crescent	1,124	1,845	1,557	1,321	875
Cromwell	1,512	1,277	1,094	671	641
Cumberland	4,414	4,119	3,696	3,948	3,955
Cushing [2]	2,940	2,814	2,792	2,839	2,862
Edmond	1,046	902	583	545	470
Fitts	2,150	1,701	1,518	1,287	1,141
Glenn [3]	2,245	2,359	2,418	2,568	2,610
Healdton	2,515	2,423	2,438	2,431	2,629
Hewitt	2,055	1,084	1,698	1,672	1,633
Knox	455	391	(4)	522	1,758
Lone Grove	190	984	388	1,497	1,199
Lucien	1,363	994	803	694	625
Oklahoma City	16,295	12,968	10,693	9,670	8,543
Pauls Valley	4,200	4,445	2,971	2,399	2,162
Ramsey	1,250	999	799	839	689
Seminole district:					
Bowlegs	1,525	1,250	1,169	1,172	1,262
Earlsboro	2,495	1,737	1,095	616	579
Little River	1,741	1,492	1,159	1,432	1,416
St. Louis [5]	2,690	1,703	1,500	1,356	1,330
Seminole City	2,240	1,990	1,307	1,271	1,086
Sholem-Alechem-Tatums-Tussy	2,486	2,208	2,160	2,435	5,196
Soldier Creek			187	1,218	1,890
South Burbank	2,500	2,370	1,886	1,455	1,076
Velma	800	1,024	2,457	8,153	13,225
West Edmond	7,752	26,548	23,565	14,936	9,322
Other fields	42,263	45,876	54,146	60,070	71,558
Total Oklahoma	123,436	139,379	137,228	142,094	154,680

[1] Includes Allen Deep only.
[2] Included Shamrock before 1945.
[3] Included Sapulpa before 1945.
[4] Included in other fields.
[5] Includes Pearson before 1947.

Pennsylvania.—A slight decline of 23,000 barrels in Pennsylvania crude production was reported in 1948; however, the total output was almost 12.7 million barrels. The Bradford field was the source of approximately 80 percent of the State's production. Drilling activity in 1948 remained virtually unchanged from the previous year, as 1,889 wells were completed compared with 1,975 in 1947. This total included 1,595 oil wells, 228 gas wells, and 66 dry holes. In all 30 deep wells (testing Middle Devonian or deeper formations) were drilled—9 gas wells, 2 for gas storage, and 19 failures. Five new gas fields and one oil pool were discovered during 1948; however, none appeared to have major importance.

In the Bradford oil field, which includes the Bradford, Guffey, and Burning Well pools, 2,270 wells were completed, approximately half being water-intake wells, in contrast with 2,140 wells drilled in 1947. There was considerable drilling activity in the East Fork Oriskany sand pool of north central Pennsylvania, where eight gas wells were completed, resulting in renewed interest in the possibilities of the Oriskany sand in the central part of the State.

Production of crude petroleum in Pennsylvania, 1944–48, by months
[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
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	1,074	956	1,066	1,120	1,134	1,092	1,049	1,132	1,082	1,160	1,056	1,075	12,996
1947	1,110	920	1,017	1,069	1,081	1,057	1,110	1,056	1,072	1,120	994	1,084	12,690
1948 [1]	1,021	961	1,115	1,089	1,071	1,093	1,083	1,073	1,048	1,047	1,046	1,020	12,667

[1] Subject to revision.

Tennessee.—In all, 58 wells were drilled in 1948, including 13 oil wells and 1 gas well, contrasted with 17 dry holes drilled during 1947. Since discovery of commercial production in the Knox dolomite in 1947, 18 wells were drilled into this formation in 1948, 2 of which were successful. Both of these were in Fentress County. Magnolia Petroleum Co. drilled the State's deepest well during the year in Grundy County. However, it was a failure and was abandoned at 4,413 feet.

The most intensive drilling activity was centered in the Kettle Creek-Pine Branch area of Clay County, where 13 wells were drilled, including 6 producers. These wells were extremely shallow—less than 700 feet.

Texas.—Crude production in 1948 in Texas soared to an all-time high of 903.3 million barrels, a gain of 83.1 million barrels over the preceding year. All districts increased production over 1947, with West Texas gaining 51.9 million barrels. The second largest increase was made in the Gulf Coast area, with 14.4 million barrels, followed by North Texas 8.3, Central Texas approximately 3.0, South Texas 2.9, Panhandle over 2.1, and East Texas district—the smallest gain—about 0.6 million barrels.

North and West Central Texas led the State in total number of wells drilled in 1948 with 3,823, while West Texas was second with 3,251 and South Texas third with 1,932. In all, 12,172 wells were drilled in the State in 1948.

Gulf Coast.—Oil production in the Gulf Coast district increased from 259.3 million barrels in 1947 to 273.7 million barrels in 1948, a gain of 14.4 million barrels. Largest increases were made by Thompsons, Sugar Valley, Oyster Bayou, Humble, Chocolate Bayou, and

Bloomington fields, but declines were reported in Conroe, Fannette, Fig Ridge, Friendswood, Markham, and Stowell fields.

Production of crude petroleum in Texas, 1944–48, by districts and fields

[Thousands of barrels]

District and field	1944	1945	1946	1947	1948 [1]
Gulf Coast:					
Agua Dulce	3, 511	3, 811	3, 786	4, 227	4, 097
Amelia	1, 682	1, 491	1, 493	1, 581	1, 581
Anahuac	11, 932	11, 168	10, 137	10, 663	10, 832
Barbers Hill	2, 069	1, 895	1, 853	1, 969	1, 944
Bay City	1, 761	1, 425	1, 420	1, 546	1, 903
Bloomington				249	1, 337
Bonnie View		352	811	1, 178	1, 299
Chocolate Bayou	338	629	1, 064	1, 613	2, 863
Clear Lake	1, 872	1, 424	1, 366	1, 305	1, 123
Conroe	23, 231	21, 378	20, 708	21, 950	20, 519
Dickinson-Gillock	2, 377	2, 138	2, 077	2, 000	2, 287
Dyersdale	681	748	859	953	1, 171
Esperson	911	1, 016	968	1, 001	1, 129
Fairbanks	2, 910	2, 644	2, 287	2, 232	2, 272
Fannette	1, 657	2, 692	3, 337	2, 770	2, 484
Fig Ridge	2, 516	2, 862	2, 614	1, 800	1, 236
Flour Bluff	1, 490	1, 435	1, 282	1, 075	1, 102
Friendswood	20, 930	20, 075	18, 781	20, 997	20, 745
Greta	3, 375	3, 233	3, 448	4, 028	4, 338
Hastings	22, 169	20, 961	19, 317	21, 279	21, 643
Heyser	3, 338	2, 807	2, 283	1, 984	1, 891
High Island	839	868	971	1, 136	1, 315
Hull	1, 645	1, 472	1, 231	1, 286	1, 520
Humble	805	820	776	762	1, 138
La Rosa	1, 681	1, 469	1, 340	1, 374	1, 052
Livingston	659	1, 273	1, 712	1, 895	1, 898
Lolita	2, 146	2, 283	2, 307	2, 229	2, 193
Lovell's Lake	1, 891	1, 765	1, 806	1, 556	1, 595
Luby	1, 581	1, 315	1, 014	919	923
Manvel	3, 024	2, 824	2, 635	2, 725	2, 913
Markham	2, 409	2, 403	1, 984	1, 783	1, 468
Midway	1, 198	1, 230	1, 109	1, 597	1, 663
Old Ocean	5, 517	6, 107	6, 088	5, 473	5, 983
Oyster Bayou	2, 267	2, 088	2, 061	2, 936	4, 218
Placedo	2, 265	2, 324	2, 177	2, 222	2, 281
Raccoon Bend	3, 675	3, 375	2, 834	2, 722	2, 492
Refugio	1, 839	1, 918	2, 418	3, 203	3, 119
Richard King	1, 206	1, 198	1, 063	1, 114	1, 041
Saxet-Saxet Heights	2, 685	2, 142	2, 498	2, 595	2, 519
Segno	1, 394	1, 355	1, 282	1, 276	1, 161
Silsbee	746	867	1, 137	1, 064	1, 114
Sour Lake	528	598	748	969	1, 180
South Houston	1, 865	1, 785	1, 558	1, 592	1, 641
Stowell	5, 522	6, 330	4, 924	4, 590	3, 762
Stratton	4, 090	4, 016	3, 604	4, 344	4, 625
Sugarland	3, 084	2, 448	1, 721	1, 691	1, 859
Sugar Valley	3		276	1, 479	2, 421
Taft	1, 097	1, 043	860	1, 032	1, 381
Thompsons	13, 609	13, 007	13, 136	15, 621	16, 927
Tomball	3, 781	3, 728	3, 711	3, 388	3, 518
West Columbia	2, 584	2, 595	2, 314	2, 394	2, 591
West Ranch	8, 102	7, 122	7, 116	7, 043	7, 031
White Point	4, 537	4, 525	3, 849	4, 563	4, 496
Withers-Magnet	6, 749	7, 391	6, 847	5, 655	5, 850
Other Gulf Coast [2]	56, 981	55, 101	52, 773	58, 677	67, 027
Total Gulf Coast	260, 754	252, 969	241, 771	259, 305	273, 711
East Texas:					
East Texas proper [3]	135, 184	131, 204	120, 789	117, 112	113, 008
Cayuga	2, 998	2, 633	2, 456	2, 285	2, 098
Hawkins	13, 178	12, 436	14, 914	17, 045	17, 609
Long Lake	1, 995	2, 042	2, 072	2, 122	2, 223
Merigale		55	333	687	1, 614
New Hope	986	1, 640	1, 284	1, 481	1, 617
Quitman	2, 083	2, 158	2, 331	2, 933	3, 715
Rodessa	2, 209	1, 716	1, 333	1, 179	1, 204
Sulphur Bluff	1, 426	1, 338	1, 247	1, 175	1, 167
Talco	8, 618	8, 248	8, 755	8, 849	8, 804
Van	11, 673	10, 968	10, 625	10, 443	12, 110
Other East Texas	3, 970	4, 448	5, 273	6, 433	7, 142
Total East Texas	184, 320	178, 886	171, 412	171, 744	172, 311

See footnotes at end of table.

Production of crude petroleum in Texas, 1944–48, by districts and fields—Con.

[Thousands of barrels]

District and field	1944	1945	1946	1947	1948 [1]
Central Texas:					
Charlotte	12	77	166	582	1,879
Darst Creek	3,438	3,188	2,595	2,541	2,574
Falls City		225	1,170	1,509	1,571
Luling	1,551	1,469	1,321	1,455	1,401
Mexia-Powell [4]	1,290	1,209	1,144	1,124	1,038
Other Central Texas	6,124	6,556	7,384	8,548	10,269
Total Central Texas	12,415	12,724	13,780	15,759	18,732
North Texas [5 6]	53,272	54,255	57,204	61,768	70,026
Panhandle [7]	33,435	31,726	29,716	29,589	31,725
South Texas [8]	41,498	48,423	54,036	59,142	62,034
West Texas:					
Andrews	7,129	14,383	18,641	22,781	31,416
Crane-Upton	17,028	18,476	18,266	20,339	21,875
Crockett	1,469	2,020	3,794	7,050	8,496
Dawson		55	974	1,210	1,550
Ector [9]	33,635	34,180	38,532	50,392	67,518
Fisher	434	324	318	512	967
Gaines-Yoakum	33,785	32,909	30,726	35,915	41,417
Garza	12	151	1,215	1,631	2,586
Glasscock-Howard-Mitchell	7,332	7,599	7,704	8,276	9,002
Hockley	23,222	24,119	21,444	19,950	29,697
King		90	578	1,138	1,088
Pecos	16,785	17,238	17,457	20,122	22,771
Reagan	2,456	3,011	2,808	2,798	2,669
Ward	7,153	6,919	6,750	6,631	6,739
Winkler	9,712	13,787	22,410	22,626	24,325
Other West Texas [2]	853	466	679	1,532	2,663
Total West Texas	161,005	175,727	192,296	222,903	274,779
Total Texas	746,699	754,710	760,215	820,210	903,318

[1] Subject to revision.
[2] Includes crude oil consumed on leases and net change in stocks held on leases for entire district.
[3] Joiner, Kilgore, Lathrop, and other pools in Cherokee, Gregg, Rusk, Smith, and Upshur Counties.
[4] Includes other fields in Falls, Freestone, Limestone, and Navarro Counties.
[5] 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.
[6] 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.
[7] Carson, Gray, Hutchinson, Moore, and Wheeler Counties.
[8] Includes fields in Brooks, Duval, Hidalgo, Jim Hogg, Jim Wells, La Salle, Live Oak, McMullen, Starr, Webb, and Zapata Counties.
[9] Includes the part of Jordan pool in Crane County.

The district reported 1,878 wells drilled in 1948 compared with 1,499 in 1947. The 1948 total is broken down as follows: 1,057 oil wells, 133 gas wells, and 688 dry holes. No outstanding discoveries were made during the year. The East Long Mott field in Calhoun County and the Sarita field in Kenedy County appear to have the best possibilities.

East Texas.—Crude production in 1948 totaled 172.3 million barrels, a gain of only 0.6 million barrels over the preceding year. Output in the huge East Texas field was 4.1 million barrels less than in 1947, whereas the Van field increased output 1.7 million barrels, the Merigale field gained 1 million barrels, and the Hawkins, New Hope, and Quitman fields had smaller increases.

In 1948, 629 wells were drilled, representing an increase of 6 percent compared with the previous year. One hundred and forty-seven wildcats and field extension wells were drilled and 21 discoveries made during the year, which included 12 new-field wildcats, 6 shallower-pool discoveries, and 3 deeper-pool discoveries. The 21 new strikes included 16 oil wells and 5 gas-distillate wells. None of the discoveries appears to have major significance, with the possible exception of the Mitchell

Creek field in Hopkins County, producing from the Paluxy sand at 4,480 to 4,600 feet.

Central Texas.—A gain of approximately 3 million barrels was made over 1947, as output rose to over 18.7 million barrels. The largest increase was made by the Charlotte field, with a production of approximately 1.9 million barrels, a gain of 1.3 million barrels contrasted with 1947.

North Texas.—Crude production in north Texas continued to climb and established a record total of 70.0 million barrels, an increase of 8.3 million barrels compared with 1947. The largest production during the year was in Wichita County, with Archer County in second place. Drilling activity continued at a high level, increasing over 30 percent from 1947.

Panhandle.—Oil production in 1948 totaled approximately 31.7 million barrels, 2.1 million barrels more than in the preceding year. Drilling activity was greatly accelerated in 1948, 659 wells being drilled or 34 percent more than in 1947. Of the total, 471 were oil wells, 143 gas wells, and 45 dry holes. No new fields were found.

South Texas.—Continuing the trend of recent years, oil production increased to 62 million barrels in 1948, a gain of almost 3 million barrels. Intensive drilling activity continued throughout the year, showing a marked increase over 1947. The most important new fields discovered during 1948 were the South Long Horn field in Duval County, the San Pablo field in Jim Hogg County, and the Quien Sabe field in Webb County. Of particular significance is the tremendous development and utilization of casing-head gas and free gas in the production of light hydrocarbons. It is anticipated that this type of operation will continue to show even greater gains in future.

West Texas.—Crude production soared to 274.8 million barrels in 1948, a gain of 51.9 million barrels contrasted with 1947. Many counties scored large gains in production; the leaders, with increases in millions of barrels, were: Ector 17.1, Hockley 9.7, Andrews 8.6, Gaines-Yoakum 5.5, Pecos 2.6, and Winkler 1.7.

Drilling activity increased sharply in 1948. Oil-well completions totaled 2,756, representing an increase of approximately 40 percent over 1947. Dry holes drilled numbered 464. However, wildcats were responsible for 107 discoveries, as follows: 46 new fields, 20 new pools, 4 deeper pools, 5 shallow pools, and 32 outposts. Greatest drilling activity was centered in the Levelland oil field in Cochran and Hockley Counties, where 531 wells were producers. Next in importance were the Toborg and Sharon Ridge fields.

Virginia.—Crude production in Virginia dropped abruptly from 61,000 barrels in 1947 to 33,000 barrels in 1948, as production declined in the Rose Hill field in the southwestern part of the State, the only commercial producing oil field. An important discovery was made in Buchanan County, where the Union Producing Co.–Ritter Lumber V–1 obtained gas from Mississippian rocks at a depth of 2,301 feet.

West Virginia.—Oil production in West Virginia increased slightly in 1948, when output totaled almost 2.7 million barrels, a gain of 70,000 barrels over the preceding year. Wells drilled in 1948 totaled 843 in contrast with 880 during 1947. Of the 843 wells drilled, 535 were completed as gas wells, 148 oil wells, and 160 dry holes. During the year, 1,132 wells were abandoned. There are approximately 40 producing wells in the Silverton oil field in Jackson County, discovered in 1947, and the daily initial production averaged 40 barrels.

Production of crude petroleum in West Virginia, 1944–48, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
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	254	225	250	256	259	259	208	274	235	258	225	226	2,929
1947	227	183	220	202	211	209	218	219	229	253	208	238	2,617
1948 [1]	210	199	234	230	222	224	230	231	225	230	232	220	2,687

[1] Subject to revision.

Wyoming.—All previous Wyoming production records were shattered in 1948, when 54.0 million barrels were produced, surpassing the 1947 total by 9.2 million barrels. Largest gains were registered in the Big Sand Draw, Elk Basin, Hamilton Dome, Lost Soldier-Ferris-Wertz, and Steamboat Butte fields.

During 1948, 584 wells were drilled, including 394 oil wells. A break-down of the exploratory wells indicates the following: 14 new fields, 3 new pools, 3 shallower pools, 13 deeper pools, 11 outposts, and 183 dry holes. During 1948 Wyoming was the center of intensive exploratory drilling in the Rocky Mountain region.

Three outstanding discoveries were made in 1948. The Seaboard Oil Co. discovery in Park County found production in the Phosphoria formation at 8,496–8,550 feet; two other pay horizons were located later in the Frontier and Tensleep formations. Pure Oil Co. struck oil in the West Poison Spider field in Natrona County in the Frontier formation at 14,309 feet—the deepest producer in the Rocky Mountain region. An extension one-half mile northwest of the strike located oil in the Mesa Verde formation at 9,230 feet, opening up new possibilities in the area.

The Sinclair Wyoming Oil Co. discovered deeper pay horizons on the Lost Soldier and Wertz structures in Sweetwater County. Of special importance was the finding of oil in the Deadwood formation, which is reported as the first commercial production in the Rocky Mountain area from rocks of Cambrian age.

Production of crude petroleum in Wyoming, 1944–48, by fields

[Thousands of barrels]

Year	Big Muddy	Big Sand Draw	Byron-Garland	Crooks Gap	Elk Basin	Frannie	Grass Creek	Hamilton Dome	La Barge	Lance Creek
1944	504		2,534	2	2,885	1,092	993	470	585	6,535
1945	549	263	3,752	464	3,190	1,487	1,016	957	510	5,503
1946	568	447	3,814	571	4,580	1,331	1,094	1,396	461	4,920
1947	668	1,462	4,653	659	4,696	1,711	1,042	2,196	416	4,294
1948 [1]	744	2,590	4,546	874	6,039	1,746	1,137	3,138	436	3,290

Year	Little Buffalo	Lost Soldier-Ferris-Wertz	Oregon Basin	Pilot Butte	Rock Creek	Salt Creek	Steamboat Butte	Winkleman	Other fields [2]	Total
1944		3,441	4,388	370	935	4,802	601	117	3,102	33,356
1945	290	3,135	4,454	260	841	4,578	1,017	228	3,725	36,219
1946	574	3,183	4,164	325	853	4,642	1,888	385	3,781	38,977
1947	982	4,003	4,009	262	867	4,566	2,800	507	4,979	44,772
1948 [1]	1,264	5,466	3,491	290	766	4,655	3,822	796	8,914	54,004

[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 30,842 in 1947 to 37,508 in 1948.

Oil-well completions rose 25 percent from 17,999 in 1947 to 22,585 in 1948, dry holes increased from 9,538 in 1947 to 12,026 in 1948, and the number of gas wells completed declined from 3,305 in 1947 to 2,897 in 1948. The number of oil wells completed in 1948 represented about 60 percent of the total wells drilled, dry holes constituted 32 percent, and gas wells completed were about 8 percent of the total.

The increase of 4,586 in total oil wells completed in 1948 compared with 1947 included increases of 1,807 in oil wells completed in Texas, 756 in California, 516 in Louisiana, 428 in Oklahoma, and 374 in Kansas.

The annual survey of the total number of producing oil wells in the United States indicated 426,280 wells on December 31, 1947, compared with 421,460 wells on December 31, 1946.

883326—50——60

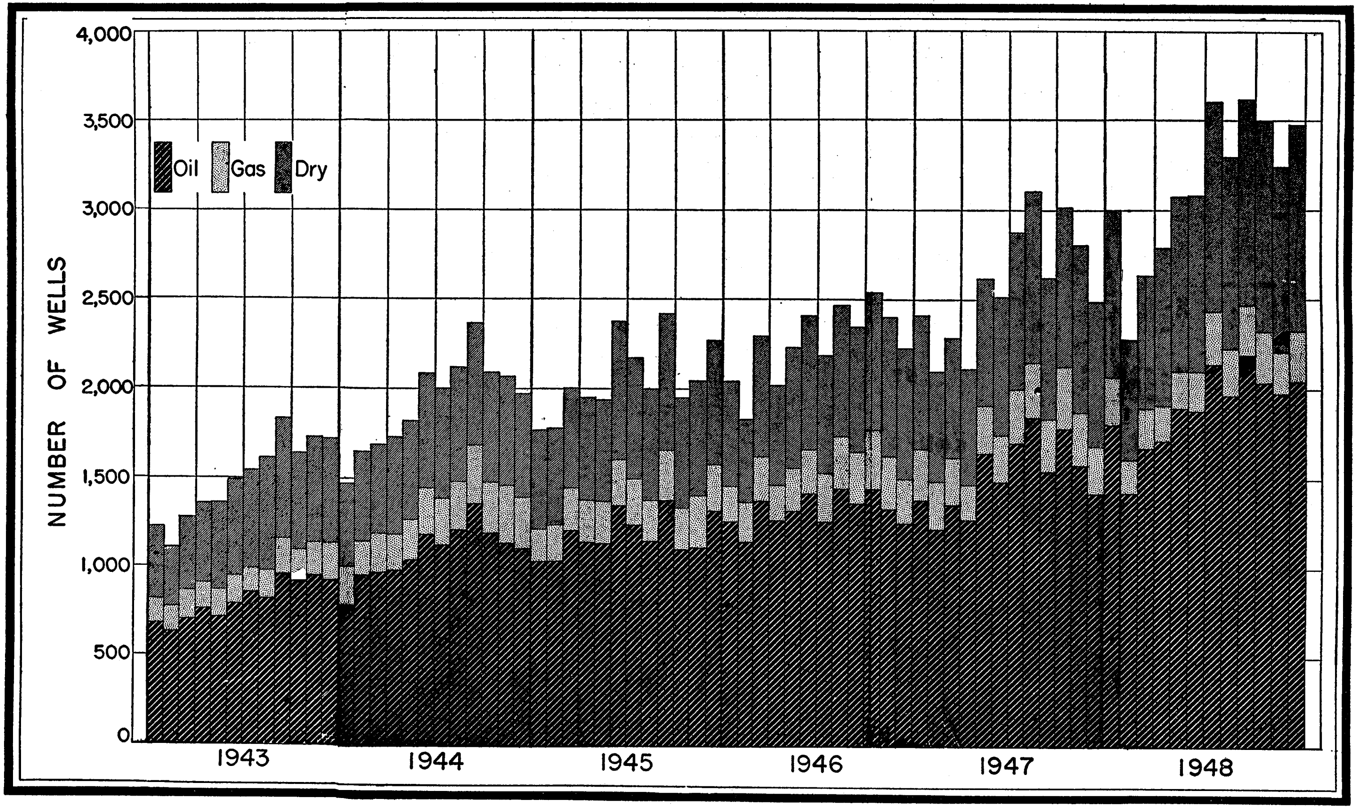

FIGURE 4.—Wells drilled in the United States, 1943–48, by months.

Wells drilled for oil and gas in the United States, 1947–48, by months

[Oil and Gas Journal]

Wells	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
													Number	Percent
1947														
Oil	1, 368	1, 201	1, 330	1, 252	1, 618	1, 470	1, 683	1, 818	1, 527	1, 763	1, 559	1, 410	17, 999	58. 4
Gas	287	265	261	195	263	258	298	304	288	341	290	255	3, 305	10. 7
Dry	748	623	686	651	728	776	887	971	797	905	951	815	9, 538	30. 9
Total	2, 403	2, 089	2, 277	2, 098	2, 609	2, 504	2, 868	3, 093	2, 612	3, 009	2, 800	2, 480	30, 842	100. 0
1948														
Oil	1, 786	1, 418	1, 665	1, 701	1, 870	1, 859	2, 129	1, 957	2, 176	2, 024	1, 964	2, 036	22, 585	60. 2
Gas	265	183	215	196	213	222	292	251	285	280	226	269	2, 897	7. 7
Dry	957	665	741	876	991	997	1, 172	1, 077	1, 143	1, 191	1, 040	1, 176	12, 026	32. 1
Total	3, 008	2, 266	2, 621	2, 773	3, 074	3, 078	3, 593	3, 285	3, 604	3, 495	3, 230	3, 481	37, 508	100. 0

Wells drilled for oil and gas in the United States, 1947–48, by States and districts

[Oil and Gas Journal]

State and district	1947				1948			
	Oil	Gas	Dry	Total	Oil	Gas	Dry	Total
Alabama	5		24	29	1		20	21
Arkansas	182	10	137	329	151	5	145	301
California	1, 639	45	369	2, 053	2, 395	21	460	2, 876
Colorado	152	7	50	209	149	10	48	207
Illinois	1, 054	10	969	2, 033	1, 262	11	1, 165	2, 438
Indiana	312	35	334	681	518	40	519	1, 077
Kansas	1, 303	452	912	2, 667	1, 677	382	1, 193	3, 252
Kentucky	289	110	261	660	349	151	403	903
Louisiana:								
Gulf Coast	443	15	193	651	457	21	291	769
Northern	593	90	292	975	1, 095	112	343	1, 550
Total Louisiana	1, 036	105	485	1, 626	1, 552	133	634	2, 319
Michigan	312	55	402	769	355	30	435	820
Mississippi	319	29	143	491	250	16	161	427
Montana	152	93	64	309	191	69	85	345
Nebraska, Missouri, Iowa			7	7	18	3	35	56
New Mexico	423	60	79	562	433	44	129	606
Oklahoma	1, 989	302	1, 532	3, 823	2, 417	258	1, 588	4, 263
Pennsylvania, New York, Ohio, West Virginia	2, 836	1, 435	685	4, 956	2, 834	1, 170	707	4, 711
Texas:								
Gulf Coast	909	111	479	1, 499	1, 057	133	688	1, 878
West Texas	1, 973	21	293	2, 287	2, 756	31	464	3, 251
East Texas	313	77	206	596	339	77	213	629
Other districts	2, 617	328	1, 956	4, 901	3, 467	301	2, 646	6, 414
Total Texas	5, 812	537	2, 934	9, 283	7, 619	542	4, 011	12, 172
Wyoming	172	19	76	267	394	7	183	584
Other States	12	1	75	88	20	5	105	130
Total United States	17, 999	3, 305	9, 538	30, 842	22, 585	2, 897	12, 026	37, 508

Producing oil wells in the United States and average production per day in 1947, by States and districts [1]

State and district	Producing oil wells: Approximate number, Dec. 31	Producing oil wells: Average production per well per day (barrels)	State and district	Producing oil wells: Approximate number, Dec. 31	Producing oil wells: Average production per well per day (barrels)
Arkansas	3,590	23.6	New York	22,500	0.6
California	24,420	38.3	Ohio	19,500	.4
Colorado	600	84.4	Oklahoma	52,200	7.4
Illinois	25,670	7.1	Pennsylvania	83,600	.4
Indiana	2,300	7.6	Texas:		
Kansas	27,500	10.7	Gulf Coast	15,100	48.2
Kentucky	14,780	1.7	West Texas	21,000	30.5
Louisiana:			East Texas	23,200	13.7
Gulf Coast	3,910	90.3	Other districts	48,300	12.4
Northern	4,790	21.6	Total Texas	107,600	21.1
Total Louisiana	8,700	52.4	West Virginia	16,250	.4
Michigan	3,540	12.6	Wyoming	4,320	28.7
Mississippi	1,120	100.2	Other States [2]	140	16.4
Montana	2,890	8.5			
Nebraska	60	10.5	Total United States	426,280	12.0
New Mexico	5,000	23.1			

[1] Figures for 1948, not yet available.
[2] Alabama, Florida, Missouri, Tennessee, and Virginia.

CONSUMPTION AND DISTRIBUTION

The increase of 9 percent in domestic crude production and the gain of 32 percent in the amount of crude oil imported provided a new supply in 1948 sufficient to cover an increase of 25.6 million barrels in crude stocks and meet an indicated demand for 2,119.8 million barrels or 8 percent more crude than in 1947. Furthermore, the increase of 79.6 million barrels of refined stocks in 1948 indicated that the demand for crude oil was inflated above actual requirements.

The indicated demand for domestic crude oil rose from 1,856.5 million barrels in 1947 to 1,994.8 million in 1948—a gain in average requirements of 364,000 barrels daily or 7 percent compared with 1947. The indicated demand for foreign crude oil rose from 97.6 million barrels in 1947 to 125.0 million in 1948—a gain of 28 percent. The demand for foreign crude oil represented 6 percent of the total in 1948 compared with 5 percent in 1947.

Of the total demand for crude oil in 1948—2,119.8 million barrels—the quantity of crude run to stills at refineries was 2,030.7 million barrels, or 96 percent of the total, and all other crude used amounted to 89.1 million barrels, or 4 percent of the total. Crude exports declined from 46.4 million barrels in 1947 to 39.8 million in 1948; crude transfers to fuel oils decreased from 30.4 million in 1947 to 27.4 million in 1948; and other crude used for fuel or lost declined from 25.1 million barrels in 1947 to 21.9 million in 1948.

Runs to Stills.—Total crude oil run to stills amounted to 2,030.7 million barrels in 1948, an average of 5,548,000 barrels daily, compared with 1,852.2 million barrels (5,075,000 barrels daily) in 1947. The increase in total runs amounted to 178.4 million barrels (473,000 barrels daily) and was 9 percent above the previous record in 1947.

Every refinery district except the Appalachian showed a substantial

Runs to stills of crude petroleum in the United States in 1948, by districts and months [1]

[Thousands of barrels]

District	January	February	March	April	May	June	July	August	September	October	November	December	Total
East Coast:													
Domestic	15,704	16,813	18,200	17,581	17,481	17,594	17,597	16,074	15,028	16,304	14,736	14,924	198,036
Foreign	8,270	7,700	8,288	8,760	10,278	9,342	10,018	10,815	11,300	11,608	11,226	11,616	119,221
Total East Coast	23,974	24,513	26,488	26,341	27,759	26,936	27,615	26,889	26,328	27,912	25,962	26,540	317,257
Appalachian	5,419	4,930	5,140	5,036	5,188	4,870	3,998	3,825	3,791	4,901	5,154	5,385	57,637
Indiana, Illinois, Kentucky, etc	27,180	24,118	26,460	26,292	27,860	26,832	28,904	28,340	28,765	29,371	29,017	29,094	332,233
Oklahoma, Kansas, Missouri, etc	13,525	12,587	13,066	13,392	14,057	14,064	14,964	15,069	14,220	13,650	13,115	13,540	165,249
Texas Inland	7,988	6,899	7,586	7,457	7,651	7,439	7,697	7,594	7,518	7,105	7,214	7,761	89,909
Texas Gulf Coast:													
Domestic	40,392	38,655	41,129	41,840	44,261	42,029	42,749	43,115	42,382	43,067	40,857	44,318	504,794
Foreign	----	67	120	157	261	136	488	640	415	588	742	1,179	4,793
Total Texas Gulf Coast	40,392	38,722	41,249	41,997	44,522	42,165	43,237	43,755	42,797	43,655	41,599	45,497	509,587
Louisiana Gulf Coast:													
Domestic	12,982	12,292	13,152	12,813	13,540	12,835	13,476	13,451	13,142	14,000	13,519	14,021	159,223
Foreign	----	----	----	----	----	----	----	----	----	----	----	----	----
Total Louisiana Gulf Coast	12,982	12,292	13,152	12,813	13,540	12,835	13,476	13,451	13,142	14,000	13,519	14,021	159,223
Arkansas, Louisiana Inland, Mississippi, etc	2,428	2,217	2,361	2,496	2,386	2,501	2,601	2,493	2,576	2,540	2,542	2,618	29,759
Rocky Mountain	5,046	4,625	4,883	4,464	4,942	4,981	5,040	5,327	5,201	5,061	4,906	5,155	59,631
California	26,862	25,111	26,622	25,910	27,800	26,329	27,014	27,499	16,942	25,234	27,138	27,724	310,185
Total:													
Domestic	157,526	148,247	158,599	157,281	165,166	159,474	164,040	162,787	149,565	161,233	158,198	164,540	1,906,656
Foreign	8,270	7,767	8,408	8,917	10,539	9,478	10,506	11,455	11,715	12,196	11,968	12,795	124,014
Grand total:													
1948	165,796	156,014	167,007	166,198	175,705	168,952	174,546	174,242	161,280	173,429	170,166	177,335	2,030,670
1947	146,897	134,953	150,120	141,210	153,348	153,604	161,844	163,068	159,771	162,854	158,719	165,858	1,852,246
Daily average 1948	5,348	5,380	5,387	5,540	5,668	5,632	5,631	5,621	5,376	5,594	5,672	5,720	5,548

[1] Subject to revision.

gain in total crude runs in 1948 compared with 1947. The principal increases by refinery districts in 1948 were gains of 72.6 million barrels in the Texas Gulf, 30.9 million in the Indiana-Illinois district, 19.9 million in the East Coast, 19.3 million in the Louisiana Gulf, 12.2 million in the Oklahoma-Kansas district, and 8.8 million barrels in the California district.

Distribution.—The demand for domestic crude petroleum is affected by total imports, the production of other light oils, and the relation of indicated crude demand to actual requirements that must be considered in the light of changes in stocks of refined oils. The total demand for domestic crude petroleum set a new record in 1948, increasing from 1,856.5 million barrels in 1947 to 1,994.8 million in 1948. This demand was met by a production of 2,016.3 million barrels of domestic crude oil, 21.5 million of which was added to stocks. The supply of domestic crude oil was supplemented by a consumption of 125.0 million barrels of foreign crude oil—a gain of 27.4 million compared with 1947. Imports of refined products, mostly residual fuel oil, decreased from 61.9 million barrels in 1947 to 58.6 million in 1948. Stocks of refined products, however, increased 79.6 million barrels in 1948 compared with a decline of 4.8 million in 1947. The production of light liquids from natural gas increased from 132.9 million barrels in 1947 to 145.8 million in 1948.

Demand for crude petroleum in the United States, 1945–48, by States of origin

[Thousands of barrels]

State	1945		1946		1947		1948 [1]	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
Alabama	151	0.4	382	1.0	408	1.1	441	1.2
Arkansas	29,272	80.2	28,068	76.9	29,511	80.8	31,562	86.2
California	329,473	902.7	310,094	849.6	330,830	906.4	336,569	919.6
Colorado	4,815	13.2	10,955	30.0	15,869	43.5	16,672	45.6
Florida	42	.1	44	.1	168	.5	326	.9
Illinois	72,907	199.7	75,851	207.8	71,828	196.8	61,392	167.7
Indiana	4,955	13.6	6,776	18.6	6,111	16.7	6,529	17.8
Kansas	95,609	261.9	96,743	265.0	106,200	291.0	109,549	299.3
Kentucky	10,247	28.1	10,399	28.5	9,963	27.3	8,478	23.2
Louisiana	131,518	360.3	145,050	397.4	160,352	439.3	179,146	489.5
Michigan	17,210	47.2	16,977	46.5	16,570	45.4	16,609	45.4
Mississippi	17,814	48.8	23,826	65.3	35,246	96.6	45,723	124.9
Montana	8,241	22.6	9,075	24.9	8,393	23.0	9,312	25.4
Nebraska	316	.9	300	.8	226	.6	240	.7
New Mexico	37,978	104.0	36,500	100.0	40,889	112.0	47,349	129.4
New York	4,666	12.8	4,860	13.3	4,741	13.0	4,612	12.6
Ohio	2,819	7.7	2,751	7.5	3,057	8.4	3,199	8.7
Oklahoma	135,318	370.7	139,878	383.2	144,379	395.5	153,241	418.7
Pennsylvania	12,487	34.2	12,724	34.9	12,812	35.1	12,178	33.3
Texas	762,576	2,089.3	757,211	2,074.6	810,557	2,220.7	897,977	2,453.5
West Virginia	2,930	8.0	2,875	7.9	2,701	7.4	2,592	7.1
Wyoming	36,247	99.3	36,679	100.5	45,545	124.8	51,038	139.4
Other States [2]	59	.2	84	.2	123	.3	93	.2
Total	1,717,650	4,705.9	1,728,102	4,734.5	1,856,479	5,086.2	1,994,827	5,450.3

[1] Subject to revision.
[2] Missouri, Tennessee, and Virginia.

The Bureau of Mines collects data relating to the receipts of domestic and foreign crude petroleum at refineries in the United States. These receipts provide the crude run to stills at refineries, small amounts of crude used for refinery fuel, and the changes in crude stocks at refineries. Classification of the receipts by States of origin shows the amount received from local production (intrastate), receipts from other States (interstate), and receipts of imported crude. The classification of receipts by methods of transportation indicates the final receipts by boat, pipe line, or tank cars and trucks. The domestic receipts by boat were in most instances originally moved by pipe line from the point of production to the point of shipment by boat.

Receipts of domestic and foreign crude petroleum at refineries increased from 1,855.6 million barrels in 1947 to 2,046.6 million in 1948—a gain of 191.0 million barrels.

These receipts provided for total runs to stills of 2,030.7 million barrels, fuel use and losses of 7.3 million, and an increase of 8.6 million barrels in crude stocks. Receipts of foreign crude oil increased from 97.5 million barrels in 1947 to 129.1 million in 1948 and represented 5.3 percent of total receipts in 1947 and 6.3 percent in 1948; interstate receipts of domestic crude rose from 716.8 million in 1947 to 787.9 million in 1948 and represented 38.6 percent of the total receipts in 1947 and 38.5 percent in 1948; and intrastate receipts of domestic crude were 1,041.3 million barrels in 1947 and 1,129.6 million in 1948 and represented 56.1 percent of the total receipts in 1947 and 55.2 percent in 1948.

Refinery receipts of crude petroleum in 1948, by methods of transportation, indicated that 72.0 percent of the total was delivered by pipe lines in 1948 compared with 73.4 percent in 1947; that 25.2 percent was delivered by boat compared with 24.1 percent in 1947; and that 2.8 percent was delivered by tank cars and trucks in 1948 compared with 2.5 percent in 1947.

Receipts of crude petroleum at refineries in the United States, 1944–48, by methods of transportation

[Millions of barrels]

Method of transportation	1944	1945	1946	1947	1948 [1]
By boat:					
Intrastate	63.2	94.1	96.7	108.5	120.9
Interstate	57.1	113.3	226.2	241.0	265.1
Foreign	44.8	74.3	86.1	97.5	129.1
Total by boat	165.1	281.7	409.0	447.0	515.1
By pipe lines:					
Intrastate	909.6	913.7	888.9	912.9	984.7
Interstate	480.8	454.2	401.4	449.7	490.0
Total by pipe lines	1,390.4	1,367.9	1,290.3	1,362.6	1,474.7
By tank car and truck:					
Intrastate	16.5	15.2	20.1	19.9	24.0
Interstate	96.5	59.1	17.8	26.1	32.8
Total by tank car and truck	113.0	74.3	37.9	46.0	56.8
Grand total	1,688.5	1,723.9	1,737.2	1,855.6	2,046.6

[1] Subject to revision.

Total deliveries to refineries by boat were 515.1 million barrels in 1948. The delivery of foreign crude totaled 129.1 million barrels, of which 123.6 million went to the east coast and 5.5 million to the Gulf coast. The interstate movement of domestic crude oil by boat amounted to 265.1 million barrels, including 193.0 million barrels shipped from the Gulf coast to the east coast, 56.6 million barrels of exchanges by boat between the Texas Gulf and Louisiana Gulf coast ports, and a balance of 15.5 million barrels for all other interstate boat shipments, of which 13.4 million represented river shipments to Kentucky refineries. The intrastate deliveries by boat amounted to 120.9 million barrels in 1948, including 48.0 million barrels in California, 44.5 million barrels delivered by boat in the Texas Gulf, 25.4 million delivered in the Louisiana Gulf, and only 3.0 million barrels of intrastate deliveries by boat in all other districts.

East coast refineries received 321.7 million barrels of crude oil in 1948, of which 123.6 million was foreign crude and 198.1 million domestic crude. The receipts of domestic crude oil included 193.0 million barrels by interstate boat movements and 5.1 million barrels by pipe line and tank car from Pennsylvania, New Mexico, and Florida. Receipts by interstate boat movements included 172.1 million barrels of Texas crude, 10.5 million of Louisiana crude, 6.9 million of Mississippi crude, 2.2 million of Oklahoma crude, and 1.3 million New Mexico crude. The east coast refineries are predominantly supplied by boat movements of crude oil; the east coast is the primary area in which domestic crude oil from the Gulf Coast States comes into direct competition with imports of foreign crude oil. The output of refineries in the east coast was further supplemented by large shipments of products from the Gulf coast refineries; this region also received most of the imports of refined products.

The total demand for domestic crude oil in 1948 was 1,994.8 million barrels, an increase of 138.3 million compared with 1947. The principal changes in the market demand for domesic crude petroleum by States of origin (computed from production and changes in crude stocks by origin) in 1948 compared with 1947 were gains of 87.4 million barrels for Texas, 18.8 million for Louisiana, 10.5 million for Mississippi, 8.9 million for Oklahoma, 6.5 million for New Mexico, 5.7 million for California, and 3.3 million barrels for Kansas. The principal declines in demand were 10.4 million barrels for Illinois, 1.5 million for Kentucky, and 0.6 million for Pennsylvania.

The market demand for Texas crude oil increased from 810.6 million barrels in 1947 to 898.0 million in 1948, and 5.3 million barrels were added to stocks of Texas crude oil. The relative contribution of Texas to the total demand for domestic crude oil was 43.8 percent in 1946, 43.7 percent in 1947, and 45.0 percent in 1948. The wide distribution of Texas crude oil means a large increase in demand in periods of rising demand and, if total demand declines sharply, Texas probably would suffer most of it. In 1948 deliveries of Texas crude oil to domestic refineries totaled 883.5 million barrels, including 495.6 million delivered to refineries within the State and 387.9 million moved to refineries in other States. Shipments to east coast refineries amounted to 172 million barrels and declined about 1 percent compared with 1947. Deliveries to refineries in Indiana, Illinois, Ohio, and Michigan were about 130 million barrels in 1948 compared with 107 million in 1947. Almost 52 million barrels of Texas crude was delivered to Louisiana refineries in 1948; about 26 million barrels were sent to refineries in Missouri, Oklahoma, and Kansas and about 7 million barrels to refineries in the Appalachian district.

California ranked second as a source of crude-oil supply in the United States, with a market demand of 336.6 million barrels in 1948 and an increase of 3.5 million barrels in crude stocks of California origin. California supplied 17.9 percent of the total demand for domestic crude oil in 1946, 17.8 percent in 1947, and 16.9 percent in 1948. The total distribution of California crude in 1948 included deliveries of 315 million barrels to refineries within the State and transfers of 19 million barrels for use directly for fuel without refining; the balance represented exports of crude oil to Canada and losses. California oil supplies most of the requirements in the Pacific Coast States and some exports to foreign markets in the Pacific. A substantial proportion of the naval requirements for fuel oil is purchased in California, and much of the fuel oil used by railroads crossing the mountains to the east is supplied from there. Within the State, oil competes with natural gas and power from hydroelectric plants.

Louisiana was the third-largest source of domestic crude-oil supply in 1948, with a production of 181.2 million barrels, increase in stocks of 2.0 million, and a market demand of 179.1 million. Louisiana contributed 8.4 percent of the total market demand for domestic crude in 1946, 8.6 percent in 1947, and 9.0 percent in 1948. Of the total deliveries of Louisiana crude to refineries in 1948, about half was sent to refineries within the State, and the balance was delivered to refineries in other States The largest outside market was in Texas, with deliveries of 59 million barrels in 1948, and the remaining interstate shipments of Louisiana crude are divided about equally between the east coast and the upper Middle West.

Oklahoma ranked fourth in supplying the demand for domestic crude oil in 1948. The relative percentage of the total, however, declined from 8.1 percent in 1946 to 7.8 percent in 1947 and 7.7 percent in 1948. Production in 1948 amounted to 154.0 million barrels, with an increase in stocks of 0.8 million and a market demand of 153.2 million. Of the 148 million barrels delivered to refineries in 1948, almost 66 million went to refineries within the State. The principal shipments of crude to other States were 25 milloin barrels to refineries in Illinois-Minnesota-Wisconsin, 24 million to Indiana, 13 million to Ohio, and 7 million to Kansas-Nebraska. Considering the fact that there is a large northward pipe-line movement of crude oil from Texas, Louisiana, Arkansas, Mississippi, and New Mexico, the demand for Oklahoma crude oil is primarily in the upper Middle West and adjacent sections of Canada.

Kansas ranked fifth as a source of domestic crude supply in 1948. The percentage of the total demand for domestic crude oil supplied by the State rose from 5.6 percent in 1946 to 5.7 percent in 1947 and declined to 5.5 percent in 1948. Crude production amounted to 110.8 million barrels in 1948, with 1.3 million barrels added to stocks and a market demand of 109.5 million barrels. About 54 million barrels of Kansas crude were delivered to refineries within the State, and the most important shipments to refineries in other States were 18 million barrels to Illinois, 13 million to Indiana, and 9 million to refineries in Oklahoma.

Daily average demand for total crude petroleum in the United States in 1947–48 by States of origin and by months

[Thousands of barrels]

State	January	February	March	April	May	June	July	August	September	October	November	December	Year
1947													
Alabama	0.7	0.8	0.8	1.6	1.0	0.7	1.9	1.3	1.1	1.2	0.8	1.4	1.1
Arkansas	72.5	84.4	79.4	84.5	76.5	82.3	76.0	85.3	76.6	86.1	82.2	84.8	80.8
California	873.1	865.5	890.1	885.0	922.7	903.7	898.2	950.8	920.3	927.0	923.0	913.6	906.4
Colorado	41.4	41.2	38.1	40.4	42.8	40.3	45.2	45.9	46.9	46.3	46.5	46.6	43.5
Florida	.2	.1	.8	.3	.6	.5	.8	1.1	----------	----------	----------	1.1	.5
Illinois	206.1	228.5	203.7	198.5	192.3	199.9	210.5	196.8	181.0	173.6	194.9	178.4	196.8
Indiana	18.1	17.1	16.7	18.2	15.6	16.9	16.8	15.2	17.8	16.6	15.2	16.6	16.7
Kansas	278.8	287.4	280.4	277.7	297.2	304.8	281.4	301.2	300.2	308.2	293.5	280.6	291.0
Kentucky	24.9	26.4	27.8	26.7	21.8	27.1	29.6	24.9	28.6	26.9	30.4	32.5	27.3
Louisiana	407.0	429.4	414.5	411.1	432.3	448.0	433.2	457.3	427.4	477.4	459.5	473.6	439.3
Michigan	45.9	45.1	43.8	43.0	43.9	40.6	50.5	40.6	47.0	47.2	50.2	47.0	45.4
Mississippi	81.2	88.5	69.1	80.9	115.8	91.7	109.5	84.9	107.0	117.8	106.1	105.4	96.6
Montana	20.2	22.1	21.3	22.5	25.5	21.7	18.9	23.5	25.4	23.4	24.6	26.6	23.0
Nebraska	.6	.6	.5	.6	.5	.6	.6	.5	.8	.6	.6	.6	.6
New Mexico	111.7	97.7	93.6	96.7	102.7	131.0	113.8	104.0	111.2	123.8	121.0	136.1	112.0
New York	12.3	13.4	11.9	11.7	12.9	12.3	13.6	15.7	13.1	13.2	12.8	12.7	13.0
Ohio	7.7	8.3	8.9	7.3	9.4	.5	8.7	7.1	8.2	8.4	7.9	9.1	8.4
Oklahoma	395.0	365.7	405.8	344.2	406.5	384.5	404.3	398.8	426.5	385.5	416.7	410.0	395.5
Pennsylvania	37.8	36.9	35.7	32.0	37.5	35.3	32.9	33.6	37.7	34.5	33.0	34.6	35.1
Texas	1,965.3	1,998.1	2,017.8	2,024.7	2,106.8	2,224.6	2,463.1	2,327.3	2,462.6	2,301.1	2,344.9	2,396.3	2,220.7
West Virginia	7.5	8.0	5.0	5.1	6.2	6.9	7.4	9.2	7.4	10.6	8.0	7.7	7.4
Wyoming	110.5	109.4	115.2	118.4	121.7	119.6	119.5	134.3	133.7	140.1	137.2	136.6	124.8
Missouri, Tennessee, Virginia	.5	.5	.4	.4	.4	.4	.4	.3	.3	.3	.2	.2	.3
Total domestic	4,719.1	4,775.1	4,781.3	4,731.5	4,992.6	5,102.9	5,336.7	5,259.6	5,380.8	5,269.8	5,309.2	5,352.1	5,086.2
Foreign	227.0	284.2	295.2	268.6	259.9	282.8	249.9	257.5	276.3	256.1	265.6	286.5	268.3
Grand total 1947	4,946.1	5,059.3	5,076.5	5,000.1	5,252.5	5,385.7	5,586.6	5,517.1	2,657.1	5,525.9	5,574.8	5,638.6	5,353.5
1948 [1]													
Alabama	1.3	----------	.4	1.3	.9	1.6	2.6	2.0	.9	1.8	.6	.9	1.2
Arkansas	79.3	91.5	85.5	92.2	84.9	89.8	85.7	77.9	88.4	84.9	81.2	94.1	86.2
California	937.4	932.9	919.5	922.2	955.6	947.3	952.2	969.4	615.8	887.2	992.2	998.0	919.6
Colorado	46.2	43.3	42.3	43.8	47.2	54.5	44.4	44.5	50.1	45.8	42.5	42.3	45.6
Florida	.5	.2	.6	.3	1.1	1.8	.5	1.5	1.1	2.8	.2	.3	.9
Illinois	195.1	172.5	149.3	153.3	173.8	167.8	164.8	159.8	179.4	203.2	152.2	141.4	167.7
Indiana	13.0	14.2	13.9	15.1	17.2	17.9	17.6	17.5	23.0	23.1	19.7	21.8	17.8
Kansas	307.6	287.5	278.9	284.3	312.2	316.7	298.6	313.7	315.7	279.3	313.4	292.4	299.3
Kentucky	25.6	13.5	29.7	29.9	26.1	22.9	19.4	22.2	19.6	23.3	25.3	20.0	23.2
Louisiana	455.0	489.0	459.8	475.2	526.4	500.3	508.8	482.5	490.7	479.8	496.4	509.7	489.5
Michigan	45.9	44.2	45.8	41.8	45.1	44.0	43.0	46.5	48.7	44.9	45.6	49.0	45.4
Mississippi	108.7	103.0	120.4	127.6	132.2	120.3	120.4	128.1	122.1	143.8	136.0	126.0	124.9

Montana	24.5	26.7	26.6	17.9	24.9	26.5	26.8	28.8	28.0	25.9	24.1	24.5	25.4
Nebraska	.6	.6	.6	.7	.8	.7	.7	.6	.6	.5	.8	.7	.7
New Mexico	125.8	113.0	130.5	146.8	139.3	125.5	117.8	115.5	144.1	129.1	129.2	135.5	129.4
New York	11.5	12.1	13.9	12.5	12.7	13.1	11.6	13.1	12.9	12.5	12.4	12.8	12.6
Ohio	8.1	9.9	9.5	9.5	8.1	9.2	6.3	7.0	8.6	6.8	12.1	10.0	8.7
Oklahoma	420.9	414.0	403.2	447.7	416.6	391.0	448.5	422.3	401.2	395.1	440.9	422.8	418.7
Pennsylvania	33.2	33.3	30.4	35.0	32.9	34.0	31.1	35.8	37.1	32.6	31.1	32.9	33.3
Texas	2,311.5	2,368.0	2,408.7	2,496.2	2,494.2	2,511.9	2,513.9	2,478.1	2,503.3	2,480.4	2,407.4	2,466.3	2,453.5
West Virginia	6.5	6.7	7.6	2.3	10.2	6.2	8.5	8.0	5.1	6.4	9.3	8.2	7.1
Wyoming	153.3	138.9	149.0	140.7	134.5	146.5	140.9	150.4	146.0	119.1	127.5	126.5	139.4
Missouri, Tennessee, Virginia	.2	.2	.3	.3	.4	.2	.2	.2	.1	.2	.1	.3	.2
Total domestic	5,311.7	5,316.2	5,326.4	5,496.6	5,597.3	5,549.7	5,564.3	5,525.4	5,242.5	5,428.5	5,500.2	5,536.4	5,450.3
Foreign	269.6	270.0	271.3	300.9	340.0	316.5	343.2	370.4	394.7	393.5	402.2	421.3	341.4
Grand total 1948	5,581.3	5,586.2	5,597.7	5,797.5	5,937.3	5,866.2	5,907.5	5,895.8	5,37.2	5,822.0	5,902.4	5,957.7	5,791.7

[1] Subject to revision.

Demand for total crude petroleum in the United States, 1947–48, by States of origin and by months

[Thousands of barrels]

State	January	February	March	April	May	June	July	August	September	October	November	December	Year
1947													
Alabama	23	22	24	47	31	22	59	40	34	37	24	45	408
Arkansas	2,248	2,363	2,461	2,536	2,371	2,468	2,357	2,645	2,297	2,668	2,467	2,630	29,511
California	27,065	24,235	27,592	26,550	28,603	27,110	27,845	29,474	27,609	28,738	27,689	28,320	330,830
Colorado	1,285	1,153	1,182	1,211	1,327	1,208	1,401	1,423	1,407	1,435	1,394	1,443	15,869
Florida	6	3	24	10	17	16	24	35	----------	----------	----------	33	168
Illinois	6,390	6,397	6,315	5,954	5,961	5,997	6,525	6,101	5,430	5,382	5,847	5,529	71,828
Indiana	562	478	518	546	484	508	522	472	533	515	457	516	6,111
Kansas	8,643	8,047	8,693	8,331	9,214	9,145	8,724	9,338	9,007	9,554	8,805	8,699	106,200
Kentucky	771	740	862	800	677	813	916	772	858	835	912	1,007	9,963
Louisiana	12,617	12,024	12,848	12,334	13,402	13,440	13,428	14,176	12,821	14,798	13,784	14,680	160,352
Michigan	1,423	1,263	1,358	1,291	1,360	1,218	1,565	1,258	1,409	1,462	1,506	1,457	16,570
Mississippi	2,517	2,479	2,143	2,428	3,590	2,752	3,394	2,633	3,211	3,651	3,182	3,266	35,246
Montana	626	620	661	676	792	652	587	729	762	725	740	823	8,393
Nebraska	18	18	17	18	17	17	20	16	25	20	20	20	226
New Mexico	3,464	2,737	2,902	2,901	3,182	3,930	3,526	3,224	3,337	3,839	3,629	4,218	40,889
New York	383	377	370	351	400	369	421	487	394	410	385	394	4,741
Ohio	238	232	277	220	291	285	269	219	245	261	237	283	3,057
Oklahoma	12,245	10,239	12,579	10,325	12,601	11,534	12,534	12,361	12,795	11,952	12,501	12,713	144,379
Pennsylvania	1,172	1,032	1,105	961	1,163	1,057	1,019	1,042	1,130	1,069	991	1,071	12,812
Texas	60,924	55,946	62,552	60,739	65,311	66,738	76,357	72,146	73,878	71,333	70,347	74,286	810,557
West Virginia	232	223	153	153	192	208	230	284	221	327	239	239	2,701
Wyoming	3,426	3,063	3,571	3,551	3,771	3,589	3,704	4,164	4,011	4,344	4,115	4,236	45,545
Other States	13	12	12	12	13	11	10	9	9	9	6	7	[1] 123
Total domestic	146,291	133,703	148,219	141,945	154,770	153,087	165,437	163,048	161,423	163,364	159,277	165,915	1,856,479
Foreign	7,039	7,958	9,153	8,058	8,058	8,485	7,748	7,981	8,291	7,940	7,968	8,883	97,562
Grand total 1947	153,330	141,661	157,372	150,003	162,828	161,572	173,185	171,029	169,714	171,304	167,245	174,798	1,954,041
Daily average:													
Domestic	4,719	4,775	4,781	4,732	4,993	5,103	5,337	5,260	5,381	5,270	5,309	5,352	5,086
Domestic and foreign	4,946	5,059	5,077	5,000	5,253	5,386	5,587	5,517	5,657	5,526	5,575	5,639	5,354
1948 [2]													
Alabama	41	----------	13	39	28	48	79	63	28	56	17	29	441
Arkansas	2,457	2,654	2,651	2,765	2,632	2,695	2,657	2,415	2,651	2,631	2,437	2,917	31,562
California	29,059	27,053	28,503	27,666	29,623	28,418	29,519	30,050	18,473	27,503	29,764	30,938	336,569
Colorado	1,431	1,257	1,311	1,314	1,463	1,636	1,376	1,378	1,502	1,420	1,274	1,310	16,672
Florida	13	5	19	10	34	53	15	46	32	86	5	8	326
Illinois	6,049	5,003	4,629	4,598	5,387	5,035	5,110	4,953	5,380	6,299	4,564	4,385	61,392
Indiana	402	411	432	453	532	538	547	542	691	716	589	676	6,529

Kansas	9,537	8,075	8,647	8,529	9,680	9,502	9,257	9,726	9,472	8,659	9,402	9,063	109,549
Kentucky	795	392	919	896	809	686	601	687	588	721	765	619	8,478
Louisiana	14,106	14,182	14,253	14,256	16,318	15,010	15,774	14,958	14,722	14,875	14,892	15,800	179,146
Michigan	1,422	1,281	1,419	1,252	1,399	1,321	1,332	1,443	1,461	1,391	1,369	1,519	16,609
Mississippi	3,371	3,276	3,732	3,829	4,098	3,607	3,733	3,971	3,662	4,458	4,081	3,905	45,723
Montana	759	774	824	537	773	795	832	893	840	802	724	759	9,312
Nebraska	18	17	18	22	24	20	21	20	18	16	23	23	240
New Mexico	3,900	3,276	4,047	4,405	4,318	3,764	3,652	3,582	4,325	4,002	3,877	4,201	47,349
New York	357	351	430	376	394	394	361	406	388	386	371	398	4,612
Ohio	251	287	295	285	250	276	194	218	259	212	363	309	3,199
Oklahoma	13,048	12,007	12,500	13,432	12,916	11,729	13,902	13,091	12,034	12,249	13,225	13,108	153,241
Pennsylvania	1,029	966	942	1,050	1,020	1,020	963	1,111	1,115	1,009	934	1,019	12,178
Texas	71,656	68,672	74,669	74,885	77,321	75,357	77,931	76,820	75,097	76,892	72,220	76,457	897,977
West Virginia	201	195	235	68	317	185	262	246	152	199	278	254	2,592
Wyoming	4,753	4,028	4,620	4,220	4,168	4,396	4,368	4,663	4,381	3,963	3,825	3,923	51,038
Other States	7	7	11	9	12	7	7	6	5	8	6	8	[3] 93
Total domestic	164,662	154,169	165,119	164,896	173,516	166,492	172,493	171,288	157,276	168,283	165,005	171,628	1,994,827
Foreign	8,358	7,832	8,411	9,028	10,539	9,493	10,638	11,482	11,841	12,200	12,066	13,060	124,948
Grand total 1948	173,020	162,001	173,530	173,924	184,055	175,985	183,131	182,770	169,117	180,483	177,071	184,688	2,119,775
Daily average:													
Domestic	5,312	5,316	5,326	5,497	5,597	5,550	5,564	5,525	5,243	5,428	5,500	5,536	5,450
Domestic and foreign	5,581	5,586	5,598	5,797	5,937	5,866	5,907	5,896	5,637	5,822	5,902	5,958	5,792

[1] Missouri (54), Tennessee (8), and Virginia (61). [2] Subject to revision. [3] Missouri (52), Tennessee (8), and Virginia (33).

Distribution of crude petroleum in the United States in 1948, 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	466								935	
Arkansas	31,675			3,182				16,305	19,396	242
California, Washington	[2] 340,089							317,052	310,185	19,423
Colorado	16,827							4,821	4,873	61
Georgia, Delaware, Florida, South Carolina	290			114			573	263	3,970	
Illinois, Minnesota, Wisconsin	64,669	23,944	17,675	1,199	2,904	24,838	45,263	6,089	121,064	640
Indiana	6,710	2,462	13,195		891	23,854	61,064	5,982	107,070	24
Kansas, Nebraska	111,073		53,483		24	7,023	6,099	2,910	68,966	339
Kentucky, Tennessee	8,559	2,416		4,405		702	107	14,342	21,677	3
Louisiana:										
Gulf	137,713			78,543			50,455	31,216	159,223	1,031
Inland	43,468			3,038			1,030	6,271	6,909	245
Maryland							12,531	570	22,456	
Massachusetts, Rhode Island				1,032			9,285		18,669	
Michigan	16,870	1,954				1,504	8,437	18,965	30,789	36
Mississippi	45,809								2,519	107
Missouri	53		310	41		822	10,466	25	11,665	52
Montana	9,380							12,282	12,335	12
New Jersey				5,716	1,940	2,207	54,659	4,542	113,743	
New Mexico	47,969				3,546		1,085		4,603	229
New York:										
East							2,858	4,671	16,648	
West	4,621	3,840	99			2,485	3,591	3,592	13,542	
Ohio:										
East	3,300	12,256	45	1,730		237	480	6,585	21,321	354
West		13,564	1,085	2,934		12,601	15,256	5,956	51,633	
Oklahoma	154,032		9,400		811	65,757	9,501		84,618	631
Pennsylvania:										
East				3,660	1,295		92,184		141,771	
West	12,667					2,312	2,862	12,892	17,926	5
Texas:										
Gulf	273,711			58,689	35,219	767	409,347	62	509,587	792
Inland	629,607				2,200	1,767	86,287		89,909	2,649
Utah								9,245	9,344	
West Virginia, Virginia	2,720	140		546		1,174	59	2,961	4,848	
Wyoming, Idaho	54,004							28,856	28,476	486
Total	2,016,282	60,576	95,292	164,829	48,830	148,050	883,479	516,455	2,030,670	27,390

[1] Subject to revision. [2] American Petroleum Institute.

Illinois was the sixth-largest supplier of domestic crude oil in 1948. Production totaled 64.7 million barrels, with an increase in stocks of 3.3 million and a market demand of 61.4 million in 1948. The sharp drop in the State's production has resulted in a decline in the market demand for Illinois crude from 4.4 percent of the national total in 1946 to 3.9 percent in 1947 and 3.1 percent in 1948. Deliveries to refineries in Illinois amounted to 24 million barrels in 1948, and deliveries to other States were 37 million barrels, including delivery of 26 million barrels to refineries in Ohio, 4 million to New York, and most of the remainder to Indiana, Kentucky, and Michigan.

Wyoming was the seventh State in importance as a source of domestic crude oil in 1948 and for the first time was included in the group of States producing more than 50 million barrels a year. Production in 1948 totaled 54.0 million barrels, with 3.0 million added to stocks and 51.0 million representing market demand. Wyoming supplied 2.6 percent of the total demand for domestic crude in 1948 compared with 2.1 percent in 1946. Deliveries to refineries in 1948 included 27 million barrels to refineries within the State and 24 million to refineries in other States. About half of the total outside shipments went to adjacent States and the other half to Illinois, Indiana, and Michigan.

The seven States included in this review supplied 90.4 percent of the total market demand for domestic crude in 1946, 89.9 percent in 1947, and 89.7 percent in 1948.

STOCKS

Changes in the stocks of all oils are an essential indication of the relation between supply and demand. The increase of 43.5 million barrels in total stocks in 1946 indicated the necessity of a larger supply of oil to rebuild depleted stocks required in the distribution of civilian requirements. At the same time, surplus stocks in military custody, not included in stocks reported to the Bureau of Mines, were in process of liquidation. In 1947 the decline of 5.0 million barrels in total stocks reflected the rapid expansion in demand and the limitation of available refinery capacity. The increase of 106.5 million barrels in total stocks in 1948 was related to the improvement in facilities available for production and refining and a slower relative rate of growth in total oil demand accentuated by abnormally mild weather at the end of the year.

Stocks of crude petroleum, natural gasoline, and refined products in the United States at end of year, 1944–48

[Thousands of barrels]

Product	1944	1945	1946	1947	1948 [1]
Crude petroleum (refinable):					
At refineries	48,377	50,276	53,113	52,864	60,783
Pipe line and tank farm	158,181	153,957	156,238	156,726	169,321
Producers	14,105	14,530	15,122	15,339	16,095
Total refinable	220,663	218,763	224,473	224,929	246,199
California heavy crude	6,107	4,496	5,703	5,725	10,055
Total crude petroleum	226,770	223,259	230,176	230,654	256,254
Natural gasoline	4,451	4,322	4,981	4,296	5,579
Refined products	245,868	235,998	271,937	267,103 [2] 265,850	345,469
Grand total	477,089	463,579	507,094	502,053 [2] 500,800	607,302

[1] Subject to revision.
[2] New basis comparable with succeeding years.

Total stocks of all oils totaled 607.3 million barrels on December 31, 1948, compared with the new basis of 500.8 million barrels on December 31, 1947. The increase of 106.5 million barrels during the year included an increase of 25.6 million in crude stocks, a gain of 1.3 million in natural-gasoline stocks, and an increase of 79.6 million in stocks of refined products.

Stocks of refined products amounted to 345.5 million barrels on December 31, 1948, compared with the new basis of 265.9 million on December 31, 1947. The total increase of 79.6 million barrels during the year included gains of 29.8 million barrels in residual fuel-oil stocks, 24.9 million in distillate fuel-oil stocks, 12.3 million in stocks of finished gasoline, 6.3 million in kerosine stocks, and 6.3 million barrels in all other stocks.

Stocks of crude petroleum in the United States in 1948, by location and by months [1]

[Thousands of barrels]

State	Jan. 1	Jan. 31	Feb. 29	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
Arkansas	2,621	2,755	2,806	2,731	2,736	3,041	2,894	2,849	3,014	3,074	2,960	2,957	2,808
California, Washington	24,423	23,546	23,446	23,843	24,018	23,441	23,061	22,988	22,487	25,831	26,938	25,145	23,572
Colorado	684	659	615	617	634	574	552	620	612	645	695	778	722
Georgia, Delaware, Florida, S. Carolina, Virginia	480	404	471	653	600	561	442	507	472	419	398	368	461
Illinois, Minnesota, Wisconsin	11,372	11,037	11,090	11,440	12,343	12,237	13,286	14,265	15,637	14,572	14,124	14,916	15,461
Indiana	2,963	3,209	3,333	3,327	3,450	3,341	3,493	3,463	3,531	3,235	3,700	3,355	3,659
Kansas, Nebraska	7,760	7,728	8,138	8,367	9,351	9,901	9,415	9,138	8,797	8,403	8,840	8,891	9,794
Kentucky, Tennessee	1,525	1,278	1,504	1,592	1,316	1,181	1,441	1,364	1,823	1,999	1,931	1,813	1,951
Louisiana, Alabama	12,323	12,750	12,835	12,882	12,483	11,581	11,907	11,842	12,137	12,675	13,241	13,767	13,925
Maryland	971	1,000	1,204	1,049	859	1,057	1,220	780	884	859	745	927	1,191
Massachusetts, Rhode Island	764	1,150	1,233	984	955	1,219	1,157	1,056	934	1,023	1,304	1,132	1,526
Michigan	1,411	1,139	1,231	1,191	1,439	1,335	1,298	1,353	1,390	1,574	1,421	1,444	1,551
Mississippi	1,057	1,280	1,473	1,341	1,157	1,121	1,041	1,086	1,228	1,218	999	1,116	1,052
Missouri, Iowa	5,278	5,147	5,194	5,294	5,271	5,474	5,498	5,754	5,672	5,500	5,806	5,686	5,875
Montana	1,196	1,163	1,068	1,016	1,228	1,257	1,265	1,254	1,185	1,138	1,242	1,311	1,349
New Jersey	4,291	5,855	5,944	6,858	7,428	7,537	6,408	6,409	6,064	6,005	5,957	6,646	6,627
New Mexico	1,598	1,629	1,709	1,910	2,106	2,035	1,991	2,214	2,017	2,009	2,183	2,399	2,192
New York	832	870	838	1,167	1,233	1,293	1,264	1,258	1,188	878	943	1,303	1,351
Ohio	5,206	4,841	5,206	6,142	4,767	4,862	5,106	5,227	5,455	5,922	7,013	7,184	7,101
Oklahoma	31,551	30,804	29,536	29,601	28,948	28,344	28,918	27,651	26,820	26,775	26,244	26,644	28,034
Pennsylvania	6,095	6,718	6,646	7,096	7,577	7,922	8,690	8,222	7,617	7,679	6,851	7,699	6,800
Texas	93,701	92,004	92,858	91,826	90,570	87,294	86,193	86,610	87,721	89,010	92,376	95,371	99,350
Utah	465	393	386	433	381	350	270	345	325	292	298	310	366
West Virginia	653	653	622	651	832	825	787	704	742	850	847	792	747
Wyoming, Idaho	5,709	5,418	5,494	5,397	5,596	6,037	5,884	6,165	6,459	6,816	7,559	8,129	8,734
Total gasoline-bearing crude	224,929	223,430	224,880	227,408	227,278	223,820	223,481	223,124	224,211	228,401	234,615	240,083	246,199
California heavy crude	5,725	6,412	6,539	6,756	7,228	7,498	7,931	7,831	7,743	8,901	9,357	9,983	10,055
Total crude petroleum	230,654	229,842	231,419	234,164	234,506	231,318	231,412	230,955	231,954	237,302	243,972	250,066	256,254

[1] Subject to revision.

Stocks of crude petroleum in the United States in 1948, by States of origin and by months [1]

[Thousands of barrels]

State of origin	Jan. 1	Jan. 31	Feb. 29	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
Alabama	26	24	62	85	80	95	88	48	26	37	22	42	51
Arkansas	3,250	3,376	3,267	3,305	3,115	3,115	2,988	3,022	3,298	3,271	3,384	3,593	3,363
California [2]	24,382	23,496	23,391	23,809	23,971	23,413	23,028	22,959	22,442	25,805	26,938	25,145	23,572
Colorado	1,300	1,302	1,319	1,392	1,432	1,413	1,189	1,272	1,337	1,253	1,304	1,440	1,455
Florida	108	119	137	144	157	145	116	126	104	95	36	52	72
Illinois	9,488	8,774	8,813	9,592	10,107	10,097	10,398	10,797	11,452	11,452	10,794	11,642	12,765
Indiana	129	161	159	170	225	240	252	275	310	254	217	287	310
Kansas	8,341	7,770	8,006	7,809	8,459	8,465	8,363	8,588	8,483	8,334	9,268	8,941	9,625
Kentucky	984	917	1,211	1,073	820	727	753	870	891	1,009	1,009	954	1,057
Louisiana	11,446	11,900	11,539	12,169	12,511	11,439	11,238	10,867	11,525	11,867	12,516	13,138	13,481
Michigan	879	858	885	863	965	916	967	1,040	1,055	1,031	1,081	1,155	1,140
Mississippi	2,470	2,625	2,768	2,766	2,589	2,308	2,461	2,755	2,805	2,999	2,610	2,505	2,556
Missouri, Nebraska	23	22	23	22	23	23	22	22	22	18	22	22	8,130
Montana	1,003	994	898	834	1,045	1,045	1,055	1,049	988	947	967	1,031	1,071
New Mexico	6,317	6,257	6,693	6,672	6,188	5,862	5,930	6,332	6,859	6,511	6,709	6,906	6,937
New York	179	197	197	177	188	180	183	218	202	203	185	200	188
Ohio	696	689	638	627	619	642	658	751	827	852	915	825	797
Oklahoma	26,584	25,653	25,259	25,360	24,507	24,543	25,527	24,613	24,665	25,507	26,645	26,526	27,375
Pennsylvania	1,278	1,270	1,265	1,438	1,477	1,528	1,601	1,721	1,683	1,616	1,654	1,766	1,767
Texas	114,130	115,407	116,233	116,913	115,636	114,387	113,158	111,142	111,072	111,196	112,697	116,790	119,471
West Virginia	475	484	488	487	649	554	593	561	546	619	650	604	570
Wyoming	7,456	7,081	7,053	6,854	6,939	7,353	7,327	7,670	7,792	8,111	9,206	9,876	10,422
Total	220,944	219,376	220,304	222,561	221,702	218,490	217,895	216,698	218,384	222,987	228,829	233,440	238,069
Foreign	3,985	4,054	4,576	4,847	5,576	5,330	5,586	6,426	5,827	5,414	5,786	6,643	24
Total gasoline-bearing crude	224,929	223,430	224,880	227,408	227,278	223,820	223,481	223,124	224,211	228,401	234,615	240,083	246,199
California heavy crude	5,725	6,412	6,539	6,756	7,228	7,498	7,931	7,831	7,743	8,901	9,357	9,983	10,055
Grand total	230,654	229,842	231,419	234,164	234,506	231,318	231,412	230,955	231,954	237,302	243,972	250,066	256,254

[1] Subject to revision. [2] Heavy crude stocks in California given below.

Stocks of crude petroleum in the United States in 1948, by classification and location [1]

[Thousands of barrels]

Classification and location	Jan. 1	Jan. 31	Feb. 29	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
At refineries:													
Arkansas	603	563	607	621	631	756	761	608	744	669	781	774	675
California, Washington	6,919	6,786	6,726	7,032	7,051	6,510	6,865	6,718	6,768	8,146	8,848	8,093	7,329
Colorado	316	313	302	283	308	271	219	272	254	275	304	304	248
Georgia, Delaware, South Carolina	476	398	467	641	594	557	438	502	466	412	390	363	455
Illinois, Minnesota, Wisconsin	2,451	2,543	2,780	2,894	2,897	2,486	2,648	2,814	3,377	3,181	3,290	3,140	3,242
Indiana	1,381	1,628	1,631	1,460	1,789	1,537	1,673	1,364	1,586	1,312	1,578	1,656	1,757
Kansas, Nebraska	1,644	1,504	1,452	1,626	2,025	2,292	2,141	2,058	1,957	1,985	2,228	2,064	2,097
Kentucky, Tennessee	723	476	646	717	676	583	793	626	1,115	1,136	1,114	1,019	1,016
Louisiana	3,855	4,085	4,132	4,678	4,514	3,943	3,831	4,134	4,433	4,480	4,715	4,523	4,532
Maryland	971	1,000	1,204	1,049	859	1,057	1,220	780	884	859	745	927	1,191
Massachusetts, Rhode Island	764	1,150	1,233	984	955	1,219	1,157	1,056	934	1,023	1,304	1,132	1,526
Michigan	497	317	313	291	508	427	335	327	386	532	397.	443	449
Mississippi	9	7	8	8	8	13	9	25	55	34	37	29	18
Missouri	248	269	281	303	308	256	249	257	277	271	249	286	247
Montana	507	458	386	378	497	406	431	453	436	400	428	455	439
New Jersey	4,200	5,746	5,796	6,708	7,280	7,367	6,205	6,128	5,797	5,696	5,618	6,295	6,255
New Mexico	60	53	66	70	65	51	56	54	63	56	57	72	68
New York	597	706	596	934	1,032	1,103	1,036	1,042	939	637	757	1,090	1,176
Ohio	1,552	1,395	1,352	1,838	1,529	1,303	1,170	1,078	1,198	1,110	1,407	1,370	1,270
Oklahoma	2,319	2,051	2,175	2,254	2,332	2,197	2,280	2,432	2,327	2,541	2,832	3,025	3,079
Pennsylvania	4,474	5,103	5,097	5,284	5,681	5,980	6,854	6,379	5,780	5,886	5,055	5,931	5,099
Texas	16,794	15,905	15,898	17,448	17,543	16,760	17,050	17,316	16,422	16,885	17,194	16,005	16,827
Utah	434	362	355	402	350	319	239	314	294	261	267	279	335
West Virginia	45	45	44	44	85	84	66	77	100	98	95	98	77
Wyoming, Idaho	1,025	1,028	1,025	1,042	1,290	1,274	1,064	1,058	1,092	942	1,131	1,256	1,376
Total at refineries	52,864	53,891	54,572	58,989	60,807	58,751	58,790	57,872	57,684	58,827	60,821	60,629	60,783
Pipe-line and tank-farm stocks:													
Arkansas	1,623	1,757	1,784	1,705	1,700	1,880	1,738	1,851	1,885	2,015	1,784	1,793	1,753
California	13,562	12,792	12,602	12,600	12,666	12,515	11,821	11,994	11,443	13,305.	13,610	12,645	12,097
Colorado	238	216	193	199	196	183	203	198	218	240	241	329	334
Illinois	8,286	7,819	7,650	7,921	8,836	9,111	10,013	10,821	11,655	10,786	10,184	11,146	11,604
Indiana	1,522	1,511	1,632	1,807	1,606	1,749	1,765	2,039	1,890	1,868	2,062	1,639	1,842
Kansas, Nebraska	5,221	5,304	5,831	5,846	6,421	6,664	6,274	6,075	5,830	5,428	5,587	5,837	6,712
Kentucky, Tennessee	742	737	798	815	580	538	588	678	648	803	757	734	875
Louisiana, Alabama	7,366	7,474	7,517	7,067	6,893	6,526	6,984	6,607	6,558	7,089	7,380	8,088	8,272
Michigan	729	622	713	750	746	703	773	831	809	847	824	801	912
Mississippi	663	853	1,075	973	789	738	632	636	758	779	537	667	604

See footnote at end of table.

Stocks of crude petroleum in the United States in 1948, by classification and location[1]—Continued

[Thousands of barrels]

Classification and location	Jan. 1	Jan. 31	Feb. 29	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—Con.													
Missouri, Iowa	5,029	4,877	4,911	4,990	4,962	5,216	5,248	5,496	5,394	5,228	5,556	5,399	5,626
Montana	539	550	517	473	581	691	679	641	584	568	639	686	740
New Jersey	91	109	148	150	148	170	203	281	267	309	339	351	372
New Mexico	998	1,031	1,088	1,275	1,466	1,389	1,335	1,565	1,339	1,348	1,516	1,727	1,544
New York	205	134	212	203	171	160	198	186	219	211	156	183	145
Ohio	3,564	3,351	3,759	4,214	3,148	3,464	3,846	4,059	4,162	4,722	5,511	5,724	5,741
Oklahoma	28,102	27,573	26,096	26,187	25,491	24,942	25,428	23,999	23,273	23,034	22,117	22,379	23,775
Pennsylvania	1,456	1,450	1,384	1,642	1,736	1,777	1,676	1,688	1,677	1,633	1,631	1,598	1,541
Texas	72,087	70,834	71,870	69,548	68,162	65,544	64,103	64,214	66,214	67,004	69,847	74,201	77,408
Utah	31	31	31	31	31	31	31	31	31	31	31	31	31
West Virginia	443	438	413	447	582	576	561	467	482	597	597	534	515
Wyoming	4,229	3,915	4,009	3,915	3,876	4,323	4,370	4,637	4,902	5,399	5,933	6,393	6,878
Total pipe-line and tank-farm stocks	156,726	153,378	154,233	152,758	150,787	148,890	148,469	148,994	150,238	153,244	156,839	162,885	169,321
Producers' stocks	15,339	16,161	16,075	15,661	15,684	16,179	16,222	16,258	16,289	16,330	16,955	16,569	16,095
Grand total: 1948[2]	224,929	223,430	224,880	227,408	227,278	223,820	223,481	223,124	224,211	228,401	234,615	240,083	246,199
1947[3]	224,473	223,848	225,121	228,981	235,710	237,768	237,278	230,974	228,523	225,258	226,666	225,462	224,929

[1] Excludes stocks of California heavy crude.
[2] Subject to revision.
[3] Final figures.

Total stocks of crude petroleum amounted to 256.3 million barrels on December 31, 1948. The increase of 25.6 million barrels during the year included a gain of 4.1 million in stocks of foreign crude oil and an increase of 21.5 million in stocks of domestic crude oil. The principal gains in domestic crude stocks in 1948, by States of origin, were 5.3 million barrels for Texas, 3.5 million for California, 3.3 million for Illinois, 3.0 million for Wyoming, 2.0 million for Louisiana, and 1.3 million for Kansas. A very unusual factor was an increase in crude stocks originating in every important producing State.

PRICES AND VALUE

The average value of crude petroleum at the well, as reported in the annual survey of the Bureau of Mines, rose from $1.41 per barrel in 1946 to $1.93 per barrel in 1947. The results of the 1948 survey are not yet available, but the average value at the well in 1948 is estimated at $2.58 per barrel. There were no general changes in the posted prices of crude oil except a reduction in some types of Pennsylvania Grade oil in December. The posted price per barrel for the Bradford and Allegany districts was reduced from $5.00 to $4.50 on December 11, 1948, and the posted price in Southwest Pennsylvania pipe lines was reduced from $4.79 per barrel to $4.29 on December 11 and further reduced to $4.10 per barrel on December 31, 1948.

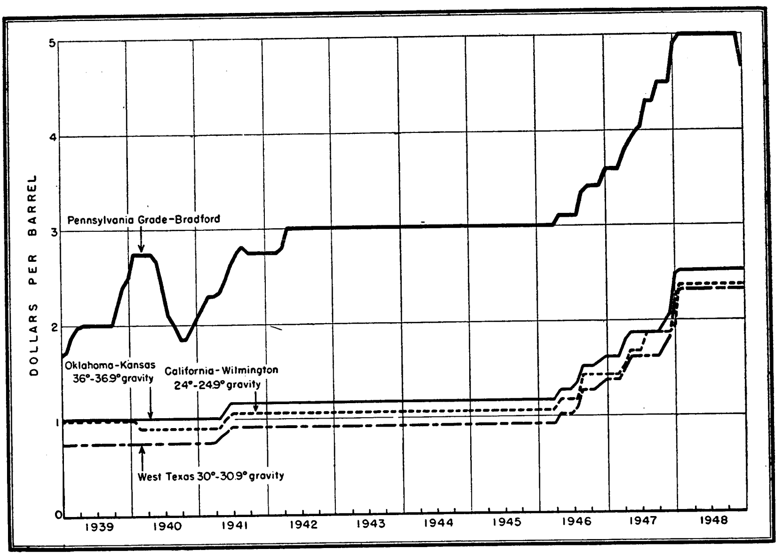

FIGURE 5.—Posted prices of selected grades of crude petroleum in the United States, 1939–48, by months.

Value of crude petroleum at wells in the United States, 1946–47, by States [1]

State	1946 Total (thousands of dollars)	1946 Average per barrel	1947 Total (thousands of dollars)	1947 Average per barrel
Arkansas	35,750	$1.26	54,500	$1.82
California	387,100	1.23	572,990	1.72
Colorado	15,650	1.32	29,680	1.89
Illinois	119,720	1.59	139,560	2.10
Indiana	10,690	1.59	12,800	2.10
Kansas	138,050	1.42	202,900	1.93
Kentucky	17,030	1.61	19,830	2.11
Louisiana:				
Gulf Coast	163,570	1.45	248,650	2.01
Northern	44,140	1.43	72,480	1.99
Total Louisiana	207,710	1.45	321,130	2.01
Michigan	27,660	1.62	34,540	2.13
Mississippi	30,130	1.24	61,470	1.76
Montana	12,710	1.44	16,960	1.94
Nebraska	400	1.35	420	1.85
New Mexico	44,540	1.21	72,440	1.77
New York	18,630	3.83	20,050	4.21
Ohio	7,710	2.65	10,440	3.36
Oklahoma	194,100	1.44	270,760	1.92
Pennsylvania	49,640	3.82	53,170	4.19
Texas:				
Gulf Coast	365,080	1.51	531,580	2.05
West Texas	236,520	1.23	401,230	1.80
East Texas	175,140	1.45	231,880	1.98
Other districts	293,660	1.43	432,940	1.96
Total Texas	1,070,400	1.41	1,597,630	1.95
West Virginia	9,960	3.40	10,210	3.90
Wyoming	44,430	1.14	75,220	1.68
Alabama, Florida, Missouri, Tennessee, and Virginia	540	1.04	1,190	1.53
Grand total	2,442,550	1.41	3,577,890	1.93

[1] Data for 1948 not yet available.

Posted price per barrel of petroleum at wells in the United States in 1948, by grades, with dates of change

Date	Pennsylvania Grade: Bradford and Allegany districts [1]	Pennsylvania Grade: In Southwest Pennsylvania pipe lines [2]	Corning Grade in Buckeye Pipe Line Co. [3]	Western Kentucky [3]	Illinois Basin [4]	Midland, Mich. [5]	Oklahoma-Kansas [6]: 34°–34.9°	Oklahoma-Kansas [6]: 36°–36.9°
Jan. 1	$5.00	$4.79	$3.10	$2.77	$2.77	$2.89	$2.53	$2.57
Dec. 11	4.50	4.29						
Dec. 31		4.10						

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, 24°–24.9° [7]	East Texas [7]	Gulf Coast: Conroe, Tex. [8]	Gulf Coast: Texas 30°–30.9° [8]	Gulf Coast: Texas 20°–20.9° [8]	Gulf Coast: Louisiana 30°–30.9° [9]
Jan. 1	$2.55	$2.32	$2.32	$2.63	$2.65	$2.83	$2.68	$2.48	$2.55

See footnotes at end of table.

Posted price per barrel of petroleum at wells in the United States in 1948, by grades, with dates of change—Continued

Date	Rodessa, La., 36°-36.9° [9]	Smackover, Ark.[10]	Elk Basin, Wyo. 30°-30.9° [4]	Salt Creek, Wyo. 36°-36.9°[11]	California [12]			
					Coalinga 32°-32.9°	Kettleman 37°-37.9°	Midway-Sunset 19°-19.9°	Wilmington, 24°-24.9°
Jan. 1	$2.57	$2.33	$2.27	$2.57	$2.49	$2.64	$2.23	$2.37

[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] Esso Standard Oil Co.
[10] Arkansas Fuel Oil Co.
[11] Stanolind Oil & Gas Co.
[12] Standard Oil Co. of California.

REFINED PRODUCTS

GENERAL REVIEW

The total demand for all oils averaged 6,129,000 barrels daily in 1948, an increase of 4 percent compared with 1947. This increase was substantially less than had been expected, particularly in the latter half of the year, when there was a relative decline in the rate of increase accentuated by abnormally mild weather in the last quarter. Crude runs to stills reached a peak in the last quarter of 1948 and, combined with a much lower demand than expected, resulted in an abnormal increase in refined stocks of 21.2 million barrels in the last quarter.

Runs to stills and production at refineries in the United States of the various refined petroleum products, 1944–48

[Thousands of barrels]

Product	1944	1945	1946	1947	1948 [1]
Input:					
Crude petroleum:					
Domestic	1,622,514	1,645,862	1,645,845	1,754,987	1,906,656
Foreign	43,170	73,672	84,352	97,259	124,014
Total crude petroleum	1,665,684	1,719,534	1,730,197	1,852,246	2,030,670
Natural gasoline	67,207	70,324	62,861	70,692	76,237
Total input	1,732,891	1,789,858	1,793,058	1,922,938	2,106,907
Output:					
Gasoline	722,718	774,460	748,411	814,841	895,913
Kerosine	78,344	81,024	104,385	110,412	121,853
Distillate fuel oil	239,152	249,224	287,896	312,173	380,639
Residual fuel oil	461,455	469,492	431,364	447,795	466,141
Lubricating oil	41,106	41,867	45,645	51,765	51,416
Wax [2]	2,883	2,921	3,003	3,624	3,515
Coke [2]	9,017	10,115	10,621	12,077	14,494
Asphalt [2]	38,479	39,196	44,911	49,286	51,919
Still gas [2]	102,239	103,458	88,136	85,564	81,159
Road oil	1,556	2,686	6,175	7,074	7,915
Other finished products	18,436	19,080	22,539	24,348	30,605
Unfinished gasoline (net)	1,745	[3] 4,892	[3] 108	984	[3] 917
Other unfinished oils (net)	2,584	[3] 5,727	[3] 1,615	[3] 1,227	[3] 381
Shortage	13,177	6,954	1,695	4,222	2,636
Total output	1,732,891	1,789,858	1,793,058	1,922,938	2,106,907

[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.

The 4-percent increase in total demand in 1948 included an 8-percent gain in motor-fuel demand compared with 1947, a 3-percent decline in residual fuel-oil demand, a 10-percent increase in distillate fuel-oil demand, a 5-percent gain in kerosine demand, and a 0.4-percent decline in the demand for all other products.

A decline of almost 20 percent in the exports of refined products substantially changed the relative gains in domestic demand. With a total increase in domestic demand of 6 percent compared with 1947, the domestic demand for motor fuel increased 9 percent, residual demand declined 4 percent, distillate demand increased 14 percent, kerosine demand rose 9 percent, and the domestic demand for all other oils gained 3 percent.

The supply of refined products is directly related to the volume of refinery output from crude oil, the production of light products derived from natural gas at natural-gasoline and cycle plants, and the imports of refined products.

Refineries operated close to capacity during most of 1948, with total crude runs to stills averaging 5,548,000 barrels daily compared with 5,075,000 barrels daily in 1947—a gain of 9 percent. Runs in the first quarter averaged 5,372,000 barrels daily, rose to 5,614,000 barrels daily in the second quarter under the stimulus of rebuilding stocks of heating oils depleted by the cold winter of 1947–48, were cut back to 5,544,000 barrels daily in the third quarter due largely to an extended strike at refineries in California in September, and reached a record level of 5,662,000 barrels daily in the fourth quarter. This high rate of refinery operations was stimulated by the determination to avoid any possibility of a shortage in oil supply such as occurred, at least locally, in the first quarter of 1948. An unexpected drop in the rate of increasing demand occurred in the latter part of the year, accentuated by abnormally warm fall and winter weather. Stocks of refined products increased by 79.6 million barrels during the year. A decrease of 13.4 million barrels in the first quarter was followed by increases of 33.6 million in the second quarter, 38.2 million in the third quarter, and 21.2 million in the fourth quarter. The large gain in stocks of refined products in the last quarter, when normally a substantial decline may be expected, resulted in such a large surplus of stocks at the end of the year as to distort normal runs and yields during much of 1949.

The output of light products at natural-gasoline and cycle plants increased from 132.2 million barrels in 1947 to 145.5 million in 1948—a gain of about 10 percent on a daily average basis. In addition, some motor benzol from coke-oven operations was blended with motor fuel, amounting to 0.7 million barrels in 1947 and 0.4 million in 1948. The light products in this group marketed in 1948 amounted to 144.6 million barrels, with about 70 percent of the total included in motor fuel, 29 percent sold as liquefied petroleum gases (LP–gases) for fuel and chemical uses, and 1 percent transferred to other products.

Salient statistics of the major refined petroleum products in the United States, 1944–48

[Thousands of barrels]

Product	1944	1945	1946	1947	1948 [1]
Motor fuel:					
Production	739, 340	798, 194	776, 583	839, 998	921, 902
Imports	3, 148	1, 807	1	358	302
Exports	100, 537	88, 059	45, 334	47, 449	37, 410
Stocks, end of year	78, 073	93, 682	89, 515	87, 407	101, 001
Domestic demand	632, 482	696, 333	735, 417	795, 015	871, 200
Kerosine:					
Production	78, 344	81, 024	104, 385	110, 412	121, 853
Imports	147				135
Exports	4, 888	6, 180	8, 637	7, 252	3, 535
Stocks, end of year	11, 150	10, 421	17, 081	17, 722	24, 010
Domestic demand	71, 812	75, 573	89, 088	102, 519	112, 165
Distillate fuel oil:					
Production	239, 152	249, 224	287, 896	312, 173	380, 639
Transfers from crude	3, 242	3, 047	3, 123	3, 263	3, 543
Imports	7, 022	4, 754	5, 204	4, 175	2, 546
Exports	43, 491	33, 496	29, 487	29, 877	21, 808
Stocks, end of year	38, 333	35, 778	59, 620	51, 081	75, 953
Domestic demand	209, 320	226, 084	242, 894	298, 273	340, 048
Residual fuel oil:					
Production	461, 455	469, 492	431, 364	447, 795	466, 141
Transfers from crude	28, 515	20, 727	23, 142	27, 091	23, 847
Imports	36, 485	31, 648	44, 647	54, 244	53, 161
Exports	12, 536	11, 669	9, 188	10, 623	12, 539
Stocks, end of year	50, 383	37, 158	47, 094	47, 091	76, 942
Domestic demand	512, 020	523, 423	480, 029	518, 510	500, 759
Lubricating oil:					
Production	41, 106	41, 867	45, 645	51, 765	51, 416
Imports			88	38	101
Exports	8, 709	6, 575	11, 051	14, 262	12, 990
Stocks, end of year	7, 815	7, 773	7, 564	[2] 7, 701	9, 843
Domestic demand	32, 363	35, 334	34, 891	36, 481	36, 385
Wax (1 bbl.=280 lb.):					
Production	2, 883	2, 921	3, 003	3, 624	3, 515
Imports		6	1	4	27
Exports	580	566	718	1, 107	994
Stocks, end of year	335	293	308	351	551
Domestic demand	2, 261	2, 403	2, 271	2, 478	2, 348
Coke (5 bbl.=1 short ton):					
Production	9, 017	10, 115	10, 621	12, 077	14, 494
Exports	1, 045	1, 046	1, 933	2, 102	2, 521
Stocks, end of year	936	791	450	343	646
Domestic demand	8, 327	9, 214	9, 029	10, 082	11, 670
Asphalt (5.5 bbl.=1 short ton):					
Production	38, 479	39, 196	44, 911	49, 286	51, 919
Imports	695	809	691	1, 159	1, 362
Exports	699	1, 289	2, 298	3, 262	1, 618
Stocks, end of year	3, 444	3, 810	3, 861	[2] 3, 771	5, 657
Domestic demand	38, 129	38, 350	43, 253	47, 023	49, 777
Still gas (1 bbl.=3,600 cu. ft.): Production	102, 239	103, 458	88, 136	85, 564	81, 159
Road oil:					
Production	1, 556	2, 686	6, 175	7, 074	7, 915
Stocks, end of year	189	370	606	613	501
Domestic demand	1, 560	2, 505	5, 939	7, 067	8, 027
Other finished products:					
Production:					
LR-gases [3]	8, 563	9, 292	15, 440	18, 670	23, 676
Other	9, 873	9, 788	7, 099	5, 678	6, 929
Transfers of LP-gases [4] from natural gasoline	16, 796	19, 978	25, 515	35, 310	41, 697
Exports	893	1, 105	2, 041	2, 188	1, 699
Stocks, end of year	965	1, 061	1, 120	[2] 1, 027	1, 307
Domestic demand	34, 108	37, 857	45, 954	57, 483	70, 323
Unfinished gasoline:					
Rerun (net)	[5] 1, 745	4, 892	108	[5] 984	917
Stocks, end of year	13, 208	8, 316	8, 208	9, 192	8, 275
Other unfinished oils:					
Rerun (net)	[5] 2, 584	5, 727	1, 615	1, 227	381
Transfers of cycle products	1, 821	848	1, 261	1, 704	1, 914
Imports	9	258	978	1, 879	982
Stocks, end of year	45, 488	40, 867	41, 491	43, 847	46, 362
Shortage	13, 177	6, 954	1, 695	4, 222	2, 636

[1] Subject to revision.
[2] Figure on new basis that excludes distributors' stocks in California and is comparable with 1948 total. Figures for 1947 on the old basis and comparable with preceding years are as follows, in thousands of barrels: Lubricating oil, 8,624; asphalt, 4,021; and other finished products, 1,107.
[3] Liquefied refinery gases.
[4] Liquefied petroleum gases.
[5] Negative quantity; represents net excess of unfinished oils produced over unfinished oils rerun.

Imports of refined products into continental United States declined from 61.9 million barrels in 1947 to 58.6 million in 1948. Residual fuel oil is the major product imported, amountng to 54.2 million barrels in 1947 and 53.2 million in 1948. Most of this residual fuel oil is withdrawn from bond duty free for use in bunkering ships engaged in the foreign trade. Other imports in 1948 included 2.5 million barrels of distillate fuel oil, 1.4 million barrels of asphalt, 1.0 million barrels of unfinished oils, 0.3 million barrels of gasoline, and small amounts of kerosine, lubricating oils, and wax.

The yields of refined products from crude oil are normally the resultant of the amount of crude oil run and the shift in the relative demand for the various refined products. In 1948 the unusual increase of almost 80 million barrels in the stocks of refined products

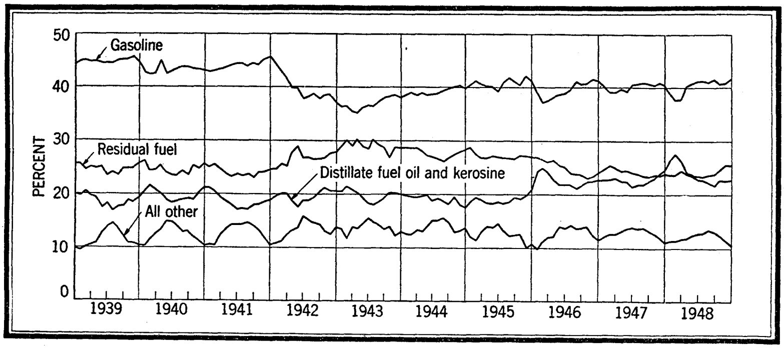

FIGURE 6—Yields of principal products from crude oil run to stills in the United States, 1939–48, by months.

Percentage yields of refined petroleum products in the United States, 1939–48

Product	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948 [1]
Finished products:										
Gasoline:										
Cracked	23.9	22.7	24.4	22.3	22.0	23.2	23.3	22.5	(2)	(2)
Straight run	21.1	20.4	19.8	17.5	15.1	16.2	17.6	17.1	(2)	(2)
Total gasoline	45.0	43.1	44.2	39.8	37.1	39.4	40.9	39.6	40.2	40.3
Kerosine	5.5	5.7	5.2	5.1	5.0	4.7	4.7	6.0	6.0	6.0
Distillate fuel oil	13.1	14.2	13.4	14.7	14.8	14.4	14.5	16.6	16.8	18.7
Residual fuel oil	24.7	24.4	24.3	26.9	29.2	27.7	27.3	24.9	24.1	23.0
Lubricating oil	2.8	2.8	2.8	2.9	2.7	2.5	2.4	2.7	2.8	2.5
Wax	.1	.1	.2	.2	.2	.2	.2	.2	.2	.2
Coke	.7	.6	.6	.5	.5	.5	.6	.6	.7	.7
Asphalt	2.2	2.3	2.6	2.6	2.6	2.3	2.3	2.6	2.7	2.6
Road oil	.6	.6	.6	.6	.2	.1	.2	.4	.4	.4
Still gas	5.5	5.5	5.9	5.9	6.1	6.1	6.0	5.1	4.6	4.0
Other	.2	.3	.4	.6	.7	1.1	1.1	1.3	1.3	1.5
Unfinished products:										
Gasoline	(3 4)	.1	.1	.1	(3)	.1	[4] .3	(3 4)	(5)	(5)
Other	[4] .9	[4] .3	[4] .2	[4] .3	.2	.1	[4] .3	[4] .1	(6)	(6)
Shortage	.5	.6	[4] .1	.4	.7	.8	.4	.1	.2	.1
Total	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] Not separated in 1947–48.
[3] Less than 0.1 percent.
[4] Negative percentage; represents excess rerun over produced.
[5] Added to finished gasoline production in computing yields in 1947–48.
[6] Added to crude runs in computing yields in 1947–48.

tended to distort yields to meet an expected rather than an actual demand. There was a small increase in the yield of gasoline from 40.2 percent in 1947 to 40.3 percent in 1948; the yield of residual fuel oil declined from 24.1 percent in 1947 to 23.0 percent in 1948; the yield of distillate fuel oil increased from 16.8 percent in 1947 to 18.7 percent in 1948; and the yield of kerosine remained at 6.0 percent for both years. If crude runs had been better-adjusted to actual demand, allowing for a moderate increase in refined stocks, the principal adjustments in yields would have been an increase for gasoline and a decrease for distillate fuel oil.

The average increase in the value of crude oil at the well—about 65 cents per barrel in 1948—was reflected in price increases for the principal refined products. The average price of Regular Grade gasoline at Oklahoma refineries rose from 8.42 cents per gallon in 1947 to 11.19 cents in 1948. The average tank-wagon price of kerosine at Chicago rose from 13.40 cents per gallon in 1947 to 15.85 cents in 1948. The average price of a selected bright at Oklahoma refineries rose from 28.84 cents per gallon in 1947 to 31.67 cents in 1948. The price of Bunker "C" oil at New York rose from $2.29 per barrel in 1947 to $3.00 in 1948. The price of No. 2 distillate heating oil at New York rose from 7.02 cents per gallon in 1947 to 9.71 cents in 1948.

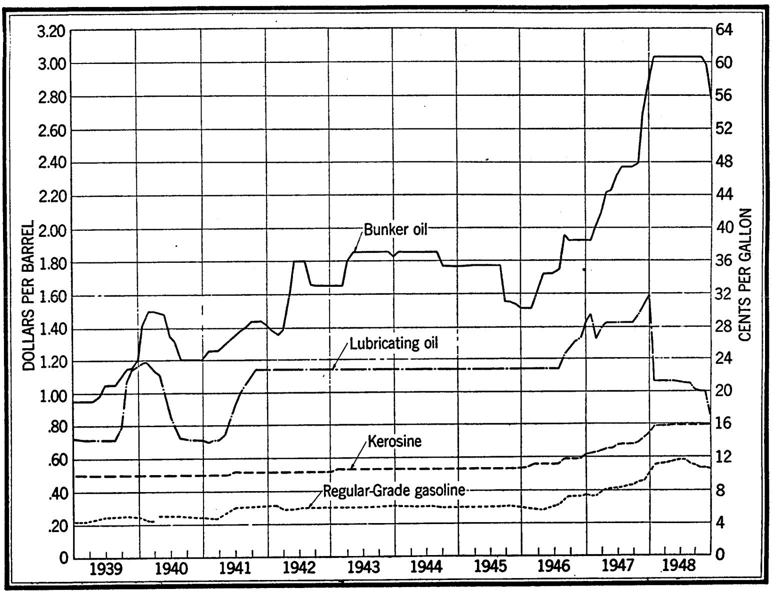

FIGURE 7.—Prices of Bunker "C" oil at New York Harbor, bright stock at Oklahoma refineries, tank-wagon prices of kerosine at Chicago, and Regular Grade gasoline at refineries in Oklahoma, 1939–48, by months.

Stocks of refined petroleum products in the United States, 1947–48, by months

[Thousands of barrels]

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
1947												
Gasoline	90,300	94,985	96,952	92,719	86,727	81,160	77,069	77,190	75,882	74,710	78,669	83,111
Kerosine	13,732	11,493	9,811	9,625	12,609	14,653	17,651	20,824	22,276	22,750	20,626	17,722
Distillate fuel oil	48,197	36,901	31,423	30,268	34,279	39,676	46,444	54,707	59,764	63,252	61,334	51,081
Residual fuel oil	41,550	38,480	37,403	36,455	39,992	43,515	47,600	51,334	52,578	52,502	52,455	47,091
Lubricating oil	7,773	7,753	8,015	7,936	8,070	8,281	8,188	8,420	8,340	8,157	8,531	[2] 8,624
Wax [1]	293	304	327	306	319	315	334	314	344	325	346	351
Coke [1]	468	385	456	445	422	443	430	549	475	483	416	343
Asphalt [1]	4,300	4,885	5,510	5,657	5,847	5,503	4,764	3,941	3,288	2,974	3,637	[2] 4,021
Road oil	634	617	688	801	1,101	1,196	898	759	664	559	577	613
Other finished products	1,070	1,062	1,169	1,126	1,268	1,241	1,352	1,245	1,205	1,180	1,207	[2] 1,107
Unfinished gasoline	9,323	8,687	8,727	9,005	8,482	8,614	8,934	8,659	8,478	7,874	8,882	9,192
Other unfinished oils	41,270	41,084	40,542	41,694	42,829	43,905	44,769	43,854	45,119	43,313	44,048	43,847
Total 1947	258,910	246,636	241,023	236,037	241,945	248,502	258,433	271,796	278,413	278,079	280,728	[2] 267,103
1948 [3]												
Gasoline	93,290	102,235	103,398	101,280	99,554	96,221	90,310	87,187	82,254	83,969	87,275	95,422
Kerosine	11,993	10,287	10,464	12,795	15,711	18,480	20,958	23,564	26,177	26,283	25,829	24,010
Distillate fuel oil	41,036	34,590	32,214	34,514	40,781	48,352	58,725	68,818	76,320	82,920	83,909	75,953
Residual fuel oil	44,636	43,156	41,945	43,301	48,788	52,465	58,431	64,096	68,005	72,363	77,033	76,942
Lubricating oil	7,892	7,829	7,961	8,022	8,411	8,166	8,350	8,747	8,884	9,306	9,512	9,843
Wax [1]	374	369	360	389	402	439	487	531	541	552	554	551
Coke [1]	337	396	331	343	417	457	502	553	544	574	583	646
Asphalt [1]	4,468	5,092	5,614	5,956	6,359	5,764	5,267	4,394	3,749	3,768	4,727	5,657
Road oil	644	730	772	1,017	1,067	1,021	879	750	654	520	471	501
Other finished products	1,171	1,231	1,234	1,224	1,397	1,349	1,335	1,334	1,367	1,377	1,443	1,307
Unfinished gasoline	8,877	8,764	8,551	8,549	8,998	8,297	8,529	8,258	8,264	8,457	8,314	8,275
Other unfinished oils	41,888	39,425	39,657	42,338	44,436	45,119	46,755	46,100	47,536	47,286	47,323	46,362
Total 1948	256,606	254,104	252,501	259,728	276,321	286,130	300,528	314,332	324,295	337,375	346,973	345,469

[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.
[2] Old basis. New basis to compare with 1948: Lubricating oil, 7,701; asphalt, 3,771; other finished products, 1,027; total 265,850.
[3] Subject to revision.

Runs to stills and production at refineries in the United States of the various refined petroleum products, 1947–48, by months

[Thousands of barrels]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1947													
Input:													
Crude petroleum	146,897	134,953	150,120	141,210	153,348	153,604	161,844	163,068	159,771	162,854	158,719	165,858	1,852,246
Natural gasoline	5,859	4,908	5,271	5,618	5,300	5,898	6,176	6,477	6,513	6,355	6,323	5,994	70,692
Total input	152,756	139,861	155,391	146,828	158,648	159,502	168,020	169,545	166,284	169,209	165,042	171,852	1,922,938
Output:													
Gasoline	64,419	58,499	64,340	61,120	65,981	67,753	71,376	73,881	71,257	73,505	69,946	72,764	814,841
Kerosine	9,415	9,243	9,476	8,854	9,284	8,717	9,117	8,970	8,547	9,308	9,352	10,129	110,412
Distillate fuel oil	24,131	21,746	25,577	22,925	24,954	24,214	26,270	26,946	27,325	29,072	28,254	30,759	312,173
Residual fuel oil	36,390	34,390	37,876	34,438	37,328	36,977	38,550	38,592	37,098	39,066	37,344	39,746	447,795
Lubricating oil	4,204	3,925	4,480	4,267	4,608	4,427	4,227	4,400	4,047	4,350	4,264	4,566	51,765
Wax [1]	299	292	334	286	320	279	320	236	321	286	307	344	3,624
Coke [1]	1,016	890	1,047	974	1,090	1,006	1,119	1,002	959	1,050	876	1,048	12,077
Asphalt [1]	2,973	2,928	3,315	3,337	4,341	4,531	4,839	5,431	5,125	4,956	3,998	3,512	49,286
Road oil	256	225	265	355	718	844	1,068	1,220	1,091	541	255	236	7,074
Still gas [1]	6,800	6,313	7,124	6,839	7,445	7,589	8,026	8,028	7,370	7,068	6,504	6,458	85,564
LR-gases	1,781	1,617	1,793	1,335	1,375	1,291	1,423	1,402	1,435	1,621	1,777	1,820	18,670
Other miscellaneous	472	509	511	475	471	440	471	472	384	466	465	542	5,678
Unfinished gasoline (net)	1,115	[2] 636	40	278	[2] 523	132	320	[2] 275	[2] 181	[2] 604	1,008	310	984
Other unfinished oils (net)	[2] 578	[2] 366	[2] 1,018	906	726	693	428	[2] 1,096	1,052	[2] 2,053	473	[2] 394	[2] 1,227
Shortage	63	286	231	439	530	609	466	336	454	577	219	12	4,222
Total output	152,756	139,861	155,391	146,828	158,648	159,502	168,020	169,545	166,284	169,209	165,042	171,852	1,922,938
1948 [3]													
Input:													
Crude petroleum	165,796	156,014	167,007	166,198	175,705	168,952	174,546	174,242	161,280	173,429	170,166	177,335	2,030,670
Natural gasoline	6,434	5,695	6,187	6,058	6,551	5,979	6,123	6,535	5,962	6,617	6,953	7,143	76,237
Total input	172,230	161,709	173,194	172,256	182,256	174,931	180,669	180,777	167,242	180,046	177,119	184,478	2,106,907

See footnotes at end of table.

Runs to stills and production at refineries in the United States of the various refined petroleum products, 1947–48, by months—Con.

[Thousands of barrels]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1948 [3]—Continued													
Output:													
Gasoline	72,178	65,659	69,795	71,892	77,052	75,862	77,344	78,499	72,484	77,196	76,541	81,411	895,913
Kerosine	10,697	11,030	11,262	10,236	9,973	9,383	9,442	9,180	9,288	9,663	10,848	10,851	121,853
Distillate fuel oil	33,539	32,688	32,548	29,352	30,764	29,930	30,820	32,190	28,960	33,140	32,434	34,274	380,639
Residual fuel oil	39,606	37,542	40,523	39,104	40,732	38,387	39,177	38,673	34,493	39,313	38,315	40,276	466,141
Lubricating oil	4,287	4,132	4,404	4,308	4,500	4,065	4,135	4,341	4,121	4,580	4,175	4,368	51,416
Wax [1]	350	294	351	332	295	308	267	267	238	263	268	282	3,515
Coke [1]	1,020	1,013	1,209	1,126	1,087	1,281	1,296	1,295	1,228	1,247	1,296	1,396	14,494
Asphalt [1]	3,231	3,035	3,432	3,723	4,501	5,011	5,394	5,842	5,072	5,159	4,211	3,308	51,919
Road oil	230	320	292	506	727	990	1,329	1,336	1,070	532	323	260	7,915
Still gas [1]	6,384	6,004	6,339	6,813	7,330	7,182	7,401	7,418	6,595	6,613	6,577	6,503	81,159
LR-gases	1,876	2,233	2,104	1,881	2,014	1,975	1,836	2,081	1,849	1,805	1,886	2,136	23,676
Other miscellaneous	693	551	591	557	692	570	489	579	455	577	594	581	6,929
Unfinished gasoline (net)	[2] 315	[2] 113	[2] 213	[2] 2	449	[2] 701	232	[2] 271	6	193	[2] 143	[2] 39	[2] 917
Other unfinished oils (net)	[2] 2,323	[2] 2,799	[2] 83	2,363	1,866	519	1,485	[2] 813	1,289	[2] 511	[2] 218	[2] 1,156	[2] 381
Shortage	777	120	640	65	274	169	22	160	94	276	12	27	2,636
Total output	172,230	161,709	173,194	172,256	182,256	174,931	180,669	180,777	167,242	180,046	177,119	184,478	2,106,907

[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 of unfinished oils rerun over unfinished oils produced.
[3] Subject to revision.

Runs to stills and production at refineries in the United States of the various refined petroleum products, 1947–48, by districts

[Thousands of barrels]

	East Coast	Appalachian	Indiana, Illinois, Kentucky, etc.	Oklahoma, Kansas, Missouri	Texas Inland	Texas Gulf Coast	Louisiana Gulf Coast	Arkansas-Louisiana Inland	Rocky Mountain	California	Total
1947											
Input:											
Crude petroleum	297, 315	60, 377	301, 357	153, 050	84, 582	437, 024	139, 940	24, 825	52, 343	301, 433	1, 852, 246
Natural gasoline	883	530	8, 088	6, 002	11, 911	16, 925	3, 100	950	918	21, 385	70, 692
Total input	298, 198	60, 907	309, 445	159, 052	96, 493	453, 949	143, 040	25, 775	53, 261	322, 818	1, 922, 938
Output:											
Gasoline	104, 098	27, 039	147, 985	77, 581	52, 599	191, 335	58, 704	9, 239	23, 373	122, 888	814, 841
Kerosine	14, 257	3, 570	18, 324	8, 792	5, 477	34, 119	17, 394	2, 578	1, 250	4, 651	110, 412
Distillate fuel oil	57, 111	7, 362	45, 749	26, 230	7, 175	82, 850	27, 512	3, 459	8, 227	46, 498	312, 173
Residual fuel oil	86, 769	10, 250	57, 259	25, 246	21, 064	88, 592	24, 324	5, 410	13, 710	115, 171	447, 795
Lubricating oil	11, 078	5, 531	5, 261	5, 861	369	15, 009	2, 350	1, 484	311	4, 511	51, 765
Wax [1]	1, 387	397	227	475	11	528	413	-----------	95	91	3, 624
Coke [1]	729	333	5, 205	728	554	1, 535	1, 184	-----------	233	1, 576	12, 077
Asphalt [1]	13, 596	2, 260	8, 693	4, 554	2, 217	2, 555	3, 269	2, 795	1, 576	7, 771	49, 286
Road oil	150	7	1, 520	557	-----------	85	3	17	1, 363	3, 372	7, 074
Still gas [1]	11, 690	3, 417	15, 580	6, 653	4, 058	24, 220	5, 636	1, 459	2, 210	10, 641	85, 564
LR-gases	2, 675	12	2, 073	329	132	4, 251	5, 036	308	62	3, 792	18, 670
Other miscellaneous	469	417	801	950	1, 111	811	93	183	66	777	5, 678
Unfinished gasoline (net)	[2] 440	[2] 65	215	62	[2] 73	1, 653	72	[2] 2	4	[2] 442	984
Other unfinished oils (net)	[2] 5, 880	[2] 89	669	244	[2] 594	6, 740	[2] 1, 667	[2] 472	97	[2] 275	[2] 1, 227
Shortage	509	466	[3] 116	790	2, 393	[3] 334	[3] 1, 283	[3] 683	684	1, 796	4, 222
Total output	298, 198	60, 907	309, 445	159, 052	96, 493	453, 949	143, 040	25, 775	53, 261	322, 818	1, 922, 938
1948 [4]											
Input:											
Crude petroleum	317, 257	57, 637	332, 233	165, 249	89, 909	509, 587	159, 223	29, 759	59, 631	310, 185	2, 030, 670
Natural gasoline	882	619	8, 423	7, 524	13, 843	18, 303	3, 188	778	1, 016	21, 661	76, 237
Total input	318, 139	58, 256	340, 656	172, 773	103, 752	527, 890	162, 411	30, 537	60, 647	331, 846	2, 106, 907

Runs to stills and production at refineries in the United States of the various refined petroleum products, 1947–48, by districts—Con.

[Thoussnds of barrels]

	East Coast	Appalachian	Indiana, Illinois, Kentucky, etc.	Oklahoma, Kansas, Missouri	Texas Inland	Texas Gulf Coast	Louisiana Gulf Coast	Arkansas-Louisiana Inland	Rocky Mountain	California	Total
1948 [4]—Continued											
Output:											
Gasoline	111,937	25,592	167,136	84,831	55,389	220,423	66,693	11,003	26,695	126,214	895,913
Kerosine	17,004	3,819	21,780	8,916	5,232	37,910	18,409	2,965	1,707	4,111	121,853
Distillate fuel oil	67,377	7,597	49,486	30,760	8,932	115,928	35,489	4,626	10,209	50,235	380,639
Residual fuel oil	84,111	9,652	57,521	27,667	22,203	95,385	27,790	6,764	14,362	120,686	466,141
Lubricating oil	11,163	5,068	5,042	6,131	383	16,129	1,978	1,376	300	3,846	51,416
Wax [1]	1,342	391	278	440	9	463	400	----------	104	88	3,515
Coke [1]	755	317	7,183	1,005	584	1,527	1,249	----------	269	1,605	14,494
Asphalt [1]	14,757	1,676	9,962	5,189	2,521	2,930	3,171	2,980	2,073	6,660	51,919
Road oil	174	7	1,913	511	----------	76	1	16	1,686	3,531	7,915
Still gas [1]	9,491	3,022	15,588	6,489	4,035	22,802	5,734	1,444	2,233	10,321	81,159
LR-gases	3,796	34	2,999	563	77	7,015	5,097	400	51	3,644	23,676
Other miscellaneous	548	296	996	977	1,538	946	87	163	90	1,288	6,929
Unfinished gasoline (net)	[2] 258	24	[2] 138	[2] 58	2,197	[2] 1,972	[2] 104	----------	1	[2] 609	[2] 917
Other unfinished oils (net)	[2] 5,516	272	2,337	[2] 1,472	[2] 781	7,518	[2] 1,997	[2] 520	97	[2] 319	[2] 381
Shortage	1,458	489	[3] 1,427	824	1,433	810	[3] 1,586	[3] 680	770	545	2,636
Total output	318,139	58,256	340,656	172,773	103,752	527,890	162,411	30,537	60,647	331,846	2,106,907

[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 of unfinished oils rerun over unfinished oils produced.
[3] Negative quantity (overage).
[4] Subject to revision.

The total reported crude-oil capacity of refineries increased from 6,034,252 barrels daily on January 1, 1948, to 6,438,995 barrels daily at the end of the year—a gain of 404,743 barrels daily. The total capacity in operation rose from 5,825,566 barrels daily on January 1, 1948, to 6,230,505 at the end of the year. The capacity of all shutdown units on January 1, 1948, was 208,686 barrels daily and 208,490 at the end of the year. The total capacity being built on January 1, 1948, was reported at 367,250 barrels daily compared with 341,500 barrels daily at the end of the year. These figures indicate a gain of almost 7 percent on total crude-oil capacity during 1948. Considering this increase in capacity, the large increase in the stocks of refined products in 1948, and the program for further building, there would appear to be ample refinery capacity to meet all requirements in the next few years.

Petroleum-refinery capacity in the United States, Jan. 1, 1944–49

Year	Number of refineries				Capacity (barrels per day)			
	Operating	Shut down	Total	Building	Operating	Shut down	Total	Building
1944	384	68	452		4,709,382	383,641	5,093,023	118,270
1945	380	33	413	1	5,077,690	223,463	5,301,153	36,075
1946	364	29	393	1	5,086,165	229,691	5,315,856	53,100
1947	361	38	399		5,336,399	233,083	5,569,482	162,200
1948	352	38	390	2	5,825,566	208,686	6,034,252	367,250
1949	336	39	375	3	6,230,505	208,490	6,438,995	341,500

Pipe Lines.—Crude-oil lines up to 24 inches in diameter are adding to the efficiency of trunk systems connecting the fields of the Southwest to the refining centers of the Middle West and East. The Big Inch lines, with their specially designed pumping equipment, are establishing new standards in operation, and eventually there will be general replacement of the 6-, 8-, and 10-inch lines on which the industry's transportation was founded and expanded for many years.

One of the largest crude pipe lines completed in 1948 was that of Magnolia Pipe Line Co. It is a 20-inch line from Corsicana, Tex., to Patoka, Ill., a distance of 648 miles, and has a daily capacity of 100,000 barrels. Of special significance is the simplicity of the station design, coupled with efficient and reliable operation. The entire line is operated as a closed system, with oil movements directed by the chief dispatcher using telephone communication exclusively. This and other 1948 crude-oil pipe-line construction projects provided a significantly increased capacity to transport oil from southwestern producing fields to refineries in the Great Lakes region. By this means a condition of scarcity of crude-oil supplies that developed in 1947 as a result of declining local production and rapidly growing consumption of refined products in the area was eliminated.

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A decided trend toward construction of products pipe lines by many oil companies has been evident in recent years to facilitate distribution of refined petroleum products to markets. A typical example is the 2,800-mile products line system of Sinclair Refining Co. from Houston, Tex., to Marcus Hook, Pa. The system is so designed that the direction of flow in certain portions of the line may be reversed at will to balance efficiently variations in demand for products, due to seasonal and other factors, and the supply from refining centers.

AVIATION GASOLINE

The total demand for aviation-grade gasoline rose from 15.2 million barrels in 1946 to 26.7 million in 1947 and 43.0 million in 1948. Exports increased from 2.3 million barrels in 1946 to 5.1 million in 1947 and 6.3 million in 1948. Domestic demand in continental United States increased from 12.9 million barrels in 1946 to 21.6 million in 1947 and 36.6 million in 1948. Domestic demand included reported deliveries to all military agencies of 1.0 million barrels in 1946, 7.1 million in 1947, and 17.6 million in 1948. As reported stocks represent only those in the custody of producers, indicated demand covers only new sales to consumers. Large stocks in military custody at the end of 1945 were in process of liquidation during 1946 and part of 1947.

The total demand for grades of 100-octane and above amounted to 5.8 million barrels in 1946, 16.5 million in 1947, and 33.2 million in 1948. Virtually all of the increase in demand has been in these grades, as the total demand for all other grades (including components marketed as such) amounted to 9.4 million barrels in 1946 and showed a small gain to 10.2 million in 1947 and a slight decline to 9.8 million in 1948.

The total demand for all motor fuel increased 66.1 million barrels in 1948 compared with 1947; this increase included the gain of 16.3 million barrels in the total demand for aviation grades of gasoline.

Aviation gasoline is discussed separately because of the special interest in this type of fuel. All aviation-gasoline figures are included in the total figures for motor fuel and gasoline in this report. The figures for aviation gasoline represent the amounts so identified and reported by the producing companies and do not include the consumption of regular automotive types of gasoline that may be used by many small planes. It should be noted that, in the production figures for aviation gasoline, the item "transfers out" represents rejected materials returned to regular grades of gasoline and that this item is subtracted from the gross production figure to determine net production of marketable grades.

Salient statistics of aviation gasoline in the United States, 1947–48, by months

[Thousands of barrels]

1947	January	February	March	April	May	June	July	August	September	October	November	December	1947	1946
Production:														
100-octane and above	704	713	954	566	1,219	1,353	1,545	2,061	2,258	2,121	2,187	2,186	17,867	5,342
Other grades	1,101	1,230	1,267	1,880	1,651	1,650	1,922	1,603	1,475	1,328	1,129	1,193	17,429	20,070
Transfers out	870	623	793	719	703	780	771	538	467	284	311	247	7,106	10,932
Exports	105	381	445	193	405	484	276	831	375	394	498	685	5,072	2,294
Stocks:														
100-octane and above	1,410	1,374	1,342	1,381	1,543	1,671	1,804	1,968	2,198	2,338	2,575	2,422	2,422	1,472
Other grades	2,912	2,919	2,826	3,311	3,268	3,176	3,340	3,512	3,605	3,581	3,531	3,642	3,642	3,081
Domestic demand: All grades	1,061	968	1,108	1,010	1,643	1,703	2,123	1,959	2,568	2,655	2,320	2,489	21,607	12,905
Total demand by grades:														
100-octane and above	571	685	899	518	1,047	1,200	1,397	1,896	2,033	1,982	1,930	2,334	16,492	5,825
Other finished	578	631	637	680	870	836	939	860	775	912	692	778	9,188	8,576
Components	17	33	17	5	131	151	63	34	135	155	196	62	999	798
Production, by districts:														
100-octane and above:														
District 1	--------	41	3	32	33	14	41	72	213	135	136	176	896	34
District 2	26	39	80	51	108	43	66	127	60	103	104	84	891	543
District 3	431	584	668	302	926	676	1,057	1,102	1,169	1,066	1,246	1,249	10,476	3,172
District 4	--------	3	3	2	2	3	5	21	24	27	19	17	126	135
District 5	247	46	200	179	150	617	376	739	792	790	682	660	5,478	1,458
Total	704	713	954	566	1,219	1,353	1,545	2,061	2,258	2,121	2,187	2,186	17,867	5,342
Other grades:														
District 1	115	117	169	130	180	213	202	225	30	33	91	40	1,545	2,400
District 2	176	115	141	202	189	228	191	86	137	114	139	101	1,819	2,070
District 3	538	665	568	1,068	642	1,058	830	957	947	860	757	857	9,747	10,105
District 4	20	37	25	26	40	26	43	38	13	20	−8	−4	276	192
District 5	252	296	364	454	600	125	656	297	348	301	150	199	4,042	5,303
Total	1,101	1,230	1,267	1,880	1,651	1,650	1,922	1,603	1,475	1,328	1,129	1,193	17,429	20,070
Stocks, by districts:														
100-octane and above:														
District 1	158	201	162	169	163	198	154	226	231	228	265	225	225	137
District 2	159	133	181	163	172	165	136	199	181	187	215	188	188	196
District 3	640	716	659	641	887	648	925	822	1,099	1,069	1,067	1,102	1,102	663
District 4	--------	3	4	4	4	5	5	3	7	6	6	4	4	--------
District 5	453	321	336	404	317	655	584	718	680	848	1,022	903	903	476
Total	1,410	1,374	1,342	1,381	1,543	1,671	1,804	1,968	2,198	2,338	2,575	2,422	2,422	1,472

Salient statistics of aviation gasoline in the United States, 1947–48, by months—Continued

[Thousands of barrels]

1947	January	February	March	April	May	June	July	August	September	October	November	December	1947	1946
Stocks, by districts—Continued														
Other grades:														
District 1	382	360	370	335	240	252	204	407	332	284	408	412	412	319
District 2	509	463	456	464	479	484	443	360	355	305	385	372	372	450
District 3	1,094	1,251	1,139	1,574	1,389	1,549	1,525	1,684	1,852	1,877	1,690	1,855	1,855	1,241
District 4	46	59	56	41	41	31	50	58	54	58	40	27	27	40
District 5	881	786	805	897	1,119	860	1,118	1,003	1,012	1,057	1,008	976	976	1,031
Total	2,912	2,919	2,826	3,311	3,268	3,176	3,340	3,512	3,605	3,581	3,531	3,642	3,642	3,081
Total demand, by districts:														
District 1	−74	41	43	44	106	19	168	−12	269	177	52	220	1,053	80
District 2	131	175	121	187	203	178	242	167	198	239	111	220	2,172	1,850
District 3	827	868	1,100	705	1,333	1,499	1,363	1,807	1,444	1,805	1,994	1,796	16,541	9,930
District 4	4	5	9	17	18	16	12	35	36	43	28	26	249	212
District 5	278	260	280	250	388	475	614	793	996	785	633	912	6,664	3,127
Total	1,166	1,349	1,553	1,203	2,048	2,187	2,399	2,790	2,943	3,049	2,818	3,174	26,679	15,199

1948[1]	January	February	March	April	May	June	July	August	September	October	November	December	1948	1947
Production:														
100-octane and above	2,385	1,825	2,329	2,945	2,775	2,943	2,747	3,190	2,562	2,864	3,143	3,713	33,421	17,867
Other grades	1,058	1,219	986	1,143	1,300	1,172	1,395	1,286	723	739	1,144	660	12,825	17,429
Transfers out	242	270	223	453	301	505	384	374	196	124	96	117	3,285	7,106
Exports	417	203	448	613	725	518	791	343	486	753	424	618	6,339	5,072
Stocks:														
100-octane and above	2,712	2,964	2,808	3,266	2,667	2,614	2,575	2,913	3,172	3,001	3,309	2,603	2,603	2,422
Other grades	3,845	4,222	4,236	4,093	4,123	3,855	3,945	3,728	3,388	3,223	3,488	3,465	3,465	3,642
Domestic demand: All grades	2,291	1,942	2,786	2,707	3,618	3,413	2,916	3,638	2,684	3,062	3,194	4,367	36,618	21,607
Total demand by grades:														
100-octane and above	2,089	1,553	2,480	2,509	3,364	2,988	2,797	2,873	2,304	3,042	2,825	4,382	33,206	16,492
Other finished	605	550	714	788	890	874	858	936	852	754	742	585	9,148	9,188
Components	14	42	40	23	89	69	52	172	14	19	51	18	603	999

Production, by districts:														
100-octane and above:														
District 1	155	114	149	168	117	192	188	274	296	174	216	204	2,247	896
District 2	81	64	81	148	149	212	135	163	191	150	186	112	1,672	891
District 3	1,417	1,051	1,274	1,710	1,327	1,521	1,531	1,632	1,615	1,918	1,913	2,115	19,024	10,476
District 4	26	18	26	22	26	41	14	23	31	36	44	35	342	126
District 5	706	578	799	897	1,156	977	879	1,098	429	586	784	1,247	10,136	5,478
Total	2,385	1,825	2,329	2,945	2,775	2,943	2,747	3,190	2,562	2,864	3,143	3,713	33,421	17,867
Other grades:														
District 1	46	63	69	94	76	54	51	44	7	30	20	59	613	1,545
District 2	54	135	159	197	130	165	134	167	67	98	19	96	1,421	1,819
District 3	701	507	645	494	941	648	815	791	771	587	868	528	8,296	9,747
District 4	20	12	5	27	15	8	31	18	24	14	−3	13	184	276
District 5	237	502	108	331	138	297	364	266	−146	10	240	−36	2,311	4,042
Total	1,058	1,219	986	1,143	1,300	1,172	1,395	1,286	723	739	1,144	660	12,825	17,429
Stocks, by districts:														
100-octane and above:														
District 1	253	325	321	313	305	313	250	291	350	263	315	258	258	225
District 2	221	210	266	306	217	213	229	240	326	308	315	311	311	188
District 3	1,388	1,426	1,293	1,580	1,283	1,374	1,244	1,282	1,500	1,485	1,707	1,438	1,438	1,102
District 4	4	4	10	8	7	7	3	8	6	4	6	8	8	4
District 5	846	999	918	1,059	855	707	849	1,092	990	941	966	588	588	903
Total	2,712	2,964	2,808	3,266	2,667	2,614	2,575	2,913	3,172	3,001	3,309	2,603	2,603	2,422
Other grades:														
District 1	441	474	481	511	540	516	447	387	341	365	343	422	422	412
District 2	395	415	451	551	547	586	598	617	557	562	497	509	509	372
District 3	1,970	1,984	2,029	1,581	1,728	1,551	1,595	1,483	1,548	1,478	1,763	1,801	1,801	1,855
District 4	35	34	26	38	38	27	42	42	51	52	38	41	41	27
District 5	1,004	1,315	1,249	1,412	1,270	1,175	1,263	1,199	891	766	847	692	692	976
Total	3,845	4,222	4,236	4,093	4,123	3,855	3,945	3,728	3,388	3,223	3,488	3,465	3,465	3,642
Total demand, by districts:														
District 1	127	45	173	173	148	171	316	295	246	252	184	228	2,358	1,053
District 2	78	188	139	198	378	310	217	277	217	234	260	198	2,694	2,172
District 3	1,593	1,344	1,865	2,017	2,248	2,057	2,256	2,365	2,004	2,524	2,228	2,821	25,322	16,541
District 4	38	30	33	38	40	60	34	36	48	51	53	43	504	249
District 5	872	538	1,024	894	1,529	1,333	884	1,008	655	754	893	1,695	12,079	6,664
Total	2,708	2,145	3,234	3,320	4,343	3,931	3,707	3,981	3,170	3,815	3,618	4,985	42,957	26,679

[1] Subject to revision.

MOTOR FUEL

The total demand for motor fuel set a new record of 908.6 million barrels in 1948 compared with 842.5 million in 1947—an increase of 66.1 million or 8 percent on a daily average basis. Exports declined sharply from 47.4 million barrels in 1947 to 37.4 million in 1948, but domestic demand in continental United States rose from 795.0 million barrels in 1947 to 871.2 million in 1948—a gain of 76.2 million or 9 percent on a daily average basis.

Salient statistics of motor fuel in the United States in 1947, by months

[Thousands of barrels]

	1947						
	Jan.	Feb.	Mar.	Apr.	May	June	July
Production:							
Refinery gasoline:							
Gasoline	56,902	52,229	57,430	54,127	59,270	60,481	63,805
Naphtha	1,658	1,362	1,639	1,375	1,411	1,374	1,395
Natural gasoline, etc	10,645	9,934	11,026	10,667	10,339	10,451	10,966
Less sales of LP-gases and transfers of cycle products [1]	3,324	3,067	3,417	2,926	2,538	2,513	2,725
Benzol	80	80	80	50	50	50	50
Total production	65,961	60,538	66,758	63,293	68,532	69,843	73,491
Daily average	2,128	2,162	2,153	2,110	2,211	2,328	2,371
Imports						101	
Exports	3,268	5,035	4,531	3,862	3,700	4,424	4,327
Daily average	105	180	146	129	119	147	140
Stocks, end of period:							
Finished gasoline	90,300	94,985	96,952	92,719	86,727	81,160	77,069
Natural gasoline	4,794	5,010	5,265	5,604	5,566	5,452	5,269
Total stocks	95,094	99,995	102,217	98,323	92,293	96,612	82,338
Domstic demand	57,114	50,602	60,005	63,325	70,862	71,201	73,438
Daily average	1,842	1,807	1,936	2,111	2,286	2,373	2,369

	1947—Continued						1946
	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
Production:							
Refinery gasoline:							
Gasoline	66,148	63,361	65,736	62,283	65,375	727,147	668,108
Naphtha	1,256	1,383	1,414	1,340	1,395	17,002	17,442
Natural gasoline, etc	11,201	11,067	11,682	11,893	12,302	132,173	115,739
Less sales of LP-gases and transfers of cycle products [1]	2,913	2,902	3,190	3,513	3,986	37,014	26,776
Benzol	50	50	50	50	50	690	2,070
Total production	75,742	72,959	75,692	72,053	75,136	839,998	776,583
Daily average	2,443	2,432	2,442	2,402	2,424	2,301	2,128
Imports	102	15		18	122	358	1
Exports	3,889	3,444	3,768	3,921	3,280	47,449	45,334
Daily average	125	115	122	31	106	130	124
Stocks, end of period:							
Finished gasoline	77,190	75,882	74,710	78,669	83,111	83,111	84,534
Natural gasoline	5,017	4,456	4,221	4,266	4,296	4,296	4,981
Total stocks	82,207	80,338	78,931	82,935	87,407	87,407	89,515
Domestic demand	72,086	71,399	73,331	64,146	67,506	795,015	735,417
Daily average	2,325	2,380	2,366	2,138	2,178	2,178	2,015

[1] Includes LP-gases sold for fuel and chemical uses.

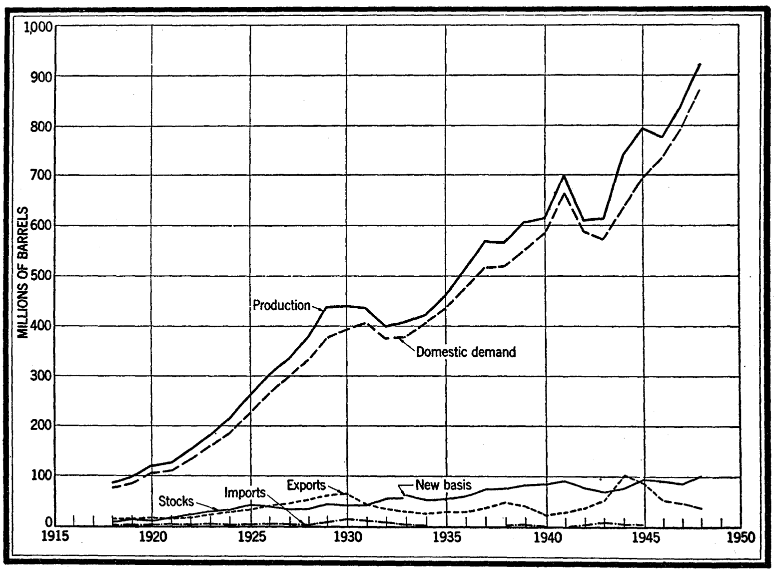

FIGURE 8.—Trends of production, domestic demand, exports, imports, and stocks of motor fuel in the United States, 1918–48

Production.—The total production of motor fuel rose from 840.0 million barrels in 1947 to 921.9 million in 1948. Production in 1948 included an output of 819.7 million barrels of gasoline and naphtha from crude oil at refineries at a yield of 40.3 percent and an output of motor fuel from other light oils amounting to 102.2 million barrels. The latter figure was obtained by adding the total production of light oils from natural gas to the small amount of motor benzol derived from coke ovens and subtracting the amounts of light oils sold as LP–gases and transferred to miscellaneous products, and a relatively small amount of other products transferred to unfinished oils. The production of these other light oils totaled 145.8 million barrels in 1948, and transfers to products other than motor fuel totaled 43.6 million barrels, leaving the net production included in motor fuel of 102.2 million barrels.

Refinery output of gasoline and naphtha in 1948 totaled 895.9 million barrels, including the output of 819.7 million barrels from crude oil and 76.2 million barrels of the other light oils shipped to refineries for blending.

The remainder of the light oils included in motor-fuel production (26.0 million barrels) were used as motor fuel or blended with gasoline outside refineries, exported, added to storage, or represented losses or shrinkage in production.

Yields.—The average refinery yield of gasoline and naphtha from crude oil reached a high of 45.0 percent in 1939. The yield was reduced substantially during the war to a minimum of 37.1 percent in 1943 but rose to 40.9 percent in 1945, when the output of aviation gasoline was at a maximum. It dropped to 39.6 percent in 1946 and rose to 40.2 percent in 1947 and 40.3 percent in 1948.

The domestic demand for motor fuel showed a relatively greater gain in 1948, whereas the demand for all other major products showed smaller relative gains than in 1947. The increase of 15.0 million barrels in the domestic demand for aviation grades of gasoline in 1948 was an essential factor in the larger demand.

Salient statistics of motor fuel in the United States in 1948, by months

[Thousands of barrels]

	1948 [1]						
	Jan.	Feb.	Mar.	Apr.	May	June	July
Production:							
Refinery gasoline:							
Gasoline	64,329	58,727	62,157	64,331	68,760	68,334	69,751
Naphtha	1,415	1,237	1,451	1,503	1,741	1,549	1,470
Natural gasoline, etc	11,997	11,344	12,268	11,676	12,044	11,522	11,843
Less sales of LP-gases and transfers of cycle products [2]	3,979	3,818	3,879	3,319	3,152	2,890	3,144
Benzol	50	28	28	28	28	28	28
Total production	73,812	67,518	72,025	74,219	79,421	78,543	79,948
Daily average	2,381	2,328	2,323	2,474	2,562	2,618	2,579
Imports	17		55				
Exports	2,315	1,736	2,613	3,655	3,644	3,377	4,332
Daily average	75	60	84	122	118	113	140
Stocks, end of period:							
Finished gasoline	93,290	102,235	103,398	101,280	99,554	96,221	90,310
Natural gasoline	4,323	4,673	4,806	5,305	5,622	6,077	6,176
Total stocks	97,613	106,908	108,204	106,585	105,176	102,298	96,486
Domestic demand	61,308	56,487	68,171	72,183	77,186	78,044	81,428
Daily average	1,978	1,948	2,199	2,406	2,490	2,601	2,627

	1948 [1]—Continued						1947
	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
Production:							
Refinery gasoline:							
Gasoline	70,471	65,048	68,881	68,066	72,488	801,343	727,147
Naphtha	1,493	1,474	1,698	1,522	1,780	18,333	17,002
Natural gasoline, etc	12,129	11,515	12,805	12,888	13,448	145,479	132,173
Less sale of LP-gases and transfers of cycle products [2]	3,410	3,560	3,936	4,059	4,465	43,611	37,014
Benzol	28	28	28	28	28	358	690
Total production	80,711	74,505	79,476	78,445	83,279	921,902	839,998
Daily average	2,604	2,484	2,564	2,615	2,686	2,519	2,301
Imports			194	18	18	302	358
Exports	3,354	3,300	2,905	2,913	3,266	37,410	47,449
Daily average	108	110	94	97	105	102	130
Stocks, end of period:							
Finished gasoline	87,187	82,254	83,969	87,275	95,422	95,422	83,111
Natural gasoline	6,308	6,287	6,173	5,857	5,579	5,579	4,296
Total stocks	93,495	88,541	90,142	93,132	101,001	101,001	87,407
Domestic demand	80,348	76,159	75,164	72,560	72,162	871,200	795,015
Daily average	2,592	2,539	2,425	2,419	2,328	2,380	2,178

[1] Subject to revision.
[2] Includes LP-gases sold for fuel and chemical uses.

Production of gasoline in the United States in 1948, by districts and months [1]

[Thousands of barrels]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Gasoline:													
East Coast	7,997	7,695	8,625	9,083	9,164	9,348	9,844	9,922	9,000	9,837	8,837	9,713	109,065
Appalachian	2,292	2,021	2,108	2,107	2,220	2,141	1,633	1,611	1,584	2,040	2,263	2,417	24,437
Indiana, Illinois, Kentucky, etc.	11,836	10,671	11,646	11,544	12,940	13,494	14,258	13,925	13,750	13,899	13,660	13,978	155,601
Oklahoma, Kansas, Missouri, etc.	6,255	5,668	5,655	5,722	6,229	6,390	6,879	6,819	6,630	6,524	6,363	6,595	75,729
Texas Inland	3,423	3,146	3,405	3,323	3,469	3,475	3,595	3,483	3,409	3,346	3,430	3,632	41,136
Texas Gulf Coast	15,871	14,048	14,607	15,976	17,403	16,393	16,529	16,723	16,722	17,047	16,513	17,750	195,582
Louisiana Gulf Coast	4,831	4,355	4,915	5,000	5,558	5,162	5,396	5,482	5,179	5,145	5,216	5,625	61,864
Arkansas, Louisiana Inland, Mississippi, etc.	894	742	763	726	766	808	879	857	928	906	902	952	10,123
Rocky Mountain	2,068	1,982	1,834	1,943	2,229	2,086	2,013	2,341	2,200	2,305	2,152	2,308	25,461
California, Washington	8,862	8,399	8,599	8,907	8,782	9,037	8,725	9,308	5,646	7,832	8,730	9,518	102,345
Total gasoline	64,329	58,727	62,157	64,331	68,760	68,334	69,751	70,471	65,048	68,881	68,066	72,488	801,343
Naphtha:													
East Coast	148	137	167	167	194	258	80	149	162	254	123	151	1,990
Appalachian	43	40	52	51	49	56	38	36	38	45	50	38	536
Indiana, Illinois, Kentucky, etc.	224	225	275	303	288	244	301	199	205	251	249	348	3,112
Oklahoma, Kansas, Missouri, etc.	118	110	137	122	155	119	143	144	145	148	149	88	1,578
Texas Inland	42	39	47	16	52	31	35	30	7	30	40	41	410
Texas Gulf Coast	528	388	427	554	605	532	518	585	517	632	539	713	6,538
Louisiana Gulf Coast	94	104	93	92	133	133	110	121	306	170	130	155	1,641
Arkansas, Louisiana Inland, Mississippi, etc.	4	6	13	11	10	----	10	7	9	13	8	11	102
Rocky Mountain	17	13	18	14	23	23	17	18	23	20	16	16	218
California, Washington	197	175	222	173	232	153	218	204	62	135	218	219	2,208
Total naphtha	1,415	1,237	1,451	1,503	1,741	1,549	1,470	1,493	1,474	1,698	1,522	1,780	18,333
Percent yield of gasoline and naphtha [2]	38.9	37.7	37.9	40.2	40.8	41.1	41.3	41.0	41.6	40.7	40.8	41.6	40.3
Natural gasoline blended at refineries	6,434	5,695	6,187	6,058	6,551	5,979	6,123	6,535	5,962	6,617	6,953	7,143	76,237
Total production:													
East Coast	8,209	7,923	8,843	9,308	9,434	9,657	9,941	10,125	9,206	10,167	9,113	10,011	111,937
Appalachian	2,385	2,112	2,213	2,203	2,316	2,243	1,720	1,695	1,672	2,133	2,365	2,535	25,592
Indiana, Illinois, Kentucky, etc.	12,803	11,580	12,616	12,579	13,943	14,439	15,237	14,815	14,663	14,878	14,608	14,975	167,136
Oklahoma, Kansas, Missouri, etc.	6,948	6,395	6,295	6,376	6,938	7,065	7,632	7,613	7,454	7,423	7,235	7,457	84,831
Texas Inland	4,634	4,155	4,408	4,363	4,954	4,584	4,488	4,595	4,737	4,719	4,729	5,023	55,389
Texas Gulf Coast	17,892	15,669	16,685	18,046	19,523	18,429	18,648	18,862	18,777	19,211	18,678	20,003	220,423
Louisiana Gulf Coast	5,151	4,672	5,256	5,296	5,895	5,481	5,750	5,876	5,752	5,660	5,700	6,204	66,693
Arkansas, Louisiana Inland, Mississippi, etc.	962	793	853	815	841	868	946	935	1,002	982	976	1,030	11,003
Rocky Mountain	2,183	2,081	1,931	2,058	2,324	2,161	2,087	2,412	2,315	2,413	2,279	2,451	26,695
California, Washington	11,011	10,279	10,695	10,848	10,884	10,935	10,895	11,571	6,906	9,610	10,858	11,722	126,214
Total: 1948	72,178	65,659	69,795	71,892	77,052	75,862	77,344	78,499	72,484	77,196	76,541	81,411	895,913
1947	64,419	58,499	64,340	61,120	65,981	67,753	71,376	73,881	71,257	73,505	69,946	72,764	814,841

[1] Subject to revision.

[2] Based on crude runs to stills adjusted for net unfinished.

Domestic Demand.—The domestic demand for motor fuel set a new record in 1948, increasing from 795.0 million barrels in 1947 to 871.2 million in 1948. Demand in 1947 represented a gain of 8 percent compared with 1946, and demand in 1948 increased 9 percent compared with 1947 on a daily average basis.

The average domestic demand for motor fuel rose from 2,178,000 barrels daily in 1947 to 2,380,000 barrels daily in 1948. Domestic demand in the first quarter of 1948 averaged 2,044,000 barrels daily (an increase of 10 percent compared with the first quarter of 1947) and represented 21 percent of total domestic demand in 1948. Domestic demand in the second quarter averaged 2,499,000 barrels daily (an increase of 11 percent compared with 1947) and represented 26 percent of the total for 1948. Domestic demand in the third quarter of 1948 averaged 2,586,000 barrels daily (an increase of 10 percent compared with 1947) and was 27 percent of the year's total. In the fourth quarter of 1948 domestic demand for motor fuel averaged 2,390,000 barrels daily (a gain of 7 percent compared with the same period of 1947) and amounted to 25 percent of the total domestic demand in 1948.

The annual survey of the Public Roads Administration includes an analysis of civilian motor-fuel consumption based on the tax returns of the various States. In 1947, this survey showed a total civilian usage of 762.8 million barrels, including a highway use of 671.8 million, nonhighway uses of 82.5 million, and losses of 8.5 million barrels. The increase in highway use was 10 percent compared with 1946. This survey for 1948 showed a total civilian usage of 826.4 million barrels, including a highway use of 725.3 million barrels, nonhighway uses of 92.1 million, and losses of 9 million. The increase in highway use was 8 percent compared with 1947 on a daily average basis. The difference between the total usage shown in these surveys and the Bureau of Mines domestic demand was 32.2 million barrels in 1947 and 44.8 million in 1948. The additional amounts in the Bureau's figures include total deliveries to the armed forces, any losses in production and transportation to the point of tax incidence, and probably some commercial and industrial uses of gasoline and naphtha, not recorded in the exemptions from State taxes.

Production and Consumption by States.—The accompanying table showing the production and consumption of gasoline by States is designed to indicate roughly the areas of surplus production and deficit supply. The refinery production used is compiled from reports to the Bureau of Mines, and the consumption figures are compiled from State tax reports by the American Petroleum Institute. The production figure employed does not include the natural gasoline blended or used outside refineries; and the consumption figure, while including military deliveries, was 25 million barrels less than the total domestic demand figure for 1948.

In 1948 the refinery production figure amounted to 895.9 million barrels and the consumption figure by States to 846.0 million barrels. The production figure includes a considerable part of the gasoline for export and also a considerable volume of gasoline added to storage in 1948.

The Gulf Coast States were the largest surplus producers of gasoline in 1948, with a refinery output of about 348 million barrels and a

Production and consumption of gasoline in the United States, 1946–48, by States

[Thousands of barrels]

State	1946		1947		1948 [1]	
	Production	Consumption [2]	Production	Consumption [2]	Production	Consumption [2]
Alabama	(3)	9,374	(3)	10,409	(3)	11,342
Arizona	—	4,084	—	4,531	—	4,936
Arkansas	4,112	6,543	4,768	7,169	6,026	7,806
California	[4] 110,372	75,461	[4] 122,888	81,144	[4] 126,214	86,744
Colorado	2,716	8,051	2,657	8,855	2,618	9,416
Connecticut	—	9,156	—	10,037	—	10,528
Delaware	—	1,666	—	1,859	—	1,988
District of Columbia	—	3,470	—	3,754	—	3,992
Florida	—	13,611	—	15,539	—	17,350
Georgia	[5] 6,635	12,919	[5] 7,461	14,045	[5] 7,984	15,195
Idaho	(6)	3,520	(6)	3,946	(6)	4,164
Illinois	[7] 53,896	39,141	[7] 58,979	43,106	[7] 75,500	46,926
Indiana	44,874	21,158	46,077	22,996	53,387	25,059
Iowa	—	17,855	—	18,784	—	20,239
Kansas	[8] 34,639	14,202	[8] 37,914	15,238	[8] 40,970	16,186
Kentucky	[9] 8,178	9,761	[9] 9,763	10,809	[9] 10,694	11,692
Louisiana	[3] 53,615	8,961	[3] 63,143	9,917	[3] 71,670	10,475
Maine	—	4,395	—	4,776	—	4,998
Maryland	(5)	9,055	(5)	9,949	(5)	10,572
Massachusetts	[10] 2,865	17,863	[10] 3,606	19,543	[10] 3,803	20,619
Michigan	8,998	34,650	10,632	38,605	11,879	41,034
Minnesota	(7)	16,949	(7)	18,182	(7)	19,604
Mississippi	(3)	7,264	(3)	8,021	(3)	8,594
Missouri	(8)	19,404	(8)	21,358	(8)	23,435
Montana	4,242	4,172	4,042	4,482	4,545	4,860
Nebraska	(8)	7,796	(8)	8,794	(8)	9,562
Nevada	—	1,424	—	1,520	—	1,558
New Hampshire	—	2,469	—	2,697	—	2,862
New Jersey	28,615	22,267	32,555	24,454	34,651	26,393
New Mexico	1,905	3,899	1,845	4,274	2,303	4,664
New York	9,792	46,328	9,446	50,509	8,858	54,359
North Carolina	—	15,154	—	16,689	—	18,161
North Dakota	—	5,434	—	5,664	—	5,965
Ohio	35,125	38,757	34,179	42,259	35,847	46,486
Oklahoma	36,463	12,492	39,667	13,840	43,861	14,637
Oregon	—	9,066	—	10,315	—	11,258
Pennsylvania	60,662	39,559	64,238	43,189	69,446	46,937
Rhode Island	(10)	3,229	(10)	3,516	(10)	3,634
South Carolina	(5)	7,426	(5)	8,315	(5)	9,188
South Dakota	—	4,992	—	5,364	—	6,074
Tennessee	(9)	11,827	(9)	12,534	(9)	13,987
Texas	225,693	53,908	243,934	55,393	275,812	63,447
Utah	(6)	3,573	(6)	3,958	(6)	4,240
Vermont	—	1,840	—	2,033	—	2,151
Virginia	—	13,367	—	14,575	—	16,105
Washington	(4)	12,562	(4)	13,765	(4)	14,739
West Virginia	2,299	6,212	2,206	6,873	2,616	8,070
Wisconsin	(7)	17,592	(7)	19,217	(7)	20,894
Wyoming	[6] 12,715	2,253	[6] 14,841	2,550	[6] 17,229	2,876
Total	748,411	716,111	814,841	779,351	895,913	846,001

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.

consumption of only 94 million. The surplus of 254 million barrels give rise to the Gulf to east coast tanker movement (amounting to 146 million barrels in 1948), to some of the largest pipe-line movements to the Middle Western States and to a major part of the gasoline exports.

The Atlantic Coast States produced only 125 million barrels in 1948 but consumed 265 million, with a deficit of 140 million barrels, primarily supplied by the Gulf to east coast tanker movement.

The Mountain States produced 27 million barrels of gasoline in 1948 and consumed 30 million, the deficit being supplied from the East or from California.

The Pacific Coast district, including five States, produced 126 million barrels of gasoline in 1948 and consumed 119 million, the surplus being available for export or shipment to the Mountain States.

The Central States, lying between the districts already discussed, produced 270 million barrels of gasoline in 1948 and consumed 338 million barrels, the deficit being supplied by pipe-line movements, river shipments, and tank-car shipments from other districts.

Methods of Distribution.—Motor fuel delivered from pipe lines in 1948 totaled 290.3 million barrels compared with 244.1 million in 1947. These totals represent about 30 percent of the total refinery production of gasoline in 1947 and over 32 percent in 1948. In the accompanying table, data are presented on a new basis, eliminating intersystem transfers. The total stocks of gasoline held by pipe lines, including working tanks and line fill, were 9.0 million barrels at the beginning of 1948 and 11.3 million at the end of the year. The indicated shortage or loss resulting from the pipe-line movement was

Movement of petroleum products by pipe lines between P. A. W. districts in 1948

[Thousands of barrels]

Month	From district 1 to district 2			From district 3 to district 1		
	Gasoline	Kerosine	Distillate fuel oil	Gasoline	Kerosine	Distillate fuel oil
January	441			1,317	362	243
February	500			1,151	368	298
March	463	13	15	1,289	303	258
April	499	8	32	1,337	197	227
May	540	37		1,379	212	185
June	507			1,390	118	189
July	524		37	1,440	177	205
August	534		7	1,475	159	233
September	272	6	19	1,369	206	194
October	306	15	49	1,391	291	199
November	279			1,211	336	262
December	239			1,249	390	267
Total	5,104	79	159	15,998	3,119	2,760

Month	From district 3 to district 2			From district 3 to district 4		
	Gasoline	Kerosine	Distillate fuel oil	Gasoline	Kerosine	Distillate fuel oil
January	1,475	104	227	69	10	9
February	1,340	67	186	47	3	3
March	1,510	49	132	45	6	8
April	1,639	36	98	81	9	
May	1,793	26	153	106		4
June	1,505	18	154	76	3	
July	1,385	31	93	111		4
August	1,434	51	219	114	5	4
September	1,435	36	241	134	5	3
October	1,745	65	118	115	8	2
November	1,704	239	98	93	16	3
December	1,686	113	467	69	13	3
Total	18,651	835	2,186	1,060	78	43

Transportation of petroleum products, by pipe lines, in 1948, by months

[Thousands of barrels]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Turned into lines: [1]													
Motor fuel	17,124	16,211	19,040	20,725	22,126	21,398	22,087	22,607	20,876	22,185	20,825	21,049	246,253
Kerosine	2,187	1,788	1,681	1,459	1,255	919	886	1,187	1,164	1,623	1,976	1,955	18,080
Distillate fuel oil	5,234	4,605	3,997	3,308	3,148	3,730	3,905	4,111	3,427	3,566	4,551	5,037	48,619
Delivered from lines: [1]													
Motor fuel	16,276	14,871	19,046	20,698	21,398	21,236	22,533	22,546	21,340	22,306	20,915	19,986	243,151
Kerosine	2,152	1,893	1,780	1,275	1,132	859	859	1,114	1,129	1,652	1,706	2,104	17,655
Distillate fuel oil	5,411	4,859	4,276	3,596	3,167	3,014	3,170	3,590	3,296	3,769	4,199	5,409	47,756
Shortage (or overage):													
Motor fuel	32	34	86	88	63	96	100	86	114	17	58	16	790
Kerosine	49	36	43	25	20	21	6	7	33	21	24	31	316
Distillate fuel oil	20	24	(22)	1	(8)	11	13	27	(8)	26	9	13	106
Stocks in lines and working tanks at end of month:													
Motor fuel	9,850	11,156	11,064	11,003	11,668	11,734	11,188	11,163	10,585	10,447	10,299	11,346	11,346
Kerosine	720	579	437	596	699	738	759	825	827	777	1,023	843	843
Distillate fuel oil	1,951	1,673	1,416	1,127	1,116	1,821	2,543	3,037	3,176	2,947	3,290	2,905	2,905

[1] The quantities turned into lines and delivered from lines are on a net basis, eliminating intersystem transfers, and are not comparable with data published for previous years.

1.1 million barrels in 1947 and 0.8 million in 1948. The tanker and barge movement of gasoline from the Gulf coast to east coast ports amounted to 132.6 million barrels in 1947 and 145.8 million in 1948.

Stocks.—Stocks of gasoline, as reported, include stocks held at refineries and bulk terminals and by pipe lines but do not include stocks in secondary distribution tanks, in consumers' hands, or in military custody.

Stocks of finished gasoline increased 12.3 million barrels in 1948—from 83.1 million on the first of the year to 95.4 million on December 31, 1948. Stocks of natural gasoline and cycle products increased 1.3 million barrels in 1948—from 4.3 million barrels to 5.6 million on December 31, 1948. Stocks of unfinished gasoline decreased from, 9.2 million barrels on January 1 to 8.3 million on December 31, 1948, a decline of 0.9 million barrels.

The change in finished-gasoline stocks in 1948 by quarters indicates a fairly normal seasonal gain of 20.3 million barrels in the first quarter, a decline of 7.2 million in the second quarter, a rather large decline of 14.0 million in the third quarter, and an unusually large increase of 13.2 million barrels in the fourth quarter. The increase in the last quarter was due primarily to relatively high crude runs combined with large surplus stocks of fuel oils, an abnormally low demand for heating oils, and the maintenance of high gasoline yields.

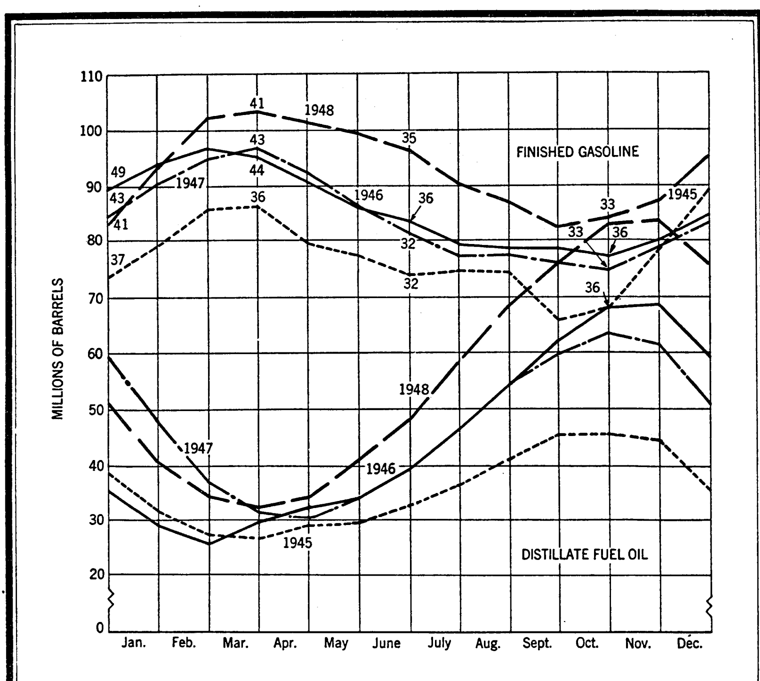

FIGURE 9.—Stocks of finished gasoline in the United States, 1945–48, by months, with figures representing days' supply at certain periods, also stocks of distillate fuel oil, 1945–48, by months.

Stocks of gasoline in the United States in 1948, by districts and months [1]

[Thousands of barrels]

District	Jan. 31	Feb. 29	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
Finished gasoline:[2]												
East Coast	19,756	21,558	22,386	23,987	24,217	24,430	23,003	22,164	20,590	20,855	21,263	22,598
Appalachian	3,071	2,994	3,118	3,084	3,058	2,855	2,667	2,894	2,792	2,907	3,148	3,212
Indiana, Illinois, Kentucky, etc	18,589	19,752	20,977	20,645	21,003	20,555	19,779	18,777	18,205	18,639	19,519	21,580
Oklahoma, Kansas, Missouri, etc	9,249	10,311	10,252	8,996	8,657	8,157	7,773	7,586	7,855	7,882	8,984	10,318
Texas Inland	3,145	3,545	3,775	3,338	3,162	3,033	2,971	3,117	2,873	2,836	2,899	3,345
Texas Gulf Coast	15,158	17,300	16,213	14,805	14,213	13,038	11,918	11,140	11,391	12,927	12,566	12,756
Louisiana Gulf Coast	5,346	5,586	5,076	5,029	4.705	4,564	4,265	4,657	4,830	4,482	5,054	6,033
Arkansas, Louisiana Inland, Mississippi, etc	2,149	2,520	2,283	1,951	2,123	2,263	2,243	2,128	2,079	1,994	2,259	2,485
Rocky Mountain	2,660	3,203	3,305	3,288	3,251	2,879	2,185	1,819	1,670	1,745	1,931	2,549
California	14,167	15,466	16,013	16,157	15,165	14,447	13,506	12,905	9,969	9,702	9,652	10,546
Total finished gasoline	93,290	102,235	103,398	101,280	99,554	96,221	90,310	87,187	82,254	83,969	87,275	95,422
Unfinished gasoline:												
East Coast	815	786	760	885	946	895	840	739	901	800	797	778
Appalachian	347	342	333	363	369	351	348	351	375	388	360	339
Indiana, Illinois, Kentucky, etc	709	640	743	853	966	844	832	792	739	908	879	727
Oklahoma, Kansas, Missouri, etc	406	398	408	417	401	319	308	329	366	243	258	258
Texas Inland	574	485	509	512	463	406	412	440	440	421	442	423
Texas Gulf Coast	3,115	3,175	3,030	3,034	3,114	3,025	3,321	3,223	3,256	3,410	3,253	3,488
Louisiana Gulf Coast	383	382	435	422	383	429	468	448	482	448	458	390
Arkansas, Louisiana Inland, Mississippi, etc	----	----	----	----	----	----	----	----	----	----	----	----
Rocky Mountain	162	144	158	125	156	186	190	175	172	159	163	151
California	2,366	2,412	2,175	1,938	2,200	1,842	1,810	1,761	1,533	1,680	1,704	1,721
Total unfinished gasoline	8,877	8,764	8,551	8,549	8,998	8,297	8,529	8,258	8,264	8,457	8,314	8,275
Total finished and unfinished gasoline:												
East Coast	20,571	22,344	23,146	24,872	25,163	25,325	23,843	22,903	21,491	21,655	22,060	23,376
Appalachian	3,418	3,336	3,451	3,447	3,427	3,206	3,015	3,245	3,167	3,295	3,508	3,551
Indiana, Illinois, Kentucky, etc	19,298	20,392	21,720	21,498	21,969	21,399	20,611	19,569	18,944	19,547	20,398	22,307
Oklahoma, Kansas, Missouri, etc	9,655	10,709	10,660	9,413	9,058	8,476	8,081	7,915	8,221	8,125	9,242	10,576
Texas Inland	3,719	4,030	4,284	3,850	3,625	3,439	3,383	3,557	3,313	3,257	3,341	3,768
Texas Gulf Coast	18,273	20,475	19,243	17,839	17,327	16,063	15,239	14,363	14,647	16,337	15,819	16,244
Louisiana Gulf Coast	5,729	5,968	5,511	5,451	5,088	4,993	4,733	5,105	5,312	4,930	5,512	6,423
Arkansas, Louisiana Inland, Mississippi, etc	2,149	2,520	2,283	1,951	2,123	2,263	2,243	2,128	2,079	1,994	2,259	2,485
Rocky Mountain	2,822	3,347	3,463	3,413	3,407	3,065	2,375	1,994	1,842	1,904	2,094	2,700
California	16,533	17,878	18,188	18,095	17,365	16,289	15,316	14,666	11,502	11,382	11,356	12,267
Total: 1948	102,167	110,999	111,949	109,829	108,552	104,518	98,839	95,445	90,518	92,426	95,589	103,697
1947	99,623	103,672	105,679	101,724	95,209	89,774	86,003	85,849	84,360	82,584	87,551	92,303

[1] Subject to revision.

[2] Includes stocks of finished gasoline at refineries, bulk terminals, and in pipe lines.

Stocks of finished and unfinished gasoline increased from 92.3 million barrels on the first of the year to 103.7 million on December 31, 1948—an increase of 11.4 million barrels. The principal changes by refinery districts were gains of 5.3 million in the Indiana-Illinois district, 3.2 million in the East Coast, 2.2 in the Oklahoma-Kansas district, 1.7 million in the Louisiana Gulf district, 1.0 in the Arkansas-Louisiana Inland district, and 0.8 in the Texas Inland district. The only declines were 3.4 million barrels in the California district and 0.4 million in the Texas Gulf district.

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 represented 43.4 days' supply in December 1946, 40.5 days' supply in December 1947, and 44.1 days' supply in December 1948.

Days' supply of motor fuel on hand in the United States at end of month, 1946–48 [1]

Month	1946			1947			1948 [2]		
	Finished gasoline	Natural gasoline	Total motor fuel	Finished gasoline	Natural gasoline	Total motor fuel	Finished gasoline	Natural gasoline	Total motor line
January	50.1	2.7	52.8	45.5	2.4	47.9	46.5	2.1	48.6
February	48.0	2.9	50.9	45.6	2.4	48.0	44.8	2.0	46.8
March	43.5	3.0	46.5	43.3	2.3	45.6	40.9	1.9	42.8
April	40.1	3.1	43.2	38.6	2.3	40.9	38.9	2.0	40.9
May	38.9	3.2	42.1	34.4	2.2	36.6	36.7	2.1	38.8
June	36.1	3.2	39.3	32.3	2.2	34.5	34.8	2.2	37.0
July	34.8	3.2	38.0	31.4	2.2	33.6	33.4	2.3	35.7
August	35.7	3.2	38.9	31.0	2.0	33.0	32.9	2.4	35.3
September	35.3	3.1	38.4	30.5	1.8	32.3	32.7	2.5	35.2
October	36.1	2.9	39.0	32.9	1.9	34.8	33.4	2.4	35.8
November	38.1	2.6	40.7	34.4	1.9	36.3	35.9	2.4	38.3
December	43.4	2.6	46.0	40.5	2.1	42.6	44.1	2.6	46.7

[1] Stocks divided by the daily average total demand (domestic demand plus exports) for succeeding month.
[2] Subject to revision.

Prices.—Gasoline prices followed the upward trend in crude-oil value in 1948. The average price of 73–75 octane gasoline at Oklahoma refineries rose from 6.31 cents per gallon in 1946 to 8.42 cents in 1947 and to 11.19 cents in 1948. The average in December 1947 was 10.30 cents per gallon; in January 1948 it rose to 11.13 cents and continued a steady rise to a peak of 11.69 cents in June 1948. It then declined to 10.75 cents in October and November, with a further decline to 10.60 cents per gallon in December.

The average dealers' net price for Regular Grade gasoline (exclusive of tax) in 50 representative cities in the United States supplies an index of gasoline prices at the wholesale level. This average price, according to the American Petroleum Institute, rose from 10.40 cents per gallon in 1946 to 12.33 cents in 1947 and 14.55 cents in 1948. Starting at 13.14 cents on December 1, 1947, it rose to 14.42 cents per gallon on January 1, 1948, and reached a peak of 14.66 cents per gallon on December 1, 1948. In this same series, the average service station price, including State and local taxes but not the Federal tax, rose from 19.27 cents per gallon in 1946 to 21.61 cents in 1947 and to 24.38 cents per gallon in 1948. Including the Federal tax of 1.50

cents per gallon, the total average price to the consumer for Regular Grade gasoline rose from 20.77 cents a gallon in 1946 to 23.11 cents in 1947 and to 25.88 cents per gallon in 1948. The average of all taxes for the year, shown in the survey of 50 cities, was 6.08 cents per gallon in 1946, 6.18 cents in 1947, and 6.34 cents in 1948. Since there was no change in the Federal tax during the period, the small increase was in State and local taxes.

Average monthly prices of gasoline in the United States, 1947–48, in cents per gallon

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
1947													
Monthly average at refineries in Oklahoma, 73–75 octane [1]	7.25	7.25	7.80	8.13	8.19	8.25	8.34	8.66	8.69	9.09	9.13	10.30	8.42
Average of 50 cities on 1st of month: [2]													
Dealers' net (ex. tax)	11.27	11.41	11.42	12.46	12.47	12.43	12.44	12.56	12.69	12.59	13.03	13.14	12.33
Service station (including State and local taxes only)	20.23	20.34	20.43	21.67	21.67	21.72	21.83	21.98	22.15	22.10	22.57	22.65	21.61
1948													
Monthly average at refineries in Oklahoma, 73–75 octane [1]	11.13	11.23	11.32	11.39	11.57	11.69	11.65	11.20	11.00	10.75	10.75	10.60	11.19
Average of 50 cities on 1st of month: [2]													
Dealers' net (ex. tax)	14.42	14.49	14.52	14.52	14.52	14.54	14.58	14.59	14.58	14.58	14.58	14.66	14.55
Service station (including State and local taxes only)	24.14	24.21	24.28	24.27	24.31	24.34	24.44	24.47	24.48	24.48	24.49	24.62	24.38

[1] National Petroleum News.
[2] American Petroleum Institute; compiled by the Texas Co.

Exports.—Exports of motor fuel, including shipments to noncontiguous Territories, rose from 45.3 million barrels in 1946 to 47.4 million in 1947 and declined sharply to 37.4 million in 1948. The exports of aviation gasoline, included in the total, amounted to 5.1 million barrels in 1947 and 6.3 million in 1948. Shipments to noncontiguous Territories, also included in the total, were 5.0 million barrels in 1947 and 4.8 million in 1948. Gasoline exports to foreign countries were 32.6 million barrels in 1948 compared with 42.5 million in 1947—a decline of 9.9 million barrels.

KEROSINE AND RANGE OIL

The production of kerosine in 1948 was not only sufficient to satisfy an expanded domestic demand and export market, but enough was also made to add a considerable quantity to storage. Only 135,000 barrels of kerosine were imported during the year.

Kerosine produced in 1948 totaled 121,853,000 barrels, a sharp upward trend over the 1947 output of 110,412,000 barrels. The large increased production of kerosine in 1948 was due chiefly to the increased runs of crude at refineries, as there was no improvement in the percentage yield, which has remained at 6.0 percent since 1946.

All refinery areas reported gains, except the California district, where the reduction in output was due largely to the strike in September and October 1948, and the Texas Inland district. The more important percentage increases were noted in the East Coast, Indiana–Illinois–Kentucky, and the Texas Gulf Coast refinery districts. The largest gain of 1948 was reported for the East Coast area, where the output of kerosine increased 19 percent. Other big increases in kerosine production were recorded for the Indiana–Illinois–Kentucky district—a gain of almost 19 percent—and for the Texas Gulf Coast district where the 1948 total was 11 percent over the output for 1947. Texas Gulf Coast continued to lead in the volume of kerosine production with about 38 million barrels, followed by Indiana–Illinois–Kentucky, with an output of about 22 million barrels. The Louisiana Gulf Coast area is also a source of relatively important quantities of kerosine with over 18 million barrels, and East Coast area, with 17 million barrels in 1948.

Salient statistics of kerosine in the United States, 1947–48, 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)	
	1947	1948 [1]	1947	1948 [1]	1947	1948 [1]	1947	1948 [1]
By months:								
January	9,415	10,697	6.4	6.4	12,325	16,198	13,732	11,993
February	9,243	11,030	6.8	6.9	10,533	12,608	11,493	10,287
March	9,476	11,262	6.3	6.7	10,079	10,884	9,811	10,464
April	8,854	10,236	6.3	6.2	8,082	7,774	9,625	12,795
May	9,284	9,973	6.1	5.7	6,068	6,508	12,609	15,711
June	8,717	9,383	5.7	5.6	5,910	6,351	14,653	18,480
July	9,117	9,442	5.6	5.5	5,348	6,561	17,651	20,958
August	8,970	9,180	5.5	5.2	5,447	6,193	20,824	23,564
September	8,547	9,288	5.4	5.8	6,580	6,365	22,276	26,177
October	9,308	9,663	5.6	5.6	8,163	9,411	22,750	26,283
November	9,352	10,848	5.9	6.4	11,070	10,928	20,626	25,829
December	10,129	10,851	6.1	6.1	12,914	12,384	17,722	24,010
Total	110,412	121,853	6.0	6.0	102,519	112,165	17,722	24,010
By districts:								
East Coast	14,257	17,004	4.8	5.4	(2)	(2)	7,177	10,330
Appalachian	3,570	3,819	5.9	6.6			406	532
Indiana, Illinois, Kentucky, etc	18,324	21,780	6.1	8.4			2,861	4,301
Oklahoma, Kansas, Missouri, etc	8,792	8,916	5.7	5.4			843	1,227
Texas Inland	5,477	5,232	6.5	5.8			554	639
Texas Gulf Coast	34,119	37,910	7.8	7.4			2,478	3,069
Louisiana Gulf Coast	17,394	18,409	12.4	11.6			1,801	2,392
Arkansas, Louisiana Inland, Mississippi	2,578	2,965	10.4	10.0			261	472
Rocky Mountain	1,250	1,707	2.4	2.9			169	233
California	4,651	4,111	1.5	1.3			1,172	815
Total	110,412	121,853	6.0	6.0	102,519	112,165	17,722	24,010

[1] Subject to revision.
[2] Figures not available.

A 15-percent increase in the domestic demand for kerosine reported for 1947 declined to 9 percent in 1948, when indicated deliveries were 112,165,000 barrels compared with 102,519,000 barrels in 1947. However, the kerosine market declined in early 1949. 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 available.

Exports of kerosine have declined noticeably in the past 2 years, as the 1948 total (3,535,000 barrels) was 51 percent less than the corresponding foreign demand of 7,252,000 barrels in 1947, which in turn was 16 percent below the peak demand in 1946.

Stocks of kerosine, which increased slightly on 1947, continued to increase sharply in 1948, when the year-end total of 24,010,000 barrels was 35 percent above the 17,722,000 held in storage at the close of 1947. About 59 percent of kerosine stocks are reported at refineries, and these reserves increased by about 41 percent—from 9,940,000 barrels in 1947 to 14,064,000 at the end of 1948.

Supplies carried at bulk teminals rose from 7,782,000 barrels in 1947 to 9,946,000 in 1948, about a 28-percent gain over the supplies held at bulk terminals at the close of 1947. The days of supply represented by kerosine held in storage at the year end increased from 42 days for 1947 to 57 days for 1948 at the subsequent January rate of total demand.

All refinery districts except California, whether predominantly supply or consumption areas, showed increases in kerosine stocks in 1948. The increase in kerosine inventories was largely attributed to the East Coast district, a major market with a gain of 3,153,000 barrels, and to Indiana–Illinois–Kentucky, with 1,440,000, out of the total increase in stocks of 6,288,000 barrels, due to mild winter in these areas. Relatively smaller increases in kerosine stocks are reported from the remaining refinery districts, except California, where stocks declined from 1,172,000 barrels in 1947 to 815,000 in 1948, due principally to the slow-down in the refineries by the strike.

Sales of kerosine continued their sharp upward trend in 1947, when reported sales of 102,703,000 barrels were 17 percent over the 1946 total of 88,090,000 barrels, according to the annual survey of the Bureau of Mines. This rapidly expanding market for kerosine, evident in 1946 and 1947, is due largely to the rapidly growing demand for range oil. All marketing areas of the country reported a higher volume of kerosine deliveries in 1947. Sales of kerosine in the East Coast area, where nearly 59 percent of the national demand is located, increased 18 percent from 51,315,000 barrels in 1946 to 60,547,000 in 1947. The larger share of these totals was reported for the New England States, where sales totaled 26,293,000 barrels in 1947—12 percent over the 1946 total of 23,433,000 barrels. The Middle Atlantic States continued as the second important market for kerosine, and deliveries in the area increased 15 percent from 19,925,000 barrels in 1946 to 22,827,000 in 1947. Sales of kerosine in the remaining section of the Atlantic Coast area—the South Atlantic States—are relatively less important in volume; however, the 1947 quantity for the area was 44 percent above the 1946 demand of 7,957,000 barrels. Dealers distributed 22,077,000 barrels of kerosine in the North Central States in 1947—a 16 percent gain over the 1946 total of 18,959,000 barrels. Considerable quantities of kerosine are also consumed in the South Central States, and the increase in sales in 1947 was 10 percent. Rocky Mountain area continues to consume the smallest amount of kerosine—about 1 percent of the national demand. However, there was an increase of about 11 percent in 1947 over 1946. The market for kerosine on the Pacific coast declined from 2,894,000 barrels in 1943 to 2,166,000 in 1946; however, in 1947 there was an increase to 2,844,000 barrels.

Sales of kerosine in the United States, 1946–47, by States and uses [1]

[Thousands of barrels]

Region [2] and State	Sold as range oil		Tractor fuel		All other uses		Total	
	1946	1947	1946	1947	1946	1947	1946	1947
Pacific Coast:								
California	250	248	-------	-------	1,221	1,809	1,471	2,057
Oregon	40	12	-------	-------	152	173	192	185
Washington	46	18	-------	-------	297	355	343	373
Arizona	31	27	-------	-------	112	181	143	208
Nevada	2	2	-------	-------	15	19	17	21
Rocky Mountain:								
Idaho	13	15	11	2	45	44	69	61
Montana	48	59	70	5	63	85	181	149
Wyoming	19	18	21	19	25	24	65	61
Utah	11	12	7	7	18	16	36	35
Colorado	65	95	107	100	83	77	255	272
New Mexico	142	208	48	44	99	159	289	411
North Central:								
North Dakota	113	168	193	181	126	135	432	484
South Dakota	138	171	192	185	112	127	442	483
Minnesota	515	576	245	240	478	551	1,238	1,367
Nebraska	335	414	173	168	241	254	749	836
Iowa	415	566	896	857	777	898	2,088	2,321
Wisconsin	369	428	442	426	571	737	1,382	1,591
Illinois	2,138	2,522	516	541	2,049	2,212	4,703	5,275
Indiana	399	475	278	275	1,221	1,473	1,898	2,223
Michigan	570	871	513	579	915	1,015	1,998	2,465
Ohio	731	986	248	256	611	736	1,590	1,978
Kentucky	197	233	103	100	693	870	993	1,203
Tennessee	449	697	194	232	803	922	1,446	1,851
South Central:								
Missouri	660	711	213	256	982	1,028	1,855	1,995
Kansas	217	294	351	370	457	545	1,025	1,209
Texas	1,362	1,621	849	988	3,016	3,103	5,227	5,712
Oklahoma	381	459	284	265	892	915	1,557	1,639
Arkansas	466	625	263	270	815	837	1,544	1,732
Louisiana	253	366	238	190	1,031	922	1,522	1,478
Mississippi	127	300	203	225	661	673	991	1,198
Alabama	240	387	109	93	685	803	1,034	1,283
New England:								
Maine	1,636	2,013	6	6	56	96	1,698	2,115
New Hampshire	982	1,305	2	2	21	31	1,005	1,338
Vermont	505	731	2	2	78	80	585	813
Massachusetts	12,838	13,567	-------	3	478	560	13,316	14,130
Rhode Island	2,423	2,862	-------	-------	68	85	2,491	2,947
Connecticut	4,219	4,824	1	5	118	121	4,338	4,950
Middle Atlantic:								
New York	8,204	9,041	78	95	1,189	1,289	9,471	10,425
New Jersey	4,195	4,791	65	61	1,174	1,255	5,434	6,107
Pennsylvania	1,658	2,150	112	219	1,297	1,302	3,067	3,671
Delaware	172	274	1	57	76	88	249	419
Maryland	807	1,034	17	55	614	690	1,438	1,779
District of Columbia	155	279	1	6	110	141	266	426
South Atlantic:								
Virginia	526	847	26	93	771	828	1,323	1,768
West Virginia	61	75	10	4	234	295	305	374
North Carolina	1,075	1,930	114	293	758	969	1,947	3,192
South Carolina	410	704	91	73	680	817	1,181	1,594
Georgia	536	1,039	131	194	609	726	1,276	1,959
Florida	961	1,432	120	167	844	941	1,925	2,540
Total	52,105	62,482	7,544	8,209	28,441	32,012	88,090	102,703

[1] Figures for 1948 by States not yet available.
[2] States are grouped according to petroleum-marketing territories rather than to conventional geographic regions.

Sales of range oil in the United States, 1945–47, by States

[Thousands of barrels]

State	1945	1946	1947	
			Total	Percent of total
Massachusetts	11,227	13,296	14,330	19.3
New York	7,122	8,546	9,471	12.8
Connecticut	3,995	4,442	5,139	6.9
New Jersey	3,756	4,426	5,073	6.8
Illinois	3,345	3,934	4,906	6.6
Rhode Island	2,132	2,524	3,027	4.1
Pennsylvania	1,365	1,913	2,501	3.4
Maine	1,522	1,763	2,181	3.0
North Carolina	885	1,106	1,969	2.7
Michigan	1,226	1,423	1,747	2.4
Texas	1,111	1,383	1,644	2.2
Florida	804	1,027	1,508	2.0
Wisconsin	949	1,072	1,488	2.0
Minnesota	926	1,097	1,455	2.0
Missouri	867	1,111	1,368	1.9
New Hampshire	873	1,028	1,359	1.8
Iowa	1,035	852	1,292	1.7
Ohio	669	852	1,208	1.6
Georgia	471	616	1,136	1.5
Maryland	696	815	1,043	1.4
Virginia	470	567	903	1.2
Indiana	604	707	864	1.2
South Carolina	366	478	775	1.1
Tennessee	433	498	753	1.0
Arkansas	454	567	746	1.0
Vermont	452	505	731	1.0
All other States	3,266	4,016	5,497	7.4
Total	51,021	60,564	74,114	100.0

The kerosine delivered for range oil has gradually increased from 56 percent of the kerosine total in 1943 to a 61 percent share in 1947, and quantities sold for this purpose increased 20 percent from 52,-105,000 barrels in 1946 to 62,482,000 in 1947. About 8 percent of all kerosine deliveries is used as tractor fuel, and the demand went from 7,544,000 barrels in 1946 to 8,209,000 in 1947. Sales of kerosine for various sundry uses, such as lamp fuel, insecticides, orchard heating, weed burning, tobacco curing, etc., rose from 28,441,000 barrels in 1946 to 32,012,000 in 1947.

Representative kerosine prices continued an upward trend in 1948 over the 1947 prices. The average quotation for 41°–43° gravity, water-white kerosine at refineries in Oklahoma rose from 9.09 cents a gallon in December 1947 to a high of 9.63 cents in July 1948. The price remained at that level through October 1948, then declined to 9.47 cents per gallon in December 1948, which brought the weighted average for 1948 to 9.58 cents a gallon, compared with 7.11 cents for 1947. The average price of kerosine, including No. 1 fuel oil at New York Harbor, increased from 9.31 cents a gallon in December to high of 11.15 cents in February 1948, remained at this level for 3 months, then declined gradually to 10.57 cents a gallon in December 1948, making the average quotation for the year 10.96 cents a gallon compared with 7.91 cents in 1947.

Monthly average prices of kerosine in the United States, 1947–48

[Platt's Oil Price Handbook]

Year and grade	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
1947													
41°–43° gravity w. w. kerosine at refineries, Oklahoma____________cents per gallon__	5.81	5.81	6.57	6.99	7.00	7.00	7.01	7.20	7.25	7.58	8.00	9.09	7.11
Kerosine (and/or No. 1 fuel oil) at New York Harbor__________cents per gallon__	7.00	6.86	7.25	7.80	7.80	7.80	7.89	8.10	8.20	8.21	8.71	9.31	7.91
Kerosine, tank-wagon at Chicago__do____	12.44	12.50	12.81	13.00	13.00	13.37	13.50	13.50	13.50	13.85	14.30	15.01	13.40
Kerosine, tank-wagon at New York City cents per gallon__	10.30	10.20	10.56	11.10	11.10	11.10	11.54	11.90	11.90	11.90	12.65	13.19	11.45
1948													
41°–43° gravity, w. w. kerosine at refineries, Oklahoma____________cents per gallon__	9.56	9.56	9.56	9.56	9.56	9.56	9.63	9.63	9.63	9.63	9.60	9.47	9.58
Kerosine (and/or No. 1 fuel oil) at New York Harbor__________cents per gallon__	10.63	11.15	11.15	11.15	11.08	10.95	10.96	10.98	10.98	10.98	10.98	10.57	10.96
Kerosine, tank-wagon at Chicago__do____	15.60	15.76	15.80	15.80	15.88	15.90	15.90	15.90	15.90	15.90	15.90	15.90	15.85
Kerosine, tank-wagon at New York City cents per gallon__	14.08	14.20	14.20	14.20	14.20	14.20	14.35	14.50	14.50	14.50	14.50	14.31	14.31

Very little kerosine is shipped from the west coast marketing area to other parts of the United States. Rail and truck shipments to other Western States totaled 25,000 barrels in 1948 compared with 16,000 in 1947. There were no tanker shipments of kerosine from California to the east coast in either 1947 or 1948. The California area received 4,000 barrels of kerosine in 1948 (none in 1947) from other States.

Records compiled by the Oil and Gas Division, United States Department of the Interior, show that some kerosine is shipped from the Gulf coast up the Mississippi River and its tributaries by barges to terminals in district 2. The volume of this movement increased from 4,244,000 barrels (385,000 barrels from Texas, 3,132,000 from Louisiana, and 727,000 from Arkansas and Mississippi) in 1947 to 4,826,000 (388,000 barrels from Texas, 3,290,000 from Louisiana, and 1,148,000 from Arkansas and Mississippi) in 1948. Barge and tanker shipments of kerosine from the Gulf to the east coast increased from 34,222,000 barrels in 1947 to 40,020,000 in 1948. The quantity credited to Texas increased from 27,542,000 barrels in 1947 to 31,-024,000 in 1948, while the totals originating in Louisiana were 6,680,-000 barrels in 1947 and 8,996,000 in 1948.

The fixed tanker rate on kerosine shipped from the Gulf coast to North Atlantic ports—not east of New York—of 36 cents a barrel ($2.85 a long ton) dating from October 15, 1945, held until the final days of December 1947. As the United States Maritime Commission sold all the tankers under its control during the latter part of 1947 and in 1948 and as there was an unusual demand because of extremely cold weather for vessels to move petroleum products in this traffic in early 1948, the tanker rate was removed from control. The rate quoted for kerosine in the Gulf coast-east coast movement rose to 90.3 cents a barrel on the last day of 1947 and reached peaks of $1.084 a barrel on January 2 and February 8, 1948. However, there was a net downward trend in tanker rates all during 1948 and final quotations were 30.7 cents a barrel on December 17 and 32.3 cents on December 24. The average for 1948 was 47.9 cents a barrel.

The tank-wagon prices of kerosine at Chicago moved upward from 15.60 cents a gallon in January 1948 to 15.90 cents in June 1948 and remained at this level throughout the year, raising the weighted average price in 1948 to 15.85 cents a gallon—an increase of 2.45 cents over the 1947 average. At New York the tank-wagon price quotation for kerosine moved upward from an average in January 1948 of 14.08 cents a gallon to a high of 14.50 cents in August, remaining at this level until December, when the quotation dropped to 14.31 cents a gallon. The weighted average for all of 1948 was 14.31 cents a gallon.

DISTILLATE FUEL OIL

Substantially increased production of distillate fuel oil, including Diesel fuel, together with slightly higher transfers and lower imports and exports, enabled oil companies not only to satisfy an increased domestic demand in 1948 but to add a large surplus to storage. The

Salient statistics of distillate fuel oil in the United States, 1947–48, by months and districts

[Thousands of barrels]

Month and district	Production		Yield (percent)		Transfers [1] East of California		Transfers [1] California		Imports		Exports		Domestic demand		Stocks, end of period	
	1947	1948 [2]	1947	1948 [2]	1947	1948 [2]	1947	1948 [2]	1947	1948 [2]	1947	1948 [2]	1947	1948 [2]	1947	1948 [2]
By months:																
January	24,131	33,539	16.4	19.9	270	298	-------	-------	543	107	1,069	1,933	35,298	42,056	48,197	41,036
February	21,746	32,688	16.1	20.6	231	269	-------	-------	406	585	1,992	1,340	31,687	38,648	36,901	34,590
March	25,577	32,548	16.9	19.5	217	300	-------	-------	365	322	2,358	1,767	29,279	33,779	31,423	32,214
April	22,925	29,352	16.3	17.9	272	289	-------	-------	215	71	3,246	1,914	21,321	25,498	30,268	34,514
May	24,954	30,764	16.4	17.7	280	302	-------	-------	386	466	2,347	2,456	19,262	22,809	34,279	40,781
June	24,214	29,930	15.8	17.8	280	276	-------	107	265	412	2,385	2,258	16,977	20,896	39,676	48,352
July	26,270	30,820	16.3	17.8	284	278	1	-------	129	66	3,561	2,486	16,355	18,305	46,444	58,725
August	26,946	32,190	16.4	18.4	312	277	-------	-------	372	3	3,274	2,167	16,093	20,210	54,707	68,818
September	27,325	28,960	17.2	18.0	269	276	-------	-------	234	-------	3,357	1,370	19,414	20,364	59,764	76,320
October	29,072	33,140	17.6	19.0	287	276	-------	19	474	270	3,239	1,510	23,106	25,595	63,252	82,920
November	28,254	32,434	17.9	19.0	285	289	-------	14	474	233	1,934	1,336	28,997	30,645	61,334	83,909
December	30,759	34,274	18.5	19.2	275	273	-------	-------	312	11	1,115	1,271	40,484	41,243	51,081	75,953
Total	312,173	380,639	16.9	18.7	3,262	3,403	1	140	4,175	2,546	29,877	21,808	298,273	340,048	51,081	75,953
By districts:																
East Coast	57,111	67,377	19.2	21.6	-------	-------	-------	-------							13,540	23,158
Appalachian	7,362	7,597	12.2	13.2	-------	-------	-------	-------							1,018	1,185
Indiana, Illinois, Kentucky, etc	45,749	49,486	15.2	14.9	466	563	-------	-------							7,297	11,395
Oklahoma, Kansas, Missouri, etc	26,230	30,760	17.1	18.6	754	660	-------	-------							3,151	5,279
Texas Inland	7,175	8,932	8.5	9.9	1,102	1,217	-------	-------							525	854
Texas Gulf Coast	82,850	115,928	19.0	22.7	470	502	-------	-------	(3)	(3)	(3)	(3)	(3)	(3)	7,782	13,636
Louisiana Gulf Coast	27,512	35,489	19.7	22.3	201	192	-------	-------							2,803	4,159
Arkansas, Louisiana Inland, Mississippi	3,459	4,626	13.9	15.5	39	44	-------	-------							398	811
Rocky Mountain	8,227	10,209	15.7	17.1	230	225	-------	-------							782	1,627
California	46,498	50,235	15.4	16.2	-------	-------	1	140							13,785	13,849
Total	312,173	380,639	16.9	18.7	3,262	3,403	1	140	4,175	2,546	29,877	21,808	298,273	340,048	51,081	75,953

[1] Figures represent crude oil used as fuel on pipe lines.
[2] Subject to revision.
[3] Figures not available.

domestic demand of 340,048,000 barrels of distillate fuel oil in 1948 was 14 percent over 1947 requirements of 298,273,000 barrels. Foreign shipments of light-grade fuel oils have decreased sharply from 29,877,000 barrels in 1947 to 21,808,000 barrels in 1948, a 27-percent decrease.

A review of the domestic demand in 1948, by quarters, reveals that peak requirements of 114,483,000 barrels came in the first 3 months when the need for heating oils was a factor and that the total for the period was 19 percent over the corresponding item of 96,264,000 barrels in 1947.

Usually requirements in the final quarter of any year are somewhat below the total for the first 3 months of the same year. However, in 1947 requirements of 92,587,000 barrels in the fourth quarter were only 4 percent less than the indicated demand in the opening period. Compared with the same two periods in 1948, the requirement of 97,483,000 barrels for the last 3 months was 15 percent less than that in the first quarter. It was warmer in the fourth quarter of 1948 than in the same months of 1947 in the New England, North Central, and Middle Atlantic regions, where about 81 percent of the heating oil is consumed. The rapidly growing requirements for light heating oils and Diesel fuel is strongly evident in the second and third quarters of 1948, when the domestic demand increased 17 percent over the same period in 1947.

A definite break-down of the domestic demand for distillate fuel oils in 1948 is not available, as the annual survey covering sales of fuel oil by the Bureau of Mines was incomplete when this manuscript was prepared. There are, however, some monthly data and other information upon which estimates of the several demands for light oil can be made. The records of the Interstate Commerce Commission show that railroads purchased 28,724,000 barrels of Diesel fuel in 1948; and it is believed that the total demand, including other distillate fuel oils, probably was 32,200,000 barrels for 1948. Monthly releases of the Bureau of the Census, United States Department of Commerce, indicate that 6,236,000 barrels of Diesel fuel were sold to vessels 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 total vessel demand for distillate grades reached 15,000,000 barrels in 1948. 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 decline in the demand for all grades of fuel oils in 1948, and it is possible that the light-fuel-oil total for both the gas and electric power industries will not exceed 15,000,000 barrels for the year. The index of manufacturing for 1948 as computed by the Federal Reserve Board was 192 compared with 187 in 1947. However, this index reflects the need for fuel of all kinds by the manufacturing industries and not that for oil alone. It is believed that the demand by industrial plants for distillate fuel oil, including Diesel fuel, will continue a sharp upward trend in 1948.

Sales of distillate fuel oil [1] in the United States, 1943–47, by uses [2]

[Thousands of barrels]

Use	1943	1944	1945	1946	1947
Railroads	8,608	10,627	14,458	17,570	23,619
Ships' bunkers (including tankers)	11,069	13,187	14,130	12,064	14,475
Gas and electric power plants	5,954	5,837	6,824	10,581	14,216
Smelters, mines, and manufacturing industries	15,125	16,953	19,071	21,317	24,489
Heating oils	112,581	111,729	121,342	[3] 139,637	178,359
Fuel oil (No. 1) sold as range oil	5,876	6,619	7,481	8,459	11,632
U. S. Navy, Army, and Coast Guard	33,383	42,879	30,366	9,385	5,176
Oil-company fuel	884	981	1,128	1,890	2,191
Miscellaneous uses	14,232	15,060	16,825	18,647	23,857
Total United States	207,712	223,872	231,625	[3] 239,550	298,014
Exports and shipments to noncontiguous Territories	24,957	43,491	33,496	29,487	29,877
Total	232,669	267,363	265,121	[3] 269,037	327,891

[1] Includes Diesel fuel.
[2] Figures for 1948 not yet available.
[3] Revised figure.

The changing demand for distillate fuel oils by various uses is shown graphically in figure 10. All light fuel oils and Diesel fuel are included.

A downward trend in exports of distillate fuel oil was reported in 1948, when the total of 21,808,000 for the year was 27 percent below the 29,877,000 total for 1947. Exports of distillate fuel oil to the United Kingdom were drastically reduced from 8,973,000 barrels in 1947 to 4,934,000 in 1948. Shipments of light fuel oil to Sweden also show a big decrease—from 2,716,000 barrels in 1947 to 853,000 in 1948. Shipments to some other countries also declined; however, the quantities involved were not relatively important. The decreased demand for distillate fuel oil in foreign countries was due principally to postwar construction and the rebuilding of the war-destroyed refineries.

The production of distillate fuel oil in 1948—380,639,000 barrels—was about 22 percent over the 1947 total of 312,173,000 barrels. The percentage yield for distillate fuel oils rose sharply from 16.9 percent in 1947 to 18.7 percent in 1948. This gain in the percentage output of light fuel oils was, however, at the expense of a lower yield for residual fuel oil—23.0 percent in 1948 compared with 24.2 percent in 1947.

All refinery districts of the country reported increased production of distillate fuel oils in 1948. Refineries operating in the Texas Gulf Coast district produced over 30 percent of the distillate fuel oils, the total for 1948 being 115,928,000 barrels, or 40 percent over the 1947 total of 82,850,000 barrels. This larger volume of light fuel oil for the area was the result of both an increase in crude runs and a higher percentage yield—22.7 percent in 1948 compared with 19.0 percent in 1947. The East Coast district was the source of 18 percent of the distillate fuel oils produced in the country, and the output there increased by 18 percent from 57,111,000 barrels in 1947 to 67,377,000 in 1948. Although the crude runs in the district increased in 1948, most of the expanded light-fuel-oil production must be credited to a stepped-up yield—21.6 percent in 1948 compared with 19.2 percent in 1947.

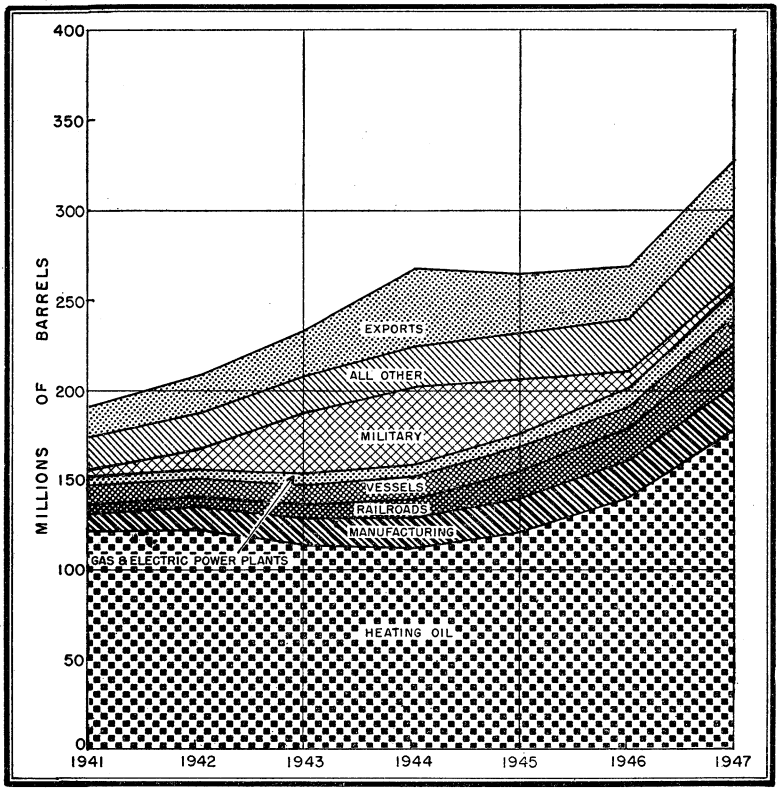

FIGURE 10.—Sales of distillate fuel oil, including Diesel oil, and range oil in the United States, 1941–47, by uses

The California refinery district continued to increase its light-fuel-oil production in 1948 and was the source of 13 percent of the Nation's production. The output increased 8 percent from 46,498,000 barrels in 1947 to 50,235,000 barrels in 1948 with a higher yield—16.2 percent in 1948 against 15.4 in 1947. The Indiana-Illinois-Kentucky refinery district produced 13 percent of all distillate fuel oils in 1948, and the quantity rose from 45,749,000 barrels in 1947 to 49,486,000 in 1948. This was the only district, however, where the yield decreased, dropping from 15.2 in 1947 to 14.9 in 1948. The higher production can be attributed solely to the 10-percent increase in runs.

An appreciable amount of light fuel oil originates in the Louisiana Gulf Coast refinery district, where the quantity increased from 27,512,000 barrels in 1947 to 35,489,000 in 1948. This gain was due to both increased yield and runs. The yield rose from 19.7 percent in 1947 to 22.3 percent in 1948, and the runs increased 20 percent. Production of distillates also rose in the Oklahoma-Kansas-Missouri district in 1948 (30,760,000 barrels or 17 percent over the 1947 quantity of 26,230,000 barrels) as the yield also increased from 17.1 percent in 1947 to 18.6 percent in 1948.

Sales of distillate fuel oil[1] in the United States, 1943–47, by States[2]

[Thousands of barrels]

Region [3] and State	1943	1944	1945	1946	1947
Pacific Coast:					
Washington	5,654	5,933	6,586	7,695	9,602
Oregon	2,850	2,927	3,219	4,592	5,720
California	17,552	18,032	16,753	17,840	20,481
Arizona	774	878	961	1,126	1,173
Nevada	582	715	715	766	951
Rocky Mountain:					
Idaho	433	569	597	787	1,034
Montana	532	989	1,745	1,381	1,660
Wyoming	308	744	1,231	537	643
Utah	487	571	703	839	1,223
Colorado	741	1,015	1,171	1,517	1,724
New Mexico	403	522	563	570	708
North Central:					
NorthDakota	550	482	662	916	1,067
South Dakota	648	618	691	909	1,338
Minnesota	5,867	5,290	5,658	7,120	9,327
Nebraska	2,010	2,561	2,578	2,716	3,340
Iowa	3,758	3,528	4,633	5,149	6,099
Wisconsin	5,572	4,986	5,074	6,106	8,203
Illinois	16,177	16,056	17,174	[4] 16,635	20,906
Indiana	2,804	2,927	3,086	3,830	6,153
Michigan	6,799	6,535	7,337	8,542	12,277
Ohio	3,543	3,586	4,414	5,054	7,479
Kentucky	1,051	1,067	1,172	1,158	1,586
Tennessee	1,095	1,168	1,331	1,559	2,018
South Central:					
Missouri	4,814	4,900	5,364	6,362	7,072
Kansas	1,539	1,615	2,115	2,282	2,881
Texas	18,595	23,551	19,724	10,686	8,035
Oklahoma	666	662	676	701	1,084
Arkansas	1,092	1,152	1,134	1,363	1,733
Louisiana	4,408	4,961	3,825	2,762	3,274
Mississippi	581	627	631	777	912
Alabama	1,286	1,375	1,255	1,473	1,937
New England:					
Maine	1,062	1,012	1,149	1,440	2,266
New Hampshire	938	820	879	1,001	1,387
Vermont	523	575	626	699	816
Massachusetts	10,190	10,460	11,640	12,865	19,290
Rhode Island	2,377	2,440	3,049	3,097	3,389
Connecticut	5,452	5,789	6,210	6,784	8,635
Middle Atlantic:					
New York	29,458	27,770	29,954	33,376	38,888
New Jersey	19,017	25,535	25,964	22,201	26,011
Pennsylvania	10,225	12,925	12,618	14,781	19,916
Delaware	650	803	512	570	783
Maryland	3,795	4,026	4,976	5,271	7,551
District of Columbia	1,907	1,786	1,863	2,039	2,733
South Atlantic:					
Virginia	2,966	3,535	2,612	3,146	4,539
West Virginia	391	314	338	374	475
North Carolina	1,227	1,252	1,584	2,177	2,552
South Carolina	824	924	917	1,144	1,427
Georgia	900	959	1,298	1,564	1,956
Florida	2,639	2,405	2,658	3,271	3,760
Total	207,712	[5] 223,872	[5] 231,625	[4] 239,550	298,014

[1] Includes Diesel fuel oil.
[2] Figures for 1948 not yet available.
[3] States are grouped according to petroleum-marketing territories rather than to conventional geographic regions.
[4] Revised figure.
[5] These totals involve some duplication owing to rehandling of fuel oil initially sold to the Government

The remaining refinery districts do not produce large amounts of distillate fuel oil. The quantities reported for the Rocky Mountain area and Texas Inland continue to show big gains (24 percent) in 1948, while the Appalachian district also increased (3 percent) in 1948.

Light crude petroleum used as fuel by pipe lines is reported as "transfers" to the distillate fuel oils; the quantities involved were 3,543,000 barrels in 1948 and 3,263,000 in 1947. Such "transfers" supply a little less than 1 percent of the total demand for all light fuel oils. The larger shares of these items were credited to Texas Inland (1,217,000 barrels) and the Oklahoma-Kansas-Missouri (660,000 barrels) refinery district. No transfers were reported for East Coast and Appalachian areas.

Imports of distillate fuel oils into continental United States continues to decline, as the quantity reported for 1948 was 2,546,000 barrels, a reduction of about 39 percent from the 1947 total of 4,175,000 barrels. Less than 1 percent of total demand for light fuel oils is made up of supplies received from foreign countries. The largest share of the imported distillate fuel oil came from Curaçao in the West Indies; however, several other countries, such as Venezuela, Mexico, and Bahrein, were credited with smaller amounts.

Stocks of distillate fuel oils in 1948 increased over the record volume of 59,620,000 barrels in 1946 by 27 percent and exceeded the year-end total in 1947 by about 49 percent to a new high of 75,953,000 barrels at the end of 1948. The light fuel oil in storage at the close of 1948 was equivalent to about a 56-day supply at the subsequent January rate of total demand; this compares with a 38-day quantity available at the end of 1947.

Both refinery and bulk-terminal stocks of light fuel oils showed outstanding increases in 1948. Quantities reported as stored at refineries rose from 32,413,000 barrels at the end of 1947 to 46,924,000 for 1948—a 45-percent gain compared with a 16-percent shrinkage of the same stock in 1947. Distillate inventories at bulk terminals—29,029,000 barrels at the close of 1948—were 56 percent over the 1947 quantity (18,668,000 barrels), and this gain contrasts with a loss of 11 percent in 1947.

All refiniery districts reported higher distillate-fuel-oil stocks at the end of 1948 compared with 1947. Light-fuel-oil inventories more than doubled in the Rocky Mountain and Arkansas-Louisiana Inland-Mississippi districts, which comprise about 3 percent of the total stock held. Supplies in the important east coast area rose from 27 percent of the national total in 1947 to a 30-percent share in 1948. The quantity at the end of 1948 (23,158,000 barrels) was 71 percent above the 1947 total (13,540,000 barrels). About 18 percent of the light-fuel-oil stocks are found in the Texas Gulf Coast area, where the total rose from 7,782,000 barrels in 1947 to 13,636,000 at the close of 1948.

The California refinery area reports a large inventory of distillate fuel oil (a little less than one-fifth of the national total), and the volume of 13,849,000 barrels in December 1948 was only 0.5 percent over the 13,785,000 barrels held at the close of 1947. The quantity of light fuel oil stored in the Indiana–Illinois–Kentucky refinery district increased 56 percent in 1948—11,395,000 barrels—over 1947 stocks of 7,297,000 barrels. The 1948 item represents a 15-percent share of the national inventory. Quantities of distillates stocks reported from Louisiana Gulf Coast region are relatively less important; however, they expanded from 2,803,000 barrels in 1947 to 4,159,000 in 1948, an increase of 48 percent. About 7 percent of the distillate stocks are carried in the Oklahoma-Kansas-Missouri group of States, and the total reported rose from 3,151,000 barrels in 1947 to 5,279,000 in 1948. Only small quantities of distillate-grade fuel oils are reported as held in the Appalachian and Texas Inland refinery districts; nevertheless, the year-end stocks all gained in 1948 over 1947.

Tanker shipments of distillate fuel oil from California to the east coast increased from 161,000 barrels in 1947 to 1,177,000 in 1948. The 1948 quantity was all moved during the January–June period and was intended to relieve an east coast shortage in distillate-fuel-oil supplies, which had resulted from a prolonged cold spell in January of that year. Rail and truck movements of distillate fuel oil from the Pacific coast marketing area (California, Oregon, Washington, Arizona, and Nevada) to other Western States totaled 1,131,000 barrels in 1947 and 1,250,000 in 1948. The California area in return also received some light fuel oil from other States—333,000 barrels in 1948 compared with 309,000 in 1947.

There is an important movement of distillate fuel oil by barge and tanker from the Gulf coast area to terminals on the Atlantic coast, and the volume increased from 80,533,000 barrels (67,286,000 barrels from Texas and 13,247,000 from Louisiana) in 1947 to 102,-609,000 (83,190,000 barrels from Texas and 19,419,000 from Louisiana) in 1948, according to the Oil and Gas Division, United States Department of the Interior. There is also a minor barge movement of distillate fuel oil from the Gulf coast up the Mississippi River to consuming areas in district 2. The total of 4,444,000 barrels for 1948 was slightly under the 1947 figure of 4,698,000 barrels. Most of this light fuel oil is credited to Louisiana, although small quantities also originate in Texas, Arkansas, and Mississippi.

Tanker rates were uncontrolled during the early months of 1948, and the freight on No. 2 distillate fuel oil brought from the Gulf coast to North Atlantic ports—not east of New York—rose from a fixed charge of 38 cents a barrel prevailing until the final few days of 1947 to $1.138 on January 2, 1948. This unusually high rate was reached again on February 8, but thereafter declined steadily to the year low of 28.6 cents a barrel on August 20 and a year-end rate of 34.0 cents on December 24. The average freight cost on No. 2 light fuel oil in the Gulf coast-east coast run was 50 cents a barrel for 1948.

The upward trend in distillate fuel-oil prices, evident since the close of price control, leveled off somewhat during 1948. The price of 9.28 cents a gallon for No. 2 Straw fuel oil at refineries in Oklahoma increased to 11.08 cents by March 1948. The average quotation then started to decline over the summer and fall months to 8.87 cents a gallon in December 1948. The average for 1948 was 9.67 ceuts per gallon compared with a 6.74-cent average for 1947. A price of 8.34 cents a gallon for No. 2 fuel oil at New York Harbor, effective December 1947, rose to a high in March 1948, when the average quotation was 10.15 cents per gallon. The price dropped to 9.75 cents per gallon in April and remained at about that level until December. The 1948 average price was 9.71 cents per gallon. Diesel oil at shore plants around New York Harbor, selling at 8.63 cents a gallon average in December 1947, was marked upward to 9.73 cents in January 1948, and this value held fairly steady for the balance of 1948. The average price for Diesel oil at shore plants for 1948 was 9.77 cents per gallon. Ships loading Diesel oil for bunkers in New York Harbor paid an average price of $3.02 a barrel in 1947, and subsequent advances

Monthly average prices of distillate fuel oil and Diesel fuel in the United States, 1947–48

[Platt's Oil Price Handbook]

Year and grade	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
1947													
No. 2 Straw fuel oil at refineries, Oklahoma......cents per gallon..	5.02	5.11	5.89	6.25	6.32	6.41	6.76	7.18	7.30	7.43	7.89	9.28	6.74
No. 2 fuel oil at New York Harbor..do....	6.29	6.00	6.31	6.80	6.82	7.06	7.19	7.20	7.20	7.22	7.77	8.34	7.02
Diesel oil, shore plants, New York Harbor......cents per gallon..	6.60	6.60	6.78	7.15	7.15	7.18	7.31	7.40	7.40	7.43	8.09	8.63	7.31
Diesel oil for ships:													
New York........dollars per barrel..	2.73	2.73	2.81	2.97	2.98	2.98	2.98	3.02	3.07	3.07	3.34	3.54	3.02
Gulf Coast........do....	2.31	2.30	2.39	2.46	2.46	2.48	2.58	2.69	2.72	2.72	2.96	3.20	2.60
California........do....	2.22	2.31	2.41	2.60	2.60	2.60	2.75	2.75	2.75	2.75	2.77	2.75	2.61
1948													
No. 2 Straw fuel oil at refineries, Oklahoma......cents per gallon..	10.53	10.63	11.08	9.86	9.50	9.50	9.50	9.23	9.13	9.13	9.11	8.87	9.67
No. 2 fuel oil at New York Harbor..do....	9.47	9.68	10.15	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.71	9.24	9.71
Diesel oil, shore plants, New York Harbor......cents per gallon..	9.73	9.75	9.75	9.75	9.75	9.75	9.75	9.85	9.85	9.85	9.85	9.65	9.77
Diesel oil for ships:													
New York........dollars per barrel..	3.94	4.01	4.01	4.01	4.01	4.01	4.01	4.01	4.01	4.01	4.02	4.02	4.01
Gulf Coast........do....	3.66	3.72	3.72	3.72	3.77	3.83	3.83	3.83	3.83	3.83	3.81	3.77	3.77
California........do....	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.28	3.35	3.20

resulted in a 1948 year-end quotation of $4.02 a barrel. Ships loading Diesel fuel at Gulf ports paid $3.20 a barrel in December 1947. The price increased to $3.66 in January 1948 and reached a high of $3.83 a barrel in June–October 1948. The year-end price in December 1948 was $3.77 a barrel. Quotations for Diesel fuel for ships likewise advanced at the California ports from $2.75 a barrel in December 1947 to $3.35 in December 1948.

Representative retail prices for light fuel oils in 1948 followed the trend noted in wholesale quotations. Records of retail fuel price for a number of cities, as published monthly by the Bureau of Labor Statistics, United States Department of Labor, list a quotation of 13.90 cents a gallon for No. 2 distillate fuel in New York for January and February; however, subsequent decreases in monthly quotations lowered the price to 12.49 cents a gallon in June 1948. There was slight increase in the summer months to 13.04 cents a gallon in September 1948, and then a drop to 12.71 cents in December 1948. A retail posting in Chicago for No. 2 distillate—13.36 cents a gallon—dating from January 1948 held until May 1948, when there was an advance to 13.57 cents. This quotation held for the balance of the year.

RESIDUAL FUEL OIL

The production of residual fuel oil increased in 1948 and was more than adequate to satisfy a lower domestic and export demand; as a result, there was a large surplus to add to inventory. The indicated domestic demand for heavy fuel oils in 1948 (500,759,000 barrels) was 3 percent below 1947 requirements of 518,510,000 barrels, while exports increased slightly from 10,623,000 barrels in 1947 to 12,539,000 in 1948, an 18-percent gain.

The drop in demand for residual fuel oils in 1948 was not evident throughout the year, as the total for the first and second quarters was above the corresponding periods of 1947. However, the relative shrinkage in quarterly requirements in 1948 increased as the year advanced. The indicated domestic demand for heavy fuel oils in the first quarter of 1948 (142,226,000 barrels) was 3 percent above the comparable 1947 total (137,459,000 barrels). The 1948 second-quarter total of 121,637,000 barrels was 1 percent over the comparable 120,385,000-barrel demand in 1947. However, in the third quarter of 1948, requirements for residual grades (111,681,000 barrels) were 8 percent below the demand in the same 3 months of 1947 (120,954,000 barrels). In the final period, when the need for heavy heating oils is a factor, total deliveries of 125,215,000 barrels in 1948 were 10 percent below the 1947 comparable item of 139,712,000 barrels. A declining market for residual fuel oil was still evident in the opening quarter of 1949, when the indicated demand of 135,352,000 barrels was 5 percent under the corresponding 1948 requirements of 142,226,000 barrels.

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Salient statistics of residual fuel oil in the United States, 1947–48, 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									
	1947	1948 [2]	1947	1948 [2]	1947	1948 [2]	1947	1948 [2]	1947	1948 [2]	1947	1948 [2]	1947	1948 [2]	1947	1948 [2]
By months:																
January	36,390	39,606	24.7	23.6	383	435	1,493	1,704	5,390	5,093	901	440	48,299	48,853	41,550	44,636
February	34,390	37,542	25.4	23.6	405	386	1,455	1,401	5,003	5,454	1,015	698	43,308	45,565	38,480	43,156
March	37,876	40,523	25.1	24.3	405	407	1,887	1,227	5,383	5,205	776	765	45,852	47,808	37,403	41,945
April	34,438	39,104	24.5	23.9	416	379	1,988	1,315	5,462	4,686	1,112	1,297	42,140	42,831	36,455	43,301
May	37,328	40,732	24.5	23.4	402	382	1,952	1,387	4,805	3,734	893	929	40,057	39,819	39,992	48,788
June	36,977	38,387	24.2	22.8	346	398	2,425	1,474	3,004	3,574	1,041	1,169	38,188	38,987	43,515	52,465
July	38,550	39,177	23.9	22.6	421	371	2,340	1,829	4,030	4,123	844	1,279	40,412	38,255	47,600	58,431
August	38,592	38,673	23.5	22.1	396	435	2,369	1,963	3,186	4,453	945	1,459	39,864	38,400	51,334	64,096
September	37,098	34,493	23.4	21.6	403	375	1,934	962	3,516	4,332	1,029	1,227	40,678	35,026	52,578	68,005
October	39,066	39,313	23.7	22.6	430	351	1,452	1,723	3,879	3,106	908	1,328	43,995	38,807	52,502	72,363
November	37,344	38,315	23.6	22.5	442	314	1,248	1,938	4,996	4,112	545	901	43,532	39,108	52,455	77,033
December	39,746	40,276	23.9	22.6	479	331	1,620	2,360	5,590	5,289	614	1,047	52,185	47,300	47,091	76,942
Total	447,795	466,141	24.2	23.0	4,928	4,564	22,163	19,283	54,244	53,161	10,623	12,539	518,510	500,759	47,091	76,942
By districts:																
East Coast	86,769	84,111	29.2	26.5											7,302	11,917
Appalachian	10,250	9,652	17.0	16.7											690	713
Indiana, Illinois, Kentucky, etc	57,259	57,521	19.0	17.3	822	528									5,072	5,465
Oklahoma, Kansas, Missouri, etc	25,246	27,667	16.5	16.7	402	362									1,729	2,956
Texas Inland	21,064	22,203	24.9	24.7	1,198	1,432									785	1,250
Texas Gulf Coast	88,592	95,385	20.3	18.7	378	290			(3)	(3)	(3)	(3)	(3)	(3)	7,412	11,791
Louisiana Gulf Coast	24,324	27,790	17.4	17.5	865	839									1,918	3,816
Arkansas, Louisiana Inland, Mississippi	5,410	6,764	21.8	22.7	566	550									174	328
Rocky Mountain	13,710	14,362	26.2	24.1	697	563									742	1,110
California	115,171	120,686	38.2	38.9			22,163	19,283							21,267	37,596
Total	447,795	466,141	24.2	23.0	4,928	4,564	22,163	19,283	54,244	53,161	10,623	12,539	518,510	500,759	47,091	76,942

[1] Represents quantities used on leases and for general industrial purposes.
[2] Subject to revision.
[3] Figures not available.

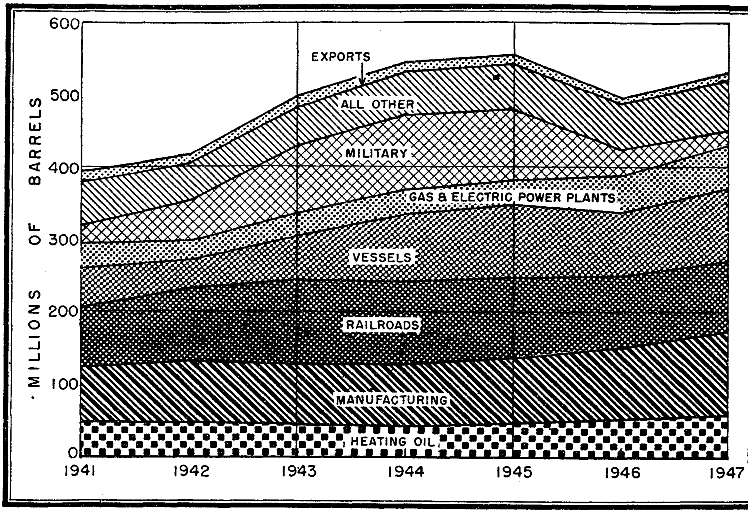

FIGURE 11.—Sales of residual fuel oil in the United States, 1941-47, by uses.

Sales of heavy fuel oil by principal uses in 1948, 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, 89,700,000 barrels; bunkering of vessels, 96,000,000 barrels (of which amount 54,813,000 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); and gas and electric power plants, 56,812,000 barrels.

Figure 11 showing sales of residual oil represents the fluctuating annual demand for residual fuel oils by principal uses in recent years. 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 1944–1946, was not repeated in 1947 and 1948. In 1948 the foreign shipments (12,539,000 barrels) were 18 percent above the 1947 total (10,623,000 barrels).

The exports of residual fuel oil to European countries reported by the Bureau of the Census, United States Department of Commerce, dropped sharply from 2,044,000 barrels in 1947 to 896,000 in 1948, showing Denmark and Sweden importing the larger shares. Exports of heavy fuel oils to Canada increased from 2,407,000 barrels in 1947 to 3,767,000 in 1948. Cuba and Mexico continued to import large quantities of residual fuel oil in 1948. Various countries received the following quantities of American heavy fuel oil in 1948: Canal Zone, 874,000 barrels; Chile, 109,000 barrels; Guatemala, 584,000 barrels; and Philippine Republic, 142,000 barrels.

Sales of residual fuel oil [1] in the United States, 1943–47, by uses [2]

[Thousands of barrels]

Use	1943	1944	1945	1946	1947
Railroads	116,278	114,535	112,297	100,305	97,500
Ships' bunkers (including tankers)	62,196	92,069	100,365	88,185	101,900
Gas and electric power plants	30,858	34,476	34,532	50,921	60,964
Smelters, mines, and manufacturing industries	84,219	86,664	91,176	[3] 99,011	115,108
Heating oils	42,670	40,474	43,874	49,734	56,402
U. S. Navy, Army, and Coast Guard	92,713	101,347	97,485	35,822	19,147
Oil-company fuel	47,123	55,363	57,336	58,054	62,649
Miscellaneous uses	6,420	4,484	5,200	5,028	6,859
Total United States	482,477	529,412	542,265	[3] 487,060	520,529
Exports and shipments to noncontiguous Territories	14,894	12,536	11,669	9,188	10,623
Total	497,371	541,948	553,934	[3] 496,248	531,152

[1] Includes Navy grade and crude oil burned as fuel.
[2] Figures for 1948 not yet available.
[3] Revised figure.

The volume of crude run through refineries in 1948 increased about 10 percent compared with 1947; however, the yield of residual fuel oils was cut from 24.2 percent in 1947 to 23.0 percent in 1948 to make more of the distillate grades. The output of residuals increased 4 percent from 447,795,000 barrels in 1947 to 466,141,000 in 1948. All refinery districts except the East Coast and Appalachian reported increases in production. About 18 percent of the heavy fuel oil made in the country is credited ot the East Coast States, and the quantity dropped 3 percent from 86,769,000 barrels in 1947 to 84,111,000 in 1948. The crude petroleum processed in the area was up slightly in 1948 compared with 1947; however, the yield for residual fuel oils was only 26.5 percent in 1948 against 29.2 percent in 1947, and hence production was lower. Runs of foreign crude (usually of high residual fuel-oil content) decreased in volume in 1948, an added factor 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 88,592,000 barrels in 1947 to 95,385,000 in 1948. Increased runs (17 percent over 1947) in this district were sufficient to counteract a lower yield (18.7 percent in 1948 compared with 20.3 percent in 1947), hence the gain in the output of heavy fuel oils. The California district produced more residual fuel oil than any other area, or 26 percent of the national production. The quantity increased 5 percent from 115,171,000 barrels in 1947 to 120,686,000, owing both to a 2-percent gain in crude runs and a slightly increased yield—38.9 percent in 1948 compared with 38.2 percent in 1947.

The Indiana-Illinois-Kentucky refinery district is also the source of an important quantity of heavy fuel oil; however, the total increase was less than 0.5 percent, or from 57,259,000 barrels in 1947 to 57,521,000 in 1948. The gain was due to a 10-percent increase in crude runs, as the yield dropped from 19.0 percent in 1947 to 17.3 percent in 1948. A higher yield and an increase in crude runs in the Oklahoma-Kansas-Missouri group of States resulted in a greater production of residual—from 25,246,000 barrels in 1947 to 27,667,000 in 1948. Similar operating conditions also prevailed in the Louisiana

Sales of residual fuel oil [1] in the United States, 1943–47, by States [2]

[Thousands of barrels]

Region [3] and State	1943	1944	1945	1946	1947
Pacific Coast:					
Washington	12,991	12,896	13,615	12,856	14,149
Oregon	15,958	15,638	17,205	14,662	15,482
California	118,848	116,127	129,514	92,039	90,916
Arizona	4,117	2,905	2,706	2,618	3,491
Nevada	6,940	7,507	6,626	5,823	5,957
Rocky Mountain:					
Idaho	603	580	557	490	460
Montana	3,804	5,460	6,253	6,274	5,444
Wyoming	2,572	5,327	4,710	4,365	3,741
Utah	887	1,202	1,396	1,324	1,486
Colorado	1,404	1,489	1,262	1,237	1,218
New Mexico	595	755	1,184	1,112	840
North Central:					
North Dakota	93	104	623	572	414
South Dakota	212	226	241	306	257
Minnesota	1,170	1,219	1,106	1,089	1,022
Nebraska	648	556	581	491	378
Iowa	986	913	882	1,029	777
Wisconsin	1,667	1,806	1,671	1,610	1,358
Illinois	14,694	15,540	15,092	15,130	17,047
Indiana	9,220	11,776	12,118	11,825	12,386
Michigan	7,257	6,506	6,482	5,760	7,046
Ohio	10,024	10,897	11,534	[4] 13,651	16,534
Kentucky	1,222	1,022	926	1,005	824
Tennessee	1,082	1,580	1,550	813	1,015
South Central:					
Missouri	6,730	6,030	5,971	5,164	6,920
Kansas	11,099	10,754	10,584	9,948	11,224
Texas	75,625	79,495	81,758	66,466	66,789
Oklahoma	9,711	8,787	8,314	8,157	8,276
Arkansas	3,229	3,110	2,321	2,331	2,253
Louisiana	12,788	14,003	13,416	13,052	14,835
Mississippi	465	618	505	294	343
Alabama	2,466	2,468	3,131	3,180	3,294
New England:					
Maine	1,754	2,061	1,718	2,258	2,809
New Hampshire	433	701	536	768	959
Vermont	110	107	142	203	262
Massachusetts	12,548	16,595	14,513	14,711	16,976
Rhode Island	3,168	4,008	4,168	5,576	7,088
Connecticut	4,114	4,347	4,934	7,117	8,838
Middle Atlantic:					
New York	27,207	25,635	27,105	30,380	32,907
New Jersey	36,111	56,143	49,272	42,814	46,167
Pennsylvania	24,515	32,529	35,210	35,097	35,794
Delaware	1,334	879	1,173	1,044	1,139
Maryland	10,854	12,287	12,889	14,604	17,119
District of Columbia	952	759	866	1,073	935
South Atlantic:					
Virginia	4,584	6,643	5,943	6,402	11,298
West Virginia	1,244	980	888	482	828
North Carolina	500	384	504	643	433
South Carolina	670	1,029	790	2,112	2,349
Georgia	2,502	2,807	2,821	3,018	2,933
Florida	10,770	14,222	14,959	14,085	15,519
Total	[5] 482,477	[5] 529,412	[5] 542,265	[4] 487,060	520,529

[1] Includes some crude oil burned as fuel.
[2] Figures for 1948 not yet available.
[3] States are grouped according to petroleum-marketing territories rather than to conventional geographic regions.
[4] Revised figure.
[5] These totals involve some duplication owing to rehandling of fuel oil initially sold to the Government.

Gulf Coast district, where heavy fuel oil realized rose from 24,324,000 barrels in 1947 to 27,790,000 in 1948. Crude petroleum processed in the Texas Inland district gained (5 percent over 1947); however, as the yield for residual grades of fuel oil dropped from 24.9 percent in 1947 to 24.7 percent in 1948, the output was only 22,203,000 barrels in 1948 compared with 21,064,000 barrels in 1947. The remaining refinery districts—Appalachian, Arkansas-Louisiana Inland, and the

Rocky Mountain—do not produce large quantities of heavy fuel oils; the Appalachian area was the only one of this group to report a decline in 1948.

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 23,847,000 barrels in 1948—12 percent under the 1947 item of 27,091,000 barrels. This crude used as fuel represented about 5 percent of the total supply of heavy fuel oil in 1948 and approximately 6 percent in 1947. The larger share of the transfers is reported from the California refinery district—19,283,000 barrels in 1948 compared with 22,163,000 in 1947. Quantities in the other refinery areas declined from 4,928,000 barrels in 1947 to 4,564,000 in 1948. No transfers of this kind are made in the east coast and Appalachian districts.

Imports of residual fuel for consumption in continental United States declined 2 percent in 1948 or from 53,161,000 barrels compared with 54,244,000 in 1947. Heavy fuel oil received from foreign sources made up 11 percent of the total supply in 1948, compared with 10 percent in 1947. Virtually all of the residual fuel oil received from abroad in 1948 came from Curaçao, Netherlands West Indies, while relatively smaller amounts were credited to a number of other countries, including Canada, Mexico, Venezuela, Trinidad, Saudi Arabia, and Bahrein.

A lower domestic demand, although coupled with lower imports and expanded exports, together with the mild winter in the New England, Middle Atlantic, and South Atlantic areas, were factors that resulted in a greatly improved residual fuel-oil stock situation in 1948 compared with 1947, even though the percentage yield was unfavorable. The volume of year-end stocks of heavy fuel oils expanded from 47,091,000 barrels in 1947 to 76,942,000 in 1948—a 63-percent gain in contrast to a slight decrease in similar inventories in 1947. Quantities reported at refineries jumped from 38,807,000 barrels at the close of 1947 to 64,664,000 in 1948—a 67-percent gain—while those held at bulk terminals were up 48 percent from 8,284,000 barrels in 1947 to 12,278,000 in December 1948.

During 1947, 3,000,000 barrels of heavy fuel oil were withdrawn from storage to meet the demand, while in 1948 the supply situation was more favorable, as there was an addition to inventory of 29,851,000 barrels. Residual grades of fuel oil held at refineries and bulk terminals at the end of 1948 were adequate for 50 days of supply at the subsequent January rate of indicated demand, and this volume compares with a 30-day supply at the close of 1947.

Nearly half of the residual fuel-oil stocks are carried in the California refinery district, and the quantity reported increased 77 percent from 21,267,000 barrels in 1947 to 37,596,000 in December 1948. Important inventories of heavy fuel oil are also held in the East Coast and Texas Gulf Coast areas, or about 15 percent of the Nation's total in each area. The East Coast quantity expanded 63 percent from 7,302,000 barrels in 1947 to 11,917,000 in December 1948, while in the Texas Gulf Coast supply area, the year-end totals were 7,412,000 barrels in 1947 and 11,791,000 in 1948. Heavy fuel-oil inventories in the Indiana-Illinois-Kentucky group of States rose from 5,072,000 barrels (11 percent of the national total in 1947) to 5,465,000—7 percent of all stocks in 1948. The heavy fuel oil stored in the remaining refinery districts is not relatively important and represented only 15 percent of the total stock in 1948. Inventories in all of these areas—Appalachian, Oklahoma-Kansas-Missouri, Texas Inland, Louisiana Gulf Coast, Arkansas–Louisiana Inland, and Rocky Mountain—were higher at the end of 1948 compared with 1947.

Very little residual fuel oil is being shipped from the West Coast area to other parts of the country. Tanker movements of this heavy grade to the east coast totaled 97,000 barrels in 1948 compared with 1,000 in 1947, while rail and truck shipments to other Western States increased from 85,000 barrels in 1947 to 243,000 in 1948. Other Western States shipped 592,000 barrels of heavy fuel oil to the California marketing area (California, Oregon, Washington, Arizona, and Nevada) in 1947 and 511,000 in 1948.

The tanker and barge movement of residual fuel oil from the Gulf area to the Atlantic coast increased from 61,189,000 barrels in 1947 to 68,662,000 in 1948, according to published records compiled by the Oil and Gas Division, United States Department of the Interior. The largest share of these shipments were credited to Texas—51,728,000 barrels in 1947 and 55,325,000 in 1948—while smaller quantities came from Louisiana—9,461,000 barrels in 1947 and 12,907,000 in 1948. Alabama shipped 430,000 barrels in this eastward movement in 1948. Some residual fuel oil is shipped by barge from the Gulf Coast area to distributing points on the Mississippi River and its tributaries in district 2. The annual total in this traffic has fluctuated from 642,000 barrels in 1946 to 1,021,000 in 1947 and then down to 658,000 barrels in 1948. Most of this residual fuel oil came from Louisiana, although some of it was credited to Texas, Arkansas, and Mississippi.

The fixed tanker rate of 43.8 cents a barrel on heavy fuel oil (Bunker C) shipped from the Gulf to the east coast, not east of New York, rose suddenly to $1.096 in the final days of December 1947. In this period and in early 1948, the United States Maritime Commission disposed of all its tankers; and, with a shortage of fuel-oil supplies in the East Coast area, tanker rates went out of control to peak levels of $1.315 a barrel on January 2 and February 8. As the seasonal demand for heavy fuel oil on the east coast tapered off, the tanker rate dropped to 32.9 cents a barrel on August 20. The fourth quarter demand in this traffic pushed up the tanker charge to 49.3 cents a barrel November 12, but it dropped thereafter to 39.5 cents a barrel in late December.

The price of representative grades of residual fuel oil moved upward in the first quarter of 1948. No. 6 was quoted at $2.55 a barrel at refineries in Oklahoma in December 1947, and the price rose each month during the first quarter of 1948 to $2.87 a barrel in March 1948. The price declined during the balance of the year, and the December average price was $1.87 a barrel, a 27-percent decrease from the comparable price in December 1947.

Market quotations on No. 5 fuel oil at New York Harbor, which averaged $3.60 a barrel in January 1948, rose slightly in February and March, reached $3.82 a barrel in April, and remained at this level until August. The price was shaded several cents a barrel during the balance of the year, and in December the quotation stood at $3.39 a barrel. The weighted price for 1948 was $3.71 a barrel.

Monthly average prices of residual fuel oil in the United States, 1947–48

[Platt's Oil Price Handbook]

Year and grade	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
1947													
No. 6 fuel oil at refineries, Oklahoma dollars per barrel	1.36	1.40	1.62	1.76	2.08	2.20	2.20	2.20	2.22	2.22	2.25	2.55	2.01
No. 5 fuel oil at New York Harbor do	2.32	2.39	2.49	2.62	2.66	2.71	2.71	2.71	2.73	2.75	3.05	3.27	2.70
Bunker "C" for ships:													
New York do	1.92	2.00	2.09	2.22	2.23	2.27	2.27	2.34	2.37	2.37	2.60	2.76	2.29
Gulf Coast do	1.54	1.57	1.66	1.85	1.90	2.10	2.15	2.24	2.24	2.27	2.39	2.60	2.04
California do	1.25	1.25	1.32	1.45	1.45	1.46	1.72	1.73	1.73	1.73	1.74	1.80	1.55
1948													
No. 6 fuel oil at refineries, Oklahoma dollars per barrel	2.70	2.80	2.87	2.73	2.63	2.63	2.58	2.38	2.15	2.02	1.90	1.87	2.44
No. 5 fuel oil at New York Harbor do	3.60	3.72	3.79	3.82	3.82	3.82	3.82	3.77	3.74	3.70	3.56	3.39	3.71
Bunker "C" for ships:													
New York do	3.03	3.03	3.03	3.03	3.03	3.03	3.03	3.03	3.03	3.03	2.98	2.78	3.00
Gulf Coast do	2.88	2.88	2.88	2.88	2.82	2.93	2.93	2.91	2.67	2.80	2.77	2.49	2.82
California do	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.13	2.18	2.11

Bunker "C" fuel oil for ships followed the general trend of other heavy fuel oils, with a quotation of $3.03 a barrel at New York Harbor for January 1948. This price held fairly steady until December 1948, when the price dropped to $2.78 a barrel. A price of $2.88 a barrel for Bunker "C" at Gulf ports, effective January 1948, remained in force until May and after several changes reached a low of $2.49 a barrel in December 1948 compared with $2.60 in the same period of 1947.

Bunker "C" for ships loading in the California area was quoted at $2.10 a barrel during the first 10 months of 1948, after which it rose to a year-end price of $2.18 a barrel.

LUBRICATING OIL

The refinery production of lubricating oils dropped from 51.8 million barrels in 1947 to 51.4 million in 1948—a decline of 1 percent in 1948 compared with gains of 13 percent in 1947 and 9 percent in 1946. The principal gain in production in 1948 was 1.1 million barrels in the Texas Gulf district, and the largest declines were 0.7 million barrels in the California district, 0.5 million in the Appalachian district, and 0.4 million in the Louisiana Gulf district.

Salient statistics of lubricating oil in the United States, 1947–48, 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)	
	1947	1948 [1]	1947	1948 [1]	1947	1948 [1]	1947	1948 [1]
By months:								
January	4,204	4,287	2.9	2.6	2,879	3,056	7,773	7,892
February	3,925	4,132	2.9	2.6	2,684	3,044	7,753	7,829
March	4,480	4,404	3.0	2.6	2,929	3,231	8,015	7,961
April	4,267	4,308	3.0	2.6	3,066	3,096	7,936	8,022
May	4,608	4,500	3.0	2.6	3,104	2,956	8,070	8,411
June	4,427	4,065	2.9	2.4	2,873	3,007	8,281	8,166
July	4,227	4,135	2.6	2.4	3,003	2,803	8,188	8,350
August	4,400	4,341	2.7	2.5	3,051	2,957	8,420	8,747
September	4,047	4,121	2.6	2.6	3,219	2,843	8,340	8,884
October	4,350	4,580	2.6	2.6	3,437	3,178	8,157	9,306
November	4,264	4,175	2.7	2.4	2,911	3,229	8,531	9,512
December	4,566	4,368	2.8	2.5	3,325	2,985	8,624 [2] 7,701	9,843
Total	51,765	51,416	2.8	2.5	36,481	36,385	8,624 [2] 7,701	9,843
By districts:								
East Coast	11,078	11,163	3.7	3.5	(3)	(3)	2,386	3,158
Appalachian	5,531	5,068	9.1	8.8			559	817
Indiana, Illinois, Kentucky, etc	5,261	5,042	1.7	1.5			886	999
Oklahoma, Kansas, Missouri, etc	5,861	6,131	3.8	3.7			538	835
Texas Inland	369	383	.4	.4			76	98
Texas Gulf Coast	15,009	16,129	3.5	3.2			2,229	2,760
Louisiana Gulf Coast	2,350	1,978	1.7	1.2			221	244
Arkansas, Louisiana Inland, Mississippi, etc	1,484	1,376	5.9	4.5			154	189
Rocky Mountain	311	300	.6	.5			91	108
California	4,511	3,846	1.5	1.2			1,484 [2] 561	635
Total	51,765	51,416	2.8	2.5	36,481	36,385	8,624 [2] 7,701	9,843

[1] Subject to revision. [2] New basis to compare with subsequent years. [3] Data not available.

The total demand for lubricating oils declined sharply in 1948. The total in 1948 amounted to 49.4 million barrels compared with 50.7 million in 1947. Exports were reduced by 1.3 million barrels, while domestic demand was 0.1 million less.

Average monthly refinery prices of 5 selected grades of lubricating oil in the United States, 1947–48, in cents per gallon

[National Petroleum News]

Year and grade	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
1947													
Oklahoma:													
200 viscosity, No. 3 color, neutral	17.32	17.32	17.93	19.00	18.77	18.50	18.50	18.50	18.50	18.71	19.25	20.41	18.56
150–160 viscosity at 210°, bright stock, 10–25 pour test	29.06	26.50	27.95	28.50	28.50	28.50	28.50	28.50	28.50	29.36	30.50	31.75	28.84
Pennsylvania:													
200 viscosity, No. 3 color, neutral, 420–425 flash, 25 pour test	37.50	37.73	38.86	39.50	39.50	39.98	40.00	40.00	40.00	40.00	40.00	40.86	39.49
600 steam-refined, cylinder stock, filterable	27.89	28.23	29.38	30.50	30.64	31.98	32.42	33.00	33.00	33.50	33.50	34.84	31.57
Gulf Coast: 500 viscosity, No. 2½–3½ color, neutral	12.44	12.75	13.32	13.50	13.50	13.50	13.50	13.50	12.89	12.75	13.42	13.84	13.24
1948													
Oklahoma:													
200 viscosity, No. 3 color, neutral	21.25	21.25	21.25	21.25	21.25	21.11	21.00	21.00	20.14	20.00	20.00	17.11	20.55
150–160 viscosity at 210°, bright stock, 10–25 pour test	32.50	32.50	32.50	32.50	32.50	32.50	32.50	32.50	31.83	30.50	30.50	27.25	31.67
Pennsylvania:													
200 viscosity, No. 3 color, neutral, 420–425 flash, 25 pour test	41.50	41.50	41.50	41.50	41.50	41.50	41.50	41.41	28.79	35.50	35.07	29.63	39.24
600 steam-refined, cylinder stock, filterable	36.00	36.00	36.39	36.50	36.50	36.50	36.50	36.39	35.14	33.93	32.86	30.22	35.25
Gulf Coast: 500 viscosity, No. 2½–3½ color, neutral	15.04	15.25	15.25	15.25	15.25	15.25	15.25	15.25	14.95	14.75	14.75	14.75	15.08

OTHER PRODUCTS

Wax.—Refinery production of petroleum wax declined for the first time since 1938. The production in 1948 amounted to 3,515,000 barrels (converted at the rate of 280 pounds to the barrel) compared with 3,624,000 in 1947.

All the producing districts except the Indiana-Illinois-Kentucky and the Rocky Mountain showed declines in 1948. Of the total decrease in production (109,000 barrels), the Texas Gulf district accounted for 65,000 barrels, the East Coast for 45,000, and the Oklahoma–Kansas–Missouri for 35,000. The principal gain in production was 51,000 barrels in the Indiana–Illinois–Kentucky district.

Total demand for wax dropped from 3,585,000 barrels in 1947 to 3,342,000 in 1948. Exports of wax decreased from 1,107,000 in 1947 to 994,000 in 1948, and domestic demand was reduced from 2,478,000 barrels in 1947 to 2,348,000 in 1948.

Salient statistics of wax in the United States, 1947–48 by types, months, and districts

[Thousands of barrels] [1]

Month and district	Production						Domestic demand (all types)		Exports (all types)		Stocks, end of period					
	1947			1948 [2]							1947			1948 [2]		
	Microcrystalline	Fully refined	Other	Mirocrystalline	Fully refined	Other	1947	1948 [2]	1947	1948 [2]	Microcrystalline	Fully refined	Other	Microcrystalline	Fully refined	Other
By months:																
January	32	156	111	31	201	118	217	240	97	92	34	127	132	83	96	195
February	32	159	101	25	181	88	194	209	87	94	45	72	187	85	101	183
March	32	169	133	25	194	132	221	262	90	102	49	75	203	84	99	177
April	17	175	94	29	186	117	225	226	82	79	44	79	183	96	98	195
May	21	178	121	21	177	97	219	182	88	103	37	83	199	101	112	189
June	18	162	99	19	178	111	206	188	77	86	39	78	198	108	120	211
July	37	160	123	6	161	100	218	142	83	80	47	71	216	101	132	254
August	6	161	69	12	170	85	165	163	92	63	44	95	175	98	148	285
September	27	148	146	31	136	71	197	158	95	70	57	88	199	96	150	295
October	13	153	120	27	150	86	205	176	100	76	57	77	191	95	147	310
November	28	180	99	32	162	74	183	224	103	42	64	93	189	95	153	306
December	32	192	120	33	162	87	228	178	113	107	69	87	195	98	140	313
Total	295	1,993	1,336	291	2,058	1,166	2,478	2,348	1,107	994	69	87	195	98	140	313
By districts:																
East Coast	119	787	481	122	823	397					33	28	84	50	55	157
Appalachian	26	143	228	14	129	248					12	22	32	16	30	47
Indiana, Illinois, Kentucky		225	2		263	15						7	48		9	56
Oklahoma, Kansas, Missouri	79	170	226	131	109	200					14	5	8	22	4	23
Texas Inland			11			9	(3)	(3)	(3)	(3)						1
Texas Gulf Coast	58	421	49	13	425	25					9	14	2	6	22	1
Louisiana Gulf Coast		86	327	3	135	262						3	6	3	6	7
Rocky Mountain	13	70	12	8	86	10					1	5	15	1	9	21
California		91			88							3			5	
Total	295	1,993	1,336	291	2,058	1,166	2,478	2,348	1,107	994	69	87	195	98	140	313

[1] Conversion factor: 280 pounds to the barrel.
[2] Subject to revision.
[3] Figures not available.

Average monthly refinery price of 124°–126° white crude scale wax at Pennsylvania refineries, 1944–48, in cents per pound [1]

[National Petroleum News]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
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
1947	6.19	7.06	7.75	7.75	7.75	7.75	7.75	7.75	7.75	7.85	7.88	8.03	7.61
1948	8.57	8.75	8.71	8.50	8.50	8.38	8.13	8.10	7.45	7.38	7.38	6.30	8.01

Coke.—The production of petroleum coke increased from 12.1 million barrels (converted at the rate of 5 barrels to the short ton) to 14.5 million in 1948. The principal gain in production was in the Indiana–Illinois–Kentucky refinery district, with an increase of almost 2 million barrels in 1948 compared with 1947. This district is the largest producer, contributing 49.6 percent of the total in 1948 compared with 43.1 percent in 1947 and 48.7 percent in 1946.

The total demand for petroleum coke increased from 12.2 million barrels in 1947 to 14.2 million in 1948. The gain of 2.0 million barrels in 1948 represented an increase of 0.4 million in exports and 1.6 million in domestic demand.

Salient statistics of petroleum coke in the United States, 1947–48, by months and districts [1]

Month and district	Production (thousands of barrels)		Yield (percent)		Domestic demand (thousands of barrels)		Stocks end of period (thousands of barrels)	
	1947	1948 [2]	1947	1948 [2]	1947	1948 [2]	1947	1948 [2]
By months:								
January	1,016	1,020	0.7	0.6	861	686	468	337
February	890	1,013	.7	.6	831	839	385	396
March	1,047	1,209	.7	.7	843	1,151	456	331
April	974	1,126	.7	.7	792	886	445	343
May	1,090	1,087	.7	.6	888	869	422	417
June	1,006	1,281	.7	.7	765	1,049	443	457
July	1,119	1,296	.7	.7	935	973	430	502
August	1,002	1,295	.6	.7	717	1,010	549	553
September	959	1,228	.6	.8	912	1,075	475	544
October	1,050	1,247	.6	.7	921	944	483	574
November	876	1,296	.6	.7	768	1,124	416	583
December	1,048	1,396	.6	.8	849	1,064	343	646
Total	12,077	14,494	.7	.7	10,082	11,670	343	646
By districts:								
East Coast	729	755	.2	.2	(3)	(3)	1	1
Appalachian	333	317	.6	.6			9	7
Indiana, Illinois, Kentucky, etc	5,205	7,183	1.7	2.2			97	155
Oklahoma, Kansas, Missouri, etc	728	1,005	.5	.6			17	39
Texas Inland	554	584	.7	.6			18	14
Texas Gulf Coast	1,535	1,527	.4	.3			6	48
Louisiana Gulf Coast	1,184	1,249	.8	.8			2	1
Rocky Mountain	233	269	.4	.5			33	11
California	1,576	1,605	.5	.5			160	370
Total	12,077	14,494	.7	.7	10,082	11,670	343	646

[1] Conversion factor: 5.0 barrels to the short ton.
[2] Subject to revision.
[3] Figures not available.

Asphalt and Road Oil.—The total demand for asphalt increased from 50.3 million barrels in 1947 (converted at the rate of 5.5 barrels to the short ton) to 51.4 million in 1948—a gain of 1.1 million barrels, representing a decline of 1.6 million in exports and an increase of 2.7 million in domestic demand. The gain in domestic demand was 6 percent in 1948 compared with gains of 9 percent in 1947 and 13 percent in 1946. The domestic demand for road oil amounted to 8.0 million barrels in 1948 compared with 7.1 million in 1947—a gain of 14 percent in 1948 compared with an increase of 19 percent in 1947.

Still Gas.—The production of still gas continued to decline from 317 billion cubic feet in 1946 to 308 billion in 1947 and to 292 billion in 1948. The principal declines compared with 1947 were about 8 billion cubic feet in the East Coast district and 5 billion in the Texas Gulf district.

Production of still gas in the United States, 1946–48, by districts [1]

District	1946		1947		1948 [2]	
	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	45,688	12,691	42,084	11,690	34,168	9,491
Appalachian	12,370	3,436	12,301	3,417	10,879	3,022
Indiana, Illinois, Kentucky, etc	60,837	16,899	56,088	15,580	56,117	15,588
Oklahoma, Kansas, Missouri, etc	24,235	6,732	23,951	6,653	23,360	6,489
Texas Inland	15,725	4,368	14,609	4,058	14,526	4,035
Texas Gulf Coast	83,142	23,095	87,192	24,220	82,087	22,802
Louisiana Gulf Coast	22,363	6,212	20,289	5,636	20,642	5,734
Arkansas, Louisiana Inland, Mississippi, etc	4,759	1,322	5,252	1,459	5,198	1,444
Rocky Mountain	7,693	2,137	7,956	2,210	8,039	2,233
California	40,478	11,244	38,308	10,641	37,156	10,321
Total	317,290	88,136	308,030	85,564	292,172	81,159

[1] Conversion factor: 3,600 cubic feet to the barrel.
[2] Subject to revision.

Miscellaneous Finished Oils.—The annual survey of miscellaneous finished oils produced at petroleum refineries was resumed for 1948, after a lapse since 1943. Liquefied gases have been omitted from the 1948 survey because these materials are now reported separately on a monthly basis.

Other oils classified in the miscellaneous group in 1943 amounted to 3,381,000 barrels. The comparable total for 1948 increased to 6,188,000 barrels.

The refinery output by classes is shown for 1948. The difference between the refinery production shown in this table, in comparison with other published production figures for the year, is due to reclassification of products.

Production of miscellaneous finished oils in the United States in 1948, by districts and classes

[Thousands of barrels]

District	Petrolatum	Absorption oil	Medicinal oil	Specialties	Solvents	Other	Total
East Coast	51	12	88	228	70	--------	449
Appalachian	156	10	----------	8	29	93	296
Indiana, Illinois, Kentucky, etc	79	----------	----------	793	--------	124	996
Oklahoma, Kansas, Missouri, etc	444	35	----------	25	21	452	977
Texas Inland	21	229	----------	50	--------	922	1, 222
Texas Gulf Coast	201	146	----------	40	93	148	628
Louisiana Gulf Coast	--------	1	----------	----------	--------	86	87
Arkansas, Louisiana Inland, Mississippi	--------	141	----------	----------	19	3	163
Rocky Mountain	--------	----------	----------	----------	--------	82	82
California	--------	----------	40	705	--------	543	1, 288
Total	952	574	128	1, 849	232	2, 453	[1] 6, 188

[1] Difference between the refinery output of other finished products and this total is due to reclassification of products.

INTERCOASTAL SHIPMENTS [2]

Shipments of mineral oils, crude and refined, from Gulf coast ports to east coast ports were 10 percent larger in 1948 than in 1947. Crude petroleum was the largest single item in these shipments; it constituted 35 percent of the total shipments in 1948, compared with 38 percent in 1947. Gasoline occupied second place in importance; shipments constituted 26 percent of the whole, both in 1947 and in 1948. With the exception of crude-petroleum shipments, which remained virtually level from 1947 to 1948, shipments of mineral oils from the Gulf coast to the east coast were appreciably larger in 1948 than in 1947.

Mineral oils, crude and refined, shipped commercially from Gulf-coast to east-coast ports of the United States, 1947–48, by classes [1]

[Thousands of barrels]

Year and class	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1947													
Crude petroleum	16, 378	13, 702	16, 383	15, 868	16, 999	18, 635	18, 953	18, 292	15, 142	15, 467	16, 837	14, 666	197, 322
Gasoline	10, 557	8, 584	11, 029	10, 156	10, 619	11, 397	12, 278	11, 519	11, 586	12, 015	11, 842	11, 048	132, 630
Kerosine	3, 984	3, 486	2, 819	2, 757	2, 081	2, 479	2, 542	2, 567	1, 671	2, 759	2, 967	4, 110	34, 222
Distillate fuel oil	9, 648	9, 188	7, 756	6, 013	4, 794	5, 071	4, 494	5, 340	5, 699	5, 132	7, 289	10, 109	80, 533
Residual fuel oil	5, 060	4, 613	4, 740	5, 389	4, 433	4, 818	4, 507	5, 077	4, 480	5, 019	5, 514	7, 539	61, 189
Lubricating oil	666	469	640	493	853	580	740	478	592	483	617	678	7, 289
Miscellaneous oils	208	235	202	239	339	242	265	534	215	251	201	340	3, 271
Total	46, 501	40, 277	43, 569	40, 915	40, 118	43, 222	43, 779	43, 807	39, 385	41, 126	45, 267	48, 490	516, 456
1948													
Crude petroleum	17, 257	15, 862	19, 044	17, 460	18, 748	17, 688	15, 859	15, 365	15, 501	15, 070	15, 856	13, 053	196, 763
Gasoline	10, 263	10, 106	11, 883	13, 537	13, 657	12, 799	12, 944	12, 795	11, 666	11, 471	12, 779	11, 890	145, 790
Kerosine	4, 763	3, 562	3, 500	3, 592	3, 067	2, 576	3, 751	2, 524	2, 531	2, 444	3, 787	3, 923	40, 020
Distillate fuel oil	13, 471	11, 906	10, 512	7, 117	7, 061	7, 821	4, 740	7, 194	5, 903	6, 865	9, 618	10, 401	102, 609
Residual fuel oil	6, 499	6, 052	6, 753	5, 392	6, 280	4, 976	5, 233	4, 959	4, 068	5, 671	5, 913	6, 866	68, 662
Lubricating oil	821	500	683	679	591	542	535	662	468	634	704	838	7, 657
Miscellaneous oils	303	310	369	242	332	610	430	536	405	445	237	305	4, 524
Total	53, 377	48, 298	52, 744	48, 019	49, 736	47, 012	43, 492	44, 035	40, 542	42, 600	48, 894	47, 276	566, 025

[1] Oil and Gas Division, U. S. Department of the Interior.

[2] By A. H. Redfield, Petroleum Economics Branch, Bureau of Mines.

FOREIGN TRADE [3]

IMPORTS

Imports of mineral oils, crude and refined, into continental United States increased 18 percent from 1947 to 1948. They constituted 7 percent of the total new supply in continental United States in 1947 and 8 percent in 1948. For the first year since 1922, total imports of mineral oils exceeded total exports.

Crude petroleum, distillate fuel oil, and residual fuel oil together made up 98 percent of the total mineral-oil imports into continental United States, both in 1947 and in 1948. Venezuela supplied 50 percent of the total imports into all the United States both in 1947 and 1948; the Netherlands Antilles 34 percent in 1947 and 30 percent in 1948; Colombia 7 percent in 1947 and 5 percent in 1948; and Mexico 7 percent in 1947 and 3 percent in 1948. A new source of supply has been found in the Middle East; the countries surrounding the Persian Gulf furnished 2 percent of the total in 1947 and 12 percent in 1948.

Mineral oils, crude and refined, imported into continental United States, 1947–48, by months [1]

[Thousands of barrels]

Year and class	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1947													
Crude petroleum	7,763	8,444	9,263	7,276	8,703	7,628	7,294	8,242	8,658	7,761	7,688	8,812	97,532
Refined products:													
Gasoline, finished						101		102	15		18	122	358
Distillate fuel oil	543	406	365	215	386	265	129	372	234	474	474	312	4,175
Residual fuel oil	5,390	5,003	5,383	5,462	4,805	3,004	4,030	3,186	3,516	3,879	4,996	5,590	54,244
Lubricating oil	7	8	5	3	2	12	1						38
Paraffin wax								1	1			2	4
Asphalt	69	118	66	121	165	68	175	144	56	109		68	1,159
Unfinished oils, other	198	61	327	112	267	261	289	20	80	101	131	32	1,879
Total	13,970	14,040	15,409	13,189	14,328	11,339	11,918	12,067	12,560	12,324	13,307	14,938	159,389
1948 [2]													
Crude petroleum	8,427	8,354	8,682	9,757	10,293	9,749	11,478	10,883	11,428	12,572	12,923	14,547	129,093
Refined products:													
Gasoline, finished	17		55							194	18	18	302
Kerosine			135										135
Distillate fuel oil	107	585	322	71	466	412	66	3		270	233	11	2,546
Residual fuel oil	5,093	5,454	5,205	4,686	3,734	3,574	4,123	4,453	4,332	3,106	4,112	5,289	53,161
Lubricating oil												101	101
Paraffin wax	5	4	4	2	3	3	3	3					27
Asphalt	60	68	98	108	234	1	221	133	68	228	117	26	1,362
Unfinished oils, other	197	177	147	181	82	21	12	5	2	78	75	5	982
Total	13,906	14,642	14,648	14,805	14,812	13,760	15,903	15,480	15,830	16,448	17,478	19,997	187,709

[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.

[3] By A. H. Redfield, Petroleum Economics Branch, Bureau of Mines.

Of the crude petroleum imported into continental United States, Venezuela furnished 77 percent of the total in 1947 and 69 percent in 1948; Netherlands Antilles 5 percent in 1947 and 4 percent in 1948; Colombia 11 percent in 1947 and 7 percent in 1948; and Mexico less than 6 percent in 1947 and less than 3 percent in 1948. The most significant change was in imports from the Middle East. Countries of the Persian Gulf which supplied less than 0.5 percent of the total in 1947 furnished 18 percent of the whole in 1948.

The Netherlands Antilles provided 90 percent of the residual fuel oil imported into continental United States and the noncontiguous Territories in 1947 and 94 percent in 1948. Mexico and Caribbean countries furnished an additional 2 percent in 1948, and the Middle East 3 percent.

Caribbean countries and Mexico, which had shipped 97 percent of the distillate fuel oil received in continental United States and the noncontiguous Territories in 1947, accounted for 76 percent of such imports in 1948. Middle Eastern countries, which had supplied 3 percent of the total distillate imports in 1947, furnished 24 percent in 1948.

EXPORTS

Continental United States in 1948 ceased to be a net exporter of mineral oils. The excess of all petroleum exports over all petroleum imports—5 million barrels in 1947—was replaced in 1948 by an excess of imports totaling 53 million barrels, as more crude petroleum was imported and exports were restricted by Federal license and the general shortage of dollar credits in foreign countries. In refined oils, however, with the exception of residual fuel oil, more was exported than imported; but the excess of exports was reduced from 56 million barrels in 1947 to 36 million barrels in 1948.

Exports and Territorial shipments of crude petroleum decreased 14 percent from 1947 to 1948. Shipments to the major consumers were reduced in 1948. Canada received 84 percent of the exports both in 1947 and in 1948. France received 9 percent of the total in 1947 and 8 percent in 1948. Cuba and Argentina obtained somewhat larger shipments in 1948 than in 1947.

Exports and Territorial shipments of refined oils were 19 percent lower in 1948 than in 1947. Shipments to Europe, Australasia, and the noncontiguous Territories were considerably decreased. The only exception to the general trend was in outward shipments to other North American countries, notably to Canada and the Netherlands Antilles.

Outward shipments of motor fuel were 26 percent lower in 1948 than in 1947. There was a notable shift from 1947 to 1948 in the destinations of motor fuel shipped out of continental United States. Europe, which took 48 percent of the total in 1947, received only 36 percent of the reduced shipments of 1948. On the other hand, other North American countries, notably Canada, accounted for 41 percent of the outward shipments of motor fuel in 1948 compared with 24 percent in 1947.

Exports and Territorial shipments of kerosine were 53 percent less in 1948 than in 1947. The principal decreases were in exports to other North American countries, notably Canada, and to Europe, especially the United Kingdom.

Distillate fuel oil exported and shipped to noncontiguous Territories declined 27 percent from 1947 to 1948. Europe, the principal foreign market for distillate fuel oil, took 46 percent less in 1948 than in 1947. Exports to the Netherlands Antilles and to smaller North American countries counteracted the general decline in shipments to the major North American consumers.

On the other hand, residual fuel oil exported and shipped to noncontiguous Territories increased 18 percent from 1947 to 1948. Increased deliveries to Canada, Cuba, and the Canal Zone raised these exports to North America 48 percent in 1948 over 1947. Europe decreased its receipts in 1948 to 43 percent of those in 1947.

Exports and Territorial shipments of lubricating oils decreased 9 percent from 1947 to 1948. The chief decrease was in exports to Oceania, which were 39 percent less in 1948 than in 1947. In spite of greater imports by the United Kingdom, the Netherlands, Spain, Portugal, and Switzerland, Europe as a whole took 3 percent less of lubricating oils from the United States.

Crude petroleum exported from the United States, 1940–48, by countries, in thousands of barrels

[U. S. Department of Commerce]

Country of destination	1940	1941	1942	1943	1944	1945	1946	1947	1948
Argentina	779	423	113	----	----	70	724	1,052	1,417
Australia	9	7	(1)	----	----	----	(1)	----	----
Belgium and Luxembourg	----	----	----	----	----	----	68	----	----
Brazil	250	273	69	2	1	75	282	68	----
British East Africa	----	----	(1)	1	(1)	(1)	----	----	----
Canada	28,778	26,516	33,753	41,942	33,738	32,841	36,595	39,058	33,298
Chile	30	----	(1)	(1)	(1)	(1)	(1)	----	----
China	----	5	----	----	----	(1)	(1)	(1)	----
Kwantung	844	324	----	----	----	----	----	----	----
Colombia	----	----	85	(1)	(1)	(1)	(1)	----	----
Cuba	822	1,219	825	791	574	824	1,158	1,354	1,498
Denmark	----	----	----	----	----	----	(1)	49	----
Egypt	----	----	(1)	6	5	(1)	(1)	----	----
France	5,420	----	----	----	----	----	2,305	4,358	2,991
Gold Coast	----	----	(1)	3	----	(1)	(1)	----	----
India	----	----	(1)	3	----	(1)	1	----	----
Italy	1,420	----	----	----	----	----	(1)	----	----
Japan	11,529	5,208	----	----	----	----	----	----	----
Mexico	349	195	103	65	60	80	102	101	62
New Zealand	(1)	----	(1)	3	----	(1)	8	----	----
Portugal	531	69	----	(1)	(1)	1	(1)	----	----
Sweden	46	----	----	----	----	104	87	(1)	----
Thailand	91	----	----	----	----	----	(1)	----	----
Union of South Africa	----	----	(1)	1	(1)	2	2	----	----
United Kingdom	533	238	598	485	421	1,284	1,233	299	471
Other countries	64	7	14	11	3	72	9	17	----
Total	51,495	34,484	35,560	43,313	34,802	35,353	42,574	46,356	39,737

1 Less than 1,000 barrels.

Mineral oils, crude and refined, shipped from continental United States, including shipments to noncontiguous Territories, 1947–48, by classes and months [1]

[Thousands of barrels]

Year and class	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1947													
Crude petroleum	2, 481	2, 585	3, 257	3, 999	4, 789	3, 758	5, 184	4, 139	4, 087	3, 712	3, 844	4, 520	46, 355
Refined products:													
Motor fuel [2]	3, 268	5, 035	4, 531	3, 862	3, 700	4, 424	4, 327	3, 889	3, 444	3, 768	3, 921	3, 280	47, 449
Kerosine	439	949	1, 079	958	232	763	771	350	515	671	406	119	7, 252
Distilled fuel oil	1, 069	1, 992	2, 358	3, 246	2, 347	2, 385	3, 561	3, 274	3, 357	3, 239	1, 934	1, 115	29, 877
Residual fuel oil	901	1, 015	776	1, 112	893	1, 041	844	945	1, 029	908	545	614	10, 623
Lubricating oil	1, 123	1, 269	1, 294	1, 283	1, 372	1, 355	1, 318	1, 117	908	1, 096	979	1, 148	14, 262
Paraffin wax	97	87	90	82	88	77	83	92	95	100	103	113	1, 107
Coke	137	142	133	193	225	220	197	166	121	121	175	272	2, 102
Asphalt	329	292	258	284	457	332	310	364	192	117	124	203	3, 262
Miscellaneous oils	195	183	234	228	209	213	195	155	126	161	150	139	2, 188
Total refined	7, 558	10, 964	10, 753	11, 248	9, 523	10, 810	11, 606	10, 352	9, 787	10, 181	8, 337	7, 003	118, 122
Total crude and refined	10, 039	13, 549	14, 010	15, 247	14, 312	14, 568	16, 790	14, 491	13, 874	13, 893	12, 181	11, 523	164, 477
1948 [3]													
Crude petroleum	2, 992	2, 626	3, 138	3, 538	3, 362	3, 419	3, 661	4, 078	3, 362	3, 404	3, 192	3, 068	39, 840
Refined products:													
Motor fuel [2]	2, 315	1, 736	2, 613	3, 655	3, 644	3, 377	4, 332	3, 354	3, 300	2, 905	2, 913	3, 266	37, 410
Kerosine	228	128	336	131	549	263	403	381	310	146	374	286	3, 535
Distillate fuel oil	1, 933	1, 340	1, 767	1, 914	2, 456	2, 258	2, 486	2, 167	1, 370	1, 510	1, 336	1, 271	21, 808
Residual fuel oil	440	698	765	1, 297	929	1, 169	1, 279	1, 459	1, 227	1, 328	901	1, 047	12, 539
Lubricating oil	1, 040	1, 151	1, 041	1, 151	1, 155	1, 303	1, 148	987	1, 141	980	740	1, 153	12, 990
Paraffin wax	92	94	102	79	103	86	80	63	70	76	42	107	994
Coke	340	115	123	228	144	192	278	234	162	273	163	269	2, 521
Asphalt	93	224	159	130	113	145	138	143	164	149	42	118	1, 618
Miscellaneous oils	152	160	146	163	116	142	126	148	129	134	121	162	1, 699
Total refined	6, 633	5, 646	7, 052	8, 748	9, 209	8, 935	10, 270	8, 936	7, 873	7, 501	6, 632	7, 679	95, 114
Total crude and refined	9, 625	8, 272	10, 190	12, 286	12, 571	12, 354	13, 931	13, 014	11, 235	10, 905	9, 824	10, 747	134, 954

[1] 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, 1946–48 [1]

[Thousands of barrels, except wax, which is in thousands of pounds]

[U. S. Department of Commerce]

Country	Motor fuel [2]			Kerosine			Fuel oil			Lubricating oil			Wax		
	1946	1947	1948	1946	1947	1948	1946	1947	1948	1946	1947	1948	1946	1947	1948
North America:															
Canada	4,734	6,087	8,929	602	3,300	1,717	3,573	8,204	9,349	303	488	475	31,776	52,364	44,621
Canal Zone	18	141	163	--------	10	38	227	519	1,086	7	11	15	7	12	--------
Costa Rica	28	22	31	1	7	9	19	8	150	10	12	11	1,447	1,629	1,953
Cuba	833	1,431	1,260	(3)	(3)	1	1,304	967	1,402	79	112	101	3,126	4,157	4,584
Dominican Republic	89	4	(3)	27	14	7	12	6	13	13	17	18	765	537	819
El Salvador	21	17	110	3	2	6	8	193	155	4	7	6	594	1,332	649
Guatemala	53	59	41	5	11	6	87	524	680	14	20	20	2,201	3,116	3,363
Mexico	1,504	2,054	1,987	145	123	95	1,255	1,900	1,678	240	330	302	3,975	11,011	26,499
Netherlands Antilles	(3)	956	1,683	--------	--------	--------	(3)	71	1,060	23	29	45	(4)	--------	--------
Other North America	224	449	329	27	28	16	71	57	187	73	108	93	1,261	1,002	1,492
Total	7,504	11,220	14,533	810	3,495	1,895	6,556	12,449	15,760	766	1,134	1,086	45,152	75,160	83,980
South America:															
Argentina	10	415	481	1	5	(3)	178	114	(3)	53	100	175	2,342	10,024	3,832
Bolivia	7	13	9	(3)	(3)	--------	(3)	(3)	9	14	16	14	2,258	2,088	2,815
Brazil	773	527	704	65	156	92	100	188	105	364	628	584	3,088	5,819	6,383
Chile	7	8	9	(3)	1	(3)	90	348	160	90	114	120	8,395	10,451	12,109
Colombia	19	3	(3)	(3)	--------	(3)	--------	(3)	(3)	39	65	50	15,284	22,098	18,874
Peru	1	1	273	--------	--------	--------	1	--------	--------	41	38	28	3,210	6,418	3,298
Surinam	(3)	(3)	(3)	(3)	9	7	--------	--------	--------	2	6	5	13	6	12
Uruguay	110	4	100	34	8	2	--------	--------	(3)	52	75	58	433	1,007	660
Venezuela	1	4	5	--------	--------	--------	1	(3)	(3)	93	144	202	3,656	5,921	6,455
Other South America	7	20	6	--------	--------	(3)	--------	1	11	23	32	24	2,035	2,278	3,262
Total	935	995	1,587	100	179	101	370	651	285	771	1,218	1,260	40,714	66,110	57,700

Europe:															
Belgium and Luxembourg	963	579	321	33	21	(3)	576	889	697	881	909	712	6,053	10,593	6,438
Denmark	568	428	465	66	24	53	908	1,369	781	228	295	239	1,888	951	3,952
France	5,489	2,558	617	341	-------	-------	2,234	675	631	1,284	853	573	6,801	15,546	6,715
Greece	2	-------	222	-------	-------	8	(3)	-------	209	47	80	99	281	541	765
Iceland	(3)	(3)	67	-------	-------	5	-------	-------	107	8	15	11	57	111	67
Ireland	(3)	(3)	(3)	-------	-------	-------	-------	-------	(3)	1	3	2	738	4,763	4,153
Italy	554	295	102	39	45	-------	111	370	-------	111	876	562	2,748	22,274	11,505
Netherlands	1,069	233	(3)	847	118	56	744	807	618	316	288	351	5,725	8,291	8,952
Norway	628	218	98	42	42	(3)	64	103	195	109	150	114	2,211	2,546	2,233
Portugal	53	50	184	100	(3)	46	-------	45	58	89	88	110	1,712	3,991	3,734
Spain	874	246	-------	75	27	-------	275	111	(3)	294	257	360	461	265	1,885
Sweden	1,328	1,834	1,147	380	115	297	1,761	3,106	1,143	487	430	343	8,269	12,196	5,596
Switzerland	138	71	172	-------	(3)	-------	199	70	288	129	96	120	4,236	2,993	4,178
U. S. S. R.	488	222	-------	20	42	-------	1,950	648	-------	57	64	23	-------	-------	-------
United Kingdom	12,602	15,874	8,764	3,013	1,429	64	14,399	9,375	4,939	1,989	1,760	2,350	49,739	35,487	29,599
Other Europe	1,462	287	428	344	8	27	517	126	60	174	181	193	328	951	5,811
Total	26,218	22,895	12,587	5,300	1,871	556	23,738	17,694	9,726	6,204	6,345	6,162	91,247	121,499	95,583
Asia:															
China and Hong Kong	1,675	1,231	1,270	876	672	181	835	1,338	562	599	525	281	11,048	12,568	11,140
India and Pakistan	(3)	(3)	2	(3)	2	4	-------	(3)	35	537	1,208	1,221	1	21	3,154
Philippines, Republic of	267	1,289	631	275	173	65	91	212	496	132	225	140	2,054	4,470	5,098
Turkey	146	2	135	41	65	18	1	19	48	75	145	124	1,094	1,479	891
Other Asia	82	153	29	23	-------	1	48	-------	132	295	636	507	465	439	2,030
Total	2,170	2,675	2,067	1,215	912	269	975	1,569	1,273	1,638	2,739	2,273	14,662	18,977	22,313
Africa:															
Algeria	250	(3)	78	85	-------	(3)	283	212	-------	64	110	53	1,501	3,598	342
Belgian Congo	(3)	19	1	1	-------	-------	2	(3)	-------	32	41	74	40	5	(4)
Egypt	(3)	(3)	(3)	(3)	(3)	(3)	-------	(3)	-------	209	189	289	93	357	653
Gold Coast	(3)	54	112	-------	38	24	-------	4	52	17	27	21	-------	21	21
Liberia	3	1	4	1	2	2	(3)	1	(3)	2	1	3	178	148	57
Morocco, French	723	454	180	326	36	(3)	411	214	168	22	88	63	562	2,500	5,045
Mozambique	354	28	10	8	-------	-------	-------	1	(3)	57	87	66	-------	1,434	-------
Nigeria	(3)	(3)	63	-------	(3)	18	-------	-------	23	15	31	20	1	(4)	-------
Southern Rhodesia	4	2	-------	1	-------	-------	-------	-------	-------	8	27	25	-------	6	50
Union of South Africa	1,016	116	83	37	(3)	3	-------	2	4	332	482	409	3,993	14,103	9,760
Other Africa	134	153	109	1	8	18	3	1	88	142	274	273	932	1,190	2,010
Total	2,484	827	640	460	84	65	699	435	335	900	1,357	1,296	7,300	23,362	17,938

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, 1946–48 [1]—Continued

[Thousands of barrels, except wax, which is in thousands of pounds]

Country	Motor fuel [2]			Kerosine			Fuel oil			Lubricating oil			Wax		
	1946	1947	1948	1946	1947	1948	1946	1947	1948	1946	1947	1948	1946	1947	1948
Oceania:															
Australia	1,711	2,619	802	206	75	18	61	825	374	517	1,016	598	1,297	3,324	110
British Oceania	93	67	57	4	15	4	61	57	18	4	5	4	------	------	------
New Guinea	------	2	------	------	12	------	------	3	------	(3)	(3)	------	------	------	------
New Zealand	786	1,166	407	86	34	2	544	342	93	121	247	170	353	1,171	678
Other Oceania	62	52	19	6	11	13	15	35	25	2	3	1	------	------	------
Total	2,652	3,906	1,285	302	147	37	681	1,262	510	644	1,271	773	1,650	4,495	788
Grand total	41,963	42,518	32,699	8,187	6,688	2,923	33,019	34,060	27,889	10,923	14,064	12,850	200,725	309,603	278,302
Shipments from continental United States to noncontiguous Territories:															
Alaska	508	783	[5] 128	------	------	(6)	1,216	1,714	[5] 388	23	42	[5] 4	------	------	(6)
Hawaii	1,533	2,526	[5] 495	160	184	[5] 42	4,298	4,704	[5] 1,217	52	101	[5] 15	175	137	[5] 64
Puerto Rico	1,431	1,571	1,580	313	369	421	194	150	171	34	55	47	242	30	35
Virgin Islands	20	22	24	7	7	8	7	7	8	(3)	7	1	------	------	------
Other	(3)	76	174	(3)	5	5	(3)	14	60	(3)	2	2	5	------	40
Total	3,492	4,978	2,401	480	565	476	5,715	6,589	1,844	109	207	69	422	167	139
Exports from noncontiguous Territories to foreign countries:															
Alaska	29	42	60	(3)	(3)	(3)	45	133	170	(3)	(3)	1	------	------	------
Hawaii	(3)	1	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	7	(3)	------	------	------
Puerto Rico	81	10	(3)	22	------	(3)	15	1	(3)	(3)	(3)	(3)	35	23	2
Total	110	53	60	22	(3)	(3)	60	134	170	(3)	7	1	35	23	2
Total net shipments from continental United States	45,345	47,443	35,040	8,645	7,253	3,399	38,674	40,515	29,563	11,032	14,264	12,918	201,112	309,747	278,439

[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.
[5] January through March. Beginning Apr. 1, 1948, data not available.
[6] Data not available.

WORLD PRODUCTION

The steadily growing demand for petroleum products in all parts of the world was reflected in an increase of 13 percent in production of crude petroleum from 1947 to 1948, as far as these totals can be calculated from incomplete data. The Western Hemisphere supplied 81 percent of the total in 1947 and 78 percent in 1948. The United States alone furnished 61 percent of the world output in 1947 and 59 percent in 1948. Venezuela, the second-largest producing country, supplied 14 percent of the total both in 1947 and in 1948. The Middle East (Bahrein Island, Iran, Iraq, Kuwait, Saudi Arabia, and Egypt) increased its share in the world output from 10 percent in 1947 to 13 percent in 1948.

The United States raised its production 9 percent from 1947 to 1948. Canada had a high proportional increase in the same period—57 percent. Mexico's production was 4 percent larger in 1948 than in 1947. Trinidad produced 2 percent less in 1948 than in 1947.

Venezuela was chiefly responsible for the increase of 12 percent in South America from 1947 to 1948. Increases in the other South American countries were large in proportion but small in quantity.

Western Europe also showed a pattern of recovery and new development as well. Petroleum production in Germany was 10 percent larger in 1948 than in 1947. The Netherlands, a comparative newcomer in petroleum production, obtained from the Schoonebeek field 133 percent more oil in 1948 than in 1947. Austria, however, produced 2 percent less petroleum in 1948 than in 1947.

For eastern Europe exact statistical data are generally lacking. The best estimates that can be made at this time indicate that the U. S. S. R. increased its production 16 percent from 1947 to 1948. Rumanian output was 8 percent larger in 1948 than in 1947. Hungary, however, produced 18 percent less petroleum in 1948 than in 1947. But Poland increased its small petroleum production 5 percent from 1947 to 1948.

The most spectacular gains in petroleum production were in the Middle East. This group of six countries increased its output 36 percent from 1947 to 1948. The Burghan field in Kuwait produced nearly three times as much in 1948 an in 1947. In Saudi Arabia the output of the Abqaiq field doubled from 1947 to 1948, so that the production of the country was 59 percent larger in 1948 than in 1947. Iran, with its production virtually controlled at the source, expanded its output 23 percent to meet the rising demand for petroleum products. In contrast, Iraq, in consequence of closing of the Haifa refinery and suspension of pipe-line shipments to Palestine in April 1948, reduced its production of crude 27 percent from 1947 to 1948. In Egypt the new Sudr field was chiefly responsible for a 55-percent increase in crude production from 1947 to 1948.

Eastern Asia showed a general pattern of recovery from war damages and political unrest. Indonesia nearly quadrupled in 1948 the diminished production of 1947, but still attained little more than half of its 1939 output. In British Borneo increased production in the Seria field of Brunei in particular boosted the output 55 percent from 1947 to 1948.

World production of crude petroleum, 1942–48, by countries, in thousands of barrels

[Compiled by B. B. Mitchell]

Country	1942	1943	1944	1945	1946	1947	1948
North America:							
Barbados	2	2	1	2	1	(1)	(1)
Canada	10,365	10,052	10,099	8,483	7,586	7,692	12,098
Cuba [2]	151	107	109	149	269	300	159
Mexico	34,815	35,163	38,203	43,547	49,235	56,284	58,508
Trinidad	22,069	21,385	22,139	21,093	20,233	20,521	20,111
United States	1,386,645	1,505,613	1,677,904	1,713,655	1,733,939	1,856,987	2,016,282
Total North America	1,454,047	1,572,322	1,748,455	1,786,929	1,811,263	1,941,784	2,107,158
South America:							
Argentina	23,704	27,714	24,230	22,881	20,604	21,846	23,734
Bolivia	308	334	314	382	363	377	464
Brazil	33	48	58	79	67	97	144
Colombia	10,487	13,261	22,291	22,449	22,118	24,794	23,792
Ecuador	2,278	2,315	2,967	2,664	2,323	2,282	2,563
Peru	13,629	14,654	14,389	13,744	12,468	12,764	14,069
Venezuela	147,675	177,631	257,046	323,156	388,486	434,905	490,015
Total South America	198,114	235,957	321,295	385,355	446,429	497,065	554,781
Europe:							
Albania	1,601	1,001	334	267	[3] 1,000	[3] 1,800	[3] 1,400
Austria	5,899	7,478	8,218	3,074	5,734	6,285	6,149
Czechoslovakia	271	[3] 200	[3] 185	91	196	210	204
France	463	[3] 356	[3] 300	197	367	363	370
Germany	5,191	4,973	6,154	3,935	4,539	4,035	4,446
Hungary	5,037	6,347	[4] 6,204	[4] 5,018	5,146	4,330	3,542
Italy	101	[3] 75	[3] 75	[3] 75	82	80	70
Netherlands		(5)	14	41	435	1,478	3,444
Poland	2,794	[3] 3,500	[3] 3,000	[6] 750	866	951	[3] 1,000
Rumania	42,094	39,182	26,191	34,772	31,434	28,552	30,868
U. S. S. R. [3] [7]	227,470	200,750	275,000	148,953	157,673	187,463	218,000
United Kingdom	605	839	703	532	412	351	323
Other Europe [3]	10	10	500	450	400	365	365
Total Europe [7]	291,536	264,711	326,878	198,155	208,284	236,263	270,181
Asia:							
Bahrein Island	6,241	6,572	6,714	7,309	8,010	9,411	10,915
Burma	2,500	1,000	[3] 750	[3] 725	15	59	360
China	340	447	505	484	513	378	533
Formosa	48	38	40	11	16	18	[3] 18
India	2,792	2,735	2,784	2,363	2,193	1,533	1,742
Indonesia	24,000	48,294	22,260	7,600	2,100	8,020	[8] 31,900
Iran	72,256	74,612	102,045	130,526	146,819	154,998	190,395
Iraq	19,726	24,848	30,943	35,112	35,665	35,834	26,115
Japan	1,652	1,727	1,601	1,544	1,343	1,276	1,122
Kuwait					5,931	16,225	46,098
Pakistan	(9)	(9)	(9)	(9)	(9)	330	490
Sarawak and Brunei	[3] 3,000	[3] 4,500	[3] 6,000	2,100	2,050	12,970	20,120
Saudi Arabia	4,530	4,868	7,794	21,311	59,944	89,852	142,853
U. S. S. R.: Sakhalin [3]	4,000	5,000	5,000	6,000	6,000	7,000	7,000
Total Asia [7]	141,085	174,641	186,436	215,085	270,599	337,904	479,661
Africa:							
Egypt	8,275	8,953	9,416	9,406	9,070	8,627	13,398
Morocco, French	41	39	32	26	20	23	102
Total Africa	8,316	8,992	9,448	9,432	9,090	8,650	13,500
Oceania: New Zealand	2	2	2	3	2	2	2
Grand total	2,093,100	2,256,625	2,592,514	2,594,959	2,745,667	3,021,668	3,425,283

[1] Less than 500 barrels.
[2] Natural naphtha and gas oil.
[3] Estimate.
[4] Data represents Trianon Hungary after October 1944.
[5] Data not available.
[6] Beginning in 1945, postwar borders.
[7] U. S. S. R. in Asia (except Sakhalin) included with U. S. S. R. in Europe.
[8] Includes New Guinea.
[9] Included with India.

Phosphate Rock

By BERTRAND L. JOHNSON AND E. M. TUCKER

GENERAL SUMMARY

MINED production of phosphate rock in the United States made a new high record in 1948, according to the reports submitted by producers to the Bureau of Mines; the total reached 9,388,160 long tons, more than a quarter of a million tons above the 1947 record high. Of this, 7,184,297 tons were mined in Florida, over 800,000 tons more than in 1947; 1,499,547 tons in Tennessee, only slightly more than in 1947; and only 704,316 tons in the Western States, about half a million tons less than in the previous year.

Sales decreased from 9,027,030 tons in 1947 to 8,668,769 tons in 1948 (see fig. 1), and the increase in Florida failed to counterbalance

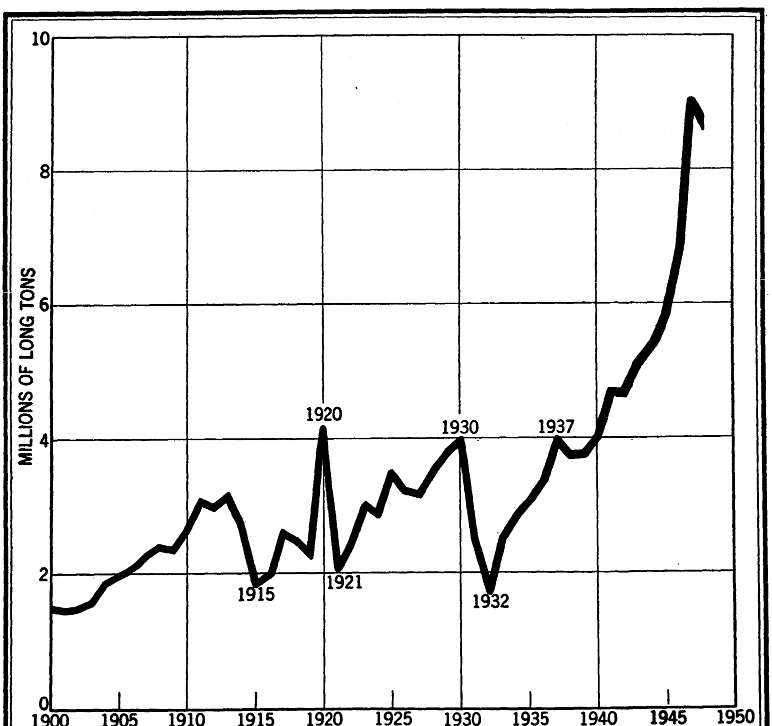

FIGURE 1.—Marketed production of domestic phosphate rock, 1900–48.

the large decrease in sales of Western States rock. The total value of the phosphate rock sold or used rose to $50,501,598 in 1948, nearly $4,000,000 above the 1947 level. The P_2O_5 content of the rock sold or used in 1948 declined from the record high of 1947 (2,903,082 tons) to 2,810,206 tons in 1948. Imports increased both in quantity and value. Exports were less in 1948 by over 600,000 tons in quantity and about $3,000,000 in value. Apparent domestic consumption increased to 7,700,081 long tons in 1948. Stocks rose sharply to 1,819,000 tons at the end of 1948, due chiefly to a large increase to those in Florida.

The Congress passed a law in June 1948 that increased the maximum acreage of phosphate leases on public lands that can be held within a State from 2,560 to 5,120 acres and fixed the national maximum holding at 10,240 acres.

Salient statistics of the phosphate-rock industry in the United States, 1947–48

	1947				1948			
	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] 9,110,989	[5] 2,938,432	(1)	(1)	9,388,160	3,035,108	(1)	(1)
Sold or used by producers:								
Florida:								
Land pebble	6,314,077	2,108,702	$31,975,858	$5.06	6,421,725	2,155,037	$37,070,381	$5.77
Soft rock	88,620	17,976	326,064	3.68	69,335	13,992	293,927	4.24
Hard rock	79,330	28,850	618,330	7.79	48,198	17,404	368,586	7.65
Total Florida	6,482,027	2,155,528	32,920,252	5.08	6,539,258	2,186,433	37,732,894	5.77
Tennessee [2]	[3] 1,411,884	[3] 399,583	[3] 7,779,099	[3] 5.51	1,307,507	369,612	8,231,251	6.30
Idaho [4]	[5] 845,045	[5] 257,186	[5] 4,077,885	[5] 4.83	434,375	131,284	2,122,089	4.89
Montana	236,229	74,713	[5] 1,571,117	[5] 6.65	248,683	78,421	1,720,254	6.92
Wyoming	51,845	16,072	290,484	5.60	138,946	44,456	695,110	5.00
Total United States	[5] 9,027,030	[5] 2,903,082	[5] 46,638,837	[5] 5.17	8,668,769	2,810,206	50,501,598	5.83
Imports [6]	43,477	(1)	505,840	11.63	48,104	(1)	608,932	12.66
Exports [7]	1,644,723	(1)	[5] 9,165,330	[5] 5.57	1,016,792	(1)	6,144,298	6.04
Apparent consumption [8]	[5] 7,425,784	(1)	----------	-------	7,700,081	(1)	----------	-------
Stocks in producers' hands, Dec. 31:								
Florida	518,000	170,000	(1)	(1)	1,145,000	376,000	(1)	(1)
Tennessee [2 3 9]	403,000	112,000	(1)	(1)	582,000	159,000	(1)	(1)
Western States	[5] 206,000	[5] 60,000	(1)	(1)	92,000	28,000	(1)	(1)
Total stocks	[5] 1,127,000	[5] 342,000	(1)	(1)	1,819,000	563,000	(1)	(1)

1 Data not available.
2 Includes sintered matrix.
3 Includes small quantity from Virginia.
4 Includes Utah.
5 Revised figure.
6 Market value (or price) at port of shipment and time of exportation to the United States
7 Exports as reported by producers.
8 Quantity sold or used by producers plus imports minus 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]

PRODUCTION

Mined production in the United States in 1948 bettered the record high production of 1947 by 277,171 long tons. The new record of 9,388,160 long tons was made as a result of an increase of over 800,000 tons in Florida and in spite of a decrease of over 500,000 tons in the mined production of the Western States. Phosphate rock was mined in 1948 in Florida, Tennessee, Idaho, Montana, Utah, and Wyoming.

Phosphate rock mined in the United States, 1939–48, by States, in long tons

Year	Florida	Tennessee[1]	Western States	United States	Year	Florida	Tennessee[1]	Western States	United States
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
1942	2,984,503	1,568,162	266,273	4,818,938	1947	6,381,282	1,489,980	[2] 1,239,727	[2] 9,110,989
1943	3,274,266	1,868,407	227,294	5,369,967	1948	7,184,297	1,499,547	704,316	9,388,160

[1] Includes small quantity of apatite from Virginia (none produced in 1948) and in 1939–43 some matrix of washer grade.
[2] Revised figure.

SALES

A marked decline occurred in 1948 in the quantity of phosphate rock sold or used by producers—from 9,027,030 long tons in 1947 to 8,668,769 tons in 1948, a drop of 358,261 tons, owing largely to the sharp drop in sales of Idaho phosphate rock. The total value of the sales in 1948, as reported by the producers, was \$50,501,598, nearly \$4,000,000 greater than in 1947.

Phosphate rock sold or used by producers in the United States, 1944–48

Year	Long tons	Value at mines		Year	Long tons	Value at mines	
		Total	Average			Total	Average
1944	5,376,643	\$20,856,429	\$3.88	1947	[1] 9,027,030	[1] \$46,638,837	[1] \$5.17
1945	5,806,723	23,951,077	4.12	1948	8,668,769	50,501,598	5.83
1946	6,860,713	31,043,821	4.52				

[1] Revised figure.

[1] Skeen, J. R., Furnace Phosphorus: Chem. & Eng. News, vol. 26, No. 33, Aug. 16, 1948, pp. 2436–37.
Chemical Engineering, vol. 55, No. 8, August 1948, p. 300.
Oil, Paint and Drug Reporter, U. S. Acts to Ease Phosphate Shortage: Vol. 154, No. 10, Sept. 6, 1948, pp. 3, 47.
Barth, T. F. W., Geochemical Cycle of Fluorine: Jour. Geol., vol. 55, No. 5, 1947, pp. 420–427.
Jacob, K. D., Phosphate Fertilizer Progress: Fertilizer Rev., vol. 23, No. 1, January-February 1948, pp. 3–9, 19–20.
Lang, A. L., Rock Phosphate for Direct Application: Fertilizer Rev., vol. 23, No. 6, November-December 1948, pp. 9–12.

The following table shows the sales of phosphate rock, by grades, for 1947 and 1948.

Phosphate rock sold or used by producers in the United States, 1947–48, by grades and States

Grades—B. P. L.[1] content (percent)	Florida		Tennessee [2]		Western States		Total United States	
	Long tons	Percent of total	Long tons	Percent of total	Long tons	Percent of total	Long tons	Percent of total
1947								
Below 60	93,028	1	743,219	53	2,669	(3)	838,916	9
60 to 66	5,798	(3)	309,572	22	[4] 274,148	[4] 24	[4] 589,518	7
68 basis, 66 minimum	761,058	12	25,186	2	[4] 196,685	[4] 17	[4] 982,929	[4] 11
70 minimum	976,436	15	191,153	13	[4] 129,504	[4] 12	[4] 1,297,093	[4] 14
72 minimum	1,526,077	24	140,797	10	[4] 391,450	[4] 35	[4] 2,058,324	23
75 basis, 74 minimum	2,281,163	35			82,938	7	2,364,101	26
77 basis, 76 minimum	837,726	13	477	(3)	1,092	(3)	839,295	9
Above 85 (apatite) Undistributed	741	(3)	1,480	(3)	54,633	5	56,854	1
Total	6,482,027	100	1,411,884	100	[4] 1,133,119	100	[4] 9,027,030	100
1948								
Below 60	69,335	1	559,827	43	3,108	(3)	632,270	7
60 to 66			506,833	39	192,527	24	699,360	8
68 basis, 66 minimum	643,627	10	15,466	1	287,871	35	946,964	11
70 minimum	864,756	13	224,453	17	338,498	41	1,427,707	16
72 minimum	1,231,699	19					1,231,699	14
75 basis, 74 minimum	2,802,851	43	924	(3)			2,803,775	33
77 basis, 76 minimum	926,990	14					926,990	11
Above 85 (apatite)								
Undistributed			4	(3)			4	(3)
Total	6,539,258	100	1,307,507	100	822,004	100	8,668,769	100

[1] Bone phosphate of lime.
[2] Includes a small quantity from Virginia in 1947.
[3] Less than 0.5 percent.
[4] Revised figure.

CONSUMPTION AND USES

The apparent consumption of phosphate rock in the United States in 1948 increased to 7,700,081 long tons from 7,425,784 tons (revised figure) in 1947, an increase of a little over 250,000 tons.

Apparent consumption[1] of phosphate rock in the United States, 1944–48, in long tons

Year	Long tons	Year	Long tons
1944	5,061,924	1947	[2] 7,425,784
1945	5,457,648	1948	7,700,081
1946	6,221,525		

[1] Quantity sold or used by producers plus imports minus exports.
[2] Revised figure.

Data on sales of phosphate rock by uses in 1947 and 1948 are shown in the accompanying table.

Phosphate rock sold or used by producers in the United States, 1947–48, by uses and States

Uses	Florida		Tennessee [1]		Western States		Total United States	
	Long tons	Percent of total	Long tons	Percent of total	Long tons	Percent of total	Long tons	Percent of total
1947								
Domestic:								
Superphosphates	4,842,304	75	275,488	20	[2] 249,874	[2] 22	[2] 5,367,666	[2] 60
Phosphates, phosphoric acid, phosphorus, ferrophosphorus	327,151	5	799,422	57	8,035	1	1,134,608	13
Direct application to soil	485,517	7	278,280	20	328	(3)	764,125	9
Fertilizer filler	18,006	(3)	19,627	1			37,633	(3)
Stock and poultry feed	36,496	1	3,732	(3)			40,228	(3)
Undistributed [4]			35,335	2	2,712	(3)	38,047	(3)
Exports [5]	772,553	12			[2] 872,170	[2] 77	[2] 1,644,723	[2] 18
Total	6,482,027	100	1,411,884	100	[2] 1,133,119	100	[2] 9,027,030	100
1948								
Domestic:								
Superphosphates	5,117,520	78	231,654	18	315,764	38	5,664,938	65
Phosphates, phosphoric acid, phosphorus, ferrophosphorus	316,658	5	761,698	58	9,527	1	1,087,883	13
Direct application to soil	513,495	8	270,899	21	7,433	1	791,827	9
Fertilizer filler	19,323	(3)	11,579	1			30,902	(3)
Stock and poultry feed	40,510	1					40,510	1
Undistributed [4]	99	(3)	31,677	2	4,141	1	35,917	(3)
Exports [5]	531,653	8			485,139	59	1,016,792	12
Total	6,539,258	100	1,307,507	100	822,004	100	8,668,769	100

[1] Includes a small quantity from Virginia in 1947.
[2] Revised figure.
[3] Less than 0.5 percent.
[4] Includes phosphate rock used in pig-iron blast furnaces, parting compounds, research, defluorinated phosphate rock, refractories, and other uses.
[5] As reported to the Bureau of Mines by domestic producers.

Certain details regarding the superphosphate industry are shown in the following table:

Production, shipments, and stocks of superphosphates (18 percent available phosphoric acid), 1944–48, in short tons

[Bureau of the Census]

	1944	1945	1946	1947	1948
Production	6,692,368	7,372,104	7,847,591	9,292,677	9,319,697
Shipments	3,951,402	4,332,992	4,421,670	4,752,324	4,789,668
Stocks in manufacturers' hands Dec. 31	794,778	808,027	646,278	856,382	1,216,788

PRICES

Prices for both Florida and Tennessee phosphate rock were raised early in 1948. It is reported (Oil, Paint and Drug Reporter, April 26, 1948) that the new Florida prices are based on costs of oil at $2.89 a barrel and labor at 98 cents an hour and that in Tennessee the prices are adjusted to costs of coal at $6 per net ton, and a labor price of 82 cents an hour. The accompanying table gives the price quotations of the Oil, Paint and Drug Reporter, at the beginning, middle, and end of 1948 for Florida and Tennessee phosphate rock. The Tennessee quotations are now given on a P_2O_5 basis instead of the B. P. L. content formerly used. Quotations for Western States phosphate rock are not given in the trade journals.

Prices per long ton of Florida and Tennessee unground, washed, and dried phosphate rock, in bulk, f. o. b. cars at mine, by grades, in 1948

[Oil, Paint and Drug Reporter]

Grades (percent) [1]	Florida land pebble			Tennessee brown rock		
	Jan. 5	June 28	Dec. 27	Jan. 5	June 28	Dec. 27
68/66 B. P. L	$3.34–$3.49	$4.61	$4.61			
70/68 B. P. L	3.74– 3.89	5.01	5.01	$5.50		
72/70 B. P. L	4.34– 4.42	$5.31– 5.61	$5.31– 5.61	6.00		
75/74 B. P. L	5.34– 5.49	6.31– 6.51	6.31– 6.51			
77/76 B. P. L	6.34– 6.49	7.31	7.31			
27–26 P_2O_5					$6.00	$6.00
29 P_2O_5				5.15		
30 P_2O_5				5.30		
30–29 P_2O_5					6.75	6.75

[1] B. P. L. signifies bone phosphate of lime.

REVIEW BY STATES

SOUTHERN STATES

Arkansas.—No development work is known to have been in progress in 1948 in the Batesville area, Independence County, Ark., where drilling operations by the State Division of Geology in 1947 proved 141,540 long tons of phosphate rock averaging 40.97 percent tricalcium phosphate.

Florida.—A new high record was made in 1948 in the total quantity of Florida phosphate rock, sold or used—6,539,258 long tons—but only slightly higher than the 1947 record. The total value of this rock—$37,732,894—was nearly $5,000,000 greater than the value of the phosphate rock sold or used in 1947. Increases occurred only in the quantity and value of the land-pebble phosphate rock sold or used.

The land-pebble phosphate-rock-mining companies in operation in 1948 were the American Agricultural Chemical Co. (Pierce); American Cyanamid Co. (Brewster); Coronet Phosphate Co. (Plant City); Davison Chemical Corp. (Ridgewood); International Minerals & Chemical Corp. (Mulberry); Pembroke Chemical Corp. (Pembroke); Swift & Co. (Agricola); and the Virginia-Carolina Chemical Corp. (Nichols).

Two papers on phosphate-rock mining and milling practices in Florida appeared in the latter part of the year.[2]

Florida phosphate rock sold or used by producers, 1944–48, by kinds

Year	Hard rock			Soft rock [1]		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
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
1947	79,330	618,330	7.79	88,620	326,064	3.68
1948	48,198	368,586	7.65	69,335	293,927	4.24

Year	Land pebble			Total		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
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
1947	6,314,077	31,975,858	5.06	6,482,027	32,920,252	5.08
1948	6,421,725	37,070,381	5.77	6,539,258	37,732,894	5.77

[1] Includes material from waste-pond operations.

The International Minerals & Chemical Corp. operated its Achan, Peace Valley, and Noralyn mines and washers and its Prairie drier in 1948; the Achan, however, was closed for 3 months. According to the annual report of the company for the fiscal year ended June 30, 1948, the Peace Valley mine operated at capacity throughout the fiscal year, and the Noralyn mine commenced production late in that year and met expectations in tonnage and quality of output. Several articles descriptive of the Noralyn mine were published in 1948.[3] This mine, located about 3½ miles south of Bartow, is reported to be the largest in the world, with a designed capacity of 1,500,000 tons of phosphate rock annually. After the overburden is stripped off, the matrix is mined by a walking dragline excavator and sluiced to a pump which forces the material in suspension to the top of the washer. The washer makes the first separation into two particle sizes, elevating the larger to pebble phosphate bins, and sending the smaller to the desliming section. The desliming section rejects the minus 200-mesh material (mainly clay) and separates the remaining solids into two portions, the smaller-mesh material going to the flotation cells and the larger to

[2] Kelly, J. E., Phosphate Mining Practice: Mining World, vol. 10, No. 9, August 1948, pp. 16–19.
Kelly, J. E., Florida Phosphate Milling: Mining World, vol. 10, No. 13, December 1948, pp. 35–37, 40.

[3] Rock Products, World's Largest Phosphate Plant: Vol. 51, No. 6, June 1948, pp. 116–121.
Engineering and Mining Journal, Noralyn Phosphate Plant World's Biggest: Vol. 149, No. 6, June 1948, pp. 70–77.
Olive, T. R., Materials Handling at International Minerals' Noralyn Phosphate Plant: Chem. Eng., vol. 55, No. 12, December 1948, pp. 100–104, 106.
Avery, W. M., Noralyn Mine Opens New Era: Pit and Quarry, vol. 40, No. 12, June 1948, pp. 66–70, 79–82.

spiral concentrators. At present all products are sent to Mulberry for drying. Construction of this plant was begun early in 1947, and it went into operation in March 1948.

The American Agricultural Corp. operated its mines Nos. 3 and 11, its tabling plant, and its drier at Pierce. The American Cyanamid Co. reports that phosphate rock was recovered from its Saddle Creek mine, washer, and flotation unit and dried at Brewster. The Coronet Phosphate Co. operated its Eleanor mine, washer, and flotation plant and dried the phosphate-rock production at the Coronet drier. A description of the Eleanor operations was published during the year.[4] The Davison Chemical Corp. mined phosphate rock from its Bonny Lake, Pauway No. 3, and Pauway No. 4 mines and dried the washed rock at its Ridgewood drying plant. The Pembroke Chemical Corp. operated its mine, washer, and drier at Pembroke.

The Armour Fertilizer Works new triple superphosphate plant development at Bartow is said to have begun early in December 1947 with the grading of a double-track spur into the property from the Seaboard Air Line and to have continued in 1948.

Swift & Co. operated its Swift No. 5 and Swift No. 6 mine and washer, drying the phosphate rock produced at its Agricola drier. The Virginia-Carolina Chemical Corp. operated its Homine mine and washer and mined feed from the Phosmico debris dumps. The Phosmico and Nichols drying plants and the company calcining kiln were also in operation. A description of the Homeland property of the Virginia-Carolina Chemical Corp. was published.[5]

In the hard-rock phosphate field, C. & J. Camp (P. O. Box 608, Ocala, Fla.) and J. Buttgenbach & Co. (P. O. Box 67, Lakeland, Fla.) operated jointly, as in recent years, and both mined and shipped hard-rock phosphate from the Section 12 mine near Dunnellon. All the shipments were for foreign consumption.

Several soft-phosphate companies were operating in the waste ponds of the hard-rock phosphate field, and one company mined and shipped a phosphatic clay from Bartow.

Tennessee.—The quantity of phosphate rock sold or used by Tennessee producers in 1948 dropped over 100,000 tons—from 1,411,884 long tons (including a small quantity of apatite from Virginia) in 1947 to 1,307,507 tons in 1948. The total value in 1948, however, was nearly $500,000 more than in 1947, according to reports from producing companies, and rose to $8,231,251.

Tennessee brown-rock phosphate was mined in 1948 by the Tennessee Valley Authority (Columbia, Tenn.) and by several private companies: Armour Fertilizer Works (Room 350, Hurt Building, Atlanta, Ga.); Federal Chemical Co. (Room 634, Starks Building, Louisville, Ky.); Harsh Phosphate Co. (Route 1, Murfreesboro Road, Nashville, Tenn.); Hoover & Mason Phosphate Co. (8 Michigan Avenue, Chicago, Ill.); International Minerals & Chemical Corp. (20 North Wacker Drive, Chicago, Ill.); Monsanto Chemical Co. (1700 South Second Street, St. Louis, Mo.); Owens Agricultural Co. (Centerville, Tenn.); and Virginia-Carolina Chemical Corp. (P. O. Box 1797, Richmond 14, Va.).

[4] Lenhart, W. B., Belt Concentration System for Phosphate Recovery: Rock Products, vol. 51, No. 11 November 1948. pp. 74–79.

[5] Lenhart, W. B., A Million-Ton Flotation Plant: Rock Products, vol. 51, No. 4, April 1948, pp. 104–110 154, 155.

Tennessee phosphate rock[1] sold or used by producers, 1944–48

Year	Long tons	Value at mines		Year	Long tons	Value at mines	
		Total	Average			Total	Average
1944	1,324,849	$5,975,337	$4.51	1947	1,411,884	$7,779,099	$5.51
1945	1,294,297	6,062,688	4.68	1948	1,307,507	8,231,251	6.30
1946	1,362,600	7,014,490	5.15				

1 Includes in 1944–47 small quantity of Tennessee blue rock and also Virginia apatite.

According to the annual report of the TVA for the fiscal year ended June 30, 1948, the TVA chemical plant at Muscle Shoals produced 153,000 tons of triple superphosphate, 6,000 tons of calcium metaphosphate, and 27,000 tons of fused tricalcium phosphate for use as plant nutrients in a program of soil and water conservation.

Because most of the remaining brown-rock phosphate deposits in Tennessee are sands mixed with clay and silica, TVA has developed washing methods in connection with mining operations that have resulted in improved recovery of the phosphate. In the fiscal year 1948, data compiled on large-scale tests of the use of caustic soda dispersant in the washing operation to improve phosphate recovery showed an increase of about one-fourth of the amount recovered and a reduction in the cost of the recovered material by about one-eighth. Means of reducing dispersant consumption and improving control methods, developed in the laboratory, were being tested at the field plant near Columbia, Tenn.

Phosphate sands ordinarily have to be made into lumps for a suitable furnace charge. TVA explorations have indicated that pelletizing or briquetting will prove cheaper and simpler than present methods of sintering and nodulizing. An experimental shaft kiln for calcining pellets in order to give them strength was developed during the year and proved considerably more economical than the rotary kiln previously used.

Tests during the 1948 fiscal year showed phosphate briquets to be an excellent low-cost charge for fused tricalcium phosphate furnaces, promising to produce a substantial saving in the cost of making this fertilizer. Equipment was being installed for the two furnaces at TVA's fused tricalcium phosphate plant near Columbia, Tenn.

A radically new type of electric furnace, having a crucible that rotates slowly, was placed in pilot-plant operation during the 1948 fiscal year. The primary objective was to develop a method for smelting phosphate sands directly, as elimination of the costly agglomeration step would significantly reduce the cost of producing concentrated fertilizers. The first phase of pilot-plant investigation showed not only that phosphate sands could be used satisfactorily as a charge but that the new furnace operates more efficiently than conventional furnaces.

During the fiscal year 1948 TVA began a study to perfect technical improvements in the wet process of triple superphosphate production, particularly for recovery of sulfuric acid from the byproduct calcium sulfate.

In the fiscal year 1948 TVA began to build a furnace of new design in which it is expected to produce calcium metaphosphate, containing about 60 percent available P_2O_5, at a cost per unit of P_2O_5 as low or lower than that for manufacturing concentrated superphosphate. The new process permits the use of pulverized rock phosphate for a large part of the furnace charge in place of lump rock or agglomerated phosphate.

Several projects were under way with respect to improvements in the TVA process for producing fused tricalcium phosphate, a fertilizer material of about 50 percent greater concentration than ordinary superphosphate. A small pilot furnace at Muscle Shoals was used during the fiscal year to test natural gas as a fuel in place of oil and to investigate the use of Florida and western phosphate rock, which would be more plentiful and economical to use in most localities. Preliminary tests showed that natural gas would be a suitable fuel. Florida ores proved amenable to processing by this method, but the western material tested proved more difficult to defluorinate. Pilot-plant tests looking toward increasing the concentration of fused tricalcium phosphate above the 27 percent average for the Columbia plant were made. With a furnace charge of high-grade phosphate rock with low silica content, a concentration of nearly 33 percent was obtained with a fuel consumption about 18 percent higher than at Columbia. In other pilot-plant tests, borax was added to the furnace charge to produce fused tricalcium phosphate containing boron, one of the "trace elements" recognized in recent years as deficient in many soils.

During the fiscal year 1948 TVA resumed studies begun several years ago for making dicalcium phosphate fertilizer by mixing pulverized phosphate rock and phosphoric acid and subjecting the mixture to moderately high temperature and pressure. The process of production of dicalcium phosphate by treating lime with phosphoric acid was still carried on by TVA. TVA's studies of the production of phosphate nitrogen fertilizers as well as potassium phosphate fertilizers were continued.

Two papers on TVA's studies (in addition to those referred to later under Technology) were published during the year.[6]

Its fifth and largest electric furnace for the production of elemental phosphorus at Monsanto, Tenn., was dedicated by the Monsanto Chemical Co. in October 1948.[7] Rated at over 20,000 kilowatts, the new furnace is reported to add nearly 50 percent to the plant's output of elemental phosphorus. Plans for constructing a washing unit to eliminate fluorine gas present in smoke emitted from the Monsanto phosphorus plant were announced at the dedication. Excavation of a large settling pond, reported one-half mile in length and averaging 20 feet in depth to prevent phosphate-bearing mud from flowing into the Duck River, was started during the summer of 1948. A new railroad spur, expected to double shipping capacity, was completed on the plant grounds.

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[6] Hudson, E. P., Phosphate Fertilizer Technology of the Tennessee Valley Authority: Manufacturing Chemist, vol. 19, 1948, pp. 519–520.

Hudson, E. P., New Fertilizer Technology: Chem. Age (London), vol. 59, No. 1527, Oct. 16, 1948, p. 521 (synopsis of a paper "TVA Phosphatic Fertilizer Technology," presented before the Fertiliser Society, London, Oct. 20, 1948.)

[7] Chemical Engineering, Phosphorus Output Boosted by Monsanto Expansion: Vol. 55, No. 12, December 1948, pp. 189–90.

Manufacturers Record, Another Furnace Added to World's Largest Phosphorus Works in Tennessee: Vol. 117, No. 12, December 1948, pp. 46–47.

The Victor Chemical Works continued production of elemental phosphorus at its electric-furnace plant in the brown-rock phosphate field.

Virginia.—No apatite was produced at the apatite-ilmenite deposit of the Calco Chemical Division, American Cyanamid Co., Piney River, Va., in 1948. No sales were made from the stocks on hand, and none of the apatite was used by the company. The shut-down of the mine and plant is reported permanent by the company.

WESTERN STATES

Sharp declines in both quantity and value featured the total marketed production of Western States phosphate rock in 1948, according to reports from producers to the Bureau of Mines. The great drop in Idaho shipments, caused by cessation of United States Army purchases in 1948 for overseas shipments to occupied territories, was not counterbalanced by the increases in shipments of Montana and Wyoming phosphate rock. (See fig. 2.) The output in 1948 came from all four States of the western field—Idaho, Montana, Utah, and Wyoming.

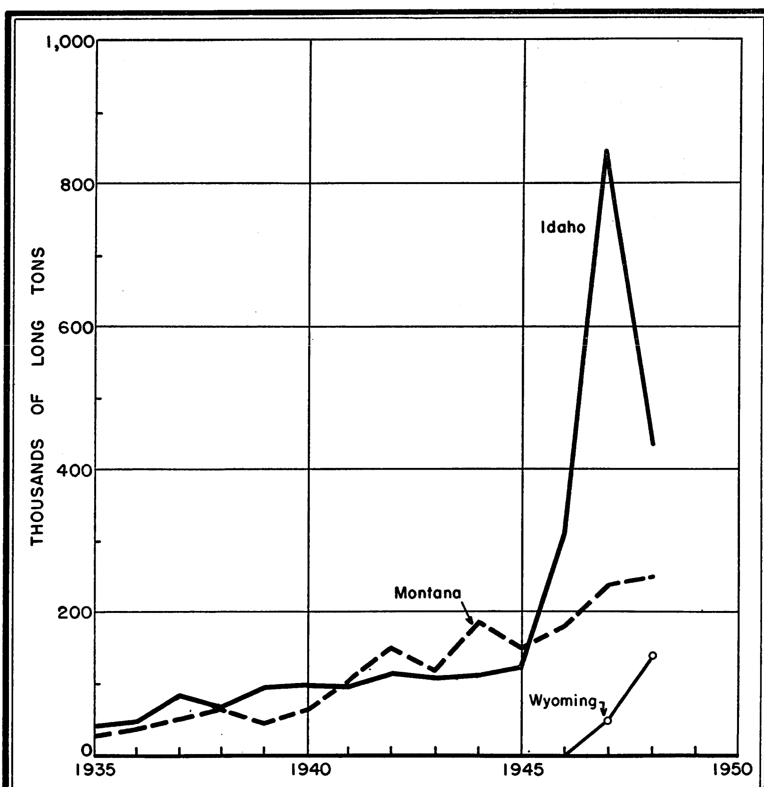

FIGURE 2.—Idaho, Montana, and Wyoming phosphate rock sold or used by producers, 1935–48

The average value per ton of the Western States phosphate rock sold or used, as reported by producers, increased slightly for the year—rising from $5.24 in 1947 to $5.52 in 1948.

In the early part of 1948 Permanente Metals Corp. was producing its fused calcium-magnesium-phosphate fertilizer, made from serpentine and Idaho phosphate rock, at its Permanente, Calif., electric-furnace plant, but it is said to have ceased operations later in the year. Manganese Products, Inc., Seattle, Wash., began production at Seattle in 1948 of an electric-furnace fused calcium-magnesium-phosphate fertilizer, using olivine from Cypress Island, Wash., and phosphate rock from the Philipsburg district, Mont. A description of the plant was published late in the year.[8]

Detailed geologic mapping of known deposits in some of the most important areas of the Idaho-Utah-Wyoming area have been completed by the Geological Survey, and work is going forward in other areas. Reconnaissance surveys are being made throughout the region. New deposits that may have commercial value have been discovered in western Montana. Mining-cost studies have been made by the Bureau of Mines, which is also experimenting with beneficiation of raw rock phosphates in its Salt Lake City laboratory. Recovery of the vanadium content of the phosphate rock by electrothermal processing is being studied by the Bureau of Mines at Albany, Oreg.

Western States phosphate rock sold or used by producers, 1944–48

Year	Idaho [1]			Montana		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1944	112,565	$584,400	$5.19	186,434	$761,745	$4.09
1945	123,340	673,627	5.46	150,858	916,288	6.07
1946	312,658	1,805,103	5.77	179,944	1,207,054	6.71
1947	[2] 845,045	[2] 4,077,885	[2] 4.83	236,229	[2] 1,571,117	6.65
1948	434,375	2,122,089	4.89	248,683	1,720,254	6.92

Year	Wyoming			Total		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1944				298,999	$1,346,145	$4.50
1945				274,198	1,589,915	5.80
1946				492,602	3,012,157	6.11
1947	51,845	$290,484	$5.60	[2] 1,133,119	[2] 5,939,486	[2] 5.24
1948	138,946	695,110	5.00	822,004	4,537,453	5.52

[1] Includes Utah in 1946–48.
[2] Revised figure.

Idaho.—Idaho retained its position as the leading phosphate-rock producer of the Western States in 1948; but its output, both in quantity and value, was cut to nearly half that of 1947. Its shipments (in-

[8] Granberg, W. J., Electric Furnace Combines Olivine and Phosphate: Rock Products, vol. 51, No. 10, October 1948, pp. 108, 110.

cluding a small quantity from Utah) were only 434,375 long tons, valued at $2,122,089. At that, however, they were greater than in any year before 1947.

As in 1947, three companies operating in Idaho reported sales of phosphate rock in 1948. The largest producer was again the Simplot Fertilizer Co., Pocatello, Idaho, which continued its mining operations at the Gay mine, Fort Hall Indian Reservation, Bingham County. Much of the output was exported. A smaller amount was used domestically, largely in the manufacture of superphosphate; but a considerable quantity was sold for direct application to the soil as a fertilizer. This firm obtained in 1948 a Government lease on 1,124 acres of phosphate rock land suitable for strip mining in Caribou County, north of Bingham County, where the company is now operating. High-grade rock is to be used in the company Salt Lake City plant. The low-grade rock is to go to the elemental phosphorus electric-furnace plant being erected at Pocatello, Idaho. This lease is the first ever issued by the Government in which development of the lower-grade phosphate rock is contemplated through stipulation for payment of royalties not only on production of 30-percent material but also "on any phosphate rock of lower grade which may be utilized."

The Westvaco Chemical Division, Food Machinery & Chemical Corp. in 1948 began the erection near Pocatello, Idaho, of an electric-furnace plant for producing elemental phosphorus, the first in the West. The initial furnace is expected to be completed early in 1949. Electric power will be obtained from the Idaho Power Co. The Union Pacific Railroad has completed a 23-mile spur linking the phosphate-rock mine with the electric-furnace plant and the Simplot superphosphate operations at Pocatello. It is expected that initially the elemental phosphorus will be shipped in tank cars to Westvaco's plant at Carteret, N. J., where it will be burned to phosphorus pentoxide and phosphoric acid. It is planned to process the phosphorus to phosphates at the company plant at its natural sodium sesquicarbonate mine at Trona, Wyo., at a later date.

The Anaconda Copper Mining Co. operated its No. 3 mine at Conda, Caribou County, Idaho. The rock mined was used largely for the production of superphosphates; a smaller quantity went into phosphoric acid and phosphate chemicals, and a yet smaller amount for direct application to the soil. None was exported.

The San Francisco Chemical Co., Montpelier, Idaho, did not operate its Waterloo mine near Montpelier, Bear Lake County, Idaho, in 1948. A considerable tonnage, already in stocks, was used domestically, and some was exported.

Montana.—Montana phosphate-rock production continues to increase; the State, however, remained in second place among the producers of the Western States. Shipments from Montana mines in 1948 totaled 248,683 long tons valued at $1,720,254. Both quantity and value exceeded those of 1947. The Montana Phosphate Products Co., Trail, British Columbia, was, as usual, the largest producer in Montana. It operated its Anderson, Anaconda, and Graveley mines, as well as several Government leases, all in the Garrison district, Powell County. All of the rock shipped was exported to the plant of the parent company at Trail, British Columbia. Mining operations were also carried on by George Relyea, Garrison, Mont., at the Relyea mine also in the Garrison district, and the production was shipped also to Trail, British Columbia. The Silica Products Co., Inc., 433 Provident Bldg., Tacoma, Wash., reported no production in 1948 at its phosphate-rock mine in the Elliston district in Powell County, but expected to operate sometime in 1949.

In the Philipsburg district, Granite County, only Manganese Products, Inc., Seattle, Wash., shipped any phosphate rock in 1948. It operated but one mine in 1948—the Edgar mine at Hall. The shipments of phosphate rock were to its own plant in Seattle, Wash., for the production of a fused calcium-magnesium phosphate fertilizer.

Utah.—The Garfield Chemical & Manufacturing Corp., Salt Lake City, Utah, mined and shipped phosphate rock from the Diamond Canyon phosphate mine on a Federal lease near Springville, Utah County, Utah, in 1948, for use in iron blast furnaces. The Utah Phosphate Co., Morgan, Utah, is reported to have a phosphate-rock mine and mill near Morgan, Morgan County, Utah; but the company did not report any operations in 1948. The phosphate rock deposit in Old Laketown Canyon in northeastern Utah is reported under lease to Idaho operators and is expected to be in production in 1949.

Wyoming.—Wyoming became an increasingly important phosphate-rock producer in 1948, more than doubling its 1947 production. Shipments totaled 138,946 long tons, valued at $695,110. Most of this output came from the Leefe mine of the San Francisco Chemical Co., Montpelier, Idaho (a subsidiary of a British copper mining company, Mountain Copper Co., Ltd.). The company mined phosphate rock in the Beckwith Hills syncline west of Sage, Wyo., on land leased from the owners, the Stauffer Chemical Co., San Francisco, Calif. Construction of a large crushing plant is reported to have been in progress during 1948 at the Leefe operations.

Phosphate Mines, Inc., continued in 1948 development of its phosphate-rock mine, 7 miles north of Kemmerer, Wyo. Two mills are said to have been installed during the year and at the end of September were about ready to operate. Sales of ground rock were made for direct application to the soil.

The John M. Thomas claims and the Thomas-Walker-Doerr Co. leases (H. F. Chaney claims) on the Sublette Range anticline in western Lincoln County are reported to have been under development in 1948.

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. Phosphate-rock export figures do not include Army shipments to occupied territories in 1946.

Phosphate rock and phosphatic fertilizers imported for consumption in the United States, 1944–48

Fertilizer	1944		1945		1946		1947		1948	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Apatite	6,090	$52,758	12,804	$102,435						
Phosphates, crude, not elsewhere specified	117,324	952,374	128,854	1,010,091	59,739	$601,683	43,477	$505,840	48,104	$608,932
Superphosphates (acid phosphate):										
Normal (standard), not over 25 percent P_2O_5 content	1,212	24,420	1,701	30,180	2,459	52,419	5,927	142,706	2,702	73,808
Concentrated (treble), over 25 percent P_2O_5 content	5	156	72	1,836	36	1,120	139	3,864	527	25,287
Total superphosphates	1,217	24,576	1,773	32,016	2,495	53,539	6,066	146,570	3,229	99,095
Ammonium phosphates, used as fertilizer	82,092	3,942,544	82,819	3,993,116	81,351	4,086,277	93,919	5,202,708	96,632	6,127,968
Bone dust, or animal carbon and bone ash, fit only for fertilizer	14,785	476,802	8,455	299,780	7,354	328,142	6,813	357,288	7,398	411,252
Guano	4,365	278,857	2,779	186,797	526	47,603			29	1,343
Slag, basic, ground or unground									29	559
Precipitated bone, fertilizer grade					670	63,782	186	17,700	458	23,146

Phosphate rock exported from the United States, 1944–48, by countries and grades

State of origin and country of destination	1944		1945		1946		1947 [1]		1948	
	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-Luxembourg			21,000	175,750			1,200	$10,800	600	$4,920
Canada	1,470	8,958	572	4,332	263	1,893	163	1,723		
Cuba							5,608	29,161	5,540	34,957
Germany									36,075	249,977
Greece			3,500	23,625						
Italy							2,991	26,559		
Netherlands							14,512	127,257		
New Zealand					12,000	102,000				
Spain							21,130	181,170		
Sweden			18,700	158,950	86,487	747,573	39,250	349,500	25,920	234,442
United Kingdom	17,914	121,400	4,500	29,250			33,960	238,723	8,036	56,252
Total high-grade hard rock	23,381	152,341	71,446	561,129	104,150	897,366	118,814	964,893	76,171	580,548

Phosphate rock exported from the United States, 1944–48, by countries and grades—Continued

State of origin and country of destination	1944		1945		1946		1947 [1]		1948	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Florida—Continued										
Land pebble:										
Australia	27,011	$163,983	46,526	$272,139	45,800	$382,705				
Belgium-Luxembourg							10,808	$91,208	71,799	$598,325
Brazil									1,999	18,991
British Guiana					5	69	915	10,124	882	11,486
Canada	166,050	1,926,142	133,690	1,518,649	144,183	1,553,518	185,611	1,701,281	143,203	1,236,181
Canary Islands							1,627	14,447		
Colombia							500	7,788	600	9,919
Cuba									8,314	54,059
Czechoslovakia			6,279	39,298						
Germany									76,667	601,066
Greece			10,996	65,980						
India							2,500	36,825	4,000	60,525
Ireland	5,447	47,280								
Italy							43,739	380,618	97,063	846,253
Mexico			51	620	2,000	11,391	7,136	31,546	8,624	47,325
Netherlands			[2] 148	[2] 888	7,992	70,970	9,969	87,991	42,984	386,990
New Zealand	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	60,397	533,713		
Sweden			5,200	44,200			24,232	215,179	8,011	71,137
Switzerland									5,010	45,182
United Kingdom			24,118	112,677	62,593	464,592	41,897	293,268	64,584	466,587
Uruguay									2,024	17,609
Yugoslavia			12,136	72,811	2,201	15,407				
Total land pebble	232,394	2,327,974	[2] 273,334	[2] 2,364,745	339,029	3,108,424	389,331	3,403,988	535,764	4,471,635
Other phosphate rock [3]	1,132	8,431	[2] 7,991	[2] 61,301	917	15,560	1,707	19,468	843	13,682
Total Florida	256,907	2,488,746	352,771	2,987,175	444,096	4,021,350	509,852	4,388,349	612,778	5,065,865
Tennessee, Idaho, and Montana rock:										
Canada	182,358	980,601	137,962	749,905	189,244	1,432,011	243,465	2,617,080	278,274	3,167,958
Japan									250,312	2,251,353
	182,358	980,601	137,962	749,905	189,244	1,432,011	243,465	2,617,080	528,586	5,419,311
Grand total	439,265	3,469,347	490,733	3,737,080	633,340	5,453,361	753,317	7,005,429	1,141,364	10,485,176

[1] Excludes 889,670 tons of Tennessee, Idaho, and Montana rock valued at $10,648,643 exported under the Department of the Army Civilian Supply Program. Of this, 10,437 tons ($126,247) went to Korea and 879,233 tons ($10,522,396) to Japan.
[2] Revised figure. [3] Includes sintered matrix.

Superphosphates (acid phosphates) exported from the United States, 1947–48, by countries

Country	1947 [1]		1948	
	Long tons	Value	Long tons	Value
Argentina	5,658	$117,837	600	$15,456
Brazil	34,524	865,194	26,088	648,592
British East Africa	976	46,206	890	80,400
Canada	120,030	2,221,204	97,939	1,794,833
Chile	315	23,624	867	64,049
China	4,469	87,450		
Formosa	475	9,496		
Colombia	1,716	83,341	2,132	155,180
Costa Rica	802	36,567	196	5,988
Dominican Republic	400	28,688	293	29,164
El Salvador	881	32,669	418	26,692
Germany			39,473	818,445
Guatemala	1,740	70,957	30	1,247
Iceland	1,403	61,795	625	45,500
Korea			160,322	3,354,738
Mexico	387	22,299	1,982	81,480
Newfoundland and Labrador			8,100	138,834
Union of South Africa			18,600	318,730
Venezuela	1,946	83,440	1,473	48,548
West Indies:				
British:				
Leeward and Windward Islands	2,568	94,010	412	7,766
Trinidad and Tobago	2,296	65,318	1,357	39,690
Other British	21	1,256	27	1,063
Cuba	49,215	1,388,643	19,652	456,114
Haiti			83	2,498
Other countries	2,764	70,751	1,280	62,151
Total	232,586	5,410,745	382,839	8,197,158

[1] Exclusive of 19,710 tons valued at $1,324,521 exported to Japan under the Department of the Army Civilian Supply Program.

Other phosphate materials [1] exported from the United States, 1944–48

Year	Long tons	Value	Year	Long tons	Value
1944	545	$70,358	1947	1,129	$220,906
1945	1,732	140,363	1948	1,002	188,163
1946	1,018	144,478			

[1] Class includes bone ash, dust, and meal; animal carbon for fertilizer; char dust; duplex basic phosphate; and South Carolina river rock.

TECHNOLOGY

Various papers on developments in phosphate-rock technology that have been published recently are listed below.[10]

[10] Curtis, Harry A., General Outline of Chemical Engineering Activities by the Staff of the Division of Chemical Engineering: TVA Chem. Eng. Rept. 1, Wilson Dam, Ala., rev. ed., 1948, 60 pp.
Stribling, M. M., Jr., Development of Processes and Equipment for Production of Phosphoric Acid by the Staff of the Division of Chemical Engineering: TVA, Chem. Eng. Rept. 2, Wilson Dam, Ala., 1948, 143 pp.
Almond, L. H., and Steinbiss, H. K., TVA Phosphoric Acid Plant Sports a New Phosphorus Combustion System: Chem. Eng., vol. 55, No. 10, October 1948, pp. 105–109.
Chemical Engineering, Equipment and Construction Materials for Phosphoric Acid (Dry Process), Phosphoric Acid (Wet Process): Vol. 55, No. 11, November 1948, pp. 108–110.
Holford, G. H., Serpentine Superphosphate: New Zealand Jour. Agric., vol. 73, 1946, pp. 229, 291–3, 295, 297–9, 301–2. (Use and manufacture of serpentine superphosphate. Results are described as unsuccessful.)
Miller, Philip, Wilson R. A., and Tusson, J. R., Production of Red Phosphorus by a Continuous Process: Ind. Eng. Chem., vol. 40, No. 2, February 1948, pp. 357–366.
Silverstein, M. S., Nordblom, G. F., Dittrich, C. W., and Jakabcin, J. J., Stable Red Phosphorus: Ind. Eng. Chem., vol. 40, No. 2, February 1948, pp. 301–303.
Chemical and Engineering News, Stabilized Red Phosphorus: Vol. 26, No. 25, June 21, 1948, pp. 1842–1843.
Rock Products, Hydraulic Gun: Vol. 51, No. 5, May 1948, p. 68.
Rock Products, Loading Phosphate Concentrates: Vol. 51, No. 5, May 1948, p. 68.
Chemical and Engineering News, TVA Calls on Chemists: Vol. 26, No. 1, Jan. 5, 1948, p. 40.
Rock Products, Pumping System for Phosphate: Vol. 51, No. 6, June 1948, p. 98.
Jacob, K. D., Phosphate Fertilizer Progress: Fertilizer Rev., vol. 23, No. 1, January-February 1948, pp. 3–9, 19–20.

WORLD PRODUCTION

The following table gives available figures on production of phosphate rock in various countries in recent years.

World production of phosphate rock by countries, 1943–48, in metric tons[1]

[Compiled by Helen L. Hunt]

Country [1]	1943	1944	1945	1946	1947	1948
Algeria	76,798	220,349	401,304	584,827	706,878	670,591
Australia:						
New South Wales	122				231	(2)
South Australia	12,976	4,167	725	20	5,171	[3] 3,500
Western Australia	43	2,251	8,619			
Austria	(2)	(2)	(2)	3,240	11,525	(2)
Belgium	108,900	52,270	17,990	69,927	58,045	68,938
Brazil (apatite)	6,111	5,216	7,463	10,421	5,592	
British West Indies: Cayman Islands	102	(2)	(2)	(2)	(2)	(2)
Canada	1,316	437	271	52		
Chile (apatite)	37,924	14,376	13,203	15,210	13,994	59,529
Egypt	315,566	318,185	349,374	294,046	371,227	377,005
France	131,020	92,966	75,459	97,285	56,786	(2)
French Oceania (exports)	188,385	203,300	259,000	241,085	205,136	183,104
Germany	585	[3] 1,000	(2)	[3][4] 400	[4] 698	[4] 473
India	1,215	232	532	247	867	(2)
Indochina, French:						
Phosphate rock	19,890	6,850			(2)	
Apatite	64,600	300			(2)	
Indonesia	[3] 24,000	[3] 24,000	(2)	(2)	(2)	
Ireland	17,252	20,300	(2)	12,189	(2)	(2)
Italy	400		1,600	(2)	(2)	(2)
Japan	201,178	52,835	(2)	(2)	(2)	3,600
Korea	24,385	33,530	(2)	(2)	(2)	(2)
Morocco, French	806,171	1,444,902	1,654,120	3,783,636	2,960,727	3,226,326
Nauru and Ocean Island (exports)					[5] 224,039	[5] 480,592
Netherlands West Indies: Curaçao (exports)	(2)	7,813	8,770	(2)	(2)	(2)
New Zealand	9,389	20,251	8,084	11,224	203	
Palestine and Israel (exports)	5,384	4,961	4,867	4,024	(2)	(2)
Seychelles Islands (exports)	1,849	5,941	7,090	21,397	14,516	21,924
South-West Africa	164		27	1,665	2,223	1,038
Spain	15,722	17,770	20,349	18,608	20,204	(2)
Sweden (apatite)	144,265	160,847	171,127	50,730	(2)	(2)
Tanganyika Territory	267	28	9	279	220	313
Tunisia	334,678	522,265	706,404	1,399,880	1,759,236	1,863,710
Uganda	(2)	(2)	8,648	7,213	7,269	
Union of South Africa	5,801	21,088	27,342	37,686	41,831	39,656
U. S. S. R. (apatite)	[3] 1,016,000	[3] 1,016,000	(2)	(2)	(2)	(2)
United States (sold or used by producers)	5,208,508	5,462,938	5,899,921	6,970,827	9,171,914	8,807,903
Total (estimate) [1]	8,796,000	9,746,000	10,746,000	14,673,000	16,745,000	16,982,000

[1] In addition to countries listed, Angaur Island, China (including Formosa), Christmas Island (near Singapore), Madagascar, New Caledonia, Republic of the Philippines, Poland, and Rumania produce phosphate rock, but data of output are not available, and no estimates have been included in the total.
[2] Data not available; estimate by author of chapter included in total.
[3] Estimate.
[4] Bizonal.
[5] Fiscal year ended June 30 of year stated.

BASIC SLAG

Basic slag forms a small source of agricultural phosphorus in the United States. Domestic production is limited to a single producing company smelting the phosphatic iron ore of the Birmingham, Ala., district; no figures of production or sales have been released for publication by this company. Annual imports are negligible. In 1948 only 29 long tons were imported. None had been imported in 1944–47.

Platinum-Group Metals

By HUBERT W. DAVIS AND CHARLOTTE R. BUCK

GENERAL SUMMARY

SUBSTANTIALLY smaller demand (chiefly by the chemical and jewelry industries), adequate supplies, and higher prices were features of platinum in 1948. Sales of platinum were the smallest since 1940. The quotation of $101 an ounce for platinum that prevailed from April 14 to June 3 was the highest since April 7, 1927. Demand for palladium was at a much higher level than in 1947, and sales in 1948 were only 6 percent less than those of platinum. Moreover, sales of palladium in 1948 have been exceeded in only two other years. Purchases of palladium by the electrical industry established a new peak in 1948. Noteworthy were the imports of 62,241 ounces of palladium from the U. S. S. R. in 1948.

Salient statistics of platinum-group metals in the United States, 1947–48, in troy ounces

	1947	1948
Production:		
Crude platinum from placers	13,836	13,741
New metals:		
Platinum	54,011	33,520
Palladium	4,156	4,408
Other	2,690	1,663
	60,857	39,591
Secondary metals:		
Platinum	54,190	58,527
Palladium	27,492	28,418
Other	5,406	6,956
	87,088	93,901

	1947	1948
Stocks in hands of refiners, importers, and dealers, Dec. 31:		
Platinum	133,300	146,823
Palladium	167,364	142,211
Other	36,859	34,540
	337,523	323,574
Imports for consumption:		
Unrefined materials	51,209	33,654
Refined metals	257,656	239,302
	308,865	272,956
Exports:		
Ore and concentrates	42	5
Refined metals and alloys, including scrap	25,549	36,465
Manufactures (except jewelry)	6,327	4,874

Platinum was refined in the United States in 1948 at a rate 15 percent lower than in 1947 and greatly below the substantially smaller demand. The refined-metal deficiency was met by imports of 103,939 ounces, chiefly from Canada (66,557 ounces), Switzerland (16,528 ounces), United Kingdom (11,559 ounces), and Palestine (4,204 ounces). The jewelry trade was again by far the largest outlet for platinum, taking 46 percent of the total sold to domestic consumers. However, sales to the jewelry industry declined for the second consecutive year and were 29 percent smaller in 1948 than in 1947. Less platinum was also sold to the chemical and dental industries, but sales to the electrical industry were up 39 percent.

Palladium was refined in the United States at a slightly higher rate in 1948 than in 1947. The quantity refined in 1948, however, was 82 percent less than sales, which were 30 percent more than in 1947. The deficit in palladium was partly met by imports of 119,949 ounces of refined metal, chiefly from U. S. S. R. (62,241 ounces), Canada (38,003 ounces), and United Kingdom (13,320 ounces), and partly by withdrawals from stocks of refiners and dealers. The larger sales of palladium in 1948 were shared by all domestic consuming industries, except the dental industry; moreover, the export demand for palladium was six times that in 1947.

More osmium and ruthenium but less iridium and rhodium were refined in the United States in 1948 than in 1947. More iridium and rhodium but less osmium and ruthenium were imported than in 1947. Sales to domestic consuming industries of iridium and ruthenium were 30 and 28 percent, respectively, less than in 1947, but those of osmium and rhodium were up 32 and 14 percent, respectively; sales of iridium, osmium, rhodium, and ruthenium for export were substantially greater than in 1947.

Imports of platinum-group metals into the United States in 1948 were 12 percent less than in 1947.

Figure 1 shows graphically the trend in world production of platinum-group metals since 1914.

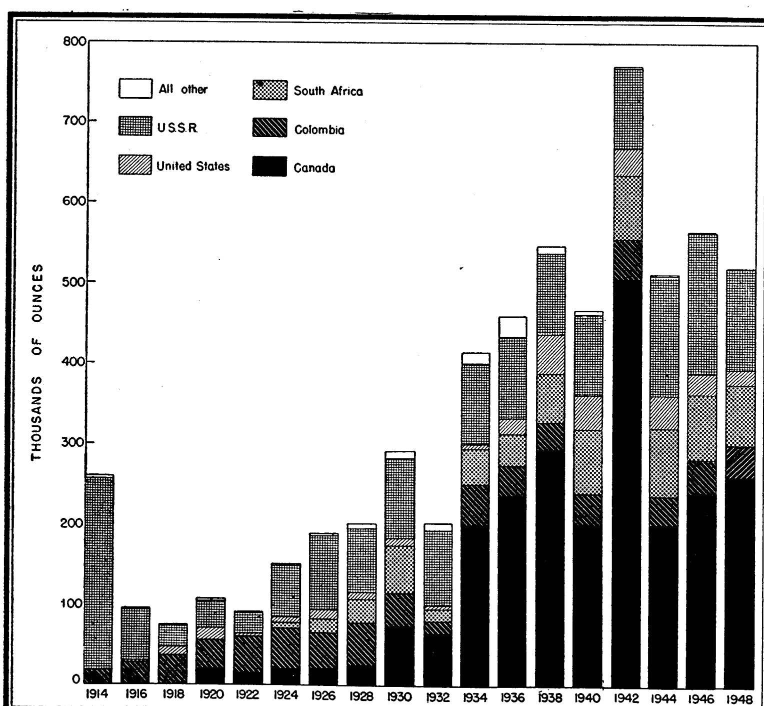

FIGURE 1.—Trend in world production of platinum-group metals, 1914–48.

CRUDE PLATINUM PRODUCTION

Crude platinum-group metals were produced in Alaska and California in 1948 and totaled 13,741 ounces, compared with 13,836 ounces in 1947. The Alaskan production came from placer deposits in the Goodnews Bay district of southwestern Alaska, and the California output was a byproduct of gold placers in Butte, Mariposa, Merced, Sacramento, San Joaquin, Shasta, Siskiyou, and Yuba Counties.

Many gold and copper ores in the United States contain small quantities of platinum-group metals. In 1948, 5,512 ounces of platinum-group metals were recovered as byproducts of refining gold and copper ores compared with 4,570 ounces in 1947.

Source of Purchases.—Purchases of domestic crude platinum-group metals by buyers in the United States were reported from Alaska, California, and Oregon in 1948 and totaled 13,871 ounces (13,795 ounces in 1947). Domestic buyers also reported purchases of 23,020 ounces of foreign crude platinum-group metals from Colombia and 225 ounces from Canada in 1948—a total of 23,245 ounces (41,239 ounces in 1947).

RECOVERY OF REFINED PLATINUM-GROUP METALS

New Metals Recovered.—Reports from refiners of crude platinum-group metals, gold bullion, nickel, and copper indicate that 39,591 ounces of platinum-group metals were recovered in the United States from such sources in 1948—a decrease of 35 percent from 1947. Of the new metals recovered in 1948, 57 percent was chiefly from crude from Colombia, 29 percent was from domestic crude (chiefly Alaska), and 14 percent was a byproduct of domestic gold and copper ores.

New platinum-group metals recovered by refiners in the United States, 1944–46, and 1947–48 by sources, in troy ounces

	Platinum	Palladium	Iridium	Osmium	Rhodium	Ruthenium	Total
1944	132,452	10,966	4,406	463	3,256	1,502	153,045
1945	162,032	28,649	5,783	845	4,731	2,466	204,506
1946	92,947	3,858	2,995	475	1,396	107	101,778
1947							
Domestic from—							
Crude platinum	10,955	133	1,056	313	374	41	12,872
Gold and copper refining	1,098	3,471	1				4,570
	12,053	3,604	1,057	313	374	41	17,442
Foreign from— Crude platinum; Nickel and copper refining	41,958	552	548	106	189	62	43,415
Total recovery	54,011	4,156	1,605	419	563	103	60,857
1948							
Domestic from—							
Crude platinum	10,338	31	694	260	137	95	11,555
Gold and copper refining	1,251	4,261					5,512
	11,589	4,292	694	260	137	95	17,067
Foreign from— Crude platinum; Nickel and copper refining	21,931	116	315	89	19	54	22,524
Total recovery	33,520	4,408	1,009	349	156	149	39,591

Secondary Metals Recovered.—In 1948, 93,901 ounces of secondary platinum-group metals were recovered from the refining of scrap metal, sweeps, and other waste products of manufacture that contain platinum-group metals—an 8-percent increase over 1947.

Substantial quantities of worn-out catalysts, spinnerets, laboratory ware, and other products are returned by consumers to refiners for refining. The refined platinum-group metals recovered from these products (or their equivalent in refined metals) are returned to the consumers. The platinum-group metals so recovered are not included in the statistics of secondary metals.

Secondary platinum-group metals recovered in the United States, 1944–48, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
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
1947	54,190	27,492	2,089	3,317	87,088
1948	58,527	28,418	2,214	4,742	93,901

CONSUMPTION

As pure metals, combined, clad, or alloyed with other metals, the platinum-group metals are utilized in the electrical and chemical industries, in dentistry and jewelry, and for numerous miscellaneous purposes. Uses of the platinum-group metals are tabulated on page 801 of the Platinum and Allied Metals chapter in Minerals Yearbook, 1943.

Sales of platinum-group metals to consumers in the United States were 366,848 ounces in 1948 compared with 387,454 ounces in 1947. No platinum-group metals were sold to the National Strategic Stock Pile in 1948; some platinum was so sold in 1947, but the quantity was not included in the figures on sales.

Platinum continued to be the most widely used metal of the group, but in 1948 sales were only 6 percent greater than those of palladium. Sales of platinum constituted 177,441 ounces (48 percent) of the total platinum-group metals sold to domestic consumers in 1948. The jewelry trade was again the chief buyer of platinum, taking 46 percent of the total, but its purchases (81,756 ounces) were 29 percent less in 1948 than in 1947. The electrical industry, which dropped to third place in 1947, purchased 42,306 ounces of platinum in 1948 and displaced the chemical industry as the second-largest buyer. Sales of platinum to the chemical industry declined 36 percent from 1947, and those to the dental industry were 3 percent less.

Next to platinum, palladium is the most extensively used metal of the group, and in 1948 sales to domestic consumers were only 6 percent less than those of platinum. Sales of palladium to domestic consumers in 1948 were 21 percent more than in 1947 and constituted 167,610 ounces (46 percent) of the total platinum-group metals sold. The electrical industry retained first place as a buyer of palladium in

1948 by taking 105,033 ounces (63 percent) of the total palladium sold to domestic consumers. Sales of palladium to the electrical industry established a new record in 1948 and were 29 percent greater than in 1947. More palladium was also sold to the chemical and jewelry industries in 1948 than in 1947, but sales to the dental industry were less.

Sales of the other platinum-group metals—iridium, osmium, rhodium, and ruthenium—were comparatively small; they made up 6 percent of the total platinum-group metals sold in 1948. Domestic demand for osmium and rhodium was 32 and 14 percent, respectively, greater than in 1947, but that for iridium and ruthenium was 30 and 28 percent, respectively, less.

The accompanying table shows sales of platinum-group metals to consuming industries in the United States in 1947 and 1948.

Platinum-group metals sold to consuming industries in the United States in 1947 and 1948, in troy ounces

Industry	Platinum	Palladium	Iridium, osmium, rhodium, and ruthenium	Total
1947				
Chemical	65,743	6,899	3,580	76,222
Electrical	30,469	81,528	2,906	114,903
Dental and medical	9,774	20,876	74	30,724
Jewelry and decorative	114,768	28,523	15,172	158,463
Miscellaneous and undistributed	2,696	443	4,003	7,142
	223,450	138,269	25,735	387,454
1948				
Chemical	41,778	13,816	5,722	61,316
Electrical	42,306	105,033	2,784	150,123
Dental and medical	9,494	16,740	171	26,405
Jewelry and decorative	81,756	31,783	10,589	124,128
Miscellaneous and undistributed	2,107	238	2,531	4,876
	177,441	167,610	21,797	366,848

STOCKS

Stocks of platinum-group metals in all forms in the hands of refiners, importers, and dealers totaled 323,574 ounces on December 31, 1948, compared with 337,523 ounces at the close of 1947.

Stocks of platinum-group metals held by refiners, importers, and dealers in the United States, Dec. 31, 1944–48, in troy ounces

Year	Platinum	Palladium	Iridium, osmium, rhodium, and ruthenium	Total
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
1947	133,300	167,364	36,859	337,523
1948	146,823	142,211	34,540	323,574

PRICES

Buyers reported purchases at $31.16 to $83.78 an ounce for domestic and foreign crude platinum-group metals in 1948. This price range results chiefly from variations in iridium content of crudes and from market fluctuations for refined platinum and ruthenium in 1948.

As a result of four advances totaling $32, the retail prices of platinum and ruthenium reached $101 an ounce on April 14, where they remained until June 4, when they were reduced to $91. On June 15 the quotations were lowered to $78, but on July 1 they were again raised to $91; and on July 26 they were advanced to $96, where they remained throughout the remainder of 1948. Iridium was quoted at $80–$85 an ounce on January 1, 1948; subsequently, several advances were made, and on April 14 the price reached $110–$120 an ounce. On June 15 the quotation on iridium was lowered to $100–$110 an ounce, but on July 26 it was raised to $110–$115, where it remained throughout the remainder of 1948. Quotations on palladium, osmium, and rhodium remained unchanged at $24, $100, and $125 an ounce, respectively, throughout 1948.

FOREIGN TRADE [1]

Imports.—Imports of platinum-group metals into the United States in 1948 were 12 percent less than in 1947. The principal sources of imported platinum-group metals in 1948 were Canada (112,301 ounces), U. S. S. R. (66,642 ounces), United Kingdom (29,127 ounces), Colombia (25,621 ounces), and Switzerland (20,713 ounces). Imports of refined metals (239,302 ounces), which comprised 88 percent of the total, were 7 percent less than in 1947, whereas those of unrefined material (33,654 ounces) were 34 percent smaller. Imports of refined platinum, palladium, osmium, and ruthenium were 6, 10, 39, and 24 percent, respectively, less than in 1947, but imports of iridium and rhodium were 9 and 176 percent, respectively, more.

Platinum-group metals imported for consumption in the United States, 1944–48 [1]

Year	Troy ounces	Value	Year	Troy ounces	Value
1944	356,212	$10,675,303	1947	308,865	$11,792,076
1945	[2] 383,658	[2] 11,591,390	1948	272,956	14,971,817
1946	407,210	14,696,320			

[1] See footnote 2 of following table.
[2] Revised figure.

[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.

Platinum-group metals [1] (unmanufactured) imported for consumption in the United States, 1947–48, by countries, in troy ounces

[U. S. Department of Commerce]

Country	Unrefined materials [2]				Refined metals					Total
	Ores and concentrates of platinum metals	Grains and nuggets (including crude, dust, and residues)	Sponge and scrap	Osmiridium	Platinum	Palladium	Iridium	Osmium	Rhodium and ruthenium	
1947										
Canada			6,262		54,728	71,048	1,660		3,955	137,653
Colombia		42,004								42,004
Ethiopia		195								195
France						625				625
Norway					395		32		225	652
Palestine and Trans-Jordan					1,075					1,075
Switzerland			1		1,248					1,249
Syria					1,506					1,506
Union of South Africa	793			115				141	61	1,110
U. S. S. R.					32,667	57,563	2,725	1,412		94,367
United Kingdom	383		1,128	284	18,995	4,716	594	636	1,508	28,244
Other countries		4	40		131	10				185
Total	1,176	42,203	7,431	399	110,745	133,962	5,011	2,189	5,749	308,865
1948										
Canada	167	50	291		66,557	38,003	1,780		5,453	112,301
China		1,080	696		884					2,660
Colombia		24,607	1,014							25,621
Ethiopia	2	740								742
France			32		470					502
Italy						1,011				1,011
Lebanon			64		1,977					2,041
Netherlands			193			1,000				1,193
Norway					791	451	75		1,146	2,463
Palestine			42		4,204					4,246
Panama, Republic of		533			217					750
Switzerland		200	267		16,528	3,718				20,713
Union of South Africa	854			216	10					1,080
U. S. S. R.						[3] 62,241	3,118	1,283		66,642
United Kingdom	797	216	235	441	11,559	[3] 13,320	499	55	2,005	29,127
Other countries	73	204	640		742	205				1,864
Total	1,893	27,630	3,474	657	103,939	119,949	5,472	1,338	8,604	272,956

[1] On the basis of detailed information received by the Bureau of Mines from importers, certain items recorded by the U. S. Department of Commerce as "ores and concentrates," "grains and nuggets," and "sponge and scrap" have been reclassified and included with other groups in this table.

[2] The concentrates 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-group 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.

[3] Adjusted by Bureau of Mines.

Platinum-group metals [1] (unmanufactured) imported for consumption in the United States, 1947–48

[U. S. Department of Commerce]

Material	1947 Troy ounces	1947 Value	1948 Troy ounces	1948 Value
Unrefined materials: [2]				
Ores and concentrates of platinum metals	1,176	$90,771	1,893	$162,573
Grains and nuggets (including crude, dust, and residues)	42,203	1,816,454	27,630	1,787,225
Sponge and scrap	7,431	384,817	3,474	261,730
Osmiridium	399	22,354	657	45,488
Total	51,209	2,314,396	33,654	2,257,016
Refined metals:				
Platinum	110,745	5,890,132	103,939	8,627,955
Palladium	133,962	2,585,115	119,949	2,578,589
Iridium	5,011	352,601	5,472	502,327
Osmium	2,189	239,605	1,338	159,232
Rhodium	2,122	239,625	5,864	672,979
Ruthenium	3,627	170,602	2,740	173,719
Total	257,656	9,477,680	239,302	12,714,801
Grand total	308,865	11,792,076	272,956	14,971,817

[1] On the basis of detailed information received by the Bureau of Mines from importers, certain items recorded by the U. S. Department of Commerce as "ores and concentrates," "grains and nuggets," and "sponge and scrap" have been reclassified and included with other groups in this table.

[2] The concentrates 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-group 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.

Exports.—Exports of refined platinum (including scrap) declined to 15,471 ounces in 1948 (17,766 ounces in 1947), but exports of the other platinum-group metals (including scrap) increased to 20,994 ounces (7,783 ounces in 1947). In 1948 the chief foreign markets for platinum were France (4,311 ounces), Palestine (3,513 ounces), Germany (2,800 ounces), Argentina (1,531 ounces), and Brazil (1,081 ounces) and for the other platinum-group metals Germany (12,278 ounces), France (3,446 ounces), Switzerland (2,046 ounces), and Austria (1,023 ounces).

Platinum-group metals exported from the United States, 1944–48

[U. S. Department of Commerce]

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
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
1947	42	1,322	17,766	977,468	7,783	256,150	6,327	335,797
1948	5	500	15,471	1,198,994	20,994	495,660	4,874	219,405

Platinum-group metals exported from the United States, 1947–48, by countries

[U. S. Department of Commerce]

Country	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
1947						
Argentina	7,649	$376,360	453	$12,809	58	$3,071
Brazil	4,017	252,942	257	8,778	109	6,447
Canada	1,184	64,108	3,749	104,278	3,382	131,357
Chile	56	3,753	3	187	17	1,284
China	89	3,617	132	11,895	240	24,245
Colombia	59	1,676	178	4,627	6	493
Cuba	586	35,244	270	8,514	37	2,213
France	747	48,900	134	17,006	10	1,650
Germany	48	2,773	48	5,739		
Hong Kong	49	3,002	101	7,657	70	6,679
Italy					1,477	113,393
Mexico	620	37,248	186	7,076	36	2,656
Netherlands	1,515	98,748			30	822
Palestine and Trans-Jordan			115	5,129	97	7,627
Philippines, Republic of	141	8,275	98	5,255	130	6,478
Poland and Danzig	80	1,828			6	486
Sweden	214	10,223	2	319	155	8,613
Switzerland	232	10,226	321	7,394		
Uruguay	163	10,325				
U. S. S. R.	60	2,972			83	2,615
United Kingdom			1,662	46,750	24	400
Venezuela	71	1,446	12	291	17	364
Other countries	186	3,802	62	2,446	343	14,904
Total	17,766	977,468	7,783	256,150	6,327	335,797
1948						
Argentina	1,531	93,063	237	4,340	14	1,603
Austria			1,023	22,634	16	140
Brazil	1,081	83,169	34	1,025	33	1,706
Canada	752	50,327	721	29,542	3,471	92,970
Chile	111	8,274			22	2,185
China	12	155	189	11,201	73	8,577
Colombia			135	3,638	15	708
Cuba	606	43,297	262	9,431	24	1,595
France	4,311	385,501	3,446	147,733		
Germany	2,800	227,375	12,278	229,721	32	4,175
Mexico	21	1,571	118	4,443	27	2,049
Netherlands	2	380			744	79,823
Palestine	3,513	275,700				
Philippines, Republic of	196	3,451	42	1,469	30	2,036
Spain			408	10,132		
Switzerland	352	9,928	2,046	15,199	9	530
Uruguay	78	7,148				
Other countries	105	9,655	55	5,152	364	21,308
Total	15,471	1,198,994	20,994	495,660	4,874	219,405

WORLD REVIEW

Canada.—According to the Dominion Bureau of Statistics, production of platinum-group metals from the nickel-copper ores of the Sudbury district, plus a small quantity from placers in British Columbia, was 116,578 ounces of platinum and 143,822 ounces of other platinum-group metals in 1948 compared with 94,570 ounces of platinum and 110,332 ounces of other platinum-group metals in 1947.

Sales of platinum-group metals by the International Nickel Co. of Canada, Ltd., were 199,560 ounces in 1948 compared with 191,761 ounces in 1947.

Colombia.—The South American Gold & Platinum Co. produced 22,779 ounces of crude platinum-group metals in 1948 (25,241 ounces in 1947). The crude material contains about 85 percent platinum-group metals. The production of crude platinum-group metals by other operators was 17,268 ounces in 1948 (13,474 ounces in 1947).

Union of South Africa.—According to the Department of Mines, 68,926 ounces of platinum-group metals were produced in South Africa in 1948 compared with 78,740 ounces in 1947. Exports (all to England) were 64,579 ounces in 1948 compared with 56,288 ounces in 1947. The platinum-group metals are produced in the Rustenburg district in the form of crude metallics and as matte containing approximately 43 ounces per ton of platinum-group metals and gold, plus nickel and copper. The approximate proportions of the different metals of the platinum group and gold recovered from the Rustenburg ores are as follows:

Metal:	*Percent*
Platinum	77.08
Palladium	16.70
Iridium	.06
Osmium and osmiridium	.14
Ruthenium	.51
Gold	5.51

Osmiridium is recovered in the treatment of gold ores on the Rand. Sales were 5,774 ounces in 1948 (6,402 ounces in 1947).

The expansion of the plant of Rustenburg Platinum Mines, Ltd., proceeded satisfactorily in 1948 and it was expected that certain portions of the new plant would be in operation in early 1949.[2] During 1949 the furnaces for smelting concentrates will be dismantled and reerected. It is anticipated that by the end of 1949 metallics and concentrates will be shipped at a rate double the 1948 output.

The Union Platinum Mining Co., which acquired a lease to mine precious metals in the Rustenburg district, was reported [3] to have begun treating about 150 tons of ore daily in early 1949. A plant to treat 500 tons daily was being erected.

[2] South African Mining and Engineering Journal, vol. 59, pt. II, No. 2916, Jan. 1, 1949, p. 549.
[3] Mining Journal (London), vol. 232, No. 5929, Apr. 9, 1949, p. 257.

World production of platinum-group metals, 1939 and 1943–48, in troy ounces

[Compiled by B. B. Mitchell]

Country and product	1939	1943	1944	1945	1946	1947	1948
Australia:							
New South Wales: Placer platinum	7	3	2	2	----------	----------	(1)
Tasmania: Placer osmiridium	283	90	107	109	95	99	(1)
Belgian Congo: From refineries:							
Palladium	3,344	----------	----------	----------	----------	----------	209
Platinum	1,157	----------	----------	----------	----------	----------	----------
Canada:							
Placer platinum	25	219,713	157,523	[3] 208,234	121,771	94,570	116,578
From refineries: [2]							
Platinum	148,877						
Other platinum-group metals	135,402	126,004	42,929	[3] 458,674	117,566	110,332	143,822
Colombia: Placer platinum (exports)	39,070	39,961	36,136	30,883	43,835	38,715	40,047
Ethiopia: Placer platinum	6,000	1,000	942	----------	[4] 140	[4] 1,548	[4] 460
Indonesia: Placer platinum	28	----------	----------	(1)	(1)	(1)	----------
Italy: From refineries: Platinum	1,608	64	----------	----------	(1)	(1)	(1)
New Zealand: Placer platinum	13	5	----------	----------	14	----------	----------
Papua: [5]							
Placer platinum	2	----------	----------	----------	----------	----------	(1)
Placer osmiridium	4	----------	----------	----------	----------	----------	(1)
Sierra Leone: Placer platinum	83	----------	----------	16	105	431	109
Union of South Africa:							
Platinum (content of platinum-group metals) [6]	18,068	73,745	22,509	22,884	22,900	78,740	68,926
Concentrates (content of platinum-group metals) [6]	41,243		58,070	52,030	51,900		
Osmiridium [7]	7,031	5,993	6,142	6,259	6,794	6,402	5,774
U. S. S. R.:							
Placer platinum / From refineries [8] (estimate)	100,000	125,000	150,000	150,000	175,000	150,000	125,000
United States:							
Placer platinum	32,460	27,162	33,625	26,551	22,949	13,836	13,741
Ore (content of platinum-group metals)	66	----------	----------	----------	----------	----------	----------
From refineries: [9]							
Platinum	5,270	5,205	3,286	1,068	555	1,038	1,251
Other platinum-group metals	3,364	5,185	3,638	3,427	2,808	3,472	4,261
Total (estimate)	543,000	629,000	515,000	[3] 960,000	567,000	499,000	520,000

[1] Data not available.
[2] Recovered from nickel-copper mattes. The figures for 1945–48 represent the platinum-group metals contained in the concentrates actually recovered, whereas those for 1939 and 1943–44 represent the metals refined from Canadian concentrates at Acton, England, plus the platinum-group 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] Exports for year ended Sept. 10 of year stated.
[5] Year ended June 30 of year stated.
[6] Produced from platinum ores.
[7] Produced from treatment of gold ores on the Rand.
[8] Recovered from nickel-copper ores.
[9] New platinum-group metals recovered in gold and copper refining of domestic materials.

Potash

By BERTRAND L. JOHNSON AND E. M. TUCKER

GENERAL SUMMARY

AGAIN new records have been made in the potash industry of the United States, according to producers' reports. In 1948 both production of marketable potassium salts and sales reached new highs, each exceeding 2 million tons. Production in 1948 was 232,717 short tons greater than in 1947; the equivalent potash content (K_2O) was 110,006 tons greater. (See fig. 1.) Sales in 1948 topped those of 1947 by 195,500 tons, with the K_2O content 90,073 tons larger. The value of the sales in 1948 was over 1¼ million dollars more than in 1947. The average value per ton of potassium salts sold in 1948 was $1.02 less than in the previous year. Stocks in producers' hands at the end of 1948 declined from the previous year and reached the low figure of 11,211 short tons K_2O. Both imports and exports of potash materials were greater in quantity in 1948 than in 1947, but the value of the imports alone increased. A new high was reached in 1948 in the

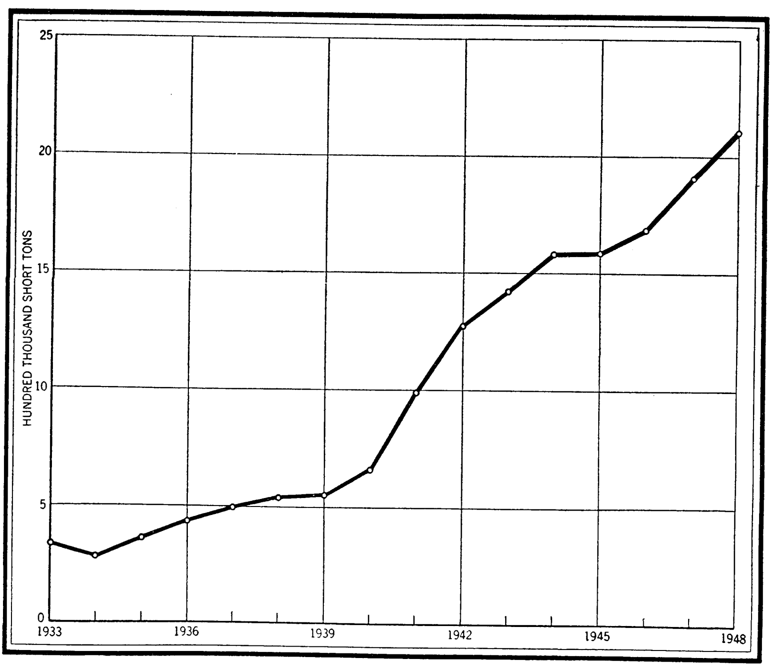

FIGURE 1.—Production of marketable potash salts in the United States, 1933–48.

apparent domestic consumption of potash (K_2O)—nearly 90,000 tons greater than in 1947.

Several articles on the potash industry were published in 1948.[1]

Salient statistics of the potash industry in the United States, 1946–48

	1946	1947	1948
Production:			
Potassium salts (marketable) ---------- short tons--	1,687,735	1,905,776	2,138,493
Approximate equivalent, K_2O ---------- do----	931,812	1,029,875	1,139,881
Sales by producers:			
Potassium salts ---------- do----	1,673,249	1,953,307	2,148,807
Approximate equivalent, K_2O ---------- do----	928,374	1,053,266	1,143,339
Value at plant ----------	$32,175,716	$34,716,051	$35,998,758
Average per ton ----------	$19.23	$17.77	$16.75
Imports:			
Fertilizer materials ---------- short tons--	7,872	47,815	47,515
Approximate equivalent, K_2O ---------- do----	2,564	25,266	26,002
Value ----------	$249,819	$1,887,771	$2,340,442
Chemical materials ---------- short tons--	8,327	3,228	5,375
Approximate equivalent, K_2O ---------- do----	1,801	712	1,179
Value ----------	$2,100,915	$587,580	$723,135
Total imports ---------- short tons--	16,199	51,043	52,890
Approximate equivalent, K_2O ---------- do----	4,365	25,978	27,181
Value ----------	$2,350,734	$2,475,351	$3,063,577
Exports:			
Fertilizer materials ---------- short tons--	96,822	102,939	104,176
Approximate equivalent, K_2O [1] ---------- do----	53,930	57,337	58,026
Value ----------	$2,983,751	$3,251,645	$3,498,240
Chemical materials ---------- short tons--	23,905	21,970	23,892
Approximate equivalent, K_2O [1] ---------- do----	11,713	10,765	11,707
Value ----------	$5,055,441	$5,434,462	$4,790,715
Total exports ---------- short tons--	120,727	124,909	128,068
Approximate equivalent, K_2O [1] ---------- do----	65,643	68,102	69,733
Value ----------	$8,039,192	$8,686,107	$8,288,955
Apparent consumption: [2]			
Potassium salts ---------- short tons--	1,568,721	1,879,441	2,073,629
Approximate equivalent, K_2O ---------- do----	867,096	1,011,142	1,100,787

[1] Estimate by Bureau of Mines.
[2] Quantity sold by producers, plus imports, minus exports.

RESERVES

The world's known reserves of high-grade soluble potash salts have been estimated to total over 37,000 million metric tons K_2O. More than 99 percent of these reserves are in western Eurasia, principally in Germany and the U. S. S. R. The reserves in Germany alone have been estimated (by Fulda) to be 20,000 million tons K_2O, and those in Russia (by Poppe) at 15,000 million tons. The combined reserves of the other Eurasian countries—Spain, France, Israel, and Trans-jordan—are placed at only 2,200 million tons. In the Western Hemisphere the United States contains the only presently known economic deposits, although substantial reserves may exist in western Canada. The potash reserves of the United States are a relatively small part of the world total—less than 0.3 percent. Latest commercial estimates place the net recoverable reserves at only 73 million short tons K_2O.

[1] Turrentine, J. W., Potash Supplies for 1948: Better Crops with Plant Food, vol. 32, No. 1, January 1948, pp. 6–8, 46–47.
Albright, H. M., Development of the Domestic Potash Industry: Min. Cong. Jour., vol. 34, No. 3, March 1948, pp. 26–29.
Turrentine, J. W., The Chemical Composition of Agricultural Potash Salts: Better Crops with Plant Food, vol. 32, No. 6, June–July, 1948, pp. 24–26, 48–49.
Senftle, F. E., The Effect of Potassium in Prospecting for Radioactive Ores: Canadian Min. Jour., vol. 69, No. 11, November 1948, pp. 55–57.

PRODUCTION AND SALES

The upward trends in the production and sales of domestic marketable potassium salts in evidence since 1934 were continued in 1948, and both were considerably larger than in 1947. Production of potassium salts in 1948 totaled 2,138,493 short tons, with an equivalent K_2O content of 1,139,881 tons. Sales were 2,148,807 tons, with an equivalent K_2O content of 1,143,339 tons. Sales of potassium salts exceeded the production in 1948, and stocks in producers' hands at the end of the year decreased from those on December 31, 1947. The value of the sales reached nearly 36 million dollars. The average value per ton of the potassium salts sold in 1948 was $16.75, $1.02 less than in 1947.

Production of both grades of muriate of potash and manure salts was larger in 1948 than in 1947. The production of sulfate of potash and sulfate of potash-magnesia continued to decline from the recent peak of 1946. (See fig. 2.)

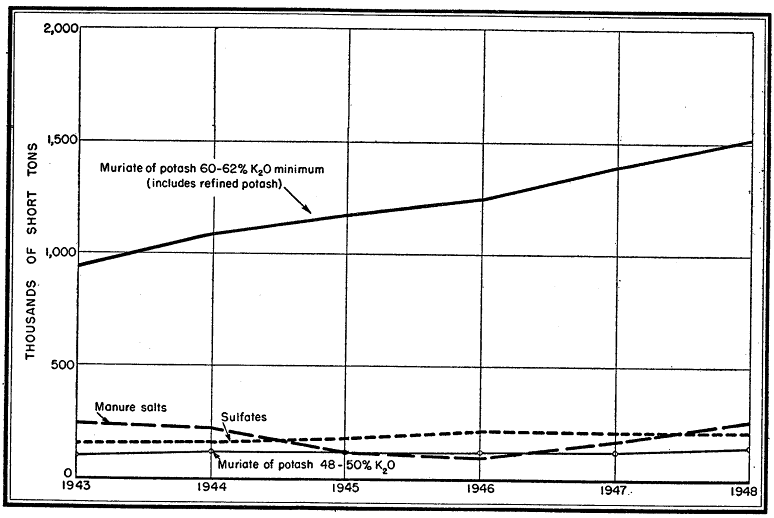

Figure 2.—Potassium salts produced in the United States, 1943–48, by grades, in short tons.

The production of the Western States remains the dominant factor in the domestic potash industry. California, New Mexico, and Utah furnished virtually all of the 1948 output, the largest part coming from the deeply buried deposits of sylvite and langbeinite, of Permian age, in the Carlsbad region, southeastern New Mexico. The eastern United States supplied only a small quantity—from well brines in Michigan and as a byproduct of cement operations in Maryland.

Potassium salts produced in the United States, 1946–48, by grades, in short tons

Grade	1946	1947	1948
Muriate of potash:			
60–62 percent K_2O minimum [1]	1,251,088	1,394,202	1,523,937
48–50 percent K_2O minimum	122,257	125,120	145,675
Manure salts	98,333	174,145	260,339
Sulfate of potash and sulfate of potash-magnesia	216,057	212,309	208,542
Total	1,687,735	1,905,776	2,138,493

[1] Includes refined potash and some 93–96 percent KCl.

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. (See fig. 3.)

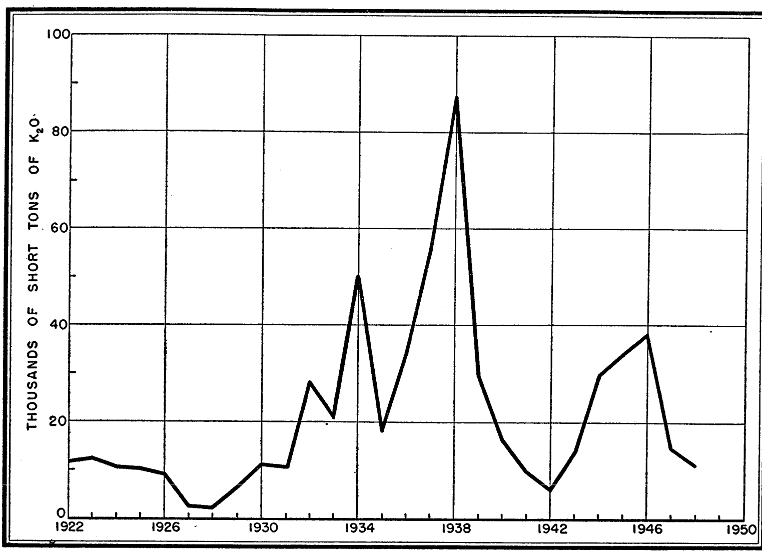

FIGURE 3.—Equivalent potash (K_2O) content in producers' stocks at end of year, 1922–48, in short tons.

Potassium salts produced, sold, and in producers' stocks in the United States, 1944–48

Year	Production			Sales				Producers' stocks, Dec. 31	
	Operators	Potassium salts (short tons)	Equivalent potash (K_2O) (short tons)	Operators	Potassium salts (short tons)	Equivalent potash (K_2O) (short tons)	Value f. o. b. plant	Potassium salts (short tons)	Equivalent potash (K_2O) (short tons)
1944	6	1,578,498	834,568	6	1,543,420	817,892	$29,487,413	76,123	29,763
1945	7	1,588,305	874,243	6	1,597,160	870,370	30,313,919	68,796	34,253
1946	7	1,687,735	931,812	7	1,673,249	928,374	32,175,716	82,554	37,999
1947	7	1,905,776	1,029,875	7	1,953,307	1,053,266	34,716,051	35,428	14,697
1948	7	2,138,493	1,139,881	7	2,148,807	1,143,339	35,998,758	25,093	11,211

The potash-producing companies in the United States in 1948, by States, were as follows:

California:
- The American Potash & Chemical Corp., 3030 West Sixth St., Los Angeles 54, Calif. (plant at Trona, on Searles Lake, Calif.).

Maryland:
- North American Cement Corp., 41 East Forty-Second St., New York, N. Y. (plant at Security, Md.).

Michigan:
- The 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 Company of America, Carlsbad, N. Mex. (mine and plant near Carlsbad, N. Mex.).
- United States Potash Co., Inc., 30 Rockefeller Plaza, New York, N. Y. (mine and plant near Carlsbad, N. Mex.).

Utah:
- Bonneville, Ltd., 540 West Seventh South, Salt Lake City 4, Utah (plant near Wendover, Utah).

REVIEW BY STATES

California.—The American Potash & Chemical Corp. remains the only potash-producing company in the Pacific Coast States. It recovers potash from the brines saturating the crystalline salt mass of Searles Lake in southeastern California; potassium chloride and potassium sulfate are marketed.

Maryland.—Maryland has but one producing potash company, the North American Cement Corp., which at its plant at Security, Washington County, near Hagerstown, recovers byproduct potash from the cement-kiln flue dust. The product, an impure sulfate of potash of low potash content, was sold for agricultural use. This operation was the only one of its kind reported in the United States in 1948.

Michigan.—The Dow Chemical Co. was the only potash-producing company in Michigan in 1948. It obtained potassium chloride from natural brine from wells at Midland, Mich.

New Mexico.—The Carlsbad region of New Mexico continued to increase its mine production of potash. Another record was made in 1948. The three companies operating in this area mined 5,108,372 short tons of sylvinite and crude langbeinite combined—an increase of 452,640 tons over 1947. The equivalent K_2O content of the mined production in 1948 was 1,069,675 short tons. The average equivalent K_2O contents of the mined salts increased from 20.74 percent in 1947 to 20.94 in 1948.

All three of the producing companies—International Minerals & Chemical Corp., Potash Company of America, and United States Potash Co.—mined sylvite (potassium chloride) and one—International Minerals & Chemical Corp.—also mined langbeinite (a 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 1948 was 1,841,054 short tons, with an equivalent K_2O content of 964,940 tons. Sales were 1,850,976 tons of salts (967,945 tons K_2O) valued at $29,177,328. Muriate of potash was produced by all three companies. Potassium sulfate and potassium-magnesium sulfate (sulfate of potash-magnesia) were produced from langbeinite by the International Minerals & Chemicals Corp., in the refinery at its mine near Carlsbad. All three producing companies had construction programs under way during 1948 to increase their output of potash salts.

Early in 1948 the Potash Company of America [2] started an extensive expansion and improvement program to include a new shaft (No. 3), a larger hoist at the No. 1 shaft, and added underground equipment—undercutter, loaders, rotary dump cars, and mine cars. The refinery is being enlarged and the flow sheet changed to include a new flotation process developed by the company staff. Apparatus to be installed include new crushing and grinding units, agitator plants, flotation machines, filters, driers, and tailing-disposal equipment. The plant for the production of high-grade potassium chloride is being enlarged. A 26-mile pipe line for fresh-water supply is to be laid.

An information circular of the Bureau of Mines [3] published in 1948 described current mining practices at the mine of the Potash Company of America.

At the mine of the United States Potash Co.,[4] a new and larger loader was put in operation underground in 1948; and a 75-foot thickener, for desliming ahead of tabling where sylvite is separated from halite, was added to the tabling plant. Haulage with a 70-ton Diesel locomotive was installed on the 16-mile company railroad between the mine and refinery.

The International Minerals & Chemical Corp. started construction early in 1948 on a new refinery at its mine near Carlsbad for the production of chemical-grade potassium chloride and for the production of an improved grade of potassium sulfate for agricultural and industrial uses. In addition, present facilities were improved to yield higher recoveries and increased capacities for all existing grades of potash salts. The new output of chemical-grade potassium chloride will serve industrial users of this grade and will also be used as the principal raw material for the firm's own potassium chlorate plant near Cincinnati. The new facilities are expected to be in operation by the spring of 1949. This will mark the entry of the company into the heavy and industrial potash chemical fields. According to the company annual report, the tonnage of potash produced in the fiscal year ended June 30, 1948, was increased over the previous year. Although the plant operated with higher wages and other increased costs, larger volume and greater efficiency provided a profit exceeding that of the previous year.

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[2] Barr, James A., Potash and Phosphate in '48: Min. Cong. Jour., vol. 35, No. 2, February 1949, pp. 115–118. Engineering and Mining Journal, New Mexico: Vol. 150, No. 4, April 1949, p. 127.

[3] Storms, Walter R., Mining Methods and Practices, Potash Company of America, Eddy County, N. Mex.: Bureau of Mines Inf. Circ. 7445, 1948, 18 pp.

[4] See footnote 2.

The underground operations of this company[5] are now completely mechanized and obtain a production of 33 to 34 tons per man per day underground. The mine is laid out on a checkerboard pattern. The face is drilled by rotary electric drills, undercut with a modified shortwall machine mounting a 9-foot bar, and blasted using "fast-delay" caps; the potash salt is loaded by machine into shuttle cars for panel haulage to main-line haulage by steel cars and electric locomotives. The mine cars are dumped by a rotary dump into a feeder hopper followed by a single-roll crusher. The crushed ore is transferred to skips by an automatic measuring pocket. This operation is more or less typical of the local practice.

The Duval Texas Sulphur Co. is reported to have drilled 32 holes in the New Mexico potash field in 1948. The Southwest Potash Co. and Wills & Weaver were new companies active in the Carlsbad area. The Continental Potash Co. continued experiments in solution mining of potash deposits by subsurface leaching methods.

The work of the Bureau of Mines, United States Department of the Interior, was described in an article published early in 1948.[6]

Utah.—Commercial production of potash in Utah in 1948 was restricted to the potassium-bearing brines of Salduro Marsh, where Bonneville, Ltd., continued to produce potassium chloride at its plant near Wendover, Tooele County, northwestern Utah. The output of the plant is reported[7] to have been about 60,000 tons of potassium chloride in 1948, and 60 persons are said to have been employed in the operations. The crude evaporated material contains potassium chloride and common salt. After separation, the potassium chloride is sent to southern and western markets, and the salt is hauled away as waste.

Prospecting for potash is reported to have continued in eastern Utah in connection with oil-well drilling, and the old Defense Plant Corporation well near Crescent Junction is said to have been sunk a little deeper.

There was no production of alunite in the Marysvale district.

CONSUMPTION

Apparent consumption of potash (K_2O) in the United States and its possessions increased from 1,011,142 short tons in 1947 to 1,100,787 tons in 1948, as determined by subtracting exports from the sum of the imports and the producers' sales. The relationship of the apparent consumption to sales of domestic producers, as reported to the Bureau of Mines, for a period of years is shown in figure 4.

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[5] See footnote 2.

[6] Storms, W. R., U. S. Bureau of Mines Work in New Mexico: New Mexico Miner and Prospector, vol. 10, No. 3, March 1948, p. 1.

[7] Engineering and Mining Journal, Utah: Vol. 150, No. 4, April 1949, pp. 125–126.

According to the American Potash Institute,

Deliveries of potash in North America continued their upward trend during 1948, when the five leading producers and three importers delivered 2,202,036 tons of potash salts containing an equivalent of 1,173,842 tons K_2O. * * * European potash salts of French and German origin totaling 69,455 tons of salts, with an equivalent of 40,069 tons K_2O, delivered in the United States and Canada, are included in these figures. Importations of potash of Russian origin are not included.

Deliveries for agricultural purposes in the continental United States for 1948 were 977,381 tons K_2O, an increase of 79,231 tons over 1947. Canada received 62,198 tons K_2O, Cuba 3,982 tons, Puerto Rico 19,471 tons, and Hawaii 9,153 tons. Exports to other countries amounted to 13,631 tons K_2O.

In this country the potash was delivered to 45 States and the District of Columbia. Georgia and Ohio were practically tied for the leading position in deliveries of agricultural potash at about 88,550 tons K_2O, followed in order by Illinois, Virginia, North Carolina, and Florida, each taking more than 60,000 tons K_2O during the year. Due to shipments across State lines consumption does not necessarily correspond to deliveries within a State.

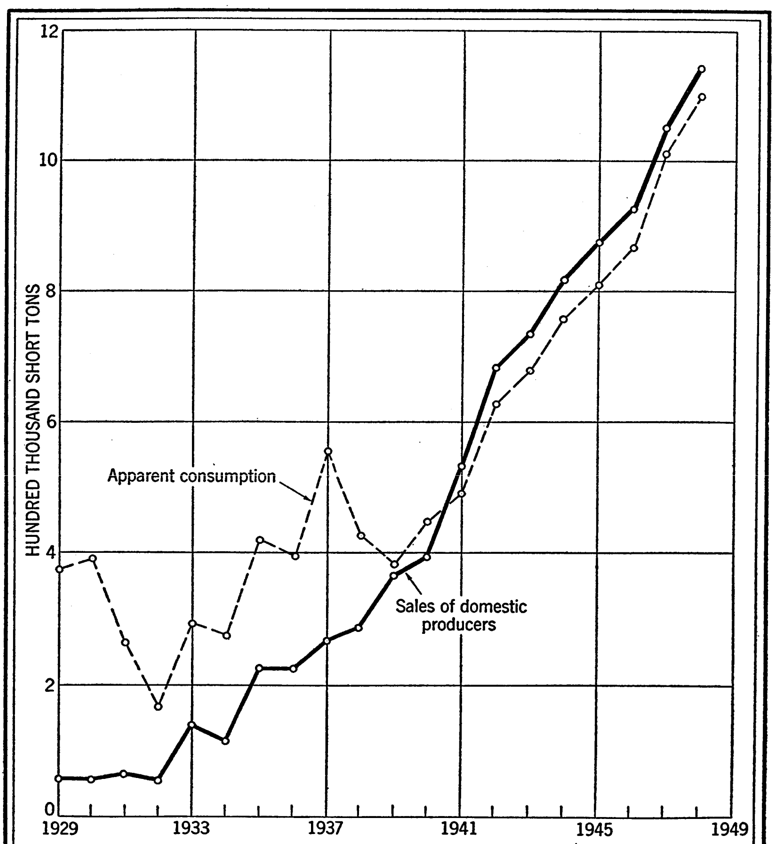

FIGURE 4.—Comparison of apparent domestic consumption of potash (K_2O) and sales by domestic producers of potash in the United States, 1929–48.

The 60 percent muriate of potash continued to be by far the most popular material, comprising 79 percent of the total K_2O delivered for agricultural purposes. The 50 percent muriate of potash made up 7 percent of the total, manure salts 6 percent, and sulphate of potash and sulphate of potash magnesia 8 percent. This was about the same pattern of distribution as in 1947.

Deliveries for chemical purposes [in 1948 in United States and Canada] were 132,787 tons of muriate of potash containing an equivalent of 83,353 tons K_2O and 9,031 tons of sulfate of potash containing 4,673 tons K_2O. The total chemical deliveries of 88,026 tons K_2O were 5,319 tons or 6 percent more than in 1947.

Deliveries of agricultural potash salts in 1948, by States of destination, in short tons of K_2O

[American Potash Institute]

Georgia	88, 547	Massachusetts	12, 218
Ohio	88, 533	Minnesota	12, 098
Illinois	83, 111	Texas	9, 873
Virginia	69, 676	Missouri	7, 373
North Carolina	68, 940	Washington	4, 770
Florida	60, 412	Connecticut	4, 570
Indiana	54, 472	Delaware	3, 863
Maryland	50, 928	Oregon	3, 060
South Carolina	50, 895	Colorado	910
Alabama	37, 809	Oklahoma	863
Tennessee	33, 283	Arizona	742
New Jersey	32, 959	North Dakota	587
Wisconsin	22, 146	Nebraska	509
Pennsylvania	20, 203	Vermont	322
California	19, 568	West Virginia	316
Louisiana	19, 338	Kansas	313
Mississippi	19, 079	Utah	288
Arkansas	19, 057	Idaho	267
New York	17, 883	New Mexico	250
Maine	15, 934	Montana	176
Michigan	15, 276	District of Columbia	119
Iowa	13, 403	Nevada	50
Kentucky	12, 352	New Hampshire	40

Deliveries of chemical potash salts in 1948, by States of destination, in short tons of K_2O

[American Potash Institute]

New York	61, 612	Oregon	600
West Virginia	4, 517	Georgia	575
California	4, 002	Kansas	532
Texas	3, 814	Tennessee	369
New Jersey	2, 411	Iowa	293
Ohio	2, 042	Oklahoma	292
Maryland	1, 683	Missouri	188
Virginia	901	Connecticut	181
Nevada	709	Massachusetts	87
Illinois	696	Florida	60
Michigan	675	Washington	50
Delaware	605	Kentucky	25
Pennsylvania	603	Wisconsin	24

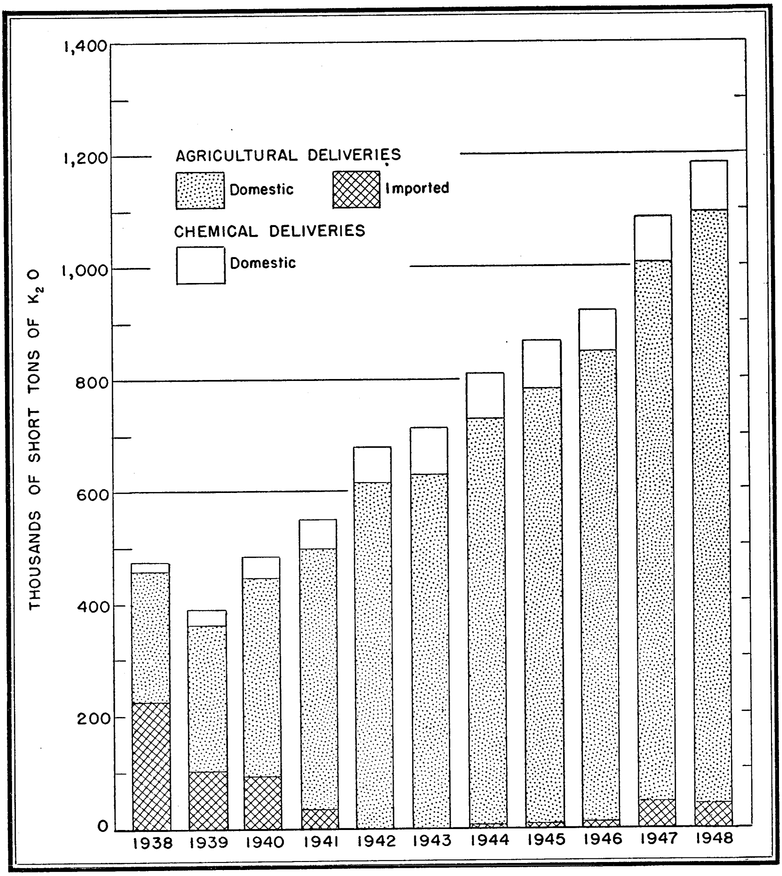

FIGURE 5.—Potash deliveries, by use groups, in North America, 1938–48 (American Potash Institute).

Deliveries of agricultural and chemical potash in North America from 1938 to 1948 are shown in the accompanying diagram (fig. 5) furnished by the American Potash Institute.

PRICES

Prices for potash at the beginning of 1948 were those listed in the producers' price schedules for the 1947–48 season (see Potash chapter, Minerals Yearbook, 1947 pp. 1013–1014.). On February 6, 1948, however, the American Potash & Chemical Corp. announced an increase in the price of Trona muriate of potash from 45.5 to 48.5 cents per unit K_2O, in bulk, f. o. b. cars Trona, Calif., effective February 10, 1948, the first increase reported in 7 years. On March 9, 1948, this company withdrew and canceled the above increase and announced that the price, terms, and conditions in its price schedule dated May 1, 1947, for Trona muriate of potash (45.5 cents per unit K_2O) would remain effective until May 31, 1948. On May 3, 1948, the company issued its regular price schedule for the period June 1, 1948, to May 31, 1949, for Trona muriate of potash for agricultural purposes, retaining its price at 45.5 cents per unit K_2O. On February 6, 1948, the American Potash & Chemical Corp. issued a supplementary price schedule raising the price of Trona sulfate of potash 95–98 percent K_2SO_4, from 74 to 79 cents per unit K_2O in bulk, f. o. b. cars, Trona, Calif., effective February 10, 1948. The regular schedule, issued on May 3, 1948, continued this price from June 1, 1948, to May 31, 1949.

Regular price schedules for New Mexico potash for agricultural purposes for the 1948–49 season were issued in April and May 1948 by the three producing companies. The quotations, based f. o. b. cars seller's plant Carlsbad, N. Mex., in bulk per ton of 2,000 pounds, minimum carlots of 40 tons, were:

Muriate of potash (62 to 63 percent K_2O)	37.5 cents per unit K_2O.
Muriate of potash (60 percent K_2O minimum)	
Muriate of potash (48 to 52 percent K_2O)	
Muriate of potash (50 percent K_2O minimum)	
Manure salts (22 percent K_2O minimum)	20 cents per unit K_2O
Manure salts (run-of-mine 20 percent K_2O minimum)	
Sulfate of potash (90 to 95 percent K_2SO_4, basis 90 percent K_2SO_4)	\$32.50 per short ton
Sulfate of potash-magnesia (basis 40 percent K_2SO_4, 18.50 percent MgO)	\$14.50 per short ton.

Sales of imported potash were reported in trade journals at 95 cents to \$1.20 per unit K_2O at Atlantic coast ports.

FOREIGN TRADE [8]

Imports.—Imports of potash salts in 1948 were only slightly larger than in 1947, rising from 51,043 short tons in 1947 to 52,890 tons in 1948, as a result of increased importations of potassium bitartrate. The total value of imports also increased, rising from \$2,475,351 in 1947 to \$3,063,577 in 1948. Russia, Germany, France, and Belgium-Luxembourg, in the order given, were the principal sources of the imports in 1948.

Potash for fertilizer use constituted 96 percent of the total K_2O imports in 1948, slightly less than in the previous year. Imports for chemical use rose from 3 percent in 1947 to 4 percent of the total in 1948.

The principal potash salt imported in 1948 for fertilizer use was the muriate (chloride), which came from the U. S. S. R., France, Belgium-Luxembourg, Germany, and Canada. A large tonnage of crude potassium sulfate came from Germany in 1948, a little more than in the previous year. Imports of the bitartrate increased markedly.

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

Early in 1948 the officers and the directors of the Pioneer Potash Corp., vested as an alien concern in 1943, were ordered by the Office of Alien Property Custodian to complete proceedings under a certificate of dissolution issued by Delaware. The order called for the payment of current and closing expenses and all accruing taxes and the setting aside of $25,000 as a reserve for legal fees owed. All remaining funds and property are to be transferred to the Attorney General.

Potash materials imported for consumption in the United States, 1947–48

[U. S. Department of Commerce]

Material	Approximate equivalent as potash (K_2O) (percent)	1947				1948			
		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:									
Manure salts	31.4	-------	-------	-------	----------	43	14	0.1	$1,938
Muriate (chloride)	56.4	35,284	19,900	76.6	$1,321,367	35,604	20,081	73.9	1,736,324
Potassium nitrate, crude	40.0	(1)	(1)	-------	26	(1)	(1)	-------	43
Potassium-sodium nitrate mixtures, crude	14.0	2,500	350	1.4	64,968	-------	-------	-------	---------
Potassium sulfate, crude	50.0	10,031	5,016	19.3	501,410	11,805	5,903	21.7	599,722
Other potash fertilizer material [2]	6.0	-------	-------	-------	----------	63	4	-------	2,415
Total fertilizer	-------	47,815	25,266	97.3	1,887,771	47,515	26,002	95.7	2,340,442
Used chiefly in chemical industries:									
Bicarbonate	46.0	-------	-------		---------	6	3		924
Bitartrate:									
Argols	20.0	2,820	564		430,271	4,818	964		485,949
Cream of tartar	25.0	117	29		69,408	360	90		143,396
Carbonate	61.0	10	6		7,294	4	2		2,157
Caustic	80.0	33	26	2.7	13,538	90	72	4.3	37,197
Chlorate and perchlorate	36.0	200	72		25,848	42	15		9,073
Cyanide	70.0	22	2		17,948	25	18		11,204
Ferricyanide	42.0	-------	-------		---------	11	5		16,692
Nitrate	46.0	(1)	(1)		1	(1)	(1)		150
Permanganate	29.0	(1)	(1)		75	-------	-------		--------
All other	50.0	26	13		23,197	19	10		16,393
Total chemical	-------	3,228	712	2.7	587,580	5,375	1,179	4.3	723,135
Grand total	-------	51,043	25,978	100.0	2,475,351	52,890	27,181	100.0	3,063,577

[1] Less than 1 ton.
[2] Chiefly wood ashes from Canada.

Potash materials imported for consumption in the United States, 1947–48, by countries, in short tons

[Figures in parentheses in column headings indicate, in percent, approximate equivalent as potash (K_2O)]
[U. S. Department of Commerce]

Country	Caustic hydroxide (80)	Muriate (chloride) (56.4)	Bitartrate: Argols or wine lees (20)	Bitartrate: Cream of tartar (25)	Potassium sulfate, crude (50)	Potassium sodium nitrate mixtures, crude (14)	Chlorate and perchlorate (36)	All other [1]	Total: Short tons	Total: Value
1947										
Argentina			1						1	$75
Belgium and Luxembourg		14,466						6	14,472	455,550
Canada		224	6						230	11,164
Chile						2,500	10		2,510	66,664
China								9	9	6,634
Cuba				8					8	5,292
France		18,922					118		19,040	792,946
Germany		1,672			10,031				11,703	584,997
Hong Kong								1	1	776
Italy			2,036	32					2,068	335,897
Morocco, French			60						60	7,675
Portugal			274	39					313	70,462
Spain				38					38	21,751
Sweden	33								33	13,523
Switzerland							53		53	7,516
Tunisia			443						443	56,432
U. S. S. R.							19		19	2,488
United Kingdom				(2)				42	42	35,509
Total	33	35,284	2,820	117	10,031	2,500	200	58	51,043	2,475,351
1948										
Algeria			882						882	77,736
Belgium and Luxembourg		8,775							8,775	396,758
Canada		1,032						106	1,138	58,773
Denmark								(2)	(2)	15
Chile			22				42		64	11,879
China								4	4	2,118
Czechoslovakia								6	6	924
France		9,097	11						9,108	411,216
Germany		2,425			11,805				14,230	695,994
Hong Kong								(2)	(2)	89
Italy			3,480	242					3,722	436,919
Morocco, French			167						167	21,418
Portugal			246	23					269	35,068
Spain		(2)		95					95	42,153
Sweden	90								90	37,068
Tunisia			10						10	10,890
U. S. S. R.		14,275							14,275	780,142
United Kingdom								55	55	44,387
Total	90	35,604	4,818	360	11,805		42	171	52,890	3,063,547

[1] Approximate equivalent as potash (K_2O)—1947: 49 percent; 1948: 44 percent.
[2] Less than 1 ton.

Exports.—The total value of the export trade in potash materials declined from $8,686,107 in 1947 to $8,288,955 in 1948, the increase in the value of the fertilizer materials failing to compensate for the decline in value of exports of potash chemicals. The exports of both fertilizer and chemical potash salts were widely distributed. Fertilizer materials went largely to Canada, with much smaller quantities to numerous other countries, mostly in the Western Hemisphere. Exports of chemical potash salts were more uniformly distributed.

Canada was the leading recipient, but large quantities went to several European countries—Belgium-Luxembourg, Italy, Netherlands, Switzerland, and Germany.

Potash materials exported from the United States, 1944–48

[U. S. Department of Commerce]

Year	Fertilizer		Chemical		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1944	110,057	$3,139,631	15,444	$3,142,096	125,501	$6,281,727
1945	104,687	2,986,990	18,966	3,648,795	123,653	6,635,785
1946	96,822	2,983,751	23,905	5,055,441	120,727	8,039,192
1947	102,939	3,251,645	21,970	5,434,462	124,909	8,686,107
1948	104,176	3,498,240	23,892	4,790,715	128,068	8,288,955

Potash materials exported from the United States, 1947–48, by countries

[U. S. Department of Commerce]

Country	Fertilizer				Chemical			
	1947		1948		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Argentina	50	$1,888	50	$3,375	1,274	$361,299	780	$187,758
Australia	----	----	----	----	1,319	212,214	899	142,845
Austria	----	----	----	----	9	2,285	237	71,792
Barbados	5,794	222,554	3,614	161,116	----	----	----	----
Belgium and Luxembourg	----	----	----	----	771	346,634	1,899	387,099
Brazil	6,002	257,651	9,873	464,045	2,577	507,127	1,804	357,111
Canada	71,968	2,088,021	73,500	2,186,206	3,840	549,524	4,711	590,942
Chile	----	----	----	----	155	44,969	119	35,460
China	6	2,160	----	----	1,433	368,095	1,261	317,647
Colombia	1,960	77,971	1,058	41,661	852	190,538	1,033	216,977
Cuba	8,614	284,874	8,294	295,820	166	53,838	215	55,823
Denmark	----	----	----	----	4	6,623	147	29,301
Dominican Republic	465	17,144	1,070	64,367	7	4,270	55	7,359
Germany	----	----	----	----	----	----	871	201,440
Greece	----	----	----	----	262	55,583	138	39,372
Guatemala	----	----	1	95	125	47,763	104	24,871
Hong Kong	----	----	----	----	979	234,323	675	152,123
Iceland	651	25,792	849	39,576	43	9,474	13	3,188
India	----	----	----	----	697	191,752	1,101	218,343
Italy	----	----	----	----	99	44,334	1,433	254,103
Jamaica	454	16,019	1,453	60,496	12	3,467	15	3,810
Leeward Islands	300	11,161	961	40,081	2	676	----	----
Mexico	1,864	53,407	1,451	46,398	1,608	358,303	1,029	273,548
Netherlands	----	----	----	----	634	241,284	1,670	329,456
New Zealand	2,550	93,131	----	----	119	25,908	58	10,280
Norway	----	----	----	----	141	30,611	75	21,237
Peru	----	----	----	----	166	57,436	82	27,563
Philippines, Republic of	747	32,841	529	26,616	137	33,371	77	23,102
Portugal	----	----	15	1,440	184	72,230	131	29,340
Sweden	2	200	----	----	601	169,101	89	30,558
Switzerland	----	----	----	----	851	398,662	1,299	255,636
Trinidad	914	38,518	221	10,444	50	14,539	11	2,243
Turkey	----	----	----	----	579	125,037	294	55,230
Union of South Africa	----	----	----	----	457	120,210	424	101,830
United Kingdom	50	7,760	----	----	622	122,175	158	37,072
Uruguay	----	----	348	13,661	75	22,796	86	28,162
Venezuela	108	4,451	551	29,231	182	84,689	133	45,565
Yugoslavia	----	----	----	----	160	29,984	1	369
Other countries	440	16,102	338	13,612	778	293,338	765	222,160
Total	102,939	3,251,645	104,176	3,498,240	21,970	5,434,462	23,892	4,790,715

WORLD REVIEW

The available statistics of potash output in the various producing countries, as well as an estimated total of world production, is shown in the accompanying table.

World production of potassium salts and equivalent K_2O, by countries, 1943–48, in metric tons [1]

[Compiled by Pauline Roberts]

Country [1]	1943		1944		1945	
	Potassium salts	Equivalent K_2O	Potassium salts	Equivalent K_2O	Potassium salts	Equivalent K_2O
North America: United States, potassium salts	1,296,215	670,534	1,431,982	757,103	1,440,879	793,096
South America: Chile, crude potassium nitrate	63,828	(2)	(2)	(2)	(2)	(2)
Europe:						
France (Alsace), crude potassium salts	4,195,111	664,497	2,951,355	466,657	855,730	144,701
Germany, crude potassium salts (carnallite, kieserite, kainite, sylvinite, and hartsalz)	16 976 952	2,086,639	15,861,933	1,925,530	(2)	(2)
Spain, crude potassium salts (salable)	439,657	87,380	675,836	115,830	710,496	[3] 113,700
Asia:						
China	3,048	(2)	1,732	(2)	(2)	(2)
India, nitrate of potash [4]	2,358	1,219	2,152	1,118	3,280	(2)
Korea, alunite	(2)	(2)	18,951	(2)	(2)	(2)
Palestine and Israel, crude potassium salts [5]	93,750	46,900	105,050	52,500	93,625	46,800
Australia, alunite	435	33	20,185	351	22,616	462
Total (estimated)		3,800,000		3,400,000		1,500,000

Country [1]	1946		1947		1948	
	Potassium salts	Equivalent K_2O	Potassium salts	Equivalent K_2O	Potassium salts	Equivalent K_2O
North America: United States, potassium salts	1,531,079	845,321	1,728,882	934,282	1,939,998	1,034,077
South America: Chile, crude potassium nitrate	(2)	(2)	(2)	(2)	(2)	(2)
Europe:						
France (Alsace), crude potassium salts	3,558,760	574,495	3,908,300	711,200	(6)	769,000
Germany, crude potassium salts (carnallite, kieserite, kainite, sylvinite, and hartsalz)	(6)	955,400	[7] 3,284,000	[7] 322,000	[7] 5,085,000	[7] 511,000
Spain, crude potassium salts (salable)	365,207	135,479	622,153	153,652	(6)	151,914
Asia:						
China	(2)	(2)	1,000	(2)	(2)	(2)
India, nitrate of potash [4]	6,466	(2)	(2)	(2)	(2)	(2)
Korea, alunite	(2)	(2)	(2)	(2)	(2)	(2)
Palestine and Israel, crude potassium salts [5]	90,571	45,300	123,163	61,600	(2)	(2)
Australia, alunite	36,427	583	35,288	[3] 1,783	39,759	1,807
Total (estimated)		2,700,000		3,000,000		3,000,000

[1] In addition to countries listed, Eritrea, Iran, Italy, Poland, and U. S. S. R. are reported to produce potash salts, but statistics of production are not available; estimates by senior author of chapter included in total.
[2] Data not available; estimate by author of the chapter included in total.
[3] Estimate.
[4] Exports plus consumption, 1943–44; exports only, 1945–46.
[5] Extracted from waters of Dead Sea.
[6] Data not available.
[7] Bizonal area only.

Canada.—The Provincial Department of Natural Resources, Saskatchewan, announced early in 1948 that it was prepared to receive applications from companies wishing to develop the recently discovered potash deposits in that Province. The leasable area covers 350,000 acres. A description of the deposits was published.[9]

France.—Exploitation has started of the extensive potash deposits discovered several years ago near Dax in southwestern France. The output is reported to be about 100 metric tons daily.

Palestine and Israel.—Potash operations in the Dead Sea area were interfered with in 1948 by the conflict between the newly created State of Israel and that of Trans-Jordan. The 25-year mandate over Palestine, which Great Britain had held since 1923, was ended at midnight May 14, 1948. The Jewish State of Israel was established in Palestine and immediately recognized by the United States. A few weeks before this mandate terminated, the Palestine Government discontinued its convoys of motor traffic from the Dead Sea to Jerusalem. Without convoys, it was impossible for Palestine Potash, Ltd., to transport supplies and fuel from the railhead at Jerusalem to its works at the north end of the Dead Sea and to transport its finished products from the Dead Sea to the railhead at Jerusalem, and production operations had to be suspended. Meetings of representatives of the Trans-Jordan Government and Palestine Potash, Ltd., were held at the north end of the Dead Sea on May 13 and May 17, 1948. At the second meeting the representatives of the Trans-Jordan Government insisted that the company employees and plant, including the installations and personnel at the south end of the Dead Sea, should be put into their hands. The Israeli Government declined to accept the proposed terms, and instructed the company employees to evacuate the northern plant. This was done, and before withdrawal, supplies were destroyed, machinery rendered unusable, and the company motorboats and barges taken to the south end of the sea. The armed forces of Trans-Jordan occupied the northern works 2 days later and were still in control of the area at the end of the year. It is reported that these works have been looted and dismantled by the Arabs after their occupation of the area. The southern plant is in the territory allocated to Israel by the partition decision of the General Assembly of the United Nations in 1948. This plant at the end of that year was in the hands of the Israeli army. It has been damaged only slightly. Its fresh-water supply system, which is located in Trans-Jordan, has been put out of operation by the Arabs.[10]

United Kingdom.—Drilling operations in a search for potassium-bearing brines are being carried on at Lowdale, Sleights, Yorkshire, England, for the Imperial Chemical Industries, Ltd. The brine, if found, will be conveyed 20 miles by pipe line to the new I. C. I. works at Wilton.

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[9] Cole, L. Heber, Potash Discoveries in Western Canada: Canadian Min. and Met. Bull., vol. 41, No. 431, March 1948, pp. 149–158. An abstract of this paper was published in The Precambrian, vol. 21, June 1948, No. 6, pp. 4–8.

[10] Palestine Potash Limited, acting chairman's speech to the 18th Annual General Meeting, Dec. 17, 1948, 2 pp. Baroway, Aaron, vice-president and secretary, Palestine Economic Corp., communication to Director, Bureau of Mines, Sept. 23, 1948.

Salines—Miscellaneous[1]

By JOSEPH C. ARUNDALE AND F. M. BARSIGIAN[2]

GENERAL SUMMARY

OPERATION of industry at high levels during 1948 brought sales of calcium chloride, soda ash, and salt cake to new records. Sales of bromine were below the wartime rate, but volume was large for peacetime. Iodine imports were greatly reduced, but domestic production supplied an increasing proportion of domestic demand. Production of boron minerals declined slightly as demand slackened.

CALCIUM CHLORIDE

A new record again was established in 1948 in sales of calcium chloride (and calcium-magnesium chloride) produced from natural brines.

No accurate use pattern is available for calcium chloride. However, its hygroscopic and antifreeze properties are utilized in stabilizing gravel or soil road surfaces, dustproofing coal, assisting the curing of concrete, in ice control on roads, as an antifreeze for ores and other material in stock piles or in transit, in refrigeration brines, and as a dehumidifier in storage areas, basements, etc. The use of calcium chloride for dust control in coal mines has increased considerably during the past few years.

Calcium chloride and calcium-magnesium chloride from natural brines sold by producers in the United States, 1944–48

[In terms of 75 percent (Ca, Mg) Cl_2]

Year	Short tons	Value	Year	Short tons	Value
1944	200,964	$1,621,227	1947	271,206	$2,650,205
1945	218,320	1,818,219	1948	301,936	3,902,788
1946	262,147	2,278,954			

[1] Former editions of this chapter included a section titled Magnesium Compounds, which now appear as a separate chapter.

[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.

The following companies produced calcium chloride (and calcium-magnesium chloride) from natural brines in 1948: California Rock Salt Co., 2436 Hunter Street, Los Angeles 21, Calif., plant at Amboy, Calif.; Hill Bros. Chemical Co., 2159 Bay Street, Los Angeles 21, Calif., plant at Amboy, Calif.; Desert Properties Co., Frank Thomas, receiver, 374 Court Street, San Bernardino, Calif., plant at Amboy, Calif.; Michigan Chemical Corp., 500 North Bankson, St. Louis, Mich.; Rademaker Chemical Corp., Eastlake, Mich.; Dow Chemical Co., Midland, Mich.; Pomeroy Salt Corp., Pomeroy, Ohio, plant at Minersville, Ohio; Westvaco Chemical Division, Food Machinery & Chemical Corp., South Charleston 3, W. Va.; and Liverpool Salt Co., Hartford, W. Va.

Calcium chloride imported for consumption in and exported from the United States, 1944–48

[U. S. Department of Commerce]

Year	Imports		Exports	
	Short tons	Value	Short tons	Value
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
1947	250	5,514	11,955	502,818
1948	5	249	11,456	437,763

BROMINE

Sales of bromine compounds were moderately lower but still well above the prewar rate. The bulk of the bromine sold was in the form of the compound ethylene dibromide for use in gasoline antiknock compounds.

A booklet describing a long list of bromine products was published by the Dow Chemical Co.[3] The Bureau of Entomology and Plant Quarantine amended its regulations to permit the use of methyl bromide as a fumigant for the treatment of cottonseed from certain counties in Texas, Oklahoma, and New Mexico that were found to be lightly infested with the pink bollworm. The chemical treatment would be in lieu of the heat treatment used in the past.[4]

The Ethyl-Dow Chemical Co. recovered bromine from sea water at Freeport, Tex., and the Westvaco Chemical Division of Food Machinery & Chemical Corp. recovered bromine from sea water at Newark, Calif. American Potash & Chemical Corp. produced bromine from the brine of Searles Lake at Trona, Calif. The following recovered bromine from well brines: Michigan Chemical Corp., St. Louis, Mich.; Great Lakes Chemical Corp., Filer City, Mich.; Morton Salt Co., Manistee, Mich.; Rademaker Chemical Corp., Eastlake, Mich.; Dow Chemical Co., Midland, Mich.; Westvaco Chemical Division, Food Machinery & Chemical Corp., South Charleston, W. Va.

[3] Dow Chemical Co., Bromine and Bromine Products: Midland, Mich., 1947, 103 pp.
[4] Oil, Paint and Drug Reporter, vol. 153, No. 25, June 21, 1948, p. 3.

According to Oil, Paint and Drug Reporter, potassium and sodium bromides, U. S. P., barrels, were quoted at 33–34 cents a pound at the end of 1948. This represented no change from the previous year. Bromine in lead-lined drums, carlots, delivered, was 19 cents a pound.

Imports of bromine and bromine compounds totaled 102 pounds, whereas 1,054,523 pounds valued at $432,992 were exported.

Bromine and bromine in compounds sold or used by producers in the United States, 1944–48

Year	Pounds	Value	Year	Pounds	Value
1944	102,112,462	$19,712,819	1947	78,177,650	$14,837,104
1945	79,709,857	14,796,229	1948	76,047,551	14,844,152
1946	42,780,925	8,560,434			

Bromine and bromine compounds sold by primary producers in the United States, 1947–48

	1947			1948		
	Pounds		Value	Pounds		Value
	Gross weight	Bromine content [1]		Gross weight	Bromine content [1]	
Elemental bromine	2,316,192	2,316,192	$358,374	3,300,496	3,300,496	$478,849
Sodium bromide	1,225,213	951,377	235,091	746,121	579,363	194,924
Potassium bromide	3,015,145	2,024,670	608,577	2,129,764	1,430,136	547,362
Ammonium bromide	509,163	415,375	118,047	370,975	302,641	105,906
Other including ethylene dibromide	85,597,321	72,470,036	13,517,015	83,791,199	70,434,915	13,517,111
Total	92,663,034	78,177,650	14,837,104	90,338,555	76,047,551	14,844,152

[1] Calculated as theoretical bromine content present in compound.

IODINE

Dow Chemical Co., Midland, Mich., and Deepwater Chemical Co., Ltd., Compton, Calif., recovered iodine from waste oil-well brines in California. As there were only two producers during 1948 statistics on domestic production of iodine may not be published. In 1937 domestic output totaled nearly 300,000 pounds and in recent years has supplied an increasing proportion of the iodine consumed in the United States.

The other important source of iodine is Chile, where crude iodine is recovered as a byproduct in the nitrate operations. Iodine from Chile is imported and distributed by Chilean Nitrate Sales Corp.

Exports of iodine and its compounds during 1948 totaled 271,459 pounds valued at $550,493. Imports of crude iodine are characteristically erratic and generally bear little relation to current consumption rates. Large stocks of crude iodine are maintained in consuming countries, principally the United States, and consumption is reflected only in long-term averages of imports. Imports of crude iodine are shown in the accompanying table.

Crude iodine imported for consumption in the United States, 1944–48

[U. S. Department of Commerce]

Year	Pounds	Value	Year	Pounds	Value
1944	1,204,303	$1,321,274	1947	2,260,506	$2,756,888
1945	220,526	232,070	1948	592,136	847,752
1946	886,578	976,190			

The results of a Bureau of Mines survey of iodine consumption are shown in an accompanying table.

Crude iodine consumed in the United States in 1948

Compound manufactured	Number of plants	Crude iodine consumed	
		Pounds	Percent of total
Resublimed iodine	5	96,472	10
Potassium iodide	7	799,619	80
Sodium iodide	3	37,898	4
Other [1]	[2] 5	59,072	6
Total	[2] 8	993,061	100

[1] Includes ammonium iodide, cadmium iodide, and other iodine products.
[2] A plant producing more than 1 product is counted but once in arriving at total.

Some interesting results of tests of the combined effect of potassium iodide and streptomycin against tuberculosis in guinea pigs were published.[5] A large amount of technical data and other information on iodine is available from the Iodine Educational Bureau, 12 Stone House, Bishopsgate, London, E. C. 2. The organization is sponsored by the principal Chilean iodine producers.

According to the Oil, Paint and Drug Reporter, the price of crude iodine, kegs, ex-warehouse Staten Island, remained at $1.729 per pound throughout the year. The price of resublimed iodine in bottles or jars ranged from $2.35 to $2.65 per pound.

SODIUM COMPOUNDS

Sodium Carbonate.—The serious shortage of alkalies that had existed for several years continued into the first part of 1948. However, later in 1948, demand lessened somewhat, and completion of most of the proposed expansions in the alkali-producing industry brought a condition of local oversupply to the market.

Sales of natural sodium carbonate by producers in California were slightly less than in the previous year. Production from Wyoming, statistics on which the Bureau of Mines is not at liberty to publish, added to the total available.

The problem of export control of soda ash, which was extremely serious at the first of 1948, largely disappeared by the end of the year. Quota restrictions on natural soda ash were lifted in the second quarter, and those on manufactured soda ash were removed several months later, although both products were still exported under license control.

[5] Woody, Edgar, Jr., and Avery, Roy C., The Combined Effect of Potassium Iodide and Streptomycin on Established Tuberculosis in Guinea Pigs: Science, vol. 108, No. 2810, Nov. 5, 1948, pp. 501–502.

Natural sodium sulfates and sodium carbonates sold or used by producers in the United States, 1944–48

Year	Sodium sulfates [1]		Sodium carbonates [2]	
	Short tons	Value	Short tons	Value
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
1947	257,294	3,329,094	293,051	5,862,178
1948	265,862	4,248,613	[3] 288,769	[3] 6,623,280

[1] Tonnage figures for sulfates include Glauber's salt converted to 100 percent Na_2SO_4 basis.
[2] Soda ash and trona.
[3] Exclusive of production in Wyoming.

Natural soda ash was produced in California by the following companies in 1948: American Potash & Chemical Corp., Trona, Calif.; Natural Soda Products Co., 506 Central Tower Building, San Francisco 3, Calif., plant at Keeler; Permanente Metals Corp., Kaiser Building, Oakland 12, Calif., plant at Lone Pine; Pittsburgh Plate Glass Co., Columbia Chemical Division, Bartlett, Calif.; and West End Chemical Co., 608 Latham Square Building, Oakland 12, Calif., plant at Westend. Westvaco Chemical Division, Food Machinery & Chemical Corp., Box 872, operated its underground trona mine at Green River, Wyo.

The price of soda ash, light, calcined, bags, carlots, works, was quoted at $1.30 to $1.40 a hundredweight in 1948, according to Oil, Paint and Drug Reporter. The 1947 price was $1.20 to $1.30.

Although a new record was established in 1948, the relatively small increase does not fully reflect the magnitude of expansion in the industry. It has been estimated that capacity would approximate 5,000,000 tons in 1948. Output of some plants was restricted by strikes and a shortage of fuel for a time during the year.

The bulk of the soda ash produced is manufactured by the ammonia-soda process. Production of that type sodium carbonate, according to the Bureau of the Census, was: 1944, 4,538,398 short tons; 1945, 4,375,017; 1946, 4,284,231; 1947, 4,519,144; and 1948, 4,575,452 tons.

The consumption pattern of sodium carbonate, as estimated by Chemical Engineering, is shown in the accompanying table.

Estimated consumption of sodium carbonate in the United States, 1944–48, by industries, in short tons

[Chemical Engineering]

Industry	1944	1945	1946	1947	1948
Glass	1,290,000	1,320,000	1,400,000	1,440,000	1,370,000
Soap	162,000	150,000	120,000	135,000	127,000
Caustic and bicarbonate	1,033,000	1,114,000	1,128,000	[1] 1,127,000	1,137,000
Other chemicals	1,025,000	960,000	910,000	1,030,000	1,030,000
Cleansers and modified sodas	100,000	110,000	125,000	130,000	135,000
Pulp and paper	170,000	175,000	190,000	220,000	230,000
Water softeners	110,000	100,000	90,000	100,000	110,000
Petroleum refining	22,000	24,000	20,000	22,000	24,000
Textiles	61,000	68,000	77,000	71,000	69,000
Nonferrous metallurgy	320,000	200,000	140,000	190,000	210,000
Exports	79,000	70,000	67,000	[1] 107,000	230,000
Miscellaneous	320,000	290,000	223,000	[1] 228,000	208,000
Total	4,692,000	4,581,000	4,490,000	4,800,000	4,880,000

[1] Revised figure.

Sodium Sulfate.—Sales of 265,862 short tons of natural sodium sulfates by domestic producers was a new record. Production of salt cake (including natural sodium sulfate) was at an all-time high. Due to the critical shortage of soda ash during 1947 and part of 1948, glass manufacturers made more extensive use of salt cake as a source of soda in the glass batch. However, the kraft pulp and paper industry continued to consume the largest portion, and substantial quantities were consumed in "soapless" detergents.

The following firms reported production of natural sodium sulfates in 1948: American Potash & Chemical Corp., Trona, Calif.; Arizona Chemical Co., 30 Rockefeller Plaza, New York 20, N. Y., plant at Brownfield, Tex.; Dale Chemical Industries, Inc., P. O. Box 319, Twenty Nine Palms, Calif., plant at Dale Lake, Calif.; Iowa Soda Products Co., P. O. Box 476, Council Bluffs, Iowa, plant at Rawlins, Wyo.; Ozark-Mahoning Co., 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, 1944–48, 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)
1944	231, 200	564, 889	69, 997
1945	200, 782	543, 371	91, 340
1946	167, 153	527, 746	122, 573
1947	197, 963	627, 331	135, 088
1948	183, 630	656, 438	169, 018

[1] Includes natural sodium sulfate as shown in table in sodium carbonate section of this chapter.

According to the Oil, Paint and Drug Reporter, at the end of 1948, price quotations on domestic salt cake were $25–$28 a short ton, bulk, works; anhydrous sodium sulfate was unchanged at $2.10 per hundred pounds, works; and Glauber's salt, $2.25–$2.50 per hundred pounds, less than carlots, bags, works.

Sodium sulfate imported for consumption in the United States, 1944–48

Year	Crude (salt cake)		Crystallized (Glauber's salt)		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1944	31, 305	$466, 935			31, 305	$466, 935
1945	20, 293	289, 940			20, 293	289, 940
1946	22, 446	352, 407			22, 446	352, 407
1947	49, 157	583, 377	91	$1, 760	49, 248	585, 137
1948	29, 612	468, 561			29, 612	468, 561

Sodium Metal.—Statistics on output of sodium metal cannot be published, as it is produced by only two companies in the United States. The Ethyl Corp., 405 Lexington Avenue, New York, N. Y., produces sodium at Baton Rouge, La.; and E. I. du Pont de Nemours & Co. produces sodium at Niagara Falls, N. Y. Important uses of this metal are as a reagent in the preparation of tetraethyl lead, in the production of sodium peroxide, sodium cyanide, and other compounds, in the refining of metals, and as a reducing agent in organic synthesis.

A paper was published describing the properties and inorganic applications of sodium.[6]

The price of sodium metal was increased at midyear to 16½ cents per pound, drums, works.

BORATES

Domestic production of boron minerals during 1948 decreased approximately 10 percent from the previous year.

In 1948 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 Sixth Street, Los Angeles 14, Calif., mine near Shoshone; and West End Chemical Co., 608 Latham Square Building, Oakland 12, Calif., plant at Westend, on Searles Lake.

According to Oil, Paint and Drug Reporter, the price of technical borax, 99½ percent, granular, bulk, carlots, freight split, was \$44.50–\$47.50 a short ton in 1948.

Producers announced a new price policy to become effective January 1, 1949, involving an f. o. b. works basis for price schedules, and elimination of the 1 percent cash discount, making terms net 30 days.[7]

Salient statistics of the boron-mineral industry in the United States, 1944–48

	1944	1945	1946	1947	1948
Sold or used by producers:[1]					
Short tons:					
Gross weight	277, 586	325, 935	430, 689	501, 935	450, 932
B_2O_3 content	91, 700	104, 600	129, 800	145, 700	134, 700
Value	\$6, 579, 587	\$7, 635, 365	\$9, 575, 866	\$11, 844, 108	\$11, 147, 735
Imports for consumption (refined):					
Pounds	----------	1, 344	100, 567	2, 000	3, 056
Value	----------	\$491	\$4, 077	\$747	\$1, 503
Exports:					
Short tons	32, 759	43, 475	53, 303	85, 736	70, 940
Value	\$1, 601, 014	\$2, 059, 510	\$2, 644, 760	\$4, 651, 642	\$4, 075, 049
Apparent consumption:[2]					
Short tons	244, 827	282, 461	377, 436	416, 200	379, 994

[1] Borax, anhydrous sodium tetraborate, kernite, boric acid, and colemanite.
[2] Quantity sold or used by producers plus imports minus exports.

Sale of the Western Borax mine of Borax Consolidated, Ltd., in Kern County, Calif., to Pacific Alkali Co., of Los Angeles, was approved as one of the moves in the dissolution of the borax trust, as ordered in a consent decree to the civil antitrust suit filed in Federal Court in September 1947.[8]

A series of articles was published on the chemistry and role of boric oxide in glass technology.[9]

The market for boron compounds in fertilizers and as a weed killer was described in an article.[10]

[6] Gilbert, H. N., Some Unique Properties of Sodium and Potassium: Chem. and Eng. News, vol. 26, No. 36, Sept. 6, 1948, pp. 2604–2606, 2660.
[7] Oil, Paint and Drug Reporter, vol. 154, No. 25, Dec. 20, 1948, p. 53.
[8] Engineering and Mining Journal, vol. 149, No. 1, Jan. 1948, p. 114.
[9] Weyl, W. A., Boric Oxide—Its Chemistry and Role in Glass Technology: Glass Ind., vol. 29, No. 3, March 1948, pp. 131–136, 156, 158; No. 4, April 1948, pp. 200–204, 228; No. 5, May 1948, pp. 264–265, 284; No. 6, June 1948, pp. 328–329, 346; No. 7, July 1948, pp. 388–390, 413–415; No. 8, August 1948, pp. 444–445, 465; No. 9, September 1948, pp. 500–502, 524, 526; No. 10, October 1948, pp. 559–561, 594.
[10] Chemical and Engineering News, vol. 26, No. 49, Dec. 6, 1948, p. 3656.

Salt

By FLORENCE E. HARRIS AND E. M. TUCKER

GENERAL SUMMARY

PRODUCTION of common salt of all types continued its upward trend in 1948. Thirteen States and Puerto Rico contributed a total of 16,403,293 short tons valued at $54,331,782 in 1948 compared with 16,053,882 tons valued at $52,191,688 in 1947. This is an increase of 2 percent in volume and 4 percent in value. The accompanying table shows an increase in apparent domestic consumption as well as larger exports.

Salient statistics of the salt industry in the United States, 1935–39 (average), and 1944–48

	1935–39 (average)	1944	1945	1946	1947	1948
Sold or used by producers:						
Dry salt:						
Evaporated (manufactured) short tons	2,507,374	3,448,578	3,182,570	3,249,457	3,158,718	3,207,403
Rock salt do	1,947,254	3,448,238	3,505,740	3,412,008	3,754,353	3,846,846
Total do	4,454,628	6,896,816	6,688,310	6,661,465	6,913,071	7,054,249
Value	$21,730,339	$37,355,192	$37,335,488	$38,294,396	$43,032,621	$46,430,927
Average per ton	$4.88	$5.42	$5.58	$5.75	$6.22	$6.58
In brine:						
Short tons	4,205,587	8,820,355	8,705,831	8,470,680	[1] 9,140,811	9,349,044
Value	$1,675,273	$6,360,300	$6,578,918	$6,618,190	[1] $9,159,067	$7,900,855
Total salt:						
Short tons	8,660,215	15,717,171	15,394,141	15,132,145	[1] 16,053,882	16,403,293
Value [2]	$23,405,612	$43,715,492	$43,914,406	$44,912,586	[1] $52.191,688	$54,331,782
Imports for consumption:						
For curing fish short tons	[3] 21,250			1,407		768
Value	[3] $43,722			$5,011		$2,744
In bags, barrels, etc. short tons	1,385	14	1,572	275	377	1,591
Value	$11,813	$700	$36,343	$4,456	$8,571	$20,971
In bulk short tons	24,131	5,540	2,981	2,571	1,533	3,262
Value	$55,876	$31,459	$37,047	$20,161	$14,322	$17,033
Total:						
Short tons	46,766	5,554	4,553	4,253	1,910	5,621
Value	$111,411	$32,159	$73,390	$29,628	$22,893	$40,748
Exports:						
Short tons	90,214	198,368	190,524	223,426	[4] 188,307	368,921
Value	$521,652	$1,620,226	$1,509,301	$1,889,522	[4] $1,588,847	$5,672,578
Apparent consumption [5] short tons	8,616,767	15,524,357	15,208,170	14,912,972	[1] [4] 15,771,006	16,039,993

[1] Revised figure.
[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.
[4] 96,479 short tons valued at $2,347,679, shipped under the U. S. Army Civilian Supply Program, is excluded from the exports shown but is deducted from apparent consumption.
[5] Quantity sold or used by producers plus imports minus exports.

The output of evaporated salt, rock salt, and brine each increased 2 percent. Comprising both rock and evaporated salt, 143,119 short tons of table salt and 70,262 tons of livestock salt were iodized in 1948. This represents an increase in iodized table salt but a decrease in iodized livestock salt.

Figure 1 compares the indexes of production of salt in brine and dry salt (evaporated and rock) with the index of industrial activity. The first two—with a 3-point rise each—did not keep pace with the 5-point rise in industrial production. However, the salt-in-brine curve, which advanced from 219 in 1947 to 222 in 1948, is still above that for industrial production, which rose from 187 in 1947 to 192 in 1948. The dry-salt curve rose from 155 in 1947 to 158 in 1948.

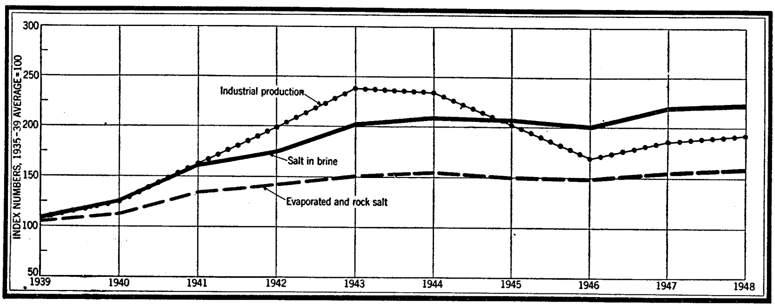

FIGURE 1.—Index of salt in brine and of evaporated and rock salt sold or used compared with industrial production, 1939–48. Index of industrial production from Federal Reserve Board.

Relative quantities of the three types of salt produced in the United States are shown in figure 2 for the 1939–48 decade.

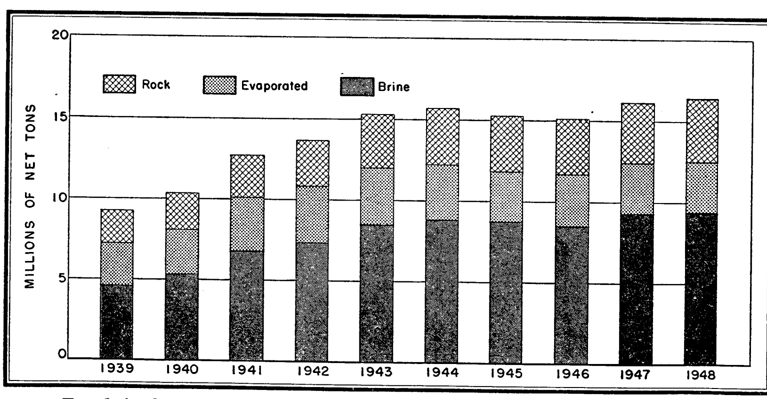

FIGURE 2.—Trends in the quantity of rock salt, evaporated salt, and brine (in terms of salt content) sold or used by producers in the United States, 1939–48.

PRODUCTION

Salt was produced by 43 companies in 71 plants in 1948. Of the total companies producing dry salt in continental United States, about 20 are small; six are medium size; and 6 may be placed in the "Large" category, which includes 5 parent companies composed of subsidiaries or divisions with large composite tonnages and 1 concern that has a large output at a single location. Of the parent companies in the "Large" classification, 1 company has 11 companies or divisions under it; 2 other companies have 5 each. Eight chemical companies operate 12 plants. Solar salt was produced in Puerto Rico in 1948 by three operators at five works.

PRODUCTION BY STATES

California.—The unique pinnacles of salt that occur in this State were described and illustrated in an article on salt lands in the Searles Lake area.[1] Imperial Salt Co., operated by Western Salt Co., San Diego, produced no salt in 1948, closed the plant, and moved the machinery. C. C. Miller's salt operation on Mono Lake, which has operated on an experimental basis, was idle during 1948.

Louisiana.—Myles Salt Co., a wholly owned subsidiary of the Morton Salt Co., was merged with the parent company October 1, 1948. Jefferson Island operations in Louisiana were described and illustrated in an article.[2]

Salt sold or used by producers in the United States, 1946–48, by States

State	1946			1947			1948		
	Quantity		Value	Quantity		Value	Quantity		Value
	Short tons	Percent of total		Short tons	Percent of total		Short tons	Percent of total	
California	729,092	5	$3,358,060	768,397	5	$3,810,898	914,035	6	$3,927,722
Kansas	815,018	5	4,014,919	904,398	6	4,534,406	831,756	5	4,960,828
Louisiana	1,846,522	12	4,612,359	1,955,382	12	5,898,828	2,223,249	13	6,444,751
Michigan	4,334,202	29	15,711,074	[1] 4,447,269	28	[1] 15,043,057	4,387,879	27	16,265,743
New Mexico	8,677	(2)	16,399	12,006	(2)	19,239	(3)	(3)	(3)
New York	2,813,782	19	10,153,274	2,923,023	18	11,875,485	3,065,831	19	13,056,542
Ohio	2,645,995	17	4,160,011	2,975,676	18	6,815,639	2,752,696	17	5,884,343
Puerto Rico	12,411	(2)	83,494	13,344	(2)	101,287	15,145	(2)	112,072
Texas	1,098,589	7	1,356,676	1,191,621	7	2,090,098	1,354,109	8	1,712,169
Utah	121,669	1	339,505	113,285	1	340,028	113,779	1	429,494
West Virginia	272,841	2	896,894	279,300	2	1,161,429	246,732	1	1,197,645
Other States [4]	433,347	3	209,921	470,181	3	501,294	498,082	3	340,473
Total	15,132,145	100	44,912,586	[1] 16,053,882	100	[1] 52,191,688	16,403,293	100	54,331,782

[1] Revised figure.
[2] Less than 0.5 percent.
[3] Included in "Other States."
[4] Comprises Nevada, New Mexico (1948 only), Oklahoma, and Virginia.

Michigan.—The great salt resources of Michigan were described in an article.[3] The Mulkey Salt Co., which before March 25, 1948, was an independent subsidiary of the Morton Salt Co., was merged and made a division of the parent company.

New York.—The Worcester Salt Co., a wholly owned subsidiary of the Morton Salt Co., was merged with the parent company January 1, 1949.

Ohio.—Salt deposits in Ohio were described in 1947.[4] The Ohio Salt Co., Wadsworth, Ohio, was merged with the Morton Salt Co. on

[1] Packard, Charles, Mysterious Giants of the Desert: Rocks and Minerals, vol. 23, No. 2, February 1948, pp. 99–104.
[2] Chemical Engineering Progress, Salt: Vol. 44, No. 2, February 1948, pp. 22, 24.
[3] Mineralogist, Enormous Salt Deposits in Michigan: Vol. 16, No. 11, November 1948, pp. 540–542.
[4] Pepper, J. F., Areal Extent and Thickness of the Salt Deposits of Ohio: Ohio Jour. Science, vol. 47, No. 6, 1947, pp. 225–239.

December 31, 1948. In May 1948 the Morton Salt Co. closed the Cleveland plant that had been acquired from the Union Salt Co.

Texas.—The facilities of the Dow Magnesium Corp. at Velasco, Brazoria County, purchased by the Dow Chemical Co., Midland, Mich., February 8, 1947, were inactive as regards salt production in 1948. The Imperial Salt Co., Missouri City (formerly at Henderson), was building an evaporation plant; it was not yet in operation in 1948. Development work on the brine wells was described.[5] The Diamond Alkali Co. of Cleveland, Ohio, opened an extension of its plant in Houston, Tex.[6]

West Virginia.—The Ohio River Salt Corp. plant at Mason was idle all of 1948 and is now being dismantled.

A railroad surveyed [7] the salt region of New York, Ohio, Pennsylvania, and West Virginia.

To summarize the corporate changes in the Morton Salt Co. to effect economies in 1948, the parent company consolidated several of its wholly owned subsidiary companies and closed one. By the end of 1948 it had 10 producing divisions in various parts of the country. In addition, it also merged the Mulkey Salt Co., a heretofore independent subsidiary, with the parent company, making it a division. The Mulkey Co. in recent years has been a distributing company only and has not been considered a producer.

PRODUCTION BY METHODS OF RECOVERY

By far the greatest percentage of salt operations in the United States is at wells. Mines are next, followed by solar salt works using sea water, salt brine of the Great Salt Lake, and various sources in desert areas that are worked by simple methods. The early salt wells were simple wells through which connate brine was pumped. In 1883 the first well into which fresh water was introduced and salt brine pumped up was installed in New York. Today connate brine is a comparatively minor source of salt in the United States. Certain modern wells supplying artificial brine are as much as 7,000 feet deep.

Salt sold or used by producers in the United States, 1947–48, by method of recovery

Method of recovery	1947		1948	
	Short tons	Value	Short tons	Value
Evaporated:				
Bulk:				
Open pans or grainers	526, 041	$6, 336, 068	462, 325	$6, 868, 010
Vacuum pans	1, 790, 346	15, 824, 364	1, 724, 264	16, 908, 921
Solar	581, 932	2, 173, 652	746, 303	2, 749, 560
Pressed blocks	260, 399	2, 708, 857	274, 511	2, 933, 694
Rock:				
Bulk	3, 685, 190	15, 350, 722	3, 798, 016	16, 510, 756
Pressed blocks	69, 163	638, 958	48, 830	459, 986
Salt in brine (sold or used as such)	[1] 9, 140, 811	[1] 9, 159, 067	9, 349, 044	7, 900, 855
Total	[1] 16, 053, 882	[1] 52, 191, 688	16, 403, 293	54, 331, 782

[1] Revised figure.

[5] Chemical and Engineering News, Imperial Salt Starts Texas Brine Operations: Vol. 26, No. 20, May 17, 1948, p. 1448.

[6] Oil, Paint and Drug Reporter, Diamond Alkali Dedicates New Electrochemical Plant: Vol. 154, No. 121, Nov. 22, 1948, pp. 5, 38.

[7] Salt in the Area Served by the Baltimore & Ohio R. R., 1948.

A discussion of the term "open pans" as used in the accompanying table seems in order, inasmuch as there is a little confusion regarding it. For many years the term "open pan" meant the type of salt pan used in the early days of salt making in the United States. Those pans were heated directly by fuel underneath the pans. Later, open pans of oblong form were made, with steam pipes running through the inside of the pans near the bottom. They became commonly known as "grainers," because of the type of the crystal produced. Although old-type pans heated by fuel underneath are still used in many salt-producing plants abroad, they are no longer used in the United States. According to W. G. Wilcox,[8] the Mulkey Salt Co., which was the last company to use them, discarded them 20 years ago. Another type of open pan is part of the Alberger process, used exclusively by one salt company. It consists of a connected pair of circular evaporator pans. The brine is first heated under high pressure and passed through flashers that reduce the pressure and temperature. No heat is applied either in or under this type of pan.

Evaporated Salt.—Plants producing evaporated salt totaled 48 in 1948, operating in 12 States and Puerto Rico.

Evaporated salt sold or used by producers in the United States, 1947–48, by States

State	1947		1948	
	Short tons	Value	Short tons	Value
California	625,379	$3,452,309	740,418	$3,464,327
Kansas	345,178	2,961,140	321,812	3,255,070
Louisiana	74,843	591,330	88,304	991,871
Michigan	896,555	8,645,977	871,226	9,705,533
New York	432,505	5,192,627	429,870	5,620,727
Ohio	446,568	4,285,469	441,169	4,287,147
Puerto Rico	13,344	101,287	15,145	112,072
West Virginia	134,872	1,017,001	120,397	1,072,758
Other States [1]	189,474	795,801	179,062	950,680
Total	3,158,718	27,042,941	3,207,403	29,460,185

[1] Includes Nevada, New Mexico, Oklahoma, Texas, and Utah.

For several years the Salt Producers Association reported monthly output of evaporated table salt by the majority of producers. Beginning July 1, 1948, the reports represented a wider coverage. Evaporated-salt producers (whether or not members of the association) reported monthly shipments to a firm of accountants, which compiled the figures and submitted a report only of totals to the association and those receiving the service. This arrangement applies to evaporated salt only and not to rock salt or brine production.

Rock Salt.—The 1948 output of rock salt from 19 mines in 8 States increased 92,493 short tons over that of 1947.

Rock salt sold by producers in the United States, 1944–48

Year	Short tons	Value	Year	Short tons	Value
1944	3,448,238	$12,225,057	1947	3,754,353	$15,989,680
1945	3,505,740	12,964,391	1948	3,846,846	16,970,742
1946	3,412,008	13,308,001			

[8] Managing director, Salt Producers Association, Detroit, Mich.

Pressed Blocks.—In 1948 the increase in pressed blocks made from evaporated salt in 22 plants was more than offset by the decrease in blocks made from rock salt in 9 plants, which reduced the total 6,221 short tons.

Pressed-salt blocks sold by original producers of the salt in the United States, 1944–48

Year	From evaporated salt		From rock salt		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
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
1947	260, 399	2, 708, 857	69, 163	638, 958	329, 562	3, 347, 815
1948	274, 511	2, 933, 694	48, 830	459, 986	323, 341	3, 393, 680

Salt Content of Brine.—Eight chemical companies operating 12 plants in 7 States reported production of salt in brine. In addition, small quantities of brine were produced by other firms for use principally in the chemical industry. Salt in brine constituted 57 percent of the total salt output in the United States in 1948.

DISTRIBUTION AND MARKETING

The accompanying table shows primary shipments of salt by the producers in the various States.

Distribution (shipments) of evaporated and rock salt in the United States, 1947–48, by States of destination, in short tons

Destination	1947		1948	
	Evaporated	Rock	Evaporated	Rock
Alabama	12, 938	88, 323	14, 875	93, 655
Arizona	16, 230	3, 038	15, 732	3, 014
Arkansas	11, 652	44, 130	11, 278	41, 607
California	331, 693	53, 709	355, 451	65, 116
Colorado	37, 565	60, 384	37, 276	36, 821
Connecticut	13, 818	17, 397	13, 432	23, 409
Delaware	4, 725	16, 387	8, 005	12, 206
District of Columbia	5, 706	2, 220	5, 843	2, 654
Florida	10, 450	36, 179	10, 342	31, 569
Georgia	21, 670	46, 710	22, 464	42, 556
Idaho	15, 996	1, 571	19, 978	1, 394
Illinois	235, 427	246, 046	227, 036	223, 613
Indiana	100, 056	72, 907	103, 022	76, 510
Iowa	114, 256	108, 675	101, 813	103, 541
Kansas	53, 741	142, 970	49, 151	137, 744
Kentucky	30, 325	70, 209	33, 803	66, 252
Louisiana	16, 277	138, 949	14, 690	135, 167
Maine	13, 382	58, 706	13, 578	59, 435
Maryland	35, 250	52, 827	36, 439	61, 379
Massachusetts	55, 738	84, 764	54, 312	93, 771
Michigan	139, 660	115, 967	118, 666	115, 852
Minnesota	111, 455	69, 688	104, 466	71, 523
Mississippi	8, 664	26, 238	9, 537	23, 018
Missouri	69, 914	78, 025	72, 937	76, 996
Montana	20, 194	3, 478	22, 215	2, 597
Nebraska	55, 960	63, 835	53, 462	61, 046
Nevada	4, 019	88, 181	5, 862	77, 662
New Hampshire	4, 628	55, 561	4, 581	54, 901
New Jersey	103, 478	138, 421	113, 268	163, 750
New Mexico	7, 291	23, 355	7, 954	22, 622
New York	222, 149	554, 376	213, 273	585, 470
North Carolina	49, 432	57, 599	48, 860	62, 988
North Dakota	11, 654	6, 177	12, 024	6, 119

Distribution (shipments) of evaporated and rock salt in the United States, 1947–48, by States of destination, in short tons—Continued

Destination	1947		1948	
	Evaporated	Rock	Evaporated	Rock
Ohio	212, 762	160, 876	208, 826	167, 616
Oklahoma	29, 639	26, 228	29, 455	31, 721
Oregon	50, 775	5, 144	64, 196	401
Pennsylvania	156, 237	131, 069	138, 986	148, 733
Rhode Island	7, 796	10, 725	8, 224	14, 584
South Carolina	9, 638	17, 658	9, 836	17, 391
South Dakota	21, 609	18, 346	21, 061	20, 362
Tennessee	28, 042	73, 300	32, 750	70, 011
Texas	60, 835	220, 111	59, 867	217, 010
Utah	22, 068	2, 233	20, 763	1, 799
Vermont	5, 066	19, 143	5, 375	18, 617
Virginia	50, 517	92, 726	53, 526	103, 855
Washington	178, 661	1, 530	161, 507	1, 227
West Virginia	156, 967	83, 032	140, 341	80, 971
Wisconsin	126, 476	39, 670	125, 357	43, 489
Wyoming	11, 042	3, 535	10, 908	2, 419
Other [1]	85, 195	222, 025	180, 800	270, 683
Total	3, 158, 718	3, 754, 353	3, 207, 403	3, 846, 846

[1] Includes salt used in Puerto Rico (evaporated salt), shipments to noncontiguous Territories of the United States, exports, and shipments to unspecified destinations.

Salt shipped to noncontiguous Territories of the United States, 1946–48

[U. S. Department of Commerce]

Territory	1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value
Alaska	[1] 4, 816	$111, 965	[1] 4, 055	$119, 614	(2)	(2)
American Samoa	6	338	2	285	1	$53
Guam			133	3, 899	98	4, 202
Hawaii	2, 528	91, 790	2, 810	90, 495	(2)	(2)
Puerto Rico	4, 741	170, 798	6, 711	345, 681	7, 000	407, 883
Virgin Islands	76	4, 730	85	5, 447	41	2, 669
Total	12, 167	379, 621	13, 796	565, 421	7, 140	414, 807

[1] Shipping weight.
[2] Data not available.

After March 1948, shippers were not required to declare manifests on merchandise shipped to Alaska or Hawaii; this is why such figures for salt do not appear in the table on noncontiguous shipments.

CONSUMPTION AND USES

Total consumption of salt increased in 1948 from 1947, but decreases were noted for most of the uses shown in the accompanying table. Increases occurred in salt used for chlorine, soda ash, dyes and organic chemicals, other chemicals, livestock, table and other household and agriculture. The largest increase was in the undistributed item, due chiefly to inclusion of most of the augmented exports.

In 1948, much was written about chlorine, the second-largest use for domestic salt. In the United States, where all chlorine is produced from sodium chloride, chlorine production approached the peak record of 1944. A concise review traces the growth of the industry for a number of years.[9] Where chlorine is made and used is given in another article.[10] The sewage and water-processing season was prolonged in 1948 by the mild weather.[11] It is reported [12] that the Grosvenor-Miller process, which has been tested successfully in pilot plants, may enable soda-ash producers to utilize hydrogen chloride, now a waste product, in the manufacture of chlorinated and certain other organic chemicals.

Salt sold or used by producers in the United States, 1947–48, by classes and uses, in short tons

Use	1947				1948			
	Evaporated	Rock	Brine	Total	Evaporated	Rock	Brine	Total
Chlorine, bleaches, chlorates, etc	368,430	711,439	1,661,943	2,741,812	336,180	705,315	1,796,533	2,838,028
Soda ash	(1)		[2] 7,382,646	[2] 7,382,646	(1)		7,392,248	7,392,248
Dyes and organic chemicals	59,683	67,100		126,783	78,873	104,401		183,274
Soap (precipitant)	43,445	16,733		60,178	33,350	10,852		44,202
Other chemicals	96,958	510,747	(3)	607,705	91,529	523,737	(3)	615,266
Textile processing	33,518	117,724		151,242	22,838	92,555		115,393
Hides and leather	95,438	155,370		250,808	79,964	150,647		230,611
Meat packing	368,670	408,019		776,689	324,041	366,259		690,300
Fish curing	40,267	22,726		62,993	15,351	19,997		35,348
Butter, cheese, and other dairy products	108,323	5,236		113,559	97,339	5,017		102,356
Canning and preserving	150,482	16,694		167,176	125,958	18,853		144,811
Other food processing	231,408	24,271		255,679	193,896	19,279		213,175
Refrigeration	40,730	196,242		236,972	20,540	196,087		216,627
Livestock	528,481	205,375		733,856	553,966	238,532		792,498
Highways, railroads, dust and ice control	6,942	466,762		473,704	8,260	460,674		468,934
Table and other household	478,647	173,411		652,058	499,339	173,648		672,987
Water treatment	220,330	231,812	(3)	452,142	193,861	253,095	(3)	446,956
Agriculture	14,785	9,198		23,983	13,609	19,867		33,476
Metallurgy	22,094	65,027		87,121	16,625	49,152		65,777
Undistributed [4]	250,087	350,467	96,222	696,776	501,884	438,879	160,263	1,101,026
Total	3,158,718	3,754,353	[2] 9,140,811	[2] 16,053,882	3,207,403	3,846,846	9,349,044	16,403,293

[1] Data for evaporated salt included with "Undistributed."
[2] Revised figure.
[3] Data for salt in brine included with "Undistributed."
[4] Comprises miscellaneous uses and data not presentable by classes (footnotes 1 and 3), including most exports.

With detergent materials coming on the market, a shift in the use of salt for soap has already become apparent. Salt is used as a precipitant in soap making and is also the basic raw material for soda needed for soap, but caustic soda also is used in making the detergents.

Most of the salt used in making chemicals is brine from wells; but, as evidenced by the tables on uses, appreciable quantities of evaporated and rock salt are utilized for the purpose.

Exclusive of chlorine, the quantity of salt used for rubber making (included in "Undistributed") was less in 1948 than in 1947. However, indications are that salt still has a place in synthetic rubber making, and this use may increase if certain applications tested extensively in 1948 are made. One of the rubber companies found that salt added to the material developed for recapping automobile tires

[9] Skeen, John R., Chlorine: A Statistical Review: Chem. and Eng. News, vol. 26, No. 30, July 26, 1948, pp. 2194–2198.
[10] Lamie, Ralph K., and MacMillin, Robert B., United States Chlorine: Where It Is Made and Where It Is Used: Chem. Ind., vol. 62, No. 4, April 1948, pp. 578–580.
[11] Oil, Paint and Drug Reporter, vol. 154, No. 20, Nov. 15, 1948, p. 37.
[12] Chemical Industries, "Waste" Hydrogen Chloride?: Vol. 63, No. 3, September 1948, pp. 371–372.

was highly successful. Rock crystals are mixed into the stock. As the tread wears down, the salt is released, and surface pores are formed which grip the road. According to an official of one company, "cold" synthetic rubber was the most important rubber development of 1948; it increases the tread wear of passenger-car tires 30 percent over the best natural rubber tires.[13]

Progress was reported in the development of new types and improvement in old types of insecticides, for some of which chloral is needed as the intermediate.

A new method of stripping nylon by use of a sodium chlorite bath was announced.[14]

Miscellaneous uses of the salt produced in 1948 included ceramics, synthetic rubber, brick and tile, paper and pulp, tobacco, and oil-well drilling. Twelve plants contributed to the total sold to the United States Government for miscellaneous purposes including exportation. Other uses were coal treatment, laundry, and cleaning.

Motorists have sometimes complained of the corrosive effects on automobiles of salt used for deicing city streets. To inhibit these effects, a company that has been experimenting and testing mixtures for some time has found that a mixture of sodium chromate or sodium dichromate with the deicing salt is successful.[15]

Federal Specification SS–S–31c on "Salt: Table and Tablets" was issued on January 22, 1948,[16] superseding SS–S–31b, issued June 8, 1944. This new guide, for use of all departments and establishments of the Government, was made effective April 15, 1948. Salt covered by this specification shall be of the following types and classes, as may be specified in the invitation for bids:

Type I. Fine ground salt.
Type II. Evaporated salt (free runing).
Type III. Salt tablets:
  Class A. Plain.
  Class B. Enteric coated.
  Class C. Impregnated.

PRICES

Unless otherwise stated, the listings in the following table are quotations on large lots, f. o. b. New York City.

Prices of bagged salt in the United States in 1948
[Oil, Paint and Drug Reporter]

	Jan. 1–18	Jan. 19–Oct. 10	Oct. 11–Nov. 7	Nov. 8–Dec. 31
	Per short ton		Per 100 pounds	
Rock salt, delivered New York:				
Carlots	$17.50	$18.10	$0.88–$0.98	$0.88–$0.98
Less than carlots	21.70	22.40–23.00	1.09–1.22	1.09–1.22
Table salt, vacuum fine:				
Carlots, works	[1] 18.60	[1] 19.60–21.60	[2] 19.60–21.60	.98–1.08
Less than carlots, delivered New York	25.10	24.40–26.40	[2] 24.40–26.40	1.20–1.32

[1] Delivered New York. [2] Per short ton.

[13] Industrial and Engineering Chemistry, vol. 41, No. 2, February 1949, p. 436.
[14] Oil, Paint and Drug Reporter, Mathieson Making New Nylon Stripping Agent: Vol. 154, No. 23,- Dec. 6, 1948, p. 51.
[15] Chemical and Engineering News, vol. 26, No. 1, Jan. 5, 1948, p. 56.
[16] Obtainable from the Superintendent of Documents, Washington 25, D. C. (5 cents).

In the San Francisco area the price of undried stack-run solar salt in 1948 was $5.30 per short ton, in carlots, f. o. b. plant.

In a decision handed down by the Supreme Court April 26, 1948, for a cement case, the basing-point pricing practice was declared illegal. This affects all companies that sell their commodities with freight included in the price or absorb freight charges therein.

On November 2, 1948, the Federal Trade Commission (Docket 4319) issued a Modified Order To Cease and Desist, in which all of the Commissioners concurred. The original order was issued on July 28, 1944. The modified order, made to conform to the opinion announced on May 3, 1948, by the Supreme Court of the United States, was as follows:

NOW THEREFORE IT IS HEREBY ORDERED that respondent, Morton Salt Company, a corporation, and its officers, representatives, agents, and employees, directly or through any corporate or other device in the sale of Morton's Free Running Table Salt, plain or iodized, or other grades of table salt in commerce as "commerce" is defined in the aforesaid Clayton Act, do forthwith cease and desist from discriminating directly or indirectly in the price of such products of like grade and quality as among wholesale or retail dealers purchasing said salt when the differences in price are not justified by difference in the cost of manufacture, sale or delivery, resulting from differing methods or quantities in which such products are sold or delivered,

(*a*) By selling such products to some wholesalers thereof at prices different from the prices charged other wholesalers who, in fact, compete in the sale and distribution of such products.

(*b*) By selling such products to some retailers thereof at prices different from the prices charged other retailers who, in fact, compete in the sale and distribution of such products.

(*c*) By selling such products to a retailer at prices lower than prices charged wholesalers whose customers compete with such retailer.

For the purpose of comparison, the term "price" as used takes into account discounts, rebates, allowances, and other terms and conditions of sale.

FOREIGN TRADE [17]

Imports.—Although small in 1948, imports of salt were the highest since 1942, when they were 7,754 short tons.

Fish-curing salt reappeared among the imports in 1948 after an absence in 1947. It came from Jamaica entirely. In 1946 such salt was reported after an absence of 3 years.

Salt imported for consumption in the United States, 1944–48, by classes

[U. S. Department of Commerce]

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
1944	14	$700	[2] 5,540	[2] $31,459		
1945	1,572	36,343	2,981	37,047		
1946	275	4,456	2,571	20,161	1,407	$5,011
1947	377	8,571	1,533	14,322		
1948	1,591	20,971	3,262	17,033	768	2,744

[1] Includes 9,001 pounds valued at $356 imported free in 1944, 1,500 pounds valued at $40 in 1945, and 2,000 pounds valued at $20 in 1946.
[2] Includes 3,818,644 pounds valued at $9,244 imported free.

[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.

Imports of Canadian packaged salt, totaling 1,586 short tons, were received chiefly through Maine and New Hampshire customs (1,480 tons). Of Canada's bulk salt, 292 tons were received by Michigan. The Bahamas shipped salt again to the United States, although not in large quantity. In the past decade (1939–48), the Bahamas supplied salt imports only one other year—97 tons valued at $298 in 1944. In 1948 the salt, all bulk, entered through the Massachusetts and Virginia customs. Leeward and Windward Islands again appeared as suppliers in 1948, the 5 tons having gone to Hawaii. They supplied salt only one other year of the decade—133 tons valued at $1,014 in 1945. Jamaica sent salt to the United States in the decade, excepting 1943 and 1944. However, although the quantity in 1948 was largest since 1942, it did not bring the average for 1945–48 (1,533 short tons valued at $5,866) up to the average for 1939–42 (10,648 tons valued at $21,770). In 1948 all Jamaica salt came in bulk through the Virginia customs.

Salt imported for consumption in the United States, 1947–48, by countries

[U. S. Department of Commerce]

Country	1947		1948	
	Short tons	Value	Short tons	Value
North America:				
Bahamas			697	$2,955
Canada	957	$16,221	1,878	26,441
Leeward and Windward Islands			5	110
Jamaica	494	1,411	3,041	11,242
Europe:				
Spain	345	2,334		
United Kingdom	1	15		
Asia: India and Dependencies	(1)	31		
Africa: Cape Verde Islands	113	2,881		
Total	1,910	22,893	5,621	40,748

[1] Less than 1 ton.

Exports.—Salt exports soared to unprecedented heights in 1948. This increase was owing chiefly to the large shipments made to Japan and Korea.

Salt exported from the United States, 1947–48, by countries

[U. S. Department of Commerce]

Country	1947 [1]		1948	
	Short tons	Value	Short tons	Value
North America:				
Bermuda	14	$800	5	$336
Canada	157,523	943,373	161,370	1,067,660
Central America:				
British Honduras	528	8,940	421	7,776
Canal Zone	733	31,642	978	42,688
Costa Rica	140	3,555	126	4,465
Guatemala	64	1,621	1,510	25,648
Honduras	203	6,102	206	5,195
Nicaragua	334	7,137	348	8,597
Panama, Republic of	132	2,736	134	4,165
Mexico	9,192	205,823	6,675	548,283
Newfoundland and Labrador	5,484	27,200	6,698	35,585

See footnotes at end of table.

Salt exported from the United States, 1947–48, by countries—Continued

[U. S. Department of Commerce]

Country	1947 [1] Short tons	1947 [1] Value	1948 Short tons	1948 Value
North America—Continued				
West Indies:				
British:				
Jamaica	38	$778	3	$70
Other British	10	547	4	519
Cuba	6,539	117,467	7,409	150,984
Caraçao (N. W. I.)	191	11,769	203	13,107
Dominican Republic	134	5,118	96	7,218
Haiti	22	1,572	9	912
Other North America	73	2,081	50	1,040
South America:				
Argentina	33	779	100	1,589
Brazil	546	20,953	67	2,481
Chile	17	1,213	24	906
Ecuador	(2)	54		
Surinam	616	11,378	231	6,046
Venezuela	4	81	6	1,033
Other South America	23	1,924	4	599
Europe:				
Belgium and Luxembourg	77	6,890	26	2,218
Sweden	116	7,581		
Yugoslavia	18	671	1	129
Other Europe	18	943		
Asia:				
China	15	4,301		
Hong Kong	40	785	61	1,790
Japan [1]	71	1,492	110,740	3,307,385
Korea [1]			67,501	283,503
Philippines, Republic of	3,779	96,872	2,146	65,510
Saudi Arabia	45	2,034	59	2,300
Other Asia	12	981	59	2,435
Africa:				
Belgian Congo	15	648	26	1,504
Cameroon			155	5,067
Liberia	850	31,161	1,206	54,470
Union of South Africa	15	893	33	2,410
Other Africa	13	1,127	12	1,136
Oceania:				
French Pacific Islands	298	8,016	132	3,178
New Zealand	332	9,801	85	2,591
Other Oceania	(2)	8	2	50
Total	188,307	1,588,847	368,921	5,672,578

[1] Excludes exports under Army Civilian Supply Program in 1947 as follows: Japan, 8 tons valued at $329; Korea, 96,471 tons valued at $2,347,350. Values subject to revision.
[2] Less than 1 ton.

WORLD REVIEW

North America.—Plans announced for expanding the salt industry in *Canada* included operations of Alberta Salt Co., Lindberg, Alta., to produce all regular packages of salt; Prairie Salt Co., Unity, Sask., to market its output in the Province; Nappan, Nova Scotia, output to supply the fishing trade; Windsor Salt Works to enlarge; and Brummer Mond Ltd., Ambustburg, Ont.—Canada's only producer of soda ash—to add substantially to its capacity. The largest company producing coarse solar salt in the *Bahama Islands* began developing a new area which it is expected will increase output considerably in 1949.

South America.—The sea-salt industry in *Brazil* was described.[18] Great efforts are being made to expand Brazil's salt production, and the alkalies industry and developments in other countries are being studied. Several other South American countries are expanding their output of salt and endeavoring to attain new markets.

[18] Menescal, F. De A. G., A Industria de Sal Marinho no Brasil: Mineracao e Metalurgia, vol. 13, No. 73 May-June 1948, pp. 11–17.

World production of salt, 1943–48, by countries, in metric tons [1]

[Compiled by P. Roberts]

Country [1]	1943	1944	1945	1946	1947	1948
North America:						
Canada	619,528	632,841	610,601	488,049	660,921	671,715
Costa Rica	3,414	6,197	6,033	8,000	6,252	6,500
Guatemala	12,618	12,645	(2)	(2)	(2)	(2)
Honduras	2,500	2,700	900	850	726	1,089
Mexico	156,000	126,267	130,380	131,972	122,235	[3] 156,685
Nicaragua	[3] 6,000	[3] 6,000	[3] 6,000	[3] 6,000	7,503	[3] 9,475
Panama	----------	10,000	2,437	7,958	4,412	3,374
Salvador	1,868	13,328	18,004	22,680	16,483	21,213
United States:						
Rock salt	2,956,625	3,128,173	3,180,337	3,095,305	3,405,874	3,489,782
Other salt	10,845,349	11,130,131	10,784,920	10,632,274	11,157,887	11,390,957
West Indies:						
British:						
Bahamas	790	60,960	38,825	36,580	60,960	63,000
Turks and Caicos Islands	[4] 8,512	33,779	21,229	31,571	----------	38,610
Cuba	18,416	15,422	63,504	58,967	54,431	55,339
Dominican Republic	12,620	[3] 11,300	[3] 15,100	[3] 15,750	13,519	16,946
Haiti [3]	8,000	8,000	8,000	8,000	8,000	8,000
Netherlands West Indies	[4] 4,791	5,764	3,109	2,017	(2)	(2)
South America:						
Argentina:						
Rock salt	751	2,237	3,275	(2)	(2)	(2)
Other salt	441,016	449,038	433,116	384,000	384,000	(2)
Brazil	416,121	453,601	506,626	609,198	562,570	781,378
Chile:						
Rock salt	34,162	42,756	47,136	52,093	54,289	47,164
Other salt	17,063	[3] 26,930	[3] 30,655	[3] 31,033	[3] 28,001	[3] 30,804
Colombia:						
Rock salt	5,260	133,862	105,072	124,367	121,247	124,081
Other salt	107,575					
Ecuador	11,947	35,958	27,600	35,070	24,943	[3] 23,000
Peru	49,027	53,818	55,143	56,615	60,108	60,002
Venezuela	36,019	44,792	57,459	90,555	35,794	35,533
Europe:						
Austria:						
Rock salt	381	3,600	(2)	554	4,348	1,752
Other salt	240,656	247,414	82,648	168,150	183,764	197,615
Bulgaria:						
Rock salt	(2)	(2)	(2)	13,659	(2)	(2)
Other salt	(2)	(2)	(2)	(2)	(2)	(2)
Czechoslovakia [5]	(2)	(2)	4,235	9,232	(2)	(2)
France:						
Rock salt and salt from springs	1,143,080	546,323	642,378	1,514,470	1,095,112	(2)
Other salt	561,010	410,506	514,038	476,750	(2)	(2)
Germany	5,434,401	3,677,247	(2)	1,541,228	[6] 1,731,000	[6] 1,912,000
Greece	71,000	21,000	90,000	105,000	51,000	52,208
Hungary	341,690	(2 7)	(2 7)	----------	----------	(2)
Italy:						
Rock salt	468,027	32,511	153,256	708,586	534,794	[3] 559,000
Other salt	401,839	450,867	995,103			
Malta	3,112	3,350	3,350	1,402	1,631	(2)
Netherlands	193,706	124,184	53,600	(2)	243,000	250,417
Poland	(2)	(2)	(2)	280,099	619,770	725,774
Rumania: Rock salt	360,240	154,090	277,183	345,000	314,485	(2)
Spain:						
Rock salt	266,226	243,076	228,029	262,651	265,248	283,952
Other salt	500,392	449,058	562,453	510,121	569,343	(2)
Switzerland	76,686	84,689	81,113	93,000	95,435	[3] 100,200
United Kingdom:						
Great Britain:						
Rock salt	21,514	17,771	17,062	20,819	40,639	(2)
Other salt	3,406,017	3,407,791	3,268,083	3,385,540	3,148,639	(2)
Ireland, Northern	11,183	11,220	12,679	13,474	12,603	13,245
Asia:						
Aden	202,434	208,603	142,191	114,856	197,672	275,408
Burma	(2)	(2)	(2)	[3] 56,000	(2)	(2)
Ceylon	13,781	28,686	42,364	43,666	23,231	78,300
China	[8] 1,516,805	[8] 1,004,248	[8] 800,435	[8] 2,267,345	2,256,502	[3] 2,842,300
Cyprus [9]	[3] 3,000	[3] 3,000	(2)	3,429	15,622	(2)
Formosa	(2)	(2)	(2)	(2)	(2)	[3] 360,000
India:						
Rock salt	332,843	205,776	256,366	266,447	1,560,471	2,377,951
Other salt	1,624,976	1,661,315	1,974,788	1,948,894		
Indochina, French	219,772	148,100	(2)	(2)	(2)	64,000
Indonesia	----------	431,000	(2)	130,000	27,000	[3] 360,000

See footnotes at end of table.

World production of salt, 1943–48, by countries, in metric tons [1]—Continued

Country [1]	1943	1944	1945	1946	1947	1948
Asia—Continued						
Iraq:						
Rock salt	(2)	(2)	2,521	2,521	(2)	(2)
Other salt	21,356	11,792	12,364	12,364	[3] 12,500	(2)
Japan	[10] 415,442	[10] 353,153	[10] 193,845	358,946	247,466	318,979
Korea	[3] 350,000	(2)	[3] 63,200	[3] 152,000	[3] 131,000	[11] 89,979
Lebanon	7,168	7,135	6,959	(2)	(2)	(2)
Palestine (including Israel):						
Rock salt	1,822	1,181	2,144	1,571	2,454	(2)
Other salt	17,955	19,055	16,350	23,163	12,567	(2)
Portuguese India [4]	10,290	11,013	9,146	15,428	13,267	10,719
Syria	17,099	21,783	[3] 12,000	[3] 34,000	30,000	(2)
Thailand	105,788	61,309	23,774	78,017	(2)	(2)
Turkey:						
Rock salt	22,976	266,330 (rock and other salt)	16,193	225,917 (rock and other salt)	278,742 (rock and other salt)	[3] 236,905 (rock and other salt)
Other salt	243,353		255,303			
Africa:						
Algeria	25,820	50,937	49,969	66,570	76,682	(2)
Belgian Congo	[3] 1,219	1,711	[3] 900	[3] 900	[3] 900	(2)
Canary Islands [3]	2,500	2,500	(2)	(2)	(2)	(2)
Egypt [4]	106,901	199,116	255,107	226,090	622,629	359,823
Eritrea	8,101	10,721	[3] 35,000	140,000	(2)	(2)
Ethiopia: Rock salt	[3] 10,000	(2)	(2)	(2)	10,000	(2)
French West Africa [3]	48,000	53,000	55,000	55,000	(2)	(2)
Kenya	15,318	14,054	15,491	15,635	14,058	(2)
Libya:						
Cyrenaica	(2)	(2)	(2)	700	200	140
Tripolitania	----------	----------	----------	2,350	3,000	6,000
Mauritius [3]	1,500	1,500	(2)	(2)	(2)	(2)
Morocco, French:						
Rock salt	12,208	34,945 (rock and other salt)	31,730 (rock and other salt)	49,545 (rock and other salt)	64,000 (rock and other salt)	(2)
Other salt	31,963					
Nigeria [3]	400	400	(2)	(2)	(2)	(2)
Portuguese East Africa	379	221	10	71	75	75
Portuguese West Africa	43,419	37,652	49,552	61,657	38,783	53,423
Somaliland:						
French	22,244	42,657	55,000	45,000	48,000	(2)
Italian	(2)	(2)	(2)	114	715	(2)
South-West Africa:						
Rock salt	2,096	2,870	3,238	3,533	2,788	4,207
Other salt	8,616	9,049	10,011	10,590	9,861	10,612
Sudan, Anglo-Egyptian	40,488	35,969	44,471	40,982	71,916	(2)
Tanganyika	11,542	11,214	9,546	13,014	10,837	12,073
Tunisia	10,053	52,478	61,289	93,400	(2)	(2)
Uganda	5,243	(2)	(2)	5,679	7,003	6,900
Union of South Africa	[12] 108,690	[12] 123,560	(2)	(2)	(2)	(2)
Australia: South Australia	187,270	167,531	173,813	160,753	157,563	88,545
Total [13]	41,186,000	37,847,000	34,984,000	38,335,000	38,751,000	42,488,000

[1] In addition to the countries listed, salt is produced in Albania, Bolivia, British Somaliland, Gold Coast, Leeward Islands, Madagascar, Pakistan, Republic of the Philippines, Portugal, Southern Rhodesia, U. S. S. R., Yugoslavia, and other Australian States (Victoria and Western Australia), but figures of production are not available. Russian production is known to exceed 4,000,000 metric tons annually. Estimates by the author of the chapter are included in the total.

[2] Data not available; estimates by the author of the chapter are included in the total.

[3] Estimate.

[4] Exports.

[5] Excludes Sub-Carpathia, ceded to Hungary and U. S. S. R.

[6] Bizonal area.

[7] Data represents Trianon Hungary subsequent to October 1944.

[8] Data represents areas designated as "Free China" during the period of Japanese occupation.

[9] Incomplete data.

[10] Fiscal year ended March 31 of year following that stated.

[11] South Korea only.

[12] Fiscal year ended June 30 of year stated.

[13] Estimated by senior author of chapter.

Europe.—An historical account of *Great Britain's* salt industry was given.[19] Recent shortages of potash there also have brought to attention studies by British scientists of the application of salt to sugar-beet cultivation, and for other crops for which common salt was used formerly as a fertilizer.[20] A report [21] described in detail an unusual system in *Germany* for dissolving salt in a salt mine and for treating the brine. In *Italy* efforts were made to expand salt output and trade of a leading salt operation.[22] The *Polish* Salt Monopoly operated four plants producing salt of various types.[23] *Rumania*, which, it is said, ranks next to the Soviet Union in salt deposits in Europe, was optimistically planning chemical industries based on these and other available basic requirements.[24] Salt production in *Switzerland*, by works and types, for 1900–47 was reported.[25]

Asia.—The *Ceylon* salt industry reported by the Government salt commissioner [26] was reviewed.[27] *China's* industry and barter agreements with *Japan* for salt were noted.[28] The salt situation in *French Indochina* [29] and *Indonesia* [30] and *Thailand's* plans [29] for salt production were reported. *India* is seeking to improve the size and quality of the output of salt and methods of obtaining it. Salt is now tax-free, the late Mohandas K. Gandhi having effected cancellation of taxes in April 1947. Miscellaneous facts on salt in *Angola, Iran, Iraq,* and *Syria* were reported briefly.[31] *Pakistan* planned to utilize salt deposits in Northwest Province and western Punjab for a chemical industry.

Africa.—In 1948, *Italian Somaliland* produced salt chiefly for local consumption.[32] Details of some of the 1948 production of salt by types were reported for *South-West Africa* and the *Union of South Africa*.[33]

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[19] Imperial Chemical Industries Magazine, The Story of the Salt Division: Vol. 26, No. 152, November 1948, pp. 203–207.
[20] Chemical Industries, Worth Its Salt: Vol. 63, No. 1, July 1948, p. 136. Chemistry and Industry, No. 2, Jan. 8, 1949, p. 18.
[21] U. S. Department of Commerce Technical Services, Soda Ash Manufacture in Southern and Western Germany: P. B.-81278, 51 pp. (mimeographed reproduction).
[22] Chemical Age (London), Italian Salt Output: Vol. 59, No. 1526, Oct. 9, 1948, p. 492.
[23] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 3, March 1948, p. 40.
[24] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 6, June 1948, pp. 51–52, 57–60.
[25] Bureau of Mines, Mineral Trade Notes: Vol. 27, No. 1, July 1948, p. 59.
[26] Tisseverasinghe, E. B., Potentialities of the Salt Industry in Ceylon: Ceylon Government, 1948, 24 pp.
[27] Bureau of Mines, Mineral Trade Notes: Vol. 27, No. 5, November 1948, pp. 56–58.
[28] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 5, May 1948, pp. 49–50.
[29] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 5, May 1948, pp. 51, 56.
[30] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 4, April 1948, p. 45.
[31] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 6, June 1948, pp. 51–52.
[32] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 5, May 1948, p. 52.
[33] Bureau of Mines, Mineral Trade Notes: Vol. 27, No. 3, September 1948, pp. 51–52.

Sand and Gravel

By D. G. RUNNER AND G. E. TUCKER

GENERAL SUMMARY

THE continued high-level construction activity of all types in 1948 resulted in heavy demands for sand and gravel. As shown in figure 1, the output of sand and gravel exceeded, by a considerable amount, the former production record established in 1942. For the second time in history, the value passed the 200-million-dollar mark.

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 chapter.

As indicated in the accompanying salient statistics table, sales in 1948 of building, paving, railroad ballast, and "other" sands by commercial operators increased over those reported for 1947; sales of gravel by this class of operators increased for all types. The combined total of sand and gravel used on Government-and-contractor operations also showed substantial increases over the previous year's totals. In general, industrial sands declined in output for 1948, but average unit values increased substantially over the previous year's figures.

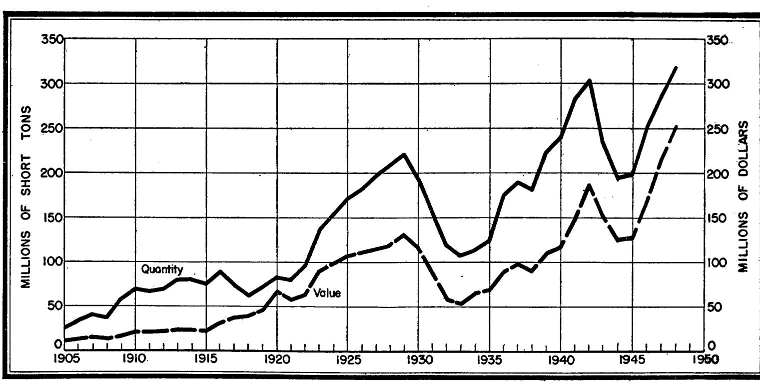

FIGURE 1.—Production of sand and gravel in the United States, 1905–48.

Sand and gravel sold or used by producers in the United States, 1947–48, by commercial and Government-and-contractor operations and by uses

	1947			1948			Percent of change in—	
	Short tons	Value		Short tons	Value		Tonnage	Average value
		Total	Average		Total	Average		
COMMERCIAL OPERATIONS								
Sand:								
Glass	5,321,247	$11,395,245	$2.14	4,542,260	$10,770,845	$2.37	−14.6	+10.7
Molding	8,308,434	11,944,228	1.44	8,265,451	12,892,392	1.56	−.5	+8.3
Building	52,475,831	39,982,460	.76	59,357,062	47,102,476	.79	+13.1	+3.9
Paving	28,386,749	20,988,676	.74	31,127,243	25,018,409	.80	+9.7	+8.1
Grinding and polishing [1]	1,099,253	1,801,989	1.64	1,119,802	2,151,095	1.92	+1.9	+17.1
Fire or furnace	373,917	426,956	1.14	322,576	492,128	1.53	−13.7	+34.2
Engine	2,683,333	2,092,656	.78	2,445,454	2,439,135	1.00	−8.9	+28.2
Filter	211,646	366,905	1.73	158,269	382,600	2.42	−25.2	+39.9
Railroad ballast [2]	852,076	382,278	.45	869,699	374,498	.43	+2.1	−4.4
Other [3]	1,406,677	1,739,367	1.24	1,588,814	2,027,982	1.28	+12.9	+3.2
Total commercial sand	101,119,163	91,120,760	.90	109,796,630	103,651.560	.94	+8.6	+4.4
Gravel:								
Building	43,494,575	40,005,616	.92	48,679,419	48,315,368	.99	+11.9	+7.6
Paving	51,863,727	42,974,456	.83	58,775,303	49,639,057	.84	+13.3	+1.2
Railroad ballast [4]	13,935,934	6,790,456	.49	14,033,722	7,888,283	.56	+.7	+14.3
Other [5]	2,149,018	1,480,350	.69	2,218,448	1,825,464	.82	+3.2	+18.8
Total commercial gravel	111,443,254	91,250,878	.82	123,706,892	107,668,172	.87	+11.0	+6.1
Total commercial sand and gravel	212,562,417	182,371,638	.86	233,503,522	211,319,732	.90	+9.9	+4.7
GOVERNMENT-AND-CONTRACTOR OPERATIONS [6]								
Sand:								
Building	1,551,000	717,000	.46	1,529,000	811,000	.53	−1.4	+15.2
Paving	6,049,000	2,316,000	.38	7,336,000	3,452,000	.47	+21.3	+23.7
Total Government-and-contractor sand	7,600,000	3,033,000	.40	8,865,000	4,263,000	.48	+16.6	+20.0
Gravel:								
Building	2,208,000	1,541,000	.70	5,487,000	3,405,000	.62	+148.5	−11.4
Paving	65,289,000	29,923,000	.46	71,411,000	33,510,000	.47	+9.4	+2.2
Total Government-and-contractor gravel	67,497,000	31,464,000	.47	76,898,000	36,915,000	.48	+13.9	+2.1
Total Government-and-contractor sand and gravel	75,097,000	34,497,000	.46	85,763,000	41,178,000	.48	+14.2	+4.3
COMMERCIAL AND GOVERNMENT-AND-CONTRACTOR OPERATIONS								
Sand	108,719,000	94,154,000	.87	118,661,000	107,915,000	.91	+9.1	+4.6
Gravel	178,940,000	122,715,000	.69	200,605,000	144,583,000	.72	+12.1	+4.3
Grand total	287,659,000	216,869,000	.75	319,266,000	252,498,000	.79	+11.0	+5.3

[1] Includes blast sand as follows—1947: 308,128 tons valued at $958,023; 1948: 381,455 tons, $1,189,530.
[2] Includes ballast sand produced by railroads for their own use as follows—1947: 5,760 tons valued at 450; 1948: 87,684 tons, $7,321.
[3] Includes some sand used by railroads for fills and similar purposes as follows—1947: 159,983 tons valued at $31,886; 1948: 197,379 tons, $34,213.
[4] Includes ballast gravel produced by railroads for their own use as follows—1947: 5,424,388 tons valued at $1,813,184; 1948: 5,126,293 tons, $1,823,741.
[5] Includes some gravel used by railroads for fills and similar purposes as follows—1947: 1,058,333 tons valued at $298,249; 1948: 1,145,673 tons, $478,907.
[6] Approximate figures for States, counties, municipalities, and other Government agencies directly or under lease.

PRODUCTION

The production of sand and gravel in 1948 totaled 319,266,000 short tons valued at $252,498,000, an increase of 11 percent quantity-wise and 16 percent in value over the 287,659,000 tons valued at $216,869,000 reported in 1947. Reflecting the construction activity, substantial increases were recorded for sand and gravel in the building and paving industry.

In 1948, as in the previous year, California was the largest producer, and Michigan, Wisconsin, Illinois, New York, Ohio, Texas, Minnesota, and Pennsylvania followed in that order. These nine States, each with an output exceeding 12,000,000 tons, accounted for 51 percent of the total production.

The following tables show details of production, by States and uses, in 1948.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States, 1944–48

Year	Sand		Gravel (including railroad ballast)		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
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
1947	108, 719, 000	94, 154, 000	178, 940, 000	122, 715, 000	287, 659, 000	216, 869, 000
1948	118, 661, 000	107, 915, 000	200, 605, 000	144, 583, 000	319, 266, 000	252, 498, 000

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1948, by States

State	Short tons	Value	State	Short tons	Value
Alabama	3, 619, 469	$2, 405, 901	Nevada	2, 248, 885	$2, 018, 151
Alaska	(1)	(1)	New Hampshire	2, 481, 658	651, 042
Arizona	2, 013, 769	1, 799, 353	New Jersey	[1] 6, 325, 445	[1] 7, 489, 662
Arkansas	[1] 2, 545, 104	[1] 2, 078, 784	New Mexico	[1] 717, 088	[1] 573, 385
California	33, 786, 520	30, 592, 965	New York	16, 369, 303	13, 382, 370
Colorado	4, 906, 299	2, 657, 610	North Carolina	4, 837, 437	3, 522, 403
Connecticut	2, 576, 848	1, 487, 530	North Dakota	5, 244, 995	1, 712, 827
Delaware	(1)	(1)	Ohio	15, 508, 815	15, 149, 848
Florida	2, 312, 131	2, 432, 575	Oklahoma	2, 004, 512	1, 088, 003
Georgia	985, 729	719, 771	Oregon	8, 384, 755	10, 628, 889
Hawaii	(1)	(1)	Pennsylvania	12, 422, 546	15, 304, 020
Idaho	3, 671, 033	2, 552, 224	Puerto Rico	(1)	(1)
Illinois	17, 400, 430	15, 101, 915	Rhode Island	633, 436	728, 990
Indiana	9, 439, 358	7, 091, 922	South Carolina	403, 285	198, 439
Iowa	8, 039, 601	3, 729, 488	South Dakota	4, 687, 055	3, 247, 428
Kansas	5, 083, 083	2, 748, 765	Tennessee	3, 816, 802	4, 147, 728
Kentucky	2, 066, 993	2, 068, 780	Texas	15, 137, 848	12, 810, 573
Louisiana	[1] 4, 319, 420	[1] 5, 204, 046	Utah	2, 278, 184	1, 368, 562
Maine	[1] 496, 355	[1] 286, 765	Vermont	731, 687	619, 069
Maryland	5, 833, 559	6, 158, 041	Virginia	4, 098, 616	3, 837, 845
Massachusetts	5, 500, 350	4, 418, 132	Washington	9, 267, 225	6, 657, 129
Michigan	20, 671, 078	14, 071, 712	West Virginia	3, 974, 264	6, 306, 898
Minnesota	13, 722, 541	4, 818, 983	Wisconsin	18, 613, 088	11, 370, 089
Mississippi	2, 879, 256	1, 519, 930	Wyoming	2, 021, 848	1, 507, 906
Missouri	4, 886, 611	4, 197, 922	Undistributed [1]	8, 192, 000	3, 844, 000
Montana	7, 383, 873	3, 256, 957			
Nebraska	4, 725, 530	2, 933, 256	Total	319, 266, 000	252, 498, 000

[1] Output of commercial producers in Alaska and Delaware and of Government-and-contractor operations in Alaska, Arkansas, Hawaii, Louisiana, Maine, New Jersey, New Mexico, and Puerto Rico comprises "Undistributed."

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1948, 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	-	-	73,550	$132,495	720,530	$578,630	33,803	$1,521
Alaska	-	-	-	-	-	-	(1)	(1)
Arizona	-	-	-	-	403,862	396,508	675	500
Arkansas	(1)	(1)	(1)	(1)	592,768	403,571	-	-
California	(1)	(1)	62,374	180,965	9,992,538	7,786,634	57,885	10,701
Colorado	-	-	-	-	331,541	304,014	26,543	38,223
Connecticut	(1)	(1)	-	-	701,061	494,412	701,869	50,133
Delaware	-	-	-	-	(1)	(1)	-	-
Florida	-	-	-	-	1,185,399	1,080,254	-	-
Georgia	18,536	$46,339	38,773	64,207	423,786	225,395	65	120
Hawaii	-	-	-	-	-	-	-	-
Idaho	-	-	-	-	166,925	174,929	176	390
Illinois	(1)	(1)	1,223,991	2,082,618	3,733,422	2,599,870	520	538
Indiana	-	-	537,561	548,425	1,359,780	1,036,362	24,250	14,000
Iowa	-	-	(1)	(1)	1,089,490	835,958	-	-
Kansas	-	-	-	-	1,432,961	816,766	1,536	540
Kentucky	-	-	(1)	(1)	426,770	392,119	-	-
Louisiana	-	-	63,830	56,392	716,042	625,862	-	-
Maine	-	-	-	-	79,978	35,718	(1)	(1)
Maryland	(1)	(1)	-	-	1,181,029	1,160,895	-	-
Massachusetts	-	-	(1)	(1)	1,754,963	1,244,910	-	-
Michigan	(1)	(1)	2,026,046	1,304,306	1,850,519	1,301,319	23,922	8,922
Minnesota	3,462	17,519	(1)	(1)	1,639,577	1,100,895	8,488	8,193
Mississippi	-	-	-	-	476,127	281,623	-	-
Missouri	366,708	685,491	(1)	(1)	949,623	763,563	5,400	2,000
Montana	-	-	-	-	149,204	183,218	13,702	18,684
Nebraska	-	-	-	-	289,560	223,630	34,460	9,249
Nevada	(1)	(1)	(1)	(1)	98,384	141,811	190,690	208,600
New Hampshire	-	-	-	-	132,049	95,350	-	-
New Jersey	(1)	(1)	1,604,097	3,048,875	2,036,669	1,442,420	-	-
New Mexico	-	-	-	-	243,103	187,357	(1)	(1)
New York	-	-	470,275	961,335	6,602,978	4,995,285	47,413	2,738
North Carolina	-	-	-	-	807,894	498,347	70,000	35,000
North Dakota	-	-	-	-	129,976	116,531	10,616	8,536
Ohio	(1)	(1)	830,910	1,862,954	3,574,152	3,110,353	-	-
Oklahoma	(1)	(1)	5,803	11,329	507,289	269,240	-	-
Oregon	-	-	(1)	(1)	908,733	992,993	(1)	(1)
Pennsylvania	(1)	(1)	349,558	769,573	3,436,945	3,725,315	-	-
Puerto Rico	-	-	-	-	-	-	(1)	(1)
Rhode Island	-	-	(1)	(1)	168,006	135,503	-	-
South Carolina	-	-	-	-	234,385	91,674	-	-
South Dakota	-	-	-	-	287,325	225,725	29,483	27,902
Tennessee	(1)	(1)	(1)	(1)	1,061,171	1,145,166	-	-
Texas	(1)	(1)	(1)	(1)	2,766,847	2,022,903	1,118	2,267
Utah	-	-	(1)	(1)	253,063	191,431	18,469	16,069
Vermont	-	-	(1)	(1)	(1)	(1)	810	75
Virginia	(1)	(1)	(1)	(1)	609,913	489,772	-	-
Washington	-	-	(1)	(1)	1,114,676	857,875	61,109	35,477
West Virginia	(1)	(1)	(1)	(1)	669,152	870,242	-	-
Wisconsin	-	-	(1)	(1)	1,913,942	1,284,879	23,653	10,978
Wyoming	-	-	-	-	96,274	128,407	36,822	41,010
Undistributed [1]	4,153,554	10,021,496	978,683	1,868,918	56,681	36,842	106,000	259,000
Total	4,542,260	10,770,845	8,265,451	12,892,392	59,357,062	47,102,476	1,529,000	811,000

[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 1948, 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	324,643	$176,812	179,503	$24,167				
Alaska	(1)	(1)						
Arizona	41,261	58,222	3,002	2,290				
Arkansas	348,652	218,370						
California	4,164,879	3,311,270	510,087	554,407	72,637	$221,647		
Colorado	10,427	11,761	52,443	9,185	(1)	(1)		
Connecticut	291,151	208,681	10,125	1,875				
Delaware	(1)	(1)			(1)	(1)		
Florida	98,266	78,197	136,350	25,250	(1)	(1)		
Georgia	279,895	198,265	36,250	9,700	26,427	21,141		
Hawaii								
Idaho	28,048	32,087	252,842	216,918				
Illinois	1,548,284	1,197,311	23,267	20,494	(1)	(1)	(1)	(1)
Indiana	1,428,387	1,072,931	34	19			(1)	(1)
Iowa	553,857	300,658	40,539	9,295	(1)	(1)		
Kansas	1,100,260	644,098	81,425	16,555	(1)	(1)		
Kentucky	480,188	514,421						
Louisiana	425,496	535,644	(1)	(1)				
Maine	28,048	15,092	(1)	(1)				
Maryland	1,607,610	1,772,921	185,700	17,590			(1)	(1)
Massachusetts	777,801	590,747	98,512	40,241	210	75	20,515	$12,535
Michigan	2,182,715	1,582,833	59,808	15,429	(1)	(1)		
Minnesota	482,731	302,606	67,420	38,192	580	280		
Mississippi	240,987	90,176	151,681	20,785				
Missouri	741,334	528,664	18,563	14,181	(1)	(1)		
Montana	(1)	(1)	276,889	42,530				
Nebraska	269,821	137,959			2,613	1,706		
Nevada			4,196	6,112				
New Hampshire	34,180	16,400	353,524	45,101				
New Jersey	980,529	720,340	(1)	(1)	67,556	189,442	(1)	(1)
New Mexico	(1)	(1)	(1)	(1)	(1)	(1)		
New York	2,057,268	1,700,659	132,486	21,414			(1)	(1)
North Carolina	244,932	136,831	1,954,307	697,241	(1)	(1)		
North Dakota	104,396	79,853						
Ohio	2,408,126	1,999,795	34,000	40,800	(1)	(1)	(1)	(1)
Oklahoma	216,266	109,858	42,000	2,500				
Oregon	299,532	312,762	(1)	(1)	(1)	(1)		
Pennsylvania	1,852,938	2,055,093			352,740	633,217	46,923	99,374
Puerto Rico								
Rhode Island	94,700	57,280	75,399	105,486				
South Carolina	63,916	32,960	32,954	20,119	(1)	(1)		
South Dakota	15,536	10,176	373,418	657,203				
Tennessee	431,812	444,756			(1)	(1)		
Texas	1,867,475	1,488,768	235,709	126,813	14,612	44,308	675	1,500
Utah	111,455	81,399	12,150	12,000				
Vermont	48,908	29,616	15,143	3,460	(1)	(1)		
Virginia	722,510	434,283	113,205	54,504				
Washington	308,692	233,796	75,223	39,991				
West Virginia	499,314	585,066			(1)	(1)	8,121	9,592
Wisconsin	1,162,497	780,774	1,250,590	257,510	21,848	49,086		
Wyoming	(1)	(1)	50,933	31,866				
Undistributed [1]	147,520	128,218	396,000	251,000	560,579	990,193	246,342	369,127
Total	31,127,243	25,018,409	7,336,000	3,452,000	1,119,802	2,151,095	322,576	492,128

[1] Figures that may not be shown separately are combined as "Undistributed."
[2] Includes 381,455 tons of blast sand valued at $1,189,530.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1948, 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)	-	-	-	-	12,164	$27,000
Alaska	-	-	-	-	-	-	-	-
Arizona	9,011	$9,011	-	-	-	-	(1)	(1)
Arkansas	(1)	(1)	-	-	-	-	-	-
California	(1)	(1)	14,284	$89,773	14,100	$7,662	79,232	326,323
Colorado	(1)	(1)	-	-	(1)	(1)	(1)	(1)
Connecticut	19,525	16,597	(1)	(1)	(1)	(1)	18,775	15,118
Delaware	(1)	(1)	-	-	-	-	-	-
Florida	(1)	(1)	-	-	-	-	-	-
Georgia	14,756	9,266	140	100	-	-	130,353	125,412
Hawaii	-	-	-	-	-	-	-	-
Idaho	-	-	-	-	-	-	1,356	2,034
Illinois	109,451	97,438	(1)	(1)	(1)	(1)	149,998	299,542
Indiana	188,235	100,941	-	-	(1)	(1)	11,415	7,576
Iowa	62,254	62,797	(1)	(1)	(1)	(1)	(1)	(1)
Kansas	97,047	81,784	(1)	(1)	125,481	42,192	10,738	5,059
Kentucky	104,668	99,203	-	-	-	-	-	-
Louisiana	16,351	9,844	-	-	36,686	14,550	-	-
Maine	-	-	-	-	-	-	2,856	1,028
Maryland	(1)	(1)	-	-	-	-	-	-
Massachusetts	41,241	34,254	(1)	(1)	-	-	56,102	25,877
Michigan	(1)	(1)	-	-	(1)	(1)	1,010	622
Minnesota	39,414	22,540	-	-	(1)	(1)	19,333	6,134
Mississippi	6,772	4,016	-	-	-	-	8,000	3,620
Missouri	26,039	19,727	500	450	42,153	10,538	(1)	(1)
Montana	-	-	-	-	-	-	57,528	30,283
Nebraska	84,163	42,080	-	-	-	-	50,804	16,153
Nevada	-	-	-	-	-	-	3,467	10,146
New Hampshire	-	-	-	-	-	-	-	-
New Jersey	35,338	24,448	34,659	91,604	-	-	29,817	81,910
New Mexico	5,893	6,548	-	-	-	-	-	-
New York	60,457	35,516	46,900	27,330	37,580	18,790	158,360	87,638
North Carolina	25,702	23,132	(1)	(1)	-	-	(1)	(1)
North Dakota	-	-	-	-	-	-	-	-
Ohio	73,208	93,112	(1)	(1)	(1)	(1)	87,091	158,880
Oklahoma	83,426	54,777	-	-	-	-	45,975	1,707
Oregon	(1)	(1)	-	-	6,602	3,876	10,471	5,447
Pennsylvania	354,165	661,527	(1)	(1)	-	-	174,144	318,022
Puerto Rico	-	-	-	-	-	-	-	-
Rhode Island	-	-	-	-	-	-	(1)	(1)
South Carolina	(1)	(1)	(1)	(1)	-	-	46,707	26,119
South Dakota	-	-	-	-	5,000	2,000	7,716	6,716
Tennessee	(1)	(1)	(1)	(1)	-	-	(1)	(1)
Texas	77,310	58,301	(1)	(1)	26,517	13,514	8,410	3,406
Utah	(1)	(1)	(1)	(1)	-	-	(1)	(1)
Vermont	2,543	2,017	-	-	-	-	1,525	1,430
Virginia	172,260	103,356	-	-	-	-	42,958	29,230
Washington	-	-	(1)	(1)	2,100	1,750	67,190	41,641
West Virginia	307,909	468,884	-	-	-	-	(1)	(1)
Wisconsin	(1)	(1)	5,000	13,750	113,240	58,757	44,095	27,384
Wyoming	-	-	-	-	-	-	-	-
Undistributed [1]	428,316	298,019	56,786	159,593	460,240	200,869	251,224	336,525
Total	2,445,454	2,439,135	158,269	382,600	869,699	374,498	1,588,814	2,027,982

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

[3] Includes 87,684 tons of ballast sand valued at $7,321, produced by railroads for their own use

[4] Includes 197,379 tons of sand valued at $34,213, 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 1948, 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	812,168	$684,630	36,974	$6,199	778,784	$664,529	491,647	$48,226
Alaska	---	---	(1)	(1)	(1)	(1)	(1)	(1)
Arizona	245,684	271,692	---	---	(1)	(1)	526,980	305,513
Arkansas	517,088	565,225	(1)	(1)	545,605	372,715	(1)	(1)
California	8,820,266	8,153,354	65,098	12,136	5,619,979	5,413,159	3,779,820	3,842,570
Colorado	465,229	535,102	1,534,584	251,912	157,339	170,814	2,220,689	1,262,111
Connecticut	501,545	476,660	---	---	243,964	163,057	58,200	21,500
Delaware	(1)	(1)	---	---	(1)	(1)	---	---
Florida	541,506	915,749	---	---	22,000	17,300	---	---
Georgia	---	---	20	55	16,728	19,771	---	---
Hawaii	---	---	(1)	(1)	---	---	---	---
Idaho	212,034	217,688	4,185	1,488	817,042	819,138	1,885,947	1,020,662
Illinois	3,096,609	2,326,240	64,959	24,611	3,793,847	2,547,188	817,543	526,562
Indiana	1,340,241	1,249,758	34,050	5,750	3,268,144	2,370,160	381,664	152,904
Iowa	726,526	831,584	---	---	1,579,886	781,159	3,873,773	752,219
Kansas	184,905	174,395	4,568	943	1,020,180	648,853	723,717	210,160
Kentucky	365,656	428,876	25,043	23,100	320,664	376,637	339,012	225,458
Louisiana	1,286,003	1,531,030	---	---	1,642,545	2,350,600	(1)	(1)
Maine	135,046	101,168	(1)	(1)	137,388	80,171	(1)	(1)
Maryland	787,787	1,082,470	---	---	1,491,645	2,016,654	548,884	50,951
Massachusetts	1,393,740	1,481,656	---	---	959,634	725,398	265,900	42,630
Michigan	2,938,832	2,415,932	314,641	58,168	5,633,860	3,867,005	4,498,058	2,415,612
Minnesota	939,585	1,138,060	90,312	7,806	1,329,531	880,283	7,332,223	752,341
Mississippi	578,585	443,167	127,825	98,462	768,633	398,770	326,514	123,245
Missouri	727,581	658,018	270	200	959,420	617,701	571,874	286,051
Montana	172,582	187,438	27,668	40,980	(1)	(1)	4,654,944	1,306,806
Nebraska	987,355	680,274	14,606	2,355	2,568,073	1,617,449	422,968	199,951
Nevada	(1)	(1)	450,632	520,407	5,300	11,339	1,159,485	427,485
New Hampshire	124,627	168,442	---	---	103,596	122,833	1,733,682	202,916
New Jersey	794,717	814,360	---	---	269,672	227,363	(1)	(1)
New Mexico	204,101	184,876	---	---	(1)	(1)	(1)	(1)
New York	2,826,616	3,041,691	25,586	3,429	2,425,193	2,127,645	1,329,280	222,243
North Carolina	413,354	642,416	28,050	28,050	822,890	984,685	405,722	411,761
North Dakota	125,101	190,615	64,338	24,632	408,587	252,258	3,840,960	853,574
Ohio	2,384,240	2,160,575	50,753	4,238	3,886,967	3,270,680	294,772	139,153
Oklahoma	110,128	85,758	31,534	34,140	(1)	(1)	575,837	75,294
Oregon	1,183,712	1,321,170	(1)	(1)	2,461,308	2,428,620	2,460,209	4,146,227
Pennsylvania	3,049,786	3,415,953	145,139	31,369	1,446,999	1,528,452	338,346	41,125
Puerto Rico	---	---	---	---	---	---	---	---
Rhode Island	93,734	108,595	---	---	42,006	44,125	129,347	232,636
South Carolina	---	---	---	---	---	---	---	---
South Dakota	36,245	33,713	226,756	74,430	322,755	197,800	3,214,515	1,948,448
Tennessee	827,243	994,447	50,828	75,300	659,809	595,351	383,743	88,247
Texas	3,210,656	3,722,125	83,066	33,293	3,535,064	3,491,618	1,257,954	264,444
Utah	312,584	224,135	37,842	35,566	273,775	197,481	1,149,015	577,723
Vermont	6,750	2,000	789	131	99,834	87,103	502,161	476,481
Virginia	611,992	751,860	---	---	1,382,932	1,688,711	384,640	169,717
Washington	2,184,366	1,694,036	432,788	521,108	1,300,231	1,161,003	2,799,407	1,639,139
West Virginia	568,743	681,791	---	---	662,676	717,703	117,134	159,564
Wisconsin	1,664,991	1,278,404	500,694	321,073	3,032,742	1,967,818	7,445,072	4,188,123
Wyoming	119,913	166,740	76,966	77,229	150,173	129,374	1,045,678	622,040
Undistributed [1]	49,267	81,500	936,000	1,086,000	1,807,903	1,488,584	7,124,000	3,078,000
Total	48,679,419	48,315,368	5,487,000	3,405,000	58,775,303	49,639,057	71,411,000	33,510,000

[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 1948, 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)			2,877,542	$2,325,788	741,927	$80,113
Alaska					(1)	(1)	(1)	(1)
Arizona	(1)	(1)	(1)	(1)	1,483,112	1,491,050	530,657	308,303
Arkansas	355,249	$200,620	1,401	$4,303	2,545,104	2,078,784	(1)	(1)
California	184,757	80,719	152,511	60,713	29,373,630	26,173,151	4,412,890	4,419,814
Colorado	58,841	35,204	(1)	(1)	1,072,040	1,096,179	3,834,259	1,561,431
Connecticut	(1)	(1)	(1)	(1)	1,806,654	1,414,022	770,194	73,508
Delaware					(1)	(1)		
Florida	321,280	309,792			2,175,781	2,407,325	136,350	25,250
Georgia					949,394	709,896	36,335	9,875
Hawaii							(1)	(1)
Idaho	302,478	66,890			1,527,883	1,312,766	2,143,150	1,239,458
Illinois	1,432,940	814,904	22,811	11,018	16,494,141	14,529,710	906,289	572,205
Indiana	618,533	413,320	52,014	38,433	8,999,360	6,919,249	439,998	172,673
Iowa	74,922	62,045	11,103	25,504	4,125,289	2,967,974	3,914,312	761,514
Kansas	295,125	101,148	903	1,138	4,271,837	2,520,567	811,246	228,198
Kentucky	(1)	(1)			1,702,938	1,820,222	364,055	248,558
Louisiana	125,493	75,341	6,974	4,783	4,319,420	5,204,046	(1)	(1)
Maine	109,729	51,797	3,310	1,791	496,355	286,765	(1)	(1)
Maryland			(1)	(1)	5,098,975	6,089,500	734,584	68,541
Massachusetts	13,007	963	16,718	7,248	5,135,938	4,335,261	364,412	82,871
Michigan	624,427	391,353	28,048	23,809	15,774,649	11,573,581	4,896,429	2,498,131
Minnesota	1,498,747	482,137	213,336	45,957	6,224,098	4,012,451	7,498,443	806,532
Mississippi	184,132	50,141	10,000	5,925	2,273,236	1,277,438	606,020	242,492
Missouri	213,731	138,613	4,500	4,037	4,290,504	3,895,490	596,107	302,432
Montana	923,803	665,232	488,066	348,315	2,410,670	1,847,957	4,973,203	1,409,000
Nebraska			1,107	2,450	4,253,496	2,721,701	472,034	211,555
Nevada	157,119	113,646			443,882	855,547	1,805,003	1,162,604
New Hampshire					394,452	403,025	2,087,206	248,017
New Jersey	(1)	(1)	81,416	164,108	6,325,445	7,489,662	(1)	(1)
New Mexico	93,211	57,103			717,088	573,385	(1)	(1)
New York	(1)	(1)	142,117	131,878	14,834,538	13,132,546	1,534,765	249,824
North Carolina	(1)	(1)			2,379,358	2,350,351	2,458,079	1,172,052
North Dakota	370,763	158,737	190,258	28,091	1,329,081	826,085	3,915,914	886,742
Ohio	1,191,866	778,761	279,823	485,155	15,129,290	14,965,657	379,525	184,191
Oklahoma					1,355,141	976,069	649,371	111,934
Oregon	355,634	295,720	18,593	9,089	5,262,933	5,389,893	3,121,822	5,238,996
Pennsylvania	90,083	50,000	34,612	61,333	11,939,061	15,231,526	483,485	72,494
Puerto Rico							(1)	(1)
Rhode Island					428,690	390,868	204,746	338,122
South Carolina	1,137	1,794			370,331	178,320	32,954	20,119
South Dakota	138,858	49,508	29,448	13,807	842,883	539,445	3,844,172	2,707,983
Tennessee	70,751	54,590	2,544	2,678	3,382,231	3,984,181	434,571	163,547
Texas	1,883,703	1,234,071	114,913	126,187	13,560,001	12,383,756	1,577,847	426,817
Utah	(1)	(1)	(1)	(1)	1,060,708	727,204	1,217,476	641,358
Vermont					212,784	138,922	518,903	480,147
Virginia	10,031	25,078			3,600,771	3,613,624	497,845	224,221
Washington	768,701	359,655	147,672	50,242	5,898,698	4,421,414	3,368,527	2,235,715
West Virginia	(1)	(1)	21,638	25,160	3,857,130	6,147,334	117,134	159,564
Wisconsin	825,967	292,761	101,581	81,225	9,393,079	6,592,405	9,220,009	4,777,684
Wyoming	442,245	310,640	(1)	(1)	811,449	735,761	1,210,399	772,145
Undistributed [1]	296,459	166,000	41,031	61,087	292,452	261,879	7,900,000	3,582,000
Total	14,033,722	7,888,283	2,218,448	1,825,464	233,503,522	211,319,732	85,763,000	41,178,000

[1] Figures that may not be shown separately are combined as "Undistributed."
[5] Includes 5,126,293 tons of ballast gravel valued at $1,823,741, produced by railroads for their own use.
[6] Includes 1,145,673 tons of gravel valued at $478,907, 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 1948 comprised 27 percent of the total tonnage, compared with 26 percent in 1947. The value of this tonnage in 1948 represented 16 percent of the total for the industry. The increase in quantity is mainly accounted for by sand and gravel utilized in paving construction, and gravel also showed a sizable gain for building purposes.

States reported 53 percent of the total Government-and-contractor output in 1948, counties 38, municipalities 2, and Federal agencies 7. In 1948, contractors furnished 50 percent of the Government-and-contractor tonnage compared with 49 percent in 1947. The average value increased 2 cents per ton in 1948.

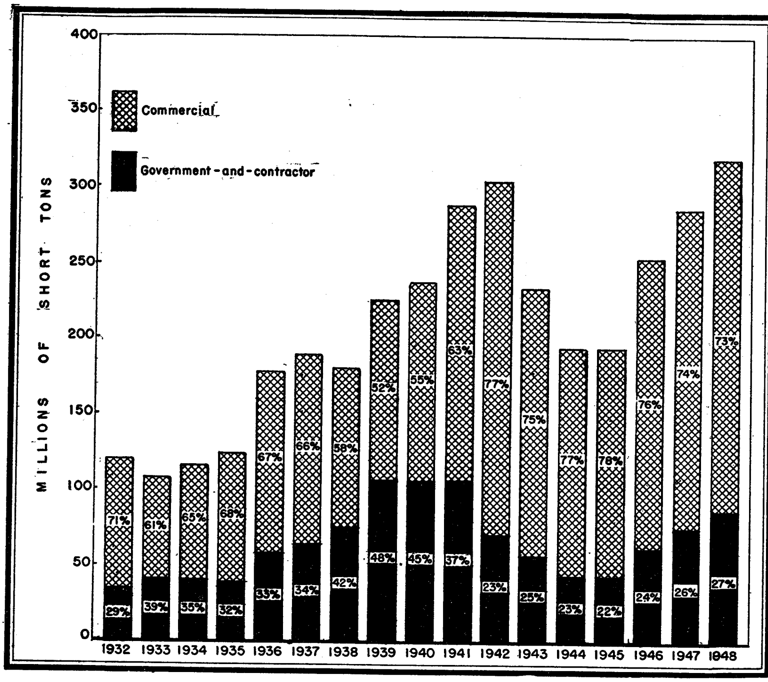

FIGURE 2.—Sand and gravel sold or used in the United States by commercial and Government-and-contractor producers, 1932–48

Sand and gravel sold or used by Government-and-contractor producers in the United States, 1944–48, 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)
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
1947	1, 551, 000	717, 000	6, 049, 000	2, 316, 000	2, 208, 000	1, 541, 000	65, 289, 000	29, 923, 000	75, 097, 000	34, 497, 000
1948	1, 529, 000	811, 000	7, 336, 000	3, 452, 000	5, 487, 000	3, 405, 000	71, 411, 000	33, 510, 000	85, 763, 000	41, 178, 000

Sand and gravel sold or used by Government-and-contractor producers in the United States, 1945–48, by type of producer

Type of producer	1945		1946		1947		1948	
	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	29,353,000	$0.31	37,614,000	$0.32	38,662,000	$0.35	42,531,000	$0.34
Contractors	14,033,000	.67	24,425,000	.46	36,435,000	.58	43,232,000	.62
Total	43,386,000	.42	62,039,000	.38	75,097,000	.46	85,763,000	.48
States	15,944,000	.44	30,812,000	.40	37,017,000	.49	45,166,000	.55
Counties	19,126,000	.28	26,005,000	.31	26,958,000	.34	32,260,000	.32
Municipalities	1,155,000	.30	1,402,000	.41	1,573,000	.46	1,881,000	.41
Federal agencies	7,161,000	.78	3,820,000	.63	9,549,000	.70	6,456,000	.83
Total	43,386,000	.42	62,039,000	.38	75,097,000	.46	85,763,000	.48

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 (commercial and Government-and-contractor) represented 73 percent of the total production in 1948 compared to 72 percent in 1947. This slight gain resulted from the increase in preparation of material by Government-and-contractor operations during 1948.

Sand and gravel (prepared or unprepared) sold or used by producers in the United States, 1947–48, by commercial and Government-and-contractor operations

	1947			1948		
	Quantity		Average value per ton	Quantity		Average value per ton
	Short tons	Percent		Short tons	Percent	
Commercial operations:						
Prepared	192,619,538	91	$0.89	212,072,878	91	$0.95
Unprepared	19,942,879	9	.51	21,430,644	9	.50
Total	212,562,417	100	.86	233,503,522	100	.90
Government-and-contractor operations:						
Prepared	14,689,000	20	.89	20,514,000	24	1.02
Unprepared	60,408,000	80	.36	65,249,000	76	.31
Total	75,097,000	100	.46	85,763,000	100	.48
Grand total	287,659,000		.75	319,266,000		.79

SIZE OF PLANTS

The average plant output of commercial operators, excepting railroad plants, approximated 96,000 short tons in 1948 compared with 92,000 tons in the previous year. Plants producing 100,000 to 200,000 tons in 1948 accounted for 20 percent of the total output, the largest quantity produced by any one group. Plants producing more than 500,000 tons annually increased from 58 to 63 and supplied 25 percent of the production. The less-than-25,000-ton group showed the greatest expansion in number of plants—from 869 to 916. 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, 1947–48, by size groups [1]

Size group, in short tons	1947				1948			
	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	869	38.9	8,366,000	4.1	916	38.6	8,975,000	4.0
25,000 to less than 50,000	388	17.4	14,098,000	6.8	395	16.7	14,486,000	6.4
50,000 to less than 100,000	404	18.1	28,729,000	14.0	429	18.1	30,277,000	13.3
100,000 to less than 200,000	298	13.3	41,655,000	20.2	324	13.7	45,203,000	19.9
200,000 to less than 300,000	136	6.1	33,165,000	16.1	148	6.3	36,078,000	15.9
300,000 to less than 400,000	56	2.5	19,395,000	9.4	60	2.5	20,505,000	9.0
400,000 to less than 500,000	27	1.2	12,065,000	5.9	36	1.5	15,909,000	7.0
500,000 to less than 600,000	25	1.1	13,614,000	6.6	20	.8	10,871,000	4.8
600,000 to less than 700,000	3	.1	1,934,000	.9	11	.5	7,076,000	3.1
700,000 to less than 800,000	7	.3	5,139,000	2.5	3	.1	2,202,000	1.0
800,000 to less than 900,000	3	.1	2,517,000	1.2	8	.3	6,782,000	3.0
900,000 to less than 1,000,000	5	.2	4,690,000	2.3	4	.2	3,826,000	1.7
1,000,000 and over	15	.7	20,547,000	10.0	17	.7	24,756,000	10.9
Total	2,236	100.0	205,914,000	100.0	2,371	100.0	226,946,000	100.0

[1] Excludes operations by or for States, counties, municipalities, and Federal Government agencies as follows—1947: 759 with an output of 75,097,000 tons of sand and gravel; 1948: 774 operations, 85,763,000 tons. Excludes operations by or for railroads as follows—1947: 163 with an ouput of 6,648,000 tons of sand and gravel; 1948: 147 operations, 6,557,000 tons.

[2] Includes a few companies operating more than 1 plant but not submitting separate returns for individual plants.

METHOD OF TRANSPORTATION

Truck transportation in 1948 moved 56 percent of shipments from commercial plants. Railroads carried most of the remainder, but their portion of the total decreased from 38 percent in 1947 to 35 in 1948. The amount shipped by waterway, a method important in a few areas, decreased 1 percent in 1948. As shown in the accompanying table, the percentage of total shipments (including Government-and-contractor material as well as the output of commercial plants) moved by truck is greater than indicated in the above figures. In 1948 truck movements comprised 68 percent of the grand total.

Sand and gravel sold or used by commercial producers in the United States, 1947–48, by methods of transportation [1]

Method of transportation	1947		1948	
	Short tons	Percent of total reported	Short tons	Percent of total reported
Truck	107,380,870	53.1	125,468,383	56.2
Rail	75,941,543	37.5	78,888,488	35.4
Waterway	19,003,120	9.4	18,838,840	8.4
Total reported	202,325,533	100.0	223,195,711	100.0
Percent of total commercial production covered		95.2		95.6

[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—1947: truck 66 percent, rail 27 percent, and waterway 7 percent; 1948: truck 68 percent, rail 26 percent, and waterway 6 percent.

CONSUMPTION TRENDS

Sand and Gravel for Construction.—The demand for sand and gravel by the construction industry in 1948, as measured by shipments from commercial plants, increased sharply over 1947. Building sand reached a total of 59,357,062 short tons, a figure 13 percent above that reported for 1947. Paving sand likewise showed a strong increase over the preceding year's figure, as did gravel for building and paving. The heavy building program, both public and private, and paving projects accounted for the substantial increase in sand and gravel consumption.

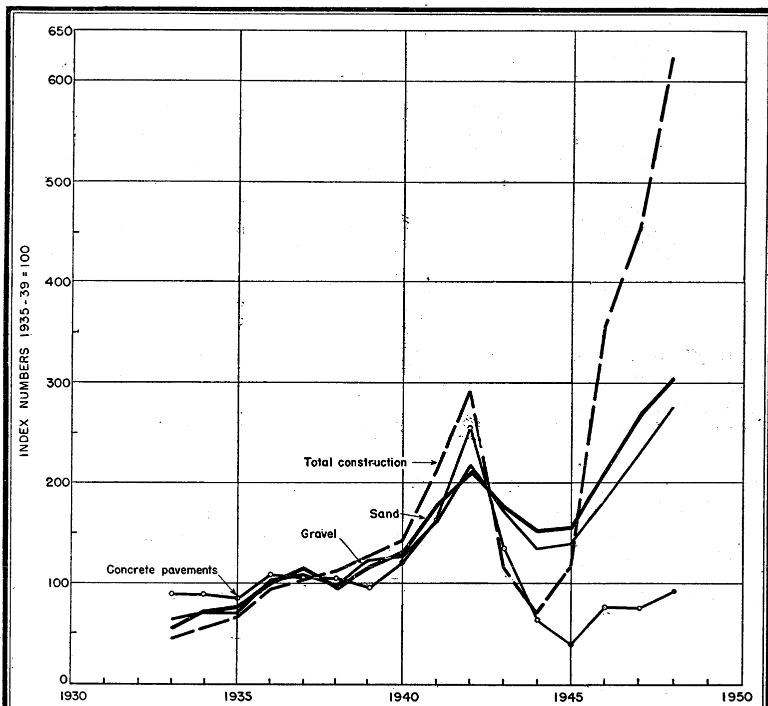

FIGURE 3.—Value of sand and gravel production compared with total construction (contract awards, value) and concrete pavements (contract awards, square yards) in the United States, 1933–48. Data on construction and pavements from the Bureau of Foreign and Domestic Commerce.

Industrial Sands.—The output of industrial sands in 1948 suffered declines ranging from 0.5 percent for molding sand to 25 percent for filter sand. The percentage decreases for glass, fire or furnace, and engine sands were 15, 14, and 9, respectively. However, the output for grinding and polishing uses increased 2 percent. The volume output of these sands depends largely on industrial production; consequently, their output is governed by industry trends.

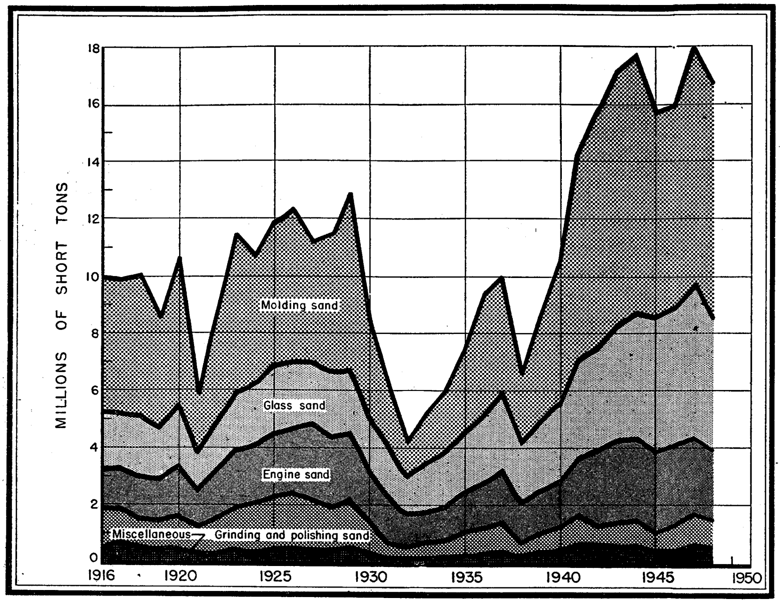

FIGURE 4.—Production of industrial sands in the United States, 1916–48.

Employment and Productivity.—In 1948 the total number of men employed in the commercial sand and gravel industry averaged more than 25,000, or about the same as in 1947. As the following table indicates, the average number of days worked (246) was the same as in the preceding year, and the average production per man per shift increased from 34.4 to 37.2 short tons. The accompanying table, showing a break-down of employment and production, by regions, of all commercial plants (except those operated by railroads) indicates that the California-Nevada region, as in 1947, employed the greatest number of men. The highest production per man per hour and shift was reported from the Michigan-Wisconsin region.

Employment in the commercial sand and gravel industry and average output per man in the United States, 1944–48, by regions [1]

	Employment: Average number of men	Employment: Time employed: Average number of days	Employment: Time employed: Total man-shifts	Employment: Time employed: Man-hours: Average per man per day	Employment: Time employed: Man-hours: Total	Production (short tons): Commercial sand and gravel	Production (short tons): Average per man: Per shift	Production (short tons): Average per man: Per hour	Percent of commercial industry represented
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
1947									
Maine, N. H., Vt., R. I., Mass., and Conn.	765	197	150,517	8.6	1,289,749	6,198,548	41.2	4.8	80.2
N. Y.	1,079	227	245,043	8.4	2,066,772	9,482,905	38.7	4.6	76.4
Pa., N. J., and Del.	2,318	276	640,643	8.5	5,450,121	16,247,643	25.4	3.0	97.6
W. Va., Va., Md., and D. C.	1,574	279	439,776	9.0	3,945,140	10,061,790	22.9	2.6	88.7
S. C., Ga., Ala., Fla., and Miss.	1,068	275	293,945	9.1	2,661,071	7,736,670	26.3	2.9	92.1
N. C., Ky., and Tenn.	919	258	236,918	9.5	2,243,670	5,742,810	24.2	2.6	79.0
Ark., La., and Tex.	1,790	268	479,581	9.3	4,462,114	14,122,938	29.4	3.2	76.8
Ohio	1,665	257	428,483	8.4	3,588,959	14,137,502	33.0	3.9	95.2
Ill. and Ind.	2,039	251	512,553	8.6	4,416,505	22,156,695	43.2	5.0	90.6
Mich. and Wis.	1,856	200	371,863	9.0	3,346,382	18,476,607	49.7	5.5	88.8
N. Dak., S. Dak., and Minn.	539	166	89,326	9.1	812,288	4,652,126	52.1	5.7	60.1
Nebr. and Iowa	409	209	85,296	9.2	787,989	3,585,440	42.0	4.6	50.5
Kans., Mo., and Okla.	940	251	235,643	8.8	2,062,929	8,301,281	35.2	4.0	88.1
Wyo., Colo., N. Mex., Utah, and Ariz.	585	204	119,593	8.3	997,805	3,893,002	32.6	3.9	78.2
Calif. and Nev.	2,451	259	635,112	8.1	5,163,405	25,384,143	40.0	4.9	88.0
Mont., Wash., Oreg., and Idaho	1,247	204	253,872	8.2	2,081,281	9,484,422	37.4	4.6	77.9
Total	21,244	246	5,218,164	8.7	45,376,180	179,664,522	34.4	4.0	84.5
1948									
Maine, N. H., Vt., R. I., Mass., and Conn.	819	212	173,454	8.6	1,492,570	7,766,192	44.8	5.2	91.6
N. Y.	1,109	235	260,717	8.4	2,189,002	11,044,255	42.4	5.0	74.4
Pa., N. J., and Del.	2,419	275	664,715	8.4	5,609,262	17,770,242	26.7	3.2	95.8
W. Va., Va., Md., and D. C.	1,747	270	471,289	9.0	4,242,050	10,854,258	23.0	2.6	86.4
S. C., Ga., Ala., Fla., and Miss.	969	268	260,022	9.1	2,360,940	8,128,399	31.3	3.4	94.0
N. C., Ky., and Tenn.	921	264	243,356	9.1	2,209,890	6,437,476	26.5	2.9	86.2
Ark., La., and Tex.	1,591	310	492,655	8.0	3,934,280	14,271,231	29.0	3.6	69.9
Ohio	1,618	259	419,236	8.4	3,512,113	14,526,897	34.7	4.1	96.0
Ill. and Ind.	2,104	244	512,484	8.5	4,354,167	22,799,985	44.5	5.2	89.4
Mich. and Wis.	2,038	206	419,649	9.0	3,760,527	22,666,492	54.0	6.0	90.1
N. Dak., S. Dak., and Minn.	763	176	134,635	9.2	1,239,238	5,239,577	38.9	4.2	62.4
Nebr. and Iowa	659	195	128,296	9.4	1,201,903	6,874,071	53.6	5.7	82.0
Kans., Mo., and Okla.	951	235	223,873	8.6	1,920,846	9,143,233	40.8	4.8	92.2
Wyo., Colo., N. Mex., Utah, and Ariz.	453	208	94,103	8.4	787,080	4,539,368	48.2	5.8	88.2
Calif. and Nev.	2,516	252	635,143	8.2	5,203,952	26,950,548	42.4	5.2	90.4
Mont., Wash., Oreg., and Idaho	1,218	210	255,540	8.2	2,085,525	11,694,539	45.8	5.6	77.4
Total	21,895	246	5,389,167	8.6	46,103,345	200,706,763	37.2	4.4	86.0

[1] Excludes plants operated by or directly for States, counties, municipalities, and Federal Government agencies.

PRICES

The average value for all shipments of sand and gravel in 1948 increased 5 percent over the previous year's figure. For commercial plants the average value increased 5 percent compared with 12 percent in 1947, thus reflecting the rise in labor and other production costs. The change for Government-and-contractor operations amounted to a 4-percent increase over 1947. Higher prices were the rule rather than the exception. Increases of 3 and 6 cents per ton were recorded for building and paving sand, increases for other types ranged from 12 cents for molding sand to 69 cents per ton for filter sand. Sand for railroad ballast decreased 2 cents per ton compared with 1947, whereas gravel for building and paving showed increases of 7 cents and 1 cent per ton, respectively. With the exception of gravel for building, the unit values of Government-and-contractor output also increased in 1948.

FOREIGN TRADE [1]

Imports of sand and gravel in 1948 amounted to 441,456 short tons, 9 percent in quantity and 14 percent in value lower than in 1947. Belgium-Luxembourg supplied virtually all of the glass sand, while Canada furnished 328,224 short tons of "other sand" with Belgium-Luxembourg, Iceland, United Kingdom, France, Turkey, Australia, and Egypt supplying the balance. The gravel imported amounted to 89,174 short tons and came from Canada and the United Kingdom.

Sand and gravel imported for consumption in the United States, by classes, 1939–48

[U. S. Department of Commerce]

Year	Sand				Gravel		Total	
	Glass sand [1]		Other sand [2]					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
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	80,861	43,976	281,141	170,226
1946	5,006	9,102	262,485	194,830	83,860	25,847	351,351	229,779
1947	7,804	12,532	297,481	283,884	177,244	100,665	482,529	397,081
1948	16,914	24,134	335,368	287,521	89,174	30,411	441,456	342,066

[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: 1939–47: "Sand, n. s. p. f."; 1948: "Sand, n. s. p. f., crude or manufactured."
[3] 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.

TECHNOLOGY

The sink-float process is used extensively in the mineral separation of metallic ores. The possibility of using this method in the sand and gravel industry for separating aggregate of different specific gravities and for the removal of such deleterious matter as clay-balls, coal, wood chips, etc., has been suggested.[2]

One method of solving the problem of blending different-size aggregates has been developed by a sand-and-gravel plant in the Northwest. A reclaiming belt serves 10 steel storage silos in such a manner as to blend the materials to meet almost any specification.[3] Another plant in the Northwest features a blending system with belt conveyors, radial stock pilers, and other features to produce many sizes of aggregate.[4]

Two aids for determining the moisture content of sand for use in connection with ready-mixed concrete have been developed. These charts, used in conjunction with the Chapman flask method will aid in producing uniform concrete.[5] A method of freeing glass sands from ferruginous impurities by two-stage flotation is described in United States Patent 2,433,633.[6] Two articles on foundry sands have been recently released.[7] The American Society for Testing Materials has published a report dealing with the characteristics and uses of mineral aggregates.[8] The use of sand and emulsified asphalt for airport runway bases has been discussed.[9]

[2] Rock Products, vol. 51, No. 10, October 1948, pp. 100–103, 117–119.
[3] Rock Products, vol. 51, No. 11, November 1948, p. 68.
[4] Rock Products, vol. 51, No. 10, October 1948, pp. 88–94.
[5] Rock Products, vol. 51, No. 5, May 1948, pp. 140–141.
[6] British Abs., November 1948, p. 614.
[7] C. A. Sanders, Foundry Sand Evaluated—Naturally Bonded vs. Synthetic Sands: Refractories Jour. London), No. 10, October 1948, pp. 369–376.
Chemical and Engineering News, vol. 26, No. 27, July 5, 1948, p. 2009.
[8] American Society for Testing Materials, Mineral Aggregates: Spec. Tech. Pub. 83, October 1948, pp. 240.
[9] American Road Builders Association, Airport Runway Base Construction with Emulsified Asphalt and Sand: Tech. Bull. 140, 1948, 6 pp.

Secondary Metals—Nonferrous

By ARCHIE J. McDERMID[1]

GENERAL SUMMARY

PLANTS recovering secondary metal from nonferrous scrap had a busy year in general in 1948. Secondary production of most metals was not as large in 1948 as in 1947, but prices received for all but magnesium were higher. Demand for metal products did not fluctuate as much as in 1947, and this was reflected in steadier operation of plants consuming scrap. Activities of aluminum ingot makers, contrary to the general trend, were severely restricted because of the dwindling supply of military aircraft scrap, so plentiful immediately after World War II. Demand for aluminum ingot by foundries was firm all year. Primary producers offered the ingot makers strong competition for available plant scrap during the year.

Salient statistics of nonferrous secondary metals recovered in the United States, 1947–48

Metal	From new scrap		From old scrap		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1947						
Aluminum	180,990	$51,147,774	163,847	$46,303,162	344,837	$97,450,936
Antimony	3,794	2,538,186	19,190	12,838,110	22,984	15,376,296
Copper	458,365	191,596,570	503,376	210,411,168	961,741	402,007,738
Lead	67,392	19,274,112	444,578	127,149,308	511,970	146,423,420
Magnesium	4,907	2,011,870	4,596	1,884,360	9,503	3,896,230
Nickel	6,734	5,073,395	2,807	2,114,794	9,541	7,188,189
Tin	11,055	17,232,534	18,999	29,615,641	30,054	46,848,175
Zinc	235,814	50,464,196	74,979	16,045,506	310,793	66,509,702
Total		339,338,637		446,362,049		785,700,686
1948						
Aluminum	191,129	55,427,410	95,648	27,737,920	286,777	83,165,330
Antimony	3,594	2,635,840	17,998	13,199,733	21,592	15,835,573
Copper	467,324	202,818,616	505,464	219,371,376	972,788	422,189,992
Lead	67,338	24,107,004	432,733	154,918,414	500,071	179,025,418
Magnesium	3,376	1,384,160	4,458	1,827,780	7,834	3,211,940
Nickel	5,944	4,679,117	2,906	2,287,603	8,850	6,966,720
Tin	10,034	19,917,490	20,090	39,878,650	30,124	59,796,140
Zinc	250,449	66,619,434	74,190	19,734,540	324,639	86,353,974
Total		377,589,071		478,956,016		856,545,087

[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.

Recovery of aluminum from scrap decreased 58,060 tons compared with 1947. Decreases in lead, magnesium, antimony, and nickel from scrap, totaled 15,651 tons, and copper, zinc, and tin from scrap made an aggregate gain of 24,963 tons. All types of aluminum- and lead-base scrap were scarce throughout 1948. The supplies of copper-base and zinc-base scrap were relatively more abundant than those of lead-base and aluminum-base, and consumption of both was a little greater than in 1947. Scrap prices reached their peaks in November and declined in December. There were numerous advances in the prices of the metals discussed in this chapter and no reductions.

The value of metals recovered in 1948 from both old and new scrap was $856,545,087 compared with $785,700,686 in 1947. The increase, as in 1947, was attributable to higher unit values. The value of metals recovered from old scrap in 1948 increased for the sixth successive year, totaling $478,956,016 compared with $446,362,049 in 1947. The new scrap recovery value increased a comparable amount and totaled $377,589,071.

The figures for the values of secondary metals recovered are calculated on the basis of replacement of primary metals by secondary; that is, it is assumed that if the plants involved had not been able to use scrap in their operations they would have had to use primary metals worth the figures quoted above. The amounts are useful for year-to-year comparisons but do not represent actual receipts by the secondary plants for their products. As a matter of fact, the unit prices of secondary metals usually are somewhat less than those of primary metals of the same purity and composition. Secondary smelters operate through their ability to remelt scrap items of different composition in the proper proportions to form ingot of specified grade at such a price that foundries will buy it instead of producing their own alloys from primary metals or scrap.

Secondary metals recovered as unalloyed metal, in alloys, and in chemical compounds in the United States, 1944–48, in short tons

Metal	1944	1945	1946	1947	1948
Aluminum	325, 645	298, 387	278, 073	344, 837	286, 777
Antimony	15, 886	17, 148	19, 115	22, 984	21, 592
Copper	950, 942	1, 006, 516	803, 546	961, 741	972, 788
Lead	331, 416	363, 039	392, 787	511, 970	500, 071
Magnesium	14, 185	9, 247	5, 117	9, 503	7, 834
Nickel	4, 321	6, 483	8, 248	9, 541	8, 850
Tin	32, 589	35, 133	27, 671	30, 054	30, 124
Zinc	345, 469	360, 444	300, 682	310, 793	324, 639

SCOPE OF REPORT

Plants canvassed in nonferrous secondary metal surveys include all known consumers of purchased nonferrous scrap metals, as well as consumers of refined copper and brass ingot. The accompanying table classifies the plants canvassed by type of operation and kind of material consumed. Secondary smelters have been recorded in more than one column if they used more than one kind of material; otherwise, there is no duplication. The tabulation of the number of plants in some categories is subject to limitations. The large number of foundries and the small size of many of them makes it impossible to obtain reports from all units. On the other hand, a few large corporations operating more than one plant prefer to file consolidated reports, in which the number and location of plants are not given, with the result that only one plant is credited. These limitations, however, do not affect seriously the validity of the data presented.

Number and classification of plants consuming nonferrous scrap metals, refined copper, and copper-alloy ingots in 1948

Kind of plant	Type of material used				
	Aluminum	Copper	Lead and tin	Zinc	All nonferrous types
Primary producers	[1] 26	17	8		
Secondary smelters	[2] 67	[3] 106	267	136	
Distillers				[4] 23	
Chemical plants	17	46		21	
Brass mills		50			
Wire mills		[5] 14			
Foundries and miscellaneous manufacturers			35	[6] 14	[7] 2,900

[1] Includes aluminum reduction plants and rolling mills.
[2] Includes 57 aluminum-alloy ingot makers, 5 army airfields, and 5 naval air stations.
[3] Includes 74 secondary copper smelters and 32 smelters using copper scrap in other than copper alloys.
[4] Includes 18 secondary plants, including zinc-dust plants, and 5 primary producers which used scrap in addition to ore.
[5] Refers to companies operating wire mills. Some companies operate more than 1 plant.
[6] Includes galvanizers, die casters, and zinc rolling mills.
[7] Chiefly brass foundries, but some aluminum foundries, iron foundries, steel plants, and miscellaneous manufacturers. Any or all types of nonferrous scrap were used by these consumers. Excludes plants not established in Bureau of Mines scrap surveys.

The statements from industry, on which data in this chapter are based, were received monthly from the larger smelters, chemical plants, and manufacturers and from brass and wire mills. Foundries, primary aluminum producers, and smaller plants of other types were canvassed on an annual basis.

Definitions of 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 the metal and has no relation to the type of product recovered, either as to quality, degree of purity, or physical characteristics.

Scrap metals are divided into three main categories: Old scrap, process or plant scrap, and defective finished or semifinished articles returned by purchasers to be reworked.

"Old" scrap is defined as consisting of metal articles that have been discarded because of wear, damage, or obsolescence, usually after serving a useful purpose. Typical examples of old scrap are discarded trolley wire, battery plates, railroad-car boxes, fired cartridge cases, automobile crank cases, used pipe, lithographers' plates, and obsolete military equipment (frequently unused).

"Process" scrap is that generated during the manufacture of articles for ultimate consumption. Typical examples of process scrap are clippings, turnings, borings, skimmings, slags, and drosses.

"Process" scrap is divided into two classifications: "Home" scrap, consumed in the plant of generation, and "new" scrap, which is consumed elsewhere, either after sale to another company or shipment to another plant of the same company. Defective articles, the third main class of scrap, are classed as new scrap for tabulation purposes. In this chapter consumption of old and new scrap only is tabulated, no record being kept, in nonferrous metal canvasses, of home scrap. Consumption of scrap is always measured at the point where it loses its identity as scrap and becomes secondary metal.

Borings and turnings and other items of process scrap when consumed outside the plant of generation are new scrap, whether clean, rusty, or oily and whether generated recently or long before reclamation. Residues are new scrap if generated in processing scrap or refined metal. For example, flue dust from smelting brass scrap is new scrap. Zinc chemical residues resulting from the consumption of zinc dust in the manufacture of sodium hydrosulfite are also new scrap. Residues generated in processing ore or concentrates are not scrap but primary residue. Old mine tailings are primary residue because generated in processing ore.

SECONDARY ALUMINUM

The recovery of secondary aluminum from scrap totaled 286,777 short tons, valued at $83,165,330, a decrease of 17 percent in quantity from the record 344,837 tons valued at $97,450,936 reclaimed in 1947. Values were calculated on the basis of the average market price of primary pig, which was 14.13 cents in 1947 and 14.50 cents a pound in 1948.

Secondary aluminum [1] recovered in the United States, 1947–48, in short tons

Secondary aluminum recovered			Recoverable aluminum-alloy content of scrap		
Form of recovery	1947	1948	Kind of scrap processed	1947	1948
As metal	5,105	2,384	New scrap:		
Aluminum alloys	338,200	282,302	Aluminum-base [2]	180,782	190,736
In brass and bronze	307	455	Copper-base	67	99
In zinc-base alloys	624	776	Zinc-base	93	95
In magnesium alloys	222	354	Magnesium-base	48	199
In chemical compounds	379	506	Total	180,990	191,129
Grand total	344,837	286,777	Old scrap:		
			Aluminum-base [3]	163,110	95,101
			Copper-base	84	93
			Zinc-base	346	292
			Magnesium-base	307	162
			Total	163,847	95,648
			Grand total	344,837	286,777

[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 166,269 tons in 1947 and 179,516 tons in 1948.
[3] Recoverable aluminum content of old aluminum-base scrap was 150,219 tons in 1947 and 86,028 tons in 1948.

The drop in recovery in 1948 is attributable to the decline in supplies of scrapped military aircraft which had been plentiful since 1942. The last important concentrations of this material were at five airfields where the Army had gathered obsolete and damaged aircraft and later sold them to contractors who melted them into alloy ingot or broke them up for shipment to smelters. All but a small fraction of this scrap had been disposed of in 1947 and the remainder in the first few months of 1948. As a result of the short supply of aircraft scrap, which is old scrap, the recovery of aluminum alloy from old aluminum-base scrap declined from 163,110 tons in 1947 to 95,101 tons in 1948. There was a moderate increase in recovery from new aluminum-base scrap. Secondary aluminum recovered as metal and in aluminum alloys decreased from 5,105 and 338,200 tons, respectively, in 1947 to 2,384 and 282,302 tons in 1948, but secondary aluminum recovered in brass and bronze, in zinc-base alloys, in magnesium alloys, and in chemical compounds increased 48, 24, 59, and 34 percent, respectively.

Production of aluminum-alloy ingot by secondary smelters (ingot makers), naval air stations, and contractors melting obsolete army planes totaled 190,039 tons in 1948, representing a decrease of 27 percent from 1947. The output of the ingot makers alone was 176,263 tons in 1948, 4,122 tons less than in 1947. The primary plants produce alloy ingot to be made into castings by foundries and into wrought products by fabricators; but the purchased scrap, home scrap, and primary aluminum from which the ingot is made are so intermingled that the quantities of scrap used in castings cannot be measured or calculated separately from those used in wrought products. Secondary production by primary producers is therefore reported as "Secondary aluminum at primary plants" in the production table. The total for this item increased from 84,074 tons in 1947 to 93,159 tons in 1948.

Production of secondary aluminum and aluminum-alloy products in the United States, 1946–48, gross weight in short tons

Product	1946	1947	1948
Secondary aluminum ingot: [1]			
Pure aluminum (98.5 percent)	2,075	5,052	2,328
Silicon (max. Cu, 1 percent)	15,700	12,370	11,786
Silicon (Cu, 1 to 2.5 percent)	7,268	5,108	4,694
No. 12 aluminum	38,286	27,605	19,509
Other aluminum-copper (max. Si, 2.5 percent) alloys	23,714	89,642	[2] 17,612
Copper-silicon (each over 2.5 percent) alloys	67,540	72,286	80,940
Aluminum-copper- or aluminum-silicon-nickel alloys	2,603	2,101	3,791
Deoxidizing and other destructive uses	31,011	28,965	34,143
Aluminum hardeners	2,242	2,695	3,989
Al-Mg and Al-Zn alloys	17,135	3,833	2,860
Miscellaneous		10,258	8,387
Total	207,574	259,915	190,039
Secondary aluminum at primary plants [3]	73,388	84,074	93,159
Aluminum powder		[4] 53	[4] 56
Aluminum-alloy castings	4,444	7,645	5,289
Aluminum in chemicals	563	379	506

[1] Gross weight of alloys, including copper, silicon, and other added elements; total secondary ingot contained 1,025 tons of primary aluminum in 1946, 1,525 tons in 1947, and 3,033 tons in 1948.
[2] Of the total, 13,776 tons produced at naval air stations and plants of contractors melting down army planes.
[3] Combined with primary aluminum for the production of wrought products and castings.
[4] Does not include production measured as ingot for graining, powder, atomizing, or chemical purposes.

Production from aircraft scrap, when melted separately, is assigned to "Other aluminum-copper" alloys. Output of this alloy declined sharply from 89,642 tons in 1947 to 17,612 tons in 1948 as a result of decreased consumption of aircraft scrap at secondary smelters from 135,795 tons in 1947 to 43,196 in 1948. Production of copper-silicon alloys (each over 2.5 percent) increased 12 percent to 80,940 tons, and that of deoxidizing ingot, after a 3-year decline, increased 18 percent to 34,143 tons. Output of No. 12 aluminum decreased to 19,509 tons in 1948. The recovery and production tables of the Secondary Copper and Brass section are compared in detail in that section, and the observations made there apply in general to the same tables in the Secondary Aluminum section.

Aluminum was reported to be gaining as a competitor of zinc in die casting in 1948.[2] Aluminum die castings can be made from a number of types of aluminum alloys, all of which can be made from scrap, but the composition of zinc die castings must be held within narrow limits. Special high-grade zinc is generally used, and the allowable maximums for tin, cadmium, and lead are less than 0.01 percent. Because of this limitation in specifications, zinc die-casting manufacturers will use only scrap castings returned by their own customers. Zinc is preferred for die casting because it has a lower melting point than aluminum and has better casting qualities, but aluminum is lighter and stronger.

The consumption of aluminum scrap in 1948 was limited to 324,495 tons because more was not available. There was strong demand for both primary and secondary aluminum that was only partly satisfied, and the shortage was accentuated by lack of water power for operating aluminum reduction works, brought on by dry weather in many areas of the country. Early in the year the Reynolds plant at Longview Wash., suspended operations because of water-power shortage, and in June this company's plant at Troutdale, Oreg., was idle as a result of floods. Primary producers and rolling mills competed with secondary smelters for scrap. Fabricators and foundries with scrap to return had an advantage in the buying of scarce ingot. The secondary smelters, which had no primary metal to sell but only the ingot they made from scrap, were at a disadvantage. The fabricators, needing primary ingot, favored the primary producers in the sale of their scrap. This situation was thoroughly discussed by Carl H. Burton, secretary of the Aluminum Research Institute.[3]

Consumption of old and new aluminum scrap in the United States in 1948, gross weight in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries: Reduction plants and aluminum rolling mills		Manufacturers and foundries: Foundries and other manufacturers		Total scrap used
	New scrap	Old scrap	New scrap	Old scrap	New scrap	Old scrap	
Pure clippings, wire, and foil	11,018	490	28,627	97	573	77	40,882
Castings and forgings	17,846	23,638	1,949	7,713	1,012	2,025	54,183
Alloy sheet	40,546	4,952	48,130	219	12	5	93,864
Scrap sheet and sheet utensil		5,652		376	1,555	386	7,969
Borings and turnings	29,271		1,966		256		31,493
Aircraft scrap		43,196		11,360			54,556
Miscellaneous aluminum and dross	22,418	18,639	5	12	474		41,548
Total	121,099	96,567	80,677	19,777	3,882	2,493	324,495

[2] Kenly, R. G., The Outlook for Zinc Markets: Am. Met. Market, vol. 56, No. 71, Apr. 12, 1949, p. 5.
[3] Burton, Carl H., Address before the Die Casting Institute: Am. Met. Market, vol. 55, No. 208, Oct. 28, 1948, pp. 1, 6.

Aluminum rolling mills consumed 100,454 tons of aluminum scrap in 1948, 10,445 tons more than in 1947; smelters and airfields consumed 217,666 tons in 1948, 94,421 tons less than in 1947. Total consumption of old scrap other than aircraft scrap decreased slightly in 1948, but treatment of new scrap increased 9,018 tons to 205,658 tons. The construction industry is currently the largest consumer of aluminum, but this metal cannot be expected to return to secondary smelters as old scrap for a considerable time. More aluminum probably will continue to be recovered from new scrap than from old for several years at least.

Stocks of aluminum scrap in the hands of consumers totaled 28,698 tons at the end of 1948 compared with 44,139 tons at the end of 1947 and 52,386 at the end of 1946. All types of scrap participated in the 1948 decline, the greatest drop being 5,945 tons or 53 percent in castings and forgings.

Consumers' stocks of aluminum-base scrap in the United States at end of year, 1947–48, gross weight, in short tons

Scrap item	Dec. 31, 1947	Dec. 31, 1948
Castings and forgings	11,296	5,351
Sheet, turnings, clippings, etc.	21,054	16,428
Aircraft scrap	6,331	2,716
Miscellaneous aluminum and dross	5,458	4,203
Total	44,139	28,698

Dealers' buying prices for cast aluminum scrap increased from an average monthly price of 7.11 cents a pound in January to 8.84 cents in June. In July it increased to 10.87 cents, then declined to 9.95 cents in October. Average prices in November and December were 12.41 and 13.25 cents, respectively, and the average for the year was 9.44 cents. The price for new aluminum clippings averaged 9.11 cents in January and 9.25 cents in February and March, then increased in each of the succeeding months of the year and was 16.75 cents in December, the average for the year being 11.82 cents. The Aluminum Co. of America advanced the price of primary aluminum pig from 14 to 15 cents a pound on June 28, 1948, because wage increases to its employees had increased the cost of production. The price was raised an additional cent on October 11.

Imports of aluminum scrap in 1948 were 71,728 tons compared with 15,719 tons in 1947. Exports were 438 tons in 1948 and 788 tons in 1947.

SECONDARY ANTIMONY

Recovery of secondary antimony from lead- and tin-base scrap totaled 21,592 short tons valued at $15,835,573, a 6-percent decrease from the 22,984 tons valued at $15,376,296 reclaimed in 1947. The value was computed at 36.67 cents a pound in 1948 and at 33.45 cents in 1947, the average New York selling price for primary antimony.

Secondary antimony recovered in the United States, 1947–48, in short tons

Secondary antimony recovered			Recoverable antimony content of scrap		
Form of recovery	1947	1948	Kind of scrap processed	1947	1948
In antimonial lead	16,638	14,163	New scrap:		
In other lead alloys	6,168	[illegible],225	Lead-base	3,794	3,594
In tin-base alloys	178	204	Tin-base		
Grand total	22,984	21,592	Total	3,794	3,594
			Old scrap:		
			Lead-base	19,035	17,816
			Tin-base	155	182
			Total	19,190	17,998
			Grand total	22,984	21,592

In 1948, 56 percent of all antimony recovered from scrap came from old battery plates, always the principal source of secondary antimony.

The quantity of battery plates treated in 1948 decreased 6 percent; correspondingly, antimony recovered from this source decreased 6 percent, from 12,950 tons in 1947 to 12,111 tons in 1948. Antimony recovered from scrap in all antimonial lead decreased at both primary and secondary plants but gained in both lead- and tin-base alloys. Remelters, smelters, and refiners recovered 95 percent of the antimony reclaimed, and bearing manufacturers and foundries the remaining 5 percent. Data on consumption of purchased scrap from which antimony was recovered will be found in the tables on consumption of lead- 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 tables.

Production of unalloyed lead from scrap in 1948 was reported as 135,071 tons, gross weight. Of this total, at least 65,000 tons were probably obtained by softening antimonial lead scrap, because the only other scrap from which secondary unalloyed lead would ordinarily be obtained was soft lead scrap from which 70,470 tons of lead were recovered in 1948. The high-antimony drosses resulting from the softening operation were consumed in other products. Of the 15,455 tons of primary antimony consumed in 1948, 9,381 tons emerged chiefly in lead and tin alloys, the balance being used in nonmetal products. Thus the secondary antimony recovered was more than twice the primary antimony used in metal products and 40 percent more than the total primary antimony consumed. As far as could be determined, all antimony recovered remained in the alloyed state, none being reclaimed as unalloyed metal or in chemical compounds.

Domestic demand for antimony nearly balanced supply in 1948, but to insure purchases for the National Strategic Stock Pile, General Preference Order M–112, controlling allocation, exports, and imports of antimony, was continued through the year.

The price of primary antimony in January 1948 was 34.61 cents a pound f. o. b. New York, according to the American Metal Market. Five increases during the year raised the New York selling price to 40.17 cents, where it remained throughout November and December.

SECONDARY COPPER AND BRASS

The recovery of secondary copper from scrap totaled 972,788 short tons, valued at $422,189,992, in 1948—an increase of 1 percent in quantity over the 961,741 tons valued at $402,007,738 recovered in 1947. Value was computed at 20.9 cents a pound in 1947 and 21.7 cents a pound in 1948, the yearly average weighted prices of all grades of refined copper sold by producers in the 2 years, exclusive of bonus payments under the Premium Price Plan terminated June 30, 1947.

Secondary copper output data are presented in two accompanying tables, the first of which is double and shows secondary copper recovered according to composition on the left and according to class of scrap processed on the right side. The data on the left side are compiled from individual plant outputs and those on the right by calculating the copper that could be recovered from the quantities of the different kinds of scrap reported used. The totals so derived for each side of the table emerge different because of slight errors introduced by the necessity of assuming recovery factors. As presented here, however, the items have been adjusted to effect the exact balance theoretically to be expected. The word "recovery" thus may be applied to both sides of the table.

The copper recovered from scrap falls mainly into two categories—that recovered as unalloyed copper and that recovered in brass and bronze. The other items are minor. Copper recovered from scrap in unalloyed form declined to 284,026 tons in 1948 from 303,092 tons in 1947 but was still well above the 136,909 tons reclaimed in this form in 1946. On the other hand, copper recovered in brass and bronze rose 5 percent to 653,281 tons in 1948 compared with 1947. The scrap from which the recovery is made is classified as new and old. Both types of scrap yielded more recoverable metal in 1948 than in 1947.

Total copper production consists of copper recovered from old and new scrap plus copper produced from primary materials. The 1,107,446 tons produced by refineries from domestic and foreign primary materials in 1948, as reported in the Copper chapter, is obviously an addition to the available supply. The reason for considering the 505,464 tons recovered from old scrap an addition to supply is more obscure. Old scrap consists of obsolete and discarded articles and equipment, returned to industry for reprocessing. These articles were subtracted from the available supply when first manufactured and therefore are an addition to it when they return in worn-out condition for reuse. The 467,324 tons of copper recovered from new scrap in 1948 is not an item to be added in arriving at total supply because it consists of material already accounted for. However, data on consumption of new scrap have significance as indicators of business activity in copper and copper-alloy fabrication and as a part of the metal-reclamation industry.

Secondary copper recovered in the United States, 1947–48, in short tons

Secondary copper recovered		
Form of recovery	1947	1948
As unalloyed copper:		
At primary plants	269,085	245,376
At other plants	34,007	38,650
Total	303,092	284,026
In brass and bronze	619,576	653,281
In alloy iron and steel	2,830	2,911
In aluminum alloys	16,962	14,678
In other alloys	443	280
In chemical compounds	18,838	17,612
Total	658,649	688,762
Grand total	961,741	972,788

Recoverable copper content of scrap		
Kind of scrap processed	1947	1948
New scrap:		
Copper-base	449,900	458,892
Aluminum-base	7,426	7,231
Nickel-base	1,037	1,192
Lead-base		7
Zinc-base	2	2
Total	458,365	467,324
Old scrap:		
Copper-base	495,789	500,872
Aluminum-base	6,686	3,831
Nickel-base	789	569
Lead-base	21	87
Tin-base	90	104
Zinc-base	1	1
Total	503,376	505,464
Grand total	961,741	972,788

The accompanying production table, unlike the recovery table which gives total recovery of copper from all types of scrap and in all products, shows only copper-base secondary products and excludes such items as copper recovered in iron and steel and aluminum alloys. The products are divided into seven groups as shown.

It will be noted that the total for the first group in the production table is the same as for the first group in the left side of the recovery table but is broken down differently. Of the total secondary refined and casting copper shown, primary refiners in 1948 produced 245,376 tons, 9 percent less than in 1947 but more than in any other year on record.

The figures for copper-alloy ingot and brass-mill billets made by ingot makers, the second and third groups in the production table, unlike the items in the recovery table and all the other entries in the production table, include both primary and secondary material. They represent the copper, zinc, and other metals recovered from all kinds of scrap, as well as added primary metals. The scrap constitutes such a large percentage of the input that the entire output is tabulated as secondary production even though a small proportion represents primary material. The total production of copper-alloy ingots, after declining for 3 years, increased 6 percent in 1948 to 302,278 tons. Changes in individual types of ingot, however, were not exceptional, the largest being a 6,670-ton rise in output of No. 1 composition ingot. The increase in brass-mill output from 404,135 tons of brass and copper products in 1947 to 437,402 tons in 1948 and the gain in brass-ingot production accounts for the rise in total secondary copper recovered; the gain would have been larger except for the drop in output of secondary refined copper.

Analysis and production of secondary copper and copper-alloy products in the United States, 1947–48

Item produced from scrap	Approximate analysis (percent)						Gross weight produced (short tons)	
	Cu	Sn	Pb	Zn	Ni	Al	1947	1948
Unalloyed copper products:								
Refined copper (electrolytic grade)	100						[1] 275,415	231,899
Casting copper	99						[2] 3,919	25,349
Copper sheet, rod, tubing, etc	99						20,346	20,989
Copper powder	98						2,991	2,324
Copper castings	98						421	3,465
Total							303,092	284,026
Brass and bronze ingots:								
Tin bronze	88	10		2			19,391	18,256
Leaded-tin bronze	88	6	1.5	4.5			16,253	17,934
Leaded red brass	85	5	5	5			113,508	120,178
Leaded semired brass	81	3	7	9			46,522	46,521
High-leaded-tin bronze	80	10	10				22,215	24,875
Do	84	6	8	2			8,074	8,137
Do	75	5	20				8,109	11,412
Leaded yellow brass	66	1	3	30			20,912	22,535
Manganese bronze	62			27		5	13,017	13,826
Aluminum bronze	89					10	1,674	2,063
Nickel silver	58	2	7	18	14		4,800	4,811
Do	65	4	3	5	22			
Low brass	80			20			1,960	2,642
Silicon bronze	92			4			2,141	2,467
Conductor bronze	94	2	2	2			831	685
Hardeners and special alloys	81						5,461	5,936
Total							284,868	302,278
Brass mill billets made by ingot makers							3,329	6,881
Brass and bronze sheet, rod, tubing, etc							[3] 383,789	[3] 416,413
Brass and bronze castings							[4] 139,880	[4] 135,092
Brass powder							1,425	1,333
Copper in chemical products (content)							[5] 18,838	17,612

[1] Total includes 19,525 tons of casting copper produced at primary plants and 255,890 tons of refined copper.
[2] Production at secondary plants only.
[3] Gross weight of secondary brass and bronze in commercial shapes. Includes 269,408 tons of copper, 2,702 tons of nickel, 3,483 tons of lead, 276 tons of tin, 107,795 tons of zinc, and 125 tons of aluminum in 1947; and 290,430 tons of copper, 3,052 tons of nickel, 4,137 tons of lead, 354 tons of tin, 118,338 tons of zinc, and 102 tons of aluminum in 1948.
[4] Gross weight of secondary metal in brass and bronze castings. Includes 110,624 tons of copper, 95 tons of nickel, 14,228 tons of lead, 5,676 tons of tin, 9,216 tons of zinc, and 41 tons of aluminum in 1947; and 107,323 tons of copper, 39 tons of nickel, 13,635 tons of lead, 5,441 tons of tin, 8,535 tons of zinc, and 119 tons of aluminum in 1948.
[5] Corrected figure.

All the items in the production table except those for the second and third groups are the outputs, chiefly, of primary producers, brass mills, foundries, and chemical plants. These producers melt so much refined copper or copper-alloy ingot with their scrap that their secondary production cannot be measured separately, like that of the ingot makers, but must be calculated as a part of the total. The calculation is made by using average recovery percentages to obtain recoverable metal content of the scrap used. The secondary output of primary producers is refined copper; but that of the brass mills and foundries includes other metals recovered from scrap such as zinc, lead, aluminum, etc., as well as copper, which are contained in brass products.

Total consumption of copper-base scrap in 1948 was 1,489,358 tons, slightly greater than in 1947, as was the case with secondary copper production and for the same reason—the increased activity by ingot makers and brass mills and despite reduced activity by primary producers. The latter consumed 500,679 tons of scrap in 1948 compared with 393,717 tons by the secondary smelters, but the output of the smelters was greater because the grade of the scrap they consumed averaged higher than that of the scrap used at primary plants. The increased consumption of scrap by the ingot makers was due to a 13-percent rise in their use of composition scrap, and the use of yellow brass scrap by brass mills increased from 263,649 tons in 1947 to 287,946 tons in 1948. The percentage of old scrap in the total used decreased from 55 percent in 1947 to 53 percent in 1948.

Consumption of old and new copper scrap in the United States in 1948, 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	[1] 43,416	[1] 47,463	19,772	39	2,485	16,473	129,648
No. 2 wire, mixed heavy, and light	[1] 54,675	[1] 101,555	23,590	2,753	2,743	11,850	197,166
Composition or red brass	45,124	60,923	--------	--------	16,916	23,221	146,184
Railroad-car boxes	--------	707	--------	--------	--------	62,807	63,514
Yellow brass	16,455	48,558	286,542	1,404	6,731	11,023	370,713
Cartridge cases	4	4,170	1,520	54,017	--------	242	59,953
Auto radiators (unsweated)	--------	33,683	--------	--------	--------	--------	33,683
Electrotype shells	--------	8,139	--------	--------	--------	--------	8,139
Bronze	4,032	25,389	977	--------	1,285	10,446	42,129
Nickel silver	1,226	2,611	15,681	590	15	20	20,143
Low brass	2,490	237	18,031	435	494	1,706	23,393
Aluminum bronze	110	357	173	--------	308	380	1,328
Low-grade scrap and residues	[1] 129,626	[1] 263,446	--------	--------	--------	293	393,365
Total	297,158	597,238	366,286	59,238	30,977	138,461	1,489,358

[1] Of the totals shown primary refiners reported the following: Unalloyed copper scrap 92,524 tons of new and 60,616 tons of old; and of low-grade scrap and residues 103,641 tons of new and 243,898 tons of old.

Demand for copper and brass scrap, especially copper scrap, exceeded the supply during most of 1948. One of the large chemical plants, facing a scarcity of refined copper and scrap, further developed a method for separating zinc from brass scrap by distillation. Commercial-grade zinc and copper suitable for use in making copper sulfate were produced. Much of the experimental work on this process had been done previously at another plant.[4]

The accompanying table stresses the relative importance of scrap in comparison with other copper raw materials in the operations of the principal consumers of copper materials. The primary producers used more scrap than any other group but recovered only the copper, and much of their scrap was low-grade material. The temperatures at which primary copper smelters operate are so high that the zinc, lead, and other metals in brass scrap except copper, are vaporized. The brass mills use plant scrap from brass fabricators as an auxiliary raw material to supplement refined copper and zinc in making brass and copper sheet, rod, tubing, and wire. According to figures recently published,[5] shipments of brass-mill products in 1948 totaled 1,075,966

[4] Poland, F. F., Scrap Recovery: Metal Ind. (London), vol. 69, No. 22, Nov. 29, 1946, pp. 448–450; No. 23, Dec. 6, 1946, pp. 466–467, 470.

[5] American Bureau of Metal Statistics, 1948 Yearbook: New York, 1949, p. 28.

tons, of which 42 percent was copper and brass sheet, 27 percent rod, 26 percent pipe and tubing, and 5 percent wire. The last item does not include wire for transmission purposes, which is considered to be a wire-mill product.

Consumption of copper and brass materials, by principal consuming groups, in 1948, in short tons

Item consumed	Primary producers	Brass mills	Wire mills	Foundries and miscellaneous	Secondary smelters
Copper-base scrap	500,679	425,524	------------	169,438	393,717
Primary material	[1] 1,107,446	------------	------------	------------	------------
Refined copper	------------	614,314	765,849	30,387	6,805
Brass ingot	------------	4,322	------------	298,770	------------
Slab zinc	------------	109,140	------------	------------	------------
Miscellaneous	------------	1,125	------------	------------	13,723

[1] Recoverable copper content; gross weight not available.

The secondary smelters' or ingot makers' chief raw material is scrap, which they do not separate into its constituent metals but remelt to form alloys of specified composition for use in foundries. Billets are made for brass mills by a few ingot plants but in relatively small quantities. The ingot maker must be able to treat scrap of all compositions to produce alloys that will compete with those made by mixing refined metal. Each new alloy that is introduced provides a new type of scrap that must be fitted into his scheme of operations. A recent innovation is the addition of small quantities of iron to cupronickel alloys used in condenser tubes. Although more expensive than other alloys commonly used for tubing in marine condensers, it is preferred for use on warships in which the wide-spread use of electric current increases galvanic corrosion. Under such conditions, brass condenser tubes are subject to severe dezincification. The purpose of adding iron to the alloy is to provide resistance to erosion and wear from impingement. Under less rigorous conditions, aluminum brass consisting of 76 percent copper, 22 percent zinc, and 2 percent aluminum is a satisfactory and less expensive alloy for condenser tubes, the aluminum preventing dezincification. Admiralty metal is lower in price than either cupronickel or aluminum brass and is more economical to use for condenser tubes under some conditions. Secondary smelters consumed 5,509 tons of brass pipe and tubing scrap, most of it old, in 1948 and brass mills 1,789 tons, all new scrap. Another innovation in 1948 was the addition of small percentages of lead to aluminum bronze to improve machinability. It was found [6] that this alloy, containing 1 percent of lead, after heat treatment, was more easily machined and had nearly the same mechanical properties as lead-free aluminum bronze.

Brass foundries used nearly all of the brass ingot produced by the secondary smelters and in addition consumed subordinate quantities of scrap and refined copper. Foundry consumption of brass ingot was tabulated for 1948 for the first time by the Bureau of Mines and was reported at 225,298 tons. Foundries and brass mills are virtually

[6] Grodsky, V. A., Improving the Machinability of Aluminum Bronze: Metal Progress, vol. 55, No. 3, March 1949, pp. 340-341.

the only consumers of this product, and the 4,322 tons which the mills used brought the total for the year to 229,620 tons. Ingot makers sold 302,910 tons of brass ingot in 1948; and, so far as can be determined, all of it went to the above groups of consumers except for a few hundred tons that were exported. If the consumption of ingot by these plants equaled their purchases, as is probable, the 229,620 tons reported to the Bureau of Mines as consumed account for 76 percent of the 302,910-ton total. In all, 3,433 foundries were canvassed on consumption of copper materials in 1948 but not all were established as plants permanently covered by the copper materials survey.

The accompanying table shows the consumption of nine types of ingot, by States, arranged in groups according to quantities used. The East Central group, which contains the Chicago area, used the greatest total—104,060 tons—and Ohio of the same group used more than any other State—34,838 tons. The group consuming the next largest total, 65,124 tons, was the Middle Atlantic, in which the New York area is located. These two groups between them consumed 74 percent of the entire quantity used by foundries in the country. Consumption of leaded red brass, which is chiefly No. 1 composition, amounted to 123,489 tons or 54 percent of the total.

Foundry consumption of brass ingot in 1948, by States

State	Tin bronze	Leaded tin bronze	Leaded red brass	High-leaded tin bronze	Leaded yellow brass	Manganese bronze	Hardeners	Nickel silver	Low brass	Total
East Central:										
Ohio	1,759	8,317	20,826	1,753	910	710	91	44	428	34,838
Illinois	1,102	3,434	18,033	678	542	1,321	296	151	633	26,190
Michigan	396	3,038	11,829	1,079	1,637	908	94		325	19,306
Wisconsin	638	1,352	5,709	1,417	2,354	366	24	1,703	68	13,631
Indiana	143	296	6,212	472	285	118	25	49	16	7,616
Minnesota	159	605	1,311	75	291	21	6	2	9	2,479
Total	4,197	17,042	63,920	5,474	6,019	3,444	536	1,949	1,479	104,060
Middle Atlantic:										
Pennsylvania	2,730	3,543	17,181	2,359	1,963	2,927	1,661	148	876	33,388
New York	1,164	2,935	10,880	6,298	246	961	62	277	522	23,345
New Jersey	776	1,126	3,981	122	659	310	10	6	62	7,052
Maryland and District of Columbia	42	315	284	144		39	17		63	904
Delaware	28	2	350	18	8	3			26	435
Total	4,740	7,921	32,676	8,941	2,876	4,240	1,750	431	1,549	65,124
New England:										
Massachusetts	731	7,148	4,765	181	387	266	71	23	225	13,797
Connecticut	446	3,251	2,884	418	1,819	146	43	3	133	9,143
New Hampshire	78	48	627	167	685	7	1		9	1,622
Rhode Island	60	191	409	62		1	2		22	747
Maine	12		314	8		52	55		19	460
Vermont			69	12			1			82
Total	1,327	10,638	9,068	848	2,891	472	173	26	408	25,851
Western:										
California	555	653	9,293	1,048	149	578	33	14	346	12,669
Washington	53	89	61	19	6	72	1		1	302
Oregon	76	64	32			3				175
Utah		45					2			47
Arizona		11	31							42
Idaho			7							7
Montana							2			2
Total	684	862	9,424	1,067	155	653	38	14	347	13,244

Foundry consumption of brass ingot in 1948, by States—Continued

State	Tin bronze	Leaded tin bronze	Leaded red brass	High-leaded tin bronze	Leaded yellow brass	Manganese bronze	Hardeners	Nickel silver	Low brass	Total
West Central:										
Missouri	287	193	1,538	78	962	27	101	2	428	3,616
Iowa	261	168	877	114	7	138				1,565
Nebraska		23	304		24	16		3		370
Kansas	1	167	99		142				2	411
Colorado	115	22	30	31	16	7	2		4	227
Total	664	573	2,848	223	1,151	188	103	5	434	6,189
Southeastern:										
Alabama	57	28	3,659	3	279	168		10		4,204
Georgia	3	279	111	1	9	3				406
Florida		1	45	2						48
South Carolina		57	6			6				69
Mississippi	12		12							24
Total	72	365	3,833	6	288	177		10		4,751
South Atlantic:										
West Virginia	63	3	254	12	582				78	992
Virginia	16	477	119	87	25	47	26			797
Tennessee	296	384	308	155	37	13	3			1,196
North Carolina	16	1	17		136					170
Kentucky	3	39	184	20	15		5			266
Total	394	904	882	274	795	60	34		78	3,421
Southern:										
Texas	272	562	624	38	10	161	4		72	1,743
Oklahoma	210	388	114	26		7	1			746
Louisiana	26	13	74	4		10			6	133
Arkansas	10		26							36
Total	518	963	838	68	10	178	5		78	2,658
Grand total	12,596	39,268	123,489	16,901	14,185	9,412	2,639	2,435	4,373	225,298

Consumers' stocks of unalloyed copper scrap were about the same at the end of 1948 as they were at the end of 1947, but the brass mills, which were the largest holders of alloy scrap, decreased their stocks, causing a drop in the total for that category. The primary refiners, chief repositories of low-grade scrap, had the same experience with that class of material.

Consumers' stocks of copper-base scrap in the United States at end of year, 1947–48, gross weight in short tons

Scrap item	Dec. 31, 1947	Dec. 31, 1948
Unalloyed copper	15,830	15,241
Copper-base alloy	72,780	59,924
Low-grade scrap and residues	66,936	47,574
Total	155,546	122,739

The demand for both refined copper and copper-base scrap increased during the first 11 months of 1948. In December there were signs that supply was catching up with demand; and scrap prices began to decline, although the price for refined copper remained firm at 23½ cents a pound. This illustrates the greater market sensitivity of scrap metal compared to primary metal, as discussed in a recently published article.[7] Dealers' buying prices for No. 1 Heavy copper scrap were relatively stable during the first 6 months at a little under 17 cents a pound, then rose to 18.99 cents in December, the average for 1948 being 17.31 cents. The price of No. 1 Composition scrap moved along a parallel line, a little under 13 cents in the first half of the year and up to 15.35 cents in November. The average for the year was 13.45 cents.

Brass and copper scrap imported into and exported from the United States, 1944–48, in short tons

	1944	1945	1946	1947	1948
Imports for consumption:					
Brass scrap	6,226	7,727	24,008	112,393	59,984
Scrap copper	1,055	1,348	1,030	5,957	9,334
Exports:					
Brass scrap	38	421	1,184	3,157	6,584
Scrap copper	99	133	909	969	2,266

SECONDARY LEAD

The secondary lead industry maintained a high rate of recovery in 1948, reclaiming 500,071 tons of lead valued at $179,025,418 compared with 511,970 tons valued at $146,423,420 in 1947. The quantity of lead recovered decreased only 2 percent, but the value increased 22 percent, being computed at 17.9 cents a pound in 1948 and 14.3 cents in 1947, the yearly average weighted price of all grades of refined lead sold by producers. Again in 1948, as was the case in the preceding 3 years, recovery of lead from scrap, as metal and in alloys, exceeded production of refined primary lead from domestic ores and base bullion and for the third successive year was greater than domestic mine production.

Secondary lead recovered in the United States, 1947–48, in short tons

Secondary lead recovered			Recoverable lead content of scrap		
Form of recovery	1947	1948	Kind of scrap processed	1947	1948
As metal:			New scrap:		
At primary plants	15,662	4,952	Lead-base	60,277	59,618
At other plants	95,843	126,951	Copper-base	7,115	7,720
Total	111,505	131,903	Total	67,392	67,338
In antimonial lead [1]	265,935	243,552	Old scrap:		
In other lead alloys	103,799	102,603	Battery lead plates	273,952	256,193
In copper-base alloys	30,137	21,499	All other lead-base	151,111	156,019
In tin-base alloys	594	514	Copper-base	19,494	20,497
Total	400,465	368,168	Tin-base	21	24
Grand total	511,970	500,071	Total	444,578	432,733
			Grand total	511,970	500,071

[1] Includes 56,456 tons of lead recovered in antimonial lead from secondary sources at primary plants in 1947 and 49,525 tons in 1948.

[7] Merrill, Charles White, Scrap Prices in the Metal Markets: Waste Trade Jour., vol. 87, No. 1, Apr. 2, 1949, pp. 94–95, 99.

More scrap went into the production of refined lead in 1948 and less into antimonial lead. Production of refined soft lead increased 20 percent—from 112,664 tons in 1947 to 135,071 in 1948—but the secondary lead content of antimonial lead produced fell 8 percent—from 265,935 tons to 243,552. Secondary lead recovered in solder increased for the third successive year whereas lead reclaimed in type metals declined for the second year and in lead babbitt remained almost unchanged. Total production of the secondary lead industry was slightly higher in 1948 than in 1947 entirely owing to the use of more primary metals with scrap and secondary.

Shipments [1] of secondary lead, tin, and lead- and tin-alloy products in the United States in 1948, gross weight in short tons

Product	Gross weight of product [2]	Secondary metal content			
		Lead	Tin	Antimony	Copper
Refined pig lead	105,347	105,347			
Remelt lead	28,738	26,135			
Lead foil	986	421			
Total	135,071	131,903			
Refined pig tin	3,424		3,424		
Remelt tin	228		84		
Tin foil					
Total	3,652		3,508		
Lead and tin alloys:					
Antimonial lead	272,592	243,552	486	14,163	67
Common babbitt	41,472	30,930	2,021	3,108	66
Genuine babbitt	3,249	237	822	137	83
Other tin babbitts	1,166	277	218	67	15
Solder	77,867	37,111	7,404	439	4
Type metals	39,579	31,620	2,008	3,580	17
Miscellaneous lead-tin alloys	3,709	2,659	180	71	
Total	439,634	346,386	13,139	21,565	252
Composition foil	586	283	115	27	
Tin content of chemical products	580		580		

[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.
[2] Difference between gross weight of products and secondary metal content represents added primary metals or impurity content.

Many problems of the secondary lead smelters differ from those of smelters of other types of nonferrous scrap metals. Lead refining is simpler than other types of metal refining and is not confined, as in the case of copper, to the larger plants. Refined lead is produced from scrap at numerous secondary lead smelters as well as at primary plants, whereas secondary refined copper is produced chiefly at 17 primary copper refineries in combination with primary metal. There are relatively few kinds of lead-base scrap, as the only other metals that are generally used in lead alloys are tin, antimony, and copper. Lead up to about 30 percent is used as an alloying ingredient in tin bronze (a copper-base alloy) and may outweigh copper in packing metal but is not used in zinc or aluminum alloys.

The product of the secondary smelters and the primary plants is about the same; but the secondary smelters, by using mainly scrap, have the elements for most products already combined. Antimonial lead can, in general, be made more economically from scrap battery plates, which contain both lead and antimony, than from primary lead and primary antimony. In 1948 lead recovered from scrap in antimonial lead at secondary smelters was 194,027 tons, whereas the lead content of antimonial lead output at primary plants totaled 100,764 tons, including 49,525 tons from scrap and 51,239 tons from primary material.

A rough approximation of the competitive positions of the secondary and primary lead industries with respect to several kinds of alloys may be obtained by comparing total lead consumption, as indicated in the Lead chapter, with the secondary lead content of metals and alloys produced, as shown in the accompanying table. The total 1948 consumption of lead for bearing metals (babbitt), solder, and type metals was 42,594, 71,025, and 26,279 tons, respectively, and the corresponding quantities of secondary lead contained were 31,444, 37,111, and 31,620 tons. The comparison indicates that production of the three products is principally secondary. On the other hand, 411,646 tons of lead were produced as metal at primary plants in 1948 compared with 126,951 tons at other plants. No scrap was used directly in either pigments or chemicals, these being made only from ores and refined lead.

Of the 500,071 tons of secondary lead recovered in 1948, 471,854 short tons were reclaimed from lead- and tin-base scrap, while the remaining 28,217 tons was reclaimed from copper-base scrap. In all, 2,820 tons of lead in lead- and tin-base scrap were added to brass and bronze to bring the total recovery of secondary lead in copper-base alloys to 21,499 tons.

Consumption of old and new lead scrap in the United States in 1948, 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		69,600	15	1,567	71,182
Hard lead		20,621	2	328	20,951
Cable lead		30,675	5	44	30,724
Battery-lead plates		384,270		161	384,431
Mixed common babbitt		11,573	377	7,806	19,756
Solder and tinny lead		9,580	1,180	228	10,988
Type metals		17,056		474	17,530
Dross and residues	87,994		4		87,998
Total	87,994	543,375	1,583	10,608	643,560

The quantity of lead-base scrap consumed in 1948 totaled 643,560 tons, a decrease of 4 percent from the peak 1947 consumption of 671,282 tons. Treatment of battery-lead plates decreased 26,657 tons (6 percent), soft lead 1,120 tons (2 percent), common babbitt 4,465 tons (18 percent), type metals 616 tons (3 percent), and drosses 5,113 tons (5 percent). The only increases in use over the preceding year were a 51-percent gain in the treatment of cable lead scrap and a very small increase in use of solder scrap. Highest operations of the year occurred in December, January, and March, in the order named, and the lowest in July.

The lead-scrap market did not weaken at any time in 1948. Lead scrap was not plentiful at the beginning of 1948 and grew scarcer as the year advanced. Smelters, in bidding for the limited supply during 1948, progressively reduced their charges on battery plates from $50 a ton to nothing. High consumption of all types of lead by manufacturers and the Government stock-piling program sustained the demand for both primary and secondary lead.

Percentage and remelt metals circulated among remelters, smelters, and refiners in 1948 totaled 53,104 short tons, consisting of 3,029 tons of solder, 3,945 tons of lead-base babbitt, 12,724 tons of soft lead, 30,517 tons of antimonial lead, 1,582 tons of type metals, 714 tons of cable lead, 512 tons of tin-base babbitt, 78 tons of remelt tin, and 3 tons of pewter.

Smelters' stocks of scrap, which had shown an almost constant decline during 1947, increased 25 percent during 1948, from 56,929 to 70,984 tons. Year-end inventories of unalloyed lead were 9 percent higher, and stocks of lead-base alloys 44 percent higher, whereas drosses and residues decreased 4 percent. Inventories of secondary pig, bar, and ingot held by smelters also increased during 1948 from 22,591 to 29,900 tons.

Consumers' stocks of lead-base scrap in the United States at end of year, 1947–48, gross weight in short tons

Scrap item	Dec. 31, 1947	Dec. 31, 1948
Unalloyed lead	2,878	3,124
Lead-base alloy	33,388	47,952
Drosses and residues	20,663	19,908
Total	56,929	70,984

The price of primary lead, which had advanced to 15 cents on March 3, 1947, remained at this level until April 5, 1948, when it was raised to 17.5 cents. Two additional rises of 2 cents each (on July 28 and November 1) brought the price to 21.5 cents, where it continued throughout the remainder of the year. With each price rise for primary metal, scrap and secondary prices were adjusted accordingly.

Imports of lead scrap totaled 15,693 tons (revised lead content) in 1947 and 28,301 tons (lead content) in 1948.

SECONDARY MAGNESIUM

Secondary magnesium (including alloying ingredients) recovered from scrap in 1948 totaled 7,834 short tons valued at $3,211,940 compared with 9,503 short tons valued at $3,896,230 in 1947. Values were calculated for both years at 20.5 cents a pound, which has been the price of magnesium since January 1943. Primary production in 1948 was 10,003 tons, all from the Freeport, Tex., plant of Dow Chemical Co. Consumption of primary magnesium was 9,661 tons compared with 6,869 tons (revised) in 1947.

Secondary magnesium recovered from scrap in magnesium alloy ingot totaled 4,604 tons, as shown in the accompanying table. Of this, 2,420 tons were secondary ingot, and the remaining 2,184 tons were incorporated in primary ingot and so, although recovered from scrap, lost its identity as secondary metal. Of the three other major items containing secondary magnesium, recovery from scrap made into anodes for cathodic protection was 45 percent less in 1948 than in 1947, recovery in aluminum alloys was 26 percent less, and recovery in magnesium-alloy castings was 6 percent less.

Secondary magnesium recovered in the United States, 1947–48, in short tons

Secondary magnesium recovered			Recoverable magnesium-alloy content of scrap		
Form of recovery	1947	1948	Kind of scrap processed	1947	1948
Magnesium-alloy ingot [1] (gross weight)	5,138	4,604	New scrap: Magnesium-base	4,907	3,376
Magnesium-alloy castings (gross weight)	1,377	1,301	Old scrap:		
Magnesium-alloy shapes	85	1	Magnesium-base	3,622	4,041
In aluminum alloys	1,883	1,388	Aluminum-base	974	417
In zinc alloys	3	6	Total	4,596	4,458
Chemical and other destructive uses	199	84	Grand total	9,503	7,834
Cathodic protection	818	450			
Grand total	9,503	7,834			

[1] Figures include secondary magnesium incorporated in primary magnesium ingot.

Consumption of secondary magnesium ingot was 2,647 tons, or 227 tons more than was produced. Of the total, 1,323 tons was used in making castings, 1,314 tons in aluminum alloys, 3 tons in zinc alloys, and 7 tons for cathodic protection. There is no duplication between these quantities and those in the preceding paragraph. The total weight of metal used in cathodic protection, for example, included 450 tons of anodes made from scrap, 7 tons from secondary alloy ingot, 85 tons from primary alloy ingot, and 309 tons from pure primary magnesium—851 tons in all. The scrap used in making the 7 tons of secondary ingot was additional to that used in making the 450 tons of anodes. It was reported that magnesium alloy had been found to be more suitable for cathodic protection than unalloyed metal.[8] If so, that fact should increase the use of scrap for such purposes because it is chiefly alloy and is cheaper than pure magnesium.

There were indications that magnesium might replace zinc for die castings used in some automobiles.[9] Magnesium die castings are lighter and have higher yield strength than zinc die castings. Perhaps its greatest weakness is its inadequate corrosion resistance,[10] but the Dow Chemical Co. has developed a plating method to overcome this defect.[9] Only strictly segregated, new die-cast scrap can be used in zinc die castings but there are no unusual restrictions on the use of magnesium scrap in magnesium die castings.

The decrease in consumption of magnesium-base scrap from 9,420 tons in 1947 to 8,163 tons in 1948 was due to a 970-ton reduction in use of cast scrap and a 477-ton reduction in borings, drosses, etc., which were partly counterbalanced by a 190-ton increase in wrought

[8] Rogers, R. R., and Stewart, W. R. G., Cathodic Protection of Steel in Various Chemical Solutions: Canadian Min. and Met. Bull., vol. 42, No. 445, May 1949, pp. 218–221.
[9] Hauser, R. F., Why Die Casting: Modern Metals, vol. 5, No. 1, February 1949, pp. 18–21.
[10] Materials and Methods, vol. 29, No. 6, June 1949, p. 82.

scrap. The percentage of old scrap used, however, increased from 42 percent of the total magnesium scrap consumed in 1947 to 54 percent in 1948. The price of remelt magnesium ingot was unchanged at 18 to 18.5 cents a pound (carlots) throughout 1948.

Stocks and consumption of magnesium scrap in the United States in 1948, gross weight in short tons

Scrap item	Stocks		Consumption in 1948
	Dec. 31, 1947	Dec. 31, 1948	
Cast scrap	3,659	3,008	4,575
Solid wrought scrap	638	898	3,321
Borings, grindings, drosses, etc	300	45	267
Total	4,597	3,951	8,163

SECONDARY NICKEL

The recovery of secondary nickel from nonferrous scrap in 1948 totaled 8,850 short tons, valued at $6,966,720, a decrease of 7 percent from the 9,541 tons valued at $7,188,189 recovered in 1947. The total value was calculated at 39.36 cents a pound in 1948 and 37.67 cents in 1947, the average spot-delivery prices of Grade F nickel ingots and shot in 10,000-pound lots at New York. The decreased recovery in 1948 was occasioned because one of the chemical plants, usually a large producer of secondary nickel salts, did not use any nickel scrap during the year. This caused recovery of secondary nickel in chemical compounds to decline from 1,765 tons in 1947 to 235 tons in 1948. Recovery of secondary nickel in iron and steel increased 25 percent, probably because production of stainless steel, of which nickel is an ingredient, reached an all-time peak [11] in 1948. Most of the 22-percent rise in recovery in copper-base alloys was in brass mill products.

Secondary nickel (nonferrous) recovered in the United States, 1947–48, in short tons

Secondary nickel recovered		
Form of recovery	1947	1948
As metal	121	99
In nickel-base alloys	2,000	1,850
In copper-base alloys	[1] 2,844	3,467
In aluminum-base alloys	[1] 955	889
In lead-base alloys	13	6
In cast iron and steel [2]	1,843	2,304
In chemical compounds	1,765	235
Grand total	9,541	8,850

Recoverable nickel content of scrap		
Kind of scrap processed	1947	1948
New scrap:		
Nickel-base	3,750	2,581
Copper-base	2,447	2,875
Aluminum-base	537	488
Total	6,734	5,944
Old scrap:		
Nickel-base	1,949	1,935
Copper-base	433	567
Aluminum-base	418	398
Lead-base	7	6
Total	2,807	2,906
Grand total	9,541	8,850

[1] Corrected figure.
[2] Includes only nonferrous nickel scrap added to cast iron and steel.

[11] Stanley, R. C., Address to Stockholders of International Nickel Co.: Metals (Daily l Reporter Monthly Suppl.), vol. 19, No. 11, May 1949, pp. 7, 9, 12.

Production of secondary Monel metal pig, shot, and castings, which had risen from 450 tons in 1945 to 1,922 tons in 1947, dropped back to 1,318 tons in 1948. Output of nickel-copper pig and shot decreased from 279 tons averaging 55 percent nickel in 1947 to 263 tons in 1948, and the nickel content fell to 50 percent. Aside from that obtained from scrap, the only production of nickel in the United States was as a byproduct of the copper refining.

Consumption of nickel scrap totaled 26,688 tons in 1948 compared with 27,001 tons in 1947, but if nickel silver (a copper-base scrap item) is excluded, the totals are 6,543 tons in 1948 and 9,619 tons in 1947. Use of nickel silver, including cupronickel, increased 16 percent or 2,763 tons, but there were declines in the other items except miscellaneous nickel alloys, a minor classification. Nickel can be incorporated in steel as an alloying ingredient by the addition of nickel oxide as well as by the addition of metallic nickel and nickel alloys. This method of introducing nickel into steel was more extensively used during the war than before and increased in 1948 compared with 1947. During 1948 a plant at Copper Cliff, Ontario, for sintering nickel oxide made from ore was placed in operation. Primary nickel oxide has been used occasionally by chemical plants in the manufacture of nickel salts, but none was so consumed in 1948. However, a little nickel oxide scrap obtained from worn-out nickel-iron storage batteries was consumed in the manufacture of nickel salts.

Consumption of old and new nickel scrap in the United States in 1948, 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	174	460	232	292	1,158
Monel metal	408	1,386	2,946	274	5,014
Nickel silver	1,227	2,611	15,697	610	20,145
Miscellaneous nickel alloys	53				53
Nickel residues	31			287	318
Total	1,893	4,457	18,875	1,463	26,688

According to the American Metal Market the spot-delivery price of Grade F nickel ingots and shot in 10,000-pound lots at New York stood at 36.49 cents a pound from the beginning of 1948 until the middle of March, when it was increased to 36.56 cents. On July 22 the price was raised again to 42.9 cents, where it remained for the rest of the year. Scrap-metal dealers' buying prices at New York were quoted at 17 cents a pound for nickel sheet and clippings and 12.5 cents a pound for Monel clippings for the first 7 months of 1948. The increase in price for primary nickel resulted in scrap price rises at the end of July to 19 and 15 cents, respectively, and at the end of August they increased again to 24 and 16 cents. The nickel scrap price was reduced in September to 21 cents, where it remained for the rest of the year. The Monel clippings price did not change after the August rise.

No imports of nickel scrap were reported in 1947 or 1948, but exports in 1948 totaled 5,826 tons compared with 8,424 tons in 1947 and 5,597 tons in 1946.

Consumers' stocks of nonferrous nickel scrap[1] in the United States at end of year, 1947–48, gross weight in short tons

Scrap item	Dec. 31, 1947	Dec. 31, 1948
Unalloyed nickel	488	261
Nonferrous nickel alloys	3,233	2,758
Nickel residues	2,032	2,262
Total	5,753	5,281

[1] Includes nickel-silver scrap.

SECONDARY TIN

Secondary tin recovered from scrap in 1948 totaled 30,124 tons valued at $59,796,140 compared with 30,054 tons valued at $46,848,175 in 1947. Values were computed at 99.25 cents per pound in 1948 and 77.94 cents in 1947, the average selling prices for Straits tin.

Detinning plants produced 3,284 tons of pig tin from old tin cans and new tin-plate clippings and 20 tons from tin-base scrap and residues. Recovery, as metal, at secondary smelters was 204 tons. The 3,508 tons of unalloyed tin reclaimed from scrap was 7 percent greater than in 1947. Total recovery of tin, as metal and in alloys and compounds, increased 0.2 percent; but, owing to the increased price, the value increased 28 percent over the preceding year. Recovery in lead- and tin-base alloys and in chemical compounds increased, but these gains were partly offset by a 15-percent decrease in brass and bronze. Shipments of secondary tin and lead-tin alloys are presented in the Lead section of this chapter.

Secondary tin recovered in the United States, 1947–48, in short tons

Secondary tin recovered			Recoverable tin content of scrap		
Form of recovery	1947	1948	Kind of scrap processed	1947	1948
As metal:			New scrap:		
At detinning plants	3,144	3,304	Tin plate	3,313	3,561
At other plants	145	204	Tin-base	2,356	1,281
			Lead-base	2,122	1,970
Total	3,289	3,508	Copper-base	3,264	3,222
In solder	6,315	7,404	Total	11,055	10,034
In tin babbitt	848	1,040			
In chemical compounds	545	580	Old scrap:		
In lead-base alloys	4,106	4,810	Tin cans	134	106
In brass and bronze	14,951	12,782	Tin-base	2,887	3,346
			Lead-base	5,318	5,349
Total	26,765	26,616	Copper-base	10,660	11,289
Grand total	30,054	30,124	Total	18,999	20,090
			Grand total	30,054	30,124

Consumption of tin-base scrap decreased 19 percent in 1948 owing entirely to less use of drosses and residues, for more block-tin pipe, pewter, and high-tin babbitt were consumed than in 1947. From lead- and tin-bearing scrap, two companies produced 90 tons of tin in chemical residues which were later reduced to pig tin at detinning plants.

Consumption of old and new tin scrap in the United States in 1948, 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		1,002	2	81	1,085
Tin scruff and dross	1,899		4		1,903
No. 1 pewter		133	3		136
High-tin babbitt		2,438		144	2,582
Residues	296		1		297
Total	2,195	3,573	10	225	6,003

An advance on June 1 from 94 cents to $1.03 per pound for primary tin was reflected in prices of tin-bearing scrap. However, supply of such scrap was reported to be not overabundant.

Supplies of tin more nearly approached demand in 1948, but restrictive measures were felt necessary because of the need for metal in the National Strategic Stock Pile. Therefore, continuation of General Preference Order M-43, controlling the distribution and use of tin, was effected early in June.

Consumers' stocks of tin-base scrap in the United States at end of year, 1947–48, gross weight in short tons

Scrap item	Dec. 31, 1947	Dec. 31, 1948
Unalloyed tin	145	121
Tin-base alloys	445	585
Drosses and residues	467	615
Total	1,057	1,321

Smelters' total stocks of tin scrap increased 25 percent in 1948. Inventories of unalloyed tin declined 17 percent, but tin-base alloys and drosses each gained 31 percent. Dealers' buying price for scrap block-tin pipe was 77.5 cents a pound through May, at which time it advanced (with the rise in the price of primary tin) to 83.5 cents and remained there for the last 7 months of the year.

Detinning Plants.—Seven detinning plants reported recovery operations in 1948: Johnston & Jennings Co., Cleveland, Ohio; Metal & Thermit Corp., South San Francisco, Calif., East Chicago, Ind., and Carteret, N. J.; Standard Metal Refining Co., Baltimore, Md.; and Vulcan Detinning Co., Sewaren, N. J., and Neville Island, Pittsburgh, Pa.

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Secondary tin recovered at detinning plants in the United States, 1947–48

	1947	1948
Scrap treated:		
Clean tin plate ... long tons	320,907	376,620
Old tin-coated containers ... do	16,741	15,079
Total ... do	337,648	391,699
Tin recovered from new tin-plate clippings ... short tons	3,313	3,561
Tin recovered from old tin-coated containers ... do	134	106
Total ... do	3,447	3,667
Tin recovered as metal ... do	[1] 3,046	[1] 3,284
Tin recovered in compounds ... do	401	383
Total ... do	[2] 3,447	[2] 3,667
Weight of tin compounds produced ... do	780	735
Average quantity of tin recovered per long ton of clean tin-plate scrap used ... pounds	20.65	18.91
Average quantity of tin recovered per long ton of old tin-coated containers used ... pounds	16.02	14.10
Average delivered cost of clean tin-plate scrap ... per long ton	$29.43	$37.48
Average delivered cost of old tin-coated containers ... do	$22.37	$27.45

[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 98 tons of tin as metal and 80 tons of tin in compounds from tin-base scrap and residues in 1947, and 127 tons of tin as metal and in compounds from these sources in 1948.

Secondary tin recovered by detinning plants, as metal and in chemical compounds, increased 6 percent in 1948. Recovery of tin from tin-plate clippings and old cans was 3,667 short tons in 1948 compared with 3,447 tons in 1947. Of the total recovered, 3,284 tons was reclaimed as metal in the form of pigs and 383 tons in the form of tin compounds.

The tonnage of tin-plate clippings treated in 1948 was the largest on record. The industry treated 376,620 long tons of tin-plate clippings in 1948—17 percent more than in 1947 and 10 percent more than the previous peak of 341,075 tons used in 1941. Old cans processed decreased 10 percent to only 15,079 long tons in 1948 compared with 16,741 tons in 1947 and a record use of 175,870 tons in 1943. Tin recovered from tin-plate clippings was 3,561 short tons in 1948, an increase of 7 percent, while that from old cans was 106 tons (mostly in the form of pig tin), a decline of 21 percent.

The average quantity of tin recovered per long ton of tin-plate scrap used declined from 20.65 pounds in 1947 to 18.91 pounds in 1948. Lower recoveries per unit reflect the treatment of a larger tonnage of electrolytic tin plate carrying a much thinner coating of tin than the heavier coated hot-dipped tin plate. The use of electrolytic tin plate has been expanding in the manufacture of cans (both general line, and packers' or sanitary) and closures. Favorable market conditions prevailed for iron and steel scrap during 1948, with the average quoted composite price for No. 1 Heavy-Melting steel scrap (according to Iron Age) at $41.66 per gross ton—the highest recorded. Steel scrap is one of the byproducts of the detinning industry, being sold to open-hearth mills in hydraulically compressed billets. The average quantity of tin recovered per long ton of old tin-coated containers used declined further to 14.10 pounds in 1948, compared with 16.02 pounds in 1947.

In addition to the tin from tin-plate clippings and old cans, detinners recovered 127 tons of tin as metal and in compounds from the treatment of other tin bearing materials in 1948. These figures are comparable to the 98 tons of tin as metal and 80 tons of tin in compounds from similar sources in 1947.

Imports of tin-plate scrap increased from 30,797 long tons in 1947 to 41,084 tons in 1948. Exports of terne-plate scrap, circles, waste-waste, and clippings also increased—from 26,558 long tons to 31,646 tons in 1948.

SECONDARY ZINC

Secondary zinc recovered in 1948 from purchased scrap and residues totaled 324,639 short tons, with a value of $86,353,974, calculated at 13.3 cents a pound, the yearly average weighted price of all grades of refined zinc sold by producers, not including bonuses paid under the Premium Price Plan terminated June 30, 1947. This tonnage was 4 percent higher than in 1947, when 310,793 tons with a value of $66,509,702 at 10.7 cents a pound were recovered.

Secondary zinc recovered [1] in the United States, 1947–48, in short tons

Secondary zinc recovered		
Form of recovery	1947	1948
As metal:		
By distillation:		
Slab zinc	58,987	59,109
Zinc dust	27,770	29,457
By remelting	10,356	10,988
Total	97,113	99,554
In zinc-base alloys	10,383	12,884
In brass and bronze	146,866	162,384
In aluminum-base alloys	906	822
In chemical products:		
Zinc oxide (lead free)	18,402	12,327
Zinc sulfate	4,249	3,758
Zinc chloride	13,959	13,980
Lithopone	17,888	18,213
Miscellaneous	1,027	717
Total	213,680	225,085
Grand total	310,793	324,639

Recoverable zinc content of scrap		
Kind of scrap processed	1947	1948
New scrap:		
Zinc-base	134,092	139,673
Copper-base	101,185	110,288
Aluminum-base	537	488
Total	235,814	250,449
Old scrap:		
Zinc-base	29,262	26,199
Copper-base	45,356	47,663
Aluminum-base	361	328
Total	74,979	74,190
Grand total	310,793	324,639

[1] Zinc content.

Zinc is unique among secondary nonferrous metals in that about half of it is recovered from copper-base scrap, whereas nearly all secondary aluminum, lead, and copper is recovered from scrap of which it is the chief constituent. In 1945, the last year of the war, 61 percent of the total secondary zinc produced was recovered from copper-base scrap compared with 52 percent in 1946 (a year of transition from war to peace), 47 percent in 1947, and 49 percent in 1948. The variations in this sequence of percentages may be explained as follows: The ratio of zinc used in brass and bronze to that used in galvanizing is greater in wartime than in peace, which causes generation of brass scrap to increase with respect to generation of zinc scrap. In years of normal industrial activity, consumption of scrap—and consequently recovery of secondary metal—varies with the availability of scrap.

Nearly all secondary zinc, aside from that recovered from copper-base scrap, is produced from zinc scrap. Of the total recovery from zinc scrap in 1948, 84 percent—about the usual proportion—was produced from new scrap. Recovery of zinc from old scrap is not as important as in other major nonferrous metals, because the uses of zinc are such that few zinc products are returned in worn-out condition for reprocessing. Usually more zinc is consumed for galvanized products than for any other purpose, and from these products the zinc is virtually unreclaimable. In the galvanizing process, however, valuable byproduct residues, including dross, skimmings, and sal skimmings, are generated from which important quantities of secondary zinc are recovered. So far as is known, only one plant recovers zinc from galvanized-steel clippings classed as new scrap.

Other zinc products from which, after being used and discarded, no zinc can generally be reclaimed are zinc oxide, zinc dust, and zinc chemicals. Zinc dust, the only one of these from which valuable byproduct residues are sometimes recovered, is used in considerable quantities in the manufacture of sodium hydrosulfite. It is not an element of the product but may be reclaimed from the residues of the process as zinc carbonate or lead-free zinc oxide of commercial grade. When sold for use as zinc oxide, as in rubber manufacturing, it is tabulated statistically as a finished product; but when sold for reprocessing, as when made into zinc chloride, it is tabulated as new scrap. Most of the chemical residues from which secondary zinc is recovered come from this source.

Production of secondary zinc and zinc-alloy products in the United States, 1945–48, gross weight in short tons

Products	1945	1946	1947	1948
Redistilled slab zinc	49, 242	44, 516	59, 542	59, 679
Zinc dust	23, 892	26, 002	28, 334	29, 932
Remelt spelter [1]	8, 090	8, 212	7, 443	7, 796
Remelt die-cast slab	4, 727	7, 829	8, 595	10, 543
Zinc-die and die-casting alloys	2, 281	3, 002	2, 698	3, 377
Galvanizing stock	701	876	774	580
Rolled zinc	3, 054	2, 729	2, 341	2, 778
Secondary zinc in chemical products	41, 866	45, 029	55, 525	48, 995

[1] Contains small tonnages of bars, anodes, etc.

In 1948, 50 percent or 162,384 tons of the secondary zinc produced was recovered as an element in brass and bronze. This was 15,518 tons more than was so recovered in 1947 and substantially exceeded the 59,109 tons recovered in redistilled slab zinc. Secondary recovery in lead-free zinc oxide declined 33 percent to 12,327 tons in 1948. Recovery from scrap in this product represents only about 10 percent of the total, as most zinc oxide is made from ore.

An important zinc product, most of which is recovered from scrap, is zinc dust. The output of dust from secondary sources in 1948 increased for the sixth straight year and totaled 29,932 tons. In 1942 this recovery was 18,101 tons. The output of redistilled slab, the largest secondary zinc product, totaled 59,679 tons in 1948.

Production in zinc chemicals, although 6,530 tons less than the 55,525 tons produced in 1947, was still higher than for any other year since 1939. The figures for redistilled slab zinc and zinc dust in the production table are slightly greater than those for slab zinc and zinc dust in the recovery table because the former table represents gross weight produced and the latter zinc content of production.

Of the 22 zinc-distillation plants producing secondary zinc in 1947, 21 were still in operation in 1948, 1 producer of slab zinc having closed during the year. Two other plants were added to the list of smelters recovering secondary zinc in 1948. One, the Eagle Picher Co. smelter at East Chicago, added zinc dust to its list of products. This company had previously developed a muffle furnace for production of zinc and zinc oxide from die-cast scrap.[12] Another distillation plant to start operations in 1948, bringing the total to 23, produced slab zinc from brass scrap, the residue being copper of enough purity for use in the manufacture of copper sulfate.

Consumption of old and new zinc scrap in the United States in 1948, 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	4,591		4,714		9,305
Sheet and strip		6,474		121	6,595
Engravers' plates		1,537		72	1,609
Skimmings and ashes	62,795		33,988		96,783
Dross	61,684		134		61,818
Die castings		20,659	393	213	21,265
Rod and die scrap		2,653			2,653
Flue dust	10,453		10,917		21,370
Chemical residues	11,281		13,322		24,603
Total	150,804	31,323	63,468	406	246,001

As usual, the bulk of the zinc scrap consumed in the secondary zinc industry was byproduct residues which accounted for 83 percent of the total used in 1948. The largest item was skimmings and ashes, chiefly the result of galvanizing operations, use of which rose from 86,168 tons in 1947 to 96,783 tons in 1948. Consumption of dross, entirely a galvanizing byproduct, increased from 57,453 tons in 1947 to 61,818 tons in 1948. The most important metallic scrap item was die castings, of which 21,265 tons were used in 1948. In spite of reports that aluminum and magnesium were gaining as competitors of zinc in the die-casting field, a record 234,628 tons of slab zinc—20,159 tons more than in 1947—were used in zinc alloys, mainly for die castings, in 1948. Consumption of die-cast scrap was about the same in each year. Consumers' stocks of zinc-base scrap were virtually the same at the end of 1948 as at the end of 1947.

[12] Johnson, Gunnard E., Development of Muffle Furnaces for the Production of Zinc Oxide and Zinc at East Chicago, Ind.: Jour. Metals, vol. 1, No. 2, sec. 3, February 1949, pp. 118–124.

Consumers' stocks of zinc-base scrap in the United States at end of year, 1947–48, gross weight in short tons

Scrap item	Dec. 31, 1947	Dec. 31, 1948
Metallic zinc scrap	3,459	3,878
Dross	8,013	8,560
Skimmings and residues	23,805	23,337
Total	35,277	35,775

Dealers' buying prices for new zinc clippings averaged 9.42 cents a pound in 1948, compared with 7.16 cents in 1947. The price increased from an average of 7.48 cents in January to 8.25 cents in February and stayed at that level until August, when it advanced to 10.25 cents. A further increase to 11.99 cents occurred in November and another in December to 12.75 cents. The price for old zinc scrap followed the same trend as that for clippings in 1948 and increased from an average of 5.29 cents in January to 10.25 cents in December, the average for the year being 7.01 cents.

United States imports of old zinc scrap totaled 1,636 tons in 1948, compared with 714 tons in 1947. Imported drosses and residues totaled 8,637 tons in 1948, an increase of 4,246 tons over the 4,391 tons (revised) imported in 1947. 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 zinc but as recovered from material other than scrap.

Slag—Iron Blast Furnace

By D. G. RUNNER

GENERAL SUMMARY

CONTINUED demands by the construction industry resulted in another prosperous year in 1948 for the iron-blast-furnace slag industry. High level activity in highway and building construction during the year was reflected in increases of slag sold or used by processors. Inasmuch as processed slag stocks are comparatively small and constant from year to year, production virtually equals sales; therefore, these terms are used interchangeably in this chapter. As indicated in the accompanying salient statistics table, sales in 1948 of all types of slag increased materially over those reported in 1947.

Iron blast-furnace slag sold or used by processors in the United States, 1944–48, by types

[National Slag Association]

Year	Air-cooled						Granulated			Lightweight		
	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
1944	10, 730, 613	$9, 260, 257	$0. 86	776, 302	$303, 460	$0. 39	733, 255	$133, 308	$0. 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	14, 332, 896	13, 250, 693	. 92	596, 957	211, 078	. 35	1, 003, 789	[1] 86, 383	------	773, 150	1, 321, 685	1. 71
1947	16, 712, 177	17, 045, 020	1. 02	447, 908	257, 683	. 58	1, 290, 958	[1] 95, 087	------	1, 130, 636	2, 127, 692	1. 88
1948	17, 656, 200	19, 254, 900	1. 09	604, 100	370, 000	. 61	1, 517, 500	[1] 184,700	------	1, 353, 200	2, 550, 400	1. 88

[1] Excludes value of slag used for cement manufacture.

PRODUCTION

The output of slag from iron blast furnaces in 1948 amounted to an estimated 39,000,000 short tons compared with 32,284,000 short tons in 1947 and indicates the increased tempo at which the steel industry operated during the year.

The quantity of slag processed for commercial use in 1948, as reported by the National Slag Association, reached a record high of 21,131,000 short tons valued at $22,360,000 representing increases of 8 and 15 percent, respectively, over the 19,581,679 short tons valued at $19,525,482 in 1947. The output of slag in 1948 came from 42 companies operating 68 slag plants. One new company started operations in 1948—the Gifford-Hill Co., Dallas, Tex., with plant at Daingerfield, Tex.

During 1948, iron blast-furnace slag was processed in the following States: Alabama, California, Colorado, Illinois, Indiana, Kentucky, Maryland, Michigan, New York, Ohio, Pennsylvania, Texas, and West Virginia. It will be noted that the majority of the plants are east of the Mississippi River. In 1948, as in 1947, Ohio was the largest processor of slag, and Alabama and Pennsylvania follow in that order. These three States supplied 66 percent of the total tonnage reported in 1948. The accompanying table shows the available details on processed slag, by States, in 1948.

Iron blast-furnace slag processed in the United States, by States, in 1948

[National Slag Association]

State	Screened air-cooled			All types		
	Quantity		Value	Quantity		Value
	Short tons	Percent of total		Short tons	Percent of total	
Alabama	4,203,000	24	$3,947,300	4,765,800	22	$4,735,800
Ohio	5,091,300	29	6,044,000	6,073,800	29	6,460,000
Pennsylvania	2,807,000	16	3,660,200	3,137,000	15	3,994,600
Other States [1]	5,554,900	31	5,603,400	7,154,400	34	7,169,600
	17,656,200	100	19,254,900	21,131,000	100	22,360,000

[1] California, Colorado, Illinois, Indiana, Kentucky, Maryland, Michigan, New York, Texas, and West Virginia.

PREPARATION

Processed blast-furnace slag is commonly marketed as air-cooled (screened or unscreened), granulated, or lightweight slag. Slag produced in blast furnaces and allowed to air-cool either in the pit or a modified bank is the chief form in which slag is processed.

Air-cooled slag is generally processed while hot. Iron is recovered by magnetic methods while the slag is being processed. The product is excavated from the pit or bank and crushed or screened, as with natural aggregates, for concrete aggregate, railroad ballast, roofing aggregate, and many other uses. Granulated slag is commonly prepared by pouring the molten material into pits in which enough water is present to cool the material quickly. Lightweight slag is prepared by processing the material in the molten condition by either the machine or pit process.

TRANSPORTATION

As in 1947, the bulk of the slag processed in 1948 was moved by rail and truck. Negligible quantities were moved by waterway. As indicated in the accompanying table, railroads handled 54 percent and trucks 45 percent of the total quantity shipped compared with 59 and 40 percent, respectively, in 1947. Trends in the methods of shipment indicate decreases in the rail shipments, while truck shipments have increased correspondingly during the past few years.

Shipments of iron blast-furnace slag in the United States, by methods of transportation, 1947–48

[National Slag Association]

Method of transportation	1947		1948	
	Short tons	Percent of total	Short tons	Percent of total
Rail	11,217,642	59	11,066,400	54
Truck	7,640,384	40	9,215,500	45
Waterway	283,697	1	145,200	1
Total shipments	19,141,723	100	20,427,100	100
Percent of total processed slag		98		97

CONSUMPTION

Screened air-cooled slag was the major product of the industry, representing 84 percent of the total slag processed. Granulated slag comprised 7 percent, lightweight 6 percent, and unscreened air-cooled slag 3 percent.

Screened Air-Cooled Slag.—Consumption of screened air-cooled slag reached an all-time high of 17,656,200 short tons, 944,000 tons above the previous record year 1947. The use of screened air-cooled slag as aggregate in portland-cement concrete construction, bituminous construction, and other road-construction uses and as railroad ballast took 15,477,400 short tons or 88 percent of the total consumption of this type of slag. Other principal uses for this material were in the manufacture of concrete block, mineral wool, and roofing.

Unscreened Air-Cooled Slag.—In 1948 the quantity of unscreened air-cooled slag processed totaled 604,100 short tons valued at $370,000. These figures represent increases of 35 and 44 percent, respectively, over the 1947 totals. Road construction consumed the bulk of this material in 1948.

Granulated Slag.—Consumption of granulated slag in 1948 totaled 1,517,500 short tons, 18 percent above the 1,290,958 tons reported in

Air-cooled iron blast-furnace slag sold or used by processors in the United States, by uses, in 1948

[National Slag Association]

Use	Screened		Unscreened	
	Short tons	Value	Short tons	Value
Aggregate in:				
Portland-cement concrete construction	1,636,000	$1,813,700		
Bituminous construction (all types)	4,141,500	4,928,100		
Highway construction [1]	5,467,700	6,388,000	260,800	$174,900
Airport construction [1]	168,400	192,700	25,000	12,500
Manufacture of concrete block	801,700	880,000		
Railroad ballast	4,232,300	3,579,200	13,300	5,700
Mineral wool	578,800	726,200		
Roofing (built-up and granules)	211,800	314,700		
Sewage trickling filter medium	10,800	14,000		
Agricultural slag, liming	43,700	56,300		
Other uses	363,500	362,000	305,000	176,900
	17,656,200	19,254,900	604,100	370,000

[1] Other than in portland-cement concrete and bituminous construction.

1947. The principal uses for this slag were in the manufacture of cement and as road fill. These two uses consumed 98 percent of the total processed. The granulated slag used in roads and streets was utilized chiefly as blanket courses and as fill material.

Lightweight Slag Aggregate.—The consumption of lightweight slag aggregate manufactured from molten slag in 1948 amounted to 1,353,200 short tons valued at $2,550,400, representing increases of 20 percent over the 1,130,636 tons valued at $2,127,692 reported in 1947. It is reported that the bulk of the output was utilized as aggregate in the manufacture of concrete block.

Granulated and lightweight iron blast-furnace slag sold or used by processors in the United States, by uses, in 1948

[National Slag Association]

Use	Granulated		Lightweight	
	Short tons	Value	Short tons	Value
Road fill, etc.	448,700	$152,100		
Agricultural slag, liming	28,800	30,900		
Manufacture of hydraulic cement	1,034,900	(1)		
Aggregate for concrete block manufacture			[2] 1,353,200	$2,550,400
Other uses	5,100	1,700		
	1,517,500	[3] 184,700	1,353,200	2,550,400

[1] Data not available.
[2] Includes a small amount used for concrete other than blocks.
[3] Excludes value of slag used for cement manufacture.

PRICES

Average prices for the various types of slag processed in 1948 are indicated in the accompanying table. Values for screened air-cooled slag ranged from 85 cents per ton for railroad ballast to $1.49 per ton for slag used in the roofing industry. Unscreened air-cooled slag values ranged from 43 cents per ton for railroad ballast to 67 cents for that utilized in highway construction (other than concrete or bituminous types). Available value figures on granulated-slag products ranged from 33 cents to $1.07 per ton, and lightweight aggregate averaged $1.88 per ton. A value for granulated slag used in the manufacture of cement could not be obtained.

Average value per short ton of iron blast-furnace slag sold or used by processors in the United States, by uses, in 1948

[National Slag Association]

Use	Air-cooled		Granulated	Lightweight
	Screened	Unscreened		
Aggregate in:				
Portland-cement concrete construction	$1.11			
Bituminous construction (all types)	1.19			
Highway construction [1]	1.17	$0.67		
Airport construction [1]	1.14	.50		
Manufacture of concrete block	1.10			$1.88
Railroad ballast	.85	.43		
Mineral wool	1.25			
Roofing (built-up and granules)	1.49			
Sewage trickling filter medium	1.30			
Agricultural slag, liming	1.29		$1.07	
Road fill, etc.			.34	
Other uses	1.00	.58	.33	

[1] Other than in portland-cement concrete and bituminous construction.

IRON RECOVERY

Iron recovered in processing slag totaled 215,848 short tons, an increase of 2 percent over the 212,575 tons reclaimed in 1947. Iron is recovered from slag either by magnetic methods or by hand picking. This recovery of iron represents an important contribution to the iron and steel industry.

EMPLOYMENT

A total of 2,087 plant and yard employees were reported by the slag industry in 1948 compared to 2,216 in 1947. The total number of man-hours utilized in 1948 was 5,419,000, representing an increase of 4 percent over the 5,212,930 hours reported in 1947.

TECHNOLOGY

The demand for lightweight aggregate resulted in further development of techniques for expanding slag. This is especially true in the pit process. In 1948, about 30 percent of all expanded slag was done by the pit method. Various companies experimented with modifications of the pit process. These ranged from methods in which the water and slag are brought together in mid air to one in which slag, water, steam, and air are brought together in equipment designed to improve control and efficiency. A method called the foaming-bed process was introduced into the United States by an English group, and a commercialized experimental unit was built at a steel plant.

Dust in slag plants has long been a problem in the industry, and dust elimination received considerable attention during 1948.

Slate

By D. G. RUNNER AND M. G. DOWNEY

GENERAL SUMMARY

SALES of slate as a whole decreased 9 percent in quantity and increased 10 percent in value in 1948 compared with 1947. Slate sold as dimension stone—that is, in the form of roofing slate, mill stock, etc.—increased 25 percent in quantity and 35 percent in value over the preceding year's figures.

Sales of roofing slate increased 28 percent in quantity and 48 percent in value and indicate the continued upward trend in the production and sales of this material. The average value per square in 1948 was $20.88, or 15 percent greater than that reported in 1947 ($18.14). In the Pennsylvania area roofing-slate sales were 21 percent greater in quantity and 43 percent higher in value than in 1947. Total values of roofing-slate sales in New York, Vermont, and Maine, although still at a relatively low level, were 54 percent greater than those in 1947. In the Buckingham region of Virginia, sales increased 53 percent quantitywise and were much greater in total value than in the previous year.

Sales of mill stock suffered a slight decline in quantity but gained 11 percent in value. Structural and sanitary slate, blackboards, and school slates showed considerable gain in quantity and value in 1948, while grave vaults and covers and billiard-table tops declined 40 and 54 percent, respectively, in quantity and 29 and 51 percent in value.

Sales of electrical slate also dropped considerably. Flagstones, stepping stones, and similar products gained 29 percent in quantity and 30 percent in value over 1947 totals.

Statistics on slate granules and flour are included in this chapter, although they have little in common with the above-mentioned slate products. Most of the slate employed in manufacturing granules and flour is unsuitable for other slate products. Granules and flour declined 14 percent quantitywise and 9 percent in value compared with 1947. Figures for sales of granules of all types, including slate, are given in the Stone chapter of this volume.

The accompanying table presents the principal statistical data for the slate industry in 1947 and 1948.

Salient statistics of the slate industry in the United States, 1947–48

	1947			1948				
	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* 170,590	64,350	$3,094,780	*Squares* 218,650	82,090	$4,566,056	+28	+48
Mill stock:								
Electrical slate	*Sq. ft.* [1] 500,930	3,650	486,687	*Sq. ft.* 373,250	2,800	451,459	−25	−7
Structural and sanitary slate	523,360	4,090	308,874	618,810	5,120	465,386	+18	+51
Grave vaults and covers	40,560	370	23,006	24,460	210	16,292	−40	−29
Blackboards and bulletin boards	786,130	2,040	373,421	928,340	2,020	535,254	+18	+43
Billiard-table tops	424,940	3,160	243,856	193,450	1,430	118,592	−54	−51
School slates	[2] 273,160	240	8,991	[2] 402,940	370	13,036	+48	+45
Total mill stock	[1] 2,549,080	13,550	1,444,835	2,541,250	11,950	1,600,019	--------	+11
Flagstones, etc.[3]	5,208,820	34,610	537,705	6,712,920	46,490	700,477	+29	+30
Total slate as dimension stone	----------	112,510	5,077,320	----------	140,530	6,866,552	+25	+35
Granules and flour	----------	763,500	6,608,234	----------	658,870	6,014,377	−14	−9
Grand total domestic production	----------	876,010	11,685,554	----------	799,400	12,880,929	−9	+10

[1] Revised figure.
[2] Square feet approximate. Number of pieces: 1947, 510,340; 1948, 751,760.
[3] Includes slate used for walkways, stepping stones, and miscellaneous uses.

SALES

Dimension Slate.—The term "dimension slate" usually is applied to slabs or blocks 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.

Dimension slate sold by producers in the United States, 1944–48

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
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
1947	170,590	64,350	3,094,780	13,550	1,444,835	34,610	537,705	112,510	5,077,320
1948	218,650	82,090	4,566,056	11,950	1,600,019	46,490	700,477	140,530	6,866,552

[1] Includes flagstones, walkways, stepping stones, and miscellaneous slate.

Inasmuch as roofing slate is used chiefly in residential building, it is interesting to follow the trend of roofing-slate sales in comparison with the number of new dwelling units. The relationship is shown in figure 1. From 1929 to 1938, sales of roofing slate compared favorably with the normally expected requirements of the building programs of those years. However, during and after the recent war, lack of experienced labor somewhat impeded the return to normal operating conditions. Other factors tending to restrict the sale of roofing slate are the inroad made by prepared roofing materials, and strikes at some of the producing quarries.

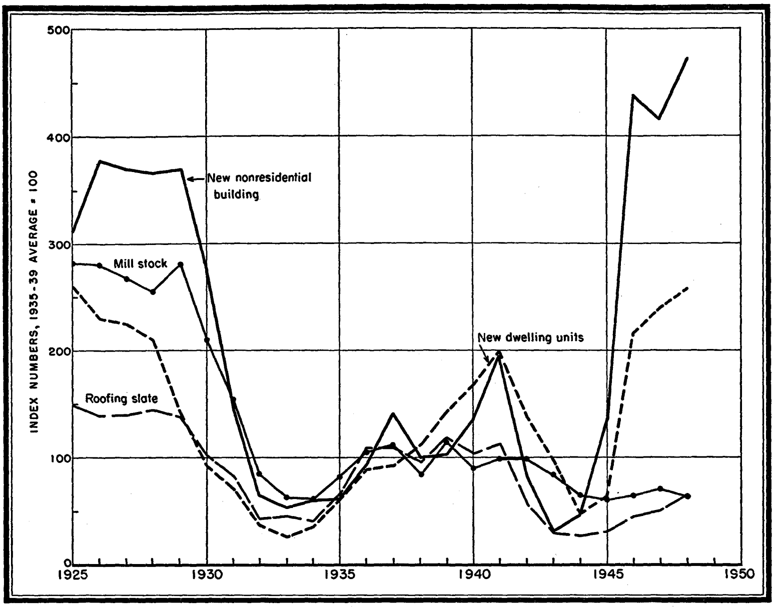

FIGURE 1.—Sales of roofing slate and mill stock compared with number of new dwelling units and value of new nonresidential construction, 1925–48. Data on number of new dwelling units (actual starts) in nonfarm areas from U. S. Department of Labor, Monthly Labor Review; on value of nonresidential construction activity from U. S. Department of Commerce, Survey of Current Business.

Mill-stock slate is used extensively for equipment in nonresidential buildings, and in general sales have closely paralleled construction activity in this field. The relationships for 1925 to 1948 are indicated in figure 1.

Figure 2 presents a graphic summary of the slate industry from 1915 to 1948, by uses. In 1925 the value of production reached a peak, followed by relative inactivity during the depression, with some gains registered prior to World War II. Some decline was noted during the early war years but since about 1944, the industry has been improving rapidly.

Figure 3 presents a statistical summary of slate production, by uses, on a quantity basis. As indicated in the figure, granules and flour assume a dominant place in the industry not only from the value of production, but quantitywise as well.

Granules and Flour.—Granules are used chiefly in surfacing prepared roofing, while flour, a byproduct of the granule industry, is used in paints, roofing mastic, linoleum, and as a filler in asphaltic road surface mixtures. Sales of granules decreased 16 percent quantitywise and 10 percent in value in 1948 as compared with 1947, while sales of flour decreased slightly in quantity but increased in value over the preceding year's figures. Granules were produced in Vermont, Pennsylvania, New York, Maryland, and Georgia, 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.

Crushed slate (granules and flour) sold by producers in the United States, 1944–48

Year	Granules		Flour		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
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
1947	593,560	5,911,151	169,940	697,083	763,500	6,608,234
1948	499,440	5,306,568	159,430	707,809	658,870	6,014,377

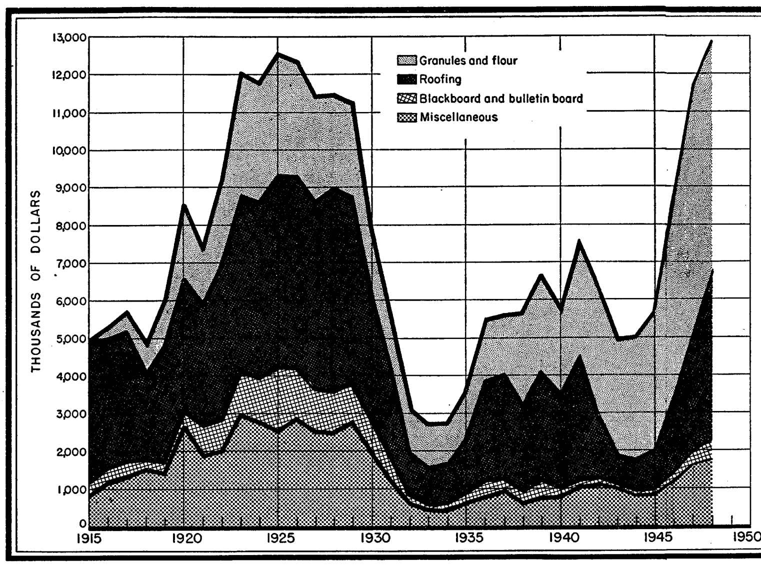

Figure 2.—Value of slate sold in the United States, 1915–48, by uses.

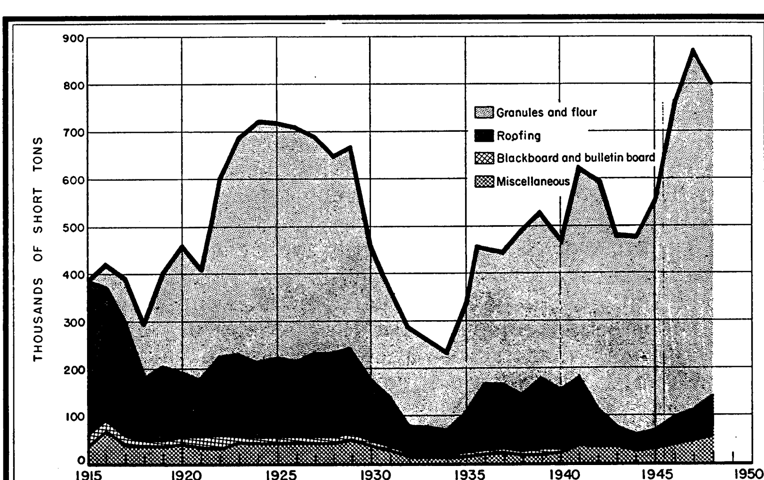

Figure 3.—Quantity of slate sold in the United States, 1915–48, by uses.

REVIEW BY STATES AND DISTRICTS

As indicated in the salient statistics table, the total domestic production of slate declined 9 percent in 1948 compared with 1947 figures. A total of 83 operators reported production in 1948, an increase of 7 compared with 1947. The accompanying table shows sales of slate in 1948, by States and uses.

Slate sold by producers in the United States, by States and uses, 1944–48

	Operators	Roofing		Mill stock		Other uses (value) [1]	Total value
		Squares (100 square feet)	Value	Square feet	Value		
1944	44	89,090	$802,179	2,041,210	$715,689	$3,486,327	$5,004,195
1945	46	101,300	976,122	2,107,780	742,345	3,940,446	5,658,913
1946	61	146,790	1,982,928	2,371,820	1,032,584	5,828,594	8,844,106
1947	76	170,590	3,094,780	[2] 2,549,080	1,444,835	7,145,939	11,685,554
1948							
Arkansas	1					(3)	(3)
California	4					(3)	(3)
Georgia	1					(3)	(3)
Maryland	1					(3)	(3)
New York	13	3,730	91,988			1,440,892	1,532,880
Pennsylvania	26	146,860	2,846,371	2,103,720	1,084,613	1,420,169	5,351,153
Vermont and Maine	32	50,700	1,203,362	437,530	515,406	2,279,260	3,998,028
Virginia	5	17,360	424,335			(3)	(3)
Undistributed						1,574,533	1,998,868
Total	83	218,650	4,566,056	2,541,250	1,600,019	6,714,854	12,880,929

[1] Flagging and similar products, granules, and flour. [2] Revised figure. [3] Included with "Undistributed."

Maine.—The principal product of the quarries near Monson is electrical slate and a small quantity of vaults and covers. As in 1947, only one company was active.

New York.—The total number of slate operators decreased 2 and the total value of slate products decreased 3 percent below 1947 figures. The chief commodities produced and sold in this State were granules, flour, and flagging, and minor quantities of roofing slate. The value of these products, exclusive of roofing slate, decreased 7 percent in 1948.

Pennsylvania.—The quarries of Lehigh and Northampton Counties furnish all types of slate products and comprise the most productive slate area in the United States. Slate produced in York County in the Peach Bottom district, on the Maryland-Pennsylvania border between Cardiff, Md., and Delta, Pa., may not be shown separately and is included with Northampton County in the accompanying table giving detailed figures for Pennsylvania.

The total value of all slate products sold in Pennsylvania in 1948 increased 24 percent compared with 1947. Sales of roofing slate increased 21 percent quantitywise and 43 percent in value. The total value of mill stock rose 8 percent compared with 1947. The percentage changes in 1948 over 1947 were as follows: Electrical slate, decrease of 75 percent in quantity and 65 percent in value; structural and sanitary slate, increases of 8 and 39 percent in quantity and value, respectively; vaults and covers, decrease of 39 percent quantitywise and 29 percent in value; bulletin and blackboards, 18-percent increase in quantity and 43 percent in value; billiard-table tops, decrease of 55 percent quantitywise and 52 percent in value; school slates showed increases of 48 percent and 45 percent, respectively, in quantity and value. The value of miscellaneous products (granules, flour, flagstones, etc.) increased 7 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 an accompanying table.

Slate sold by producers in Pennsylvania in 1948, 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	7	10,010	$201,155	34,040	$27,336	(1)	(1)		
Northampton and York [2]	19	136,850	2,645,216	3,230	3,821	518,210	$371,595	24,000	$15,817
Total: 1948	26	146,860	2,846,371	37,270	31,157	518,210	371,595	24,000	15,817
1947	21	121,480	1,988,255	150,660	89,242	478,810	267,828	39,500	22,140

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	226,140	$108,821			402,940	$13,036	$401	$350,749
Northampton and York [2]	702,200	426,433	192,960	$117,754			1,419,768	5,000,404
Total: 1948	928,340	535,254	192,960	117,754	402,940	13,036	1,420,169	5,351,153
1947	786,130	373,421	424,940	243,856	273,160	8,991	1,324,463	4,318,196

[1] Small amount of slate for structural and sanitary use produced in Lehigh County included under Northampton and York Counties.
[2] York County produced granules and flour only.

Vermont.—To avoid revealing the output of an individual firm, Maine has been included with Vermont in the accompanying table. The total value of slate products sold in 1948 in Vermont and Maine was 3 percent greater than in 1947. Gains of 46 percent and 17 percent, respectively, were made in total sales value of roofing slate and mill stock in 1948, while value of other uses (flagging, granules, flour) decreased 13 percent.

Virginia.—The principal product of the Buckingham County quarries is roofing slate. The high-quality Virginia slate, which is dark gray or slightly greenish, has been produced for many years. In 1948, 17,360 squares of roofing slate, valued at $424,335, were produced in this district, representing increases of 53 percent in quantity and 63 percent in value over 1947 totals. Substantial amounts of granules were produced in 1948 but details cannot be given because of the small number of operations.

Other Districts.—Slate products, chiefly granules and flour, were produced in Montgomery County, Ark., near Glenwood; near Placerville, Eldorado County, and in Inyo County, Calif.; and near Fairmount, Bartow County, Ga.

PRICES

The average price of roofing slate, f. o. b. quarry or mill, as reported to the Bureau of Mines, increased $2.74 per square to $20.88 per square in 1948. In Pennsylvania it was $19.38 per square, in New York $24.66, in Vermont and Maine $23.73, and in Virginia $24.44.

The average value of mill stock rose to 63 cents per square foot in 1948, an increase of 6 cents over 57 cents in 1947. The average value of electrical slate increased 24 cents (to $1.21), structural and sanitary slate 16 cents ($0.75), grave vaults and covers 10 cents ($0.67), blackboards and bulletin boards 10 cents ($0.58), and billiard-table tops 4 cents per square foot (to $0 61), compared with 1947. The average sales value of granules a short ton increased 67 cents while flour increased 34 cents.

Price History.—The trend of annual average value of roofing slate and mill stock compared with wholesale prices of all building materials over a 34-year period is indicated in figure 4. From 1915 to 1920 slate prices (compared with 1935–39 base period) have been somewhat below the general average for building materials, while from 1921 to 1936 they were above. Fairly close agreement with the general average was maintained from 1936 to 1945, at which time a persistent uptrending began in the values of roofing slate.

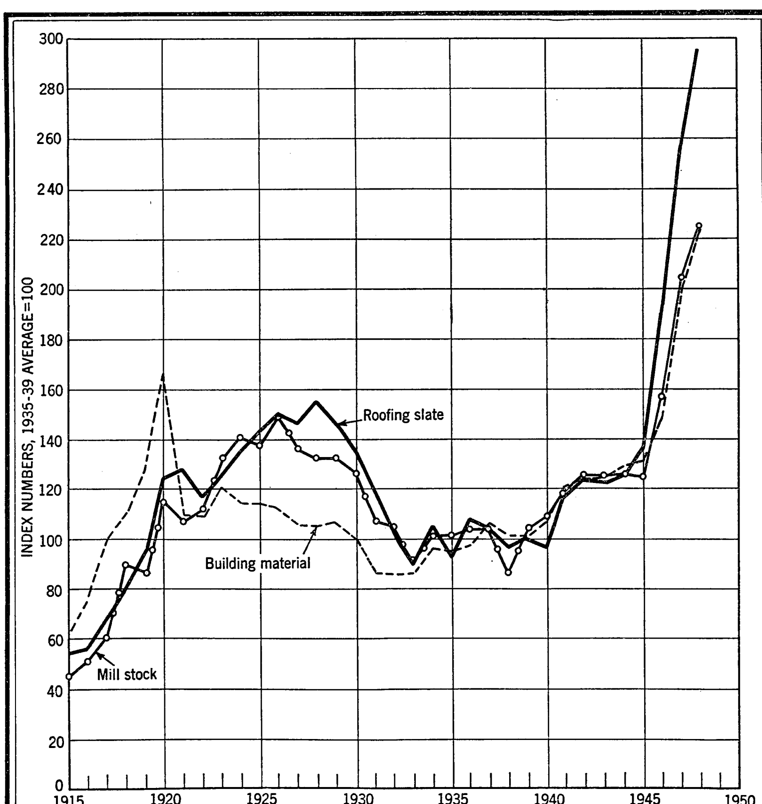

FIGURE 4.—Average value of slate compared with wholesale prices of building materials in general, 1915–48. Wholesale prices from U. S. Department of Labor.

FOREIGN TRADE

Imports.[1] —The value of slate imported for consumption has been increasing somewhat during recent years, amounting to $616 in 1946, $5,747 in 1947, and $13,652 in 1948. Of this latter figure $182 (2,790 square feet) was for roofing and $13,470 was classified as "other." Details are shown in an accompanying table.

Slate imported for consumption in the United States, by countries, 1942–48 [1]

[U. S. Department of Commerce]

Country	1942	1944	1946	1947	1948
Canada	$177		$23	$16	$1,078
China				39	66
Italy			83	5,688	11,584
Japan					89
Mexico		$50	64		
Norway					10
Portugal			446		317
Spain					424
Switzerland					31
United Kingdom		1		4	53
Total	177	51	616	5,747	13,652

[1] No imports during 1943 and 1945.

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 1948 the total value of exports was $587,328, a decrease of 3 percent compared with 1947.

Slate exported from the United States, by uses, 1944–48 [1]

Use	1944	1945	1946	1947	1948
Roofing	$5,398	$3,465	$7,103	$13,748	$4,476
School slates [2]	24,008	4,751	21,701	30,436	25,846
Electrical	3,782	2,490	5,117	3,164	4,245
Blackboards	14,674	20,211	40,294	47,899	65,314
Billiard tables	75,797	161,439	47,605	43,161	58,692
Structural (including floors and walkways)	180,697	2,316	386,642	466,736	428,755
Slate granules and flour		219,933			
Total	304,356	414,605	508,462	605,144	587,328

[1] Figures collected by the Bureau of Mines from shippers of products named.
[2] Includes slate used for pencils and educational toys.

TECHNOLOGY

The use of lightweight aggregates in the building construction industry has become of prime interest in the past few years. Two recent reports covering the utilization of slate in the manufacture of this aggregate have been released.[2]

UNION OF SOUTH AFRICA

Shortage of steel and cement in the Union of South Africa has given impetus to production of slate in the Transvaal. Annual production from all quarries is reported to exceed a value of £100,000 annually.[3]

[1] Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerie.
[2] Pennsylvania State College, Properties and New Uses of Pennsylvania Slate, Mineral Industries Exp. Station, Bull. 47. 168 pp.
Conley, J. E., Wilson, Hewitt, Klinefelter, T. A., and others, Production of Lightweight Concrete Aggregates from Clays, Shales, Slates, and Other Materials: Bureau of Mines, Rept. of Investigations 4401, 1948, 121 pp.
[3] Mine and Quarry Engineering, vol. 14, No. 9, September 1948, p. 291.

Stone

By D. G. RUNNER, NAN C. JENSEN, AND M. G. DOWNEY

GENERAL SUMMARY

OUTPUT of crushed and dimension stone combined (225,535,390 short tons) in 1948 increased substantially over the 1947 total. Production in 1948 was up 9 percent, and the total value ($328,-984,571) was 14 percent greater than the value reported in 1947. Sales of crushed and broken stone in 1948 were 9 percent greater in quantity and 13 percent greater in value than in 1947, while dimension-stone production increased 18 percent quantitywise and 17 percent in value. In common with the general trend of prices, the average unit values for some classes of dimension stone showed increases over 1947 figures.

As in the past, the tables in 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 material 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, 1944–48, by kinds

Year	Granite		Basalt and related rocks (trap rock)		Marble		Limestone	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
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
1947	12,443,320	34,123,460	19,616,020	25,755,314	227,880	10,252,522	150,408,820	186,548,286
1948	13,685,880	38,807,266	20,654,580	29,916,965	276,000	10,421,254	166,742,390	215,451,016

Year	Sandstone		Other stone [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
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
1947	6,809,080	16,586,504	18,049,670	16,078,396	207,554,790	289,344,482
1948	7,289,950	18,048,947	16,886,590	16,339,123	225,535,390	328,984,571

[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, 1947–48, by uses

Use	1947		1948	
	Quantity	Value	Quantity	Value
Dimension stone:				
Building stone:				
Rough construction [1] ... short tons	200,420	$1,996,445	289,480	$2,510,957
Cut stone, slabs, and mill blocks [1] ... cubic feet	7,203,530	16,614,261	9,208,020	22,398,186
Approximate equivalent in short tons	538,870		691,720	
Rubble ... short tons	268,890	715,296	276,200	573,713
Monumental stone ... cubic feet	3,778,060	19,814,723	3,724,250	20,541,071
Approximate equivalent in short tons	312,150		306,770	
Paving blocks ... number	683,950	56,118	392,110	32,810
Approximate equivalent in short tons	4,830		3,210	
Curbing ... cubic feet	634,860	1,109,897	769,300	1,382,278
Approximate equivalent in short tons	51,860		62,950	
Flagging ... cubic feet	520,490	585,782	520,420	585,104
Approximate equivalent in short tons	41,440		41,280	
Total dimension stone (quantities approximate, in short tons)	1,418,460	40,892,522	1,671,610	48,024,119
Crushed and broken stone:				
Riprap ... short tons	5,732,740	6,513,792	5,707,410	7,553,156
Crushed stone ... do	123,427,850	139,320,324	139,723,160	166,195,528
Furnace flux (limestone) ... do	32,570,270	28,687,950	34,901,940	34,250,008
Refractory stone [2] ... do	2,704,220	5,536,738	2,557,050	6,531,084
Agricultural (limestone) ... do	22,605,500	35,075,883	20,941,530	32,034,698
Other uses ... do	19,095,750	33,317,273	20,032,690	34,395,978
Total crushed and broken stone ... do	206,136,330	248,451,960	223,863,780	280,960,452
Grand total (quantities approximate, in short tons)	207,554,790	289,344,482	225,535,390	328,984,571

[1] To avoid disclosure of individual outputs, dimension stone for refractory use is included with building stone. Rough construction and sawed building stone includes—1947: 36,690 short tons of stone for refractory use valued at $905,943; 1948: 16,360 tons, $465,528.
[2] Ganister (sandstone), mica schist, soapstone, and dolomite.

Stone sold or used by noncommercial producers in the United States, 1947–48, by uses

[Included in total production]

Use	1947		1948	
	Short tons	Value	Short tons	Value
Building stone	10,120	$24,499	19,270	$51,882
Rubble	24,980	31,668	85,330	93,900
Riprap	1,032,240	1,148,361	1,337,260	1,467,397
Crushed stone	11,899,150	12,941,922	13,512,810	16,924,108
Agricultural (limestone)	422,420	599,008	330,180	461,047
Other uses	817,170	674,063	1,277,010	1,133,329
Total	14,206,080	15,419,521	16,561,860	20,131,663

Stone sold or used by producers in the United States, 1947–48, by States

State	1947		1948	
	Short tons	Value	Short tons	Value
Alabama	2,795,240	$4,624,892	2,475,530	$4,482,133
Alaska	(1)	(1)	40,730	54,637
Arizona	353,880	219,891	307,570	263,157
Arkansas	[2] 210,100	[2] 448,650	1,379,410	1,883,500
California	[2] 12,757,790	[2] 13,012,556	[2] 11,936,240	[2] 13,155,454
Colorado	1,069,250	1,406,989	2,195,250	2,490,449
Connecticut	[2] 1,362,840	[2] 1,929,548	1,525,490	2,283,298
Delaware	(1)	(1)	36,390	89,970
Florida	3,534,010	4,511,894	[2] 4,154,920	[2] 5,115,974
Georgia	2,960,520	9,977,938	3,631,430	10,801,355
Hawaii	[2] 786,010	[2] 1,470,703	[2] 837,600	[2] 1,917,003
Idaho	[2] 1,044,780	[2] 991,599	1,081,060	1,003,858
Illinois	[2] 15,545,130	[2] 18,160,506	[2] 18,533,290	[2] 22,823,138
Indiana	[2] 5,589,550	[2] 11,254,020	[2] 6,574,390	[2] 14,989,239
Iowa	5,586,460	7,385,436	6,387,620	8,332,682
Kansas	4,792,850	4,867,789	5,315,680	5,481,190
Kentucky	[2] 4,990,170	[2] 5,875,574	6,154,950	7,598,309
Louisiana	892,110	827,184	(1)	(1)
Maine	[2] 158,150	[2] 1,557,978	288,760	2,021,035
Maryland	[2] 1,552,610	[2] 2,416,393	1,874,270	3,115,196
Massachusetts	[2] 2,565,960	[2] 5,644,821	[2] 2,367,140	[2] 6,592,952
Michigan	18,600,370	12,601,288	[2] 19,704,150	[2] 14,620,527
Minnesota	[2] 1,372,220	[2] 3,854,473	1,804,960	5,090,652
Mississippi	(1)	(1)	24,330	27,980
Missouri	[2] 8,438,320	[2] 11,195,993	[2] 9,020,580	[2] 12,320,220
Montana	632,620	574,726	614,950	613,024
Nebraska	219,780	537,824	366,110	707,327
Nevada	1,691,700	1,068,840	554,880	680,957
New Hampshire	109,230	399,879	88,430	314,353
New Jersey	3,857,710	6,136,857	3,591,440	6,375,877
New Mexico	477,970	251,080	531,300	293,858
New York	11,197,990	14,992,064	12,687,970	17,261,486
North Carolina	5,018,060	7,561,167	5,237,050	7,713,859
North Dakota	-------	-------	(1)	(1)
Ohio	[2] 18,710,890	[2] 23,633,433	20,274,570	27,552,017
Oklahoma	2,610,770	2,679,855	4,027,630	4,141,379
Oregon	3,002,000	4,425,847	3,682,420	5,733,658
Pennsylvania	[2] 22,352,810	[2] 31,938,877	23,172,190	35,189,148
Puerto Rico	104,470	194,746	[2] 159,350	[2] 311,985
Rhode Island	[2] 32,090	[2] 400,602	107,080	536,651
South Carolina	2,207,840	3,921,465	2,443,750	4,543,436
South Dakota	885,650	3,554,096	763,080	3,911,236
Tennessee	6,796,630	10,617,502	8,011,360	12,932,537
Texas	3,786,040	4,277,404	[2] 3,844,350	[2] 4,658,720
Utah	[2] 178,680	[2] 368,255	279,660	477,654
Vermont	392,420	7,652,139	395,380	7,992,144
Virginia	8,359,420	12,377,061	7,366,520	12,157,241
Washington	3,865,110	4,550,275	5,229,500	6,382,462
West Virginia	4,888,860	6,033,930	4,929,910	5,802,683
Wisconsin	[2] 5,897,960	[2] 11,669,611	[2] 7,224,330	[2] 12,581,046
Wyoming	1,393,070	1,497,034	964,460	1,265,694
Undistributed	1,926,700	3,793,798	1,335,980	2,300,231
Total	207,554,790	289,344,482	225,535,390	328,984,571

[1] Included with "Undistributed."
[2] To avoid disclosing confidential information certain State totals are incomplete, the figures not included being combined with "Undistributed." The class of stone omitted from such State totals is noted in the State tables in the Statistical Summary chapter of this volume.

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. The principal uses of dimension stone are for the construction of masonry walls and for memorials. Crushed and broken stone, on the other hand, consists primarily of irregular fragments sized chiefly by mechanical screening. The main uses of crushed and broken stone are as concrete aggregate, railroad ballast, furnace flux, and various industrial uses.

Dimension-stone producers may be divided into three main groups on the basis of method of operation. The first group quarries stone and sells it as rough blocks or slabs; the second 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 not the third. Bureau of Mines statistics are compiled from reports of quantities and values of original sales; as a result, they include some material sold as rough blocks and some sold as finished products.

Total sales of dimension stone in 1948 increased 18 percent in quantity and 19 percent in value compared with 1947. These over-all figures include slate, but detailed statistics of this branch of the industry appear in the Slate chapter of this volume.

Dimension stone sold or used by producers in the United States, 1947–48, by kinds and uses

Kind and use	1947	1948	
		Total	Percent of change
Granite:			
Building stone:			
Rough construction ... short tons	73,060	136,630	+87
Value	$322,004	$421,178	+31
Average per ton	$4.41	$3.08	−30
Cut stone, slabs, and mill blocks ... cubic feet	509,830	713,350	+40
Value	$2,863,506	$3,913,426	+37
Average per cubic foot	$5.62	$5.49	−2
Rubble ... short tons	86,910	109,660	+26
Value	$214,221	$236,774	+11
Monumental stone ... cubic feet	3,268,650	3,326,990	+2
Value	$14,854,098	$16,458,601	+11
Average per cubic foot	$4.54	$4.95	+9
Paving blocks ... number	683,950	392,110	−43
Value	$56,118	$32,810	−42
Curbing ... cubic feet	553,910	699,370	+26
Value	$970,840	$1,259,932	+30
Total:			
Quantity ... approximate short tons	521,630	639,180	+23
Value	$19,280,787	$22,322,721	+16
Basalt and related rocks (trap rock):			
Building stone:			
Rough construction ... short tons	23,020	3,340	−85
Value	$59,332	$16,700	−72
Average per ton	$2.58	$5.00	+94
Rubble ... short tons	15,820	54,890	+247
Value	$11,492	$60,613	+427
Total:			
Quantity ... short tons	38,840	58,230	+50
Value	$70,824	$77,313	+9

Dimension stone sold or used by producers in the United States, 1947–48, by kinds and uses—Continued

Kind and use	1947	1948 Total	1948 Percent of change
Marble:			
Building stone (cut stone, slabs, and mill blocks)...cubic feet..	501,590	576,500	+15
Value	$4,276,453	$5,022,973	+17
Average per cubic foot	$8.53	$8.71	+2
Monumental stone...cubic feet..	509,410	397,260	−22
Value	$4,960,625	$4,082,470	−18
Average per cubic foot	$9.74	$10.28	+6
Total:			
Quantity...approximate short tons.	85,920	82,700	−4
Value	$9,237,078	$9,105,443	−1
Limestone:			
Building stone:			
Rough construction...short tons..	45,790	47,930	+5
Value	$112,868	$202,819	+80
Average per ton	$2.46	$4.23	+72
Cut stone, slabs, and mill blocks...cubic feet..	4,839,130	6,222,430	+29
Value	$6,793,365	$10,103,934	+49
Average per cubic foot	$1.40	$1.62	+16
Rubble...short tons..	129,900	86,510	−33
Value	$247,833	$184,917	−25
Flagging...cubic feet..	145,620	185,180	+27
Value	$67,425	$91,196	+35
Total:			
Quantity...approximate short tons..	542,630	607,130	+12
Value	$7,221,491	$10,582,866	+47
Sandstone:			
Building stone:			
Rough construction...short tons..	25,800	25,380	−2
Value	$118,561	$130,434	+10
Average per ton	$4.60	$5.14	+12
Cut stone, slabs, and mill blocks...cubic feet..	1,352,980	1,695,740	+25
Value	$2,680,937	$3,357,853	+25
Average per cubic foot	$1.98	$1.98	------------
Rubble...short tons..	27,640	22,320	−19
Value	$208,239	$80,026	−62
Curbing...cubic feet..	80,950	69,930	−14
Value	$139,057	$122,346	−12
Flagging...cubic feet..	368,400	321,640	−13
Value	$509,166	$477,165	−6
Total:			
Quantity...approximate short tons..	187,530	204,250	+9
Value	$3,655,960	$4,167,824	+14
Miscellaneous stone: [1]			
Building stone...cubic feet..	386,180	910,030	+136
Value	$1,383,680	$1,739,826	+26
Average per cubic foot	$3.58	$1.91	−47
Rubble...short tons..	8,620	2,820	−67
Value	$33,511	$11,383	−66
Flagging...cubic feet..	6,470	13,600	+110
Value	$9,191	$16,743	+82
Total:			
Quantity...approximate short tons..	41,910	80,120	+91
Value	$1,426,382	$1,767,952	+24
Total dimension stone, excluding slate:			
Quantity...approximate short tons..	1,418,460	1,671,610	+18
Value	$40,892,522	$48,024,119	+17
Slate as dimension stone [2]...approximate short tons..	112,510	140,530	+25
Value	$5,077,320	$6,866,552	+35
Total dimension stone, including slate:			
Quantity...approximate short tons..	1,530,970	1,812,140	+18
Value	$45,969,842	$54,890,671	+19

[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 purposes. Continued building activity in 1948 resulted in an output of 12,701,220 cubic feet of stone—an increase of 32 percent in quantity and 34 percent in value over the 1947 figures. With the exception of basalt, gains were registered in all kinds of building stone. The following table gives the quantity and value of the major types of building stone sold or used in 1948.

Building stone sold or used by producers in the United States in 1948, by kinds

Kind	Rough			
	Construction		Architectural	
	Cubic feet	Value	Cubic feet	Value
Granite	1,652,600	$421,178	165,410	$305,664
Basalt	39,290	16,700		
Marble			177,650	582,979
Limestone	570,390	202,819	2,990,510	2,805,343
Sandstone	320,890	130,434	384,090	463,317
Miscellaneous	[1] 910,030	[1] 1,739,826		
Total	[1] 3,493,200	[1] 2,510,957	3,717,660	4,157,303

Kind	Finished				Total	
	Sawed		Cut			
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
Granite [2]	334,990	$1,149,955	212,950	$2,457,807	2,365,950	$4,334,604
Basalt					39,290	16,700
Marble	138,110	796,214	260,740	3,643,780	576,500	5,022,973
Limestone	2,286,640	2,805,767	945,280	4,492,824	6,792,820	10,306,753
Sandstone	1,016,120	1,889,502	295,530	1,005,034	2,016,630	3,488,287
Miscellaneous	(1)	(1)			910,030	1,739,826
Total	[1] 3,775,860	[1] 6,641,438	1,714,500	11,599,445	12,701,220	24,909,143

[1] Sawed miscellaneous stone included with construction stone.
[2] Sawed stone corresponds to dressed stone for construction work (walls, foundations, bridges) and cut stone to architectural stone for high-class buildings.

GRANITE

In 1948 sales of granite increased 23 percent in quantity and 16 percent in value compared with 1947. The greatest value gains were in the building-stone branch of the industry—architectural stone sales showed an increase of 123 percent, while sales of rough construction and dressed stone increased 31 and 32 percent, respectively, compared with 1947. Rubble increased 26 percent in quantity and sales value increased 11 percent over the previous year. Monumental-stone sales values registered gains of 12 and 10 percent, respectively, for rough and dressed material. The output of paving blocks was 43 percent less in quantity; and correspondingly, value decreased 42 percent compared with 1947. The number of cubic feet and value of curbing increased about a fourth and a third, respectively, over the previous year's totals. Unit prices in the building and monumental categories were higher for rough architectural and both classes of monumental stone.

Granite (dimension stone) sold or used by producers in the United States in 1948, by States and uses

State	Active plants	Building								Monumental				Paving blocks		Curbing		Total	
		Rough				Dressed		Rubble		Rough		Dressed							
		Construction		Architectural															
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Cubic feet	Value	Cubic feet	Value	Number	Value	Cubic feet	Value	Short tons (approximate)	Value
California	17	750	$4,525	2,930	$13,162	----	----	810	$4,668	29,620	$103,959	(1)	(1)	----	----	(1)	(1)	5,330	$285,214
Colorado	6	----	----	----	----	----	----	----	----	1,890	5,430	1,440	$19,400	----	----	----	----	280	24,830
Connecticut	6	3,090	13,093	1,690	3,381	15,410	$57,302	5,470	18,461	(1)	(1)	(1)	(1)	----	----	2,430	$5,546	10,920	178,053
Georgia	14	9,150	11,010	----	----	(1)	(1)	57,320	81,775	649,520	1,600,075	148,440	1,207,132	(1)	(1)	(1)	(1)	142,760	3,062,168
Maine	8	(1)	(1)	34,780	54,231	118,320	839,994	170	1,360	9,080	10,766	32,080	338,137	(1)	(1)	(1)	(1)	27,380	1,327,095
Maryland	4	(1)	(1)	(1)	(1)	----	----	(1)	(1)	----	----	----	----	----	----	(1)	(1)	(1)	(1)
Massachusetts	7	(1)	(1)	28,130	106,361	(1)	(1)	(1)	(1)	14,450	68,691	(1)	(1)	(1)	(1)	(1)	(1)	83,550	2,841,237
Minnesota	19	----	----	----	----	(1)	(1)	----	----	91,110	229,880	(1)	(1)	----	----	----	----	24,900	2,460,654
Missouri	2	----	----	(1)	(1)	----	----	(1)	(1)	(1)	(1)	----	----	----	----	----	----	4,610	129,429
Montana	2	----	----	----	----	----	----	----	----	(1)	(1)	(1)	(1)	----	----	----	----	70	4,857
New Hampshire	4	(1)	(1)	----	----	(1)	(1)	(1)	(1)	10,190	35,800	(1)	(1)	----	----	----	----	2,760	218,199
New York	3	20	1,016	58,300	66,000	3,240	24,000	1,950	7,500	----	----	----	----	(1)	(1)	(1)	(1)	(1)	(1)
North Carolina	6	77,170	139,865	(1)	(1)	(1)	(1)	4,130	21,236	41,980	133,311	(1)	(1)	71,270	$3,563	(1)	(1)	95,100	922,086
Oklahoma	7	----	----	(1)	(1)	(1)	(1)	(1)	(1)	19,390	62,989	34,960	412,041	----	----	(1)	(1)	5,100	600,531
Oregon	1	----	----	----	----	----	----	----	----	----	----	(1)	(1)	----	----	----	----	(1)	(1)
Pennsylvania	5	(1)	(1)	1,690	5,910	----	----	(1)	(1)	(1)	(1)	(1)	(1)	----	----	----	----	18,950	128,439
Rhode Island	2	----	----	----	----	----	----	----	----	43,930	274,848	----	----	----	----	----	----	3,580	274,848
South Carolina	4	(1)	(1)	(1)	(1)	----	----	(1)	(1)	(1)	(1)	----	----	----	----	(1)	(1)	37,560	1,348,622
South Dakota	9	----	----	----	----	(1)	(1)	----	----	(1)	(1)	210,800	2,276,401	----	----	----	----	24,150	2,751,998
Texas	3	----	----	----	----	----	----	----	----	(1)	(1)	(1)	(1)	----	----	----	----	650	25,523
Vermont	5	----	----	1,750	1,750	----	----	----	----	1,046,580	3,974,622	----	----	----	----	----	----	84,910	3,976,372
Virginia	2	(1)	(1)	----	----	(1)	(1)	----	----	----	----	(1)	(1)	----	----	----	----	(1)	(1)
Washington	3	----	----	----	----	----	----	500	2,500	----	----	2,030	25,153	----	----	----	----	670	27,653
Wisconsin	8	----	----	----	----	(1)	(1)	(1)	(1)	21,250	63,759	88,370	1,271,634	(1)	(1)	(1)	(1)	9,960	1,354,424
Undistributed	----	46,450	251,669	36,140	54,869	410,970	2,686,466	39,310	99,274	583,990	1,837,888	245,890	2,506,685	320,840	29,247	696,940	1,254,386	55,990	380,489
Total	147	136,630	421,178	165,410	305,664	547,940	3,607,762	109,660	236,774	2,562,980	8,402,018	764,010	8,056,583	392,110	32,810	699,370	1,259,932	639,180	22,322,721
Average unit value	----	----	$3.08	----	$1.85	----	$6.58	----	$2.16	----	$3.28	----	$10.55	----	$0.08	----	$1.80	----	$34.92
Short tons (approximate)	----	(2)	----	13,660	----	45,280	----	----	----	210,120	----	62,890	----	3,210	----	57,730	----	----	----

[1] Included with "Undistributed."
[2] 1,652,600 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, 1944–48 [1]

Year	Cubic feet	Value	Year	Cubic feet	Value
1944	733,500	$2,553,681	1947	937,403	$3,534,798
1945	713,050	2,308,506	1948	1,039,580	3,952,622
1946	990,156	3,461,801			

[1] Barre granite is sold also for construction and crushed stone.

Estimated output of monumental granite in the Barre district, Vermont, 1946–48 [1]

	1946	1947	1948
Total quarry output, rough stock ... cubic feet	982,692	927,046	1,043,958
Shipped out of Barre district in rough ... do	196,538	185,409	208,792
Manufactured in Barre district ... do	786,154	741,637	835,166
Light stock consumed in district ... do	524,103	494,424	556,778
Dark stock consumed in district ... do	262,051	247,213	278,388
Number of cutters in district	1,500	1,748	1,748
Average daily wage	$11.00	$12.50	$12.50
Average number of days worked	250	186	252
Total pay roll for year	$4,125,000	$4,064,100	$5,506,200
Estimated overhead	2,062,500	2,032,050	2,753,100
Estimated value of light stock	2,718,781	2,688,430	2,421,984
Estimated value of dark stock	1,621,442	1,606,878	1,447,618
Estimated polishing cost	2,236,418	1,865,681	2,099,965
Estimated sawing cost	1,750,240	1,460,098	1,644,234
Total value of granite	14,514,381	13,717,237	15,873,101

[1] Through cooperation 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 widely as building stone. Sales in 1948 increased 50 percent in quantity and 9 percent in value. Rubble—a crude form of building stone—increased 247 percent quantitywise, while rough construction decreased 85 percent, carrying value fluctuations of 427 and 72 percent, respectively. Basalt and associated rocks are used to some extent for memorials, but such stones are normally classed in trade as "black granite" and are therefore included with statistics for monumental granite.

Basalt and related rocks (trap rock) (dimension stone) sold or used by producers in the United States in 1948, by States and uses

State	Active plants	Building stone				Total	
		Rough construction		Rubble			
		Short tons	Value	Short tons	Value	Short tons	Value
California	1			(1)	(1)	(1)	(1)
Montana	1			(1)	(1)	(1)	(1)
Oregon	2	3, 340	$16, 700	(1)	(1)	(1)	(1)
Washington	1			(1)	(1)	(1)	(1)
Wyoming	1			(1)	(1)	(1)	(1)
Undistributed				54, 890	$60, 613	58, 230	$77, 313
Total	6	[2] 3, 340	16, 700	54, 890	60, 613	58, 230	77, 313
Average unit value			$5. 00		$1. 10		$1. 33

[1] Included with "Undistributed."
[2] 39,290 cubic feet (approximate).

MARBLE

In 1948 the total output of marble suffered slight declines in quantity and value compared with 1947. Marble for building stone increased 15 percent in quantity and 17 percent in value, while monumental-stone sales decreased 22 and 18 percent in quantity and value, respectively. The gain in building-marble sales reflects the continued construction activity throughout the country. The average unit values for building and monumental marble increased 18 and 54 cents, respectively, to $8.71 and $10.28, while the total average unit value was increased 21 cents to $9.35.

Marble (dimension stone) sold by producers in the United States, 1947–48, by uses

Use	1947		1948	
	Cubic feet	Value	Cubic feet	Value
Building stone:				
Rough:				
Exterior	34, 040	$147, 483	17, 930	$86, 963
Interior	141, 680	385, 139	[1] 159, 720	[1] 496, 016
Finished:				
Exterior	48, 820	542, 888	82, 520	713, 799
Interior	277, 050	3, 200, 943	316, 330	3, 726, 195
Total exterior	82, 860	690, 371	100, 450	800, 762
Total interior	418, 730	3, 586, 082	476, 050	4, 222, 211
Total building stone	501, 590	4, 276, 453	576, 500	5, 022, 973
Monumental stone:				
Rough Finished	509, 410	4, 960, 625	397, 260	4, 082, 470
Total monumental stone	509, 410	4, 960, 625	397, 260	4, 082, 470
Total building and monumental	1, 011, 000	9, 237, 078	973, 760	9, 105, 443
Approximate short tons	85, 920		82, 700	

[1] Includes onyx for the manufactu of mantels, lamp bases, desk sets, clock cases, and novelties.

Marble (dimension stone) sold by producers in the United States in 1948, 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	19,000	$55,000	300	$2,000	19,300	1,640	$57,000
Georgia	1	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Maryland	1	7,560	62,093			7,560	640	62,093
Minnesota	1	(1)	(1)			(1)	(1)	(1)
Missouri	3	57,370	432,259	5,380	29,636	62,750	5,330	461,895
North Carolina	1			6,620	63,009	6,620	560	63,009
Tennessee	7	271,100	2,085,673	11,100	171,800	282,200	23,990	2,257,473
Utah	1	(1)	(1)			(1)	(1)	(1)
Vermont	6	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Undistributed		221,470	2,387,948	373,860	3,816,025	595,330	50,540	6,203,973
Total	24	576,500	5,022,973	397,260	4,082,470	973,760	82,700	9,105,443
Average unit value			$8.71		$10.28			[2] $9.35
Short tons (approximate)		48,940		33,760				

[1] Included with "Undistributed."
[2] Average value per cubic foot.

LIMESTONE

Limestone is widely used in such public buildings as post offices, churches, museums, schools, and commercial buildings. Since the war, the industry has been climbing steadily in production. The year 1948 was no exception, as building stone, both rough and finished, showed substantial increases in tonnage and value. The output of rubble declined in quantity and value, while sales value of flagging increased one-third over the 1947 figure.

The average unit values for all classes increased in 1948. The over-all average unit value of all dimension limestone increased to $17.43 a short ton in 1948 compared with $13.31 in 1947.

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 1948. Accompanying tables show production in the Bedford-Bloomington, Ind., and Carthage, Mo., areas over a 5-year period.

Purchased Indiana limestone sold by mills in the Indiana oolitic limestone district, 1944–48, by classes

Year	Sawed and semifinished		Cut		Total	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
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
1947	68,020	72,594	994,510	3,583,166	1,062,530	3,655,760
1948	357,080	491,898	845,850	3,558,754	1,202,930	4,050,652

[1] A small quantity of sawed and semifinished stone included with cut stone.

Limestone (dimension stone) sold or used by producers in the United States in 1948, 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	2			(1)	(1)	(1)	(1)					(1)	(1)
California	4	90	$341					1,450	$6,869			1,540	$7,210
Colorado	1			(1)	(1)							(1)	(1)
Connecticut	1	200	510									200	510
Illinois	10	790	838					14,710	21,388	31,500	$7,136	18,180	29,362
Indiana	17	150	290	2,328,180	$1,914,559	2,657,210	$5,518,813	4,500	3,584	1,380	700	366,190	7,437,946
Iowa	3	(1)	(1)					(1)	(1)			1,410	5,298
Kansas	11	(1)	(1)	(1)	(1)	(1)	(1)	4,920	4,140	(1)	(1)	25,260	396,607
Kentucky	4	(1)	(1)					(1)	(1)			960	1,052
Michigan	3	1,360	12,563			880	2,250	150	600	13,030	7,749	2,690	23,162
Minnesota	6	(1)	(1)	(1)	(1)	113,000	405,000	4,400	14,048	(1)	(1)	20,450	529,548
Missouri	10	(1)	(1)			(1)	(1)	15,460	61,344	12,650	9,455	25,180	238,259
New York	1	(1)	(1)									(1)	(1)
Ohio	2	(1)	(1)					(1)	(1)			(1)	(1)
Pennsylvania	6	6,150	13,784	9,990	12,643			(1)	(1)	(1)	(1)	20,820	61,124
Puerto Rico	4	13,200	50,250					8,350	8,650			21,550	58,900
South Dakota	2									(1)	(1)	(1)	(1)
Tennessee	2							(1)	(1)			(1)	(1)
Texas	6			245,930	281,119	133,860	389,449	2,830	4,704			30,360	675,272
Utah	1	(1)	(1)					(1)	(1)			(1)	(1)
Virginia	2							(1)	(1)			(1)	(1)
West Virginia	1	(1)	(1)									(1)	(1)
Wisconsin	13	4,730	19,705	264,780	417,592	8,570	20,895	6,950	12,183	119,280	59,732	43,090	530,107
Wyoming	1	(1)	(1)									(1)	(1)
Undistributed		21,260	104,538	141,630	179,430	318,400	962,184	22,790	47,407	7,340	6,424	29,250	588,509
Total	113	47,930	202,819	2,990,510	2,805,343	3,231,920	7,298,591	86,510	184,917	185,180	91,196	607,130	10,582,866
Average unit value			$4.23		$0.94		$2.26		$2.14		$0.49		$17.43
Short tons (approximate)		(2)		219,910		237,680				15,100			

[1] Included with "Undistributed."
[2] 570,390 cubic feet (approximate).

Limestone sold by producers in the Indiana oolitic limestone district, 1944–48, by classes

Year	Construction					
	Rough block		Sawed and semifinished		Cut	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
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
1947	2,082,330	1,492,620	1,398,440	1,563,008	470,620	1,834,447
1948	2,328,180	1,914,559	1,974,730	2,312,829	682,480	3,205,984

Year	Construction—Continued			Other uses		Total	
	Total						
	Cubic feet	Short tons (approximate)	Value	Short tons	Value	Short tons (approximate)	Value
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
1947	3,951,390	286,480	4,890,075	90,440	306,784	376,920	5,196,859
1948	4,985,390	361,440	7,433,372	165,400	328,656	526,840	7,762,028

[1] Cut stone is included with sawed and semifinished stone.

Limestone and marble sold by producers in the Carthage district, Jasper County, Mo., 1944–48, 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
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
1947	58,220	487,799	2,980	24,357	61,200	5,200	512,156	300,680	513,273	305,880	1,025,429
1948	64,510	532,905	5,380	29,636	69,890	5,940	562,541	230,540	396,006	236,480	958,547

SANDSTONE

The total production of sandstone in 1948 increased 9 percent in quantity and 14 percent in value over the 1947 figures. Stone for rough construction decreased 2 percent in quantity and increased 10 percent in value, whereas the output of rough architectural virtually trebled in quantity and sales value. Dressed sawed material decreased n quantity and increased slightly in value, while cut stone doubled in quantity and increased 52 percent in value. Rubble, curbing, and flagging decreased both in quantity and value compared with 1947 totals.

As in previous years, Ohio was the principal producer. Its quarries contributed 51 percent of the total output in 1948. Other producing States, in order of output, were Pennsylvania, Tennessee, and New York.

Sandstone (dimension stone) sold or used by producers in the United States in 1948, 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
California	3	3,410	$21,600							(1)	(1)			(1)	(1)	6,990	$49,015
Colorado	1							25,640	$24,000	300	$900			38,460	$15,000	5,300	39,900
Illinois	1									(1)	(1)					(1)	(1)
Indiana	1			(1)	(1)			(1)	(1)					(1)	(1)	(1)	(1)
Kansas	2	(1)	(1)	10,260	$10,000					(1)	(1)					1,070	10,230
Massachusetts	1					(1)	(1)	(1)	(1)							440	35,100
New Jersey	1	80	328	1,400	896											190	1,224
New Mexico	2	(1)	(1)							(1)	(1)					(1)	(1)
New York (bluestone)	8			(1)	(1)	(1)	(1)	96,890	166,920	450	5,100	9,700	$15,560	62,070	108,095	15,340	336,188
Ohio	7			146,160	190,601	974,700	$1,777,119	125,610	512,138			55,100	102,228	121,150	210,957	103,150	2,793,043
Pennsylvania [2]	15	14,100	60,842	15,480	6,901					9,350	45,662	5,130	4,558	56,020	93,729	29,750	211,692
Tennessee	2	860	5,540	201,570	239,894			16,430	70,510					13,530	25,704	18,920	341,648
Virginia	3	4,360	30,500							(1)	(1)			(1)	(1)	12,440	45,590
Washington	1					35,220	70,870	13,390	175,041							3,890	245,911
West Virginia	2									(1)	(1)					(1)	(1)
Wisconsin	4							(1)	(1)	(1)	(1)					2,040	27,700
Undistributed		2,570	11,624	9,220	15,025	6,200	41,513	17,570	56,425	12,220	28,364			30,410	23,680	4,730	30,583
Total	54	25,380	130,434	384,090	463,317	1,016,120	1,889,502	295,530	1,005,034	22,320	80,026	69,930	122,346	321,640	477,165	204,250	4,167,824
Average unit value			$5.14		$1.21		$1.86		$3.40		$3.59		$1.75		$1.48		$20.41
Short tons (approximate)		(3)		29,190		74,010		23,050				5,220		25,080			

[1] Included with "Undistributed."
[2] Includes 144,320 cubic feet of bluestone (approximately 12,210 tons) valued at $126,528 sold for construction, curbing, and flagging.
[3] 320,890 cubic feet (approximate).

The accompanying table shows the sales of bluestone in 1944–48. Bluestone is a type of sandstone that splits readily into thin, uniform slabs. It is particularly well adapted for flagging but is also used for building stone and curbing. The output of bluestone in 1948 increased 19 percent in quantity and 42 percent in value compared with 1947 figures.

Bluestone (dimension stone) sold or used in the United States, 1944–48 [1]

Year	Cubic feet	Value	Year	Cubic feet	Value
1944	156, 160	$108, 732	1947	274, 680	$326, 168
1945	109, 330	89, 448	1948	325, 940	462, 716
1946	273, 720	274, 517			

[1] New York and Pennsylvania were the only States that produced bluestone.

MISCELLANEOUS STONE

Types of stone other than those included in the major groups already discussed are covered in the following table. The principal types in this classification are mica schist, argillite, light-colored volcanic rocks (such as rhyolite), soapstone, and greenstone. The quantity sold in 1948 increased 91 percent while the value increased 24 percent compared with 1947 figures.

Miscellaneous varieties of stone (dimension stone) sold or used by producers in the United States in 1948, 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
California	2	(1)	(1)	(1)	(1)	(1)	(1)	700	$7, 915
Georgia	1	(1)	(1)					(1)	(1)
Maryland	4	18, 430	$50, 327	(1)	(1)	(1)	(1)	21, 010	62, 573
New Jersey	1	2, 000	22, 000					2, 000	22, 000
New York	1	(1)	(1)					(1)	(1)
Pennsylvania	3	(1)	(1)			(1)	(1)	46, 550	194, 264
Virginia	2	(1)	(1)	530	$2, 512	500	$9, 838	(1)	(1)
Undistributed		55, 770	1, 667, 499	2, 290	8, 871	600	6, 905	9, 860	1, 481, 200
Total	14	[2] 76, 200	1, 739, 826	2, 820	11, 383	[3] 1, 100	16, 743	80, 120	1, 767, 952
Average unit value			$22. 83		$4. 04		$15. 22		$22. 07

[1] Included with "Undistributed."
[2] Approximately 910,030 cubic feet.
[3] Approximately 13,600 cubic feet.

TRENDS IN USE OF DIMENSION STONE

A 33-year history of the output of dimension stone by kinds is indicated in figure 1. Since the period 1920–30, depression, war, and the competition of other building materials have combined to keep demand at relatively low levels. However, since the low of 1944 the curve has been upward and indications are good for continued increases.

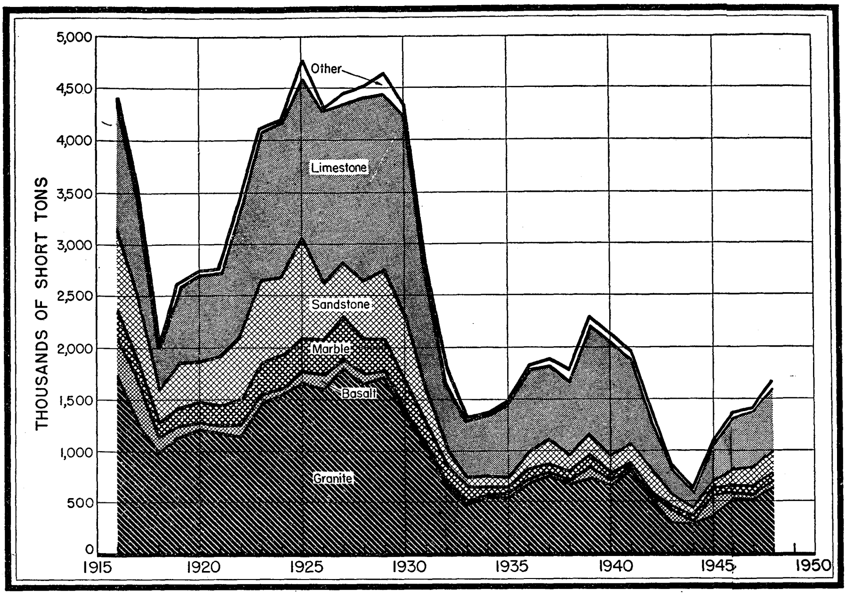

FIGURE 1.—Sales of dimension stone in the United States, by kinds, 1916–48.

Figure 2 traces for a 34-year period the history of production of all building stones and of the principal variety—limestone—in their relation to nonresidential building, the class of construction using stone most extensively. Activity in building-stone production in peacetime generally follows the trend of nonresidential construction, but wartime construction that reached a peak in 1942 failed to use the products of the building-stone industry to a comparable degree. The industry since 1944 is following the general trend but at a lower level.

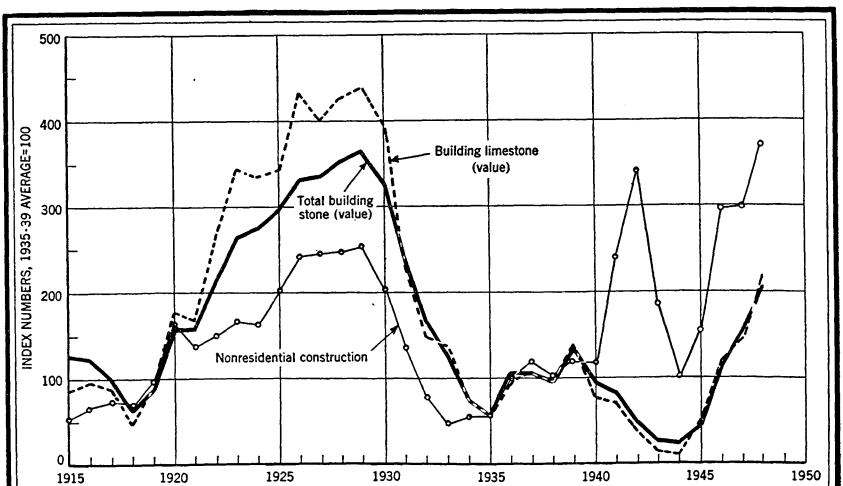

FIGURE 2.—Sales of all building stone and building limestone compared with nonresidential construction (public and private), 1915–48. Data on nonresidential building construction from Bureau of Foreign and Domestic Commerce.

TECHNOLOGY

In 1948 the American Society for Testing Materials, through its Committee C–18, issued two new tentative methods for testing building stone and slate and a new set of tentative definitions of natural building stone terms. The complete titles of these are: Tentative Method of Test for Combined Effect of Temperature Cycles and Weak Salt Solutions on Natural Building Stone,[1] Tentative Method of Test for Durability of Slate for Roofing,[2] and Tentative Definitions of Terms Relating to Natural Building Stone,[3] The last specification includes definitions of granite, limestone, marble, greenstone, and sandstone, with their many type variations. A paragraph on rock textures, such as porphyritic, clastic, etc., is also included.

A project that promises to be valuable to building-stone producers is the stone-wall exposure panel erected in 1948 at the National Bureau of Standards. This masonry wall contains building stones from 47 States and 16 foreign countries, and the chief purpose is to study the effect of natural weathering processes on the various rock types. Other items under investigation include watertightness of joints, durability of mortars, waterproofing, and structural movements. It is expected that a great many years exposure will be required before definite conclusions can be drawn.

A process for the production of artificial stone, covered by British Patent 593,648, has been announced. The method calls for comminuted CaO to be partly hydrated by water vapor and then mixed with argillaceous material and water into a moldable state. The molded shape is then hardened by the action of steam under pressure.[4]

CRUSHED AND BROKEN STONE

Over 223 million short tons of crushed and broken stone were produced in 1948, in addition to that used for making cement and lime. Output increased 9 percent in quantity and 13 percent in value over 1947 totals. Chief tonnage gains were in concrete and road metal, railroad ballast, and stone for metallurgical purposes. The average value at the quarry increased 5 cents to $1.26 per ton.

The accompanying table of salient statistics shows the quantity sold and the value of the output during 1947 and 1948, by uses. Detailed data on asphaltic stone and slate granules and flour are given in the Asphalt and Slate chapters of this volume.

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[1] A. S. T. M. Designation C218–48T, 1948 Supplement to Book of A. S. T. M. Standards, part II, pp. 140–142.

[2] A. S. T. M. Designation C217–48T, 1948 Supplement to Book of A. S. T. M. Standards, part II, pp. 143–144.

[3] A. S. T. M. Designation C119–48T, 1948 Supplement to Book of A. S. T. M. Standards, part II, pp. 145–147.

[4] British Abstracts, BI, II, III, April 1948, p. 159.

Crushed and broken stone sold or used by producers in the United States, 1947–48, by principal uses

Use	1947			1948		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Concrete and road metal	107,077,590	$125,753,455	$1.17	121,542,170	$149,879,694	$1.23
Railroad ballast	16,350,260	13,566,869	.83	18,180,990	16,315,834	.90
Metallurgical	32,570,270	28,687,950	.88	34,901,940	34,250,008	.98
Alkali works	7,074,270	5,295,318	.75	7,349,540	5,942,572	.81
Riprap	5,732,740	6,513,792	1.14	5,707,410	7,553,156	1.32
Agricultural	22,605,500	35,075,883	1.55	20,941,530	32,034,698	1.53
Refractory (ganister, mica schist, dolomite, soapstone)	2,704,220	5,536,738	2.05	2,557,050	6,531,084	2.55
Asphalt filler	486,470	1,422,998	2.93	553,360	1,593,820	2.88
Calcium carbide works	846,860	846,293	1.00	1,052,080	1,027,952	.98
Sugar factories	649,420	1,349,886	2.08	471,030	1,098,933	2.33
Glass factories	756,930	1,576,701	2.08	666,360	1,410,120	2.12
Paper mills	569,930	1,049,591	1.84	475,880	908,098	1.91
Other uses	8,711,870	21,776,486	2.50	9,464,440	22,414,483	2.37
Total	206,136,330	248,451,960	1.21	223,863,780	280,960,452	1.26
Portland and natural cement and cement rock [1]	49,530,000	(2)		54,513,000	(2)	
Lime [3]	13,558,000	(2)		14,528,000	(2)	
Grand total	269,224,000	(2)		292,905,000	(2)	
Asphaltic stone	1,004,740	3,756,074	3.74	1,084,004	3,634,917	3.35
Slate granules and flour	763,500	6,608,234	8.66	658,870	6,014,377	9.13

[1] Value reported as cement in chapter on Cement.
[2] No value available for stone used in manufacture of cement and lime.
[3] Value reported as lime in chapter on Lime.

The following tables show the tonnage and value of stone used for concrete and road metal and railroad ballast for a series of years and by States for 1948.

Crushed stone for concrete and road metal and railroad ballast sold or used by producers in the United States, 1944–48

Year	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
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
1947	107,077,590	125,753,455	16,350,260	13,566,869	123,427,850	139,320,324
1948	121,542,170	149,879,694	18,180,990	16,315,834	139,723,160	166,195,528

Crushed stone for concrete and road metal and railroad ballast sold or used by producers in the United States in 1948, by States

State	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	[1]	[1]	[1]	[1]	66,150	$85,367
Alaska	40,730	$54,637	[1]	[1]	[2] 40,730	[2] 54,637
Arizona	[2] 65,920	[2] 61,868	182,950	$106,300	[2] 248,870	[2] 168,168
Arkansas	679,100	1,087,505	324,560	269,740	1,003,660	1,357,245
California	[2] 8,008,380	[2] 7,406,442	968,020	718,127	[2] 8,976,400	[2] 8,124,569
Colorado	136,010	279,126	[1]	[1]	[2] 136,010	[2] 279,126
Connecticut	[2] 1,364,680	[2] 1,788,530	82,690	90,957	[2] 1,447,370	[2] 1,879,487
Delaware	34,390	85,970			34,390	85,970
Florida	[2] 3,754,130	[2] 4,532,984	[1]	[1]	3,763,630	4,536,234
Georgia	[2] 2,820,490	[2] 3,582,962	[1]	[1]	2,874,720	3,661,996
Hawaii	837,400	1,916,101	200	902	837,600	1,917,003
Idaho	732,450	705,261	[1]	[1]	[2] 732,450	[2] 705,261
Illinois	10,671,540	12,113,887	1,062,160	974,182	11,733,700	13,088,069
Indiana	3,735,880	4,057,797	248,960	260,165	3,984,840	4,317,962
Iowa	4,022,190	4,785,571	5,820	5,821	4,028,010	4,791,392
Kansas	2,489,860	3,025,216	1,868,630	772,398	4,358,490	3,797,614
Kentucky	4,973,770	6,334,264	415,310	349,092	5,389,080	6,683,356
Louisiana	[1]	[1]			[1]	[1]
Maine	168,510	310,850			168,510	310,850
Maryland	1,537,630	2,303,978	[2] 44,000	[2] 57,200	[2] 1,581,630	[2] 2,361,178
Massachusetts	1,869,290	2,490,326	178,350	191,641	2,047,640	2,681,967
Michigan	2,697,570	2,249,786	260,740	286,618	2,958,310	2,536,404
Minnesota	1,135,020	1,322,792	[2] 174,080	[2] 115,497	[2] 1,309,100	[2] 1,438,289
Missouri	4,917,720	6,265,077	[2] 48,590	[2] 57,887	[2] 4,966,310	[2] 6,322,964
Montana	11,470	16,134	367,650	317,837	379,120	333,971
Nebraska	[1]	[1]			[1]	[1]
Nevada	383,820	357,577			383,820	357,577
New Hampshire	61,450	77,400			61,450	77,400
New Jersey	3,006,430	4,797,745	[1]	[1]	[2] 3,006,430	[2] 4,797,745
New Mexico	186,220	54,130	342,650	228,240	528,870	282,370
New York	8,640,130	11,577,182	[2] 1,359,950	[2] 1,394,610	[2] 10,000,080	[2] 12,971,792
North Carolina	4,460,830	5,763,446	[2] 542,640	[2] 673,884	[2] 5,003,470	[2] 6,437,330
Ohio	[2] 8,069,750	[2] 9,095,689	1,351,330	1,508,684	[2] 9,421,080	[2] 10,604,373
Oklahoma	2,750,050	2,575,746	[2] 878,350	[2] 439,173	[2] 3,628,400	[2] 3,014,919
Oregon	2,985,940	5,088,686	446,590	443,892	3,432,530	5,532,578
Pennsylvania	[2] 9,179,000	[2] 12,905,449	[2] 314,520	[2] 403,395	9,760,610	13,712,865
Puerto Rico	[2] 125,890	[2] 241,455	8,890	8,930	[2] 134,780	[2] 250,385
Rhode Island	87,440	186,542			87,440	186,542
South Carolina	1,934,780	2,640,178	324,300	382.075	2,259,080	3,022,253
South Dakota	[2] 483,540	[2] 742,734	586,840	557,691	[2] 1,070,380	[2] 1,300,425
Tennessee	5,662,740	7,149,002	274,140	231,183	5,936,880	7,380,185
Texas	[2] 2,134,530	[2] 2,265,028	258,850	228,575	[2] 2,393.380	[2] 2,493,603
Utah	[2] 50,000	[2] 35,000	[1]	[1]	110,870	152,103
Vermont	[2] 66,250	[2] 104,244	[1]	[1]	89,720	138,407
Virginia	4,233,300	6,131,021	[1]	[1]	[2] 4,233,300	[2] 6,131,021
Washington	[2] 3,267,300	[2] 3,833,270	[1]	[1]	4,429,440	5,174,413
West Virginia	1,464,980	1,685,359	518,290	534,838	1,983,270	2,220,197
Wisconsin	4,749,330	4,688,354	[1]	[1]	[2] 4,749,330	[2] 4,688,354
Wyoming	58,660	77,156	680,910	638,081	739,570	715,237
Undistributed	795,680	1,030,237	4,060,030	4,068,219	3,212,260	3,034,375
Total	121,542,170	149,879,694	18,180,990	16,315,834	139,723,160	166,195,528

[1] Included with "Undistributed."
[2] To avoid disclosing confidential information, total is somewhat incomplete, the figures not included being combined as "Undistributed."

COMMERCIAL AND NONCOMMERCIAL OPERATIONS

In contrast with strictly commercial operations, noncommercial operations represent tonnages reported by States, counties, municipalities, and other Government agencies produced by themselves or by contractors for their consumption. The accompanying table shows the production of crushed stone for concrete and road metal during recent years by both types of operations. For a number of years before 1940, Government-sponsored enterprises produced 29 to 46 percent of the total output. Many of these enterprises served make-work projects designed to relieve unemployment. However, the war changed this situation, and unemployment virtually disappeared.

Consequently the output of crushed stone by noncommercial agencies dropped to 7 percent of the total production in 1945 and 1946. In 1947 and 1948 the tonnage increased to 11 percent.

Crushed stone for concrete and road metal sold or used by commercial and noncommercial operators in the United States, 1944–48

[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
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
1947	95,178,440	1.19	+13	89	11,899,150	1.09	+84	11	107,077,590	+19
1948	108,029,360	1.23	+14	89	13,512,810	1.25	+14	11	121,542,170	+14

GRANULES

Output of granules for roofing purposes has been canvassed since 1942. The following table shows total production and value for the past 5 years. Separate figures for slate granules are given in the Slate chapter of this volume.

Roofing granules [1] sold or used in the United States, 1944–48, by kinds

Year	Natural		Artificially colored		Brick		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
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
1947	504,980	4,166,810	1,133,870	[2] 17,559,227	56,570	998,434	1,695,420	[2] 22,724,471
1948	448,150	3,828,307	1,002,430	16,563,351	35,110	586,173	1,485,690	20,977,831

[1] Manufactured from stone, slate, slag, and brick.
[2] Revised figure.

SIZE OF PLANTS

In 1947 the average crushed-stone plant produced approximately 120,000 short tons; in 1948 this average was increased to about 131,000 tons. During the year 538 of the plants reported less than 25,000 tons, but they produced only 3 percent of the total output. On the other hand, the 29 plants that produced 900,000 tons or over contributed 26 percent of the total. The accompanying table shows additional details of the size pattern of the industry.

Number and production of commercial crushed-stone [1] plants in 1947–48, by size of output

Size of output	1947 Number of plants	1947 Total production of plants (short tons)	1947 Percent of total	1947 Cumulative total (short tons)	1948 Number of plants	1948 Total production of plants (short tons)	1948 Percent of total	1948 Cumulative total (short tons)
Less than 1,000 tons	71	28, 490	0. 02	28, 490	45	19, 910	0. 01	19, 910
1,000 to 25,000	524	5, 673, 240	2. 96	5, 701, 730	493	5, 312, 260	2. 56	5, 332, 170
25,000 to 50,000	251	9, 250, 630	4. 82	14, 952, 360	272	9, 836, 410	4. 75	15, 168, 580
50,000 to 75,000	189	11, 406, 070	5. 95	26, 358, 430	199	12, 245, 870	5. 91	27, 414, 450
75,000 to 100,000	118	10, 171, 300	5. 30	36, 529, 730	103	8, 785, 280	4. 24	36, 199, 730
100,000 to 200,000	205	27, 466, 960	14. 32	63, 996, 690	211	29, 510, 390	14. 24	65, 710, 120
200,000 to 300,000	98	23, 837, 510	12. 43	87, 834, 200	106	25, 757, 880	12. 43	91, 468, 000
300,000 to 400,000	54	18, 823, 270	9. 81	106, 657, 470	54	18, 704, 550	9. 03	110, 172, 550
400,000 to 500,000	23	10, 309, 220	5. 37	116, 966, 690	29	13, 103, 030	6. 32	123, 275, 580
500,000 to 600,000	18	9, 726, 530	5. 07	126, 693, 220	15	8, 303, 370	4. 01	131, 578, 950
600,000 to 700,000	15	9, 707, 840	5. 06	136, 401, 060	12	7, 574, 620	3. 66	139, 153, 570
700,000 to 800,000	6	4, 570, 890	2. 38	140, 971, 950	7	5, 182, 000	2. 50	144, 335, 570
800,000 to 900,000	3	2, 591, 740	1. 35	143, 563, 690	10	8, 474, 400	4. 09	152, 809, 970
900,000 tons and over	26	48, 259, 700	25. 16	191, 823, 390	29	54, 403, 250	26. 25	207, 213, 220
	1, 601	191, 823, 390	100. 00	191, 823, 390	1, 585	207, 213, 220	100. 00	207, 213, 220

[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, closely followed by rail. As in the past years, waterways provide relatively minor but locally important transportation facilities. In previous years the table included only transportation statistics on the commercial stone used for concrete and road metal. However, since 1946, the table has included all commercial crushed stone.

Crushed stone sold or used in the United States in 1948, by methods of transportation

Method of transportation	Commercial operations: Short tons	Commercial operations: Percent of total	Commercial and noncommercial [1] operations: Short tons	Commercial and noncommercial [1] operations: Percent of total
Truck	92, 286, 380	44	108, 743, 640	49
Rail	80, 114, 420	39	80, 114, 420	36
Waterway	25, 243, 290	12	25, 243, 290	11
Unspecified	9, 762, 430	5	9, 762, 430	4
	207, 406, 520	100	223, 863, 780	100

[1] Entire output of noncommercial operations assumed to be moved by truck.

GRANITE

Sales of crushed and broken granite increased 9 percent in quantity and 11 percent in value in 1948, while the average sales value per ton increased 1 cent to $1.26. Sales of riprap increased substantially as did crushed stone for concrete and road metal. Stone for railroad ballast declined 21 percent in quantity and 25 percent in value compared with 1947 figures. Sharp declines were recorded in the output and value of stone for "other uses." Unit values increased slightly for riprap and "other uses," while decreases of 4 and 6 cents were noted for concrete and road metal and railroad ballast, respectively. North Carolina was the principal producer in 1948, followed by Georgia, South Carolina, California, and Virginia, in that order.

From the reports submitted, the number of individual operations supplying noncommercial crushed stone cannot be determined with any degree of accuracy. Therefore, in the accompanying tables covering granite and most 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)

Commercial trap rock normally includes basalt, gabbro, diorite, and other dark igneous rocks and is widely used in industry for concrete and road metal and for railroad ballast. Other uses include riprap, fill material, roofing granules, and unspecified uses. In 1948 Washington was the leading producer, followed by New Jersey, Oregon, Pennsylvania, Massachusetts, Connecticut, and California in that order. Sales of crushed and broken trap rock were 5 percent greater in quantity and 16 percent greater in value than in 1947. The average unit value increased 14 cents to $1.45 in 1948. See second table following for details.

Granite (crushed and broken stone) sold or used by producers in the United States in 1948, 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			[2]	[2]					[2]	[2]
California	297,060	$403,064	742,810	$761,118	[2]	[2]	[2]	[2]	1,562,010	$1,466,917
Colorado			[2]	[2]					[2]	[2]
Connecticut							30	$166	30	166
Delaware			34,390	85,970			2,000	4,000	36,390	89,970
Georgia	66,790	84,204	2,526,740	3,191,985	[2]	[2]	[2]	[2]	2,866,040	3,731,573
Idaho			[2]	[2]					[2]	[2]
Maine	[2]	[2]	[2]	[2]					9,920	22,690
Maryland	[2]	[2]	[2]	[2]					158,060	313,798
Massachusetts	[2]	[2]	368,690	498,529			[2]	[2]	401,160	550,026
Minnesota	[2]	[2]	[2]	[2]	172,830	$113,497	[2]	[2]	216,820	195,649
Missouri	1,180	1,516							1,180	1,516
Montana	[2]	[2]			[2]	[2]			284,580	210,852
New Hampshire	[2]	[2]	61,450	77,400			[2]	[2]	85,670	96,154
New Jersey			[2]	[2]					[2]	[2]
New York	[2]	[2]							[2]	[2]
North Carolina	20,180	32,380	2,726,460	3,401,762	542,640	673,884	82,260	218,669	3,371,540	4,326,695
Oklahoma			[2]	[2]					[2]	[2]
Oregon			[2]	[2]			[2]	[2]	[2]	[2]
Pennsylvania			66,760	123,429					66,760	123,429
Puerto Rico			15,300	15,300					15,300	15,300
Rhode Island	630	2,755	5,790	17,229			1,430	9,506	7,850	29,490
South Carolina	[2]	[2]	1,721,880	2,351,790	324,300	382,075	[2]	[2]	2,104,980	2,759,117
Vermont			[2]	[2]					[2]	[2]
Virginia			726,930	1,145,648	419,620	486,141			1,146,550	1,631,789
Washington	[2]	[2]	[2]	[2]			26,250	58,935	250,910	324,488
Wisconsin	[2]	[2]	[2]	[2]			[2]	[2]	151,430	126,091
Undistributed	172,750	151,805	779,690	1,107,750	463,800	379,866	676,060	704,172	309,520	468,835
Total	558,590	675,724	9,776,890	12,777,910	1,923,190	2,035,463	788,030	995,448	13,046,700	16,484,545
Average unit value		$1.21		$1.31		$1.06		$1.26		$1.26

[1] Includes stone used for concrete pipe, fill material, poultry grit, road base, stone sand, and unspecified uses.
[2] Included with "Undistributed."

Basalt and related rocks (trap rock) (crushed and broken stone) sold or used by producers in the United States in 1948, 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			45,000	$24,750					45,000	$24,750
California	37,210	$61,144	1,027,060	1,097,946	248,720	$220,009			1,312,990	1,379,099
Connecticut	2,610	2,813	1,364,680	1,788,530	82,690	90,957			1,449,980	1,882,300
Hawaii			837,400	1,916,101	200	902			837,600	1,917,003
Idaho			592,920	590,484					592,920	590,484
Maine			(2)	(2)					(2)	(2)
Maryland			(2)	(2)	(2)	(2)			599,380	925,501
Massachusetts	(2)	(2)	1,202,540	1,626,673	178,350	191,641	(2)	(2)	1,479,680	2,001,864
Michigan			(2)	(2)					(2)	(2)
Minnesota	(2)	(2)	(2)	(2)	(2)	(2)			(2)	(2)
Montana	(2)	(2)							(2)	(2)
Nevada			(2)	(2)					(2)	(2)
New Jersey	79,720	129,561	2,642,070	4,315,074	(2)	(2)	(2)	(2)	2,982,280	4,754,532
New Mexico			(2)	(2)					(2)	(2)
New York	2,180	2,178	1,046,680	1,671,845	210,340	290,192			1,259,200	1,964,215
North Carolina			(2)	(2)					(2)	(2)
Oregon	(2)	(2)	2,572,450	4,518,064	(2)	(2)			2,752,410	4,700,567
Pennsylvania	440	524	1,502,260	2,060,863	60,250	100,669			1,562,950	2,162,056
Puerto Rico			2,110	2,290	4,510	3,680			6,620	5,970
Rhode Island			(2)	(2)					(2)	(2)
Texas	(2)	(2)	(2)	(2)	(2)	(2)			(2)	(2)
Virginia			364,200	629,682					364,200	629,682
Washington	444,100	287,305	3,095,160	3,624,358	(2)	(2)	(2)	(2)	4,541,310	5,072,637
Wisconsin			(2)	(2)			(2)	(2)	(2)	(2)
Wyoming			(2)	(2)					(2)	(2)
Undistributed	270,160	252,121	855,960	1,377,002	1,551,120	1,826,638	273,260	$1,135,656	809,830	1,828,992
Total	836,420	735,646	17,150,490	25,243,662	2,336,180	2,724,688	273,260	1,135,656	20,596,350	29,839,652
Average unit value		$0.88		$1.47		$1.17		$4.16		$1.45

[1] Includes stone sold for fill material, roofing granules, and unspecified uses.
[2] Included with "Undistributed."

MARBLE

Marble producers, in the course of their manufacturing processes, accumulate large quantities of waste material consisting of either defective blocks or cuttings and spalls from marble-dressing operations. This byproduct material usually is marketed for the wide variety of uses listed in the footnote of the accompanying table. The average value varies from State to State because in certain States a large portion of this material is marketed for such high-priced products as terrazzo or marble flour, whereas in others a considerable amount is sold for roadstone, concrete aggregates, or for other low-priced uses. The average unit value decreased 34 cents in 1948 to $6.81.

Marble (crushed and broken stone) sold by producers in the United States in 1948, by States [1]

State	Active plants	Short tons	Value	State	Active plants	Short tons	Value
Alabama	2	(2)	(2)	Texas	1	13,400	$160,800
California	1	3,140	$56,466	Utah	1	5,500	57,000
Colorado	1	1,910	47,800	Virginia	1	4,400	51,419
Georgia	1	(2)	(2)	Washington	5	3,590	14,564
Maryland	1	5,440	76,393	Undistributed		93,540	473,777
Missouri	1	1,490	10,000				
New Jersey	1	1,220	21,092	Total	22	193,300	1,315,811
New York	1	22,840	230,176	Average unit value			$6.81
Tennessee	5	36,830	116,324				

[1] Includes stone used for agriculture, asphalt filler, cast stone, composition flooring, crushed stone, magnesia, mineral food, plaster, poultry grit, shingles, spalls, stucco, terrazzo, tile, whiting (excluding marble whiting made by companies that purchase their marble), and unspecified uses.
[2] Included with "Undistributed."

LIMESTONE

Because of its wide distribution and relatively moderate production costs, limestone is used more extensively than any other type of crushed and broken stone. Sales of limestone were reported to the Bureau of Mines from 44 States and 2 Territories in 1948. In 1948, limestone (excluding that used in the manufacture of cement and lime) constituted 74 percent of the total crushed and broken stone produced in the United States. With the exception of stone for agriculture, all classes showed increases in quantity and value. The tonnages consumed in "Miscellaneous uses," which as a group gained 4 percent in output, are shown in an accompanying table.

Limestone (crushed and broken stone) sold or used by producers in the United States in 1948, 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	----	----	1,837,350	$2,042,804	(1)	(1)	(1)	(1)	229,050	$287,805	227,890	$416,492	2,360,440	$2,832,468
Arizona	13,880	$41,640	24,300	36,612	20,920	$37,118	----	----	----	----	----	----	59,100	115,370
Arkansas	----	----	71,000	71,004	234,520	614,956	(1)	(1)	22,790	34,180	(1)	(1)	342,320	772,853
California	16,740	3,371	75,880	183,860	284,020	326,262	----	----	430	2,906	401,570	1,429,967	778,640	1,946,366
Colorado	----	----	521,520	1,025,508	63,060	216,099	----	----	----	----	686,760	628,231	1,271,340	1,869,838
Connecticut	----	----	(1)	(1)	(1)	(1)	----	----	42,780	146,415	(1)	(1)	64,360	222,269
Florida	(1)	(1)	----	----	3,754,130	4,532,984	(1)	(1)	99,300	334,431	292,450	246,219	4,154,920	5,115,974
Georgia	----	----	----	----	293,750	390,977	----	----	(1)	(1)	(1)	(1)	564,530	1,085,692
Hawaii	----	----	----	----	----	----	----	----	----	----	(1)	(1)	(1)	(1)
Idaho	----	----	----	----	51,380	35,873	----	----	----	----	2,500	5,000	53,880	40,873
Illinois	105,100	152,389	1,036,300	1,359,398	10,671,540	12,113,887	1,062,160	$974,182	5,098,210	6,908,409	541,800	1,285,511	18,515,110	22,793,776
Indiana	109,710	150,683	103,260	123,298	3,735,880	4,057,797	248,960	260,165	1,840,650	2,420,203	169,740	539,147	6,208,200	7,551,293
Iowa	149,820	177,103	28,140	36,843	4,022,190	4,785,571	5,820	5,821	2,135,620	3,085,872	44,620	236,174	6,386,210	8,327,384
Kansas	453,570	505,376	(1)	(1)	2,218,130	2,797,264	209,920	208,406	449,510	667,574	(1)	(1)	3,347,850	4,273,960
Kentucky	31,720	30,964	----	----	4,973,770	6,334,264	415,310	349,092	719,680	869,251	13,510	13,686	6,153,990	7,597,257
Louisiana	----	----	----	----	(1)	(1)	----	----	----	----	(1)	(1)	(1)	(1)
Maine	(1)	(1)	----	----	34,450	91,730	----	----	(1)	(1)	(1)	(1)	125,690	473,179
Maryland	----	----	----	----	896,180	1,209,764	44,000	57,200	14,380	72,954	66,920	95,751	1,021,480	1,435,669
Massachusetts	----	----	(1)	(1)	(1)	(1)	----	----	143,090	514,826	62,240	338,699	225,720	896,227
Michigan	(1)	(1)	10,730,970	6,712,640	2,680,270	2,229,390	260,740	286,618	(1)	(1)	5,268,220	4,326,432	19,667,640	14,429,456
Minnesota	4,880	6,687	(1)	(1)	1,033,600	1,168,364	1,250	2,000	163,310	245,234	(1)	(1)	1,232,040	1,518,276
Mississippi	----	----	----	----	----	----	----	----	24,330	27,980	----	----	24,330	27,980
Missouri	761,830	913,169	31,810	51,748	4,385,420	5,808,843	48,590	57,887	1,853,680	2,691,824	477,110	1,189,582	7,558,440	10,713,053
Montana	(1)	(1)	(1)	(1)	(1)	(1)	----	----	----	----	27,930	82,314	152,000	212,119
Nebraska	273,690	344,663	----	----	(1)	(1)	----	----	----	----	(1)	(1)	366,110	707,327
Nevada	----	----	(1)	(1)	(1)	(1)	----	----	----	----	(1)	(1)	(1)	(1)
New Jersey	----	----	17,570	34,229	(1)	(1)	----	----	119,950	417,868	(1)	(1)	258,450	1,133,705
New York	204,030	352,951	123,060	138,945	7,418,060	9,712,299	1,149,610	1,104,418	298,960	856,911	1,946,290	2,202,450	11,140,010	14,367,974
North Carolina	----	----	----	----	1,316,700	1,822,012	(1)	(1)	(1)	(1)	----	----	1,352,180	1,862,39[illegible]

Ohio	32,100	$43,294	6,862,470	6,444,067	8,064,850	9,087,524	1,351,330	1,508,684	2,422,460	3,635,073	1,185,190	2,336,764	19,918,400	23,055,406
Oklahoma	39,000	48,138	(1)	(1)	2,089,850	2,175,836	(1)	(1)	182,010	260,166	44,620	106,333	2,483,980	2,701,765
Oregon	----------	----------	----------	----------	(1)	(1)	----------	----------	(1)	(1)	(1)	(1)	171,550	209,337
Pennsylvania	140,770	216,098	9,734,180	11,792,738	6,964,360	9,525,363	254,270	302,726	890,890	2,458,130	1,782,930	3,458,774	19,767,400	27,753,829
Puerto Rico	----------	----------	----------	----------	108,480	223,865	4,380	5,250	----------	----------	3,020	2,700	115,880	231,815
Rhode Island	----------	----------	----------	----------	----------	----------	----------	----------	14,000	63,000	----------	----------	14,000	63,000
South Carolina	----------	----------	----------	----------	(1)	(1)	----------	----------	(1)	(1)	(1)	(1)	(1)	(1)
South Dakota	18,250	19,298	----------	----------	283,870	393,720	----------	----------	----------	----------	13,390	19,215	315,510	432,233
Tennessee	(1)	(1)	(1)	(1)	5,660,620	7,146,678	586,840	557,691	825,820	1,044,147	655,640	1,085,684	7,778,870	9,904,024
Texas	51,570	57,423	389,810	355,850	1,972,780	2,143,886	274,140	231,183	66,190	53,740	426,970	500,376	3,181,460	3,342,458
Utah	(1)	(1)	(1)	(1)	50,000	35,000	----------	----------	----------	----------	44,170	144,167	203,510	251,904
Vermont	(1)	(1)	(1)	(1)	66,250	104,244	(1)	(1)	(1)	(1)	113,070	833,306	285,320	1,229,110
Virginia	(1)	(1)	(1)	(1)	2,923,170	3,997,223	514,320	507,912	691,780	977,984	1,038,130	1,752,492	5,489,540	7,631,545
Washington	----------	----------	(1)	(1)	(1)	(1)	----------	----------	16,830	76,963	140,900	338,696	162,680	420,825
West Virginia	----------	----------	2,457,550	2,754,856	1,028,910	1,587,925	518,290	534,838	37,460	86,905	438,120	715,799	4,480,330	5,680,323
Wisconsin	66,130	83,860	(1)	(1)	4,538,550	4,455,556	(1)	(1)	1,433,850	1,980,512	77,730	145,036	6,431,550	7,034,414
Wyoming	60,100	117,612	(1)	(1)	53,210	60,584	447,570	495,172	(1)	(1)	134,510	396,811	697,920	1,073,715
Undistributed	49,410	52,944	856,770	1,085,608	521,780	733,945	369,630	383,733	1,104,520	1,813,435	1,199,770	2,604,192	1,252,380	1,529,712
Total	2,582,300	3,317,663	34,901,940	34,250,008	82,414,650	99,956,803	7,767,130	7,832,978	20,941,530	32,034,698	17,527,710	27,476,000	166,135,260	204,868,150
Average unit value	----------	$1.28	----------	$0.98	----------	$1.21	----------	$1.01	----------	$1.53	----------	$1.57	----------	$1.23

[1] Included with "Undistributed."

Limestone (crushed and broken stone) sold or used by producers in the United States for miscellaneous uses, 1947–48

Use	1947		1948	
	Short tons	Value	Short tons	Value
Alkali works	7,074,270	$5,295,318	7,349,540	$5,942,572
Calcium carbide works	846,860	846,293	1,052,080	1,027,952
Coal-mine dusting	386,980	1,351,922	414,910	1,640,476
Filler (not whiting substitute):				
Asphalt	486,470	1,422,998	553,360	1,593,820
Fertilizer	483,770	862,389	612,040	1,155,690
Other	143,270	371,921	262,680	841,406
Filter beds	33,970	61,566	19,940	38,985
Glass factories	756,930	1,576,701	666,360	1,410,120
Limestone sand	743,060	651,607	1,033,820	954,544
Limestone whiting [1]	492,040	4,237,606	537,230	3,590,757
Magnesia works (dolomite) [2]	358,320	458,075	229,200	315,680
Mineral food	402,070	1,937,359	422,850	1,843,910
Mineral (rock) wool	25,780	30,489	40,540	47,053
Paper mills	569,930	1,049,591	475,880	908,098
Poultry grit	66,710	543,476	72,040	653,087
Refractory (dolomite)	1,540,740	1,728,623	1,323,090	1,497,285
Road base	771,010	523,573	272,640	229,054
Stucco, terrazzo, and artificial stone	32,560	309,919	36,520	381,282
Sugar factories	649,420	1,349,886	471,030	1,098,933
Other uses [3]	579,450	955,037	1,164,220	1,642,181
Use unspecified	414,440	586,909	517,740	663,115
Total	16,858,050	26,151,258	17,527,710	27,476,000

[1] Includes stone for filler for asbestos products, calcimine, caulking compounds, ceramics, chewing gum, explosives, floor coverings, foundry compounds, glue, grease, insecticides, leather goods, paint, paper, phonograph records, picture-frame moldings, plastics, putty, roofing, rubber, tooth paste, wire coating, and unspecified uses.
[2] Includes stone for refractory magnesia.
[3] Includes stone for acid neutralization, athletic-field marking, carbon dioxide, chemicals (unspecified), concrete blocks and pipes, dyes, fill material, light bulbs, motion-picture snow, oil-well drilling, patching plaster, pharmaceuticals, rayons, roofing granules, spalls, and water treatment.

Dolomite (calcium-magnesium carbonate) has a variety of uses, some of which are 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.

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, 1947–48

	1947		1948	
	Short tons	Value	Short tons	Value
Dolomite for—				
Basic magnesium carbonate [1]	358,320	$458,075	229,200	$315,680
Refractory uses	1,540,740	1,728,623	1,323,090	1,497,285
Dolomitic lime for—				
Refractory (dead-burned dolomite)	1,395,200	14,295,359	1,544,760	17,847,182
Paper mills	48,000	453,000	56,000	554,000
Total (calculated as raw stone)	4,785,000		4,754,000	

[1] Includes dolomite for refractory magnesia.

The following table shows the tonnages and values of fluxing stone sold for use in various metallurgical operations.

Sales of fluxing limestone, 1944–48, 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
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
1947	25, 817, 270	22, 000, 942	6, 059, 440	5, 862. 292	512, 880	593, 811	180, 680	230, 905	32, 570, 270	28, 687, 950
1948	26, 339, 790	24, 721, 052	7, 873, 410	8, 695, 137	503, 490	609, 354	185, 250	224, 465	34, 901, 940	34, 250, 008

[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 the Minerals Yearbook, they are not covered in the Stone chapter. However, a commodity review of limestone would be incomplete without suitable 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, 1946–48, in short tons

Use	1946	1947	1948
Limestone (as given in this report) (approximate)	134, 717, 000	150, 409, 000	166, 742, 000
Portland and natural cement and cement rock [1]	43, 877, 000	49, 530, 000	54, 513, 000
Lime [2]	11, 985, 000	13, 558, 000	14, 528, 000
Total	190, 579, 000	213, 497, 000	235, 783, 000

[1] Reported in terms of cement in Cement chapter of this volume.
[2] Reported in terms of lime in Lime chapter of this volume.

SANDSTONE

Sales of crushed and broken sandstone increased 7 percent in quantity and value in 1948 compared with 1947. Increases in tonnage were registered for refractory stone, concrete and road metal, and "other uses," whereas riprap and railroad-ballast output declined. Average unit values increased for refractory stone, riprap, and railroad ballast and decreased for all others. California, Pennsylvania, and Colorado were principal producers.

MISCELLANEOUS STONE

Crushed and broken stone, other than the five principal varieties already discussed, includes light-colored volcanic rocks, schists, boulders from river beds, serpentine, and flint. The following table shows sales of stone of these types in 1948. Total sales decreased 7 percent in quantity and about one percent in value in 1948 compared with the preceding year. California was the principal producer in 1948. Other States producing more than a million tons were Kansas, Missouri, and Oklahoma. The average unit value increased 6 cents in 1948 to $0.87. See second table following for details.

Sandstone (crushed and broken stone) sold or used by producers in the United States in 1948, 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)
Arizona	-----	-----	(2)	(2)	-----	-----	-----	-----	-----	-----	(2)	(2)
Arkansas	(2)	(2)	-----	-----	(2)	(2)	-----	-----	-----	-----	(2)	(2)
California	6,220	$57,063	(2)	(2)	1,189,610	$1,221,579	(2)	(2)	(2)	(2)	1,522,120	$1,403,923
Colorado	(2)	(2)	(2)	(2)	19,900	12,962	-----	-----	766,370	$333,442	811,480	392,717
Kansas	-----	-----	9,850	$8,372	78,750	134,411	77,040	$92,454	1,210	77	166,850	235,314
Maine	-----	-----	-----	-----	(2)	(2)	-----	-----	-----	-----	(2)	(2)
Massachusetts	-----	-----	-----	-----	(2)	(2)	-----	-----	-----	-----	(2)	(2)
Minnesota	-----	-----	(2)	(2)	-----	-----	-----	-----	-----	-----	(2)	(2)
Missouri	-----	-----	(2)	(2)	-----	-----	-----	-----	-----	-----	(2)	(2)
Montana	-----	-----	(2)	(2)	-----	-----	(2)	(2)	-----	-----	130,170	126,914
Nevada	-----	-----	(2)	(2)	-----	-----	-----	-----	-----	-----	(2)	(2)
New Mexico	-----	-----	-----	-----	(2)	(2)	342,650	228,240	-----	-----	(2)	(2)
New York	-----	-----	-----	-----	(2)	(2)	-----	-----	-----	-----	(2)	(2)
North Carolina	-----	-----	-----	-----	(2)	(2)	-----	-----	-----	-----	(2)	(2)
Ohio	85,140	1,130,686	67,320	229,398	4,900	8,165	-----	-----	49,640	291,288	207,000	1,659,537
Oklahoma	-----	-----	-----	-----	(2)	(2)	-----	-----	-----	-----	(2)	(2)
Pennsylvania	675,900	2,438,069	(2)	(2)	645,620	1,195,794	(2)	(2)	-----	-----	1,428,070	3,786,416
South Dakota	88,130	185,200	(2)	(2)	199,670	349,014	-----	-----	(2)	(2)	414,340	708,809
Tennessee	-----	-----	-----	-----	(2)	(2)	-----	-----	(2)	(2)	(2)	(2)
Texas	-----	-----	-----	-----	10,000	25,000	-----	-----	-----	-----	10,000	25,000
Utah	(2)	(2)	-----	-----	-----	-----	-----	-----	-----	-----	(2)	(2)
Virginia	98,240	234,622	-----	-----	96,610	167,402	14,440	14,440	5,230	7,868	214,520	424,332
Washington	-----	-----	(2)	(2)	(2)	(2)	-----	-----	-----	-----	(2)	(2)
West Virginia	(2)	(2)	-----	-----	(2)	(2)	-----	-----	-----	-----	446,740	116,607
Wisconsin	(2)	(2)	-----	-----	-----	-----	-----	-----	(2)	(2)	575,350	3,491,157
Wyoming	-----	-----	-----	-----	(2)	(2)	(2)	(2)	-----	-----	(2)	(2)
Undistributed	280,330	988,159	304,220	459,749	924,690	570,172	224,750	266,188	819,270	3,231,309	1,159,060	1,510,397
Total	1,233,960	5,033,799	381,390	697,519	3,169,750	3,684,499	658,880	601,322	1,641,720	3,863,984	7,085,700	13,881,123
Average unit value	-----	$4.08	-----	$1.83	-----	$1.16	-----	$0.91	-----	$2.35	-----	$1.96

[1] Includes sandstone for chemical use, fill material, poultry grit, road base, rock wool, roofing granules, spalls, stone sand, and unspecified uses.
[2] Included with "Undistributed."

Miscellaneous varieties of stone (crushed and broken stone) sold or used by producers in the United States in 1948, by States and uses

State	Riprap		Crushed stone: Concrete and road metal		Crushed stone: Railroad ballast		Other uses[1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alaska			([2])	([2])					([2])	([2])
Arizona	10,760	$9,385			182,950	$106,300	260	$53	193,970	$115,738
Arkansas	([2])	([2])	([2])	([2])	([2])	([2])			([2])	([2])
California	903,900	1,725,957	5,048,900	$4,325,799	556,730	381,056	233,250	120,517	6,742,780	6,553,329
Colorado			([2])	([2])	([2])	([2])			100,230	75,821
Florida	([2])	([2])	([2])	([2])					([2])	([2])
Georgia			([2])	([2])					([2])	([2])
Idaho			([2])	([2])	([2])	([2])			([2])	([2])
Kansas [3]			[4] 192,980	[4] 93,541	1,581,670	471,538			[4] 1,774,650	[4] 565,079
Maine	320	326	87,290	88,676					87,610	89,002
Maryland			([2])	([2])			([2])	([2])	([2])	([2])
Massachusetts	8,590	33,498	168,000	235,000					176,590	268,498
Michigan			([2])	([2])			([2])	([2])	33,820	167,909
Missouri [3]	([2])	([2])	[4] 532,300	[4] 456,234	([2])	([2])	([2])	([2])	[4] 1,424,350	[4] 766,068
Montana			([2])	([2])					([2])	([2])
Nevada			([2])	([2])					([2])	([2])
New Jersey			([2])	([2])					([2])	([2])
New York			([2])	([2])	([2])	([2])			([2])	([2])
North Carolina			([2])	([2])					([2])	([2])
North Dakota							([2])	([2])	([2])	([2])
Ohio			([2])	([2])					([2])	([2])
Oklahoma [3]			654,800	392,880	878,350	439,173			1,533.150	832,053
Oregon	([2])	([2])	212,370	261,001	([2])	([2])			639,510	614,166
Pennsylvania			([2])	([2])			([2])	([2])	230,940	767,899
Puerto Rico			([2])	([2])					([2])	([2])
Rhode Island			([2])	([2])					([2])	([2])
South Carolina			([2])	([2])					([2])	([2])
South Dakota			([2])	([2])					([2])	([2])
Tennessee			([2])	([2])					([2])	([2])
Texas	([2])	([2])	151,750	96,142	([2])	([2])	([2])	([2])	608,480	429,667
Utah			([2])	([2])	([2])	([2])			([2])	([2])
Virginia			122,390	191,066					122,390	191,066
Washington	([2])	([2])	([2])	([2])	([2])	([2])	([2])	([2])	223,890	246,209
West Virginia			([2])	([2])					([2])	([2])
Wisconsin			10,910	17,153					10,910	17,153
Wyoming			([2])	([2])	([2])	([2])			([2])	([2])
Undistributed	425,140	357,438	1,848,700	2,059,328	2,295,910	1,723,316	698,250	985,794	2,903,200	2,871,514
Total	1,348,710	2,126,604	9,030,390	8,216,820	5,495,610	3,121,383	931,760	1,106,364	16,806,470	14,571.171
Average unit value		$1.58		$0.91		$0.57		$1.19		$0.87

[1] Includes stone used for agriculture, asphalt filler, concrete blocks, fill material, refractory, road base, roofing granules, spalls, stucco, and unspecified uses.
[2] Included with "Undistributed."
[3] Chats; figures collected by Denver, Colo., office of the Bureau of Mines. Missouri figures also include chert aggregates.
[4] Includes a small quantity of stone.

MARKETS

As has been shown in preceding sections of this chapter, the principal utilization of crushed stone is as aggregate in concrete and road metal used in the construction of buildings and highways. It follows, therefore, that crushed stone sales should more or less parallel the trends of portland-cement shipments, the area of new concrete pavements, and the value of new construction. These relationships are shown in figure 3.

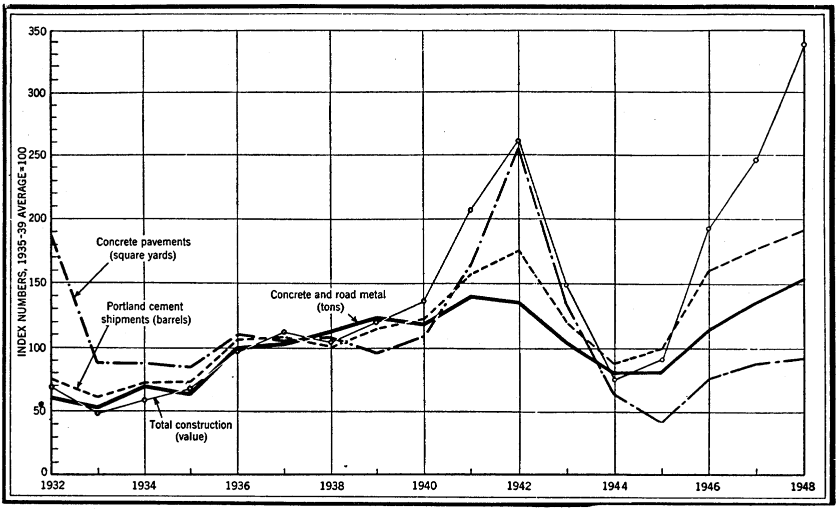

FIGURE 3.—Crushed-stone aggregates (concrete and road metal) sold or used in the United States compared with shipments of portland cement, total construction (value), and concrete pavements (contract awards, thousands of square yards), 1932–48. Data on construction and concrete pavements from Bureau of Foreign and Domestic Commerce.

The metallurgical industries operated at high rates during 1948. Pig-iron production—more than 60 million short tons—was 3 percent greater than in 1947; and steel production—more than 88 million tons—was 4 percent greater than in the previous year. As a result of these increases, metallurgical stone sales increased 7 percent over 1947. The correlations of fluxing-stone output with pig-iron production and of refractory stone with steel-ingot production are shown in figure 4.

TECHNOLOGY

It has been known for some time that marble is adversely affected by temperature differentials and that permanent growth is sometimes induced by these cycles. The expansion is normally accompanied by decreases in such structural properties as strength, elasticity, and coherence. A granulated effect (commonly called "sugaring") in various marbles appears to be attributed to the unusual thermal expansion of the component calcite crystals. This unequal expansion tends to loosen the inherent bond between the crystals thereby resulting in crumbling or disintegration. Tests are being made at the National Bureau of Standards to determine the basic reasons for marble weathering.[5]

[5] National Bureau of Standards, Technical News Bulletin: Vol. 32, No. 3, March 1948, pp. 28–29.

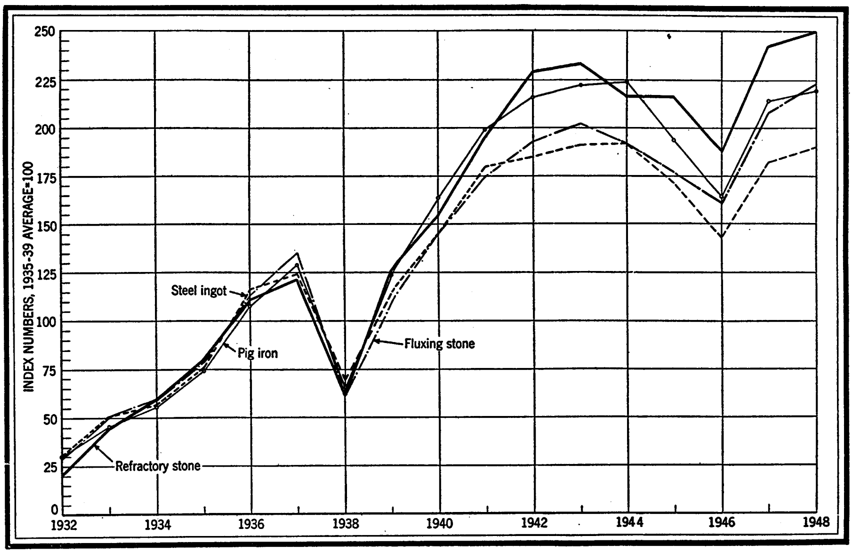

FIGURE 4.—Sales (tons) of fluxing stone and refractory stone (including that used in making lime) compared with production of steel ingot and pig iron, 1932–48. Statistics of steel-ingot production compiled by American Iron and Steel Institute.

The use of limestone to neutralize acid wastes has recently been reported.[6]

During 1946 the Bureau of Mines examined several high-grade limestone deposits in Washington. A report covering examination of the Sauk Mountain deposit has been released.[7]

In connection with the preparation of crushed stone for marketing, a method for washing finer sizes of the material is being used. The method includes the use of a series of nozzles of ¾-inch pipe slightly flattened and using a high velocity of water trained on the crushed aggregate.[8]

The use of "skull crackers" in quarrying operations was mentioned in the 1946 and 1947 Stone chapters. A recent report describes the use of a skull breaker for secondary breaking in a limestone quarry.[9]

Extenders are widely used in the paint industry. A study of the commercial possibilities of using finely ground limestone for this purpose has been recently reported.[10]

FOREIGN TRADE[11]

Importation of stone into the United States in 1948 suffered a decline in value compared with 1947. Decreases in total value were registered for marble, granite, and quartzite but travertine imports

[6] Reidl, A. L., Limestone Used To Neutralize Acid Wastes: Chem. Eng., vol. 54, No. 7, July 1947, pp. 100–101.
[7] Popoff, Constantine C., Investigation of Sauk Mountain Limestone Deposits in Skagit County, Wash.: Bureau of Mines Rept. of Investigations 4355, 1948, 14 pp.
[8] Rock Products, vol. 51, No. 12, December 1948, p. 84.
[9] Mosier, McHenry, A Skull Breaker in a Limestone Quarry: Bureau of Mines Inf. Circ. 7472,1948, 4 pp.
[10] Kimmel, A. L., and Tyner, M., Florida Limestone as a Paint Extender: Rock Products, vol. 51, No. 1, January 1948, pp. 118–120.
[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.

almost doubled over those reported for the preceding year. A slight increase in value was recorded for "other" stone.

The export trade in 1948, although relatively small, increased slightly in quantity and value for marble and other building and monumental stone. The bulk is shipped to Canada with most of the remainder to other countries in the Western Hemisphere. The value of "other manufactures of stone" decreased slightly in 1948.

Stone and whiting imported for consumption in the United States, by classes, 1947–48

[U. S. Department of Commerce]

Class	1947		1948	
	Quantity	Value	Quantity	Value
Marble, breccia, and onyx:				
Sawed or dressed, over 2 inches thick......cubic feet..	21	$77	648	$5,586
In blocks, rough, etc......do....	169,812	703,311	109,345	436,305
Slabs or paving tiles......superficial feet..	83,739	30,345	147,053	85,197
All other manufactures......	....	99,115	....	132,429
Total......	....	832,848	....	659,517
Granite:				
Dressed......cubic feet..	51,046	484,574	23,537	218,213
Rough......do....	89,697	262,390	84,504	265,962
Paving blocks, wholly or partly manufactured...number..	1	29	1	71
Total......	....	746,993	....	484,246
Quartzite......short tons..	215,688	592,485	225,342	491,343
Travertine stone......cubic feet..	24,860	43,108	51,259	85,643
Stone (other):				
Dressed......	....	3,498	....	3,957
Rough (monumental or building stone)......cubic feet..	5,872	10,500	4,516	6,078
Rough (other)......short tons..	43,774	81,831	43,590	100,612
Marble chip or granito......do....	11,928	81,224	7,743	70,988
Crushed or ground, n. s. p. f......	....	6,328	....	4,833
Total......	....	183,381	....	186,468
Whiting:				
Chalk or whiting, precipitated......short tons..	2,375	99,488	1,253	58,629
Whiting, dry, ground, or bolted......do....	3,089	43,971	7,268	109,311
Whiting, ground in oil (putty)......do....	(1)	22	(1)	37
Total......	....	143,481	....	167,977
Grand total......	....	2,542,296	....	2,075,194

[1] Less than 1 ton.

Stone exported from the United States, 1944–48

[U. S. Department of Commerce]

Year	Marble and other building and monumental stone		Other manufactures of stone (value)
	Cubic feet	Value	
1944......	78,164	$201,036	$176,423
1945......	119,004	337,666	174,874
1946......	224,692	463,572	280,380
1947......	320,016	583,826	567,388
1948......	345,697	584,050	516,725

Sulfur and Pyrites

By G. W. JOSEPHSON AND M. G. DOWNEY [1]

GENERAL SUMMARY

THE high level of industrial activity was reflected in the sulfur production of 1948. In the United States a native-sulfur production record was established as the industry tried to satisfy the unprecedented requirements of domestic consumers and a great foreign demand. Italian sulfur producers were in a less favorable position because of cost disadvantages. Their output increased slightly and their export situation was improved somewhat through governmental assistance programs, but many basic difficulties remain to be solved.

The rate of consumption of native sulfur has become so great that reserve problems are receiving serious attention. No outstanding discoveries were revealed in 1948 but exploration is very active.

International trade in pyrites, particularly in Europe, gradually is resuming its prewar pattern; consequently, production in the exporting countries, such as Spain, Portugal, and Cyprus, increased. In the United States pyrite output declined slightly but was still near the record rate.

The trend of sulfur prices continued upward, but increases have been much less than those for most other commodities.

Salient statistics of the sulfur industry in the United States, 1935–39 (average) and 1945–48

	1935–39 (average)	1945	1946	1947	1948
Sulfur:					
Production of crude sulfur..long tons..	2,175,057	3,753,188	3,859,642	4,441,214	4,869,210
Shipments of crude sulfur—					
For domestic consumption..do....	1,420,236	2,914,603	2,939,140	3,529,043	3,715,999
For export..do....	566,361	918,691	1,189,072	1,299,060	1,262,913
Total shipments..do....	1,986,597	3,833,294	4,128,212	4,828,103	4,978,912
Imports:					
Ore..do....	555				
Other..do....	3,427	33	35	15	38
Exports of treated sulfur..do....	16,374	23,971	56,748	50,477	32,630
Producers' stocks at end of year[1]..do....	3,560,000	3,500,000	3,200,000	2,800,000	2,700,000
Price of crude sulfur per long ton f. o. b. mines....	$17.40	$16	$16	$16–$18	$18
Pyrites:					
Production..long tons..	544,144	722,596	813,372	940,652	928,531
Imports..do....	433,485	186,507	182,893	126,553	107,411
Price of imported pyrites c. i. f. Atlantic ports, cents per long-ton unit..	12–13	14	14	15	15
Sulfuric acid: Production of byproduct sulfuric acid (basis, 100 percent) at copper and zinc plants..short tons..	564,794	842,635	716,216	725,197	641,445

[1] Stocks held at mines only.

[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.

SULFUR

DOMESTIC PRODUCTION

Production of sulfur continued at a high rate throughout 1948; and a new record, 10 percent above the previous high, was established. Demand from both domestic and foreign consumers was so great that shipments from the mines—4,978,912 tons—exceeded production (4,869,210). These tonnages apply only to the output of Frasch-process mines. Relatively small quantities of sulfur were also produced by conventional mining methods in California, Colorado, Nevada, Texas, and Wyoming. This material is consumed principally in treating alkaline soils.

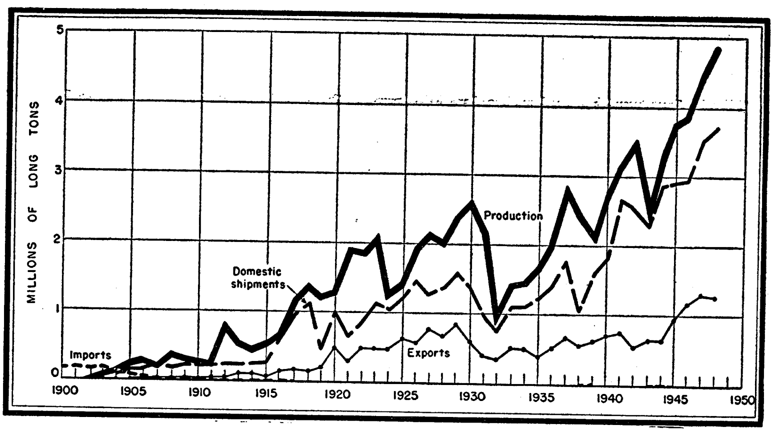

FIGURE 1.—Domestic production, shipments for domestic consumption, exports, and imports of crude sulfur, 1900–48.

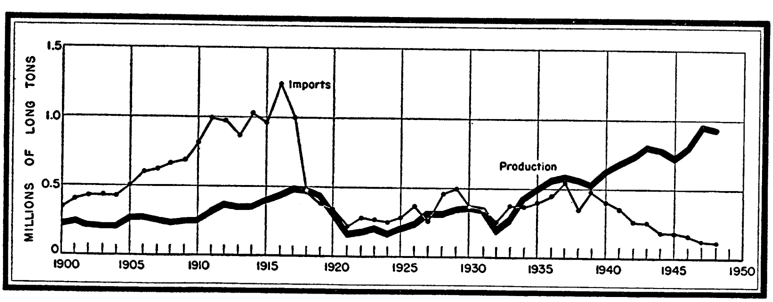

FIGURE 2.—Domestic production and imports of pyrites, 1900–48.

Mines in Texas produced 79 percent and those in Louisiana nearly 21 percent of the native sulfur output of the United States in 1948.

California.—Sulfur ore was produced at the Crater Claims in Inyo County by Roy Kitching, and at Leviathan, Alpine County, by the Siskon Mining Corp.

Colorado.—General Agricultural Products Co. mined sulfur ore in Delta County.

Louisiana.—In 1948, for the first time, annual production of sulfur in Louisiana from the Grande Ecaille mine of the Freeport Sulfur Co.

in Plaquemines Parish exceeded 1,000,000 tons. A $7,000,000 program of improvement and expansion was completed in 1948. Experiments in the transportation of molten sulfur by barge from the mine to Port Sulphur have been successful.

Nevada.—In Humboldt County, W. S. Peterson produced sulfur at the Oscar Streeter mine.

Texas.—In 1948 sulfur was produced in Texas by the following firms: Duval Texas Sulfur 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 at Moss Bluff Dome, Liberty County; and the Pecos Orla Sulphur Co., Inc., at Michigan Claims, Culberson County.

The construction program of the Texas Gulf Sulphur Co. at Moss Bluff Dome was completed in 1948 and the first production was reported in June. Sulfur from this dome will be shipped by barge to Galveston.

Wyoming.—Development work on a sulfur mine at Afton, Wyo., was carried on by Star Valley Mines, Inc. Near Cody, Wyo., the Cody Sulfur Co. was active, and the Interstate Chemical Co. was preparing to produce sulfur from local geyser deposits. The market for material from this area is primarily in soil conditioner, but experimental work looking toward its use in the preparation of phosphatic fertilizer is being carried on.

Sulfur produced and shipped in the United States, 1944–48 [1]

Year	Produced (long tons)			Shipped	
	Texas	Louisiana	Total	Long tons	Approximate value
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
1947	3,561,214	880,000	4,441,214	4,828,103	85,200,000
1948	3,867,545	1,001,665	4,869,210	4,978,912	89,600,000

[1] In addition to the refined sulfur shown, native sulfur ore (10–70 percent S) for agricultural use was produced in Colorado and Texas in 1944–48 and in California and Nevada in 1946–48. Total shipments of this material were as follows, in long tons: 1944—1,639 ($8,950); 1945—1,615 ($12,170); 1946—6,344 ($95,531); 1947—4,303 ($65,124); 1948—1,700 ($30,220).

Sulfur produced in Texas in 1948, by companies, in long tons

Company	First quarter	Second quarter	Third quarter	Fourth quarter	Total
Texas Gulf Sulphur Co	742,403	782,364	797,761	797,424	3,119,952
Freeport Sulphur Co	85,620	96,605	95,330	90,390	367,945
Jefferson Lake Sulphur Co., Inc	60,840	51,522	51,399	48,357	212,118
Duval Texas Sulphur Co	30,285	47,410	41,480	48,355	167,530
Total	919,148	977,901	985,970	984,526	3,867,545

RECOVERY AS BYPRODUCT

The major sulfur requirements of the United States are supplied by native sulfur and pyrites that are mined specifically for that purpose. However, considerable quantities of sulfur are also obtained as byproducts of other operations. A large tonnage of pyrites is recovered as a flotation concentrate in milling copper and zinc ores and a comparatively modest tonnage as coal brasses in the washing of midwestern coal. Statistics of these materials are included in the Pyrites section of this chapter.

Large volumes of sulfur-bearing gases are evolved in smelting metal sulfide ores. During 1948 the equivalent of 187,000 long tons of sulfur was recovered from this source in the form of sulfuric acid. The following table shows the output of acid at smelters during the past 5 years.

Byproduct sulfuric acid (basis, 100 percent) produced at copper, zinc, and lead plants in the United States, 1944–48, in short tons

	1944	1945	1946	1947	1948
Copper plant [1]	248, 988	231, 697	171, 687	126, 494	111, 967
Zinc plants	652, 001	610, 938	544, 529	598, 703	529, 478
Total	900, 989	842, 635	716, 216	725, 197	641, 445

[1] Includes sulfuric acid produced as byproduct at a lead smelter.

In many other industrial operations sulfur fumes are also available, but only a small fraction of the total is recovered in useful form. However, the movement toward more complete utilization of this resource has gathered impetus in recent years as more attention has been directed toward the substantial quantities of sulfur that can be obtained from sour natural gases, and toward the smog that has become a serious problem in many cities. As sulfur compounds in the air are said to contribute to the formation of smog, serious efforts are being made in Los Angeles and other cities to reduce the quantities of sulfur released into the air by oil refineries and other industrial plants.

During 1948 construction was progressing on two natural-gas cleaning plants in Wyoming (one by Texas Gulf Sulphur Co. and one by Stanolind Oil & Gas Co.) and one (a Simon-Carves plant being built for the Hancock Chemical Co.) in California for the treatment of oil refinery gases in the Los Angeles area. The Freeport Sulphur Co. was preparing to construct a plant near Westville, N. J., to recover sulfur from refinery gases.

During 1948 coke-oven, refinery, natural, and other industrial gases produced in nine States provided a total of 44,369 tons of elemental sulfur (calculated as 100 percent sulfur) when treated by the Thylox, Sasco, and other processes. Shipments totaled 54,349 long tons, of which 94 percent was sold as brimstone and the remainder as paste containing 40 to 51 percent sulfur. In addition, 27,953 tons of hydrogen sulfide (containing 25,792 long tons of sulfur) were recovered in 1948 in four States by the Phenolate, Phosphate, and Girbotol processes.

CONSUMPTION AND USES

Consumption of sulfur, as shown in the accompanying table, again reached a new record in 1948—7 percent above the previous high established in 1947. Apparent sales, a calculated figure which includes exports, were also at a record level—5,015,230 long tons.

Apparent consumption of sulfur in the United States, 1944–48, in long tons

	1944	1945	1946	1947	1948
Shipments to consumers (apparent)	3,580,058	3,849,591	4,094,191	4,839,548	5,015,230
Imports	32	33	35	15	38
Total	3,580,090	3,849,624	4,094,226	4,839,563	5,015,268
Exports:					
Crude	653,686	918,691	1,189,072	1,299,060	1,262,913
Refined	21,546	23,971	56,748	50,477	32,630
Total	675,232	942,662	1,245,820	1,349,537	1,295,543
Apparent consumption	2,904,858	2,906,962	2,848,406	3,490,026	3,719,725

The pattern of sulfur consumption, by industries, has been estimated by Chemical Engineering as follows:

Sulfur consumed in the United States, 1944–48, by uses, in long tons

[Chemical Engineering]

Use	1944	1945	1946	1947	1948
Chemicals [1]	1,585,000	1,605,000	1,460,000	1,760,000	1,790,000
Fertilizer and insecticides	580,000	600,000	620,000	740,000	800,000
Pulp and paper	300,000	297,000	305,000	370,000	380,000
Explosives [1]	88,000	90,000	90,000	100,000	110,000
Dyes and coal-tar products	75,000	75,000	80,000	95,000	98,000
Rubber	55,000	58,000	65,000	65,000	63,000
Paint and varnish	90,000	94,000	105,000	190,000	240,000
Food products	7,000	7,000	7,000	8,000	8,000
Miscellaneous	140,000	135,000	175,000	212,000	211,000
Total	2,920,000	2,961,000	2,907,000	3,540,000	3,700,000

[1] To avoid disclosing estimated consumption of sulfur in direct war applications, such as military explosives, sulfur so used is included with "Chemicals."

Large quantities of elemental sulfur are consumed in such products as rubber and insecticides, and the paper industry converts a considerable tonnage into liquors used in manufacturing paper. However, the largest percentage (approximately three-fourths) is converted into sulfuric acid. A publication of interest to sulfur consumers is being prepared by J. R. West of the Mellon Institute. It is to contain a comprehensive compilation of the known properties of sulfur and will be published by the American Chemical Society. Chemical Engineering has estimated the consumption of sulfuric acid by the major consuming industries as follows:

Sulfuric acid (basis, 100 percent) consumed in the United States, 1944–48, by industries, in short tons

[Chemical Engineering]

Industry	1944 [1]	1945 [1]	1946 [2]	1947 [2]	1948
Fertilizer	2,640,000	2,850,000	3,020,000	3,515,000	3,650,000
Chemicals	2,490,000	2,220,000	1,760,000	2,000,000	2,070,000
Petroleum refining	1,020,000	1,020,000	1,000,000	1,065,000	1,070,000
Paints and pigments	510,000	520,000	550,000	665,000	680,000
Coal products	625,000	600,000	510,000	640,000	650,000
Rayon and cellulose film	450,000	495,000	556,000	610,000	650,000
Iron and steel	560,000	570,000	475,000	550,000	570,000
Other metallurgical	350,000	330,000	280,000	315,000	315,000
Industrial explosives	120,000	100,000	105,000	125,000	130,000
Textiles	75,000	70,000	75,000	73,000	70,000
Miscellaneous	350,000	400,000	320,000	372,000	370,000
Total	9,190,000	9,175,000	8,651,000	9,930,000	10,225,000

[1] To avoid disclosing estimated consumption of acid in direct war applications, such as military explosives, acid so used is combined with "Chemicals."
[2] Revised figures.

As indicated in the table, the market for sulfuric acid was strong in almost all uses in 1948 and a record was attained.

The sulfuric acid production capacity of the United States was expanded greatly during the war, and a postwar oversupply was expected. Since the war, some ordnance plants have been idle and some old plants dismantled but demand for acid has been so great that much new construction has been required and in 1948 it was estimated that the total United States capacity had increased to more than 12,000,000 tons.[2]

In Minerals Yearbook, 1946, statistics showing distribution of sulfuric acid production by market areas were published. Exactly comparable data are not available for subsequent years, but the accompanying table provides somewhat similar information that was obtained by the Bureau of the Census in its census of manufacturers.

Production and shipment of sulfuric acid[1] (100 percent H_2SO_4), by regions and by States, in 1947

[Bureau of the Census]

Region and State	Number of producing establishments	Total production, short tons	Total shipments and transfers: Short tons	Total shipments and transfers: Value f. o. b. plant (thousands of dollars)
New England[2]	5	183,151	102,156	1,808
Middle Atlantic:				
Pennsylvania	14	855,608	744,565	10,168
Other[3]	12	1,432,890	813,616	12,440
Total Middle Atlantic	26	2,288,498	1,558,181	22,608
North Central:				
Illinois	15	1,135,991	837,008	10,894
Ohio	14	624,377	446,755	6,660
Other[4]	11	658,433	300,478	4,011
Total North Central	40	2,418,801	1,584,241	21,565
South:				
Georgia	15	241,789	36,525	425
South Carolina	9	165,981	12,200	164
Other[5]	68	4,654,566	2,814,166	33,184
Total South	92	5,062,336	2,862,891	33,773
Far West[6]	14	827,380	717,287	9,375
Total United States[7]	177	10,780,166	6,824,756	89,129

[1] Gross quantities including spent sulfuric acid fortified in contact units.
[2] Includes data for plants located as follows: Connecticut—1; Maine—1; Massachusetts—2; Rhode Island—1.
[3] Includes data for plants located as follows: New Jersey—9; New York—3.
[4] Includes data for plants located as follows: Indiana—3; Michigan—5; Missouri—2; Wisconsin—1.
[5] Includes data for plants located as follows: Alabama—10; Arkansas—1; Delaware—1; Florida—6; Kentucky—1; Louisiana—6; Maryland—6; Mississippi—3; North Carolina—9; Oklahoma—2; Tennessee—3; Texas—7; Virginia—12: West Virginia—1.
[6] Includes data for plants located as follows: Arizona—2; California—8; Colorado—1; Montana—1; Utah—1; Washington—1.
[7] Includes data for 85 plants operating chamber units, 82 plants operating contact units, and 10 plants operating both types of units.

[2] Kastens, M. L., and Hutchinson, J. C., Contact Sulfuric Acid from Sulfur: Ind. Eng. Chem., vol. 40, No. 8, August 1948, pp. 1340–1349.

STOCKS

During 1948 sales were so great that, despite record production, producers' stocks of native sulfur declined 4 percent to 3,225,014 long tons, 2,694,449 of which were held at the mine and 530,565 at ports, consuming centers, or in transit.

PRICES

The price of crude sulfur quoted during 1948 was $18 per long ton f. o. b. mines for the domestic market, and $20–$22 for export. Refined-sulfur prices were also advanced during the year.

FOREIGN TRADE

In recent years imports of elemental sulfur into the United States as shown in the accompanying table, have been negligible. Foreign producers of native sulfur find it difficult to compete with the low-price output of Frasch mines. Byproduct sulfur produced in Canada is no longer exported to the United States but is used in that country. It is reported that relatively small quantities of crude sulfur ore are imported from Mexico into southern California from time to time for use as soil conditioner.

On the other hand, exports are very large. In 1948, 1,262,913 long tons of crude and 32,630 tons of crushed and refined sulfur were shipped out of the United States. This is nearly as large a movement as in the record year 1947.

An accompanying table shows the wide distribution of American sulfur in the world market.

Sulfur imported into and exported from the United States, 1944–48

[U. S. Department of Commerce]

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
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
1947			15	5,014	1,299,060	25,388,093	50,477	2,318,956
1948			38	13,299	1,262,913	26,779,444	32,630	1,774,358

[1] Less than 1 ton.

Sulfur exported from the United States, 1947–48, by countries

[U. S. Department of Commerce]

Country	Crude				Crushed, ground, refined, sublimed, and flowers of—			
	1947		1948		1947		1948	
	Long tons	Value	Long tons	Value	Pounds	Value	Pounds	Value
North America:								
Canada	315,698	$6,249,777	304,228	$6,050,327	8,541,250	$250,188	6,927,472	$199,240
Central America	66	3,581	105	2,700	651,217	22,224	757,894	30,993
Mexico	1,209	33,492	2,201	51,899	4,043,962	73,544	5,148,961	111,347
Newfoundland and Labrador	11,493	203,772	14,240	255,450	2,160	117		
West Indies	26,339	516,368	23,822	507,284	247,960	9,867	445,181	20,172
Total North America	354,805	7,006,990	344,596	6,867,660	13,486,549	355,940	13,279,508	361,752
South America:								
Argentina	40,151	801,578	43,269	943,468	648,664	53,173	44,700	10,696
Brazil	31,763	634,387	30,141	672,261	9,104,510	252,437	5,882,110	220,391
Chile					4,000	1,343		
Colombia	655	20,949	1,055	33,686	653,858	19,022	590,083	15,838
Ecuador			69	2,449	132,482	5,962		
Peru	2	112			706,454	19,306	941,673	49,814
Uruguay	2,600	47,990	4,165	90,297	1,536,282	28,907	400	136
Venezuela	11	605	3	230	208,739	4,476	552,576	12,382
Other South America					34,096	1,228	16,050	603
Total South America	75,182	1,505,621	78,702	1,742,391	13,029,085	385,854	8,027,592	309,860
Europe:								
Albania					577,900	8,843		
Austria			3,180	104,940	79,000	1,148		
Belgium and Luxembourg	65,777	1,316,102	76,889	1,692,748	722,926	14,151	788,057	14,624
Czechoslovakia	700	14,130	12,500	288,750	4,080	240		
France	113,400	2,268,000	69,880	1,532,760	13,600	3,396	31,350	7,620
Germany	4,500	146,250	16,844	384,871	274,750	4,503	472,625	8,031
Greece	7	150			45,370,065	652,895	13,727,227	207,362
Malta, Gozo, and Cyprus Islands					218,460	3,230		
Netherlands	44,467	996,153	7,018	154,880	2,954,619	53,499	943,740	17,194
Norway					69,875	1,823	130,836	2,670
Portugal			700	18,900	784,159	15,095	113,612	4,008
Rumania					320,490	5,625		
Spain	15,020	288,000			33,000	1,056	7,950	1,710
Sweden	9,820	193,900	15,184	333,349	328,796	11,742	288,500	11,865
Switzerland	78	3,240	28,034	616,748	558,174	51,447	395,611	14,028

United Kingdom	316,773	5,715,310	345,312	7,215,977	15,300	5,865	3,550	728
U. S. S. R.	14,627	341,459	400	9,600				
Yugoslavia					22,046	416		
Other Europe	27	888	7,028	153,900	2,200	70	2,250	495
Total Europe	585,196	11,283,582	582,969	12,507,423	52,349,440	835,044	16,905,308	290,335
Asia:								
Ceylon							1,057,200	22,349
China	340	13,375	1,711	58,629	1,448,561	28,802	7,296,360	145,925
French Indochina					295,981	7,693	27,000	810
Hong Kong	389	15,651	298	7,993	1,996,213	41,110	2,617,080	48,304
India	28,518	623,888	35,267	802,594	6,132,847	141,988	10,710,309	233,406
Iran	16,478	375,047	8,379	216,417				
Korea			440	25,276			4,143,900	134,067
Lebanon							595,215	8,902
Netherlands Indies	954	20,988			27,324	2,521	157,341	3,811
Palestine and Trans-Jordan	2,198	61,765	614	15,378	2,604,290	38,879	2,240,108	33,691
Philippines, Republic of					47,745	3,819	74,960	7,166
Syria					55,500	981	54,615	1,169
Turkey					13,382,963	275,956		
Other Asia	253	8,047	1,608	44,186	207,977	6,718	617,076	23,882
Total Asia	49,130	1,118,761	48,317	1,170,473	26,199,401	548,467	29,591,164	663,482
Africa:								
Algeria	13,500	270,000	10,500	231,000				
Angola							65,478	1,500
Belgian Congo					2,000	63	12,000	468
British East Africa	250	5,885			218,300	5,000		
Egypt	1,000	27,180			3,724,687	62,592		
Madeira Islands					221,605	6,903	44,000	2,090
Mauritius and dependencies					530,442	15,245	821,975	23,184
Mozambique	294	15,558	223	8,456	265,353	6,263	708,344	13,322
Tunisia	1,100	22,000	2,000	44,000				
Union of South Africa	39,767	678,475	42,348	858,368	2,660,547	82,287	3,348,390	92,322
Other Africa					1,028	636		
Total Africa	55,911	1,019,098	55,071	1,141,824	7,623,962	178,989	5,000,187	132,886
Oceania:								
Australia	93,490	1,830,200	103,229	2,255,063	131,912	7,703	62,110	3,519
New Zealand	85,346	1,623,841	50,029	1,094,610	247,935	6,959	225,304	12,524
Total Oceania	178,836	3,454,041	153,258	3,349,673	379,847	14,662	287,414	16,043
Grand total	1,299,060	25,388,093	1,262,913	26,779,444	113,068,284	2,318,956	73,091,173	1,774,358

WORLD REVIEW

Native sulfur is a mineral that is found in a great many countries, but in most instances the deposits are relatively small in size or low in grade. The bulk of the production comes from a few countries, but many countries maintain a small output for local needs. At present complete official statistics of a number of countries are not available, but it is estimated that in 1948 the world output of native sulfur totaled approximately 5,300,000 long tons—a new record. A notable trend is the increasing use of elemental sulfur obtained from sources other than native sulfur deposits. These include various by-product sources and sulfur obtained from pyrites by such methods as the Orkla process. It is estimated that the total world sulfur production, including both native and elemental sulfur derived from other sources, reached a record total of over 5,500,000 long tons in 1948.

Chile.—Sulfur deposits owned by Nicolas Yutronic & Co., located near the town of San Pedro de Atacama at an altitude of 17,000 feet, were described.[3] The deposits are of volcanic origin and are estimated to contain about 7,500,000 tons of sulfur.

After the war sulfur output declined in Chile, and no substantial recovery was noted in 1948.

World production of native sulfur, by countries,[1] 1942–48, in long tons

[Compiled by Pauline Roberts]

Country [1]	1942	1943	1944	1945	1946	1947	1948
Argentina	2,148	10,649	11,092	9,072	[2] 13,000	[2] 13,000	(3)
Bolivia (exports)	3,626	7,079	6,151	640	468	2,275	2,707
Chile	29,570	32,360	30,380	28,617	15,185	11,717	13,258
Ecuador		61	13	102	26	23	43
Formosa	124	863	230	34	280	[2] 350	[2] 1,000
France (content of ore)	703	1,000	1,021	2,672	2,083	10,602	13,779
Greece	4,685	6,373	1,860	448	972	[2] 780	(3)
Guatemala	[2] 10	[2] 10		(3)	(3)	(3)	(3)
Italy (crude) [4]	223,410	135,756	76,081	73,990	140,765	146,088	[2] 170,000
Japan [5]	[6] 160,917	[6] 145,368	[6] 70,394	[6] 21,088	21,051	28,740	40,126
Mexico	[7] 26,115	[7] 4,400	[7] 5,100	[7] 7,100	(3)	3,200	2,100
Palestine	[7] 713					(3)	(3)
Peru	1,126	564	601	1,197	363	779	971
Spain	5,000	5,511	6,280	4,840	4,000	3,600	16,973
Turkey (refined)	2,695	3,326	3,348	4,088	2,970	2,611	2,369
United States	3,460,686	2,538,786	3,218,158	3,753,188	3,859,642	4,441,214	4,869,210
Total [8]	4,000,000	3,000,000	3,500,000	4,000,000	4,200,000	4,800,000	5,300,000

[1] Native sulfur believed to be produced also in China, Cuba, Egypt, India, Indonesia, Iran, and U. S. S. R., but complete data are not available; estimates by senior author of chapter included in total.
[2] Estimate.
[3] Data not available; estimate by senior author of chapter included in total.
[4] In addition, 30,734 tons of sulfur rock was reported in 1942. Similar data not available for later years.
[5] Preliminary data.
[6] Fiscal year ended March 31 of year following that stated.
[7] Incomplete data.
[8] Estimated by senior author of chapter.

France.—Sulfur deposits in France are said to exist in four regions: Apt, Narbonne, Marseille, and Manosque. Reserves for one concession of 355 hectares at Apt are said to total 25,000 tons. Seven beds, ranging in thickness from 0.3 to 1.2 meters, are known in the Manosque area. Reserves are estimated at 3,000,000 tons. The

[3] Bureau of Mines, Mineral Trade Notes: Vol. 27, No. 3, September 1948, pp. 53–56.

Narbonne region is said to have reserves of over 10,000,000 tons. Here a plant having an ore crushing capacity of 1,500 tons per day beneficiates sulfur by flotation.[4] In general, the sulfur ore mined in France is lean—apparently about 10 percent sulfur in 1947. It is beneficiated to a product containing 30–38 percent sulfur.

Germany.—Byproduct sulfur recovery is being revived in Germany. In the Anglo-American zone it was expected that about 20,000 tons would be derived from gases in 1948.[5]

Greece.—Nisyros, Dodecanese Islands, has substantial deposits of sulfur. One survey indicated reserves of 2 million tons of ore containing 337,000 tons of sulfur in a single region. Sulfur has been mined on Nisyros in the past and there is some prospect of development to supply Greek needs now purchased abroad.[6]

India.—At Sindhri, Bihar, a plant is being constructed in which gypsum will be used as a raw material in the manufacture of ammonium sulfate. The waste sludge may be used in the manufacture of cement.

Italy.[7]—Italian sulfur production and exports increased in 1948 but the industry—particularly the Sicilian portion—is not considered to be in a healthy condition. Operations on the mainland are in better condition because they fit into the major domestic manufacturing industries, whereas Sicilian producers must export most of their raw sulfur output. Sicilian sulfur is at a disadvantage in the international market because its price is much higher than that of American sulfur mined by the Frasch process. Production costs of five representative mines are said to range from 28,000 to 42,250 lire per ton. Early in 1948 the Government raised the price of raw sulfur to an average of about 29,000 lire per ton (superior yellow, 30,000; inferior yellow, 29,500; good Sicily, 28,500; common, 28,300). A Government-sponsored marketing organization, Ente Zolfi Italiani, purchased sulfur at the above prices and sold it at a loss abroad at a price of about 23,000 lire through compensation agreements. (American sulfur is said to be sold at the equivalent of 18,000 lire c. i. f. Europe.) This practice apparently enabled most of the producers to break even, but many said that they were still operating at a loss. Exports from Sicily, almost all of which were placed through compensation agreements, increased from 34,550 metric tons in 1947 to 60,209 in 1948. France was the principal buyer, taking 51,717 tons. Warehouse stocks rose to about 110,000 tons and if production is maintained at a 100,000-ton rate (1948 production in Sicily was 108,300), without a substantial increase in exports, stocks are expected to continue to increase sharply in 1949.

Under these conditions, there is pressure on the Government to increase the price paid the miners, whereas foreign purchasers call for reductions to competitive levels. Some efforts are also being made to reduce costs of production. These include efforts to reduce financing costs, improve mining practice, reduce power costs, and improve transportation. Probably the most notable action toward cost reduction in 1948 was the purchase by the Cozzo Disi mine of Ameri-

[4] Mining Magazine (London), The French Sulphur Industry: Vol. 78, No. 6, June 1948, pp. 380–382.
[5] Chemical Age (London), Germany Sulphur Production: Vol. 58, No. 1504, May 8, 1948, p. 663.
[6] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 5, May 1948, pp. 53–54.
[7] Harris, Raymond J., Production Costs—The Gordian Knot of Sicilian Sulphur: Consular Rept. 7, Palermo, Italy, Mar. 15, 1949, 37 pp.

can equipment for beneficiating sulfur by flotation. It is anticipated that flotation will increase greatly the efficiency of recovery, as the losses in standard Calcarone and Gill furnace methods are large.

Mexico.—The existence of sulfur domes in Mexico have been known for many years but no commercial production has come from them. In 1948 interest in this area increased considerably. The Mexican Gulf Sulphur Co., which has carried on an exploration program over a period of years, entered into an agreement with the Jefferson Lake Sulphur Co. looking toward further exploration and eventually commercial production from the San Cristobal Dome.

An extensive exploration program is also reported to have been carried out in the State of Veracruz by the Pan American Sulphur Co.

Rumania.—Sulfur is said to occur near the village of Varilou, Prahova, about 20 miles from Ploesti in the oil area.[8]

Turkey.—From the Keciburlu mines Turkey produced 12,470 metric tons of sulfur ore in 1947 and refined about 2,600 tons of sulfur. This is less than requirements; about 7,000 tons were imported.[8]

PYRITES

DOMESTIC PRODUCTION

In 1948 domestic production of pyrites continued at a high level—only 1 percent lower than the record established in 1947.

Pyrites (ores and concentrates) produced in the United States, 1944–48

Year	Quantity: Gross weight (long tons)	Quantity: Sulfur content (percent)	Value	Year	Quantity: Gross weight (long tons)	Quantity: Sulfur content (percent)	Value
1944	788, 530	42. 2	$2, 598, 000	1947	940, 652	41. 7	$4, 070, 000
1945	722, 596	41. 0	2, 700, 000	1948	928, 531	41. 8	3, 950, 000
1946	813, 372	41. 5	3, 228, 000				

As shown in the accompanying table, pyrites output has increased considerably during the past several years. However, it is in no position to make a strong bid for the major part of the American sulfur market owing to the comparatively low cost of native sulfur. Pyrites, therefore, is used in those areas in which it has some local advantage, such as a low shipping cost or availability as a byproduct in an area of good sulfuric acid demand. The bulk of the production is converted into sulfuric acid by the producing companies before being sold in the open market. In 1948 producing companies consumed 738,227 long tons and sold only 176,370 tons.

California.—Output from the Hornet mine of the Mountain Copper Co., Shasta County, made California the third-largest pyrites-producing State in 1948

[8] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 5, May 1948, p. 54.

Colorado.—The Rico Argentine Mining Co., Dolores County, and the Empire Zinc Division of the New Jersey Zinc Co., Eagle County, produced pyrites in Colorado in 1948.

Indiana.—Output of pyrite (coal brasses) by the Snow Hill Coal Corp. at the Tallydale mine, Vigo County, decreased in 1948.

Montana.—The Anaconda Copper Mining Co. recovered a substantial tonnage of pyrite in 1948 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 1948.

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. Virginia was the second-largest pyrites-producing state in 1948.

Wisconsin.—The Vinegar Hill Zinc Co. recovered pyrites and converted them into acid in Layfayette County.

PRICES

Pyrites prices vary greatly according to the local demand and distance from competitive sources of sulfur. The average value f. o. b. mine of pyrites produced in the United States was reported by producers to be $4.25 per ton in 1948, the range being from less than $1.50 to as much as $6.00. Oil, Paint and Drug Reporter quoted Spanish pyrites at about $8–$10 per ton c. i. f. Atlantic ports. E&MJ Metal and Mineral Markets quoted nominal prices of 14–16 cents per unit of sulfur delivered to United States ports. Sources in the industry estimate that Spanish pyrite delivered to the east coast of the United States was valued during the past year for its sulfur content at approximately 15 cents per unit.

FOREIGN TRADE

The United States has no export trade in pyrites but imports substantial tonnages to the east coast consuming areas. The quantity, however, has declined greatly from the totals common before the War. Canada is now our principal source of foreign pyrites, a position held formerly by Spain. Imports from both Canada and Spain declined in 1948, and the total was 15 percent lower than in 1947.

As shown in an accompanying table, nearly all pyrites entered through the Buffalo and Philadelphia custom districts.

883326—50——76

Pyrites, containing more than 25 percent sulfur, imported for consumption in the United States, 1944–48, by countries

[U. S. Department of Commerce]

Country	1944		1945		1946		1947		1948	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Canada	166,575	$302,747	137,238	$276,832	121,807	$269,179	85,094	$266,698	75,248	$169,551
Mexico	--------	--------	57	160	--------	--------	--------	--------	--------	--------
Norway	--------	--------	1,150	1,725	--------	--------	--------	--------	--------	--------
Portugal	--------	--------	--------	--------	--------	--------	300	2,664	--------	--------
Spain	14,188	36,896	48,062	133,900	61,086	170,053	41,159	106,136	32,163	89,994
Total	180,763	339,643	186,507	412,617	182,893	439,232	126,553	375,498	107,411	259,545

Pyrites, containing more than 25 percent sulfur, imported for consumption in the United States, 1944–48, by customs districts, in long tons

[U. S. Department of Commerce]

Customs district	1944	1945	1946	1947	1948
Buffalo	134,955	127,765	121,807	36,610	66,385
Connecticut	--------	--------	--------	34	37
Galveston	--------	19	--------	--------	--------
Michigan	29,785	9,414	--------	--------	--------
New York	--------	--------	--------	300	--------
Ohio	1	5	--------	--------	--------
Philadelphia	14,188	49,212	61,086	89,609	40,989
San Diego	--------	38	--------	--------	--------
Washington	1,834	54	--------	--------	--------
Total	180,763	186,507	182,893	126,553	107,411

WORLD REVIEW

Pyrites deposits of commercial size have world-wide distribution; and in many important industrial countries, particularly in Europe, pyrites constitute the major source of sulfur. World production statistics for recent years are shown in the accompanying table.

From the incomplete information available, it is estimated that total world output of pyrites in 1948 increased to approximately 9,000,000 metric tons.

Australia.—Plans for the erection of sulfuric acid plants by the Zinc Corp., New Broken Hill Consolidated, and Imperial Smelting Corp. have been announced.[9]

It is reported that about £A 1,500,000 will be spent in an attempt to develop the use of some 3,000,000 tons of pyrites at Mount Morgan mines for the production of sulfuric acid.[10]

Canada.—Two major Canadian companies are showing active interest in the sulfur business. The International Nickel Co. of Canada, Ltd., proposes to recover liquid sulfur dioxide as a byproduct of its smelter operations, and Noranda Mines, Ltd., carried on plant-

[9] Chemistry and Industry (London), No. 6, Feb. 7, 1948, p. 95.

[10] South African Mining and Engineering Journal, Australian Pyrites Plan: Vol. 59, Part 1, No. 2892, July 17, 1948, p. 596.

World production of pyrites (including cupreous pyrites), by countries,[1] 1938 and 1945–48, in metric tons

[Compiled by Pauline Roberts]

Country [1]	1938		1945		1946		1947		1948	
	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	29, 280	[2] 11, 900	40, 360	16, 505	35, 295	14, 471	35, 900	15, 078
Australia:										
New South Wales	----	----	(3)	(3)	14, 439	6, 930	22, 353	10, 729	(3)	(3)
Tasmania	51, 084	25, 300	40, 813	20, 000	37, 893	18, 570	52, 351	26, 175	44, 973	22, 217
Western Australia	(3)	(3)	67, 571	(3)	79, 032	(3)	45, 049	19, 314	38, 102	15, 981
Austria	(3)	(3)	2, 180	800	3, 823	1, 332	6, 129	2, 047	7, 871	2, 942
Brazil	----	----	(3)	(3)	(3)	(3)	3, 600	(3)	3, 600	(3)
Canada	40, 464	20, 300	206, 586	99, 974	183, 191	87, 577	161, 718	79, 502	166, 985	79, 039
China	(3)	(3)	(3)	(3)	(3)	(3)	64, 876	29, 200	42, 907	19, 300
Cyprus (exports)	523, 574	256, 551	101, 681	48, 807	260, 314	119, 744	358, 611	175, 719	375, 862	180, 414
Czechoslovakia	(3)	(3)	533	192	7, 999	2, 880	6, 002	[2] 2, 200	3, 195	[2] 1, 200
Finland	102, 979	44, 281	110, 320	48, 541	126, 310	55, 627	152, 268	[2] 67, 000	(3)	(3)
France	147, 850	67, 005	168, 145	67, 765	218, 510	86, 597	196, 180	[2] 78, 500	179, 000	[2] 68, 000
Germany	465, 241	176, 191	[4] 73, 000	(3)	238, 700	[2] 85, 000	[5] 321, 000	[5] 128, 400	[5] 383, 100	[5] 153, 245
Greece	244, 000	118, 605	6, 510	3, 125	80, 140	38, 467	58, 525	28, 100	16, 236	[2] 7, 800
Italy	930, 312	386, 079	108, 342	47, 335	400, 519	[2] 184, 300	628, 799	[2] 283, 900	[2] 753, 650	[2] 346, 700
Japan	[6] 2, 122, 128	[6] 912, 515	[6] 118, 750	[6] 51, 063	474, 842	204, 182	832, 845	349, 795	1, 138, 000	489, 340
Korea	132, 614	53, 146	62, 064	[2] 24, 800	(3)	(3)	(3)	(3)	(3)	(3)
Norway	1, 027, 776	446, 939	247, 465	106, 369	539, 850	232, 710	720, 015	310, 079	735, 422	(3)
Poland	92, 209	36, 883	(3)	(3)	28, 253	[2] 11, 300	39, 659	[2] 15, 900	(3)	(3)
Portugal	558, 327	251, 250	170, 967	[2] 76, 900	314, 976	[2] 141, 740	390, 224	[2] 163, 900	556, 135	[2] 233, 600
Rumania	[2] 80, 900	(3)	(3)	(3)	4, 873	(3)	(3)	(3)	(3)	(3)
Southern Rhodesia	27, 065	10, 900	33, 465	[2] 13, 390	25, 413	[2] 10, 160	17, 144	[2] 7, 115	13, 224	[2] 5, 500
Spain	2, 727, 003	[2] 1, 145, 341	899, 760	[2] 377, 900	1, 175, 976	[2] 493, 910	1, 010, 982	[2] 428, 300	1, 110, 724	[2] 469, 200
Sweden	186, 390	84, 345	261, 984	131, 096	280, 208	136, 781	310, 571	147, 602	(3)	(3)
Tunisia	(3)	(3)	460	200	2, 775	1, 275	6, 340	[2] 2, 800	3, 215	[2] 1, 400
Turkey	(3)	(3)	----	----	300	(3)	5, 000	(3)	(3)	(3)
Union of South Africa	31, 017	13, 947	38, 556	16, 745	38, 044	16, 553	34, 820	15, 166	35, 992	15, 456
U. S. S. R.	[2] 600, 000	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
United Kingdom	4, 351	(3)	23, 439	(3)	20, 959	(3)	10, 106	(3)	(3)	(3)
United States	564, 547	222, 612	734, 194	301, 000	826, 427	342, 967	955, 749	398, 975	943, 434	394, 583
Uruguay	70	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Yugoslavia	150, 402	67, 681	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Total [7]	11, 000, 000	4, 700, 000	5, 500, 000	2, 300, 000	7, 000, 000	3, 000, 000	8, 500, 000	3, 500, 000	9, 000, 000	3, 800, 000

[1] In addition to countries listed, Belgium, Egypt, Hungary, India, Iran, and Ireland produce or have produced pyrites, but production data are not available; estimates by senior author of chapter included in total.
[2] Estimate.
[3] Data not available; estimate by senior author of chapter included in total.
[4] British zone only.
[5] Bizonal area.
[6] Preliminary data for fiscal year ended Mar. 31 of year following that stated.
[7] Estimated by senior author of chapter.

scale tests of a method of recovering elemental sulfur from pyrites. If successful, these sources are capable of eventually making Canada self-sufficient in sulfur.[11]

Finland.—Sulfur for Finland's domestic consumption is obtained as a flotation pyrite byproduct of the copper-zinc ore from the Outokumpu field. Recovery commonly exceeds 100,000 tons a year.[12]

France.—The three principal deposits of pyrites in France are said to be at Saint-Bel, near Lyons, Chizeuil in Saone-et-Loire, and Soulier at Ales Aubenas and Privas. French industry is said to be hampered by lack of sulfur minerals. Its domestic sources of sulfur and pyrites are too small to supply the need and some interest has been shown in byproduct sulfur from coal and in gypsum.[13]

Germany.—It was reported that production of pyrites in the British and American zones of Germany was to be increased to about 360,000 tons per year, which compares with an estimated requirement of 930,000.[14] Apparently this production goal was attained in 1948. During the war the Meggan mine in the British zone produced as much as a million tons of pyrite per year.

An electrolytic method of recovering zinc from pyrite cinders has been used in Germany. The process simultaneously produces free chlorine.[15]

Greece.—In 1947 the Kassandra mine supplied 47,264 tons of pyrite and the Ermioni mine 11,261 tons. Exports totaled 20,416 metric tons, valued at £2.0.8 per ton.[16]

Rumania.—A decline in pyrite production in Rumania is indicated by a report that the first-quarter output in 1948 totaled 4,012 tons as compared with 12,363 in the first quarter of 1947.[17]

Spain.—The export trade of the Spanish pyrites industry improved in 1948. Exports went chiefly to Belgium, Bizonal Germany, Netherlands, and the United Kingdom.

Resumption of shipments of Spanish pyrites to France in exchange for phosphates was reported.[18]

Spanish pyrites appears to have some price advantage in the European market as one trade report indicated the Spanish price to be 40 shillings per ton as compared to 70–80 shillings for Italian.[19]

Production of pyrites has been limited by want of replacement parts, oil, and general supplies needed for operations.

Union of South Africa.—Although some domestic pyrites are used in manufacturing sulfuric acid in South Africa, the country still depends in part upon imported sulfur. To improve their techniques and increase the degree of self-sufficiency, investigations were in progress of methods of flash-roasting pyrites.[20]

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[11] The Northern Miner (Toronto), Broadening Market for Mines Output: Vol. 34, No. 11, June 3, 1948, pp. 1–3.
[12] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 4, April 1948, p. 46.
[13] Chemical and Engineering News, French Sulfur Supplies: Vol. 26, No. 1, Jan. 5, 1948, p. 61.
[14] Chemical Age (London), vol. 59, No. 1514, July 17, 1948, p. 97.
[15] Mining Journal (London), Pure Zinc from Pyrites Cinders: Vol. 230, No. 5868, Feb. 7, 1948, p. 101.
[16] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 5, May 1948, p. 47.
[17] Oil, Paint and Drug Reporter, vol. 154, No. 18, Nov. 1, 1948, p. 65.
[18] Chemical Age (London), vol. 58, No. 1497, Mar. 20, 1948, p. 413.
[19] Mining World, vol. 10, No. 6, May 1948, p. 23.
[20] Mining and Industrial Magazine of South Africa, vol. 38, No. 6, June 1948, pp. 357, 359.

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 1948, 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 slightly higher in quantity in 1948 than in 1947, and considerably higher in value. Exports of "talc, steatite, soapstone, and pyrophyllite, crude and ground" decreased slightly in quantity and increased slightly in value; but the exports of "powders—talcum (in packages), face, and compact" were cut sharply in value, dropping from $4,681,964 in 1947 to $2,661,132 in 1948.

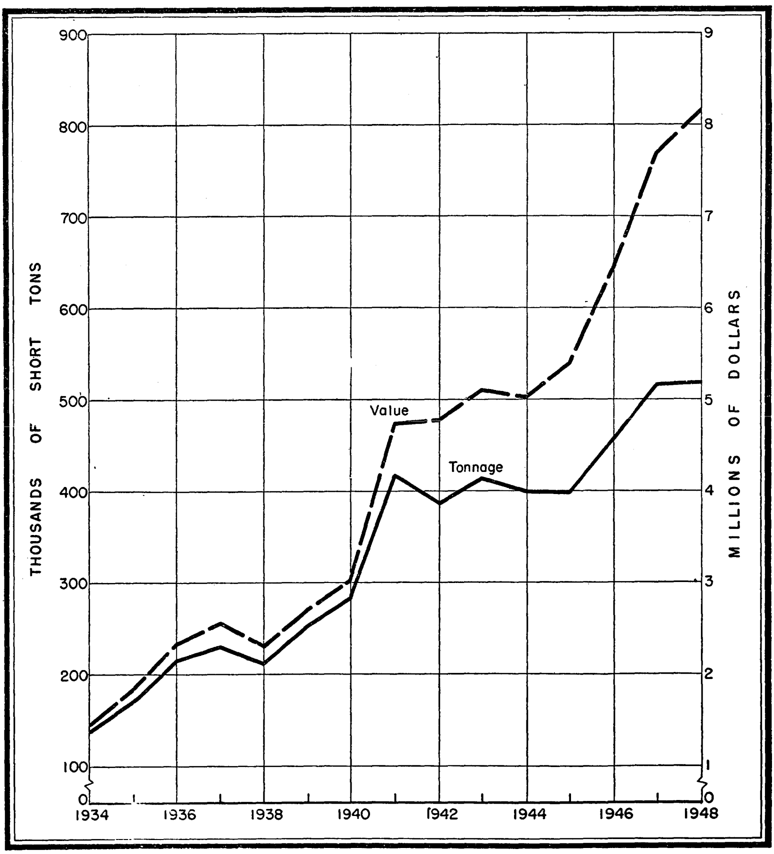

FIGURE 1.—Sales of domestic talc, pyrophyllite, and ground soapstone, 1934–48.

[1] Including data on ground soapstone.

Salient statistics of the talc, pyrophyllite, and ground-soapstone industries in the United States, 1947–48

	1947		1948	
	Short tons	Value	Short tons	Value
Mined [1]	516,453	(2)	528,543	(2)
Used by producers	470,478	(2)	481,424	(2)
Sold by producers:				
Crude [1]	47,925	$389,535	49,124	$408,186
Sawed and manufactured	1,018	239,407	920	227,963
Ground	467,151	7,053,539	468,702	7,629,214
Total sales	516,094	7,682,481	518,746	8,265,363
Imports for consumption: [3]				
Crude and unground steatite and French chalk	48	1,962	85	4,835
Cut and sawed	27	8,235	98	29,133
Ground, washed, or pulverized	17,629	414,726	18,194	484,857
Total imports	17,704	424,923	18,377	518,825
Exports:				
Talc, steatite, soapstone, and pyrophyllite, crude and ground	17,557	429,803	16,327	432,176
Powders—talcum (in packages), face, and compact	(2)	4,252,161	(2)	2,228,956
Total exports	----------	4,681,964	----------	2,661,132

[1] Includes pinite.
[2] Figure not available.
[3] Exclusive of "Manufactures, n. s. p. f., except toilet preparations," as follows: 1947: $13,525; 1948: $14,772. Quantities not available.

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, given before the 1947 chapter in footnotes to various tables, are shown in tabular form in the 1947 and the 1948 talc chapters.

Eleven States reported sales of talc, pyrophyllite, or ground soapstone in 1948. The greater part of the total sales was made in the Eastern States.

Pyrophyllite recently discovered (1947) in the South Mountain area of Pennsylvania has been described in recent articles.[2] The deposit is at Gargol in Adams County on the eastern flank of the broad South Mountain uplift in pre-Cambrian volcanic rocks (aporhyolites), exposed at the surface by erosion cutting into the core of the South Mountain anticline. The deposit appears to strike northeasterly for at least 450 feet and to dip steeply southeast. It is at least 75 feet wide. The deposit appears to have been formed through the replacement of the acid volcanic rocks by hot ascending waters. Diamond drilling is being carried on to appraise the volume and quality of the pyrophyllite deposit. Preliminary tests have proved that

[2] Stephenson, R. C., Occurrence of Pyrophyllite in Adams County, Pennsylvania: Paper read at Am. Inst. Min. and Met. Eng. meeting in New York, Feb. 15–19, 1948; abs. in Rock Products, vol. 51, No. 4, April 1948, p. 144.
Stephenson, R. C., Pyrophyllite Discovery Adds New Mineral Resource: Pennsylvania Dept. of Internal Affairs Bull., Harrisburg, Pa., vol. 16, No. 3, February 1948, pp. 3–5.

material from the Gargol deposit is comparable to North Carolina pyrophyllite. The large areal extent of the aporhyolite rocks of the South Mountain region suggest that there may be additional pyrophyllite reserves of possible commercial value.

Maps of the Watertown talc mine, Moretown, Vt., were released, as Strategic Minerals Investigations Preliminary Maps 3–225, by the Geological Survey in September 1948. These maps, resulting from surveys in 1944 and 1945, include a geologic surface map, underground maps, and structure sections.

A description of steatite-grade talc deposits in California was published early in 1948.[3] Steatite is known to occur in California in many places, especially in Inyo County. Studies of the deposits showed that steatite is not invariably formed by the hydrothermal alteration of dolomite, although this applies to the Talc City deposit. Some other steatite deposits have resulted from hydrothermal alteration of a silica rock resembling quartzite. Talc samples have been obtained from occurrences in altered granite, altered andesite, altered limestone, and altered phyllite.

A brief illustrated description[4] of the Gerhardt pyrophyllite deposit, about 4 miles west of Staley, Randolph County, N. C., appeared late in 1948. The original 200-foot-high pyrophyllite knob has been mined away on one side. The open pit at the base of the cliff is reached by a deeply cut and tunneled road. The pyrophyllite occurs as massive, as flake, and as very fine radiating fibrous masses, usually white to buff, but in places green or stained brown or red by iron oxides.

PRODUCTION AND SALES

The quantity of domestic talc, pyrophyllite, and ground soapstone sold or used in 1948 was slightly greater than in 1947, according to reports of the producers to the Bureau of Mines. This output—518,746 short tons—was a new record. The total value of $8,265,363 was over one-half million dollars greater than in 1947 and again reached an all-time high. The average value per ton rose from $14.89 in 1947 to $15.93, an increase of over $1 per ton.

Talc, pyrophyllite,[1] and ground soapstone sold by producers in the United States, 1944–48, by classes

Year	Crude [1]			Sawed and manufactured		
	Short tons	Value at shipping point		Short tons	Value at shipping point	
		Total	Average		Total	Average
1944	45,654	$514,476	$11.27	938	$223,924	$238.72
1945	35,979	367,488	10.21	733	182,904	249.53
1946	36,963	348,484	9.43	756	227,751	301.26
1947	47,925	389,535	8.13	1,018	239,407	235.17
1948	49,124	408,186	8.31	920	227,963	247.79

See footnote at end of table.

[3] Page, B. M., Some California Talc Deposits of Steatite Grade: Min. and Ind. News, vol. 16, No. 1, January 1948, pp. 12–13.

[4] King, C. H., The Gerhardt Pyrophyllite Deposit: Rocks and Minerals, vol. 23, Nos. 9–10, September–October 1948, pp. 800–801.

Talc, pyrophyllite,[1] and ground soapstone sold by producers in the United States, 1944–48, by classes—Continued

Year	Ground			Total		
	Short tons	Value at shipping point		Short tons	Value at shipping point	
		Total	Average		Total	Average
1944	352,271	$4,279,062	$12.15	398,863	$5,017,462	$12.58
1945	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
1947	467,151	7,053,539	15.10	516,094	7,682,481	14.89
1948	468,702	7,629,214	16.28	518,746	8,265,363	15.93

[1] Includes pinite; no sales in 1945–46.

Pyrophyllite[1] produced and sold by producers in the United States, 1944–48

Year	Production (short tons)	Sales					
		Crude		Ground		Total	
		Short tons	Value	Short tons	Value	Short tons	Value
1944	67,252	5,683	$52,343	60,560	$504,739	66,243	$557,082
1945	77,716	6,215	38,166	71,379	613,034	77,594	651,200
1946	97,765	10,716	85,002	85,835	913,301	96,551	998,303
1947	108,450	6,204	27,626	97,536	1,135,100	103,740	1,162,726
1948	107,885	5,175	25,766	102,152	1,313,266	107,327	1,339,032

[1] Exclusive of pinite.

Sales by States.—In 1948 New York was still the leading producing State by a considerable margin, with North Carolina in second place and California third. Sales of each of these leading States and Georgia reached new levels. Sales of pyrophyllite, most of which comes from North Carolina, increased in 1948.

Talc, pyrophyllite, and ground soapstone, sold by producers in the United States, 1947–48, by States

State	1947		1948	
	Short tons	Value	Short tons	Value
California	91,537	$1,595,422	98,681	$1,773,764
Georgia	49,441	673,251	53,602	624,694
Maryland, Pennsylvania, and Virginia	47,111	401,599	[1] 40,276	[1] 341,875
Nevada [2]	9,767	175,489	8,019	107,730
New York	(3)	(3)	119,716	2,613,935
North Carolina	97,484	1,186,463	104,052	1,455,691
Vermont	77,327	999,704	70,922	1,014,718
Other States [4]	143,427	2,650,553	23,478	332,956
Total	516,094	7,682,481	518,746	8,265,363

[1] Pennsylvania reported no sales in 1948.
[2] Includes pinite.
[3] Included with "Other States"; Bureau of Mines not at liberty to publish figure.
[4] Montana, New York (1947 only), Texas, and Washington.

CONSUMPTION AND USES

Five industries—paint, ceramics, rubber, insecticides, and roofing—consumed 80 percent of the sales of domestically produced talc, pyrophyllite, and ground soapstone in 1948, according to reports from the producers. Increases were reported in the ceramics, insecticides, and paper industries. The paint industry was the leading consumer by a narrow margin—ceramic use was almost as great. Each took 21 percent of the total. The insecticides, rubber, and roofing industries were in close competition for third place.

Talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1947–48, by uses [1]

Use	1947		1948	
	Short tons	Percent of total	Short tons	Percent of total
Paint	112,101	22	108,505	21
Ceramics	94,755	18	107,907	21
Rubber	71,840	14	66,226	13
Insecticides	66,952	13	72,740	14
Roofing	63,545	12	54,990	11
Paper	31,772	6	32,430	6
Toilet preparations	13,147	3	7,431	1
Foundry facings	7,496	1	6,764	1
Crayons	603	(2)	400	(2)
Other uses [3]	36,120	7	37,995	7
Unclassified	17,763	4	23,358	5
Total	516,094	100	518,746	100

[1] Partly estimated. Includes pinite.
[2] Less than 0.5 percent.
[3] Refractory, textile, asphalt filler, plaster, plastics, and miscellaneous other uses.

PRICES

Prices of ground talc per ton, carlots, bags, f. o. b. works, quoted by the Oil, Paint and Drug Reporter showed little change throughout 1948. These prices for weeks near the beginning, midyear, and end of the year are shown in the following table.

Ground talc prices in 1948, carlots, bags, tons

[Oil, Paint and Drug Reporter]

Class	Jan. 5	May 31	Dec. 27
Domestic, f. o. b. works:			
Ordinary:			
California	$22.00–$30.00	$22.00–$30.00	$22.00–$30.00
New York	21.00	21.00	21.00
Vermont	14.00	14.00	14.00
Fibrous (New York):			
Off color	24.00	24.00	24.00
325 mesh:			
88.95–99.95 percent	21.00	21.00	21.00
98–99.5 percent	25.00	23.00–28.00	23.00–28.00
Imported (Canadian)	35.00–45.00	35.00–45.00	35.00–45.00

Prices for pyrophyllite, bulk, carlots, mines, according to Oil, Paint and Drug Reporter, remained as follows throughout the year:

Standard:	
200 mesh	$11.00–$11.50
230 mesh	12.00
325 mesh	14.00
No. 3: 200 mesh	9.50
Insecticite grade: 200 mesh	9.00–10.00
Rubber grade: 140 mesh	7.00

FOREIGN TRADE [5]

Imports.—Increases occurred in 1948 over 1947 in both total quantity and value of "Talc, steatite or soapstone, and French chalk" imported for consumption in the United States—673 tons in quantity and $93,902 in value. As usual by far the greater part of the imports was the "ground, washed, powdered, or pulverized" material. The value of the imports of "Manufactures, n. s. p. f. except toilet preparations" increased in 1948 a little more than $1,000 over 1947; the greater part of this material came from China. Italy was the principal source of the ground material, with Canada in second place and France third. (See fig. 2.)

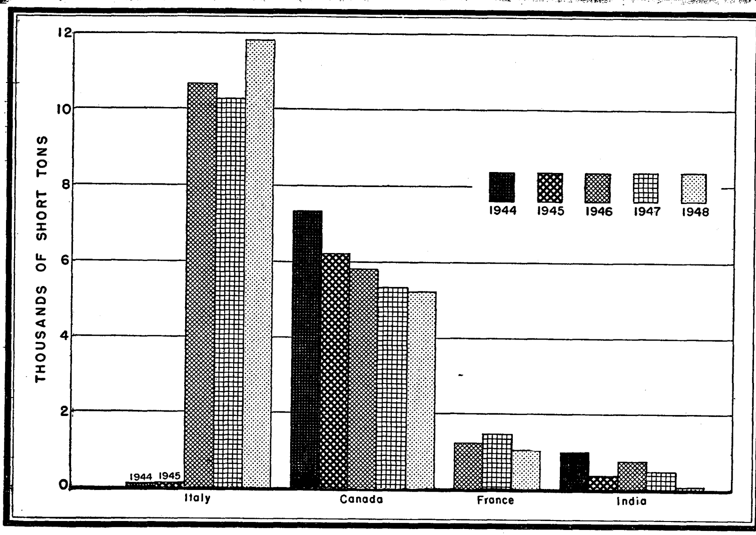

FIGURE 2.—Talc, steatite or soapstone, and French chalk imported for consumption in the United States, 1944–48, by principal countries.

Talc, steatite or soapstone, and French chalk imported for consumption in the United States, by classes, 1944–48

[U. S. Department of Commerce]

Year	Crude and unground		Ground, washed, powdered, or pulverized, except toilet preparations		Cut and sawed		Total unmanufactured		Manufactures, n. s. p. f. except toilet preparations (value)
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	
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
1947	48	1,962	17,629	414,726	27	8,235	17,704	424,923	13,525
1948	85	4,835	18,194	484,857	98	29,133	18,377	518,825	14,772

[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.

Talc, steatite or soapstone, and French chalk imported for consumption in the United States, by classes and by countries, 1947–48

[U. S. Department of Commerce]

Country	Crude and unground		Ground, washed, powdered, or pulverized except toilet preparations		Cut and sawed		Total unmanufactured		Manufactures, n. s. p. f. except toilet preparations (value)
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	
1947									
Belgium-Luxembourg	--------	--------	101	$1,364	--------	--------	101	$1,364	--------
Canada	30	$285	5,261	59,168	3	$624	5,294	60,077	--------
China	--------	--------	(1)	334	--------	--------	(1)	334	$13,515
Egypt	3	170	--------	--------	--------	--------	3	170	--------
France	--------	--------	1,500	32,545	3	713	1,503	33,258	--------
Hong Kong	--------	--------	--------	--------	--------	--------	--------	--------	9
India	11	1,336	480	13,352	--------	--------	491	14,688	--------
Italy	--------	--------	10,287	307,963	21	6,898	10,308	314,861	--------
Union of South Africa	4	171	--------	--------	--------	--------	4	171	--------
United Kingdom	--------	--------	--------	--------	--------	--------	--------	--------	1
Total	48	1,962	17,629	414,726	27	8,235	17,704	424,923	13,525
1948									
Belgium-Luxembourg	--------	--------	98	1,365	--------	--------	98	1,365	--------
Canada	45	518	5,165	64,030	4	168	5,214	64,716	23
China	--------	--------	--------	--------	--------	--------	--------	--------	13,674
Egypt	4	327	--------	--------	--------	--------	4	327	--------
France	(1)	5	1,146	19,345	5	1,225	1,151	20,575	999
Hong Kong	--------	--------	--------	--------	--------	--------	--------	--------	47
India	28	3,447	53	1,441	--------	--------	81	4,888	3
Italy	--------	--------	11,732	398,676	89	27,740	11,821	426,416	--------
Panama, Republic of	--------	--------	--------	--------	--------	--------	--------	--------	8
Switzerland	2	247	--------	--------	--------	--------	2	247	--------
Union of South Africa	6	291	--------	--------	--------	--------	6	291	--------
United Kingdom	--------	--------	--------	--------	--------	--------	--------	--------	18
Total	85	4,835	18,194	484,857	98	29,133	18,377	518,825	14,772

[1] Less than 1 ton.

Exports.—The quantity of "Talc, steatite, soapstone, and pyrophyllite, crude and ground" exported from the United States in 1948 dropped over 1,000 tons from the 1947 record. The value of these exports increased, however, over $2,000 to $432,176, a new record. The value of the exports of "Powders—talcum (in packages), face and compact" decreased about 2 million dollars, nearly half of the 1947 value.

Talc, pyrophyllite, and talcum powders exported from the United States, 1944–48

[U. S. Department of Commerce]

Year	Talc, steatite, soapstone, and pyrophyllite, crude and ground		Powders—talcum (in packages), face and compact (value)
	Short tons	Value	
1944	10,709	$229,293	$1,328,890
1945	11,314	280,590	2,276,758
1946	16,373	394,799	3,517,827
1947	[1] 17,557	[1] 429,803	4,252,161
1948	16,327	432,176	2,228,956

[1] Excludes 599 short tons, valued at $30,589, sent to Japan under the Army Civilian Supply Program.

Tariff.—The import duties on talc—both those set by the act of 1930 and those which became effective in 1948 are given in the following table.

United States import duties on talc

Description	Act of 1930	Modified rate in effect June 15, 1948
Talc, steatite or soapstone, and French chalk:		
Crude and unground	¼ cent per pound	⅛ cent per pound.
Ground, washed, powdered, or pulverized (except toilet preparations):		
French chalk	35 percent ad valorem	35 percent ad valorem.
Other:		
Valued at not more than $14 per ton	do	10 percent ad valorem.
Valued at more than $14 per ton	do	35 percent ad valorem.
Cut or sawed, or in blanks, crayons, cubes, disks, or other forms	1 cent per pound	1 cent per pound.
Manufactures (except toilet preparations) of which talc, steatite, or soapstone, or French chalk is the component material of chief value, wholly or partly finished and n. s. p. f.:		
If not decorated	35 percent ad valorem	17½ percent ad valorem.
If decorated	45 percent ad valorem	22½ percent ad valorem.

Importers of high-grade talc valued at more than $14 a ton asked late in 1948 that tariffs on this product be removed because they report that it does not compete with any domestic product. The chief supplier of high-grade talc to this country is said to be Italy; it is stated that 95 percent of all the Italian talc imported is used for the production of cosmetics and baby powder, and the remaining 5 percent is reported to be used in the rubber-thread industry, where no substitute has been found for the unique "slip" of Italian talc.[6]

TECHNOLOGY

Numerous articles on the technology of talc have been published recently.[7]

[6] Oil, Paint and Drug Reporter, Talc Importers Ask Reduction: Vol. 154, No. 24, Dec. 13, 1948, p. 61.
[7] Brunetti, Cledo, and Curtis, R. W., Printed Circuit Techniques: Nat. Bureau of Standards Circ. 48. 1948, 43 pp.
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Hausner, H. H., and Gunzenhauser, A., Steatite Becomes a Major Ceramic with a Big Future: Ceram. Ind., vol. 51, No. 1, July 1948, pp. 76–77, 79, 83; vol. 51, No. 2, August 1948, pp. 74–76; vol. 51, No. 3, September 1948, pp. 90–91.

WORLD REVIEW

The production of talc, pyrophyllite, and ground soapstone in various countries in recent years is shown in the accompanying table.

World production of talc, pyrophyllite, and soapstone, by countries, in metric tons, 1941–48 [1]

[Compiled by Pauline Roberts]

Country [1]	1941	1942	1943	1944	1945	1946	1947	1948
Argentina	1,975	4,770	3,557	3,421	2,681	3,760	(2)	(2)
Australia:								
New South Wales	1,153	1,454	1,814	1,874	1,776	1,665	1,181	(2)
South Australia	2,972	2,577	3,336	3,930	3,037	3,727	4,532	[3] 4,300
Tasmania	—	—	—	4	155	50	—	22
Western Australia	—	308	74	266	—	396	216	73
Austria	35,956	42,933	57,639	44,628	4,470	21,600	24,500	47,300
Canada	31,417	27,096	23,735	29,571	24,574	26,628	24,230	23,587
Chile	(2)	—	276	935	477	640	1,085	270
China	76,000	80,000	(2)	(2)	(2)	(2)	(2)	(2)
Egypt	5,229	1,875	2,054	4,265	3,868	4,760	4,630	5,521
Finland	(2)	(2)	(2)	(2)	75	300	(2)	(2)
France	64,188	50,150	48,300	26,720	40,650	63,350	73,116	(2)
Germany	12,170	13,526	(2)	(2)	6,300	13,800	[4] 20,484	[5] 28,214
Greece	—	—	—	—	—	500	[3] 500	1,800
India	26,571	45,327	16,700	21,735	22,872	96,220	19,857	(2)
Indochina, French	370	260	360	532	—	—	(2)	(2)
Italy	73,475	80,462	75,781	38,019	39,861	31,000	50,000	(2)
Japan	(2)	(2)	(2)	(2)	(2)	[3] 116,000	166,446	237,000
Kenya	(2)	(2)	(2)	123	202	490	297	322
Korea	(2)	4,121	(2)	41,211	(2)	[3 6] 300	[3 6] 700	(2)
Madagascar	(7)	(7)	39	(7)	—	—	(2)	(2)
Newfoundland	508	1,580	2,439	224	711	660	220	(2)
New Zealand	(2)	15	63	25	—	—	—	—
Norway	33,012	34,933	35,514	[8] 6,448	15,051	(2)	(2)	(2)
Rumania	3,347	3,052	1,609	(2)	(2)	267	(2)	(2)
Spain [9]	29,148	36,497	14,238	10,470	19,319	30,665	31,616	[10] 14,439
Sweden	5,233	6,153	5,335	5,512	7,806	8,851	9,796	(2)
Union of South Africa	2,458	1,985	5,344	2,875	1,947	3,680	2,700	4,897
United Kingdom	4,552	2,231	2,815	2,829	2,170	3,437	3,379	(2)
United States [11]	377,722	351,952	374,546	361,841	361,406	414,641	468,190	470,596
Uruguay	2,111	4,588	1,985	2,257	1,823	1,818	2,675	2,984
Total (estimate) [1]	840,000	850,000	790,000	720,000	660,000	910,000	980,000	1,070,000

[1] In addition to countries listed, talc or pyrophyllite is reported produced in Brazil, Bulgaria, French Morocco, Tanganyika, and U. S. S. R., but data on production are not available; no estimate included in total.
[2] Data not available; estimate by author of chapter included in total.
[3] Estimate.
[4] United States zone only.
[5] Bizonal area.
[6] South Korea only.
[7] Less than 1 ton.
[8] Excludes soapstone.
[9] Includes steatite as follows—1941: 18,948 tons; 1942: 24,859; 1943: 9,741; 1944: 7,369; 1945: 15,577; 1946: 19,541; 1947: 20,835; 1948: 14,439.
[10] Excludes talc.
[11] Talc, pyrophyllite, pinite, and ground soapstone sold by producers.

Canada.—The Canadian talc and soapstone industry in 1947 was described as follows: [8]

During 1947 the shipments of talc and soapstone by Canadian producers amounted to 26,709 tons valued at $266,377, compared with 29,353 tons worth $303,684 in 1946. The operators in Quebec shipped 13,279 tons of talc and soapstone worth $123,467, and mines in Ontario sold 13,430 tons, mostly high-grade milled talc, valued at $142,910.

[8] Deir, A. R., The Talc and Soapstone Industry in Canada, 1947: Canada Dept. Trade and Commerce, Dominion Bureau of Statistics, Mining, Metallurgical, and Chemical Statistics, Ottawa, Canada, 1948, 6 pp.

Imports of talc and soapstone in 1947 amounted to 8,472 tons valued at $196,-697, and the exports of talc totaled 5,807 tons worth $68,394.

The 5 operating firms employed 73 persons, to whom $110,527 were paid in salaries and wages. Fuel and electricity cost $22,786 and the expenditure for freight and process supplies amounted to $18,904.

The Bureau of Mines, Ottawa, has given the following information on the talc industry:

The Quebec talc and soapstone bodies occur in highly metamorphosed basic rocks, mainly serpentine and pyroxenite. The talcose material is rather high in iron due to the presence of residual chlorite, and there is often considerable carbonate present. It yields a slightly off-color, grey powder.

In Ontario, output of prime white foliated talc products from the Madoc area during the 41 years since operations were commenced is estimated at about 460,000 tons. Since 1937, Canada Talc, Limited, which operates the adjoining Conley and Henderson mines, now combined into a single operation, has been the only important producer. The company's new grinding mill, with a capacity of about 5 tons an hour of finished products, came into operation early in 1945. About 75 percent of the mill feed is from the Conley mine and 25 percent from the Henderson. Coarse rejects are screened and dedusted for the production of granular roofing grades.

The Madoc talc occurs in a series of closely spaced veins traversing white Grenville crystalline dolomite limestone, and varies from coarsely foliated, to massive compact material. Tests by the Bureau of Mines, Ottawa, several years ago, showed that the carbonate content can be reduced by flotation to below the tolerance demanded for even the most exacting uses, including steatite insulators, but no commercial use of beneficiation has been made.

In British Columbia, some ground soapstone for local roofing and building use is produced in Vancouver by George M. Richmond and Company, 4190 Blenheim Street, from waste imported from the State of Washington.

Domestic grey talc suitable for roofing, rubber, and paper use, sold in 1947 for $7.50 to $10 a short ton, according to fineness, similar talc from Vermont was quoted at $11.50 to $12.50 in bulk. White talc from Madoc, Ontario, continued to be quoted at from $8.50 for the coarser, roofing grade, $9.50 to $28 for finer mesh sizes, to $44 for minus 400-mesh material. New York fibrous talc, 325-mesh, sold for $18.50 to $20. Imported superfine Italian and French cosmetic talcs may cost as high as $80 per ton delivered.

Average value of the ground talc produced in Ontario in 1947 was $10.65 per ton, and of the ground material (comprising both talc and soapstone) supplied by Quebec, $8.34 per ton. Average value of sawn soapstone furnace blocks was $30 per ton, or $2.70 per cubic foot, and of talc crayons about $250 per ton, or $1.06 per gross. Soapstone waste for grinding sold for $2 per ton, f. o. b. mine. Average declared unit value of exports of ground talc was $11.60 per ton.

Under the new Multilateral Trade Agreement, effective January 1, 1948, the duty on ground talc exported to the United States was reduced from 17½ percent to 10 percent ad valorem on material valued at not over $14 a ton. On material valued at over $14 a ton, the duty remains at 35 percent. The duty on crude material is ¼ cent a pound,[9] whereas cut soapstone or talc in the form of bricks, crayons, blanks, etc., is dutiable at 1 cent a pound. Talc, ground or unground, enters Canada under the British Preferential tariff at 15 percent: imports from the United States are dutiable at 20 percent.

Additional statistical details are contained in the report as well as the names and addresses of the five operating firms in Ontario and Quebec.

[9] According to the U. S. Tariff Commission the modified rate on United States imports is now ⅛ cent a pound.

Tin

By SAMUEL A. GUSTAVSON AND JOHN B. UMHAU

GENERAL SUMMARY

WORLD mine output of tin increased 39,000 long tons (34 percent) in 1948 over 1947, a rate of increase exceeded only in 1936 and 1940. Most of this gain was in Malaya and Indonesia, where output expanded 66 and 92 percent, respectively. World smelter production increased 28,600 tons (23 percent), mostly due to the output of Malaya, which resumed its prewar rank as the world's leading producer. For the first time since 1943, world consumption, though still limited by Combined Tin Committee allocations and national controls, was exceeded by production. The International Tin Study Group met twice during 1948, continuing its investigation of means for stabilization of the tin industry through international cooperation as prescribed under the Havana Charter.

Consumption of tin in 1948 in the United States increased 3 percent over 1947; primary tin increased 1 percent and secondary 7 percent. The Government retained control of distribution and use of the domestic supply for the seventh consecutive year and fixed the price. Controls were retained in 1948 chiefly to minimize consumption, thereby providing a larger share of the new supply of tin for strategic stock-piling. Domestic primary smelter output, virtually all from the Government-owned smelter at Texas City, increased 10 percent. Secondary production was little changed in 1948 compared to 1947. On a tonnage basis pig-tin imports resumed the dominant position in the foreign tin trade of the United States in 1948 for the first time since 1941. Imports of metal nearly doubled and exceeded the tin content of concentrates by nearly a third. Receipts of concentrates in terms of metal were, nevertheless, 32 percent greater than in 1947. The increase was chiefly from Indonesia and from war-accumulated stocks in Thailand. Bolivian imports decreased 3 percent. Domestic stocks of pig tin and tin in ore and concentrates at the year's end were 99,870 long tons, a 19-percent increase over year-end stocks in 1947. Most of this increase was in Government stocks, while consumers' stocks remained virtually unchanged. The domestic price for grade A tin was $0.94 a pound until raised to $1.03 on June 1. The average price for grade A was $0.9925 in 1948, the highest on record.

Salient statistics of tin in the United States, 1939–43 (average) and 1944–48

	1939–43 (average)	1944	1945	1946	1947	1948
Production—						
From domestic mines......long tons..	30	5	----------	----------	1.3	5.8
From domestic smelters [1].......do....	8,177	30,884	40,475	43,500	33,300	36,703
From secondary sources........do....	32,180	29,100	31,400	24,700	26,800	26,900
Imports for consumption:						
Metal.............................do....	74,891	13,338	8,493	15,520	24,899	49,196
Ore (tin content)...............do....	16,592	35,548	[2] 33,479	[2] 38,138	[2] 28,365	37,492
Exports (domestic and foreign).....do....	1,608	843	882	881	420	91
Monthly price of Straits tin at New York:						
Highest............cents per pound..	55.08	[3] 52.00	[3] 52.00	70.00	94.00	103.00
Lowest.............................do....	49.14			[3] 52.00	70.00	94.00
Average............................do....	51.20			54.58	77.94	99.25
World mine production........long tons..	[2] 183,300	[2] 100,800	86,600	[2] 86,800	[2] 114,200	153,200

[1] Including tin content of ores used direct to make alloys.
[2] Revised figure.
[3] Ceiling price.

GOVERNMENT CONTROLS

Tin controls were continued during 1948 for the seventh consecutive year, mainly to permit the Government to hold consumption to a minimum and thereby promote strategic stock piling. Control was administered by the Office of Materials Distribution and Office of Domestic Commerce, United States Department of Commerce, under Conservation Orders M–43 (tin) and M–81 (cans) as embodied in the Second War Powers Act as amended.[1] An amendment to M–43 December 31, 1947, amplified restrictions on imports of tin and derivatives. Amendments to M–43, effective May 11, announced May 7, included stronger control of delivery, use, and small-order provisions, simplification of schedules, additional specifications to guide tin-plate manufacturers, revision of import-export provision to cover all forms of tin, and restriction of tin coating on general purpose crowns to 0.25 pound per base box whether for domestic or export use.

Manufacturers were not permitted to use more tin for cans in 1948 than in 1947 and were restricted on the type of cans for packaging certain products. Amendments to M–81 during 1948 were issued effective February 29, May 7, and May 18. The amendment of February 29 set forth in direction 10 was, in general, to effect savings in tin consumption to increase the quantity of metal available for stock piling and to improve distribution among and within the various groups of can users. The May 7 amendment incorporated provisions formerly contained in direction 10. The use of 0.25-pound electrolytic tin plate for cans containing soluble coffee and 2-pound and larger cans of regular coffee was permitted by the May 18 amendment.

On December 30, 1948, the Office of Domestic Commerce announced that the present tin-conservation program would continue essentially unchanged, with M–43 and M–81 in effect through June 30, 1949.

[1] The Second War Powers Act was amended by act of Feb. 28, 1948 (Public Law 427, 80th Cong.), and extended (90 days) until May 31, 1948, and again extended by act of June 4, 1948 (Public Law 606, 80th Cong.), made retroactive to June 1, to June 30, 1949.

Purchase of tin metal, ore, and concentrates and pricing were again centered in the Reconstruction Finance Corporation.[2] RFC also has authority to improve, develop, maintain, and operate by lease or otherwise the Government-owned tin smelter (Longhorn smelter) at Texas City, Tex., and to finance research in tin smelting and processing. The law requires RFC to submit semiannual reports.

DOMESTIC PRODUCTION

MINE OUTPUT

Domestic mine production of tin was only 5.8 long tons in 1948. Virtually the entire production was derived from placer deposits in Alaska. The Northern Tin Co. (formerly the Arctic Tin Co.) operating a placer on Buck Creek, Seward Peninsula, Alaska, reported treating 2,100 cubic yards of material from which 7.5 short tons of cassiterite concentrates, assaying about 70 percent tin, were recovered. Cleary Hill Mines Co. recovered a small quantity of tin in the course of gold placer mining at the Tofty placer, Hot Springs district, Yukon River Basin region, Alaska. About 3,000 pounds of tin concentrates were recovered from placer operations by Peggy Keenan on the Parrot claims in Pennington County, S. Dak. A small portable washing, screening, and jigging plant on the property has been treating gravel to recover tin, tungsten, gold, tantalum, and columbium. Early in 1948, about 2.5 tons of alluvial tin concentrates originating in Alaska were purchased by the Office of Metals Reserve. The year of production is not known, but this output has been credited to 1947. In the program for recovery of other minerals contained in ore mined chiefly for molybdenum at Climax, Colo., the Climax Molybdenum Corp. expects to obtain some tin. None was produced in 1948.

Reports of investigations made in previous years of the Morelock Creek and the Tozimoran Creek[3] tin placer deposits in the Fort Gibbon District, Alaska;[4] churn drilling at Cape Mountain tin placer deposits, Seward Peninsula, Alaska;[5] and sampling methods and results at the Sullivan Creek tin placer deposits, Manley Hot Springs, Tofty, Alaska,[6] were published by the Bureau of Mines during 1948.

The Bureau of Mines analyzed a selected group of trench and core samples from the outermost pegmatite zone of the old Mateen deposit[7] in the Black Hills, S. Dak., which were found to contain 0.05 percent or less of tin. Two additional core samples analyzed by the South Dakota State School of Mines and Technology showed 0.45 and 0.25 percent tin.

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[2] Public Law 125, 80th Cong., 61 Stat. 190 extended by amendment by Public Law 824, 80th Cong. (approved June 29, 1948) to June 30, 1951.

[3] Thomas, Bruce I., and Wright, W. S., Morelock Creek Tin Placer Deposits, Fort Gibbon District, Alaska: Bureau of Mines Rept. of Investigations 4322, 1948, 8 pp.

[4] Thomas, Bruce I., and Wright, W. S., Tozimoran Creek Tin Placer Deposits, Fort Gibbon District, Alaska: Bureau of Mines Rept. of Investigations 4323, 1948, 11 pp.

[5] Heide, Harold E., and Sanford, Robert S., Cape Mountain Tin Placer Deposits, Seward Peninsula, Alaska: Bureau of Mines Rept. of Investigations 4345, 1948, 14 pp.

[6] Thorne, Robert L., and Wright, W. S., Sullivan Creek Tin Placer Deposits, Manley Hot Springs, Tofty, Alaska: Bureau of Mines Rept. of Investigations 4346, 1948, 8 pp.

[7] Staff of the Minneapolis Branch, Mining Division, Investigation of the Mateen Spodumene Deposit, Pennington County, S. Dak.: Bureau of Mines Rept. of Investigations 4339, 1948, p. 17.

Mine production of tin (content) in the United States, 1944–48, by States, in long tons

Year	Alaska	South Dakota	Other States [1]	Total	
				Long tons	Value
1944		(2)	(2)	5.4	$6,200
1945–46					
1947	1.3			1.3	2,200
1948	[3] 5.8	(3)		5.8	12,780

[1] Comprises California, New Mexico, and North Carolina.
[2] Bureau of Mines not at liberty to publish separately.
[3] A very small quantity from South Dakota is included with Alaska.

SMELTER OUTPUT

Production of refined tin from ores and concentrates smelted in the United States was essentially that of the Government-owned smelter at Texas City. This smelter (Longhorn smelter) produced 36,678 long tons of tin in 1948 and 33,292 tons in 1947. As the result of experimenting on processes to recover tin from low-grade complex tin ores and concentrates, the Vulcan Detinning Co. recovered a small tonnage of tin metal. The company annual report for 1948 contains the following statement:

> During the year work was begun on the construction of a plant for the recovery of tin from low-grade tin concentrates by a novel method developed by our Research Department after years of experimentation as referred to several times in past reports. This plant is expected to have a minimum capacity of twenty-five to fifty tons of concentrates per day, depending on the grade, equivalent to five tons of metallic tin, and is designed so as to permit ready expansion by the addition of multiple units should results so warrant.
>
> The cost of this plant will be approximately $750,000.00 and working capital required to finance the purchase of supplies of concentrates and to carry the necessary inventories of tin will be considerable and are expected to employ most or all of the funds retained from past earnings.

During 1948 the Longhorn smelter treated concentrates chiefly from Bolivia, Indonesia, and Thailand. The tonnage treated from Indonesia tripled, while that from Bolivia decreased both in quantity and grade. RFC ore-purchase program discussions have included the possibility of obtaining concentrates from Malaya with Economic Cooperation Administration assistance. RFC has advised ECA that it will purchase up to 16,000 tons of tin contained in concentrates from Yunnan and Kwangsi Provinces in connection with the ECA China program. Part of the accumulated middling rejects have been treated by the smelter; and about 3,600 tons were shipped to the Capper Pass smelter, Hull, England, with the return to this country of the tin content in the form of high-grade electrolytic tin. Of the total tin produced at the Longhorn smelter in 1948, 62 percent was 3–Star grade; 8 percent, 2–Star–B; 16 percent, 2–Star–C; 7 percent 2–Star–D, and 7 percent, No–Star–G. In 1947 the percentages of total production of the various grades were, respectively, 58, 20, 13, 6, and 3.

The Longhorn smelter is operated on a cost-plus-fixed-fee agreement by Tin Processing Corp., a subsidiary of N. B. Billiton Maatschappij. The annual fixed fee during the fiscal year ended June 30, 1948, and

June 30, 1949, was $200,000. Before June 30, 1947, the annual fee was $150,000.

A contract for constructing a waste acid plant was let to the Chemical Construction Corp. on a cost-plus-fixed-fee basis. The estimated cost is $2,655,000. Actual plant construction was started during October 1948. Preparatory work—access roads, railway spurs, etc.—commenced earlier in the year. Progress on plant construction during 1948 was slow owing chiefly to delays in deliveries of machinery and materials, and completion was not expected until the latter part of 1949. Water consumption by industrial plants in the Texas City area has resulted in a marked lowering of the water table. Wells have shown much reduced capacity or have failed completely. The addition of the waste acid plant will bring an even more acute shortage in the water supply. To remedy this, the smelter began changing its piping system to permit reuse of water, and RFC plans to purchase from the Galveston County Water Co. enough water to make up any remaining shortage. The source of this additional water will probably be the Brazos River.

The total cost of the smelting program at Texas City from June 1940 through June 1948 amounted to $346,821,585, including fixed assets ($8,641,688) and the cost of concentrates ($311,433,293) at United States port. Total sales to June 30, 1948, amounted to $247,716,810. The June 30 inventory of tin was 18,797 long tons and 77,089 tons of concentrates containing an estimated 24,785 tons of tin.

Longhorn tin-smelter production, by months, 1942–48, in long tons

Month	1942	1943	1944	1945	1946	1947	1948
January		2,611	2,153	3,114	3,812	3,024	3,172
February		2,334	2,419	3,162	3,823	2,815	2,800
March		1,491	2,513	3,310	3,881	2,877	2,602
April	525	1,055	2,611	3,407	3,891	2,816	2,906
May	1,246	1,032	2,402	3,451	3,904	3,112	3,310
June	1,663	1,498	2,439	3,502	3,856	2,712	3,651
July	1,924	1,184	2,618	3,548	3,853	2,517	3,509
August	1,655	1,347	2,553	2,912	3,672	2,237	3,509
September	2,026	2,029	2,501	3,323	3,323	2,356	2,859
October	2,014	2,089	2,651	3,558	3,125	3,026	2,300
November	2,300	2,020	2,852	3,628	3,119	2,759	2,907
December	2,343	2,037	2,907	3,676	3,209	3,041	3,153
Total	15,696	20,727	30,619	40,591	43,468	33,292	36,678

SECONDARY TIN

Secondary tin recovered from all sources totaled 26,900 long tons in 1948, an increase of less than 0.5 percent over 1947. However, due to increase in price, the value was 28 percent greater than in 1947. Detinning plants supplied 12 percent of the total recovered during the year. To maintain comparability the quantities shown in the columns entitled "Tin recovered at detinning plants" in the accompanying table include that recovered from tin-plate clippings and old containers only. Detinning plants also recovered 113 long tons from other sources. During 1948 a 6-percent increase in tin recovered by detinning plants, a 30-percent increase in all types of babbitt, and a 17-percent increase in solder offset a 15-percent decrease in secondary tin in bronze and brass. The tonnage of tin-plate clippings treated in 1948 was the largest of record. The industry treated 376,620 long tons of tin-plate clippings in 1948—17 percent more than in 1947 and exceeding by 10 percent the previous peak of 341,075 tons used in 1941. The average quantity of tin recovered per long ton of tin-plate scrap used declined from 20.65 pounds in 1947 to 18.91 pounds in 1948. Lower recoveries per unit reflect the treatment of a larger tonnage of electrolytic tin plate carrying a much thinner coating of tin than hot-dipped tin plate. For additional data concerning the secondary tin industry, see Secondary Metals—Nonferrous chapter of this volume.

Secondary tin recovered in the United States, 1939–43 (average) and 1944–48, 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	Total: Value
1939–43 (average)	4,080	510	4,590	4,740	27,440	32,180	$36,973,844
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
1947	2,720	360	3,080	2,900	23,900	26,800	46,848,175
1948	2,930	340	3,270	3,100	23,800	26,900	59,796,140

CONSUMPTION

APPARENT CONSUMPTION

Apparent consumption, derived by adding net imports of pig tin to domestic smelter production, increased 49 percent in 1948 over 1947. As changes in consumer, dealer, and Government stocks are not taken into account, apparent consumption may vary greatly from actual consumption as measured in finished products. In 1948, it was considerably in excess of actual consumption chiefly as a result of stock piling by the Government. The accompanying table gives the data for 1939–48. A comparable series for 1910–38 was published in Minerals Yearbook, 1939 (p. 680).

Apparent consumption of tin, 1939–48, in long tons [1]

1939	67,997
1940	123,537
1941	141,618
1942	42,512
1943	31,638
1944	43,379
1945	48,086
1946	58,144
1947	57,771
1948	85,808

[1] Exports of domestic tin are not included in 1939–41. They are included in the figures for 1942–48 and are 244, 398, 405, 708, 859, 415, and 78, respectively.

CONSUMPTION BY USES

Total domestic consumption of tin was 3 percent more in 1948 than in 1947 and 17 percent above the 1935–39 average. Primary tin use increased only 1 percent, whereas secondary use increased 7 percent. The consumption of primary tin was 59,863 long tons, the greatest since the extraordinary peak of 1941 (103,086 tons), but was

4 percent less than the 1935–39 average. Consumption of secondary tin in 1948 was 30,925 tons.

The use pattern was virtually unchanged from 1947. The five largest tin-consuming items—tin plate and terneplate, bronze, solder, babbitt, and tinning—accounted for 93 percent of the total tin consumed in 1947 and 1948. Tin plate and terneplate used more than half the total primary tin consumed and 2 percent more than in 1947. This was about 470 tons (1 percent) less than in the prewar (1935–39) period, but tin and terneplate output was about 70 percent greater. The large increase in tin-plate output against a comparably small increase in the use of tin is chiefly due to the progressive increase in use of electrolytic tin plating, which requires less tin. In 1948, for the first time in history, electrolytic tin-plate production exceeded that of hot-dipped. Of the total tin plate produced in 1948, electrolytic lines accounted for 51 percent (48 percent in 1947) and hot-dipped operations accounted for 49 percent (52 percent in 1947). Hot-dipped tin plate has been used chiefly to make sanitary or packers' cans (57 percent in 1948), while about 90 percent of electrolytic has been divided between general line and sanitary cans and also a sizable tonnage for crowns and closures. In 1948, electrolytic tin plate used for sanitary cans increased more than 10 percent and amounted to about 40 percent of total tin plate used for that purpose. The demand for tin mill products for cans of all kinds increased 10 percent in 1948. The greatest proportion of all cans produced is for the food pack, which use increased 8 percent. Use for packing nonfood products increased 15 percent. Exports of tin cans increased 40 percent.

Use of primary tin for solder in 1948 was 6 percent greater than in 1947 and was exceeded only in 1941. Consumption in babbitt decreased for the fourth consecutive year and was 5 percent less in 1948 than in 1947. Bronze and brass again ranked third in use of virgin metal, but consumption was 13 percent less than in 1947.

Consumption of primary and secondary tin in the United States, 1939–43 (average) and 1944–48, in long tons

	1939–43 (average)	1944	1945	1946	1947	1948
Stocks on hand Jan. 1 [1]	44, 512	34, 735	27, 391	25, 789	27, 100	25, 743
Net receipts during year:						
Primary	71, 363	55, 323	54, 663	56, 603	59, 882	62, 119
Secondary	5, 364	2, 536	2, 623	2, 236	2, 836	3, 004
Terne	940	228	312	257	417	681
Scrap	23, 701	28, 883	28, 498	26, 057	26, 598	29, 840
Total receipts	101, 368	86, 970	86, 096	85, 153	89, 733	95, 644
Available	145, 880	121, 705	113, 487	110, 942	116, 833	121, 387
Stocks on hand Dec. 31 [1]	46, 407	27, 391	25, 789	27, 100	25, 743	27, 070
Total processed during year	99, 473	94, 314	87, 698	83, 842	91, 090	94, 317
Intercompany transactions in scrap	2, 590	3, 205	3, 239	2, 091	1, 957	2, 535
Total consumed in manufacturing	96, 883	91, 109	84, 459	81, 751	89, 133	91, 782
Plant losses	824	1, 140	876	808	1, 033	994
Tin content of manufactured products	96, 059	89, 969	83, 583	80, 943	88, 100	90, 788
Primary	68, 907	59, 156	55, 642	54, 627	59, 166	59, 863
Secondary	27, 152	30, 813	27, 941	26, 316	28, 934	30, 925

[1] Stocks shown exclude tin in transit or in other warehouses on Jan. 1, as follows: 1944, 316 tons; 1945, 1,941 tons; 1946, 1,600 tons; 1947, 1,000 tons; 1948, 940 tons; and 1949, 328 tons.

Consumption of tin in United States, 1946–48, by finished products, in long tons of contained tin

Product	1946			1947			1948		
	Primary	Secondary	Total	Primary	Secondary	Total	Primary	Secondary	Total
Tin plate	26,127		26,127	30,980		30,980	31,503		31,503
Terneplate	208	238	446	192	309	501	420	252	672
Solder	13.443	3,673	17,116	14,126	5,954	20,080	15,038	6,087	21,125
Babbitt	4,125	2,874	6,999	3,708	2,952	6,660	3,507	3,546	7,053
Bronze and brass	5,963	16,594	22,557	4,545	16,429	20,974	3,952	17,739	21,691
Collapsible tubes	701	88	789	853	91	944	600	39	639
Tinning	1,903	205	2,108	2,172	335	2,507	2,298	223	2,521
Foil	174	46	220	162	182	344	179	60	239
Pipe and tubing	273	64	337	408	83	491	257	66	323
Type and metal	123	1,865	1,988	130	1,457	1,587	129	1,787	1,916
Bar tin	891	78	969	881	65	946	916	132	1,048
Miscellaneous alloys	373	168	541	226	234	460	170	211	381
White metal	68	77	145	57	202	259	39	150	189
Chemicals and miscellaneous	255	346	601	726	641	1,367	855	633	1,488
Total	54,627	26,316	80,943	59,166	28,934	88,100	59,863	30,925	90,788

STOCKS

Stocks of pig tin and tin in ore were 99,870 long tons at the end of 1948, or 19 percent more than the 83,672 tons at the beginning of the year. In addition, about 12,400 tons (11,710 tons at beginning of year) were in process in scrap, and as secondary tin. Stocks of virgin pig tin held by consumers were virtually unchanged. Government stocks of pig tin increased 41 percent, but tin in ore declined 6 percent. The inventory of tin contained in low-grade rejects at the Texas City smelter was less than 6,600 tons. At the beginning of 1948, there were on hand about 38,000 tons of these rejects, containing over 8,000 tons of tin. Defense stocks held by the Navy and Bureau of Federal Supply were augmented by the transfer of 24,077 long tons, so that the National Strategic Stock Pile of pig tin was 36,217 long tons at the end of 1948.

Stocks of virgin pig tin in the United States, Dec. 31, 1944–48, in long tons [1]

	1944	1945	1946	1947	1948
At consumers' plants	17,337	14,102	14,532	13,677	14,349
At other warehouses and in transit	1,941	1,600	1,000	940	328
Held by jobbers	47	69	124	157	100
Total consumers' stocks	19,325	15,771	15,656	14,774	14,777
Afloat to United States (estimated)	1,800		1,570	6,220	25
Total stocks [1]	21,125	15,771	17,226	20,994	14,802

[1] Excludes Government purchases delivered for stock piling or at Texas City smelter. Also excludes tin in process and secondary pig tin.

PRICES

Tin prices continued to be set by Government acts in 1948. The price changed only once in the United States, when RFC announced a new price of $1.03 a pound for grade A tin on June 1. This was a 9-cent increase per pound over the previous price of 94 cents which had been in effect since December 19, 1947. The 1948 average price of 99.25 cents per pound was the highest of record and was 27 percent above the 1947 average of 77.94 cents. It was almost two-and-a-half times what it was before the war. The price of \$1.03, however, was exceeded in 1918, when the market reached \$1.10 a pound for a very short period. Brass and bronze ingot makers advanced their prices of ingots 1 cent a pound effective June 3, as a direct result of the price increase June 1.

On January 1, 1948, a new tin-plate price became effective at \$6.80 per base box, responding to the 94-cent pig-tin price of December 19, 1947. Some producers of tin plate reduced prices 10 cents on May 1, 1948. As a result of the increase in the tin price to \$1.03, the 1949 price per base box for 1.50-pound hot-dipped tin plate was raised to \$7.75 in December 1948. Higher tin prices were expected to accelerate the trend in the use of more electrolytic tin plate. Tin-can prices (No. 2 sanitary), stable since 1939, rose to \$21.63 per thousand, in carlots f. o. b. factory, January 2, 1947; to \$24.61 on January 2, 1948; and to \$27.29 on January 3, 1949.

Tin prices, 1925–29 (average), 1939–43 (average), and 1944–48

	1925–29 (average)	1939–43 (average)	1944	1945	1946	1947	1948
Average prices:							
New York: [1]							
Straits tin .... cents per pound..	56.64	51.20	[2] 52.00	[2] 52.00	[3] 54.58	77.94	99.25
99.75-percent tin (English refined) cents per pound..	(4)	49.97	[5] 51.625	[5] 51.625	[5] 54.208	77.512	98.692
99-percent tin ....do....	55.50	49.97	[6] 51.125	[6] 51.125	[6] 53.708	76.896	97.562
London: [7]							
Standard tin ....£ per long ton..	254.6	258.9	[8] 300.0	[8] 300.0	[9] 321.2	426.3	548.1
Do............cents [10] per pound..	55.17	46.97	54.04	[11] 54.04	57.83	77.66	98.64
Premium allowed over standard:							
Straits...........£ per long ton..	5.1	(4)	(4)	(4)	(4)	(4)	(4)
Banka......................do....	6.9	(4)	(4)	(4)	(4)	(4)	(4)
English.....................do....	−.7	(4)	(4)	(4)	(4)	(4)	(4)
Price indexes (1925–29 average=100):							
Straits tin (New York).............	100	91	92	92	96	138	175
Copper (New York)..................	100	78	80	80	93	143	150
Lead (New York)....................	100	78	87	87	109	196	241
Nonferrous metals [12]..............	100	84	87	87	100	142	159
All commodities [12]................	100	91	106	108	121	155	168

[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.

In the United Kingdom the price of common tin (99 percent minimum, up to and under 99.75 percent tin) was increased £9 to £519 per long ton on January 6, 1948; and £50 to £569 on June 1, 1948. The average price was £548 0s. 11d. in 1948. The January 6 price change resulted from settlement of the price under the United States-Bolivian contract. Coincident with the January increase, the official buying price for Nigerian tin concentrates was raised from £477 to £485 10s. per ton of tin-in-ore f. a. s. Nigerian port. The buying price for Malayan tin remained unchanged at £500, at that time. Effective April 7, 1948, however, the British Ministry of Supply announced that the Malayan buying price had been adjusted to £504 per ton and selling price to £505 10s. from £504, both ex smelter Penang and Singapore. The June increase followed discussions between a Malayan delegation, the Tin Study Group, the British Colonial Office, and the Ministry of Supply. With the June price increase, the price paid for Malayan metal was increased from £504 to £554 per ton; and for Nigerian concentrates from £485 10s. to £535 10s. The selling price of Malayan metal was raised from £505 10s. to £555 10s., thus reducing from £4 to 30s. per ton the differential between buying and selling price, seemingly to a great extent to resolve the dissatisfaction of producers.

In Canada, bulk purchasing of metal by the Government ceased in the fall of 1947, and price controls were suspended May 1948.

FOREIGN TRADE [8]

Imports of pig tin and ore and exports of tin plate are the main items in the foreign trade of the United States in tin. Of less importance has been the foreign trade in tin plate and terneplate scrap, circles, strips, waste-waste, miscellaneous tin and manufactures, and compounds. Tin contained in the babbitt, solder, type metal, and bronze imported and exported is accounted for in the Lead and Copper chapters of this volume. Exports of tin cans were 40,824 short tons in 1948 compared with 29,189 tons in 1947.

Tin has been one of the principal imports of the United States, ranking sixth in value among all commodities before the war (1935–39 average), and eighth in 1948. The relative position of tin in value among minerals imported (net imports) in 1948 was exceeded only by gold.

On a tonnage basis pig-tin imports resumed the dominant position in the foreign trade of the United States in tin in 1948 for the first time since 1941. Imports of metal increased 98 percent over 1947 and exceeded tin content of concentrates by 31 percent. Malaya, with nearly 70 percent of the total, was the principal source. Smelting plants in Belgium and the Netherlands shipped substantial quantities for the first time since 1940. Imports of tin in concentrates increased 32 percent as compared with 1947, mainly due to a large gain (217 percent) in receipts from Indonesia. Imports from Thailand, mostly from war-accumulated stocks, increased 37 percent. Bolivia, the main source, accounting for 54 percent of the total, furnished 3 percent less than in 1947. Bolivia has been the source of 73 percent of the tin in concentrates imported from 1941 to 1948, inclusive.

Since 1941 the United States has been the world's principal source of tin plate. In 1948, exports of tin plate, etc., decreased slightly (1 percent) from the high level attained in 1947. Tin-plate exports as such in 1948 were 539,945 long tons against the record high of 542,274 in 1947 and nearly 3 percent more than the previous high of 525,377 in 1942. In 1948 ground was lost in the export markets of Australia–New Zealand, Canada, and Latin America (chiefly Argentina, Brazil, and Mexico). A gain of 26 percent recorded in Europe was mostly accountable to ECA. In some instances the decline in exports was greater than the decline in consumption of tin plate in a

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

particular market. Consumption in Argentina declined 18 percent, but United States exports thereto declined 29 percent. Exports of tin plate from the United Kingdom to Argentina increased 37 percent in 1948. Significantly, consumption in Australia–New Zealand increased 10 percent, whereas United States exports thereto decreased more than a third, but shipments from the United Kingdom were nearly double the previous year's. The decline in exports to Canada exceeded Canada's decline in consumption.

According to the American Iron and Steel Institute, producers in 1948 shipped for export 601,697 short tons (565,817 in 1947) of tin plate, of which 508,474 (506,347 in 1947) were hot-dipped and 93,223 (59,470 in 1947) electrolytic.

Under the Second Decontrol Act, exports were controlled by fixed quotas and Office of International Trade, United States Department of Commerce, license, and import purchase of tin was exclusively by the Government. Shipments to Canada are exempt from export control. Tin ores and concentrates may be imported freely. The tinplate export-quota program was conducted with assistance of industry Tin Plate Advisory Committee. Quarterly tin-plate export allocations (excluding Canada) were 514,000 short tons in 1948.

Foreign trade of the United States in tin concentrates and tin, 1942–48

[U. S. Department of Commerce]

Year	Imports				Exports			
	Concentrates (tin content)		Bars, blocks, pigs, grain, or granulated		Ingots, pigs, bars, etc.			
					Domestic		Foreign	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
1942	28,933	[1] $32,454,284	26,753	$29,311,113	244	$290,804	165	$229,512
1943	21,857	[1] 24,954,251	11,919	13,081,756	398	464,053	1,372	1,567,043
1944	35,548	[1] 41,942,055	13,338	15,049,200	405	488,508	438	532,861
1945	33,479	[1] 44,795,893	8,493	9,213,425	708	890,661	174	223,623
1946	[1] 38,138	[1] 50,716,210	15,520	18,507,043	859	1,153,936	22	31,939
1947	[1] 28,365	[1] 42,576,966	24,899	42,684,651	415	650,162	5	9,887
1948	37,492	72,170,372	49,196	103,322,952	78	163,428	13	27,699

[1] Revised figure.

Concentrates (tin content) imported for consumption in the United States, 1941–48, by countries [1]

[U. S. Department of Commerce]

Country	1941		1942		1943		1944		1945		1946		1947		1948	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Algeria					8	$7,125										
Argentina	102	$107,021					60	$77,498								
Australia													2	$1,036		
Belgian Congo					4,094	4,511,588	7,549	9,368,309	7,401	$9,214,245	7,214	$8,981,430	379	631,060		
Bolivia	22,021	21,597,529	20,750	$23,157,000	17,351	20,005,703	27,701	32,160,861	25,936	35,376,704	28,588	38,994,032	20,984	30,654,538	20,288	$37,721,704
Brazil	(2)	5									7	9,821	1	2,493	2	3,365
British Equatorial Africa												259				
Cameroun, French			161	154,934	72	83,490	177	254,844	46	68,136	37	55,367				
Chile						198						6				
China		396													16	15,737
French Equatorial Africa					211	211,810			83	123,346	21	31,500				
French Africa, Other	179	174,362														
Indochina, French	7	6,000														
Indonesia	6,220	5,654,146	7,977	9,109,734							2,206	2,532,488	4,163	6,671,603	13,195	26,652,641
Mexico	114	105,911	45	32,616	121	134,337	61	80,543	13	13,462			5	5,982	36	12,331
Peru															79	133,906
Portugal	8	7,575									38	56,767				
Spain															11	11,436
Thailand													2,826	4,601,681	3,865	7,619,185
Union of South Africa	19	18,744														
United Kingdom											27	54,540	5	8,573	(2)	67
Total	28,670	27,671,689	28,933	32,454,284	21,857	24,954,251	35,548	41,942,055	33,479	44,795,893	38,138	50,716,210	28,365	42,576,966	37,492	72,170,372

[1] Revised figures.
[2] Less than 1 ton.

Tin [1] imported for consumption in the United States, 1946–48, by countries

[U. S. Department of Commerce]

Country	1946		1947		1948	
	Long tons	Value	Long tons	Value	Long tons	Value
Belgian Congo	627	$730,238	4,550	$8,104,276	2,046	$4,463,295
Belgium-Luxembourg					6,874	15,355,653
Bolivia					49	95,279
China	984	1,210,129	2,639	4,323,184	1,615	3,172,982
Indonesia	5,409	6,402,249	39	66,850		
Japan	1,969	2,290,890				
Malaya, Federation of	2,139	2,492,099	13,432	23,207,914	34,176	71,389,379
Mexico	24	27,215				
Netherlands					843	1,899,249
Portugal	9	10,517	(2)	66	95	195,223
Thailand	87	100,906	4,031	6,648,718	2,978	5,591,093
United Kingdom	4,272	5,242,800	208	333,643	520	1,160,799
Total	15,520	18,507,043	24,899	42,684,651	49,196	103,322,952

[1] Bars, blocks, pigs, grain, or granulated.
[2] Less than 1 ton.

Foreign trade in tin plate, taggers tin, and terneplate in various forms, 1944–48, in long tons

[U. S. Department of Commerce]

Year	Tin plate, taggers tin, and terneplate		Tin-plate circles, strips, cobbles, etc. (exports)	Waste-waste tin plate (exports)	Terneplate clippings and scrap (exports)	Tin-plate scrap	
	Imports	Exports				Imports	Exports
1944	112	436,632	1,294	3,103	161	17,323	112
1945	147	471,080	1,684	12,215	378	18,072	433
1946	298	355,794	4,030	6,690	590	24,530	141
1947	585	553,748	5,340	21,209	9	30,797	[1] 54
1948	184	548,021	3,247	28,121	278	41,084	1,125

[1] Revised figure.

Tin plate, taggers tin, and terneplate (including long ternes) exported from the United States, 1947–48, by principal countries

[U. S. Department of Commerce]

Country	1947 Long tons	1947 Value	1948 Long tons	1948 Value
Algeria	2,831	$481,019	3,993	$715,272
Argentina	52,142	8,830,093	37,055	6,821,619
Australia	69,591	10,854,731	43,835	7,675,274
Belgium-Luxembourg	18,299	2,855,240	19,915	3,643,193
Brazil	68,237	10,783,982	62,490	10,991,796
Canada	70,047	9,081,802	49,603	7,191,526
Chile	9,537	1,510,501	9,505	1,773,240
China	7,780	1,183,645	4,763	871,993
Colombia	4,284	675,869	4,413	777,828
Cuba	18,893	3,067,336	20,237	3,722,574
Denmark	6,993	1,070,164	7,091	1,274,786
Egypt	722	125,589	3,062	586,382
France	7,289	1,194,015	14,287	2,737,300
Greece	1,977	300,555	4,768	827,508
Hong Kong	2,761	451,038	2,669	377,904
India	1,714	286,884	12,749	2,297,053
Indochina, French	992	139,628	1,792	292,715
Indonesia	2,476	388,165	6,422	1,137,526
Ireland	802	128,518	1,386	285,774
Italy	11,175	1,675,386	10,707	1,820,420
Japan			3,108	695,300
Lebanon			1,884	326,695
Madagascar	1,292	202,520	2,361	451,039
Malaya, Federation of	2,029	282,701	3,063	467,632
Mexico	18,826	2,856,987	13,616	2,332,339
Morocco, French	7,633	1,263,832	8,031	1,585,541
Netherlands	30,880	4,843,337	38,797	6,984,822
New Zealand	12,056	1,860,494	7,783	1,369,138
Norway	20,758	2,953,828	22,519	3,799,901
Palestine and Trans-Jordan	1,133	180,940	1,382	259,357
Peru	2,879	450,977	2,996	576,308
Philippines, Republic of	8,096	1,169,720	9,911	1,687,467
Poland	313	92,010		
Portugal	14,251	3,658,221	19,365	4,365,079
Spain	211	32,783	730	149,727
Sweden	13,720	2,162,632	14,211	2,548,916
Switzerland	7,878	1,307,271	13,367	2,387,653
Tunisia	1,164	186,851	945	185,097
Turkey	6,018	1,048,143	10,077	1,636,381
Union of South Africa	25,253	3,804,232	32,780	5,598,747
U. S. S. R.	676	90,497		
Uruguay	8,530	1,427,029	8,321	1,576,577
Venezuela	3,020	493,763	3,632	680,570
Other countries	8,590	1,464,874	8,400	1,616,635
Total	553,748	86,917,802	548,021	97,102,604

Foreign trade in miscellaneous tin, tin manufactures, and tin compounds, 1944–48

[U. S. Department of Commerce]

Year	Miscellaneous tin and manufactures: Imports: Tin foil, tin powder, flitters, metallics, and tin manufactures n. s. p. f. (value)	Imports: Dross, skimmings, residues, and tin alloys, n. s. p. f.: Pounds	Imports: Dross, skimmings, residues, and tin alloys, n. s. p. f.: Value	Exports—tin scrap and other tin-bearing material, except tin-plate scrap (value)	Tin compounds: Imports (pounds)	Tin compounds: Exports (pounds)
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)
1947	2,023	[2] 233,932	[2] 27,334	883,782	30,760	(1)
1948	18,327	1,679,331	659,450	1,710,273	10,917	(1)

[1] Not separately classified. [2] Revised figure.

TECHNOLOGY

The Tin Research Institute released for publication several technical reports [9] on varied subjects relating to tin and its industrial applications. The Jones & Laughlin Steel Corp. revealed a magnetic method for separating sheets of tin plate to prevent feeding "doubles." A magnetic field causes the sheets to repel each other with enough force to spread them; then an air blast completes separation. Emery Industries, Inc., and the Armour Research Foundation of Illinois Institute of Technology were developing dimers as substitutes for palm oil used in hot dipping practices.

United States patents issued during 1948 relative to tin include the following:

Muskat, Irving E., Method of Treating Tin-Containing Materials: U. S. Patent 2,434,283–4, Jan. 13, 1948.
Lebedeff, Yurri E., Recovering Metallic Tin and Antimony—Tin Alloy from Sb-Sn-As Bearing Materials: U. S. Patent 2,436,010, Feb. 17, 1948.
Lebedeff, Yurri E., Recovering Tin from Stannic Chloride: U. S. Patent 2,436,868, Mar. 2, 1948.
Richter, Hartmut W., Preparing Potassium Stannate: U. S. Patent 2,436,974, Mar. 2, 1948.
Jordan, James F., Method of Refining Tin Metal: U. S. Patent 2,441,768, May 18, 1948.
Harris, Elmer F., Electrodeposition of Tin: U. S. Patent 2,450,794–5, Oct. 5, 1948.
Herbert, William S., and Francis, H. T., Apparatus for Electrolytically Determining the Thickness of Metal Coatings: U. S. Patent 2,457,234, Dec. 28, 1948.

An article was published on methods of determining the weight of tin coatings on tin plate.[10]

WORLD REVIEW

INTERNATIONAL TIN STUDY GROUP

Representatives of eight major tin-producing and consuming countries met in London in October 1946 and agreed that a study group should be established. The International Tin Study Group was organized at a metting in Brussels in April 1947. A brief report on the meetings held by the Study Group through 1948 has been published as follows:[11]

At the first meeting of the International Tin Study Group held in Brussels in April, 1947, terms of reference for the Group were agreed. The principal features of these terms of reference are (1) that membership shall be open to all countries principally interested in the production, consumption or trade in tin; (2) that the Group shall have the functions of considering possible solutions to any problems or difficulties which are unlikely to be resolved by the ordinary development of world trade in tin; and (3) that the Group should establish a permanent secretariat.

The second Group Meeting was held in Washington in April, 1948. The Group reviewed the world tin position and agreed to recommend to member-governments the setting up of a Working Party to examine the appropriateness and practicability of framing an intergovernmental agreement on tin conforming to the general spirit and principles of the Charter of the International Trade Organization. The meeting of this Working Party was held in The Hague in June, 1948.

[9] Information concerning the institute's work and publications can be obtained in the United States from Tin Research Institute, Inc., 429 West Sixth Ave., Columbus 1, Ohio.
[10] Mackenzie, H. A., Determination of Tin Coating Weights on Tin Plate: Soc. Chem. Ind., September 1947, pp. 312–319.
[11] International Tin Study Group, Statistical Bulletin: Vol. 2, No. 6, June 1949, inside coverage page.

The Group held its third meeting in The Hague on October 25th/29th, 1948. 55 delegates and advisers were present from the 14 member governments. The Group had before it the report of the Working Party. The purport of this report was that it would be appropriate and practicable to conclude an international tin agreement on the lines set out in the report. The Group modified these proposals in certain respects and forwarded to the member-governments a recommendation that, after certain preparatory steps have been taken the member-governments should be asked to inform the Secretary whether they would be disposed to enter into an agreement on the broad lines proposed, and are willing to attend a conference to put the agreement into final form and to conclude it. If a sufficient number of affirmative replies is received, the Secretary-General of the United Nations will be asked to convene an inter-governmental tin conference in the spring of 1949.

A Management Committee supervises the work of the Secretariat. The following are represented on that Committee: Belgium, Bolivia, British Colonies, France, Netherlands, United Kingdom and United States of America.

The Secretariat has been established at 7, Carel van Bylandtlaan, The Hague, Holland, to which all communications should be addressed.

The present membership of the Group is:

Australia	France
Belgium	India
Bolivia	Italy
British Colonies	Netherlands
Canada	Thailand
China	United Kingdom
Czechoslovakia	U. S. A.

WORLD MINE PRODUCTION

World mine production of tin increased 34 percent in 1948. Of the total, Asia supplied 56 percent, South America 25 percent, Africa 16 percent, and other sources 3 percent. Most of the gain was provided by Malaya and Indonesia. Production in 1948 was 39,000 long tons more than 1947—a single year's advance in world output exceeded only in 1936 and 1940, when the increase over the preceding year was 44,000 tons and 69,500 tons, respectively. Production in 1948 was 94 percent of the 1925–29 average and 89 percent of the 1935–39 average, but was less than two-thirds of the 1941 peak. The estimated world production of 163,000 tons for 1948 by the Statistical Committee of the first Tin Study Group meeting in April 1947 was not realized by 9,800 long tons. It was revised downward to 150,000 tons at the second meeting of the group held in Washington in April 1948, which proved to be underestimated by only 3,200 tons.

WORLD SMELTER PRODUCTION

World smelter production increased 23 percent in 1948. Excluding strategic stock-pile accumulations, smelter production exceeded world consumption by nearly 19,000 long tons. The Malayan tin-smelting plants at Penang and Singapore resumed their prewar rank as the world's most important sources of pig tin. Next in rank as important smelting centers are the United States, United Kingdom, Netherlands, and Belgium. More than half (51 percent) of world smelter output in 1948 was acquired by the United States. Allocations of tin metal to the United States by the Combined Tin Committee amounting to 42,160 long tons had been acquired before the close of 1948.

World mine production of tin (content of ore), by countries, 1939–48, in long tons[1]

[Compiled by B. B. Mitchell]

Country	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
North America:										
Canada	------	------	29	553	347	231	379	390	319	309
Mexico	289	345	212	364	426	317	174	262	174	182
United States	34	49	56	6	6	5	------	------	1	6
Total North America	323	394	297	923	779	553	553	652	494	497
South America:										
Argentina	1,655	1,481	921	998	1,070	986	974	[2] 600	522	273
Bolivia (exports)	27,211	37,940	42,199	38,291	41,523	38,720	42,487	37,619	33,266	37,336
Brazil	------	------	------	------	172	154	122	269	272	240
Peru	47	72	47	75	79	73	54	31	79	74
Total South America	28,913	39,493	43,167	39,364	42,844	39,933	43,637	38,519	34,139	37,923
Europe:										
France	------	------	------	------	------	------	------	------	45	78
Germany [3]	285	293	303	547	[2] 980	[2] 980	------	------	[2] 100	[2] 100
Italy	256	309	230	197	160	43	35	100	50	120
Portugal [4]	1,163	1,538	1,467	1,482	2,073	164	576	352	361	753
Spain	106	100	103	151	197	441	1,141	921	303	[2] 400
United Kingdom	1,633	1,620	1,509	1,363	1,359	1,289	993	849	802	1,281
Total Europe	3,443	3,860	3,612	3,740	4,769	2,917	2,745	2,222	1,661	2,732
Africa:										
Belgian Congo	7,140	12,075	15,751	16,191	17,480	17,326	17,077	14,091	14,897	14,073
Cameroun, French	243	218	220	238	229	163	116	111	114	126
Morocco, French	31	20	26	4	11	9	11	12	12	------
Nigeria	9,567	12,177	12,229	12,574	12,835	12,512	11,224	10,333	9,133	9,237
Portuguese East Africa	7	6	4	10	6	8	2	2	[2] 2	[2] 1
Rhodesia:										
Northern	------	16	10	2	3	6	18	6	1	------
Southern	451	450	231	162	178	123	125	100	117	105
South-West Africa	156	137	120	116	146	126	180	174	146	111
Swaziland	114	103	131	113	109	77	53	37	23	20
Tanganyika (exports)	224	258	247	192	158	123	136	131	90	97
Uganda (exports)	354	334	302	283	296	281	215	206	154	190
Union of South Africa	482	518	463	508	526	505	503	487	485	457
Total Africa	18,769	26,312	29,734	30,393	31,977	31,259	29,660	25,690	25,174	24,417
Asia:										
Burma	5,964	5,626	[2] 5,000	[2] 500	[2] 1,000	[2] 500	[2] 200	243	1,818	1,163
China	15,000	11,500	12,000	[2] 7,000	[2] 7,500	[2] 3,000	[2] 1,500	1,320	[2] 4,000	[2] 4,800
Indochina, French	1,467	1,472	1,295	1,029	653	358	86	------	------	30
Indonesia	27,893	43,193	[1] 51,000	9,938	17,632	6,753	948	6,473	15,915	30,562
Japan	1,473	1,760	2,177	1,894	1,107	374	56	57	110	120
Malaya, Federation of	46,827	84,082	[2] 78,000	15,748	26,000	9,309	3,152	8,432	27,026	44,815
Thailand	15,637	17,116	15,828	7,833	5,840	3,296	1,775	1,056	1,403	4,240
Total Asia	114,261	164,749	165,300	43,942	59,732	23,590	7,717	17,581	50,272	85,730
Oceania: Australia	3,067	3,501	3,494	2,931	2,635	2,547	2,282	2,127	2,445	1,874
World total	168,800	238,300	245,600	121,300	142,700	100,800	86,600	86,800	114,200	153,200

[1] Based partly on the Statistical Bulletin of the International Tin Study Group, The Hague
[2] Estimate by authors of chapter.
[3] Data include Sudetenland, 1939–45.
[4] Excluding mixed concentrates.

World smelter production of tin, by countries, 1939–48, in long tons

[Compiled by B. B. Mitchell]

Country	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
Argentina	1,080	881	768	709	552	662	469	837	433	[1] 254
Australia	3,294	3,544	3,656	3,024	2,565	2,442	2,359	2,225	2,371	1,885
Belgian Congo	2,711	7,832	11,818	13,963	11,068	[2] 10,000	[2] 8,500	[2] 4,210	[2] 3,588	3,875
Belgium	3,100	-------	-------	-------	-------	-------	-------	1,405	12,059	10,469
Bolivia	-------	-------	-------	-------	-------	-------	-------	-------	-------	81
Canada	-------	-------	29	553	347	231	379	390	319	309
China	14,019	10,517	6,862	7,677	3,708	2,160	3,268	1,929	3,907	1,606
Germany	2,200	489	424	965	1,174	1,020	-------	-------	-------	[3] 26
Indochina, French	-------	-------	69	337	389	213	14	-------	133	[1] 60
Indonesia	13,941	22,035	[1] 23,000	[1] 8,000	[1] 12,000	[1] 3,000	[1] 500	-------	-------	136
Italy	146	330	73	232	-------	2	6	10	46	[1] 120
Japan (preliminary)	2,025	1,661	2,620	3,870	2,058	759	121	162	190	146
Malaya, Federation of	[4] 81,536	126,945	119,381	12,912	30,462	10,983	3,038	11,533	29,318	49,707
Mexico	90	116	150	320	395	286	166	263	172	181
Netherlands	[1] 14,600	2,967	-------	-------	-------	-------	-------	945	8,981	16,402
Norway	283	206	98	48	23	27	80	308	-------	([5])
Portugal	30	781	1,481	2,381	3,058	373	182	114	373	[1] 240
Spain	138	112	86	99	121	515	1,111	1,440	703	352
Thailand	-------	-------	-------	-------	2,352	3,535	1,652	389	141	-------
Union of South Africa	-------	33	143	535	862	1,150	1,033	858	601	554
United Kingdom	42,000	43,000	40,000	37,279	31,573	28,589	27,549	29,121	28,083	30,218
United States [6]	-------	1,391	1,839	16,168	21,489	30,884	40,475	43,500	33,300	36,703
Total (estimate)	181,000	223,000	212,500	109,100	124,200	96,800	90,900	99,600	124,700	153,300

[1] Estimated by authors of the chapter and in a few instances from Statistical Bulletin of the International Tin Study Group.
[2] Exports.
[3] Bizonal area.
[4] Exports plus difference between carry-over (on lighters and warrants) at end and beginning of year.
[5] Data not available; estimate by authors of chapter included in total.
[6] Including tin content of ores used direct to make alloys.

REVIEW BY COUNTRIES

Bolivia.—Exports of tin in concentrates and ore by Bolivia (37,336 long tons) in 1948 were 12 percent more than in 1947. The increase was chiefly due to higher tin prices, no serious labor disturbances, and larger shipments by the Patiño group. Extraordinarily large shipments were made in December—14 percent larger than the monthly average for the peak year 1929. Of the total exported in 1948, the United States was the destination of 54 percent, and virtually all of the remainder went to the United Kingdom. Argentine imports of tin metal in 1948 produced by the Oruro smelter amounted to only 27 tons. No ores or concentrates were shipped to Argentina, which was entitled to receive concentrates containing 8,000 metric tons of tin—a large part of Bolivia's tin production—under the Argentine-Bolivian tin contract of March 6, 1948.[12]

Until a joint Bolivian-Argentine Commission is established for handling the various problems connected with the contract, plans for delivering tin ore and concentrates to Argentina will not be set. As 1948 closed, there were reports from La Paz indicating that public opinion in Bolivia favored abrogation of the basic 5-year trade pact with Argentina which included the tin provision. There was a great shortage of dollars in Argentina, making it impossible to carry out the agreement. Of significance in the Argentine dollar shortage was the inclusion in a trade agreement between Argentina and the United Kingdom, signed by representatives of the two governments at Buenos Aires on February 12, 1948, of a provision that provided for the British

[12] A translation of the text of the contract was given in American Metal Market, vol. 55, No. 53, Mar. 18, 1948, p. 6. Subsequent agreement on payments was reached on July 26, 1948.

Government to accomplish the purchase for Argentine consumption, during 1948, through usual trade channels 1,000 metric tons of tin and 34,000 tons of tin plate. The tin was to be subject to allocation by the Combined Tin Committee, and of the tin plate 26,000 tons was to be for the British food pack.

The 2-year (1948–49) tin contract between the United States and the Bolivian tin producers of December 31, 1947,[13] established a new base price of 90 cents per pound (the 1947 price was 76 cents) for payable tin in concentrates, f. o. b., vessel, South American ports. The price is to vary directly with fluctuations in the RFC selling price of grade A tin at New York. Effective June 1, 1948, the RFC advanced its selling basis for grade A 9 cents, following a rise effected by the British Ministry of Supply in London. Consequently, a corresponding increase to 99 cents became available to the Bolivian producers. Under contract terms it was possible for them to obtain this higher price on material they delivered to RFC agents in South America during March, April, and May.

Relatively high wage levels and other factors favorable to labor kept the mines free for the most part from strife and work stoppages. However, late in the year a reorganized local labor union, affiliated with the Federacion Sindical de Trabajadores Mineros de Bolivia (FSTMB) and an allegedly independent union vied with each other for representation of the Catavi miners. There was difficulty on the part of both in meeting the Bolivian Labor Law requiring at least 50 percent representation of the workmen in an industry the union is to represent. Nevertheless, the Government apparently recognized both unions. In January 1949 both had submitted petitions for wage increases. Mediation boards were set up for each union.

New export taxes were imposed in Bolivia in 1948, and the portion of foreign exchange that miners must sell to Banco Central was increased. A large group of medium-size miners were reclassified as small miners, with the result that they were no longer able to retain as large a share of their foreign exchange as formerly. A July decree raised the surtax on tin exports from 120 percent to 500, or roughly from 1 to 4½ U. S. cents per pound. A decree of July 29 modified existing regulations covering the obligatory sale to the Banco Central of foreign exchange derived from tin exports. Until July 1, exporters were required to sell only 60 percent of their foreign exchange, and this percentage will still be applied when the price of tin does not exceed 90 cents. However, when the price exceeds 90 cents, exporters may retain 40 percent of the first 90 cents but must sell 100 percent of the exchange received over 90 cents. This had the effect of reducing the exporters' share of their foreign exchange 36 percent because tin has been selling at 99 cents since April. Under the law of February 20, 1948, a tax of ¼ cent per pound was levied on tin produced, for use by certain universities of Bolivia to finance the employment of foreign technicians and the acquisition of laboratory equipment for the Oruro and Potosi Schools of Mines. Under the same law there was also an export tax levy of 1 cent per pound of fine tin, the proceeds to be used for recreational and social benefits of mine workers.

[13] Text of this 1948–49 supplemental Bolivian Tin Contract given in American Metal Market, vol. 55, No. 20. Jan. 29, 1948, p. 6.

Small miners were permitted to retain 20 percent of their foreign exchange receipts, the remainder to be sold to the Banco Minero as previously. Banco Minero was scheduled to enter more energetically into the development of minerals in Bolivia. Part of the profits Banco Minero earned from operating the San Jose mine were planned for use in building a cement factory and for developing copper mining in the Carangas district. Also, the Bolivian Congress authorized Banco Minero to negotiate for a $6,000,000 loan to construct a tin-concentrating plant in Oruro. Banco Minero proposed negotiating the loan with the Export-Import Bank.

During 1948 shipments by the Patiño group (amounting to 46 percent of the Bolivian total) increased 3,404 tons or 25 percent; those of the Hochschild group (23 percent—excluding output of leased San Jose mine) were 4 percent lower; those of Aramayo (6 percent) were 17 percent lower; and medium, small, and Banco Minero operations (25 percent) were 19 percent higher. Of the Hochschild Group, Cia. Unificado del Cerro de Potosi increased its output 2 percent, and Compania Minera de Oruro (Colquiri) increased 7 percent. These two operations accounted for 97 percent of the production by Hochschild in 1948, as compared with 88 percent in 1947. More than 12 percent of Hochschild's 1947 operations were not producing or showed substantial declines in 1948. The San Jose mine of Compania Minera de Oruro (Hochschild—operating under lease by Banco Minero) virtually doubled its shipments in 1948. Empressa Minera Santa Fe, the larger of the direct exporters of the "medianos," decreased its shipments 17 percent from a total of 1,230 tons in 1947 to 1,020 in 1948. The International Mining Co. increased its shipments 9 percent from 413 long tons in 1947 to 450 in 1948. Bolivian International Mining shipped small tonnages in June, September, October, and November for a total of about 37 long tons, before closing down in mid-November preliminary to the appointment of receivers. Tin-ore buying by Banco Minero from small miners apparently was on a reduced scale, as the tonnage shipped from this source declined 25 percent in 1948. The Oruro smelter (Fundicion de Oruro—M. Pero) shipped 104 long tons of fine tin in bars in 1948 compared with 22 tons in 1947.

The results of wartime beneficiation studies by the Bureau of Mines at the request of the Metals Reserve Co. on a sample of complex tin-tungsten ore from the Urania mine, a property owned by H. I. Altshuler of Bolivia, were published.[14]

Burma.—Tin mining in Burma continued on a reduced scale in 1948, with production at about one-third the prewar rate. Exports of tin in concentrates, however, were about 3 percent above 1947; some of this had been mined and processed before the war. Internal disorders continued, with armed conflict in some parts of the country. Mining operations on an important scale were handicapped by dacoity and shortages of mining equipment, explosives, and labor. Mawchi Mines, Ltd., which supplied half the tin mined in Burma before the war, was greatly curtailed, producing only about 820 long tons of mixed tin-wolfram concentrates or one-sixth its prewar annual output. The company rebuilt mill, which began operations on a small scale in February 1948, had reached 130 tons of mixed concen-

[14] Potter, G. M., and Sandell, W. G., Concentration of Urania Tin-Tungsten Ore from Bolivia, South America: Bureau of Mines Rept. of Investigations 4185, 1948, 10 pp.

trates per month by August. However, thereafter, output was reduced to less than half, as the mine was in the area held by the insurgent Karens. The Burmese Government embargoed explosives into the area, and communication and transport facilities were interrupted.

Anglo-Burma Tin Co., Ltd., almost doubled its output compared with 1947, as operations at Heinda in the Tavoy district were uninterrupted. Tavoy Tin Dredging Corp. reported three dredges working, but output was considerably below the prewar level. Thalbawleik Tin Dredging, Ltd., was operating in Lower Burma on a much reduced scale.

In January 1948 Burma became an independent nation with a constitution containing a clause providing that development of natural resources of the country be by the State or corporations having a majority of Burmese capital.

China.—Tin mining in China appears to have produced proportionally better results in 1948 than was the case in some other minerals. Production of tin may have been as much as 25 percent more than is shown in the world table. World trade in Chinese tin was nearly 10 percent greater than in 1947. Production of metallic tin by National Resources Commission was 1,606 long tons or about 11 percent more than in 1947. The general situation has been much confused. With Government controls relaxed since 1946, the gathering of statistical data has been more difficult without knowledge of the output of private or provincial operations. In Kwangtung and Kwangsi Provinces, where ore is processed and the products used locally, unofficial trade returns indicated that exports of slabs and ingots were 700 tons in first half of 1948 compared with 480 in corresponding period of 1947.

The principal tin-mining district of China is near Ko-chiu, Yunnan Province, where mining has been carried on for centuries. The Yunnan Consolidated Tin Corp. (a joint enterprise of NRC, Bank of China, and Yunnan Provincial Government) has been exploiting and developing the mines and smelters of the area. The company used some modern equipment to produce half the district's output, while poorly financed private operators using primitive methods mined the other half. Some Yunnan tin was being transported by air to Haiphong, where most of it moved over the French Railroad before the war. Now, however, the greater portion moves by a 50- to 75-day overland-water route to Shanghai, or via Canton to Hong Kong for marketing. China has large tin resources. In a description of the Chinese tin-mining industry, Dickerman [15] states:

> It would not be difficult with modern mining, concentrating, and smelting methods to produce 15,000 to 20,000 tons of tin a year.

During the latter part of October 1948, ECA announced that $3,000,000 had been allocated for rehabilitation of tin, tungsten, and antimony mines in China as part of a $37,750,000 provisional allotment of $70,000,000 for a China reconstruction and replacement program. Owing to the rapidly deteriorating military and economic situation in China, this was suspended in December, except where there would be total loss of investment on work nearing completion.

[15] Dickerman, Nelson, Mineral Resources of China: Bureau of Mines, Foreign Minerals Survey, vol. 2, No. 7, January 1948, pp. 81–88.

ECA also aided in accelerating shipments of supplies of tin, antimony, and tungsten to the United States.

Indonesia.—The mines of Indonesia set a postwar record in 1948 with a production of 30,562 long tons of tin. This was almost double the output of 1947 and 5 percent more than the 1935–39 annual average. This was accomplished with less equipment than was available in 1941, being attributable to the eight new dredges that were active most of 1948. Minor mechanical troubles experienced with the two new American-made dredges, satisfactorily repaired late in the year, retarded further increased production. There were no labor troubles. The islands of Banka (56 percent), Billiton (36 percent), and Singkep (8 percent) represent the principal sources. The best postwar month for production on Banka was November (2,021 tons) and on Billiton and Singkep, August (1,401 tons). During 1948, 40 percent of the total tin shipped was sold to the United States (the remaining 60 percent went to Arnhem, Netherlands) under a contract that expired December 31, 1948. Renewal terms had been agreed upon for another year for 25 percent, with a maximum of 20,000 tons of tin in concentrates.

In 1941 there were in operation 114 pumps, monitors, and suction and bucket dredges and 1 lode mine. The lode mine was destroyed during the war by the Japanese. At the end of 1948, alluvial mining was being conducted with 75 pumps, monitors, and suction and bucket dredges—Banka about 43 and Billiton 32. A number of profitable but small diggings or private mines were also being worked. In addition there were five or six dredges and four small placers, including two new bucket dredges that had been brought into full operation early in 1948 on Singkep. Singkep suffered war damage more heavily than the other tin islands, and rehabilitation of installations has not been as rapid. Production in 1948 was, however, expanded beyond the prewar record.

The prewar smelters on Banka (annual capacity, 30,000 tons) have not been repaired, and the Netherlands operators do not intend to resume operations in the near future. Plans for eventual resumption of tin smelting in Indonesia, however, are being studied by the Tin Council.

The Netherlands Indian Tin Council was established by a Government decree of February 14, 1948. The Tin Council is charged with coordination, under Government supervision, of exploitation, production, and selling policies of Indonesian tin. The Council also formulates long-time plans for future exploitation, including eventual resumption of tin smelting in Indonesia. On March 5, 1948, an agreement was made between the Government of Indonesia and the Billiton Co. (N. V. Gemeenschappelijke Mijnbouwmaatschappij Billiton) by which Bankatinwinning will be managed by Billiton Co. for 5 years. As of March 1, Billiton Co. also entered into agreement with the Sales Department of Government Mining Products of the Government of Indonesia for cooperating in tin sales.

On January 17, 1948, Netherlands Government and Indonesian Republic signed an agreement on principles of political settlements and truce looking toward a United States of Indonesia. The tin islands are excluded, as they have been set apart as autonomous territories. Following military action in December 1948, all of

Indonesia, except for some parts of Sumatra, was brought under Netherlands control.

Malaya, Federation of. [16]—The tin-mining industry in Malaya showed a steady and progressive increase during 1948, in spite of lawlessness and prevalence of banditry. Malaya resumed its prewar rank as the leading source of tin in the world, both in mining and smelting operations. During the year 145 mining properties resumed operations, bringing the total worked to 633 when the year closed (there were more than 1,000 before the war). The labor force employed in tin mining had been increased from 39,362 at the beginning of 1948 to 46,858 at the year's end. Mine production of tin in ore was 44,815 long tons in 1948, compared with 27,026 tons in 1947; 84,082 in the peak year of 1940; and an average of 55,309 per year during the prewar period 1935–39. An output of 4,267 tons was made in December, the highest postwar rate, due mainly to increased output at Chinese mines.

Mining operations suffered temporary set-backs owing to labor disputes and generally unsettled conditions. Over-all industrial relations in the mining industry began to show considerable improvement near the end of the first half of 1948. Subsequently, however, political disturbances retarded expansion of production facilities. Terrorists (roving bands of Chinese bandits) failed in their efforts to drive European miners away. In general, dredging companies were able to maintain full working time, but many opencast operations were running only during the daylight hours in the latter part of the year. Insofar as known, no dredge had been sunk or damaged by terrorists. Prospecting in new areas was almost at a standstill owing to danger of bandits. During the latter part of 1948 (for several months beginning in July) terrorists greatly increased their activities, seemingly directing their efforts toward intimidation of miners and killing from ambush keymen, mostly Europeans in charge of tin or rubber operations. By mid-November security forces appeared to have the situation under control and were progressively exterminating bandit gangs.

Rehabilitation of prewar equipment progressed with some improvement in supply of steel and machinery, although delivery of electrical equipment was too slow to be satisfactory. Rehabilitation has been confined mainly to dredges requiring a minimum of replacements; present plans call for 80 dredges and 550 gravel pumping mines to be in operation by 1950. There has been no indication of any plans for expanding production facilities beyond prewar capacity. The large dredges in operation at present use 18-cubic-foot buckets with a maximum digging depth of 130 feet. Eventually, dredges for mining to 170- to 180-foot depths are scheduled. Under the rehabilitation program, capital has been made available to dredging companies in the form of payments on war damage claims and special loans paid in installments as the work progresses. Similarly, Chinese operations were being financed and special loans were made to operators on recommendation of the Tin Mines Loan Committee. This was being done by the Government without the necessity of an increase in industry capitalization.

[16] The Federation of Malaya became effective February 1, 1948, succeeding the Malayan Union set up on April 1, 1946, Penang being incorporated in the Malayan Union and Federation. Singapore became a separate crown colony April 1, 1946.

The main tin-producing areas are in the State of Perak, which accounted for 65 percent of the total output in 1948, and the State of Selangor, with 26 percent. In 1948 production in Perak increased 64 percent, and Selangor increased 70 percent. Dredging and gravel pumping accounted for 85 percent of the tin mined in 1948; this was about the same proportion as before World War II. Dredging accounted for 49 percent of the tin mined in 1948 compared with an annual average of 47 percent before the war and 52 percent in 1940, the peak year. Compared with 1947, dredging operations increased 72 percent in 1948 and gravel pumping 85 percent. However, tonnagewise dredging and gravel pumping together were 16 percent below the prewar annual average—dredging 12 percent lower and gravel pumping 21 percent. Dredging units operating were expanded from 56 at the beginning to 67 at the close of the year. In January, 57 dredges averaged 36 tons of concentrate per dredge, and during October–November 67 were producing at the same monthly rate. Before the war (1935–38), production per dredge averaged 46 tons per month. In 1939, the Ayer Hitam Tin Dredging, Ltd., dredge, situated in Selangor, had the most outstanding production of any in the Federation of Malaya; it worked a little over 1,000,000 cubic yards of gravel in an aggregate running time of approximately 4 months, with production of 12,971 piculs of tin ore, equivalent to about 580 tons of tin. During 1948 the number of gravel pumping mines increased from 323 in January to 445 in December, with production of 16,254 tons of tin—95 percent of the Storke report estimate of 17,000 for 1948. In January 1941 there were 104 dredges and 745 gravel-pumping mines operating.

In 1948 the smelting plants at Penang (Eastern Smelting Co., Ltd.) and Singapore (Straits Trading Co.) produced 49,707 tons of tin metal (29,318 in 1947), reestablishing their prewar position as the principal source of pig tin in the world. Concentrates treated were derived mostly from Malaya, with smaller tonnages from Burma, French Indochina, and Thailand. The tin content of concentrates from Malaya was 44,792 long tons (about the same as mine production) compared with 26,380 in 1947. Imports originating elsewhere contained 3,517 tons of tin in 1948 against 3,413 in 1947. The plants shipped 47,214 tons of metal (about 61 percent from Penang and 39 percent from Singapore). Nearly 63 percent was sold to the United States in 1948. Stocks of tin metal increased from 4,711 tons at the beginning of 1948 to 7,148 at the end, while stocks of tin in concentrates (including mine stocks) decreased from 5,220 tons at the beginning to 5,045 at the end.

All pig tin produced in Malaya was sold direct to the British Ministry of Supply, which set the price. The price of refined tin, ex smelter at Penang and Singapore, was raised from £500 per long ton to £504 on April 6, 1948, and £554 on June 1, 1948 (guaranteed by MOS until June 30, 1949). At this price the miner probably gets the equivalent of about 61½ U. S. cents per pound ex mine, which seemed attractive enough to stimulate production.

There was in effect an export tax of about 15 percent on mine shipments, and for the first time an income tax of 20 percent on corporation earnings, modified or graduated from 10 to 30 percent on personal earnings. An export tax amounting to U. S. $243 per ton is levied on all tin shipped from Malaya regardless of destination. From June 30, 1948, the S$30.00 per picul (equivalent to about 10.3 U. S. cents per pound) special tax, which had been in effect since 1903 on all ore exported for smelting elsewhere than in the British Empire, was removed, in accordance with the Geneva Tariff Agreement.

Mexico.—According to the Federal Geological Survey, the large placers containing tin, mercury, and minor quantities of silver and gold found near Guadalcazar, State of San Luis Potosi, Mexico, cannot be mined commercially at 1946 metal prices.[17]

Nigeria.—Tin production in Nigeria increased 1 percent in 1948, despite the trend toward lower-grade ore and a decrease in mine shipments. All Nigerian concentrates go to the United Kingdom, where receipts increased from 8,916 long tons (tin content) in 1947 to 9,207 tons in 1948. There was no serious labor trouble in Nigeria in 1948 comparable to the 2-week strike in the first part of June 1947. The average value of gravel worked dropped from 2.26 pounds of cassiterite per cubic yard in 1939 to 0.96 pound in 1947. Total reserves of cassiterite for all companies was 111,402 tons at the beginning of 1948. Operations by the main producer—Amalgamated Tin Mines of Nigeria, Ltd.—increased 5 percent with the output of 5,755 tons of cassiterite in 1948, compared with 5,495 in 1947. The company ore reserves were increased after an intensive prospecting program. The Ministry of Supply continued to take all tin concentrate, f. a. s. Nigerian ports. The price paid for metal content was £477 per long ton when 1948 opened, rising to £485 10s. on January 6 and to £535 10s. June 1. Legislation in 1947 removed all restrictions on the mining and export of tin ore in effect under the Tin Ordinance.

Thailand.—With progressive rehabilitation, production of tin in concentrates by the mines of Thailand rose to 4,240 long tons in 1948 against 1,403 in 1947. At the end of 1948, 10 bucket dredges were in operation, producing about 900 long tons of ore per month. Twenty-one were being rehabilitated, and 10 have been abandoned, dismantled, or scrapped. About 41 dredges were operating in 1941, producing 1,500 long tons per month. Before the war, 75 percent of the output was worked by the British (chiefly Australian) with modern equipment and the rest by Chinese. All the ore was sent to Penang and Singapore for smelting. The war-produced stocks of 7,528 long tons of tin metal and 8,684 tons of ore, registered with the Thailand Government on January 1, 1947, were disposed of by early 1948. Of the ore, 4,319 tons were allocated for purchase to the United States and 4,365 to the United Kingdom. In 1947, the RFC acquired and shipped to the United States 4,824 tons of metal and 4,287 tons of ore. In 1948, RFC purchased and shipped 5,752 tons of ore and 2,194 tons of metal from the remainder of these stocks and from current production.

Siamese Tin Syndicate began dredging at Ngow on February 9, 1948. Bangrin Tin Dredging Co., Ltd., restarted a dredge in April on the Sydney area, with expectations of starting another (No. 1) by the year's end. Operations were resumed on Puket Island by Kamra Tin Dredging on May 21 and by Puket Tin Dredging, Ltd., in mid-November.

[17] Fries, Carl, Jr., and Schmitter, Eduardo, Tin-Bearing Placers Near Guadalcazar, State of San Luis Potosi, Mexico: Geol. Survey Bull. 960-D, 1948, pp. 109-147.

Under a Thailand-Japan agreement, Japan will supply, among other things, rolling stock, railway and electrical equipment, aluminum, and iron ware. Thailand's shipments will include tin and tin ore. Export control over tin ore was lifted in June 1948. There were reports that Russia was making bids for substantial quantities of Thailand's tin ore.

Under exchange priority restrictions, tin exporters had to surrender 50 percent of their foreign exchange to the Central Bank.

United Kingdom.—Seventy-five years ago the mines of the United Kingdom were the world's leading source of tin. They produced less than 1 percent of the world total in 1948. Geevor and South Crofty continued to be the only mines active. Geevor's mill treated 49,839 tons to recover 542 tons of tin concentrates (black tin containing about 65 percent tin), against 45,537 tons in 1947 for a recovery of 530 tons. The company contract with the Ministry of Supply ended April 19, 1948, and the former practice of selling direct to the smelter on basis of the ruling price was resumed. South Crofty has been working on a reconstruction program which includes driving a new section for the purpose of abandoning old drifts and reconditioning a shaft to improve ventilation. The old Basset mine dumps continue to be worked by the British Malayan Tin Syndicate. The dewatering of New Consols, an old mine at Luckett village near Gunnislake, suffered some delay owing to pump trouble. Some small operators were working "tin-streams."

There are important tin-smelting plants in the United Kingdom. Smelter production increased 8 percent in 1948. Most of the material treated comes from Bolivia and Nigeria. Imports of concentrates (tin content) increased from 23,736 long tons in 1947 to 28,777 in 1948. Stocks of tin increased 16 percent, being 18,019 at the beginning of 1948 and 20,937 at the end. Of the year-end stocks 61 percent was in metal and 39 percent in concentrates—metal stocks increased 39 percent whereas concentrates declined 8 percent. Consumers' stocks of pig tin decreased from 3,016 tons to 2,225 at the year end. The Government's reserve of pig tin was 10,592 tons at the close of 1948 compared with 6,188 when the year opened. Stocks of tin in concentrates in the United Kingdom were 6,386 tons at the end of 1948—virtually unchanged from the beginning of the year. Concentrates afloat had declined from 2,458 tons at the opening to 1,734 at the year's close. The United Kingdom export trade in metal was only 2,216 tons in 1948 (licenses are necessary for exports of metal). Small tonnages were reported shipped to the United Kingdom, mostly from Malaya and Hong Kong. Foreign trade in metallic tin was but a fraction of prewar transactions.

The United Kingdom is the second-largest tin consumer in the world. Restrictions on the use of tin continued to be relaxed in 1948. It was, however, necessary to obtain a license from the Nonferrous Metals Directorate of the Ministry of Supply to purchase tin. Consumption of virgin tin (25,241 long tons) was 8 percent less in 1948, mostly due to decreases in 62 percent used for solder, other alloys, etc. The remaining 38 percent used in tin plate increased 7 percent in 1948. Tin-plate production increased 10 percent, being 610,100 long tons in 1948 (802,560 long tons, 1935–39) compared with 553,200 in 1947. For the first time, statistics of electrolytic production (38,352 long tons) were included in the total for 1948. A third of the tin plate produced in the United Kingdom in 1948 was exported. Shipments to Australia, New Zealand, and Argentina, accounting for 54 percent, increased 80 percent over 1947. The bulk of the tin-plate industry was scheduled to be absorbed by the Government under the Iron and Steel Bill, the details of which were released early in November 1948.

Britain's Four-Year Plan submitted to the Organization for European Economic Cooperation on October 1, 1948, for reaching a balance of payments by 1952–53, proposes or forecasts expansion of tin production to 94,500 tons of concentrates (70,000 tons tin) in 1950 for Nigeria and Malaya. ECA authorized $15,700,000 for purchase of Bolivian tin concentrates by the United Kingdom. Russia agreed to supply Great Britain with 750,000 tons of coarse grain between February and September 1948, under a major trade agreement signed December 27, 1947. Thereunder, the two countries were to discuss the question of British supply of tin to Russia. The trade agreement of February 12, 1948, between Argentina and the United Kingdom provides, among other things, for the British Government to facilitate the purchase (for Argentina consumption) during 1948 of 1,000 metric tons of tin and 34,000 tons of tin plate through usual trade channels. The tin was to be subject to Combined Tin Committee allocation, and 26,000 tons of the tin plate was for the British food pack.

The London average price of tin (minimum 99 percent) was £548 0s. 11d. in 1948. The official price was raised £9 on January 6, 1948, and £50 on June 1, 1948. The price was at £569 when the year closed, with 99.75 percent at £572½.

Titanium

By HELENA M. MEYER

GENERAL SUMMARY

PUBLIC interest in titanium has been stimulated by recent developments that foreshadow large-scale use of the metal as a structural material. The popular (as well as technical) press has given much space during the past year or more to information on titanium and predictions as to its future. Despite the very recently acquired public awareness of this metal, the paint pigment—titanium dioxide—has been an important article of commerce for years; since the late nineteen thirties it has been manufactured in greater quantities than any other white pigment. Production of titanium pigments has followed annual expanding plant capacity and has established new peaks each year since 1943. Production facilities, however, have been inadequate to supply the total extra tonnages required for war and subsequently for swollen postwar consumer needs.

The titanium industry in 1948 was featured by the new record high production and shipments of pigments for the fifth consecutive year, by new peak domestic production and shipments of ilmenite for the second successive year, by new maximum consumption for the sixth year, by higher domestic shipments of rutile than ever before, by imports of ilmenite that were smaller than in only two preceding years—1947 and 1939 (being about the same as in 1946) and by extensive research in connection with titanium metal and alloys.

The United States postwar titanium supply differed markedly from the prewar balance. Before World War II India was supplying United States consumers with most of their needs for ilmenite, chief source of titanium. War disruption to sea-borne trade gave impetus to the search for alternate supplies, with the result that the United States now has the largest single ilmenite-producing mine in the world, the property of the National Lead Co. at Tahawus, N. Y., and that other new properties are in production, plan to produce in the near future, or are being investigated. Doubtless the prospective need for nearby sources, capable of assuring large tonnages of titanium-bearing ores, for the time when the metal will come into large-scale production, was a contributory factor in the development of new sources of supply. In this connection the announcement in 1948 that the Kennecott Copper Corp. and the New Jersey Zinc Co. were to exploit a very large deposit of ilmenite in Quebec, Canada, was an outstanding event of the year. Titanium from this property is destined for pigment purposes in the early days of production, but the operators are looking forward to an eventual large market for reduction to metal.

Production and shipments of ilmenite in the United States were both 14 percent greater than in 1947. Imports were 20 percent below 1947 but were above all earlier years except 1939, approximating those for 1946. Shipments and imports together were 10 percent more than consumption; stocks in industry hands gained 17 percent and were equivalent to nearly 1 year's needs at the peak consumption rate maintained in 1948. Consumption of ilmenite increased 18 percent in 1948 to a new top.

Earlier reports of this series have discussed the extensive Bureau of Mines investigations in connection with the production of ductile titanium, resulting in the development of at least one method applicable to large-scale operation. Later technologic advances are discussed under Technology.

Rutile production declined 14 percent from the all-time peak in 1947, but shipments rose 92 percent over the low postwar rate in 1947 and exceeded all earlier years. Imports fell 31 percent from 1947 owing to curtailment in receipts of rutile in mixed zircon-rutile-ilmenite concentrates from Australia. Industry stocks dropped 34 percent in 1948 and at the end of the year would support consumption at the 1948 rate for nearly 1 year.

Quotations for ilmenite were virtually unchanged throughout the year, a slight downward revision during the year coinciding with a drop in the content of titanium dioxide specified. Concentrates (57–60 percent TiO_2) per gross ton, f. o. b. Atlantic seaboard, according to grade and impurities, were quoted at the beginning of the year at \$19–\$20, and at the end of the year 56–59-percent concentrates were \$18–\$20. All the quotations were reported to be nominal. Rutile quotations continued to be nominally 8–10 cents a pound for concentrate guaranteed minimum 94 percent TiO_2, unchanged for a number of years, until December when they were given as 6–8 cents.

DOMESTIC PRODUCTION

Both production and shipments of ilmenite were 14 percent above 1947, and both established new all-time peaks for the second successive year. Rutile production was 14 percent lower than the all-time top in 1947. Shipments, on the other hand, were nearly double the relatively low rate for 1947, were one-third larger than production, and were the largest in the industry's history. Shipments of ilmenite ranged from 44 to 60 percent TiO_2 and of rutile from 93 to 94 percent TiO_2.

California.—Live Oak Mines and Ferro-Titan Minerals Co., operating in Los Angeles County, produced small quantities of ilmenite and of mixed ilmenite-magnetite concentrates in 1948. Production expansion appeared to hinge on the development of a larger market on the west coast or on sufficient reduction in production costs to justify entering more distant markets.

Florida.—The report of this series for 1947 discussed the approaching advent of a new producer of titanium-bearing material in Florida. The E. I. duPont de Nemours & Co., Inc., operation near Starke did

Production and mine shipments of titanium concentrates from domestic ores in the United States, 1944–48, in short tons

Year	Ilmenite				Rutile			
	Production	Shipments			Production	Shipments		
		Gross weight	TiO_2 content	Value		Gross weight	TiO_2 content	Value
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
1947	336,533	336,061	157,328	5,029,490	8,562	5,157	4,813	533,548
1948	383,745	381,508	177,447	5,793,973	7,380	9,907	9,226	647,334

not get into production in 1948 but was expected to begin early in 1949. Production of ilmenite and rutile in Florida in 1948 came from the Rutile Mining Co. of Florida near Jacksonville and the Riz Mineral Co. near Vero Beach. The latter property was operated under the name as given and under the name of the Florida Ore Processing Co., Inc.

New York.—Production of titanium-bearing ore at Tahawus, Essex County, by the National Lead Co. continued to break records in 1948 and was again the predominating reason for the record performance of the United States as a whole. The mine continued to lead all others in the world in production of ilmenite. Drilling and blasting at Tahawus were recently described.[1]

North Carolina.—The Yadkin Mica & Ilmenite Co., subsidiary of the Glidden Co., produced 28,990 tons of ilmenite (averaging 51 percent TiO_2) at Finley, Caldwell County, and shipped 28,790 tons. The 1948 output was 6 percent above 1947, itself 60 percent higher than in 1946.

Virginia.—Ilmenite and rutile were produced in Virginia again in 1948 near Roseland, Nelson County, by the American Rutile Corp., subsidiary of the Metal & Thermit Corp. The Calco Chemical Division of American Cyanamid Co. continued to produce ilmenite at Piney River, Nelson County. The Roseland property was closed from January through August, there being no mine nor mill activity during this period.

CONSUMPTION AND USES

The consumption of ilmenite in 1948 was 18 percent higher than in 1947, marking continuation of the establishment of new high record rates of use for the sixth consecutive year. The manufacture of pigments, as usual, took 99 percent of all ilmenite consumed. Rutile consumption, which had dropped notably since the end of the war, gained 28 percent in 1948 and was the highest since 1944. Welding-rod coatings took 80 percent of the total compared with 84 percent in 1947.

[1] Begor, C. R. and Quam, C. A., Drilling and Blasting at Tahawus: Min. Cong. Jour., vol. 34, No. 8, August 1948, pp. 24–27.

Consumption of ilmenite and rutile in the United States, 1944–46 (total) and 1947–48, by products, in short tons

Product	Ilmenite		Rutile	
	Gross weight	Estimated TiO_2 content	Gross weight	Estimated TiO_2 content
1944	360,941	175,475	14,813	13,837
1945	381,178	187,580	9,791	9,144
1946	404,283	202,663	7,134	6,670
1947				
Pigments (manufactured titanium dioxide) [1]	473,154	248,231		
Welding-rod coatings [1]	144	74	6,425	5,907
Alloys and carbide	5,972	2,431	1,131	1,050
Ceramics			102	95
Miscellaneous	254	123	34	31
Total consumption	479,524	250,859	7,692	7,083
1948				
Pigments (manufactured titanium dioxide) [1]	558,448	297,728		
Welding-rod coatings [1]	145	72	7,885	7,289
Alloys and carbide	6,377	2,591	952	889
Ceramics			175	166
Miscellaneous	30	17	851	800
Total consumption	565,000	300,408	9,863	9,144

[1] "Pigments" include all manufactured titanium dioxide, consumption of which in welding-rod coatings was 1,257 tons in 1947 and 1,338 tons in 1948.

Titanium Pigments.—Production and shipments of titanium pigments in 1948 were greater than ever before, establishing new peaks for the fifth successive year. Recent production has been dictated largely by pigment plant capacities, because for a number of years over-all demand has called for even larger tonnages than the record quantities made available. Figures on this industry are supplied in confidence and, consequently, are not given here. The annual increases in pigment-plant capacities for several years were inadequate, owing to difficulties in obtaining structural and other materials. Total capacity was expanded another 10 percent approximately in 1948, and still further gains are expected in 1949. Consumption of ilmenite was at a new maximum in 1948. Earlier reports of this series have pointed out that use of titanium pigments, whereas rising largely on merit, have been influenced also by shortages of competitive products, notably those made from lead.

According to information received from a leading manufacturer, the use pattern for titanium pigments in 1948 was as follows: 78 percent was for paint, varnish, and lacquer, 7 percent for paper, 3 percent for rubber and plastics, 2½ percent for textiles and leather, 2 percent for floor coverings, 1½ percent for welding rods, and 6 percent for other purposes.

Paint capable of resisting temperatures of more than 1,000° F. have been developed as a result of research by the Australian Council for Scientific and Industrial Research.[2] Basis of the new paints is butyl titanate.

[2] Metal Bulletin (London), Titanium: No. 3346, Nov. 30, 1948, p. 17.

According to the November 5, 1948, issue of Chemical Trade Journal and Engineer (London), titanium dioxide is being made from rutile on a pilot-plant scale at Melbourne, Australia, by Zircon Rutile, Ltd. If the pilot-plant results justify it, consideration is to be given it was said, to the erection of a larger plant.

Welding-Rod Coatings.—Production of titanium-coated welding rods was 188,000 short tons in 1948, a gain of 23 percent over 1947, itself 15 percent above 1946; 267,000 tons were produced in 1945, 382,000 in 1944, and 481,000 in 1943. In 1948, 56 percent of the rods were coated with natural rutile, 32 percent with manufactured titanium dioxide, and 6 percent each with both varieties and with ilmenite.

Other Uses.—Titanium metal, a laboratory curiosity until recently, has become a widely discussed subject with the advent of production on a commercial basis and with publicity that production at costs that would invite large-scale operations is an early possibility. The metal is discussed under Technology.

Developments in titanium enamels were discussed[3] in a recent article, which said that the superior performance of titanium enamels has enabled them to make inroads into the zircon business, despite higher cost. Antimony enamels were said still to lead where acid resistance is the principal requirement and where low opacity is no draw-back. Another article[4] discussed the improved physical properties of titanium enamels.

STOCKS

Inventories of ilmenite rose 17 percent in 1948 and those of rutile fell 34 percent. Totals for each closely approximated 1 year's needs at the consumption rates maintained in 1948.

Stocks of titanium concentrates in the United States at end of year, 1947–48, in short tons

Stocks	1947				1948			
	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	1,706	776	3,953	3,687	3,983	1,800	1,500	1,399
Distributors[1]	5,684	3,126	8,642	8,123	4,499	1,809	4,218	3,986
Consumers	[2] 446,052	[2] 229,128	1,342	1,232	522,077	250,559	3,493	3,255
Total stocks	[2] 453,442	[2] 233,030	13,937	13,042	530,559	254,168	9,211	8,640

[1] Includes ilmenite and rutile content of mixed zirconium-titanium concentrates.
[2] A large quantity previously counted as stocks was written off company books in 1947.

PRICES

Quotations in E&MJ Metal and Mineral Markets covering ilmenite were virtually unchanged throughout the year. A slight downward

[3] Chemical Industries, Titania on Top: Vol. 63, No. 5, November 1948, pp. 770–771.
[4] King, Burnham W., Titanium Enamels: Steel, vol. 122, No. 25, June 21, 1948, pp. 108, 111, 128, and 130.

revision coincided with a drop in content of titanium dioxide specified, from a range of 57–60 percent TiO_2 content to 56–59 percent. Quotations for 57–60 percent TiO_2 concentrates, per gross ton, f. o. b. Atlantic seaboard, according to grade and impurities, were \$19–\$20 when the year began; beginning January 14 the titanium dioxide content specified was dropped to 56–59 percent, and the price was reported as \$18–\$19; and from September 15 on the price was \$18–\$20 with no change in grade indicated. The quotations were all reported as nominal. Nominal quotations for rutile have been 8–10 cents a pound for concentrate guaranteed minimum 94 percent TiO_2 for a number of years until December 1948, when a range of 6–8 cents was reported.

At the beginning of the year, Steel quoted ferrotitanium, Eastern Zone, contract, ton lots at \$1.35 and less-ton lots at \$1.40 per pound of contained Ti for 20 to 25 percent, Al 3 percent, Si 4 percent, and C 0.10 percent, the last three all maximums. The quotations were \$1.23 and \$1.25, respectively, for ton and less-ton lots, for 40–45 percent Ti, with the following maximums: Al 7 percent, Si 4 percent, and C 0.10 percent. For the Central Zone, 4 cents should be added for 20–25 percent Ti grade and 2.1 cents for 40–45 percent grade; Western, 13.5 cents for 20–25 percent and 7.2 cents for 40–45 percent. For high-carbon ferrotitanium, 15–20 percent, contract basis, per net ton, f. o. b. Niagara Falls, N. Y., freight allowed to destination east of Mississippi river and north of Baltimore and St. Louis, 6.8 percent C, the quotation was \$142.50; 3–5 percent C, \$157.50. These quotations held until October 4 when they were changed and continued for the remainder of the year as follows:

Ferrotitanium, Low-Carbon: (Ti 20–25 percent, Al 3.5 percent maximum, Si 4 percent maximum, C 0.10 percent maximum) contract, ton lots, 2″ x D, \$1.40 per pound of contained Ti; less ton \$1.45. (Ti 38–43 percent, Al 8 percent maximum, Si 4 percent maximum, C 0.10 percent maximum). Ton lot \$1.28, less ton \$1.35, f. o. b. Niagara Falls, N. Y., freight allowed to St. Louis. Spot add 5c.

Ferrotitanium, High-Carbon: (Ti 15–18 percent, C 6–8 percent). Contract \$160 per net ton, f. o. b. Niagara Falls, N. Y., freight allowed to destination east of Mississippi river and north of Baltimore and St. Louis.

Ferrotitanium, Medium-Carbon: (Ti 17–21 percent, C 3–4.5 percent). Contract, \$175 per ton, f. o. b. Niagara Falls, N. Y., freight not exceeding St. Louis rate allowed.

Titanium metal, 96–98 percent, was quoted at \$6–\$7 a pound at the beginning of the year, dropping to \$5–\$6 in mid-September, at which level it continued for the remainder of the year. E. I. du Pont de Nemours' production was available in limited quantities as sponge metal and in ingots of 10 and 100 pounds.

Manufactured titanium dioxide (anatase), chalk-resistant, plain, and (rutile) nonchalking, in bags, carlots, delivered, were quoted in the Oil, Paint and Drug Reporter at 17½, 17½, and 19½ cents a pound, respectively, when the year began. The first two were raised to a range of 17½–18 cents in midyear, continuing at that level until early in September, when they were established at 18 cents and the nonchalking grade moved to 20 cents. Early in December the chalk-resistant and plain grades were quoted at 18–19½ cents and the nonchalking at 20–21½; they were then established at the higher part of the range, where they continued for the remainder of the year.

FOREIGN TRADE [5]

Imports.—Receipts of ilmenite were only 80 percent of the peak quantity imported in 1947 but were smaller only than that year and 1939, approximating the total for 1946. India continued to be by far the chief source of imported concentrates, supplying 76 percent of the total compared with 87 percent in 1947. Norway continued to ship increasing quantities to the United States, the total for 1948 being 37 percent above that in 1947; Norway supplied 17 percent of total imports. A noteworthy gain was made in receipts of ilmenite from Brazil, and British Malaya appeared in the import declaration as a supplier for the first time. Australia was the only country to ship rutile of the United States in 1948. Receipts dropped, owing to discontinuation of entries of mixed zircon-rutile-ilmenite concentrates from that country. Imports of ferrotitanium for consumption, all from the United Kingdom, were 28 short tons.

Titanium concentrates [1] imported for consumption in the United States, 1944–48, by countries, in short tons

[U. S. Department of Commerce]

Country of origin	1944	1945	1946	1947	1948
ILMENITE					
Australia [2]	79	1,753		[3] 1,659	(4)
Brazil	5,511	10,508	2	1	8,708
British Malaya					3,335
Canada	32,580	6,987	1,250	7,122	4,519
Ceylon	4,648				
India	62,066	179,693	218,623	262,503	184,309
Norway		9,895	21,077	30,026	41,248
Total as reported	104,884	208,836	240,952	301,311	242,119
Australia: In "zirconium ore" [2]	4,064	[5] 1,236	1,388		
Grand total	108,948	210,072	242,340	301,311	242,119
Value of "as reported"	$596,034	$1,217,339	$1,440,112	$1,791,020	$1,758,838
RUTILE					
Australia [2]	1,896	3,070	4,377	7,460	8,771
Brazil	1,669	234	31		
Cameroun (French) [6]				3	
India	134			113	
Norway					(4)
Total as reported	3,699	3,304	4,408	7,576	8,771
Australia:					
In "zirconium ore" [2]	6,320	7,298	1,456		
In "ilmenite"				[3] 5,061	
Grand total	10,019	10,602	5,864	12,637	8,771
Value of "as reported"	$272,283	$98,170	$213,795	$468,810	$588,713

[1] Classified as "ore" by the U. S. Department of Commerce.
[2] Most of the imports of titanium from Australia in 1944–47 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 3 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] Most of the ilmenite, rutile, and zircon from Australia in 1947 was imported in the form of zircon-rutile or zircon-rutile-ilmenite mixed concentrates. These concentrates (including separated concentrates of a single mineral) totaled 36,074 short tons, of which 1,659 were ilmenite, 12,521 rutile, and 21,894 zircon. For statistical convenience, it can be assumed that 5,061 tons of the material reported by the Department of Commerce as ilmenite was actually rutile; the value of this 5,061 tons of rutile, however, is inseparable from the ilmenite as reported.
[4] Less than 1 ton.
[5] Includes 309 tons not recovered from mixed concentrates.
[6] Includes quantities reported by the U. S. Department of Commerce as originating in French Equatorial Africa, from which no rutile production has been recorded.

[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.

Exports.—Of the concentrates exported in 1948, 631 tons went to Canada, 474 to Netherlands, 141 to Belgium, and 138 to the Union of South Africa. Of the pigments, 19,787 tons went to Canada, 1,061 to Netherlands, 1,005 to Belgium, 848 to Brazil, 700 to Cuba, and 660 to Mexico. Virtually all of the ferro-alloys exported was shipped to Canada. Total titanium products exported were valued at $7,400,000; tetrachloride and other compounds are no longer classified separately and are not included in this total.

Exports of titanium products from the United States, 1944–48, by classes

[U. S. Department of Commerce]

Year	Concentrates		Ferro-alloys		Dioxide and pigments		Tetrachloride and other compounds	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1944	291	$51,828	[1] 793	[1] $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)
1947	1,266	192,703	509	80,590	21,171	5,183,936	(2)	(2)
1948	1,454	187,225	480	82,874	26,824	7,126,956	(2)	(2)

[1] Includes metal and nonferrous alloys.
[2] Beginning Jan. 1, 1946, not separately classified.

TECHNOLOGY

Many reports on titanium technology were published during the year.

The interest of the Department of the Navy in titanium because of its promise as a structural material led to a symposium on the subject, sponsored by the Office of Naval Research, on December 18, 1948, in Washington, D. C. The papers submitted were combined in a report entitled "Titanium" and included the following:

The Bureau of Aeronautics' Titanium Program, by N. E. Promisel, Chief, Materials Branch, Bureau of Aeronautics, Navy Department.

The Program of the Air Matériel Command on Titanium Alloys, by Richard R. Kennedy, Wright-Patterson Air Force Base.

The Titanium Program of Army Ordnance, by Laurence S. Foster, Watertown Arsenal Laboratory.

Production of Titanium Powder at Boulder City, by F. S. Wartman, Metallurgist, Bureau of Mines, Boulder City, Nevada.

Fabrication of Titanium and Investigations of Titanium-Nickel Alloys in the Bureau of Mines Laboratories, by J. R. Long, College Park Branch, Metallurgical Division, Bureau of Mines.

Physical and Mechanical Properties of Commercially Pure Titanium, by C. I. Bradford, J. P. Catlin, and E. L. Wemple, Remington Arms Co.

Production and Properties of Iodide Titanium, by Bruce W. Gonser, Research Supervisor, Battelle Memorial Institute, Columbus, Ohio.

Properties of Iodide-Type Titanium, by F. B. Litton, Foote Mineral Co.

Induction Melting of Titanium Metal in Graphite, by J. B. Sutton, Pigments Department, E. I. DuPont de Nemours & Co.

The Production and Arc Melting of Titanium, by C. T. Greenidge and L. W. Eastwood, Battelle Memorial Institute.

Some Preliminary Tests to Determine Applications for Titanium, by W. Lee Williams, U. S. Naval Engineering Experiment Station, Annapolis, Md.

Some Preliminary Data on Alloys of Titanium, by E. I. Larsen, E. F. Swazy, L. S. Busch, and R. H. Freyer, P. R. Mallory & Co., Inc.

Titanium-Base Alloys, by Howard C. Cross, Battelle Memorial Institute.

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Some Aspects of the Metallurgy of Titanium Alloys, by P. H. Brace, Westinghouse Research Laboratories.

The Titanium-Base Alloys Program of the Naval Research Laboratory, by E. J. Chapin, Metallurgy Division, Naval Research Laboratory.

First Progress Report on Titanium-Carbon and Titanium-Nitrogen phase Diagrams, by J. P. Nielsen, College of Engineering, New York University.

Long's paper summarized two recently completed reports, subsequently published,[6] and concerned the fabrication of titanium and the studies of titanium-rich alloys being conducted in the laboratories of the Bureau of Mines. Titanium is active chemically and at high temperatures reacts readily with the atmosphere, making it extremely difficult to produce a pure metal by melting and casting, as with most other metals. However, the Bureau developed a process in which titanium powder can be heated to elevated temperatures while sealed in ductile, gastight containers. Hot-rolling the complete assembly produces a solid, nonporous metal for working into construction members, machinery parts, and other materials. As a byproduct of research on pure metallic titanium, Bureau metallurgists also are investigating the possibilities of titanium alloys for engineering purposes, as pure metals in general show relatively large improvements in properties when alloyed with other metals. The titanium-nickel series is the first of several alloys to be tested in Bureau laboratories. The report describes experiments on alloys containing up to 40 percent nickel.

The article by Bradford and others stated that Remington's program has progressed to the point where 20- to 25-pound ingots are being cast and small quantities of narrow sheet and round rod are being produced. Most of the company's effort was said to be devoted to research on titanium-rich alloys. Preliminary work indicated that the machinability of titanium is similar to that of austenitic stainless steel. The General Electric Co. River Works at West Lynn, Mass., and several other companies were said to be conducting preliminary welding experiments with Remington titanium. The experiments indicate that titanium can be readily spot-welded, seam-welded, and inert-arc-welded to other pieces of titanium. Titanium's sea-water and marine atmospheric corrosion resistance were said to be truly outstanding, being better than austenitic stainless, Monel, and the cupronickel alloys, and as good as the best-known materials—platinum and Hastelloy C.

In his paper, Gonser says that interest in the production of titanium by the iodide process is broader than merely the production of a relatively pure metal as a base for investigations, almost regardless of cost. It is a method for making a high-quality metal in a compact form, which can be processed directly without smelting or without compacting and sintering into ingots by powder metallurgy. Essentially, he says, the process depends upon the formation of a volatile iodide by reacting crude titanium with iodine in the absence of any other reactive gas, then depositing the titanium on a hot filament by thermal decomposition of the iodide. This action is cyclic, as the gaseous product of decomposition reacts with more crude metal;

[6] Long, J. R., Hayes, E. T., Root, D. C., and Armantrout, C. E., A Tentative Titanium-Nickel Diagram: Bureau of Mines Rept. of Investigations 4463, 1949, 13 pp.
Long, James R., and Hayes, Earl T., Sheath Working of Metal Powders: Bureau of Mines Rept. of Investigations 4464, 1949, 13 pp.

so the action in its simplest form is refining in a closed container. At present iodide titanium is still on a laboratory scale. The metal produced by this method, Gonser states, forms an excellent base for alloying and for studies of fundamental properties.

E&MJ Metal and Mineral Markets of September 30, 1948, quotes the Northern Miner as stating that Dominion Magnesium, Ltd., is producing a few pounds of titanium metal at Haley, Ontario. Pilot-plant production, using a process said to differ from United States practice, points to a price of around $1.50 a pound. The process used by the Canadian company was developed by L. M. Pidgeon and D. W. Rostrom.

An article [7] recently published discussed experiments with the metal in Australia. It commented on the large-scale production of crude titanium tetrachloride from rutile sand during the war. Reduction of purified titanium tetrachloride with magnesium has been tried on a small scale and reasonably pure metal, which may be worked either cold or at 500° to 600° C., has been made. This type of process, it is stated, could easily be modified so as to yield certain alloys directly, for example, alloys of titanium with zirconium, iron, silicon, and tantalum.

WORLD REVIEW

Available data on world production of ilmenite and rutile in recent years are shown in the accompanying table. Notes on operations in certain important producing and consuming countries follow the world table.

World production of titanium concentrates (ilmenite and rutile), 1941–48, by countries, in metric tons

[Compiled by B. B. Mitchell]

Country	1941	1942	1943	1944	1945	1946	1947	1948
ILMENITE								
Australia:								
New South Wales	3,521	3,651	3,815	3,590	2,485	1,636	3,515	1,897
Queensland	258	937	1,655	3,697	4,186	4,258	2,934	3,393
Tasmania							844	
Brazil (exports)	4,471			3,250	5,000			7,900
Canada	11,477	9,100	62,992	30,820	12,834	1,275	6,445	
Egypt	2	[2] 691		9	9	146		1,034
India	131,111	49,977	38,396	102,412	174,848	187,993	257,476	(1)
Malayan Union	[3] 44						[4] 13,291	12,909
Norway	61,086	60,713	66,191	63,975	28,312	52,574	69,711	93,322
Portugal	798		121		301	633	243	[3] 141
Senegal [5]	1,000	4,840	730		3,200	4,310	8,457	3,690
Spain	71	85	178	548	216	128	149	127
United States	21,135	70,042	184,657	252,749	279,880	256,230	305,296	348,126
Total ilmenite	234,974	200,036	358,735	461,050	511,271	509,183	668,361	(1)
RUTILE								
Australia:								
New South Wales	3,549	4,496	4,828	4,597	5,292	4,876	9,068	8,937
Queensland	267	1,007	1,902	4,246	4,609	3,407	4,338	6,411
Brazil (exports)	2,369	4,615	4,557	1,564	160	28	5	
Cameroun (French)	1,800	2,400	2,735	3,320	1,440	1,260	800	(1)
India	1,891	2,295	2,396	1,672	620	262	159	(1)
Norway	172	77	116	85	76	63	51	
United States	2,839	2,402	3,617	6,279	6,513	6,761	7,767	6,695
Total rutile	12,887	17,292	20,151	21,763	18,710	16,657	22,188	23,000

[1] Data not available.
[2] Includes 26 tons of garnet-ilmenite.
[3] January to September, inclusive.
[4] Exports.
[5] Approximately 20 percent of ilmenite concentrates is zircon.

[7] Worner, H. W., Titanium and Zirconium, New Metals in Australian Metallurgy: Chem. Eng. and Min. Rev. (Melbourne), vol. 40, No. 7, Apr. 10, 1948, pp. 254–262.

AUSTRALIA

Details covering heavy mineral production and other data were made available [8] in the latter part of the year. The most extensive known deposits of black sands were said to occur along the coast near the border of New South Wales and Queensland, largely between Southport, 17 miles north of the border, and Ballina, 50 miles below the border. (See fig. 1.) Information on reserves is fragmentary, but

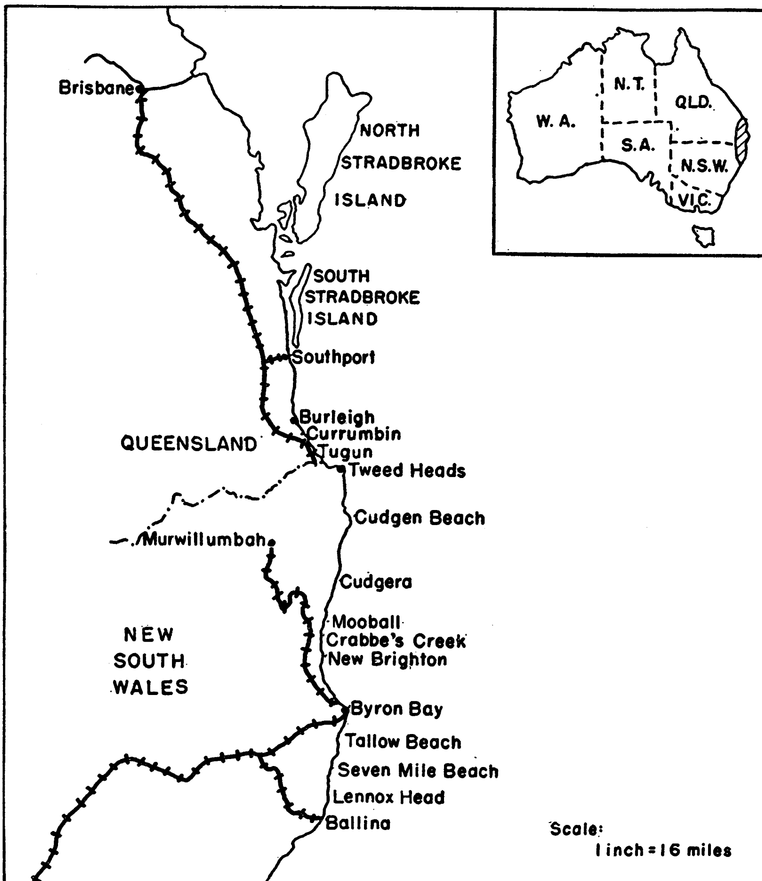

FIGURE 1.—Map showing location of heavy mineral deposits in Northern New South Wales and Southern Queensland.

investigations of all deposits are in progress in connection with the question of the probable amount of monazite available. In the areas close to the beach along the New South Wales-Queensland coast, now being worked, it has been estimated that reserves of high-grade sands are sufficient to last only 10 to 20 years at the current rate of production. Much larger unworked deposits, however, are said to occur in

[8] Lamm, Donald W., Heavy Minerals of the Australian Beach Sands: Consular Rept. 86, American Embassy, Canberra, Australia, Sept. 9, 1948, 17 pp.

the sand dunes behind the present beaches, particularly in the Byron Bay, New Brighton—Cudgera, Cudgen, and Currumbin—Southport areas. The report states that competent geologists have described as "very large" reserves of sands on the east coast of North Stradbroke Island. The average mineral content is low and the sands are not workable by methods now being used in Australia.

Production figures are given in the accompanying world table. Domestic demand for rutile and zircon is very small. Thus, foreign markets are necessary to keep production going. Companies evidently refrain from expanding production to ultimate limits to prevent the accumulation of cumbersome surpluses.

In the fiscal years 1945–46 and 1946–47, exports of rutile were 5,857 and 11,090 long tons, respectively, and of ilmenite, 804 and 938 tons, respectively. The United States was the destination of 78 and 81 percent and the United Kingdom 21 and 12 percent, respectively, of the rutile shipped from the country.

The ilmenite produced on the east coast has too high a chrome content to be usable for pigment purposes, chief use of ilmenite, and ilmenite stock piles are said to have accumulated.

In earlier years Australian rutile, ilmenite, and other minerals were shipped from the country chiefly in the form of mixed concentrates for separation in the importing country. The requirement that the monazite content of the concentrates be sold to the Government, however, has made exportation of mixed concentrates no longer possible.

Seven firms are actively engaged in commercial mining operations for zircon and rutile; another company has discontinued operations temporarily, and two others were planning operations soon. Information on these companies, given in the report, is briefed as follows:

Mineral Deposits Syndicate.—Deposits in the Broadbeach-Burleigh area and plant at Southport, Queensland. Average monthly output of mixed concentrates is 600 long tons. Mining is done by stripping the overburden with a bulldozer and selective hand loading into motor trucks, the overburden being replaced. The sands are treated at the plant by the use of Wilfley tables, draining, and rotary drier. Rotary magnetic separators are used to eliminate the ilmenite, followed by electrostatic separation of the zircon-rutile and cleaning by a magnetic separator. Products are zircon and rutile concentrates of 85- and 95-percent purity, respectively.

Associated Minerals.—Deposits in the Southport-Broadbeach area and plant at Southport. Average monthly production is 500 long tons. Mining methods same as foregoing. The sands are treated by Wilfley and curvilinear tables, rotary drier, then electromagnetic and electrostatic separation of the zircon and rutile, with further cleaning of each product by both electrostatic and electromagnetic methods. Products are zircon (93-percent purity) and rutile (96 percent) concentrates.

Rutile Sands Pty.—Deposits on the Tugen-Currumbin beaches and plant at Currumbin, Queensland. Average monthly production is 650 long tons. Mining methods same as previous two companies. The sands are treated by Wilfley tables, draining, and rotary drier, followed by electrostatic and electromagnetic separation. Zircon concentrates of 90 percent and rutile of 96-percent purity are produced.

Tweed Rutile Syndicate.—Deposits at Cudgen and the adjacent beach area and plant at Cudgen, N. S. W. Monthly output is 500 long tons. The sands are mined by stripping the overburden with horse-drawn scoops, then loading the black sands on motor trucks by use of a small Diesel shovel. The sands are treated by the use of Wilfley tables, then moved by conveyor to the drier and separated and cleaned by electrostatic and electromagnetic methods. Products are zircon and rutile concentrates of 95- and 96-percent purity, respectively.

Titanium Alloy Manufacturing Co., Ltd.—Deposits and plant the same as Tweed. Average monthly production is 900 long tons. The overburden is removed by power scoops, and the heavy minerals are then piled, and loaded by use of a small drag scraper into 2-foot-gage railway trucks drawn by a Diesel locomotive. The sands are treated by using Wilfley tables, draining, rotary drier, then electrostatic treatment (the company has six units). The ilmenite is removed by a magnetic separator. Products are zircon and rutile concentrates of 98- and 94-percent purity, respectively.

Metals Recoveries, Ltd.—Deposits in the area between Cudgera and New Brighton and plant at Crabbe's Creek and Mooball Landing, N. S. W. Approximate monthly production is 250 long tons. The overburden is removed by horse-drawn scoops, and there is selective hand loading of the black sands into trucks. The sands are treated by the use of Wilfley and curvilinear tables at Crabbe's Creek and carted to Mooball where they are dried, passed through a electromagnetic separator, and through an electrostatic separator. Products are zircon and rutile concentrates of 97-percent purity each.

Zircon Rutile, Ltd.—Deposits at Seven Mile and Tallow Beach, Byron Bay, and plant at Byron Bay. Largest of the operating firms with an average monthly output of 1,000 long tons. Mining by removing overburden with bulldozers and stacking the heavy mineral sands, then loading on trucks by an overloader. A dragline loader is also used. The Wilfley tables are at the beach, and the concentrates are carted to the main plant at Byron Bay. The zircon is removed by flotation, the tailings, being passed over cleaner curvilinear tables then through the drier. The ilmenite and other slightly magnetic minerals are removed magnetically, and the zircon concentrate is dried and cleaned magnetically. The zircon concentrate is graded at 99.5 percent and the rutile at 96-percent pure.

Swansea Minerals.—Deposits and plant at Swansea Beach, N. S. W. when firm was producing, average monthly output was 300 long tons, but operations closed temporarily at end of June 1948. The black sands were hand-loaded into trucks and only Wilfley tables used in treating them. The firm marketed a mixed concentrate consisting of 44 percent zircon, 41 percent ilmenite, 10 percent rutile, and 5 percent other heavy minerals.

Alluvial Gold, Ltd.—Leases covering about 590 acres in the Murwillumbah district, N. S. W. Preliminary borings indicate that the area contains 130,000 tons of rutile and 250,000 tons of zircon ore.

Zinc Corp.—Large mining firm investigating deposits on North Stradbroke Island, for which it has important lease holdings. Leases apparently taken in the name of Australian Mining & Smelting Co., Ltd., and later transferred to the Titanium & Zirconium Industries

Pty., Ltd., which is doing preliminary boring. Both companies are subsidiaries of the Zinc Corp.

James Scott-Moffatt.—He has applied for dredging leases for an 80-acre area on South Stradbroke Island, requesting a 21-year lease. Plans to concentrate heavy minerals on island and transport them to Brisbane to be separated.

Rare Metals Pty., Ltd.—Had just commenced operations on commercial scale when report was prepared. Deposit at Cheyne Beach, 40 miles east of Albany, Western Australia. Sample shipment of 100 tons of sand sent to England had an over-all mineral yield of 69 percent. Concentrating plant will be at Albany, and the company planned soon to send 10,000 long tons there for processing. Ilmenite in this deposit is virtually free of chrome (which characterizes much of Australia's ilmenite) and is thus suitable for commercial use. Zircon and rutile will also be marketed.

British Titan Products.—A subsidiary of Imperial Chemical Industries (British). No information available regarding firm's plans.

CANADA

Announcement was made during the year of an extensive development program in new titanium-iron ore fields in the Allard Lake area of eastern Quebec. The work has been in progress for several years and has been carried on jointly by the Kennecott Copper Corp. and the New Jersey Zinc Co. According to the Northern Miner,[9] upwards of 125,000,000 tons of high-grade, easily accessible titanium-bearing ore has been outlined by diamond drilling at Tio Lake. The report credits discovery of the deposit to J. A. Retty of the Quebec Bureau of Mines, who carried out in 1941 the first geological work to be done in the Lower Romaine River area, in Saguenay County, on the north shore of the Gulf of St. Lawrence, about 400 miles below Quebec City. Dr. Retty called attention to the presence of several large masses of anorthosite rocks, some of which were rich in ilmenite, and indicated that ore bodies of considerable size well might be developed.

The Quebec Iron & Titanium Corp.—owned two-thirds by Kennecott and one-third by New Jersey Zinc—was organized to equip and operate the property, according to the 1948 annual report to stockholders of the Kennecott Copper Corp. A railroad 27 miles in length will be required to transport the ores to the St. Lawrence River at Havre St. Pierre, and grading for 4½ miles of the distance had been completed early in 1949. From Havre St. Pierre the ore will be moved up the St. Lawrence about 600 miles to Sorel, where the smelting operation will be conducted utilizing the hydroelectric power available in that area. Production on a small scale is scheduled to begin late in 1950, and the company hopes to be treating 1,500 tons of ore a day by the end of 1951. An over-all expenditure of $25,000,000, about two-thirds in the Sorel area, is expected to be needed to bring the operation to the initial capacity indicated. Through extended research an electric smelting method for separating the ore into mer-

[9] Northern Miner, New Titanium-Iron Ore Fields Add Impulse to Industry: Vol. 34, No. 22, Aug. 19, 1948, pp. 1, 8-9.

chantable iron and high-grade titanium oxide slag was developed. In speaking of the market for their product, Kennecott stated:

> At the beginning of operations the principal demand for the titanium slag will be for conversion into titanium oxide for use in the paint, white rubber, paper and ceramic industries. Eventually, however, there should be a substantial market for the slag to process into titanium metal, which, because of its strength, corrosion resistance and relatively light weight, should be superior to other metals for many purposes. As research is currently being carried on by many organizations to find a low-cost process for producing the metal, it is quite possible that developments in this direction will be realized within a reasonable length of time.

According to the Northern Miner of January 20, 1949, plans cover an initial 1,500-ton unit, but the plant is laid out to accommodate four such units. The annual treatment of 550,000 tons of ore is expected to yield 175,000 tons of high-grade iron and 250,000 tons of TiO_2 slag.

OTHER COUNTRIES

Czechoslovakia.—Production of titanium oxide at Aussig was discussed in a recent report.[10] The data were given entirely from memory. The plant was said to have had a capacity of 600 to 900 metric tons of titanium oxide before the war. Planned extensions to 1,200–1,500 tons were not completed. Supplies of ilmenite had come from Travancore, Portugal, and Norway and just before the war were largely from Malaya. Norwegian ilmenite was used solely during the war. Another report [11] stated that a deposit of ilmenite of excellent quality had been located near Pilsen.

United Kingdom.—The British Titan Products Co., Ltd., which has operated a titanium pigments plant at Bellingham since 1934, planned [12] to complete a new plant at Grimsby before the end of 1948. Production was expected to begin early in 1949 and to expand to 10,000 tons of rutile-grade titanium oxide pigment annually. The Grimsby works will have its own sulfuric acid plant, which is expected to produce 110 tons of sulfuric acid a day and is said to be the largest single contact unit in the country. Imports of titanium ores into the United Kingdom totaled 57,493 long tons in 1948 compared with 71,250 tons in 1947.

[10] Richmond, J. T. (interrogation of Walter Neumann, Nov. 17, 1947), Production of Titanium Oxide at Aussig: British Intelligence Objectives Subcommittee Final Rept. 1410, 1947, 4 pp.
[11] Chemical Engineering, vol. 55, No. 10, October 1948, p. 226.
[12] Chemical Age (London), A Triumph for Engineers: Vol. 59, No. 1516, July 31, 1948, pp. 157–159.

Tungsten

By HUBERT W. DAVIS

GENERAL SUMMARY

GREATLY expanded domestic production and imports, higher level of consumption, reduction in the rate of duty, and lower prices were features of the tungsten industry in 1948.

Despite a 24-percent reduction in the rate of duty, domestic output and shipments of tungsten concentrates reversed a 4-year downward trend. Production and shipments of tungsten concentrates (60 percent WO_3 basis) were 4,210 and 4,005 short tons, respectively, in 1948, increases of 32 and 29 percent over 1947. California displaced Nevada as the premier tungsten-producing State in 1948. The Climax Molybdenum Co. began commercial recovery of tungsten concentrate as a byproduct of molybdenite production at the Climax mine in Lake County, Colo., in May 1948.

Salient statistics of tungsten ores and concentrates in the United States, 1944–48, in pounds of contained tungsten

Year	Production	Shipments from mines	Imports for consumption	Consumption	Industry stocks at end of year		
					Producers	Consumers and dealers	Total
1944	9,764,647	9,786,537	18,396,277	19,165,000	435,634	1,510,419	1,946,053
1945	5,388,639	5,266,818	4,773,861	14,146,000	557,042	3,784,429	4,341,471
1946	4,671,042	4,942,282	6,869,438	6,458,000	285,865	3,694,256	3,980,121
1947	3,026,470	2,944,622	6,018,005	7,812,000	368,316	[1] 3,343,392	[1] 3,711,708
1948	4,006,741	3,811,639	7,548,101	8,853,000	563,418	5,284,901	5,848,319

[1] Revised figure.

Imports of tungsten ores and concentrates for consumption in the United States were also larger in 1948; they were 7,931 short tons (60 percent WO_3 basis), an increase of 25 percent over 1947. Asia, chiefly China, supplied 68 percent of the total imports in 1948 and 123 percent more than in 1947. Imports from South America, however, were 28 percent smaller in 1948 than in 1947. Of the total imports, 1,792 tons (60 percent WO_3 basis) were received from China duty free for the United States Government.

Consumption of tungsten concentrates (60 percent WO_3 basis) in the United States was 9,300 short tons in 1948, compared with 8,200 tons in 1947. The quantity of concentrates converted to ferrotungsten was 8 percent greater in 1948 than in 1947. A much greater export

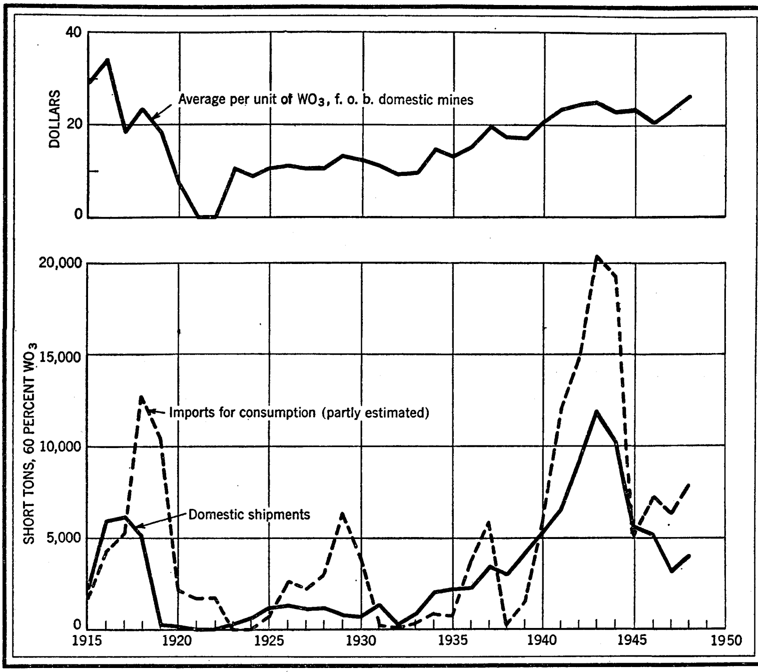

FIGURE.—Trends in domestic shipments, imports, and average price of tungsten ores and concentrates, 1915–48.

demand for ferrotungsten, which increased to 1,255,435 pounds (gross weight) in 1948 from 81,983 pounds in 1947, was more than enough to account for the larger quantity of concentrates used in making ferrotungsten in 1948. Usage of tungsten concentrates charged directly to the steel bath was 32 percent greater than in 1947. Consumption of concentrates in tungsten-metal powder and other tungsten products gained 12 percent.

Industry stocks of tungsten concentrates (60 percent WO_3 basis) were 6,145 short tons on December 31, 1948, compared with 3,900 tons at the end of 1947.

Effective May 22, 1948, the rate of duty on tungsten ores and concentrates was reduced to \$6.03 a short-ton unit of WO_3; the former rate was \$7.93 a unit.

RESERVES

Information on reserves of tungsten ore in the United States, prepared by the Bureau of Mines and Geological Survey, was published in hearings before a subcommittee of the Committee on Public Lands, United States Senate, Eightieth Congress, first session, 1947 (pp. 300–303); an abstract is contained in the chapter of this series for 1947 (p. 1187).

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. The leading tungsten producers and many small operators depend on ore carrying tungsten only as scheelite (calcium tungstate). Hübnerite (manganese tungstate), wolframite (iron-manganese tungstate), and ferberite (iron tungstate), in the order listed, contributed smaller quantities of the tungsten in domestic ore mined in 1948. Most of the concentrates are converted to ferrotungsten and tungsten metal. Some high-purity concentrates, however, are charged directly to the steel bath.

Despite a 24-percent reduction in the rate of duty and substantially lower price, production of concentrates (60 percent WO_3 basis) reversed a 4-year downward trend in 1948, when 4,210 short tons were produced compared with 3,180 tons in 1947. Output in 1948 was obtained from many widely scattered operations in eight States and Alaska, but three States—California, Nevada, and North Carolina—supplied 94 percent of the total; and six operators—Climax Molybdenum Co., Nevada-Massachusetts Co., Nevada Scheelite, Inc., Surcease Mining Co., Tungsten Mining Corp., and United States Vanadium Corp.—produced 90 percent of the United States total. California displaced Nevada as the premier tungsten-producing State in 1948. Despite a 63-percent gain in output in North Carolina, it dropped to third place in 1948.

Tungsten concentrates produced and shipped in the United States, 1947–48, by States

State	Produced				Shipped from mines			
	1947		1948		1947		1948	
	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	5	326	1	85	13	751		
Arizona	13	805	23	1,388	13	805	23	1,388
California	476	28,535	1,779	106,765	394	23,650	1,767	106,006
Colorado	61	3,678	198	11,854	68	4,046	208	12,463
Idaho	139	8,356	2	117	61	3,656	86	5,201
Missouri			8	484			4	242
Montana	1	34			4	244		
Nevada	1,906	114,383	1,254	75,245	2,002	120,129	949	56,929
North Carolina	578	34,656	942	56,522	538	32,295	965	57,924
Utah	1	55	3	146	1	55	3	146
Total	3,180	190,828	4,210	252,606	3,094	185,631	4,005	240,299

Tungsten concentrates shipped from mines in the United States, 1944–48

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
1944	10,283	9,786,537	$14,407,143	$23.35	$1.47
1945	5,534	5,266,818	7,692,691	23.17	1.46
1946	5,193	4,942,282	6,283,413	20.17	1.27
1947	3,094	2,944,622	4,349,851	23.43	1.48
1948	4,005	3,811,639	6,312,161	26.27	1.66

Tungsten ore and concentrates shipped from mines in the United States, by States, with shipments for maximum year and cumulative shipments from 1900 to end of 1948, in short tons of 60 percent WO_3

State	Maximum shipments		Shipments by years							Total shipments from 1900 to end of 1948	
	Year	Quantity	1943	1944	1945	1946	1947	1948 Quantity	1948 Percent of total	Quantity	Percent of total
Alaska	1916	47	10	19		19	13			177	0.15
Arizona	1936	489	62	29	97	20	13	23	0.57	3,913	3.18
California	1943	3,871	3,871	3,027	1,073	1,262	394	1,767	44.12	36,452	29.62
Colorado	1917	2,707	378	296	234	213	68	208	5.19	24,834	20.18
Connecticut	1916	3								11	.01
Idaho	1943	4,648	4,648	4,005	2,130	641	61	86	2.15	15,294	12.43
Missouri	1940	13	1	1				4	.10	35	.03
Montana	1946	84		25	(1)	84	4			508	.41
Nevada	1942	3,052	2,910	2,665	1,857	2,617	2,002	949	23.70	36,703	29.83
New Mexico	1915	45		9						103	.08
North Carolina	1948	965	40	186	132	307	538	965	24.09	2,168	1.76
Oregon	1917	(1)								(1)	(2)
South Dakota	1917	270		7	4	1				1,296	1.05
Texas	1946	1				1				1	(2)
Utah	1917	33	21	9	5	27	1	3	.08	238	.19
Washington	1938	303	4	5	2	1				1,326	1.08
Total	1943	11,945	11,945	10,283	5,534	5,193	3,094	4,005	100.00	123,059	100.00

1 Less than half a ton.
2 Less than 0.01 percent.

Alaska.—J. H. Scott Co., operating the Riverside mine near Hyder, produced (but did not ship) a small quantity of concentrate averaging 50 percent WO_3 in 1948. The Yukon Corp. did some prospecting at the Big Chief mine near Fairbanks in 1948.

The tungsten deposits in Alaska have been described.[1]

Arizona.—Production and shipments of tungsten concentrates in Arizona were 20 short tons averaging 69.4 percent WO_3 in 1948 compared with 16 tons averaging 50.3 percent WO_3 in 1947. The outputs in both years came from several widely scattered operations.

California.—California ascended from third to first place as a tungsten-producing State in 1948, chiefly because of greatly increased operations at the Pine Creek mine and concentrator and partly to a much higher rate of activity at the Spud Patch placer and to reopening of the Strawberry mine. Output of concentrates was 1,542 short tons averaging 69.2 percent WO_3 in 1948, compared with 521 tons averaging 54.8 percent WO_3 in 1947. Shipments of tungsten concentrates totaled 1,549 tons averaging 68.4 percent WO_3 in 1948, compared with 515 tons averaging 45.9 percent WO_3 in 1947. Although concentrates were produced at a number of widely scattered operations, six producers (Alpine Mining Co., Consolidated Tungsten, Strawberry Tungsten Mine, Surcease Mining Co., Tulare County Tungsten Mines, and United States Vanadium Corp.) supplied 96 percent of the State total. The bulk of the remainder was contributed by Embree & Eliason Mining Co., Sheridan & Bennett, Hanging Valley Tungsten Co., W. C. Thompson, and O. A. Kittle Mining & Exploration Co.

1 Thorne, R. L., and others, Tungsten Deposits in Alaska: Bureau of Mines Rept. of Investigations 4174, 1948, 51 pp.

The Pine Creek mine and concentrator of United States Vanadium Corp. near Bishop were operated at greatly increased rates in 1948; and the company output of tungsten concentrates, which was nearly 12 times more than in 1947, was the largest in the United States. The driving of a 7,240-foot low-level adit, which was begun in 1945, was completed in 1948, and installation of 36-inch gage track in the tunnel was begun.

Surcease Mining Co. continued to work the Spud Patch and other placers in San Bernardino County, and its output of concentrate in 1948 was 121 percent greater than in 1947.

The Harrel Hill mine in Tulare County, operated by Consolidated Tungsten, and the Alpine mine in Alpine County, operated by Alpine Mining Co., were worked at much higher rates in 1948 than in 1947.

About half as much tungsten concentrate was produced in 1948 as in 1947 by Tulare County Tungsten Mines, operating the Big Jim mine in Tulare County.

The Strawberry mine in Madera County was reopened in 1948 by the Strawberry Tungsten Mine, which drove two new adits 190 feet, deepened the shaft 40 feet, and rebuilt the mill.

The O. A. Kittle Mining & Exploration Co., which leased the Round Valley mine in Inyo County, found an ore body by diamond drilling.

The Tungstar Corp. leased the Black Rock mine in Mono County and began development in December 1948. The mill to serve the mine was being rehabilitated for operation in 1949. The Tungstar Corp. also plans to diamond-drill its Tungstar mine in Inyo County.

The tungsten occurrences in the Darwin district have been described briefly.[2]

Colorado.—Production and shipments of tungsten concentrates (60 percent WO_3 basis) in Colorado were 198 and 208 short tons, respectively, in 1948 compared with 61 and 68 tons, respectively, in 1947.

The Climax Molybdenum Co., operating the world's largest known molybdenite deposit at Climax, Lake County, began recovery of the very small tungsten content of its ore in May 1948.

The Firth-Sterling Steel & Carbide Corp. (Wolf Tongue Division), Tanner & Smith, and George H. Teal & Associates were the chief producers of tungsten concentrates in Boulder County in 1948. The Firth-Sterling Steel & Carbide Corp. discontinued mining and milling tungsten ore December 24, 1948, and was liquidating its tungsten holdings. This company has been active in mining tungsten ore in the Boulder County field since 1905.

Idaho.—A new concentrator to serve the Ima mine in Lemhi County was under construction in 1948 by Bradley Mining Co. The mill, which replaces one destroyed by fire December 10, 1947, was completed and put into operation in January 1949. Development was done at the Ima mine during 1948.

Missouri.—The And-Mor Mining Co., Inc., operated the Apex mine in Madison County, near Fredericktown, in 1948.

Nevada.—Nevada, which for three successive years had been the premier tungsten-producing State, surrendered the lead to California in 1948. Production of concentrates was 1,076 short tons averaging

[2] Butner, D. W., Investigation of Tungsten Occurrences in Darwin District, Inyo County, Calif.: Bureau of Mines Rept. of Investigations 4475, 1949, 6 pp.

70 percent WO_3 in 1948 compared with 3,550 tons averaging 32 percent WO_3 in 1947. Shipments were also smaller and were 874 tons averaging 65 percent WO_3 in 1948 compared with 3,576 tons averaging 34 percent WO_3 in 1947.

The Nevada-Massachusetts Co., the largest producer of tungsten concentrates in the United States in 1947, dropped to second place in 1948; its output was 19 percent smaller than in 1947. The mill and the Stank, Humboldt, and Sutton No. 2 mines were operated steadily. Work was discontinued at the O'Byrne mine after March 1. Very little underground development was done in 1948. Open-pit mining continued to yield satisfactory tonnages in 1948.

The second-largest producer of tungsten concentrates in Nevada in 1948 was Nevada Scheelite, Inc., operating a mine of the same name in Mineral County; output was four times that in 1947.

The chief smaller producers of concentrates in 1948 were the Atolia Mining Co., operating the Lincoln mine in Lincoln County; Minerva Scheelite Mining Co., operating the Scheelite Chief mine in White Pine County; Tungsten Minerals, Inc., operating the Tungstonia mine also in White Pine County; United States Vanadium Corp., operating the Riley mine in Humboldt County; and the Cherry Creek Mining Co., operating the Cherry Creek mine in White Pine County. The Lincoln mine was closed in July 1948, and operations at the Riley mine were discontinued for an indefinite period in early 1948. The Scheelite Chief mine, formerly worked by Tungsten Metals Corp., was rehabilitated, and a mill of 25-ton daily capacity was built to serve it. Much development was done at the Tungstonia mine in 1948.

North Carolina.—Despite a 63-percent gain in production of tungsten concentrates, North Carolina dropped from second to third place as a tungsten-producing State in 1948. Output was 969 short tons averaging 58.3 percent WO_3 in 1948 compared with 585 tons averaging 59.2 percent WO_3 in 1947. Shipments were also much larger and totaled 990 tons averaging 58.5 percent WO_3 in 1948 compared with 542 tons averaging 59.6 percent WO_3 in 1947.

The Tungsten Mining Corp., operating the Hamme mine in Vance County, continued to be the only producer of tungsten concentrates in North Carolina. The major development program, which was inaugurated by the company in June 1947, was continued in 1948; as a result, 17,382 feet of diamond drilling and 7,526 feet of underground development were done; a 215-foot shaft was sunk to open the Sneed No. 2 ore body, and from this shaft a 500-foot drift was driven to open the Sneed No. 1 ore body. The sinking of a central shaft was begun to facilitate mining operations and to free shaft ore pillars. Winzes were sunk to the 400- and 500-foot levels, respectively, of veins No. 2 and No. 3. To increase milling capacity, a rod mill for regrinding was added, and for upgrading concentrates a six-pole magnetic separator was installed.

The Seminole Rock & Sand Co. did no development at its property in Vance County in 1948. However, it shipped a small quantity of concentrate which was produced in 1944.

The tungsten deposits in Vance County have been described.[3]

Utah.—Small quantities of tungsten concentrates were produced in Tooele County, Utah, in 1948 by the Star Dust Mines, Inc., operating the Star Dust mine; C. H. Wilson, operating the Yellow Hammer mine; and Fred Cook (property not reported).

CONSUMPTION

Consumption of tungsten concentrates (60 percent WO_3 basis) in the United States was about 9,300 short tons in 1948 compared with 8,200 tons in 1947. Of the total consumed in 1948, about 4,100 tons (44 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 1,850 tons (20 percent) were so used in 1948. Tungsten-metal powder and other tungsten products, chiefly the former, utilized about 3,350 tons or 36 percent of the total concentrates consumed in 1948.

PRICES

Prices on tungsten concentrates were, in general, downward in 1948. According to the Engineering and Mining Journal, quotations on imported concentrates had declined from \$30 a short-ton unit of WO_3, duty paid, on January 1 to \$23.50–\$24 a unit on September 9; thereafter prices firmed somewhat and at the year end had advanced to \$24.25–\$24.75 a unit. Domestic scheelite of good known analysis, in carlots, delivered, was quoted at \$30 a short-ton unit of WO_3 from January 1 to June 16, at \$28 a unit from June 17 to November 3, and at \$28.50 a unit from November 4 to December 31. The use of high-purity scheelite for direct smelting has placed a premium on this type of concentrate. As reported to the Bureau of Mines, the average price for domestic concentrates shipped to consumers was \$26.27 a short-ton unit of WO_3 in 1948.

FOREIGN TRADE[4]

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 9,763,761 pounds (tungsten content), equivalent to 10,259 short tons of 60 percent WO_3 in 1948, an 8-percent gain over 1947. This quantity represents the ores and concentrates received in the United States, irrespective of final disposition. Although ores and concentrates were received from 17 foreign countries in 1948, 4—China (50 percent), Korea (18 percent), Brazil (9 percent), and Bolivia (5 percent)—supplied 82 percent of the total.

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[3] McIntosh, F. K., Investigation of the Hamme Tungsten District, Vance County, N. C., and Mecklenburg County, Va.: Bureau of Mines Rept. of Investigations 4380, 1948, 6 pp.

[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.

Tungsten ores and concentrates imported into the United States, 1947–48, by countries

[U. S. Department of Commerce]

Country	General imports [1]		Imports for consumption [2]		
	Gross weight (pounds)	Tungsten content (pounds)	Gross weight (pounds)	Tungsten content (pounds)	Value
1947					
Argentina	624,902	343,952	605,104	306,098	$248,209
Australia	61,801	31,521	415,524	222,994	124,114
Belgian Congo	983,357	550,328	956,099	534,343	516,543
Bolivia	2,857,025	1,093,463	2,040,934	829,062	688,069
Brazil	2,163,454	1,225,435	1,584,420	905,704	840,863
British East Africa	50,347	26,686	38,052	19,907	16,575
Canada	717,920	175,679	296,157	150,914	126,901
Chile	106,200	58,613	116,726	63,387	61,590
China	4,287,934	2,313,657	3,019,317	1,650,354	2,563,507
Cuba			100	28	24
Indonesia	141,934	80,502	198,057	110,018	109,702
Korea	1,921,375	953,711			
Malaya, Federation of			8,649	4,850	4,590
Mexico	326,994	151,926	92,510	48,700	45,240
New Zealand	11,200	6,297	11,200	6,297	4,565
Peru	35,274	19,024	199,117	78,610	70,976
Portugal	322,736	154,523	222,018	107,084	104,130
Southern Rhodesia			383,572	203,254	193,410
Spain	2,301,519	1,031,076	226,638	114,472	101,987
Thailand	1,633,692	778,092	947,460	533,827	480,517
Union of South Africa	14,800	7,630	203,052	109,869	102,915
United Kingdom			39,034	18,233	17,400
Total	18,562,464	9,002,115	11,603,740	6,018,005	6,421,827
1948					
Argentina	16,174	8,261	16,174	8,261	12,058
Australia	164,051	87,974	6,782	3,629	3,435
Belgian Congo	199,810	110,758	209,922	116,417	122,937
Bolivia	1,499,527	506,268	1,184,831	507,490	489,172
Brazil	1,546,394	864,736	1,517,649	847,557	912,723
British East Africa	20,539	11,337	20,539	11,337	14,824
Canada	583,195	337,878	631,030	363,391	432,182
Chile			76,796	40,641	39,041
China	9,186,480	4,893,326	6,964,372	3,699,850	3,827,676
French Indochina	803,360	178,401			
Japan	55,115	36,370	135,662	71,095	68,311
Korea	3,598,789	1,723,275	1,813,771	980,765	947,062
Mexico	314,370	151,492	289,422	153,432	166,600
Peru	533,251	157,497	779,597	157,768	145,540
Portugal	24,125	10,207	25,873	12,240	8,807
Southern Rhodesia	77,840	31,136	25,406	12,728	12,795
Spain	503,416	261,791	580,466	181,617	207,617
Thailand	809,333	393,054	693,748	379,883	366,481
Total	19,935,769	9,763,761	14,972,040	7,548,101	7,777,261

[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.

Imports of ores and concentrates for consumption in the United States were 7,548,101 pounds (tungsten content), equivalent to 7,931 short tons of 60 percent WO_3 in 1948, a gain of 25 percent over 1947. 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 and concentrates which enter duty free for the United States Government. China (49 percent), Korea (13 percent), Brazil (11 percent), and Bolivia (7 percent) supplied 80 percent of the total. Of the total imports, 1,705,831 pounds (tungsten content), equivalent to 1,792 short tons of 60 percent WO_3, from China were duty-free for the United States Government.

In 1948, 972 short tons (60 percent WO_3) of ores and concentrates were withdrawn from warehouses for smelting, refining, and export (954 tons in 1947), and 391 tons (gross weight) were reexported (933 tons in 1947). Ores and concentrates withdrawn for smelting, refining, and export and for reexport are free of duty.

Effective May 22, 1948, the rate of duty on tungsten ores and concentrates was reduced to 38 cents a pound on the metallic tungsten contained therein. This is equivalent to $6.03 a short-ton unit.[5] The former rate was 50 cents a pound or $7.93 a short-ton unit.

Exports of tungsten ores and concentrates from the United States were 415 short tons (gross weight) in 1948 compared with 155 tons in 1947. Of the 1948 exports, 180 tons went to the United Kingdom, 108 tons to Germany, 54 tons to Sweden, 35 tons to India, 20 tons to Italy, 18 tons to France, and 19 pounds to Canada.

Imports of tungsten metal were 224 pounds in 1948 (10,890 pounds in 1947). No tungstic acid was imported in 1948 (4 pounds in 1947). There were no imports of ferrotungsten, tungsten carbide, or combinations containing tungsten or tungsten carbide in 1947 or 1948.

Exports of tungsten metal, stellite, wire, shapes, and alloys other than ferrotungsten were 181,956 pounds in 1948 (243,741 pounds in 1947). Exports of ferrotungsten were 1,255,435 pounds (gross weight) in 1948 (81,983 pounds in 1947).

WORLD REVIEW

Argentina.—Argentina formerly ranked as the second-largest producer of tungsten in South America; but in 1944 it was displaced by Brazil, and in 1946 it was displaced by Peru as the third-largest producer. Output in Argentina comes from the Provinces of Catamarca, Córdoba, Mendoza, San Juan, and San Luis. Production of tungsten (60 percent WO_3 basis) in Argentina advanced uninterruptedly from 392 metric tons in 1934 to reach a peak of 2,390 tons in 1943. During the three following years output declined progressively and had dropped to 457 tons in 1946. Except for a small tonnage mined in the course of maintenance work, production was virtually suspended in 1947 and 1948. The marked decline in tungsten operations was attributed to termination of war contracts, increase in cost of production, lack of a home market, and uncertainty of getting working permits promptly.[6] To promote tungsten production in Argentina, it has been proposed that a law be introduced that would cover such points as setting a reasonable price for the producer under different circumstances, permitting the state to collect a stock of tungsten minerals for emergency, and controlling employer-employee relationships.

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[5] 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).

[6] Chemical Engineering, vol. 55, No. 9, September 1948, p. 312.

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World production of tungsten ores, by countries, in metric tons of concentrates containing 60 percent WO_3, 1941–48 [1]

[Compiled by B. B. Mitchell]

Country [1]	1941	1942	1943	1944	1945	1946	1947	1948
North America:								
Canada	32	244	618	214	-------	-------	375	727
Cuba (exports)	-------	7	7	-------	9	-------	-------	-------
Mexico	191	193	516	336	134	95	97	168
United States (shipments)	5,957	8,467	10,836	9,329	5,020	4,711	2,807	3,633
Total North America	6,180	8,911	11,977	9,879	5,163	4,806	3,279	4,528
South America:								
Argentina	1,720	2,115	2,390	2,043	1,067	457	33	33
Bolivia (exports)	4,353	5,606	6,902	7,935	3,851	2,120	2,635	2,485
Brazil (exports)	35	9	1,264	2,221	2,192	1,623	1,329	1,144
Chile	1	-------	3	3	-------	(2)	(2)	-------
Peru	337	510	722	635	523	510	579	227
Total South America	6,446	8,240	11,281	12,837	7,633	4,710	4,576	3,889
Europe:								
France	120	95	126	84	185	286	391	(2)
Italy	1	5	2	2	6	(2)	(2)	(2)
Norway	8	7	-------	4	5	-------	-------	(2)
Portugal	5,834	5,220	7,477	4,088	-------	630	3,149	2,930
Spain	415	1,462	3,902	2,393	283	431	461	888
Sweden	228	267	290	335	413	490	322	(2)
United Kingdom	127	198	237	350	120	108	68	(2)
Total Europe	6,733	7,254	12,034	7,256	1,012	(2)	(2)	(2)
Asia:								
Burma	8,300	1,346	1,346	1,346	-------	-------	1,045	(2)
China	13,538	12,962	9,734	3,502	2,929	2,691	6,900	12,200
India	77	87	85	33	22	3	(2)	(2)
Indochina, French	333	213	107	83	8	-------	(2)	-------
Indonesia	(3)	-------	-------	-------	(2)	(2)	(2)	(2)
Japan	[4] 601	[4] 817	[4] 733	[4] 575	[4] 193	[4] 59	19	9
Korea:								
North	4,650	6,062	6,932	8,402	1,513	1,180	975	(2)
South							1,227	1,300
Malaya, Federation of	[5] 56	61	146	217	29	10	50	87
Thailand	961	1,653	1,738	1,135	461	201	486	495
Total Asia	28,516	23,201	20,821	15,293	5,155	4,144	(2)	(2)
Africa:								
Belgian Congo	123	315	467	433	513	397	670	236
Egypt	43	17	42	16	-------	-------	-------	15
Morocco, French	-------	(3)	-------	3	-------	-------	-------	-------
Nigeria	-------	100	75	30	6	5	4	4
Southern Rhodesia	264	504	806	757	287	53	26	80
South-West Africa	116	122	174	118	4	-------	10	12
Tanganyika (exports)	1	2	3	-------	-------	-------	-------	(3)
Uganda	-------	7	33	95	92	102	139	126
Union of South Africa	142	400	430	660	452	144	91	151
Total Africa	689	1,467	2,030	2,112	1,354	701	940	624
Oceania:								
Australia:								
New South Wales	95	52	75	53	53	42	45	(2)
Northern Territory	333	159	193	102	140	74	103	72
Queensland	137	217	177	229	155	75	82	96
Tasmania	577	475	463	300	800	850	902	1,031
New Zealand	79	73	121	159	37	30	24	28
Total Oceania	1,221	976	1,029	843	1,185	1,071	1,156	(2)
Grand total (estimate) [1]	49,800	50,000	59,200	48,200	21,500	17,300	25,000	32,000

[1] In addition to countries listed, tungsten ore is produced in U. S. S. R., but data on production are not available; no estimate included in total.
[2] Data not available; estimates by author of chapter included in total.
[3] Less than 1 ton.
[4] Preliminary data for the fiscal year ended Mar. 31 of year following that stated.
[5] January to September, inclusive.

Australia.—During the year ended October 31, 1948, the King Island Scheelite, N. L., milled 142,641 long tons of scheelite ore averaging 0.6 percent WO_3, which yielded 591 tons of concentrate. In the corresponding year 1947 it milled 128,628 tons of ore averaging 0.652 percent WO_3, which yielded 613 tons of concentrate averaging 64.7 percent WO_3. The mine, which is on King Island in Bass Strait, is worked by the open-pit method and is served by a treatment plant (capacity 20,000 tons of ore monthly) comprising gravity units for recovery of the coarse mineral and a flotation section for recovery of slimed material.

Bolivia.—Bolivia continued to be the largest tungsten producer in South America. Most of the deposits are in the Departments of La Paz, Oruro, Potosí, and Cochabamba. Output (as indicated by exports) was 2,485 metric tons (60 percent WO_3 basis) in 1948 compared with 2,635 tons in 1947.

Brazil.—Brazil continued to be the second-largest producer of tungsten in South America. The principal deposits are in the States of Paraíba and Rio Grande do Norte. Continuing a downward trend that has persisted for four successive years, exports of tungsten concentrates (65 percent WO_3) were 1,056 metric tons in 1948 compared with 1,226 tons in 1947.

Burma.—Before World War II Burma ranked second to China as a tungsten-producing country. The chief producing mines have been the Mawchi in the southern part of Karenni State, and the Hermingyi, in the Tavoy District. Mining of tungsten was resumed in the Tavoy and other districts of Lower Burma in 1947.

Production of tungsten concentrates in Burma in 1947, by districts, in long tons

District	Wolframite concentrates	Mixed tin and wolframite concentrates
Amherst		2
Mergui	154	73
Tavoy	180	935
Thatôn		163
Yamèthin	15	47
Total	349	1,220

Mining and milling operations were resumed at the Mawchi mine in March 1948. However, because of the political unrest in Karenni, the Government of Burma placed an embargo on supplies of explosives for the Mawchi mine, and as a consequence full-scale production was not attained in 1948; only 836 long tons of mixed tin-wolfram concentrates were produced. On reoccupation of the property, which was captured by the Japanese during World War II, 589 tons of mixed tin-wolfram concentrates were recovered and shipped to Great Britain.

Canada.—Production of tungsten concentrate (WO_3 content) in Canada was 962,000 pounds in 1948 compared with 496,023 pounds in 1947. Output in both years was from British Columbia, presumably from the Emerald mine.

Chile.—Chile ranks last among the five South American countries that produce tungsten. The deposits are in the northern part of central Chile and near Santiago. The deposits in the northern part of the country have been described.[7]

China.—In 1948, as in 1947, China was the premier producer of tungsten. Exports of tungsten from China increased phenomenally in 1948 and were the largest since 1942; they were about 11,300 metric tons in 1948 compared with 6,109 tons in 1947; the average WO_3 content was about 65 percent.

France.—The entire production of tungsten concentrate in France is from the Montmins mine in the Department of Allier.[8] Outputs were 227 metric tons averaging 75.54 percent WO_3 in 1946 and 350 tons (WO_3 content not stated) in 1947.

Korea.—Production of tungsten concentrates (60 percent WO_3 basis) in South Korea was 1,300 metric tons in 1948 compared with 1,227 tons in 1947.

Peru.—Production of tungsten concentrates in Peru declined markedly in 1948 and was the smallest since 1939; nevertheless, it has displaced Argentina as the third-largest tungsten producer in South America. Output (60 percent WO_3 basis) was 227 metric tons in 1948 compared with 579 tons in 1947. The principal deposits are in the Departments of La Libertad and Ancash; there are other deposits in the Departments of Puno and Huancavelica.

Portugal.—Portugal is the largest producer of tungsten in Europe, and the Panasqueira, Ribeira, and Borralha mines are the chief producers. As a result of greatly increased demand and competitive buying by the Allies and Germany during World War II, production reached a peak of 7,477 metric tons (60 percent WO_3 basis) in 1943. However, on the eve of the invasion (June 6, 1944) of France by the Allies, Portugal prohibited the exportation, circulation, and transit of tungsten and also suspended the operation of existing mines and the development of new ones. As a consequence, the smaller mines were closed completely, whereas the larger mines went on a maintenance basis. In late 1945 the prohibition on mining of tungsten was lifted; likewise, the restrictions on sales were removed, but half of the exports were required to be supplied from the Government's stock. As a result of this requirement and of greatly lessened demand following the end of hostilities, output in Portugal was at a low rate in 1946. Greatly accelerated world demand and much higher prices in 1947 were accompanied by increased operating schedules; as a result, Portugal regained its position as the leading tungsten-producing country in Europe. Output (60 percent WO_3 basis) increased from 630 metric tons in 1946 to 3,149 tons in 1947 but declined to 2,930 tons in 1948.

The three largest producing tungsten mines in Portugal have been described[9] as follows:

> **Panasqueira Mine.**—The British Beralt Tin and Wolfram Limited operates this mine located about 800 meters above sea level 28 kilometers west of Fundao which is 308 kilometers by road northeast of Lisbon on the flank of the Serra da Estrela. At present, it is producing about 170 tons per month of concentrate containing 73 percent WO_3 and 10 tons of cassiterite concentrate containing 70 percent tin. The Panasqueira mine is believed to be the largest individual producer of wolframite in operation today anywhere in the world. The ore deposits con-

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[7] McAllister, J. F., and Ruiz F., Carlos, Geology of Tungsten Deposits in North-Central Chile: Geol. Survey Bull. 960-C, 1948, pp. 89-106.

[8] Mining and Metallurgy, vol. 29, No. 501, September 1948, p. 499.

[9] Kelsey, E. T., Portuguese Tin and Tungsten Industries: Am. Embassy, Lisbon, Portugal, Rept. 7, Feb. 18, 1949, 12 pp.

sist of numerous irregular veins which represent the filling of a system of flat dipping fracture planes in slates with interbedded quartzite and are situated near a granite contact. Largely hydrothermal in origin, the veins are up to 50 centimeters thick and contain wolframite or cassiterite or mixtures of the two along with arsenopyrite, pyrite, chalcopyrite, apatite, and various carbonates, in a quartz gangue. Ore currently being mined analyzes approximately 0.63 percent WO_3 and 0.05 percent Sn. Mining through adits is done by long wall stopping with pack walls of waste or shock packs. Hand sorting in the stopes eliminates half the volume. The balance goes to a mill where sulphides are floated off, after grinding, and wolframite ultimately recovered by magnetic separation after passing through jigs for preliminary gravity separation. Mechanical equipment is electrically operated with power supplied by the Serra da Estrela company and in addition to well equipped shops includes air compressors delivering 6,000 cubic feet of free air per minute. Besides drills, small air hoists and pumps only are used. Mules are used for tramming in the main haulageway. Concentrates are trucked to rail at Fundao, thence sent by train 250 kilometers to Lisbon or, occasionally, trucked direct to Lisbon whence shipment is made by sea to the United Kingdom. Employees at present total 2,500. Approximately 500 tons of mixed pyrites are also recovered every month. These are sold in Portugal and their arsenic content recovered.

Ribeira Mine.—The American owned Ribeira mine, now under option to the Empresa Tecnica e Administracoes of Lisbon, controlled by Mr. John C. Allan, Director of Panasqueira mine, is situated about 25 kilometers southeast of Braganca near the Spanish frontier. The deposit, located four miles east of a granite contact, consists of eight quartz veins, 30 to 80 centimeters in width, containing wolfram and scheelite with some chalcopyrite and arsenopyrite in slates and quartzite. Mining is done through adits over a vertical range of 150 meters and 200 meters on strike. Ore now being mined averages 1 percent Sn and 0.2 percent WO_3. Mining is by open stope and milling at present is a rudimentary mixture of hand dressing and gravity concentration followed by magnetic separation. A new mill now under construction is expected to more than double present monthly production which averages seven tons of cassiterite concentrate containing 70 percent Sn and two tons of wolfram minerals concentrate containing 65 percent WO_3. Although this property has been intermittently mined for 60 years or more, development work has not been sufficient to make an accurate forecast of reserves but in the manager's opinion they should be substantial. At present, 200 men are employed, including those constructing the new mill.

Minas da Borralha.—The French owned Minas de Borralha S. A., operates the Minas de Borralha near Venda Nova in the Braga District almost equidistant between Braga and Chaves and some 15 miles south of the Spanish frontier. Present monthly production is given as 40 tons of concentrate containing 65 percent WO_3. When development work and mill enlargement now under way is completed late in 1949, monthly production should average 100 tons of concentrate. The wolframite with a little scheelite occurs in quartz veins in schists or granite near a granite-schist contact. An analysis of the ore is not available but some chalcopyrite, pyrite and arsenopyrite occur. No cassiterite is present. Mining is by open stope reached through adits. Mechanical equipment includes an air compressor. Concentration is by magnetic separation. Ore is shipped by truck to Oporto, thence by boat principally to France. Some 400 workmen are employed underground and on the surface.

South-West Africa.—The O'Okiep Copper Co. continued development and stope preparation of the ore body in its wolframite mine in Namaqualand. A mill to serve the mine was completed and put into operation in October 1948, and the company anticipates that by the summer of 1949 it will be working on a basis of 125 tons of milling ore per day.

United Kingdom.—The production of tungsten in Great Britain is a byproduct of tin mining in Cornwall. The comparatively small domestic output, however, is insufficient for requirements, and the country imports ores and concentrates from many sources. Portugal, Burma, Bolivia, and China, in the order listed, were the chief sources of supply for Great Britain in 1948.

Uranium, Radium, and Thorium

By ALLAN F. MATTHEWS

GENERAL SUMMARY

OPERATION of the first nuclear reactor outside of the American-British-Canadian sphere was announced in France toward the close of 1948. This indication of worldwide atomic developments was noted apprehensively, as it was not paralleled by any perceptible progress in international control of atomic energy.

In the United States a domestic-ore purchase program was launched, a major overhaul of the Hanford reactors was completed, three atomic weapons were tested (at Eniwetok), and nearly 3,000 orders for isotopes were shipped. Expenditures by the Atomic Energy Commission in the fiscal year ended June 30, 1949, were $631,000,000 (338 million for plant and equipment and 293 million for operations), bringing total United States expenditures on atomic energy to $3,474,000,000. The number of scientists and engineers in Atomic Energy projects was 7,000 to 8,000 in July 1945; 3,500 to 4,000 in July 1946; 4,000 to 4,500 in July 1947; and 7,000 to 7,500 in July 1948. By the end of 1948 the AEC had a larger technical staff than the Manhattan District (its predecessor) ever had, although the new team contained fewer prominent men and was composed largely of younger scientists and engineers.

The first uranium–233 ever produced, a few hundred milligrams prepared in a Hanford reactor, was announced by Dr. Glenn T. Seaborg March 5, 1948. The following month the Atomic Energy Commission declared that it considered U–233, which is derived by transmutation of common thorium, to be a fissionable material. However, the AEC added that it was interested in monazite and thorium only for experimental purposes, according to an October 14 statement, quoted in full in the Monazite section of the Minor Nonmetals chapter of this volume.

An interpretation of the Atomic Energy Act of 1946 [1] was published by two lawyers who participated in its drafting. The Atomic Energy Commission, from its inception January 1, 1947, through 1948, comprised David E. Lilienthal (chairman), Robert F. Bacher,

[1] Newman, James R., and Miller, Byron S., The Control of Atomic Energy: McGraw-Hill Book Co. Inc., New York, 1948, 434 pp.

Sumner T. Pike, Lewis L. Strauss, and William W. Waymack (except that Waymack resigned effective December 21, 1948). The first terms of office of these five members were to expire August 1, 1948, and the second terms were to be 1 to 5 years so as to stagger future 5-year terms, according to the Atomic Energy Act. However, the Congress amended the act on June 19, 1948, and merely extended the original terms to June 30, 1950. President Truman reluctantly signed the bill July 3 and stated it was "not in the best public interest, since it invests the atomic energy program with an aura of uncertainty * * *."

MINE AND MILL PRODUCTION

The uranium exploration program of the Geological Survey by 1948 included diamond drilling at a rate of 200,000 feet a year. The drilling is concentrated in public lands that the United States Department of the Interior withdraws from entry at the request of the Atomic Energy Commission. Such areas withdrawn in 1948 totaled approximately 155 square miles and comprised portions of Mesa, Montrose, and San Miguel Counties, Colo., and of Grand County, Utah. This is part of the Colorado Plateau region, a long-established source of carnotite (a radium-bearing potassium-uranium vanadate). Of the lands withdrawn, those found to contain no uranium will again be open for entry, and those showing uranium will become available for development and mining by private operators under special arrangement with the Government.

According to an Atomic Energy Commission statement December 17, 1948, the Colorado Plateau is the only region in the United States where uranium is now mined, and the output is very small compared to total United States requirements and to supplies available from foreign sources. A vein of pitchblende was discovered by Consolidated Caribou Silver Mines, Inc., in its Caribou mine, Grand Island district, Boulder County, Colo.

The United States Vanadium Corp. roscoelite mill at Rifle, Garfield County, Colo., and the Vanadium Corp. of America carnotite mill at Naturita, Montrose County, Colo., yield uranium precipitates. Contracts for Atomic Energy Commission procurement of these precipitates were extended in 1948. Furthermore, the AEC initiated plans to put three idle vanadium mills back to work, with production of uranium as their primary purpose. Toward this end, it purchased the plant at Monticello, Utah, in June 1948, from the War Assets Administration. The ore-purchasing agent is the American Smelting & Refining Co. By the end of the year negotiations were nearly complete for rehabilitation and operation of the plants at Durango and Uravan, Colo., by private companies. All five mills were expected to be operating before the end of 1949. The Vanadium Corp. of America may build a plant in the White Canon district, San Juan County, Utah, to process copper-uranium ores of Arizona and Utah.

Monazite was separated in a mill at McCall, Idaho, from black sands recovered as a byproduct of gold placering. The operator—Rare Earths, Inc.—reportedly shipped 40 tons of monazite in 1948. Monazite is expected to be a byproduct of titanium-zirconium operations from Florida dune and beach sands.

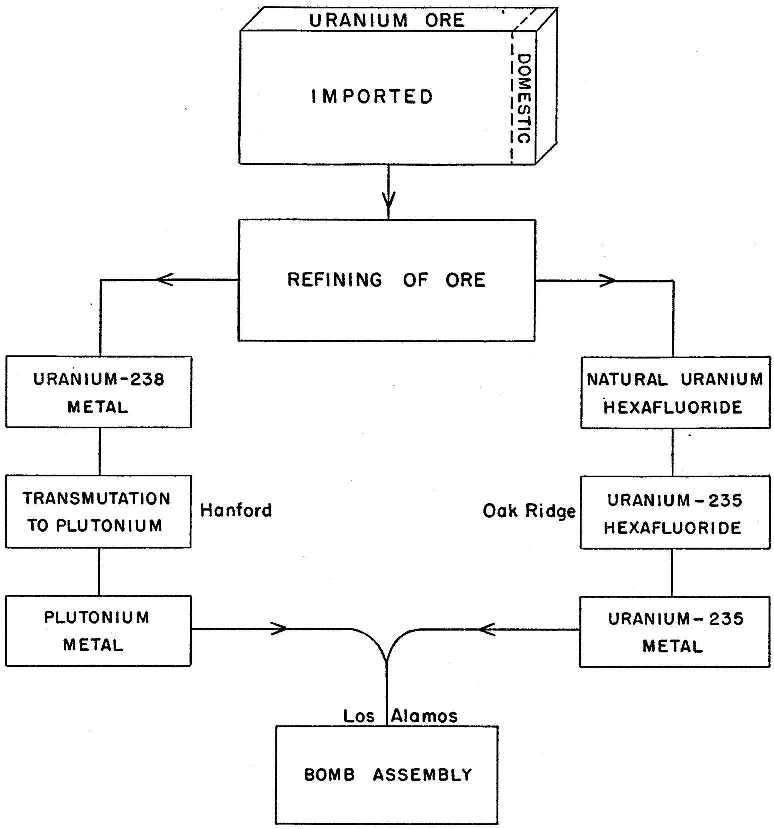

FIGURE 1.—Flow sheet of production of fissionable materials. (The division between domestic and imported ores is schematic and not based on actual data.)

REFINERY AND REACTOR PRODUCTION

Uranium.—During 1948 a new plant for producing uranium dioxide (brown oxide) was completed, and construction of a uranium-metal refinery estimated to cost $2,500,000 was begun. The operating costs per unit of uranium product have been reduced substantially, as shown by the following Atomic Energy Commission index numbers:

Year	Dioxide	Tetrafluoride	Hexafluoride	Metal
1946	100	100	100	100
1947	83	91	97	79
1948	79	84	87	75

Uranium hexafluoride is treated at Oak Ridge, Tenn., by a gaseous diffusion process to separate fissionable uranium (U–235) from common inert uranium (U–238). The Oak Ridge plant is operated by the Carbide & Carbon Chemical Corp., subsidiary of Union Carbide & Carbon Corp. At Hanford, Wash., the General Electric Co. operates uranium-graphite reactors (piles), in which a small portion of the common uranium is transmuted into fissionable plutonium. Both companies are contractors for the Atomic Energy Commission. A major overhaul of the Hanford reactors was undertaken in late 1947 and the first half of 1948. By the end of 1948 the production rate of the original reactors was greater than any achieved in wartime, according to the Atomic Energy Commission. Furthermore, new reactors were under construction in 1948.

Isotopes.—Shipments of isotopes from Oak Ridge, Tenn., exceeded 5,000 by the end of 1948. Data on the weight and radioactivity of such shipments are seldom published. A typical shipment of carbon-14, for example, is 1 millicurie.[2]

Isotopes shipped by the U. S. Atomic Energy Commission, by kinds, 1946–48, in number of shipments

Kind of isotope	1946[1]	1947		1948	
	Second half	First half	Second half	First half	Second half
Iodine-131	68	208	287	454	524
Phosphorus-32	48	212	325	422	479
Carbon-14	47	41	67	67	57
Sodium-24	1	31	49	64	55
Sulfur-35	12	19	20	15	26
Cobalt-60	4	20	12	10	20
Iron-55 and -59	5	21	20	14	19
Calcium-45	5	17	25	15	18
Potassium-42	6	17	14	10	14
Gold-198 and -199	17	46	6	17	12
Strontium-89 and -90	3	4	5	10	8
Others (49)	30	63	123	140	174
Total radioactive	246	699	953	1,238	1,406
Deuterium oxide (heavy water)		31	60	55	58
Deuterium (heavy hydrogen)		22	58	39	30
Boron-10		2	22	13	10
Oxygen-18			14	9	3
Electromagnetic concentrated				37	61
Total stable		55	154	153	162
Grand total isotopes	246	754	1,107	1,391	1,568

[1] Shipped by Manhattan District, Corps of Engineers, U. S. Army Service Forces.

Radium and Polonium.—Production of primary refined radium in the United States in 1948 was 7 grams, all by International Rare Metals Refinery, Inc., Mount Kisco, N. Y. An approximately equal quantity was refined by the company from waste and scrap during the year. Vitro Manufacturing Co., Pittsburgh, Pa., shipped 709 milligrams of radium from stocks. International Rare Metals Refinery, Inc., shipped several thousand millicuries of polonium and several hundred millicuries of radium D in 1948. Its sole distributor is Canadian Radium & Uranium Corp., New York, N. Y.

Thorium.—Thorium compounds are produced from monazite by Lindsay Light & Chemical Co., West Chicago, Ill., and Wolff-Alport, Brooklyn, N. Y. Thorium metal, 99.5 percent, is produced by Westinghouse Electric Corp., Pittsburgh, Pa., and by Metal Hydrides, Inc., Beverly, Mass. (subsidiary of Ventures, Ltd.).

[2] 1 millicurie is the quantity of a radioactive substance having the same alpha radiation as 1 milligram of radium.

Shipments of primary radium refined in the United States, 1941–43 (average) and 1944–48 [1]

Year	From domestic ores		From Canadian ores		Total	
	Milligrams	Estimated value	Milligrams	Estimated value	Milligrams	Estimated value
1941–43 (average)	2,042	$51,600			2,042	$51,600
1944	200	3,700	21,800	$403,300	22,000	407,000
1945	200	3,700	31,400	580,900	31,600	584,600
1946	200	3,700	17,400	321,900	17,600	325,600
1947	16,400	303,400			16,400	303,400
1948	4,219	77,980	3,510	63,200	7,729	141,180

[1] Excludes confidential figures representing certain shipments in October 1943 to May 1944.

CONSUMPTION AND USES

Weapons.—The center for development of atomic weapons is the Los Alamos Scientific Laboratory, Los Alamos, N. Mex., operated for the AEC by the University of California. A branch is the Sandia Laboratory, near Albuquerque, N. Mex., which works closely with the armed forces. Two small research reactors—one of enriched U–235 and the other plutonium—operate at Los Alamos to provide data for weapon development. Three atomic weapons were detonated at the AEC proving ground on Eniwetok Atoll, Marshall Islands, in April and May 1948.

Possible effects of the atomic bombardment of American cities and some aspects of atomic defense were discussed.[3]

Industrial Power.—Construction of two reactors for the experimental production of atomic power is expected to be completed in 1950 or 1951. One in Saratoga County, N. Y., will be operated by the General Electric Co. as part of the Knolls Atomic Power Laboratory and the other at the Argonne National Laboratory, Cook County, Ill., by the University of Chicago. These forerunners may lead to practical reactors that in 5 to 15 years will enter into competition with other sources of power, according to an estimate by AEC Commissioner Sumner T. Pike May 1, 1948. The present cost of a reactor approximates $50,000,000. The AEC announced December 29, 1948, that it had contracted for the Westinghouse Electric Corp., Pittsburgh, Pa., to construct an experimental nuclear reactor meeting specifications for the propulsion of naval ships.

A report to the AEC by its General Advisory Committee (J. Robert Oppenheimer, chairman)[4] included the following statements of the prospects for useful power from nuclear energy and of the principal factors involved:

> In anticipation of a rapidly growing shortage of uranium, great attention has been given to "breeding," a process in which plutonium or uranium 233 is pro-

[3] Lapp, R. E., Atomic Bomb Explosions—Effects on an American City: Bull. Atomic Scientists, vol. 4, No. 2, February 1948, pp. 49–54.
Augur, Tracy B., The Dispersal of Cities as a Defense Measure: Bull. Atomic Scientists, vol. 4, No. 5, May 1948, pp. 131–134.
Augur, Tracy B., The Dispersal of Cities—a Feasible Program: Bull. Atomic Scientists, vol. 4, No. 10, October 1948, pp. 312–315.
Coale, Ansley J., Reducing Industrial Vulnerability; Protection for a Representative Industry (Aluminum): Supplement (mim.) to Problem of Reducing Vulnerability to Atomic Bombs, 1948, 38 pp.
Hopley, Russell J., Civil Defense for National Security: Report to the Secretary of Defense by the Office of Civil Defense Planning, 1948, 301 pp.

[4] Atomic Energy Commission, 4th Semiannual Rept.: 1948, pp. 43–46.

duced by the power reactor at a rate greater than its consumption. It is theoretically possible—but in practice will be very difficult—to build an industrial reactor that will cause excess neutrons to be absorbed in a blanket of either U 238 or thorium, producing plutonium or U 233 which can serve as new fuel to continue the operation indefinitely as long as new natural uranium or thorium is supplied. This greatly increases the availability of fuel, for most of the uranium, not just the small 235 fraction of it, is consumable, and moreover the larger resources of thorium can be used. It might even be possible by these means to build up fissionable material faster than it is consumed.

Nevertheless, the engineering difficulties associated with breeding are enormous. The conditions which have to be fulfilled to obtain high neutron economy are difficult to reconcile with those needed to obtain a high power output for a given material investment * * *.

Another very important factor in the possibility of widespread use of atomic power will be the cost of uranium. At the price of uranium compounds before the war, the cost of uranium fuel would compete with coal under almost any condition * * *.

If unfavorable assumptions are made about the cost of uranium and the technical practicability of breeding, the result is that atomic power would not compete with coal power in the United States except in regions where the cost of transportation of the fuel from the mine is the determining factor, or under other special conditions where the small bulk and weight of the uranium fuel are particularly valuable. On the other hand, if favorable assumptions are made about the cost of uranium and the technical practicability of breeding, the ultimate capacity may become comparable to and even larger than the present coal industry and will operate at a lower cost, at least as far as fuel expenditure is concerned. At the present time, sufficient knowledge does not exist to make a definite choice between these two alternative possibilities. It should be pointed out that, in either case, the cost of a nuclear-fuel power plant will be substantially greater than that of a coal-burning plant of similar capacity * * *.

We do not see how it would be possible under the most favorable circumstances to have any considerable portion of the present power supply of the world replaced by nuclear fuel before the expiration of 20 years.

Economic data pertaining to the development of atomic power were presented in a University of Chicago report.[5] Some of the basic problems were outlined.[6]

Radiography.—Almost half of the radioactive isotopes shipped to date are used in medical therapy, notably iodine-131 for treating hyperthyroidism (overactivity of the thyroid gland) and phosphorus-32 for

Isotopes shipped by the U. S. Atomic Energy Commission by uses, 1946–48, in number of shipments

Use	1946 [1]	1947		1948		Total		
	Radioactive [2]	Radioactive	Stable	Radioactive	Stable	Radioactive	Stable	Grand total
Medical therapy	88	716	--------	1,142	--------	1,946	--------	1,946
Animal physiology	78	508	35	777	35	1,363	70	1,433
Physics	17	134	104	202	205	353	309	662
Chemistry	27	138	57	225	50	390	107	497
Plant physiology	16	62	5	116	6	194	11	205
Industrial research	14	51	7	85	16	150	23	173
Bacteriology	4	33	1	53	3	90	4	94
Metallurgy	2	10	--------	11	--------	23	--------	23
Other	--------	--------	--------	33	--------	33	--------	33
Total	246	1,652	209	2,644	315	4,542	524	5,066

[1] Shipped by Manhattan District, Corps of Engineers, U. S. Army Service Forces.
[2] No stable isotopes shipped in 1946.

[5] Menke, J. R., Nuclear Fission as a Source of Power: Econometrica, vol. 15, No. 4, October 1947, pp. 314–334. Reprinted by the University of Chicago as Cowles Commission Special Paper 1.

[6] Pike, Sumner T., Metallurgical and Economic Problems of Atomic Power Plants: Metal Prog., vol. 53, No. 6, June 1948, pp. 823–826.

polycythemia (overproduction of red blood corpuscles). Other isotopes are used largely in a wide variety of research projects, described in detail in the AEC Fourth Semiannual Report. The diffusion of metals and the chemistry of steelmaking are being investigated with "tracer" isotopes at the Carnegie Institute of Technology, Pittsburgh, Pa., and at the Stevens Institute of Technology, Hoboken, N. J.[7] Studies on cobalt-60, according to the AEC, show considerable promise that it may be a cheap and plentiful substitute for radium.

About half of the radium (primary and secondary) sales in 1948 were for medical use, and the remainder was divided almost equally among luminous compounds, industrial radiography, and research.

Nonenergy Uses.—Consumption of uranium compounds for purposes unrelated to atomic energy was restricted in 1948 to less than 2 short tons for the second successive year.

Consumption of uranium compounds for nonenergy purposes in the United States, 1943–48, in pounds of contained U_3O_8

[U. S. Atomic Energy Commission]

Industry	1943	1944	1945	1946	1947	1948
Chemical (including catalytic)	[1] 4,000	[1] 6,700	[1] 3,800	2,500	2,400	1,993
Ceramic (including glass)	7,500	100	150	1,000	825	385
Photographic	(1)	(1)	(1)	360	----------	225
Electrical	250	800	1,000	300	150	200
Total	11,750	7,600	4,950	4,160	3,375	2,803

[1] Photographic included with chemical.

PRICES

Uranium Ore.—A scale of commercial prices paid for uranium-vanadium ores during most of 1947 and early 1948 was quoted in Minerals Yearbook, 1947, page 1206. To stimulate domestic production of uranium ores, the Atomic Energy Commission in April and June 1948 announced guaranteed minimum prices at which it would purchase ores. The provisions of the program [8] are outlined below.

CARNOTITE AND ROSCOELITE IN COLORADO PLATEAU AREA (COLORADO, UTAH, NEW MEXICO, AND ARIZONA)

Buyer.—U. S. Atomic Energy Commission, P. O. Box 270, Grand Junction, Colo. Deliveries will be accepted at depots at Monticello, Utah, beginning July 1948 and at Durango, Colo., soon thereafter. The buyer is not obligated to, but may, purchase in excess of 5,000 short tons annually from ony one seller.

Specifications.—Minimum 0.10 percent uranium oxide (U_3O_8). Maximum 3 parts of lime ($CaCO_3$) to 1 part vanadium pentoxide (V_2O_5); maximum 6 percent lime. Must not contain other impurities harmful to buyer's extraction process. Maximum lump size 12 inches. Minimum quantity 10 short tons (dry weight) of ore or concentrate.

Discovery Bonus.—None.

Payment for Uranium.—The uranium content of carnotite and roscoelite ores and concentrates will be paid for at the rate of 30 cents per pound of contained U_3O_8 for ore containing 0.10 percent U_3O_8, plus 30 cents for each 0.01 percent

[7] Harwood, Julius J., Tracers in Metallurgy: Nucleonics, vol. 2, No. 1, January 1948, pp. 57–61.

[8] Atomic Energy Commission Regulations, part 60, Domestic Uranium Program Circ. 1, Ten-Year Guaranteed Minimum Price, Apr. 9, 1948; Circ. 2, Bonus for the Discovery and Production of High-Grade Domestic Uranium Ore, Apr. 9, 1948; Circ. 3, Guaranteed Three-Year Minimum Price for Uranium-Bearing Carnotite-Type or Roscoelite-Type Ores of the Colorado Plateau Area, Apr. 9, 1948; Circ. 4, Temporary Additional Allowances, Colorado Plateau Area Carnotite-Type and Roscoelite-Type Ores, June 15, 1948. Reprinted in AEC 5th Semiannual Rept., 1949, pp. 160–165.

above 0.10 percent up to and including 0.14 percent U_3O_8. Ores assaying 0.15 percent or more U_3O_8 will be paid for at the rate of $1.50 per pound of contained U_3O_8; plus a development allowance of 50 cents per pound of contained U_3O_8; plus a premium of 25 cents per pound for each pound of U_3O_8 in excess of 4 pounds U_3O_8 per short ton, and an additional premium of 25 cents per pound for each pound in excess of 10 pounds U_3O_8 per short ton; plus a facilities allowance of 50 cents per pound of U_3O_8 contained in ore and concentrates assaying 0.20 percent or more U_3O_8. The following table shows what these prices amount to, per ton, for various grades.

Prices established in April and June 1948 by the U. S. Atomic Energy Commission for uranium in Colorado Plateau carnotite and roscoelite

Content		Price per short ton of ore or concentrate				
Percent U_3O_8	Pounds U_3O_8 per short ton	Base price	Development allowance [1]	Premium	Facilities allowance [2]	Total price [3]
0.10	2	$0.60				$0.60
.11	2.2	1.32				1.32
.12	2.4	2.16				2.16
.13	2.6	3.12				3.12
.14	2.8	4.20				4.20
.15	3	4.50	$1.50			6.00
.20	4	6.00	2.00		$2.00	10.00
.25	5	7.50	2.50	$0.25	2.50	12.75
.30	6	9.00	3.00	.50	3.00	15.50
.40	8	12.00	4.00	1.00	4.00	21.00
.50	10	15.00	5.00	1.50	5.00	26.50
.75	15	22.50	7.50	4.00	7.50	41.50
1.00	20	30.00	10.00	6.50	10.00	56.50
1.25	25	37.50	12.50	9.00	12.50	71.50
1.50	30	45.00	15.00	11.50	15.00	86.50
1.75	35	52.50	17.50	14.00	17.50	101.50
2.00	40	60.00	20.00	16.50	20.00	116.50

1 To be spent only for maintaining and increasing the developed reserves of uranium ores.
2 To be spent only for reopening and equipping closed mines and increasing the production facilities of mines in operation.
3 In addition, there is payment for continued vanadium and a haulage allowance (described below). The base price, development allowance, and premium are guaranteed until Jan. 1, 1952, and the facilities allowance is guaranteed until July 1, 1949. There is no discovery bonus.

Payment for Vanadium.—The vanadium content of carnotite and roscoelite ores and concentrates will be paid for at the rate of 31 cents per pound of contained V_2O_5. But no payment will be made for V_2O_5 in excess of 10 pounds for each pound of U_3O_8 contained.

Haulage Allowance.—A haulage allowance of 6 cents per ton-mile for transporting ore or concentrate from the mine to the Commission's purchasing depot will be paid. The maximum allowance is limited to a haulage of 100 miles.

Other Domestic Uranium Ores and Concentrates

Buyer.—U. S. Atomic Energy Commission, Attention: Division of Raw Materials, P. O. Box 30, Ansonia Station, New York 23, N. Y. Prices are guaranteed until Jan. 1, 1960.

Specifications.—Minimum 10 percent uranium oxide (U_3O_8). Minimum quantity 10 short tons (dry weight) of ore or concentrate. The Atomic Energy Commission will negotiate for delivery of particularly high-grade ores and concentrates in quantities smaller than those specified as the minimum.

Discovery Bonus.—A bonus of $10,000 will be paid for delivery of the first 20 short tons of uranium ore or concentrate assaying 20 percent or more U_3O_8 from any single mining location, lode, or placer that has not previously been worked for uranium.

Payment for Uranium.—Domestic uranium ores and concentrates (other than Colorado Plateau carnotite and roscoelite) will be purchased at a minimum price of $3.50 per pound of recoverable uranium oxide (U_3O_8), f. o. b. mine or mill, less buyer's cost of refining. The Atomic Energy Commission may negotiate higher prices for any acceptable material in quantities substantially in excess of the minimum quantity. It may negotiate higher prices where special conditions prevail, taking into consideration milling costs, transportation costs, and other applicable factors.

Payment for Accessory Metals.—Consideration will be given to recoverable gold, silver, radium, thorium, and other valuable constituents.

Uranium Metal and Compounds.—No official figures have been released indicating the cost of refining uranium metal on a large scale. One scientist estimated in 1947 that metal from concentrates of 1 percent or higher would approximate $5 a pound and from concentrates of 0.1 percent, $50 a pound.[9] Black uranium oxide was quoted by Oil, Paint and Drug Reporter at $2.55 a pound and uranium yellow (sodium uranate) at $1.65 a pound throughout 1948. Canadian Chemistry and Process Industries listed sodium uranate (yellow or orange) at $2.20 a pound in 1948.

Radium and Polonium.—The leading domestic refiner reported the average 1948 price of radium at $18 a milligram, radium D at $75 a millicurie, and polonium at $5 a millicurie.

Isotopes.—The prices of the principal isotopes distributed by the Atomic Energy Commission were unchanged in 1948 from 1947. For 1947 quotations, see Minerals Yearbook, 1947, pages 1206–1207.[10]

Thorium.—Monazite concentrates, 70 percent rare-earth oxides, c. i. f. Atlantic ports, were quoted at $140–$150 a short ton in January to March 1948, $175–$185 in April to October, $170 in November and early December, and $200 in late December, According to E&MJ Metal and Mineral Markets. The slight price dip in November coincided with the first significant domestic shipment in many years. The Metal Bulletin (London) listed thorium metal as "nominal" during 1948. Oil, Paint and Drug Reporter quoted thorium nitrate at $3.50 a pound throughout 1948.

FOREIGN TRADE[11]

A substantial part of the uranium used in the American atomic energy program has come from the high-grade ore deposits of the Belgian Congo and Canada, with the greater quantity from the Belgian Congo, according to the Atomic Energy Commission. Statistics on United States imports and exports of uranium and thorium are withheld from publication at the request of the Atomic Energy Commission.

Uranium and thorium are in a group of minor metals and alloys whose tariff rate was reduced from 25 to 12½ percent ad valorem, effective January 1, 1948, in accordance with the General Agreement on Tariffs and Trade concluded at Geneva October 30, 1947. Thorium compounds are dutiable at 35 percent. Uranium ores and concentrates, uranium compounds, radium, radium salts, radioactive substitutes, monazite, and other thorium ores are on the free list.

Exports of radioactive isotopes, according to the AEC, have totaled 355 shipments (20 in 1947 and 335 in 1948). Of these, 68 went to the United Kingdom (including overseas territories), 62 to Sweden,

[9] Menke, J. R., work cited in footnote 5, p. 323.

[10] The first sentence of footnote 3, page 1207, of Minerals Yearbook, 1947, should be corrected to read: Not quoted with potassium chloride in March to December 1947.

[11] 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.

Radium salts imported for consumption and exported from the United States, 1944–48

[U. S. Department of Commerce]

Year	Imports: Radium salts: Grams	Imports: Radium salts: Value: Total	Imports: Radium salts: Value: Average per gram	Imports: Radioactive substitutes (value)	Exports: Radium salts: Grams	Exports: Radium salts: Value: Total	Exports: Radium salts: Value: Average per gram
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
1946	17.229	326,450	18,900		(1)	(1)	(1)
1947	76.681	1,504,814	19,600		(1)	(1)	(1)
1948	76.118	1,385,337	18,200	6,273	(1)	(1)	(1)

[1] Not separately classified.

60 to Australia, 35 to Belgium, 25 to the Netherlands, 24 to Denmark, 21 to Argentina, and 60 to twelve other countries. No stable isotopes have been exported by the Commission.

The AEC announced July 30, 1948, issuance of the first export licenses for particle accelerators. The licenses were for shipping high-voltage x-ray generators to the National Physical Laboratory, Teddington, England, and to the Sheffield National Centre for Radiotherapy, Sheffield, England.

TECHNOLOGY

An explanation of atomic principles, notable for its simplicity of presentation, was published.[12]

Exploration methods for uranium ores were outlined,[13] and the Geiger-Müller counter was described in detail.[14] Procedures for refining uranium and thorium were reviewed.[15]

Scientists at Iowa State College, Ames, Iowa, are studying the properties of uranium, thorium, beryllium, and rare-earth metals and are developing better processes for producing them in extremely pure form. The Atomic Energy Commission announced in mid-1948 that it will establish at New Brunswick, N. J., a chemical laboratory for quality control of the processing of uranium, beryllium, and other materials of importance in developing atomic energy. The AEC also stated, at the end of 1948, that E. I. du Pont de Nemours & Co.,

[12] Darrow, K. K., Atomic Energy: John Wiley & Sons, Inc., New York, 1948, 80 pp.

[13] Faul, Henry, Radioactive Exploration with Geiger Counters: Am. Inst. Min. and Met. Eng. Min. Technol., vol. 12, No. 6, November 1948, Tech. Pub. 2460, 18 pp.

Leach, Paul, Jr., Uranium Ore—How to Go About Finding and Mining It: Eng. and Min. Jour., vol. 149, No. 9, September 1948, pp. 75–77.

Senftle, F. E., The Effect of Potassium in Prospecting for Radioactive Ores: Canadian Min. Jour., vol. 69, No. 11, November 1948, pp. 55–57.

[14] Brown, Sanborn C., Theory and Operation of Geiger-Müller Counters: Nucleonics, vol. 2, No. 6, June 1948, pp. 10–22; vol. 3, No. 2, August 1948, pp. 50–64; vol. 3, No. 4, October 1948, pp. 46–61.

[15] Irvine, John W., Jr., Heavy Elements and Nuclear Fuels; The Science and Engineering of Nuclear Power (Clark Goodman, ed.): Addison-Wesley Press, Inc., Cambridge, Mass., 1947, vol. 1, ch. 11, pp. 369–377.

Kroll, W. J., Rare-Metal Metallurgy: Metal Ind. (London), vol. 73, Oct. 1, 1948, pp. 263–265.

Meister, George, Production of Thorium, Zirconium and Uranium: Metal Prog., vol. 53, No. 4, April 1948, pp. 515–520.

Inc., Wilmington, Del., will survey plutonium chemical problems with a view to improving production processes.

Industrial diamonds are used in laboratories as counters to measure atomic radiation.

The biological effects of radioactivity, particularly regarding permissible levels of exposure, are under detailed study.[16]

WORLD REVIEW

Uranium reserves were commented on by David E. Lilienthal, chairman, United States Atomic Energy Commission, December 17, 1948, as follows:

> An unwarranted impression that a shortage of uranium will drastically limit the possibilities of atomic energy has been caused by estimates that known reserves of uranium would last perhaps only 30 years or not more than 40. Estimates of the total world supply of uranium have run from 30,000 tons to 500,000 tons, seventeen times as much. Estimates of rates of potential consumption of the fissionable material derived from uranium have also varied considerably.
>
> The people of the United States are entitled to know that these estimates of a short-lived atomic enterprise are not correct * * *. The Atomic Energy Commission of the United States is responsible for one of the most extensive and intensive searches for a mineral that has ever been conducted, and on a world-wide basis. We do not expect that there will be an unlimited supply but there is no sound basis for a conclusion that usable uranium ore supplies will not be available for the indefinite future.

The United Nations Atomic Energy Commission reported [17] in 1948 that it had reached an impasse. It recommended that negotiations in the Commission be suspended until the General Assembly finds that there exists a basis for agreement on the international control of atomic energy. The principal difficulty confronting the commission was rejection by the Soviet Union of a control plan, approved by most members of the commission, on the ground that such a plan constituted an unwarranted infringement of national sovereignty. In the fall of 1948 Canada proposed that the General Assembly approve the Atomic Energy Commission's control plan, and the United States recommended a six-power discussion to find a means for continuing the Commission's work.[18]

Problems of international control were discussed during 1948 by J. Robert Oppenheimer, chairman, General Advisory Committee, United States Atomic Energy Commission [19]; Frederick Osborn, chairman and deputy United States representative to the United Nations Atomic Energy Commission [20]; Philip C. Jessup, deputy United States representative in the United Nations Security Council [21]; and P. M. S. Blackett, British physicist.[22] Representatives of Canada,

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[16] Lapp, R. E., and Andrews, H. L., Health Physics: Nucleonics, vol. 3, No. 3, September 1948, pp. 60–67.
Western, Forrest, Problems of Radioactive Waste Disposal: Nucleonics, vol. 3, No. 2, August 1948, pp. 43–49.

[17] United Nations Atomic Energy Commission, Third Report, to the Security Council, May 17, 1948: U. S. Dept. of State Pub. 3179, 1948, 78 pp.

[18] Austin, Warren R., U. S. Proposes Six Sponsoring Powers Discuss Atomic Energy Issue: U. S. Dept. of State. Bull., vol. 19, No. 487, Oct. 31, 1948, pp. 535–540.
Austin, Warren R., The United Nations and Specialized Agencies—Adoption of Atomic Energy Resolution: U. S. Dept. of State Bull., vol. 19, No. 489, Nov. 14, 1948, pp. 602–606.
The two above statements were also published in Atomic Energy and Conventional Armaments: U. S. Dept. of State Pub. 3414, 1949, pp. 1–22.

[19] Oppenheimer, J. Robert, International Control of Atomic Energy: Foreign Affairs, vol. 26, No. 2, January 1948, pp. 239–252.

[20] Osborn, Frederick, Atomic Impasse 1948: U. S. Dept. of State Pub. 3272, 1948, 48 pp.

[21] Jessup, Philip C., U. S. Position and Views on Atomic Energy: U. S. Dept. of State Bull., vol. 18, No. 468, June 20, 1948, pp. 798–799.

[22] Blackett, P. M. S., Military and Political Consequences of Atomic Energy: Turnstile Press, Ltd., London, 1948, 222 pp.

the United Kingdom, and the United States held the First International Conference on Declassification November 14–16, 1947, at Washington, D. C., and the second such conference September 6–9, 1948, at Harwell, England. The three countries also continued their wartime cooperation in raw-materials procurement and in exchange of certain technical information regarding extraction chemistry, low-power reactors, isotopes, and health. In 1948 the United Nations issued an international bibliography on atomic energy [23] and a five-language glossary of technical terms pertaining to atomic energy.

WESTERN HEMISPHERE

Argentina.—The National Government has been exploring uranium occurrences in Mendoza Province, 20 kilometers from the capital city, and at the Santa Ana mine (formerly worked for beryl), San Luis Province. Technologists of the University of Cuyo found uranium in the asphaltite and petroleum of Tupungato, Mendoza.[24] A deposit of autunite, torbernite, and gummite in the Cañada de Alvarez area, Córdoba Province, has been known for more than a decade.

British Guiana.—The British Guiana Government drafted a bill to control prospecting, mining, and export of radioactive minerals.[25] Specimens of euxenite have been found in the Kanuku Mountains.

Canada.—Canada is overtaking the Belgian Congo as the world's greatest producer of uranium ore, according to Arvid Thunaes, Radioactivity Division, Canadian Bureau of Mines in a statement September 2, 1948.[26] All—or nearly all—uranium mining in the Dominion in 1948 was at Port Radium, Great Bear Lake, Northwest Territories, by Eldorado Mining & Refining (1944), Ltd., a Crown corporation. Promising pitchblende occurrences in the Lake Athabaska, Black Lake, and Lac la Ronge regions of northern Saskatchewan were explored. Uranium-ore development was continued in 1948 at Contact Lake, Northwest Territories, and deposits were discovered at Theano Point, near Sault Ste. Marie, Ontario, and at Gun Lake, Bridge River district, British Columbia.

C. D. Howe, Minister of Trade and Commerce, said in a statement in parliament March 16, 1948, "the Government is now satisfied that it is in the best interest of Canada that restrictions against private prospecting and private development of radioactive minerals should be removed." The Government will purchase uranium concentrates on the following basis:

1. A minimum uranium content equivalent to 10 percent by weight of uranium oxide (U_3O_8) in the ores or concentrates will normally be required.
2. Prices will be based upon the uranium content of the ores or concentrates, and will be at the minimum rate of $2.75 per pound of contained (U_3O_8) f. o. b. rail and will be guaranteed for a period of five years.
3. This price includes all radioactive elements in the ores or concentrates, but consideration will be given to the commercially recoverable value of non-radioactive constituents by adjustment of price or by the redelivery of the residues containing such constituents.
4. Under special circumstances, consideration may be given to payment of a higher price or to acceptance of ores or concentrates of lower grade.

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[23] United Nations, An International Bibliography on Atomic Energy; Political, Economic, and Social Aspects: Vol. 1, 1948, 89 pp. (prelim. ed., mim.).
[24] Engineering and Mining Journal, vol. 149, No. 1, January 1948, p. 124.
[25] Mining Journal (London), vol. 228, No. 5836, June 28, 1947, p. 388.
[26] Metal Bulletin (London), No. 3323, Sept. 10, 1948, p. 13.

5. All operations will be carried on subject to the provisions of the atomic energy regulations of Canada.[27]

Greenland.—A rich and large deposit of galena, with uranium and silver in association, was reported found at King Oscar's Fjord, eastern Greenland, by a Danish geological expedition under the leadership of Dr. Lauge Koch.[28]

Venezuela.—Pitchblende and other radioactive minerals have been noted in a pegmatite dike, near Merida, worked for scrap mica, and in a quarry near Timotes.[29]

AFRICA

Belgian Congo.—Both concentrates and untreated ores were sold in 1947, according to the annual report of the dominant uranium producer, Union Minière du Haut Katanga. Construction of a plant for treating uranium ores near the Shinkolobwe mine was begun and is expected to begin operations at the end of 1950.[30]

Mozambique.—A deposit of samarskite was discovered near Tete, capital of the district of that name, Mozambique. Fifty tons of hand-cobbed concentrate, analyzing 8 to 12 percent uranium oxide plus thorium, tantalum, columbium, etc., were exported to the United Kingdom, and a permit for shipment of an additional 100 tons was procured.[31]

Union of South Africa.—The discovery of low concentrations of uranium in most of the gold mines on the Witwatersrand and in boreholes in the Orange Free State was announced by Governor General Gideon Brand Van Zyl, January 16, 1948. This led J. W. Musset, South African Minister for Economic Development, to declare, April 21, "We believe we have more uranium in this country than in any other country in the world." [32] Production and use of fissionable materials and radioisotopes were brought under Government control by the Union Parliament September 7, 1948.

EUROPE

Czechoslovakia.—Absolute control of the production of the Jachymov (Joachimsthal) uranium mines was given to the U. S. S. R. in a secret treaty between that country and Czechoslovakia signed in Prague, October 1945, according to Ivo Duchacek, former chairman of the foreign relations committee of the Czechoslovak Parliament.[33]

France.—The Commissariat à l'Énergie Atomique announced July 23, 1948, that mining of uranium ore would begin immediately on a commercial scale at Grury, near Autun, Department of Sâone-et-Loire, and near Lachaux, along the border of the Departments of Allier and Puy-de-Dôme. Development of uranium deposits near Antsirabé, Madagascar, and explorations in lower Ivory Coast (French West Africa) and Middle Congo (French Equatorial Africa) were in

[27] Precambrian, vol. 21, No. 4, April 1948, p. 33.
[28] Metal Industry (London), vol. 73, No. 14, Oct. 1, 1948, p. 277.
Precambrian, vol. 21, No. 11, November 1948, p. 41.
[29] Davey, J. C., Radioactive Minerals of the Venezuelan Andes: Trans. Royal Geol. Soc. Cornwall, vol. 17, 1946, pp. 313–316.
[30] Metal Bulletin (London), No. 3345, Nov. 26, 1948, p. 7.
[31] Altaffer, Leland C., Report on Travel in the Colony of Mozambique: Consular Rept., Laurenço Marques, Portuguese East Africa, May 29, 1948, p. 4.
[32] Chemical Age (London), vol. 58, No. 1503, May 1, 1948, p. 630
[33] Washington Post, June 8, 1948, p. 3.

progress. Construction of an ore concentrator at Lachaux was expected to be completed by the end of 1948.[34]

Uranium compounds are refined on a limited industrial scale at Le Bouchet, 30 miles from Paris. France has obtained from Norway a quantity of heavy water probably nearly equal to 2 years of Norwegian output, according to Lew Kowarski,[35] scientific director of the French commissariat. The total staff of the commissariat in early 1948 was about 500 persons (exclusive of miners). The first French nuclear reactor, built of uranium oxide and heavy water and having a power output of a few watts, began operation at Fort de Châtillon, near Paris, December 15, 1948.[36]

Germany.—The extent of atomic energy developments in Germany in 1940–44 was unknown to scientists and officials in the United States until November 1944, 6 months before the end of the European phase of World War II. It was assumed in the United States that German progress had paralleled ours and probably was leading. This supposition caused considerable concern among those who knew something of American-British progress on the atomic bomb. Allied troops invading the continent of Europe were equipped with special detectors for radioactive materials, but fortunately such precautions proved to be entirely unnecessary. Not only were no facilities for making atomic bombs built or under construction in Europe, but German scientists had been unable to figure out even the theoretical approach to such a bomb. This information on German uranium efforts, and that in the following paragraphs, was revealed by Dr. Samuel A. Goudsmit[37] professor of physics at Northwestern University, who was appointed by the United States War Department as scientific head of the Alsos Mission. The principal duty of the Alsos Mission was to follow immediately in the wake of the Allied armies in the invasion of Europe to determine precisely how much the Germans knew about the atomic bomb and how far they had progressed in its construction. It was classified a "top-top-secret" intelligence job, the military head of which was Col. Boris T. Pash, United States Army.

Secret atomic bomb research was found to have begun in Germany early in 1939 under the supervision of Erich Schumann, chief of the Ordnance Department. He directed small-scale experiments in an underground shelter at the proving ground at Kummersdorf, near Berlin. Unaware of Schumann's army group, Abraham Esau, president of the German Bureau of Standards, called a meeting of half a dozen physicists in April 1939 and formed the "Uranium Club," with headquarters at the Kaiser Wilhelm Institute for Physics, Berlin. The two groups became aware of each other when they collided in efforts to procure uranium; after a quarrel, they agreed to divide such uranium supplies as were available. The uranium metal used in German experiments was produced by Auergesellschaft A. G., subsidiary of Deutsche Gold und Silber Scheideanstalt, Berlin. Considerable difficulty was encountered preparing uranium in slabs instead of powdered form, and success in producing suitable metal apparently was not achieved until a short time before the German defeat.

The administrative chief of all war research in German universities, including the work of the Reich's Research Council and the Uranium Club, was Rudolph Mentzel, who Goudsmit describes as "only a second-rate chemist who had climbed to his high post through the devious channels of Nazi party politics." Esau,

[34] Roubault, M., [The Status of French Research and Production of Uranium and Thorium]: L'Écho des Mines et de la Métallurgie (Paris), No. 3401, October 1948, p. 191.
[35] Kowarski, L., Atomic Energy Developments in France: Bull. Atomic Scientists, vol. 4, No. 5, May 1948, pp. 139–140, 154–155.
Kowarski, Lew, France's Place in International Picture of Atomic Energy Development: Nucleonics, vol. 2, No. 5, part 1, May 1948, pp. 59–65.
[36] Nucleonics, vol. 4, No. 1, January 1949, p. 61.
[37] Goudsmit, Samuel A., Alsos: Henry Schuman, Inc., New York, 1947, 259 pp.

called "incompetent," remained in charge of physics until replaced at the beginning of 1944 by a first-class physicist, Walther Gerlach of the University of Munich, who did much to bring unity among the various groups. Actual scientific work on nuclear physics was under the leadership of Werner Heisenberg.

Nuclear physics research facilities existed at a number of localities in Germany, but they were meager compared with Allied establishments. There was only one German cyclotron in operating condition (compared with about 20 in the United States at the time); it was in Walther Bothe's physics laboratory at the Kaiser Wilhelm Institute for Medical Research, Heidelberg. The Germans also utilized Frederic Joliot-Curie's cyclotron in Paris. Research on heavy water and on uranium-isotope separation by gaseous diffusion was conducted by P. Harteck at the University of Hamburg. A small centrifuge project was set up at the same university by Will Groth and, after several moves to avoid bombings, finally was established in the town of Celle, north of Hannover. By means of the centrifuge it was hoped to prepare some uranium slightly richer in U–235 than natural uranium and thus facilitate pile experiments, but Goudsmit states that, with the single centrifuge in working order, it would have taken a hundred years to produce any useful results. A nuclear physics laboratory was installed in a wing of the Strasbourg Hospital. There, upon liberation of that French city in November 1944, the Alsos Mission found papers revealing the scope of German work in nuclear physics. Another such laboratory was under the direction of Otto Hahn (discoverer of the principle of uranium fission in December 1938) at the Institute for Physical Chemistry in Berlin; it was later moved to the village of Tailfingen, southeast of Hechingen.

There were two German efforts to construct uranium piles. One was at Gerlach's laboratory in the village of Thuringen, where the Alsos Mission found blocks of pressed uranium oxide. Additional uranium used there was also discovered in Munich. The other pile was erected by Heisenberg at the Kaiser Wilhelm Institute for Physics, Berlin. There in July 1945 the Alsos Mission found in the back yard uranium oxide blocks and pieces of nulcear apparatus, and in the subbasement a pit in which the pile had been constructed. Metal containers and frames for the pile arrangement were still standing nearby. To escape Allied bombings of Berlin, Heisenberg moved his principal laboratory to Hechingen, 30 miles southwest of Stuttgart, and rebuilt his uranium pile in a cave in the nearby town of Haigerloch. Goudsmit quoted an Associated Press interview with Heisenberg to the effect that the Alsos Mission found there (after the town's capture by French troops in April 1945) all the carefully buried materials—2 tons of uranium, 2 tons of heavy water, and 10 tons of carbon. However, Goudsmit added that he was prohibited from divulging how much uranium and heavy water were found in Germany or what was done with it.

German uranium-pile work did not get beyond a very early stage. Its scientists never succeeded in producing a chain reaction, and they did not think of using plutonium in a bomb. To the very end they labored under the misapprehension that a bomb could be made like a pile. Although the work had high priority, it never evolved beyond a very small scale. Heisenberg told a news reporter that he had been building a uranium pile to create energy for machines and not for bombs. However, Goudsmit found ample documentary evidence to the contrary and interprets the statement as an attempt to explain the failure to keep pace with Allied physicists and to ward off the attendant blow to the prestige of German science.

Norway.—Uranium ore mined at Evje in Setesdal and heavy water produced by Norsk Hydro-Elektrisk Kvaelstofaktieselskab at Rjukan will be adequate for Norway's first atomic pile. It will be part of the atomic center under construction at Kjeller, near Oslo.[39] The Norwegian Government has applied to United States occupation authorities in Germany for return of 8 flasks of heavy water, each containing about 21 pints, stolen by German scientists early in 1945.[40]

U. S. S. R.—Uranium and thorium deposits are known to occur in the Caucasus Mountains, the Central Asia region (Tashkent, Tadzhik,

[39] Chemical age (London), vol. 59, No. 1535, Dec. 11, 1948, p. 781.
[40] Chemical Age (London), Nazis looted Heavy Water: Vol. 58, No. 1504, May 8, 1948, p. 644.

and Fergana), and Tannu Tuva and uranium deposits also in the Kola Peninsula (near Kirovsk) and the Altai Mountains. Uranium-ore treatment plants are reported to be in the northern Ural Mountains and the Altai Mountains, and atomic research centers at Leningrad, Moscow, Kharkov, and Sverdlovsk.[41] Exiled Estonian diplomats claimed in July 1948 that Russia was refining uranium from oil shale mined in Esthonia. The Soviet Union continued to import uranium concentrates from mines it controlled in Czechoslovakia, Saxony, and possibly Bulgaria.

United Kingdom.—The British Ministry of Supply announced that its second atomic pile, "Bepo" (British experimental pile), began operating July 3, 1948, at low power. The location was the Atomic Energy Research Establishment, Harwell, near Didcot, Berkshire. The new pile was expected to operate at a power level of several thousand kilowatts and to yield useful isotopes and a small quantity of plutonium for experimental work.[42]

ASIA AND AUSTRALIA

Australia.—Uranium ore was discovered in an abandoned copper-silver mine in New South Wales.[43] An exhaustive study was made of Queensland beach sands, which yield a heavy-mineral concentrate of zircon, rutile, ilmenite, and about 0.5 percent monazite.[44] An amount of £150,000 was allocated for exploration of radioactive mineral resources in 1947–48 by the Commonwealth Bureau of Mineral Resources in cooperation with State mines departments.

China.—Uranium was discovered near Chungshan and Hoshein in eastern Kwangsi Province.[45] Dr. C. Y. Yang, research director of Wah Chang Trading Corp., credited the report because it came from Dr. Wong Wen Hao, prominent geologist.[46]

India.—Uranium occurs in scattered pegmatite localities in India, but no deposits of commercial importance have been reported. The beach sands of Travancore, however, are estimated to contain more than 2,000,000 tons of monazite averaging 8 to 9 percent thorium dioxide.[47] Following an embargo on exports of monazite, Travancore reportedly entered into a 5-year agreement for delivering several thousand tons of monazite annually to Great Britain; but if such an agreement actually existed, it did not become effective. The new Government of India, inaugurated August 15, 1947, began negotiations with the State of Travancore for joint control of thorium. Meanwhile, a joint committee, comprising six members of the Indian Board of Atomic Research and three members of the Travancore Government, was formed to advise Government officials on research, development, and use of thorium.[48] The Board of Atomic Research

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[41] Metal Bulletin (London), The Metal Industries of the Soviet Union: No. 3327, Sept. 24, 1948, p. 20.
[42] Skinner, H. W. B., The Work of the Harwell Establishment: Bull. Atomic Scientists, vol. 4, No. 4, April 1948, pp. 107–109.
Metal Industry (London), Atomic Energy—Ministry of Supply Research Establishment, Harwell: Vol. 73, No. 5, July 30, 1948, pp. 83–86.
[43] Metal Industry (London), vol. 72, No. 6, Feb. 6, 1948, p. 117.
[44] Connah, T. H., Reconnaissance Survey of Black-Sand Deposits, South-East Queensland: Queensland Govt. Min. Jour. (Brisbane), vol. 49, No. 561, July 1948, pp. 223–245.
Carlson, O. J., A Progressive South Coast Industry—Mining the Beach Sands of Queensland: Queensland Govt. Min. Jour. (Brisbane), vol. 49, No. 566, December 1948, pp. 476–482.
[45] Metal Industry (London), vol. 71, No. 25, Dec. 19, 1947, p. 512.
[46] Myler, Joseph L., United Press dispatch, Jan. 23, 1948.
[47] E&MJ Metal and Mineral Markets, vol. 18, No. 25, June 19, 1947, p. 3.
[48] Chemical Age (London), vol. 57, No. 1485, Dec. 27, 1947, p. 822.

(Dr. Homi J. Bhabha, chairman) was formed under the auspices of the Indian Council of Scientific and Industrial Research. The country's principal atomic research center is the Tata Institute of Fundamental Research, Bombay, which in 1947 developed a new economical method of extracting thorium nitrate from monazite, measured cosmic rays, and planned construction of a betatron generating 200 million electron-volts.[49] Atomic research is conducted also at two institutions in Calcutta—Bose Research Institute and Calcutta University.

Korea.—Monazite was continued on the approved export list, effective April 1, 1948, issued by the Department of Commerce, South Korean Interim Government.[50]

Malaya, Federation of.—As a byproduct of alluvial tin mining, 1,187 metric tons of monazite and zircon concentrates were produced in Malaya in 1942–45, the period of Japanese occupation. This quantity comprised 224 tons of monazite, 210 tons of mixed monazite-zircon, and 753 tons of zircon.[51]

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[49] Chemical and Engineering News, vol. 25, No. 27, July 7, 1947, p. 1972.
[50] Foreign Commerce Weekly, vol. 31, No. 4, Apr. 24, 1948, p. 15.
[51] Bureau of Mines, Mineral Trade Notes: Vol. 25, No. 4, October 1947, p. 14.

Vanadium

By HUBERT W. DAVIS

GENERAL STATEMENT

FOR security reasons, publication of figures on production and consumption of vanadium ore in the United States in 1948 has been suspended.

DOMESTIC PRODUCTION

The center of domestic vanadium-ore mining in the United States is the Colorado-Utah region. Small outputs are made in Arizona, Nevada, and New Mexico, and vanadium-bearing phosphate rock is mined in Idaho.

Vanadium in ores and concentrates produced in the United States, 1938–47 [1]

Year	Vanadium, pounds	Year	Vanadium, pounds
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
1942	4,439,130	1947	2,117,962

[1] Data for 1940–47 are receipts at mills and Government purchasing depots.

USES

Vanadium is used in various forms; but about 90 percent is consumed as ferrovanadium in the manufacture of tool steels, engineering steels, high-strength structural steels, nonaging rimming steels, and special wear-resistant cast irons. Some ferrovanadium is used in welding-electrode coatings and as a deoxidizer, and some metal is utilized in magnets. Some vanadium oxide is also used in the production of tool steel. The largest uses for vanadium oxide and ammonium metavanadate are as catalysts, in glass and ceramic glazes, for driers in paints and inks, and for laboratory research.

PRICES

For many years vanadium ore has been quoted at 27½ cents a pound of V_2O_5. This quotation, however, disregards the grade of the ore or the presence or absence of objectionable impurities—matters of importance to the refiners, inasmuch as they vitally affect recovery. Throughout 1948 vanadium pentoxide (technical grade) was quoted at \$1.20 a pound of V_2O_5 and ferrovanadium at \$2.90–\$3.10 a pound of contained vanadium (depending upon the grade of the alloy).

FOREIGN TRADE[1]

Imports of vanadium concentrates (all from Peru) were 1,051,675 pounds (contained vanadium) in 1948, a gain of 7 percent over 1947. There were no imports of flue dust containing vanadium or of ferrovanadium or vanadium oxide. Vanadium ore and concentrates enter the United States free of duty. However, the rate of duty on ferrovanadium is 12½ percent ad valorem and on vanadic oxide, anhydride, salts, and compounds and mixtures of vanadium 40 percent ad valorem.

Vanadium ore or concentrates and vanadium-bearing flue dust imported for consumption in the United States, 1939–48

Year	Vanadium ore or concentrates			Vanadium-bearing flue dust		
	Pounds		Value	Pounds		Value
	Gross weight	Vanadium content		Gross weight	Vanadium content	
1939	31,387,722	2,132,548	$991,511	(1)	(1)	(1)
1940	45,102,004	2,574,951	1,216,705	(1)	(1)	(1)
1941	24,645,686	2,138,608	1,012,991	(1)	(1)	(1)
1942	36,492,268	2,422,376	1,274,483	624,423	154,028	$29,545
1943	22,117,131	2,052,620	1,080,150	748,749	64,393	53,553
1944	4,247,490	1,284,603	633,719	191,901	40,171	28,059
1945	8,776,328	1,550,479	725,362	133,795	26,293	19,378
1946	2,784,349	791,057	390,077	97,750	20,931	13,480
1947	3,274,548	983,869	448,076	143,124	71,819	15,483
1948	4,034,509	1,051,675	534,374	----------	----------	----------

[1] Not separately recorded.

Exports of vanadium ore and concentrates were 13,180 pounds (contained vanadium) valued at $32,263 in 1948, compared with 7,661 pounds valued at $15,788 in 1947. The 1948 exports comprised 8,140 pounds to Switzerland and 5,040 pounds to Canada. Exports of ferrovanadium were 238,824 pounds (gross weight) valued at $390,428 in 1948 compared with 178,198 pounds valued at $266,040 in 1947.

WORLD REVIEW

World production of vanadium ores is limited almost entirely to four countries—Northern Rhodesia, Peru, South-West Africa, and the United States. From 1939 through 1947 output from these sources has ranged from 1,400 to 4,400 metric tons, and from 1941 through 1947 the United States has been the leading producer.

Vanadium has also been recovered commercially from phosphate rock, iron ore, chrome ore, magnetite beach sands, caustic-soda solution employed in Bayer process of refining bauxite, naphtha soot collected from the smokestacks of ships and industrial plants, and vanadiferous ashes derived from asphaltites.

Because complete information on the quantity of vanadium recovered as byproducts of iron ore and other raw materials is lacking, it is not possible to determine world production of vanadium from

[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.

all sources. Consequently, the accompanying table reflects only the production of vanadium in ores and concentrates for the countries listed, plus the quantity recovered in the United States as a byproduct of phosphate rock.

World production of vanadium in ores and concentrates, 1939–48, in metric tons

[Compiled by B. B. Mitchell]

Country	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
Argentina	15	1	6			4	3	6	7	(1)
Mexico	80	32	(2)							
Northern Rhodesia	384	368	342	388	426	254	219	68	56	173
Peru	1,016	1,214	1,017	1,010	847	514	688	322	435	511
South-West Africa	514	428	269	453	577	385	420	430	282	187
United States (shipments) [3]	900	981	1,140	2,014	2,534	1,600	1,344	577	961	(4)
Total [5]	2,909	3,024	2,774	3,865	4,384	2,757	2,674	1,403	1,741	(4)

[1] Figure not available.
[2] Less than 1 ton.
[3] Includes also vanadium recovered as a byproduct of phosphate-rock mining.
[4] Bureau of Mines not at liberty to publish figure.
[5] Total represents data only for countries shown in table and excludes vanadium in ores produced in French Morocco, Spain, and U. S. S. R., for which figures are not available; also excluded from the total are the quantities of vanadium recovered as byproducts from other ores and raw materials.

Argentina.—Vanadium occurs in small deposits widely scattered in the Provinces of Córdoba and San Luis. A small quantity of ore is mined for the production of 3 to 4 metric tons of vanadium pentoxide annually.

Northern Rhodesia.—The Rhodesia Broken Hill Development Co., Ltd., was again the only producer of vanadium in Northern Rhodesia. Output of vanadium oxide was 331 long tons averaging 92.06 percent V_2O_5 in 1948 compared with 108 tons averaging 92.04 percent V_2O_5 in 1947. During 1948 the feed to the gravity concentrating plant was 48,770 short tons of material averaging 1.08 percent V_2O_5, which consisted largely of vanadium-bearing laterites from old surface dumps. Leach-grade material produced at the gravity plant was 6,918 short tons containing 287 tons of V_2O_5, the recovery being 54.5 percent. Feed to the vanadium leach plant was 10,944 short tons of materials assaying 4.08 percent V_2O_5, and the recovery was 76.8 percent and the acid factor 15½ pounds of sulfuric acid per pound V_2O_5 in fused vanadium pentoxide produced.

Peru.—The famous Mina Ragra mine of the Vanadium Corp. of America in the Andes near Ricran, Department of Junin, has been an important source of vanadium since 1907, when production was begun. Output in Peru was 913 metric tons V_2O_5 in 1948 compared with 776 tons V_2O_5 in 1947. The gain in output was attributed to the installation of two additional rotary kilns, which permitted the concentrating plant to treat more tonnage.

South-West Africa.—The Abenab West lead-vanadium mine of the South West Africa Co., Ltd., was the only producer of vanadium in South-West Africa in 1948. Output of ore and concentrates (V_2O_5 content) was 368 short tons in 1948 compared with 556 tons in 1947. Exports of ores and concentrates (V_2O_5 content) were 515 short tons, of which 57 percent went to France, 27 percent to the United Kingdom, and 16 percent to the Netherlands. Research work undertaken upon samples taken from the mine was sufficiently promising to justify the installation of a flotation plant, which was under construction at the end of 1948. The vanadium deposits of South-West Africa, of which the Grootfontein occurrences are the most important yet exploited, have been described [2] in some detail.

[2] Mining and Industrial Magazine of Southern Africa, Vanadium in South-West Africa: Vol. 38 No. 9, September 1948, pp. 477–479.

Zinc [1]

By RICHARD H. MOTE AND ESTHER B. MILLER

GENERAL SUMMARY

ALTHOUGH fewer primary zinc smelters operated in 1948 than in 1947 and production at several plants was curtailed owing to work stoppages and other causes, the domestic slab-zinc production in 1948 dropped only 1 percent from the peacetime record high output established in 1947. Production from domestic ores rose 5 percent to the highest level since 1944, but the use of foreign ore declined. Redistilled slab-zinc output increased 5 percent in 1948 and was the greatest annual production on record. Domestic mine production of recoverable zinc dropped slightly more than 1 percent, despite a gain of 6 percent from mines in the combined Western States that placed zinc output in that region at the highest point in mining history. Idaho continued to lead the States in mine production of zinc.

A gain in slab-zinc imports was insufficient to offset a drop in imports of zinc in ores and concentrates, with the result that total imports declined 3 percent. Exports of slab zinc dropped 38 percent from 1947.

The demand for slab zinc remained heavy in 1948, as use of the metal for galvanizing and die casting advanced to new record highs. Total domestic slab-zinc consumption gained 4 percent over 1947.

[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.

Producers' stocks of slab zinc were sharply reduced during the year, whereas consumers' inventories gained and at year end were higher than at any time since July 1946.

During 1948 the market price for Prime Western grade slab zinc, East St. Louis, rose from 10.50 cents a pound to 17.50 cents.

Government regulations requiring a license for the exportation of slab zinc and zinc semimanufactures remained operative throughout the year.

Salient statistics of the zinc industry in the United States, 1939–43 (average) and 1944–48

	1939–43 (average)	1944	1945	1946	1947	1948
Production of primary slab zinc:						
By sources:						
From domestic ores......short tons..	591,570	574,453	467,084	459,205	510,058	537,966
From foreign ores......do....	176,172	294,849	297,477	269,057	292,437	249,798
Total..........	767,742	869,302	764,561	728,262	802,495	787,764
By methods:						
Electrolytic......percent of total..	29	37	35	39	37	40
Distilled......do....	71	63	65	61	63	60
Production of redistilled secondary slab zinc......short tons..	52,052	49,037	49,242	44,516	59,542	62,320
Stocks on hand at primary smelters Dec. 31......short tons..	75,685	233,044	254,692	175,513	67,046	19,179
Price:						
Prime Western at St. Louis:						
Average for period..cents per pound..	7.09	8.25	8.25	8.73	10.50	13.58
Highest quotation......do....	8.25	8.25	8.25	10.50	10.50	17.50
Lowest quotation......do....	4.50	8.25	8.25	8.25	10.50	10.50
Yearly average at London......do....	....	4.63	5.18	7.75	12.58	14.38
Mine production of recoverable zinc short tons..	702,044	718,642	614,358	574,833	637,608	629,977
Tri-State district (Joplin) percent of total..	33	26	23	24	17	14
Western States......do....	38	46	48	48	54	58
Other......do....	29	28	29	28	29	28
World smelter production of zinc short tons..	1,909,157	1,791,500	1,404,300	1,549,600	1,759,000	1,865,100

DOMESTIC PRODUCTION

Statistics on zinc production are compiled both on a mine basis and on a smelter basis. The mine-output data, based upon the zinc content of ores and concentrates produced (adjusted to account for average smelting losses), are the most precise measure of zinc output from year to year. Smelter production of slab zinc presents a more accurate figure of actual zinc recovery but usually differs from the mine figure owing to overlap or lag between mine shipments and smelter receipts and treatment of ores and concentrates. Over a period of years, however, these variations tend to balance within the limits of statistical error.

MINE PRODUCTION

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, Montana, Arizona, Colorado, New Mexico, Utah, Nevada, and Washington, in descending order of productivity in 1948).

Mine production in the combined Western States gained 6 percent over 1947 to reach the highest point in mining history. Over 58 percent of the total domestic output of zinc in 1948 (54 percent in 1947) was produced in the Western States. Idaho continued to be the largest producer of zinc in the United States. More than 97 percent of the Idaho zinc output in 1948 came from the Coeur d'Alene region; zinc-lead ores and old tailings concentrated yielded nearly 91 percent of the total zinc. Among the Western States, Montana displaced Arizona as the second-largest zinc producer. Output advanced 29 percent over 1947 to reach the highest level since 1941. For the second year in Montana history, zinc production exceeded copper output. Zinc-lead ore yielded 93 percent of Montana's zinc in 1948, and 6 percent was from zinc ore and old slag. Each year from 1940 through 1947, Arizona had succeeded in establishing a new record in zinc output, but in 1948 the production dropped slightly, leaving 1947 as the all-time record high. About 88 percent of the zinc output in 1948 was recovered from zinc-lead ore, 10 percent from zinc-copper ore, and nearly all the remainder from zinc-lead-copper ore and zinc ore. Zinc production in Colorado increased 17 percent in 1948. Eagle County again ranked first among Colorado counties in zinc output. Zinc ore yielded 40 percent of the Colorado total zinc, and zinc-lead ore 54 percent. New Mexico zinc production declined 6 percent from the 1947 output. As usual, the Central district, Grant County, produced most (85 percent) of the State output of zinc. Zinc ore yielded 85 percent of the total zinc produced. Of the 10 leading zinc producers in Utah in 1948, only 4 succeeded in increasing their outputs of recoverable zinc above 1947 figures. Output at the Butterfield property doubled, and increases were made at the United States & Lark group and at properties of the New Park Mining Co. and the Park Utah Consolidated Mines Co. Production of zinc in Nevada gained sharply in 1948 to approach the record level attained in 1946. About 92 percent of the 20,288 tons produced in 1948 was mined in the Pioche district, Lincoln County; nearly 98 percent of the zinc recovered was from zinc and zinc-lead ore. But for the 6-month work stoppage at the Grandview mine of the American Zinc, Lead & Smelting Co., Washington zinc output in 1948 probably would have established an all-time record. The Holden mine of the Howe Sound Co. in Chelan County produced over three times as much zinc in 1948 as in 1947, and the Deep Creek mine in Stevens County also made a large gain.

Mine production of recoverable zinc in the United States, 1939–43 (average) and 1944–48, by States, in short tons

State	1939–43 (average)	1944	1945	1946	1947	1948
Western States and Alaska:						
Alaska					25	22
Arizona	15,372	29,077	40,226	43,665	54,644	54,478
California	599	8,455	9,923	6,877	5,415	5,325
Colorado	19,784	39,955	35,773	36,147	38,745	45,164
Idaho	74,239	91,372	83,463	71,507	83,069	86,267
Montana	48,084	36,127	17,403	16,770	45,679	59,095
Nevada	11,407	20,699	21,457	22,649	16,970	20,288
New Mexico	40,703	50,727	40,295	36,103	44,103	41,502
Oregon			1		1	
South Dakota	32	56			19	29
Texas				44	22	
Utah	42,560	38,994	33,630	28,292	43,673	41,490
Washington	12,522	11,904	11,693	11,329	13,800	12,638
Total	265,302	327,366	293,864	273,383	346,165	366,298
West Central States:						
Arkansas	209	19	303	85	18	31
Kansas	62,045	63,703	48,394	47,703	41,497	35,577
Missouri	23,308	36,626	22,175	22,234	17,074	6,463
Oklahoma	146,102	91,449	69,300	69,552	51,062	43,821
Total	231,664	191,797	140,172	139,574	109,651	85,892
States east of the Mississippi River:						
Illinois	5,918	7,262	8,310	8,798	10,073	12,980
Kentucky	790	341	182	314	508	639
New Jersey	92,161	80,288	81,392	64,454	76,871	76,332
New York	40,391	35,541	24,978	32,515	34,116	34,566
Tennessee	37,816	40,831	33,824	24,614	31,212	29,524
Virginia	19,657	19,667	16,075	16,905	16,788	15,882
Wisconsin	8,345	15,549	15,561	14,276	12,224	7,864
Total	205,078	199,479	180,322	161,876	181,792	177,787
Grand total	702,044	718,642	614,358	574,833	637,608	629,977

Mine production of recoverable zinc in the United States, 1947–48, by months, in short tons

Month	1947	1948	Month	1947	1948
January	55,036	48,548	August	48,855	50,073
February	51,770	48,758	September	47,608	53,393
March	55,874	55,356	October	51,506	54,624
April	58,447	53,752	November	48,976	57,133
May	59,098	52,238	December	50,598	56,626
June	62,121	52,060			
July	47,719	47,416	Total	637,608	629,977

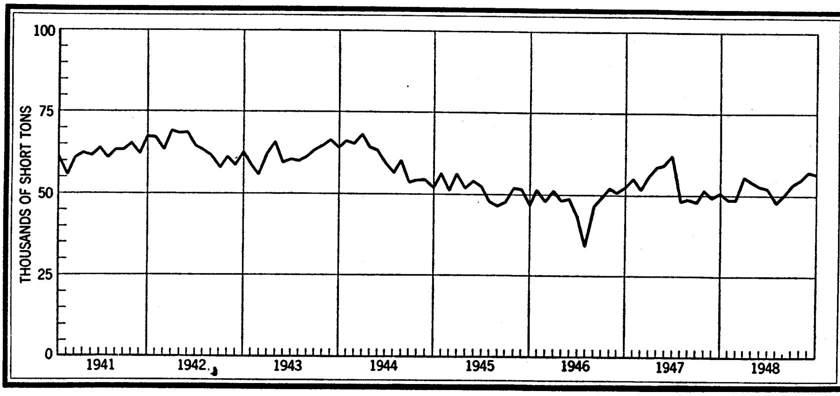

FIGURE 1.—Mine production of recoverable zinc in the United States, 1941–48, by months, in short tons.

Mine production of recoverable zinc in Arkansas, Kansas, Missouri, and Oklahoma decreased 22 percent to the lowest level since 1896 despite a higher annual average concentrate market price than in any year prior to World War II. The output of zinc concentrates in the Tri-State district dropped from 204,068 tons in 1947 to 159,609 tons in 1948. Some of the marginal mines and tailing mills that contributed to the output in the first half of 1947, while Federal premiums were being paid, were nonproductive in 1948. From July 1 to September 5 the mines and mills of the Eagle-Picher Mining & Smelting Co. were shut down by a work stoppage, and other mines that shipped ore to the Eagle-Picher Central mill could not operate during this period.

The total production in States east of the Mississippi River decreased 2 percent in 1948; zinc output from this region accounted for 28 percent of the total domestic output.

The 25 leading zinc-producing mines in the United States in 1948, listed in the following table, yielded 60 percent of the total domestic zinc output; the 3 leading mines produced over 23 percent and the 6 leading mines nearly one-third.

Twenty-five leading zinc-producing mines in the United States in 1948, in order of output

Rank	Mine	District	State	Operator	Type of ore
1	Franklin & Sterling Hill	New Jersey	New Jersey	The New Jersey Zinc Co	Zinc.
2	Butte Mines	Summit Valley (Butte)	Montana	Anaconda Copper Mining Co	Zinc-lead.
3	Copper Queen	Warren (Bisbee)	Arizona	Phelps Dodge Corp	Do.
4	Balmat	St. Lawrence County	New York	St. Joseph Lead Co	Do.
5	United States & Lark	West Mountain (Bingham)	Utah	U. S. Smelting, Refining & Mining Co	Do.
6	Star	Hunter	Idaho	Sullivan Mining Co	Do.
7	Eagle	Red Cliff	Colorado	Empire Zinc Division, New Jersey Zinc Co	Zinc.
8	Austinville	Austinville	Virginia	The New Jersey Zinc Co	Zinc-lead.
9	Combined Metals group	Pioche	Nevada	Combined Metals Reduction Co	Do.
10	Mascot No. 2	Eastern Tennessee	Tennessee	American Zinc Co. of Tennessee	Zinc.
11	Kokomo Unit	Ten Mile	Colorado	American Smelting & Refining Co	Zinc-lead.
12	Walter Hartley	Tri-State	Kansas	St. Louis Smelting & Refining Co	Zinc.
13	Ground Hog group	Central	New Mexico	American Smelting & Refining Co	Do.
14	Emma	Summit Valley (Butte)	Montana	Anaconda Copper Mining Co	Zinc-lead.
15	Oswaldo	Central	New Mexico	Kennecott Copper Corp	Zinc.
16	Page	Yreka	Idaho	Federal Mining & Smelting Co	Zinc-lead.
17	Edwards	St. Lawrence County	New York	St. Joseph Lead Co	Zinc.
18	Sidney	Yreka	Idaho	Sidney Mining Co	Zinc-lead.
19	Ely Valley	Pioche	Nevada	Ely Valley Mine	Do.
20	Bayard Mine group	Central	New Mexico	U. S. Smelting, Refining & Mining Co	Zinc.
21	Davis-Bible group	Eastern Tennessee	Tennessee	Universal Exploration Co	Do.
22	Lawyers-Skelton	Tri-State	Oklahoma	Nellie B. Mining Co	Zinc-lead.
23	Iron King	Big Bug	Arizona	Shattuck Denn Mining Corp	Do.
24	Grasselli	Eastern Tennessee	Tennessee	American Zinc Co. of Tennessee	Zinc.
25	Hanover Mine group	Central	New Mexico	Empire Zinc Division, New Jersey Zinc Co	Do.

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.

Mine production of recoverable zinc in the United States, by districts that produced 1,000 tons or more during any year, 1944–48, in short tons

District	State	1944	1945	1946	1947	1948
Tri-State (Joplin region)	Kansas, southwestern Missouri, Oklahoma.	190,270	139,274	139,038	109,338	84,839
Coeur d'Alene region	Idaho	85,227	78,030	67,429	79,251	83,801
New Jersey	New Jersey	80,288	81,392	64,454	76,871	76,332
Summit Valley (Butte)	Montana	7,874	8,364	7,108	40,712	52,625
Central	New Mexico	44,648	36,245	32,279	38,155	35,140
St. Lawrence County	New York	35,541	24,978	32,515	34,116	34,566
Eastern Tennessee [1]	Tennessee	40,831	33,824	24,614	31,212	29,524
Warren (Bisbee)	Arizona	8,070	18,078	22,374	32,546	27,669
West Mountain (Bingham)	Utah	19,151	14,670	7,593	20,446	22,077
Pioche	Nevada	17,983	16,575	15,764	14,362	18,612
Red Cliff	Colorado	20,492	15,805	16,437	17,375	16,355
Austinville	Virginia	18,257	16,000	16,905	16,788	15,882
Upper Mississippi Valley	Northern Illinois, Iowa,[2] Wisconsin.	17,242	19,318	18,344	17,077	14,061
Ten Mile	Colorado	1,483	2,142	2,490	4,587	10,338
Park City region	Utah	9,556	7,435	8,876	10,956	10,320
Kentucky-Southern Illinois	Kentucky, Southern Illinois	5,910	4,735	5,044	5,728	7,422
Metaline	Washington	9,236	7,794	7,685	9,754	5,985
Big Bug	Arizona	3,794	4,922	5,234	4,991	5,832
Pima (Sierritas, Papago, Twin Buttes).	do	5,170	3,697	3,948	4,727	5,758
California (Leadville)	Colorado	7,984	7,419	5,996	4,809	5,726
Magdalena	New Mexico	4,474	3,044	3,474	5,013	4,856
Coso	California	555	996	854	603	4,497
Old Hat (Oracle)	Arizona	2,521	4,750	4,235	3,427	3,796
Tintic	Utah	3,450	2,928	3,710	3,969	3,680
Rush Valley and Smelter (Tooele County).	do	6,224	7,720	6,365	5,642	3,552
Upper San Miguel	Colorado	828	1,458	1,963	2,067	3,486
Smelter (Lewis and Clark County).	Montana	20,623	2,235	4,995	748	3,417
Chelan Lake	Washington	1,074	2,419	1,730	1,000	3,289
Northport	do	1,438	1,410	1,790	2,788	3,271
Pioneer (Rico)	Colorado	4,557	3,920	3,435	3,433	3,180
Cochise	Arizona	46	1,300	2,877	3,143	2,875
Harshaw	do	2,051	1,666	1,128	2,006	2,875
Eureka (Bagdad)	do	234	425	325	257	2,321
Tomichi	Colorado	431	430	440	1,684	1,983
Warm Springs	Idaho	4,000	2,797	2,161	2,791	1,545
Heddleston	Montana	1,529	1,878	1,516	1,482	1,437
Aravaipa	Arizona	308	333	152	20	1,098
Pinos Altos	New Mexico	508	298	81	724	1,056
Animas	Colorado	577	795	1,590	1,310	748
Wallapai	Arizona	1,046	684	486	857	672
Patagonia	do	1,261	683	833	314	350
Sheridan	Montana	1,053	861	785	527	201
Breckenridge	Colorado	318	723	1,110	1,279	171
Eureka	Nevada	195	1,204	3,705	897	19
Campo Seco	California	712	2,134	3,301	2,350	
Flat Creek	do	1,532	1,714	1,926	1,707	
Packer Creek	Montana	1,389	254		83	
Hunter Valley	California	3,346	3,311			
Pioneer (Superior)	Arizona	3,850	2,297			
Yankee Hill	California	1,444	1,251			
Livingston	Virginia	1,410	75			

[1] Includes very small quantity produced elsewhere in State.
[2] No production in Iowa since 1917.

SMELTER PRODUCTION

During 1948, 19 primary zinc-reduction plants were in operation, of which 10 operated with horizontal retorts exclusively, 1 with both horizontal and vertical retorts, 3 with vertical retorts exclusively (1 electrothermic), and 5 with electrolytic methods.

Horizontal-Retort Plants.—The total number of retorts reported at active horizontal-retort primary plants in 1948 was 59,168, a 15-percent decrease from the 69,950 retorts on December 31, 1947, at plants that operated during that year. Of the total retorts reported, 53,332 (90 percent) were in use at the close of 1948, compared with 51,668 (74 percent) in operation at the end of 1947.

Vertical-Retort Plants.—Four vertical-retort continuous distilling plants operated during 1948. The St. Joseph Lead Co. operated its 13 electrothermic units at Josephtown, Pa., at about 87 percent capacity throughout the year. Of the 66 vertical retorts at the remaining 3 plants, 61 were in operation on December 31, 1948.

Electrolytic Plants.—Five electrolytic plants were in operation during 1948, as in 1947. There were 3,370 cells at the plants on December 31, 1948, of which 3,310 (98 percent) were in operation; the number of cells at the end of 1947 was 3,210, of which 3,176 (99 percent) were operating.

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, 1948, had a stated annual capacity to produce 1,010,933 tons of slab zinc under normal operating conditions, allowing for necessary shut-downs for repairs. This figure, which compares with a 998,087-ton reported capacity at the end of 1947, indicates that the 1948 output was 84 percent of the capacity, as compared with 86 percent in 1947. Horizontal- and vertical-retort plants operated at 82 percent of a stated 610,697-ton capacity (88 percent of a 599,502-ton capacity in 1947), electrolytic plants at 91 percent of a 345,172-ton capacity (86 percent of a 341,701-ton capacity in 1947), and secondary smelters at 58 percent of a 55,064-ton capacity (66 percent of a 56,884-ton capacity in 1947).

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 1948:

Arkansas:
- Fort Smith—The Residue Co.

Illinois:
- Fairmont City—American Zinc Co. of Illinois.
- 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.
- Palmerton—New Jersey Zinc Co.

Slag-Fuming Plants.—The following companies operated slag-fuming plants in 1948 and produced impure zinc oxide, which was further treated for the recovery of slab zinc:

Idaho:
- Bradley—Bunker Hill & Sullivan Mining & Concentrating Co.

Montana:
- East Helena—Anaconda Copper Mining Co.

Texas:
  El Paso—American Smelting & Refining Co.
Utah:
  Tooele—International Smelting & Refining Co.

The American Smelting & Refining Co. slag-fuming plant at El Paso, Tex., under construction during 1947, was completed and began operating in August 1948. During 1948 these four plants treated 510,581 tons of hot and cold slag, which yielded 87,104 tons of oxide fume containing 53,394 tons of recoverable zinc. Corresponding figures for the three operating plants in 1947 were 587,364, 94,996, and 56,025 tons, respectively.

The St. Joseph Lead Co. continued experimental operation of its slag-fuming plant at Herculaneum, Mo., in 1948 and recovered slab zinc as a direct product of the operation that treats lead blast-furnace slag containing 12 to 16 percent zinc.

Active Zinc-Reduction Plants.—Operations at active primary zinc smelters and electrolytic plants in 1948 were below capacity, due in part to labor-management difficulties that precipitated strikes at smelters at Forth Smith, Ark., in August, September, and October, and at East St. Louis and Hillsboro, Ill., in August through December. The Donora, Pa., smelter was shut down temporarily in November to determine the cause and extent of noxious fumes that were reported to have caused illness and death among residents of Donora. A list of the zinc-reduction plants operating in the United States in 1948 follows:

Primary zinc distillers

Horizontal-retort plants

Arkansas:
  Fort Smith—Athletic Mining & Smelting Co.
Illinois:
  Fairmont City—American Zinc Co. of Illinois.
  La Salle—Matthiessen & Hegeler Zinc Co.
Oklahoma:
  Blackwell—Blackwell Zinc Co.
  Henryetta—Eagle-Picher Mining & Smelting Co.
  Bartlesville—National Zinc Co., Inc.
Pennsylvania:
  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:
  Depue—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., Inc.

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.

Secondary zinc distillers

Alabama:
- Fairfield—W. J. Bullock, Inc.

California:
- Los Angeles—American Smelting & Refining Co., Federated Metals Division.
- Torrance—Pacific Smelting Co.

Illinois:
- Beckemeyer—American Smelting & Refining Co., Federated Metals Division.
- Hillsboro—American Zinc, Lead & Smelting Co.
- Sandoval—Sandoval Zinc Co.

Maryland:
- Baltimore—Brooklyne Chemical Works, Inc.

New York:
- Rome—Rome Smelting & Refining Corp.

Pennsylvania:
- Bristol—Superior Zinc Corp.
- Philadelphia—General Smelting Co.

West Virginia:
- Wheeling—Wheeling Steel Corp.

PRIMARY AND REDISTILLED SECONDARY SLAB ZINC

The output of primary slab zinc in 1948 dropped nearly 2 percent from the 1947 production. The use of foreign concentrates declined, and the slab zinc produced from this source fell 15 percent. Output from domestic ore, largest since 1944, rose 5 percent.

Production of redistilled slab zinc from zinc scrap increased 5 percent in 1948 to the highest level on record. Of the 62,320 short tons of redistilled secondary slab zinc produced, 28,070 tons (45 percent) were derived from primary smelters and 34,250 tons (55 percent) were produced at secondary plants. Data on output of remelted secondary slab zinc are not included with those for redistilled metal. In 1948 the production of slab zinc recovered by remelting purchased scrap was 7,796 tons (7,443 tons in 1947). Zinc rolling mills and other substantial consumers of slab zinc recover large quantities of zinc from their own plant scrap; but such metal is not measured statistically, for it seldom enters the market as scrap.

Primary and redistilled secondary slab zinc produced in the United States, 1939–43 (average) and 1944–48, in short tons

Year	Primary			Redistilled secondary	Total (excludes zinc recovered by remelting)
	Domestic	Foreign	Total		
1939–43 (average)	591,570	176,172	767,742	52,052	819,794
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
1947	510,058	292,437	802,495	59,542	862,037
1948	537,966	249,798	787,764	62,320	850,084

[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 1948 output of primary zinc, 60 percent was distilled and 40 percent was produced electrolytically, compared with 63 and 37 percent, respectively, in 1947.

Production of Intermediate grade and Regular High Grade rose 6 percent and 3 percent, respectively, in 1948. Output of Special High Grade increased for the third consecutive year and was nearly 4 percent above the 1947 production. Owing to the substantial supply of brass scrap available for the manufacture of brass products and a drop in demand for Brass Special grade zinc, smelter output fell 25 percent. Declines of 2 percent and 63 percent were recorded in the production of Prime Western and Selected grades, respectively. Of the total 1948 production (comparable 1947 figures in parentheses), 37 percent (37 percent) was Prime Western, 29 percent (28 percent) Special High Grade, 23 percent (22 percent) Regular High Grade, 5 percent (7 percent) Brass Special, 5 percent (4 percent) Intermediate, and 1 percent (2 percent) Selected.

Distilled and electrolytic zinc, primary and secondary, produced in the United States, 1944–48, in short tons

CLASSIFIED ACCORDING TO METHOD OF REDUCTION

Year	Electrolytic primary	Distilled	Redistilled secondary [1]		Total
			At primary smelters	At secondary smelters	
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
1947	295,520	506,975	22,093	37,449	862,037
1948	312,477	475,287	28,070	34,250	850,084

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		
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
1947	239,274	190,429	36,812	61,104	12,844	321,574	862,037
1948	248,346	196,482	38,892	45,946	4,723	315,695	850,084

[1] For total production of secondary zinc see chapter on Secondary Metals—Nonferrous.

PRIMARY SLAB ZINC, BY STATES

Montana continued to be the leading producer of primary slab zinc in 1948; Pennsylvania and Oklahoma remained in second and third places, respectively. Of the States for which production figures may be shown separately, Illinois, Idaho, and Arkansas occupied the next three positions. As usual, in Montana and Idaho slab zinc was produced by electrolytic methods only. In Illinois and Texas both electrolytic and distilled zinc metal was recovered, whereas in all other States zinc was recovered by distillation alone.

Primary slab zinc produced in the United States, by States where smelted, 1939-43 (average) and 1944-48, in short tons

Year	Arkansas	Idaho	Illinois	Montana	Oklahoma	Pennsylvania	Texas and West Virginia [1]	Total	
								Short tons	Value
1939-43 (average)	35,357	35,247	140,071	173,134	92,318	200,571	91,044	767,742	$115,681,000
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
1947	17,158	41,801	113,192	197,453	128,398	193,524	110,969	802,495	171,894,429
1948	15,586	42,064	93,229	207,717	137,844	171,276	120,048	787,764	209,860,330

[1] Includes Missouri 1943-44 and 1947-48.

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 12 percent in 1948.

Sulfuric acid (basis, 100 percent) made at zinc-blende roasting plants in the United States, 1944-48

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
1944	652,001	$8,344,143	201,109	$2,573,734	853,110	$10,917,877	$9.94
1945	610,938	7,944,478	235,594	3,063,603	846,532	11,008,081	10.10
1946	544,529	6,842,541	160,886	2,021,696	705,415	8,864,237	9.76
1947	598,703	8,001,205	266,104	3,556,281	864,807	11,557,486	10.38
1948	529,478	7,478,271	233,099	3,292,261	762,577	10,770,532	10.97

[1] Includes acid from foreign blende.
[2] At average of sales of 60° B. acid.

ZINC DUST

All previous records for production of zinc dust were broken in 1948, the total output being 5 percent above the former high point reached in 1947. Zinc powder and blue powder are not included in the Bureau of Mines production totals; 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 1948 ranged from 95.00 to 99.74 percent and averaged 97.73 percent. Shipments of zinc dust, which totaled 31,389 tons—2 percent of which went to foreign countries—were slightly lower than production. The quantity consumed at manufacturers' plants (2 percent of output) was smaller than the difference between production and shipments with the result that producers' stocks increased from 1,156 tons at the beginning to 1,205 tons at the close of the year.

The average price of zinc dust shipped to domestic consumers in 1948 was 15.55 cents a pound compared with 12.4 cents in 1947. 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, 1939–43 (average) and 1944–48

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average per pound			Total	Average per pound
1939–43 (average)	22,158	$4,090,688	$0.092	1946	28,574	$6,057,688	$0.106
1944	26,511	5,408,244	.102	1947	30,602	7,589,296	.124
1945	25,877	5,227,154	.101	1948	32,217	10,051,704	.156

[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.

CONSUMPTION AND USES

According to reports from 589 plants, 817,735 tons of slab zinc were put in process in 1948, a 4-percent increase over the 1947 total but 8 percent below the record level of 888,626 tons in 1944. Receipts at consumers' plants in 1948 were 833,464 tons. A comparison of the calculated figure of slab zinc available to consumers and the actual measured consumption since 1943 indicates that coverage of the plant survey was approximately 97 percent.

Galvanizing continued as the principal use of slab zinc, and the quantity consumed for this purpose in 1948 was the greatest in the history of the zinc industry. Consumption of slab zinc for the manufacture of brass products continued to decline. The quantity of zinc used for zinc-base alloys reached an all-time high of 234,628 tons, a gain of 9 percent over the previous record of 214,469 tons in 1947.

Consumption of slab zinc in the United States, 1944–48, by industries, in short tons [1]

Industry and product	1944	1945	1946	1947	1948
Galvanizing: [2]					
Sheet and strip	119,381	135,383	113,816	115,147	120,360
Wire and wire rope	44,350	46,083	43,667	49,726	49,906
Tubes and pipe	50,472	63,163	62,460	77,238	81,874
Fittings	14,113	10,014	10,593	10,467	14,037
Other	87,675	82,538	89,223	108,749	104,792
Total galvanizing	315,991	337,181	319,759	361,327	370,969
Brass products:					
Sheet, strip, and plate	246,402	146,375	66,125	50,212	51,813
Rod and wire	70,970	67,299	53,387	34,653	32,076
Tube	27,725	21,507	19,173	15,488	15,890
Castings and billets	16,703	12,942	4,776	3,155	4,228
Copper-base ingots	17,174	9,893	4,379	7,299	3,546
Other copper-base products	2,953	1,361	1,262	1,540	1,587
Total brass products	381,927	259,377	149,102	112,347	109,140
Zinc-base alloy:					
Die castings	76,201	121,966	206,237	210,214	230,995
Alloy dies and rod	8,245	8,286	5,313	3,802	3,171
Slush and sand castings	75	584	661	453	462
Total zinc-base alloy	84,521	130,836	212,211	214,469	234,628
Rolled zinc	76,524	97,589	92,397	70,680	76,672
Zinc oxide	20,198	18,113	19,170	18,376	15,657
Other uses:					
Wet batteries	2,174	1,790	1,635	1,462	1,368
Desilverizing lead	2,051	2,095	1,781	2,687	2,654
Light-metal alloys	2,047	1,469	545	607	1,125
Other [3]	3,193	3,861	4,642	4,405	5,522
Total other uses	9,465	9,215	8,603	9,161	10,669
Total consumption [4]	888,626	852,311	801,242	786,360	817,735

[1] Excludes some small consumers.
[2] Includes zinc used in electrogalvanizing and electroplating, but excludes sherardizing.
[3] Includes zinc used in making zinc dust, bronze powder, alloys, chemicals; castings, and miscellaneous uses not elsewhere mentioned.
[4] Includes 6,982 tons of remelt zinc in 1944, 5,111 tons in 1945, 3,912 tons in 1946, 3,577 tons in 1947, and 3,141 tons in 1948.

The quantity of slab zinc consumed for rolled products in 1948 increased 8 percent over the 1947 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 1948 amounted to 15,032 tons—a slight increase from the 14,952 tons processed in 1947. Purchased zinc scrap in the form of zinc clippings, old zinc scrap, and engravers' plates totaling 3,689 tons were melted and rolled in 1948 (3,050 tons in 1947). Production of rolled zinc from slab zinc and purchased scrap was 77,669 tons, an increase of 9 percent over the 1947 total. Inventories of rolled zinc were 1,968 tons on December 31, 1948, compared with 1,852 tons on the same date in 1947. In addition to the actual shipments of 54,386 tons of rolled zinc in 1948, the rolling mills processed 38,200 tons of rolled zinc (including that which was remelted and rerolled) in manufacturing 23,851 tons of semifabricated and finished products.

Rolled zinc produced and quantity available for consumption in the United States, 1947–48

	1947			1948		
	Short tons	Value		Short tons	Value	
		Total	Average per pound		Total	Average per pound
Production:						
Sheet zinc not over 0.1 inch thick	20,598	$7,357,171	$0.180	18,974	$7,952,260	$0.210
Boiler plate and sheets over 0.1 inch thick	1,624	578,853	.148	1,344	440,543	.164
Strip and ribbon zinc [1]	47,837	15,253,466	.164	56,301	19,439,164	.173
Foil, rod, and wire	1,138	540,770	.238	1,050	602,710	.287
Total rolled zinc	71,197	23,730,260	.167	77,669	28,434,677	.183
Imports	1	457	.229	120	32,871	.137
Exports	[2] 7,950	[2] 3,089,705	[2] .194	6,380	2,715,839	.213
Available for consumption	[2 3] 63,984			71,293		
Value of slab zinc (all grades)			.107			.133
Value added by rolling			.060			.050

[1] Figures represent net production. In addition 14,952 tons of strip and ribbon zinc in 1947 and 15,032 tons in 1948 were rerolled from scrap originating in fabricating plants in connection with zinc rolling mills.
[2] Revised figure.
[3] Allowances made for change in producers' stocks of rolled zinc.

The following table shows the six commercial grades of refined slab zinc and purchased remelt spelter consumed by the various industries in 1948. Of the 817,735 tons of domestic and foreign zinc consumed, 40 percent was Prime Western, 33 percent Special High Grade, and 16 percent Regular High Grade, compared with 42, 31, and 15 percent, respectively, in 1947. All grades of zinc were used for galvanizing and in the manufacture of brass. 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, 75 percent of the total used in this industry being of the two highest grades.

Consumption of slab zinc in the United States in 1948, by grade and industry, in short tons

Industry	Special High Grade	Regular High Grade	Intermediate	Brass Special	Selected	Prime Western	Remelt	Total
Galvanizers	13,903	12,446	13,798	15,180	520	312,949	2,173	370,969
Brass products	22,005	60,159	4,021	8,978	1,666	11,600	711	109,140
Zinc-base alloy	229,057	5,479	12	0	0	64	16	234,628
Rolled zinc	3,180	34,230	17,704	20,175	0	1,383	0	76,672
Zinc oxide	537	13,627	0	493	0	1,000	0	15,657
Other	892	4,518	1,707	551	0	2,760	241	10,669
Total	269,574	130,459	37,242	45,377	2,186	329,756	3,141	817,735

CONSUMPTION OF SLAB ZINC BY GEOGRAPHIC AREAS [2]

The geography of slab zinc consumption is available in detail only since 1940. During the 9-year period through 1948 substantial shifts are observable, largely the result of conversion to war production in

[2] This section is based partly on a detailed study by Ransome, Alfred L., Consumption of Slab Zinc in the United States by Industries, Grades, and Geographic Divisions, 1940–45: Bureau of Mines Inf. Circ. 7450, 1948, 30 pp.

1940–41 and reconversion to peacetime consumption in 1945–46. The distribution of total slab zinc consumed for all uses according to geographic divisons and by States and for individual uses is shown in the following tables.

Consumption of Slab Zinc for All Uses.—During the period 1940–45 Illinois ranked first among the 42 zinc-consuming States and the District of Columbia with an annual average of 123,677 short tons. The use of zinc in Illinois has increased in the years following and the State has maintained its lead in zinc consumption. Connecticut, which averaged second during the war period owing to the large quantities of zinc consumed in the brass plants of that State, has since dropped to fifth place. Since 1940 Pennsylvania has held either second or third place. The greatest concentration of slab-zinc consumption is in the region comprising Illinois, Indiana, Michigan, Ohio, and Wisconsin. This area, which has consistently ranked first in zinc consumption since 1940, uses nearly half the total quantity of slab zinc consumed annually in the United States. The region of least consumption is the Mountain States, including Arizona, Colorado, Idaho, Nevada, New Mexico, and Utah, which has accounted for less than 0.3 percent of the total.

Consumption of slab zinc in the United States, 1940–45 (average) and 1946–48, by geographic divisions and States

Geographic division and State	1940–45 (average annual)		1946		1947		1948	
	Short tons	Rank	Short tons	Rank	Short tons	Rank	Short tons	Rank
I. New England:								
Connecticut	120,810	2	72,886	4	58,170	4	57,003	5
Massachusetts	14,357	14	11,262	15	11,241	15	10,535	15
Maine	988	23	203	30	93	30	78	31
New Hampshire	246	30	(1)	37	(1)	34	(1)	35
Rhode Island	193	32	(1)	28	(1)	25	(1)	29
Total	136,594	3	84,677	3	69,992	3	67,952	3
II. Middle Atlantic:								
New Jersey	22,607	11	18,660	11	23,173	10	21,138	12
New York	48,222	7	45,809	6	44,620	7	47,351	6
Pennsylvania	111,142	3	122,472	3	120,081	3	131,101	3
Total	181,971	2	186,941	2	187,874	2	199,590	2
III. South Atlantic:								
Delaware	1	41						
District of Columbia	152	34	(1)	36	(1)	33	(1)	33
Florida	186	33	(1)	35				
Georgia	1,076	22	2,145	19	2,750	19	2,738	19
Maryland	24,830	9	16,696	12	23,276	9	24,966	9
North Carolina	1	41						
South Carolina	152	34	(1)	33	(1)	31	(1)	32
Virginia	700	25	201	31	234	28	365	27
West Virginia	19,333	12	21,858	9	21,641	11	23,845	10
Total	46,431	4	41,029	4	47,963	4	52,038	4
IV. East North Central:								
Illinois	123,677	1	155,838	1	140,586	1	152,690	1
Indiana	63,373	5	64,849	5	56,908	5	61,363	4
Michigan	48,659	6	44,148	7	45,418	6	42,024	7
Ohio	105,134	4	125,635	2	135,204	2	132,735	2
Wisconsin	27,333	8	13,204	14	12,691	14	12,117	14
Total	368,176	1	403,674	1	390,807	1	400,929	1

See footnote at end of table.

Consumption of slab zinc in the United States, 1940–45 (average) and 1946–48, by geographic divisions and States—Continued

Geographic division and State	1940–45 (average annual)		1946		1947		1948	
	Short tons	Rank	Short tons	Rank	Short tons	Rank	Short tons	Rank
V. East South Central:								
Alabama	17,540	13	16,569	13	17,048	12	22,030	11
Kentucky	6,325	16	5,979	17	7,893	16	9,014	16
Mississippi	6	39						
Tennessee	706	24	946	22	1,718	21	1,242	23
Total	24,577	6	23,494	7	26,659	7	32,286	5
VI. West North Central:								
Iowa	5,742	17	6,482	16	7,258	17	7,409	17
Kansas	18	37	318	27	33	32	22	34
Minnesota	2,048	19	3,063	18	3,796	18	4,232	18
Missouri	9,372	15	18,763	10	16,268	13	17,625	13
Nebraska	575	26	924	24	1,650	22	1,551	22
Total	17,755	7	29,550	5	29,005	5	30,839	6
VII. West South Central:								
Louisiana	212	31	(1)	32	(1)	29	(1)	30
Oklahoma	466	28	(1)	25	(1)	24	(1)	24
Texas	2,141	18	1,563	20	2,134	20	1,726	21
Total	2,819	8	2,385	8	3,063	8	2,900	8
VIII. Mountain:								
Arizona	16	38						
Colorado	1,352	21	1,286	21	1,650	22	1,830	20
Idaho	375	29	(1)	29	(1)	26	(1)	26
Nevada	45	35						
New Mexico	3	40						
Utah	23	36	(1)	34	(1)	35	(1)	36
Total	1,814	9	1,633	9	2,086	9	2,321	9
IX. Pacific:								
California	23,417	10	26,571	8	27,443	8	27,616	8
Oregon	478	27	354	26	339	27	361	28
Washington	1,682	20	934	23	1,129	23	903	25
Total	25,577	5	27,859	6	28,911	6	28,880	7
Grand total	805,714		801,242		786,360		817,735	

[1] Nominal quantity consumed included with subtotal for division, as less than 3 companies reported.

Consumption of Slab Zinc for Galvanizing.—The iron and steel industry is the largest consumer of slab zinc, which it uses for galvanizing or rustproofing sheets, wire, tubes and pipes, building and pole-line hardware, railway-signal equipment, chains, bolts, screws, and a multitude of other items. It is, therefore, quite understandable that the principal iron and steel producing States are also the principal consumers of zinc for galvanizing. From 1940 through 1943, Pennsylvania ranked first among the 34 States which consumed zinc for this purpose. In 1944 Ohio displaced Pennsylvania and retained the top position in the succeeding years through 1948. The greatest concentration of zinc consumption for galvanizing is the region comprising Illinois, Indiana, Pennsylvania, and Ohio, which accounted for 62 percent of the average annual domestic consumption for this use in the period 1940–45. In 1946, total zinc used for galvanizing in these States rose to 65 percent, but declined to 63 percent in 1947 and 1948.

Consumption of slab zinc for galvanizing in the United States, 1940–45 (average) and 1946–48, by States

State	Geographic division	1940-45 (average annual)		1946		1947		1948	
		Short tons	Rank	Short tons	Rank	Short tons	Rank	Short tons	Rank
Alabama	V	17,471	5	(1)	6	(1)	7	(1)	7
California	IX	12,726	8	14,307	8	17,016	8	15,046	8
Colorado	VIII	1,317	18	(1)	20	(1)	20	(1)	19
Connecticut	I	3,284	14	3,196	15	3,405	16	3,752	15
Florida	III	184	29	(1)	33				
Georgia	III	1,074	21	(1)	18	(1)	18	(1)	17
Illinois	IV	29,753	3	37,161	3	44,087	3	47,660	3
Indiana	IV	22,369	4	25,007	4	27,018	4	26,458	4
Iowa	VI	188	28	(1)	29	(1)	31	(1)	31
Kentucky	V	6,259	12	(1)	9	(1)	9	(1)	9
Louisiana	VII	205	27	(1)	26	(1)	27	(1)	28
Maine	I	801	22	(1)	25	(1)	29	(1)	29
Maryland	III	17,434	6	15,968	7	22,464	5	24,422	5
Massachusetts	I	6,507	11	5,154	10	6,769	11	6,065	10
Michigan	IV	4,065	13	3,537	14	4,045	14	3,513	16
Minnesota	VI	2,045	17	2,889	16	(1)	15	4,062	14
Missouri	VI	3,070	15	3,898	13	(1)	13	4,483	13
Nebraska	VI	148	31	(1)	27	(1)	24	(1)	27
New Hampshire	I	58	33	(1)	34				
New Jersey	II	7,305	9	5,016	12	5,012	12	5,104	12
New York	II	6,956	10	5,095	11	7,395	10	5,906	11
Ohio	IV	66,504	2	78,628	1	82,679	1	82,622	1
Oklahoma	VII	453	26	(1)	23	(1)	23	(1)	21
Oregon	IX	463	25	(1)	24	(1)	26	(1)	24
Pennsylvania	II	70,445	1	63,852	2	71,013	2	73,806	2
Rhode Island	I	168	30	(1)	30	(1)	25	(1)	25
South Carolina	III	106	32	(1)	31	(1)	30	(1)	30
Tennessee	V	622	23	(1)	22	(1)	21	(1)	22
Texas	VII	1,188	19	(1)	19	2,069	19	(1)	20
Utah	VIII	19	34	(1)	32				
Virginia	III	563	24	(1)	28	(1)	28	(1)	26
Washington	IX	1,118	20	(1)	21	1,095	22	(1)	23
West Virginia	III	17,353	7	(1)	5	(1)	6	(1)	6
Wisconsin	IV	2,534	16	2,693	17	2,953	17	2,560	18
Total		304,755		317,222		358,533		368,796	

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

Consumption of Slab Zinc for Brass Products.—From 1940 through 1948 Connecticut has ranked first among the States consuming slab zinc for brass products; but, owing to the wartime demand for brass and the construction of new plant facilities, there has been some change in the rank of the other leading States. In 1940 Michigan was in second place, followed by New York, Illinois, Ohio, and Pennsylvania among the top six, whereas in 1948 Illinois ranked second, with Michigan in third place, followed by New York, Ohio, and Wisconsin.

Consumption of slab zinc for brass products in the United States, 1940–45 (average) and 1946–48, by States

State	Geographic division	1940–45 (average annual)		1946		1947		1948	
		Short tons	Rank	Short tons	Rank	Short tons	Rank	Short tons	Rank
Alabama	V	69	19	(1)	17	(1)	19	(1)	13
California	IX	1,868	12	1,019	11	665	11	718	11
Colorado	VIII	17	22	(1)	15	(1)	14	(1)	16
Connecticut	I	112,834	1	62,519	1	47,903	1	46,671	1
Delaware	III	1	29	------	------	------	------	------	------
District of Columbia	III	152	17	(1)	19	(1)	17	(1)	15
Florida	III	------	33	(1)	30	------	------	------	------
Georgia	III	1	30	(1)	22	(1)	21	(1)	22
Illinois	IV	30,286	3	14,865	3	11,712	3	13,228	2
Indiana	IV	12,984	7	2,115	10	1,835	10	2,217	10
Iowa	VI	1	31	(1)	27	(1)	25	(1)	27
Kansas	VI	17	23	(1)	13	(1)	20	(1)	19
Kentucky	V	22	21	(1)	28	(1)	24	(1)	23
Maine	I	156	16	(1)	23	(1)	27	------	------
Maryland	III	7,342	10	723	12	(1)	12	544	12
Massachusetts	I	6,386	11	4,086	9	2,797	9	2,734	9
Michigan	IV	31,200	2	16,310	2	12,104	2	10,333	3
Minnesota	VI	2	28	------	------	------	------	------	------
Missouri	VI	312	14	123	14	99	13	136	14
Nebraska	VI	7	26	(1)	31	(1)	22	(1)	26
New Hampshire	I	180	15	(1)	25	(1)	18	(1)	20
New Jersey	II	9,124	9	7,109	8	7,617	5	5,643	7
New York	II	24,267	4	12,864	4	7,320	6	7,838	4
Ohio	IV	20,975	6	11,355	5	7,901	4	7,059	5
Oregon	IX	15	24	(1)	24	(1)	26	(1)	24
Pennsylvania	II	12,698	8	7,115	7	4,825	8	4,610	8
Rhode Island	I	9	25	(1)	21	(1)	23	(1)	21
South Carolina	III	46	20	(1)	26	------	------	(1)	28
Texas	VII	6	27	(1)	20	23	15	(1)	17
Utah	VIII	1	32	(1)	29	(1)	28	------	------
Virginia	III	84	18	(1)	16	(1)	16	(1)	18
Washington	IX	557	13	33	18	------	------	(1)	25
Wisconsin	IV	23,137	5	7,689	6	(1)	7	6,278	6
Total	------	294,756	------	148,327	------	111,997	------	108,429	------

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

Consumption of Slab Zinc for Zinc-Base Alloys.—The automobile industry is the largest user of zinc-base alloys, principally for die-cast parts and assemblies such as fuel pumps, carburetors, radiator grilles, windshield wipers, and a wide variety of both interior and exterior hardware. Thus the region embracing Illinois, Indiana, Michigan, Ohio, and Wisconsin in which the automobile industry is centered is the area of greatest concentration of slab zinc consumed for zinc-base alloys. Nearly 61 percent of the zinc used for die-castings and other zinc-base alloys in 1948 was consumed in this region.

Consumption of slab zinc for zinc-base alloys in the United States, 1940–45 (average) and 1946–48, by States

State	Geographic division	1940–45 (average annual)		1946		1947		1948	
		Short tons	Rank	Short tons	Rank	Short tons	Rank	Short tons	Rank
California	IX	8,223	5	10,526	8	8,352	9	10,775	8
Connecticut	I	2,410	10	5,387	9	(1)	10	(1)	10
Florida	III	1	19						
Illinois	IV	30,802	1	55,093	1	44,231	1	54,602	1
Indiana	IV	6,743	7	13,654	7	13,369	6	14,958	6
Kansas	VI		21	(1)	12				
Kentucky	V	40	14						
Maine	I	11	18						
Maryland	III	49	13						
Massachusetts	I	21	15	(1)	14	(1)	14	(1)	14
Michigan	IV	12,939	4	(1)	3	(1)	3	(1)	4
Missouri	VI	5,649	8	(1)	6	11,572	7	12,724	7
New Jersey	II	4,050	9	4,290	10	8,471	8	8,266	9
New York	II	13,440	3	22,883	5	25,135	4	28,312	3
Ohio	IV	16,939	2	34,800	2	43,851	2	42,092	2
Oklahoma	VII	13	17						
Pennsylvania	II	7,886	6	23,584	4	21,131	5	26,429	5
Rhode Island	I	16	16						
Texas	VII	853	12	(1)	13	(1)	12	(1)	12
Virginia	III		22		15	(1)	15	(1)	13
Washington	IX	1	20			34	13		
Wisconsin	IV	1,635	11	(1)	11	3,221	11	(1)	11
Total		111,721		211,885		214,434		234,612	

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

Consumption of Slab Zinc for Rolled Zinc.—During the period 1940–48, although the quantity of slab zinc consumed for rolled zinc changed widely, the geographic pattern and rank of the consuming States varied but little. Illinois and Indiana ranked first and second, respectively, and accounted for the greater quantity of slab zinc consumed for rolling in the United States. Pennsylvania held third place through 1946 but was displaced in 1947 and 1948 by Iowa, which moved up from fourth position. Except for 1943 through 1945, New York has been the fifth-ranking State in the consumption of zinc for rolling.

Consumption of slab zinc for rolled zinc in the United States, 1940–45 (average) and 1946–48, by States

State	Geographic division	1940–45 (average annual)		1946		1947		1948	
		Short tons	Rank	Short tons	Rank	Short tons	Rank	Short tons	Rank
Connecticut	I	1,646	7	(1)	8	(1)	7	(1)	8
Illinois	IV	31,332	1	46,025	1	(1)	1	35,964	1
Indiana	IV	17,946	2	(1)	2	(1)	2	(1)	2
Iowa	VI	5,554	4	(1)	4	(1)	3	(1)	3
Massachusetts	I	1,399	8	(1)	6	(1)	6	(1)	7
New York	II	3,129	5	(1)	5	(1)	5	(1)	5
Pennsylvania	II	7,184	3	(1)	3	(1)	4	(1)	4
West Virginia	III	1,910	6	(1)	7	(1)	8	(1)	6
Total		70,100		92,397		70,680		76,672	

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

Consumption of Slab Zinc for Zinc Oxide.—Because of the small number of companies consuming slab zinc in the manufacture of zinc oxide and to prevent disclosure of individual company figures, it was impossible to prepare a table showing specific quantities consumed. A table is included, however, to show the relative rank of each State and the totals for each year.

Consumption of slab zinc for zinc oxide in the United States, 1940–45 (average) and 1946–48, by States

State	Geographic division	1940–45 (average annual)		1946		1947		1948	
		Short tons	Rank	Short tons	Rank	Short tons	Rank	Short tons	Rank
Illinois	IV	1,407	3	(1)	2	(1)	2	(1)	2
Indiana	IV	3,032	2	(1)	3	(1)	3	(1)	3
New Jersey	II	1	4	------	------	------	------	------	------
Pennsylvania	II	11,877	1	16,482	1	(1)	1	(1)	1
Total	----------	16,317	------	19,170	------	18,376	------	15,657	------

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

Consumption of Slab Zinc for Other Uses.—The distribution by States of the quantity of zinc consumed for such purposes as slush castings, wet batteries, desilverizing lead, light-metal alloys (other than zinc-base alloys), zinc dust, sundry chemicals, and bronze powder is shown in the following table.

Consumption of slab zinc for other uses in the United States, 1940–45 (average) and 1946–48, by States

State	Geographic division	1940–45 (average annual)		1946		1947		1948	
		Short tons	Rank	Short tons	Rank	Short tons	Rank	Short tons	Rank
Arizona	VIII	16	22	------	------	------	------	------	------
California	IX	598	5	287	7	522	4	407	6
Colorado	VIII	21	20	(1)	17	(1)	18	(1)	20
Connecticut	I	633	4	(1)	4	41	12	(1)	7
Florida	III	1	29	------	------	------	------	------	------
Idaho	VIII	375	9	(1)	12	(1)	9	(1)	5
Illinois	IV	98	12	(1)	13	(1)	10	(1)	13
Indiana	IV	299	11	(1)	9	(1)	11	(1)	14
Kansas	VI	1	30	(1)	14	(1)	16	(1)	16
Kentucky	V	5	28	------	------	------	------	------	------
Louisiana	VII	7	24	------	------	------	------	------	------
Maine	I	20	21	------	------	------	------	------	------
Maryland	III	6	25	------	------	------	------	------	------
Massachusetts	I	45	17	(1)	15	(1)	13	(1)	15
Michigan	IV	455	6	(1)	11	(1)	14	(1)	12
Minnesota	VI	1	31	------	------	(1)	19	------	------
Mississippi	V	6	26	------	------	------	------	------	------
Missouri	VI	340	10	(1)	10	416	5	226	10
Nebraska	VI	420	8	(1)	3	(1)	3	(1)	3
Nevada	VIII	45	18	------	------	------	------	------	------
New Hampshire	I	8	23	------	------	------	------	------	------
New Jersey	II	2,128	1	1,828	2	1,844	2	1,931	2
New Mexico	VIII	1	32	------	------	------	------	------	------
New York	II	431	7	(1)	8	(1)	6	(1)	4
North Carolina	III	1	33	------	------	------	------	------	------

See footnote at end of table.

Consumption of slab zinc for other uses in the United States, 1940–45 (average) and 1946–48, by States—Continued

State	Geographic division	1940–45 (average annual)		1946		1947		1948	
		Short tons	Rank	Short tons	Rank	Short tons	Rank	Short tons	Rank
Ohio	IV	716	3	370	5	271	7	271	8
Pennsylvania	II	1,053	2	(1)	1	(1)	1	(1)	1
Rhode Island	I	1	34						
Tennessee	V	84	14	(1)	6	(1)	8	(1)	9
Texas	VII	94	13					(1)	18
Utah	VIII	1	35	(1)	18	(1)	17	(1)	17
Virginia	III	53	16	(1)	19	(1)	20	(1)	19
Washington	IX	6	27					(1)	11
West Virginia	III	70	15	(1)	16	(1)	15		
Wisconsin	IV	26	19						
Total		8,065		8,329		8,763		10,428	

1 Bureau of Mines not at liberty to publish figure.

STOCKS

Producers' Stocks.—Inventories of slab zinc at producers' plants fell 70 percent in 1948 to the lowest year-end level since 1940, owing mainly to substantial quantities shipped for Government account.

Stocks of zinc at zinc-reduction plants in the United States at end of year, 1939–43 (average) and 1944–48, in short tons

	1939–43 (average)	1944	1945	1946	1947	1948
At primary reduction plants	75,685	233,044	254,692	175,513	67,046	19,179
At secondary distilling plants	1,595	652	1,451	756	1,601	1,669
Total	77,280	233,696	256,143	176,269	68,647	20,848

Consumers' Stocks.—Consumers' stocks on December 31, 1948, were 15,741 tons (19 percent) greater than at the beginning of the year. At the average monthly rate of consumption in 1948, consumers' stocks on hand December 31 were nearly 1½ months' requirements.

Consumers' stocks of slab zinc at plants at the beginning and end of 1948, by industries, in short tons

	Galvanizers	Brass mills [1]	Die casters [2]	Zinc rolling mills	Oxide plants	Others	Total
Dec. 31, 1947	[3] 40,004	[3] 12,846	[3] 19,188	6,590	[3] 996	[3] 1,225	[3 4] 80,849
Dec. 31, 1948	45,764	18,539	24,582	5,983	258	1,464	[4] 96,590

1 Includes brass mills, brass ingot makers, and brass products.
2 Includes producers of zinc-base die castings, zinc-alloy dies, and zinc-alloy rods.
3 Revised figure.
4 Stocks on Dec. 31, 1947 and 1948, exclude 319 tons (revised figure) and 307 tons, respectively, of remelt spelter.

Reconstruction Finance Corporation Stocks.—Slab zinc stocks of 29,446 tons and stocks of zinc concentrates totaling 65,851 tons of recoverable zinc held by the RFC on January 1, 1948, were transferred during the year to the Treasury Department Bureau of Federal Supply.

PRICES

The market price for Prime Western grade slab zinc, f. o. b. East St. Louis, was quoted at 10.5 cents per pound until January 21, 1948, when it advanced to 12 cents. A further advance to 15 cents occurred on July 28, and on October 18 another rise to 15.5 cents was announced. An additional increase on November 12 raised the quotation to 17.5 cents, at which level it remained the balance of the year. The weighted average price received by the producers for all grades of zinc sold in 1948 was 13.3 cents a pound, f. o. b. plants, compared with 10.7 cents in 1947.

The official London maximum price of £70 0s. per long ton for foreign zinc delivered to consumers, duty paid, fixed by the British Ministry of Supply on January 2, 1947, was advanced to £75 0s. on January 30, 1948. Another rise to £92 0s. occurred on October 1, and on December 1 the price was fixed at £106 0s., at which level it remained for the remainder of the year.

Price of zinc concentrates and zinc, 1944–48

	1944	1945	1946	1947	1948
Joplin 60-percent zinc concentrates:					
Price per short ton......dollars..	55.28	55.28	51.12	66.20	86.37
Average price common zinc at—					
St. Louis (spot)......cents per pound..	8.25	8.25	8.73	10.50	13.58
New York......do....	8.65	8.65	9.15	11.01	14.21
London [1]......do....	4.63	5.18	7.75	12.58	14.38
Price indexes (1925–29 average=100):					
Zinc (New York)......	122	122	128	155	200
Lead (New York)......	87	87	109	196	241
Copper (New York)......	80	80	93	143	150
Nonferrous metals [2]......	87	87	100	142	159
All commodities [2]......	106	108	121	155	168

[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 60-percent zinc concentrates at Joplin, and of common zinc (prompt delivery or spot) St. Louis and London, 1947–48 [1]

Month	1947			1948		
	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)	Metallic zinc (cents per pound)	
		St. Louis	London [3]		St. Louis	London [3]
January	64.00	10.50	12.58	73.88	11.08	12.58
February	64.00	10.50	12.58	78.00	12.00	13.48
March	64.00	10.50	12.58	78.00	12.00	13.48
April	64.00	10.50	12.58	78.00	12.00	13.48
May	64.00	10.50	12.58	78.00	12.00	13.48
June	64.00	10.50	12.58	78.00	12.00	13.48
July	64.00	10.50	12.58	82.08	12.46	13.48
August	64.00	10.50	12.58	95.00	15.00	13.48
September	70.35	10.50	12.58	95.00	15.00	13.48
October	70.35	10.50	12.58	96.38	15.19	16.53
November	70.35	10.50	12.58	104.46	16.67	16.53
December	70.35	10.50	12.58	110.00	17.50	19.05
Average for year	66.20	10.50	12.58	86.37	13.58	14.38

[1] Joplin: Metal Statistics, 1949, p. 559. St. Louis: Metal Statistics, 1949, p. 555. 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. Premium ended June 30, 1947.
[3] Average price for foreign zinc converted to cents per pound with the pound sterling at $4.02½.

Average price received by producers of zinc, 1944–48, by grades, in cents per pound [1]

	1944	1945	1946	1947	1948
Grade A:					
Special High Grade	8.90	8.89	9.18	11.10	13.72
Regular High Grade	8.62	8.60	8.81	10.76	13.40
Grade B: Intermediate	8.74	8.66	9.08	11.19	13.49
Grades C and D:					
Brass Special	8.48	8.48	9.00	10.67	13.33
Selected	8.27	8.32	8.89	10.26	13.05
Grade E: Prime Western	8.24	8.24	8.60	10.39	12.93
All grades	8.6	8.6	8.88	10.71	13.32
Prime Western; spot quotation at St. Louis	8.25	8.25	8.73	10.50	13.58

[1] Does not include overquota premium payments made by Office of Metals Reserve in 1944–47.

In Canada, the price for High Grade zinc delivered at Toronto or Montreal was 11 cents per pound until January 21, 1948, when it was advanced to 12.5 cents. On July 30 the price increased to 15.5 cents and nearly 3 months later on October 25 the quotation was raised to 16 cents. The fourth and final advance during 1948 occurred on December 1 when the price was quoted at 18 cents.

The Australian price of £A22 per long ton, f. o. b., Risdon, Tasmania, for zinc for consumption, fixed in February 1940, continued throughout 1948. At the beginning of 1949 the quotation was raised to £A40.

FOREIGN TRADE [3]

Imports.—Total imports of zinc in ores and concentrates in 1948 declined 11 percent from 1947. Of the 264,218 tons of contained zinc so imported, 54 percent came from Mexico, 21 percent from Canada, 9 percent from Peru, 4 percent each from Italy and Newfoundland, 3 percent from Spain, and 5 percent from (in order of decreasing importance) Japan, Bolivia, Union of South Africa, Korea, Australia, Argentina, Saudi Arabia, and Honduras.

Zinc imported for consumption in the United States, 1944–48, by classes

[U. S. Department of Commerce]

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	
1944	415,004	$18,678,957	63,626	$6,132,877	15	$2,540	5,603	$300,188			$25,114,562
1945	331,533	15,021,771	96,760	12,173,525	(3)	2	7,299	476,920	362	$39,789	27,712,007
1946	166,885	8,122,471	104,015	16,474,850	(3)	10	4,137	300,429	77	4,942	24,902,702
1947	194,822	12,165,163	[4] 72,063	[4] 14,822,407	1	457	[4] 5,105	[4] 439,511			[4] 27,427,538
1948	133,814	11,737,624	92,547	24,932,488	120	32,871	10,273	1,181,495	41	5,370	37,889,848

[1] Includes dross and skimmings as follows—1944: 4,694 tons, $224,995; 1945: 4,291 tons, $230,973; 1946: 2,851 tons, $188,972; 1947: 4,391 tons, $353,415 (revised figures); 1948: 8,637 tons, $873,099.
[2] In addition, manufactures of zinc imported as follows—1944: $14,223; 1945: $8,077; 1946: $1,929; 1947: $4,429; 1948: $16,056.
[3] Less than 1 ton.
[4] Revised figures.

[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.

Slab-zinc imports totaled 93,283 tons and were 29 percent greater than the quantity imported in 1947. Canada accounted for 83 percent of the total and Mexico ranked second with 6 percent. The first substantial imports from Europe since 1939 originated in Norway, Italy, and Belgium.

Zinc imported into the United States, in ores, blocks, pigs, or slabs, by countries, 1946–48, in short tons [1]

[U. S. Department of Commerce]

Country	1946	1947	1948
Ores (zinc content):			
Argentina	8,295		77
Australia	3,780	864	495
Bolivia	26,207	17,176	4,515
Canada	57,298	42,430	55,386
Italy		11,613	11,288
Japan			5,018
Korea			1,902
Mexico	127,685	163,726	142,134
Newfoundland and Labrador		8,873	9,753
Peru	48,791	49,952	22,475
Spain		3,321	9,101
Union of South Africa		4	2,035
Other countries	(2)		39
Total ores	272,056	297,959	264,218
Blocks, pigs, or slabs:			
Australia	3,221	3	75
Belgium and Luxembourg			1,145
Canada	85,194	54,954	77,711
Italy			1,579
Japan		16,927	4,686
Mexico	15,777	332	5,737
Norway			2,240
Other countries	551	96	110
Total blocks, pigs, or slabs	104,743	72,312	93,283

[1] Data include zinc imported for immediate consumption plus material entering country under bond.
[2] Less than 1 ton.

Exports.—The value of exports of zinc ores, concentrates, and manufactured articles containing zinc of foreign and domestic origin (excluding galvanized products, alloys, and pigments) amounted to $19,910,911 in 1948, compared with $27,714,840 (revised figure) in 1947. 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 drawback of 99 percent of the import duty is refunded upon the basis of zinc contained in the finished product. Draw-back refunds were made on 29,738 tons in 1944 and on 7,494 tons in 1945; corresponding 1946–48 data are not yet available.

Slab zinc was exported in 1948 to 24 foreign countries representing shipments to every continent except Australia and Africa. United Kingdom was the destination of nearly 57 percent of the 65,757 tons of slab zinc exported during the year. Over 17 percent was shipped to India, and Belgium and France received 8 and 3 percent, respectively.

Zinc ores and manufactures of zinc, exported from the United States, 1944–48

[U. S. Department of Commerce]

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
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	47,224	8,222,940	13,846	4,468,328	366	89,439
1947	1,404	215,123	106,669	22,817,004	10,898	4,234,306	1,646	448,407
1948	3,547	422,314	65,757	15,898,693	7,344	3,290,410	891	299,494

[1] Less than 1 ton.

Slab and sheet zinc exported from the United States, by destinations, 1945–48, in short tons

[U. S. Department of Commerce]

Destination	Slabs, plates, and block				Sheets, strips, or other forms, n. e. s.			
	1945	1946	1947	1948	1945	1946	1947	1948
Country:								
Argentina	110	3,811	5,809	961	274	1,353	890	478
Austria				213				1
Belgium and Luxembourg	2,060	4,601	7,971	5,132	(1)	5	13	17
Brazil	441	1,301	1,735	1,279	321	1,256	628	106
Canada	24	1	3	504	2,956	2,975	2,579	3,584
Chile	587	687	600	980	7	322	291	152
China		1,667	611	44	2	757	431	106
Colombia	1	32		3	62	53	143	134
Cuba	141	67	182	303	67	70	91	103
Czechoslovakia		1,118	3,347				726	
Finland		950	2,330			9	19	
France	2,204	(1)	5,253	2,205		7		6
Germany			392	3,473				
India and Pakistan		7,898	10,748	11,550	10	324	753	548
Indonesia		1		1		12	146	242
Italy			903	112				
Mexico	113	54	54	61	413	460	628	568
Netherlands		2,491	2,509	280		72	398	74
Portugal	17	2	269		277	520	339	243
Sweden	470	1,293	2,454		94	537	379	8
Switzerland	1,336	4,205	1,492	1,273	110	956	241	38
Tunisia					44	74	119	
Turkey	3	213	333	6	243	2,388	210	22
Union of South Africa					186	38	93	80
United Kingdom		16,628	59,289	37,269	4	46	95	109
Other countries	275	204	385	108	1,165	1,612	1,686	725
Total	7,782	47,224	106,669	65,757	6,235	13,846	10,898	7,344
Continent:								
North America	299	136	262	872	3,563	3,603	3,441	4,374
South America	1,392	5,902	8,153	3,254	964	3,254	2,194	1,032
Europe	6,087	31,405	86,561	49,969	643	2,345	2,333	577
Asia	3	9,781	11,693	11,662	364	3,919	2,131	1,266
Africa	1	(1)			693	724	446	94
Oceania					8	1	353	1

[1] Less than 1 ton.

Tariff.—Action taken at the Geneva Trade Conference of 1947 made permanent as of January 1, 1948, the import duties on slab zinc, zinc ore, and the principal zinc products established under the Mexican Trade Agreement of January 30, 1943, and reduced the rates on zinc oxide and lithopone. Thus the tariff on zinc-bearing ores in 1948 remained at ¾ cent per pound (zinc content); the rate on zinc in blocks, pigs, or slabs, and dust continued at ⅞ cent per pound, and zinc sheets remained dutiable at 1 cent a pound. The import duty on zinc oxide and leaded zinc oxides containing not more than 25 percent lead was lowered from 1.1 cents to 0.6 cent per pound, and the rate on lithopone containing less than 30 percent zinc sulfide was set at 0.875 cent a pound.

WORLD PRODUCTION

World smelter production of zinc in recent years, insofar as data are available, is shown in the following table.

World production of zinc, 1942–48, by countries where smelted, in metric tons

[Compiled by B. B. Mitchell]

Country [1]	1942	1943	1944	1945	1946	1947	1948
Argentina	410	658	976	983	1,814	2,631	1,602
Australia	75,474	76,972	79,979	85,118	77,541	70,535	83,104
Belgium	28,620	27,770	8,660	11,712	79,325	133,011	153,928
Canada	195,769	187,342	152,876	166,302	168,448	161,367	178,329
China	396	500	331	328	----------	320	330
Czechoslovakia	(2)	(2)	(2)	3,300	(3)	1,964	(3)
France	22,829	21,490	8,793	8,414	31,014	46,007	55,514
Germany [2]	314,100	312,000	259,600	(3)	[4] 14,855	[4] 20,723	[4] 41,357
Indochina, French	5,462	4,138	[5] 622	----------	----------	----------	----------
Italy	34,129	25,152	----------	1,565	15,262	25,974	26,757
Japan	[6] 54,730	[6] 60,948	[6] 62,673	[6] 18,553	11,253	14,849	21,200
Mexico	51,743	54,449	49,248	48,985	41,982	56,749	48,323
Netherlands	5,153	4,565	2,105	----------	2,011	9,532	13,588
Northern Rhodesia	13,046	13,620	14,712	15,485	17,466	21,479	22,526
Norway	7,693	15,376	11,777	9,228	30,210	34,580	42,000
Peru	941	1,225	1,447	1,688	1,473	1,013	1,464
Poland	(2)	(2)	(2)	36,385	56,614	71,756	87,089
Spain	19,150	19,200	18,054	17,310	17,568	19,825	21,240
Sweden	----------	----------	1,790	2,929	----------	----------	----------
U. S. S. R	(3)	(3)	(3)	(3)	(3)	[7] 106,000	(3)
United Kingdom [8]	72,437	70,345	73,190	63,034	66,405	69,360	73,138
United States	809,088	854,844	788,613	693,594	660,665	728,007	714,644
Total (estimate) [1]	1,800,000	1,840,000	1,625,200	1,274,000	1,405,800	1,595,700	1,692,000

[1] In addition to the countries listed, Rumania and Yugoslavia produce zinc, but no estimates for them are included in the totals. Rumania produced about 2,300 metric tons in 1947, and Yugoslavia about 5,000 tons annually prewar.
[2] Data for Austria, Czechoslovakia, and Poland in 1942–44 included with Germany.
[3] Data not available; estimate by senior author of Chapter included in total.
[4] Bizonal area; includes production from reclaimed scrap.
[5] Estimated figure.
[6] Preliminary data for fiscal year ended March 31 of year following that stated.
[7] Fiscal year ended June 30 of year stated.
[8] Some secondary metal included.

Minor Metals

By JACK W. CLARK [1]

BARIUM AND STRONTIUM

THE 1948 output of barium metal amounted to a few thousand pounds, being little changed from 1947. Production was reported by Kemet Laboratories Co., Inc. (unit of Union Carbide & Carbon Corp.), Cleveland, Ohio, and King Laboratories, Inc., Syracuse, N. Y. The latter company also produced barium "getter" alloys and strontium metal. Cooper Metallurgical Associates, Cleveland, Ohio, produced strontium metal only. Metal Hydrides, Inc., Beverly, Mass., reported production of barium and strontium hydrides on a small scale.

The principal raw materials from which barium and strontium are derived are the minerals barite and celestite (see the Barite and Minor Nonmetals chapters of this volume).

Consumption and Uses.—Apparent consumption of barium in 1948 amounted to several thousand pounds, that of strontium to less than 100 pounds.

Barium and strontium are used principally as "getters" [2] in the electronics industry, both the pure metals and alloys with aluminum or magnesium being employed. "Gettering" is the process of removing the last traces of gas from an enclosed space, as in an electronic tube that has already been evacuated to a high degree by other means. To achieve this final evacuation small bits of barium or strontium metal or their alloys are introduced into the nearly evacuated tubes; upon heating, the residual traces of gas are removed by chemical combination with the highly reactive hot metal. Barium has been used also in spark-plug electrode alloys to increase discharge efficiency and as a hardening agent in lead-base bearing alloys, only 0.4 percent barium being required for this purpose.

[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.
[2] Light Metals (London), Gettering and Getters: Vol. 7, Nos. 72-73, January-February 1944, pp. 34-52, 77-94.

Prices.—Barium metal, over 99 percent pure, ranged in price from about \$5 per pound up to nearly \$10, according to quantities purchased; strontium prices varied from under \$7 per pound up to about \$35, depending upon purity. It has been estimated the cost of producing barium could be reduced below \$1 per pound if specialized uses requiring ton lots could be found.[3] Similar possibilities exist for strontium.

Technology.—During the year a patent was granted on a process for making barium, strontium, calcium, or magnesium by thermal reduction of the oxides with aluminum, using various moderating agents, such as aluminum nitride and ferrosilicon.[4]

Canada.—The most noteworthy development in barium metal supply was the initiation of production on a large scale by Dominion Magnesium, Ltd., Haley's Station, near Ottawa, Ontario, Canada. Production of barium had begun there in 1947 with an output of 1,040 pounds and rose sharply in 1948 to 10,652 pounds (\$9,483). In addition, about 100 pounds of strontium metal were produced. Canadian output of both metals in 1948 exceeded severalfold that of all United States producers combined.

BERYLLIUM

The only primary commercial source of beryllium to date has been the mineral beryl, which is characteristically found in the coarsely crystalline pegmatite dikes of some granite regions. The beryllium oxide content of beryl ranges from about 11 to 14 percent. The complex silicate, helvite (BeO content similar to beryl), has been found erratically distributed in a lime silicate (tactite) zone at Iron Mountain, north of Winston, N. Mex. The superficial resemblance of helvite to garnet suggests the possibility that it may have been overlooked elsewhere.

Mine Production.—Interest in mining domestic beryl was keen in 1948, and prices reached an all-time high; but, surprisingly, output dropped nearly 50 percent below that reported for 1947. With a few exceptions, domestic beryl is normally produced as a byproduct or coproduct in the mining of feldspar, quartz, mica, or lithium minerals.

Beryllium concentrates (beryl) shipped from mines in the United States, 1942–48, by States, in short tons

[Compiled by R. W. Metcalf]

State	1942	1943	1944	1945	1946	1947	1948
Colorado	3	68	35			(1)	(1)
Connecticut			(1)			(1)	
Maine	45	2	2			(1)	(1)
Massachusetts		(1)	4				
New Hampshire	16	42	(1)	1	5	(1)	(1)
New Mexico		(1)	29			(1)	
South Dakota	205	238	306	38	95	70	45
Other [2]		6	12			75	54
Total: Short tons	269	356	388	39	100	145	99
Value	\$24,188	\$44,407	\$56,135	\$6,133	\$17,787	\$25,214	\$26,600
Average value per ton	\$89.92	\$124.74	\$144.68	\$157.26	\$177.87	\$173.89	\$268.68

[1] Included with "Other." Bureau of Mines not at liberty to show separately.
[2] Includes States indicated by footnote 1; in addition, 1943–44, North Carolina and Virginia.

[3] Kroll, W. J., Processes for Making Barium and Its Alloys: Bureau of Mines Inf. Circ. 7327, 1945, 16 pp
[4] Kemmer, Frank R., Manufacture of Alkaline Earth Metals: U. S. Patent 2,448,000, Aug. 24, 1948.

The Sitting Bull and Ingersoll mines of the Black Hills Keystone Corp., both near Keystone, S. Dak., produced beryl during 1948 but were shut down in October, reportedly because of the poor demand for lithium ores. The largest production for the year from any individual property was that from the Palermo mine, near West Rumney, N. H., operated by the Ashley Mining Co. A small quantity of beryl was produced by Joe Grover from the Grover mine near Idaho Springs, Colo. Small lots reached ore buyers from many other properties of uncertain identity, principally in South Dakota, New Hampshire, Colorado, and Maine. Michael Lyons of the Beryl Ores Co., Loveland, Colo., was active during the year as a buyer of small lots of beryl ore and held leases on a number of properties in Colorado and South Dakota. The Hyatt Beryl mine, Drake, Colo., was operated in 1948 to obtain fine-grained beryliferous rock for use in the development of milling methods applicable to low-grade beryl ores. The Bureau of Mines and the Geological Survey were active during 1948 in exploring and evaluating beryl pegmatites and in developing beneficiation methods.

The Black Hills region of South Dakota continued to be the principal domestic source of beryl, total production to date being about 1,800 tons. Important shipments have been made from Colorado (total production, about 500 tons), Maine, New Hampshire, and New Mexico. Small shipments have been recorded from Connecticut, Idaho, Massachusetts, New York, North Carolina, Virginia, and Wyoming. Specimens of beryl have been found in many other States. Total reserves of inferred and indicated beryl ore in Colorado are estimated at 2,000 to 5,000 tons;[5] the beryl pegmatites of the Eight Mile Park area were described.[6] Reserves of beryl at the Muscovite mine between Avon and Deary, Latah County, Idaho, have been estimated at 150 to 450 tons. The Geological Survey estimated indicated and inferred beryl reserves for Connecticut at about 860 tons.[7] The Bureau of Mines published a report of investigations on Beryl Mountain, Sullivan County, N. H.[8]

Refinery Production.—As in previous years, the producers of beryllium metal, alloys, and compounds in 1948 were the Brush Beryllium Co., Cleveland and Lorain, Ohio; Beryllium Corp., Temple, near Reading, Pa.; and Clifton Products, Inc., Painesville, Ohio. The Ceramic Division, Champion Spark Plug Co., Detroit, Mich., consumes beryl solely for dielectric manufacture. On September 21, 1948, the Brush Beryllium Co. plant at Lorain suffered a serious fire, damage being confined to the oxide production facilities. It was reported that Clifton Products Co. did not operate in the latter part of the year.

Output of all types of beryllium products in 1948 was up sharply over the previous year and consumption was correspondingly higher. Because of the apparent importance of beryllium to the atomic energy program, the activities of all refiners were necessarily partly secret.

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[5] Vanderwilt, John W. (ed.), State of Colorado Mineral Resources Board, Mineral Resources of Colorado: 1947, pp. 467–468.

[6] Heinrich, William E., Pegmatites of Eight Mile Park, Fremont County, Colo.: Am. Mineral., vol. 33, Nos. 9–10, September–October 1948, pp. 550–587.

[7] Cameron, Eugene N., and Shainin, Vincent E., Beryl Resources of Connecticut: Econ. Geol., vol. 42, No. 4, June 1947, pp. 353–367.

[8] Levin, S. B., Beryl Mountain, Sullivan County, N. H.: Bureau of Mines Rept. of Investigations 4216, 1948, 3 pp.

Several reports were published in 1948 treating beryllium toxicology.[9]

Uses.—Beryllium finds its most important commercial application as an alloying agent with copper. The usual alloy contains a little over 2 percent beryllium and is outstanding because of its fatigue, corrosion, and wear resistance, hardness, tensile strength, high electrical and thermal conductivity, low-creep tendency, and nonmagnetic and nonsparking properties. Beryllium-copper is widely used for current-carrying springs, pressure-responsive elements, switches, welding tips, disks, platers' bars, matrix metal in diamond-drill bits, valve guides, nonmagnetic ball bearings, nonsparking tools and parts, and tubing subjected to vibration or repeated flexing.

Beryllium-nickel possesses much higher tensile strength than the copper alloy. It has been used for watch balance wheels and in airplane parts. Beryllium added to aluminum in small quantities imparts high strength, thermal stability, and unusual oxidation resistance. A large manufacturer of camera shutters is reported to have discontinued using spring steel in favor of beryllium-aluminum.

Addition of 0.005 to 0.01 percent beryllium to magnesium has a marked effect in reducing oxidation.[10] Beryllium confers to zinc alloys reduced creep, increased tensile strength, and improved corrosion resistance.[11]

As the pure metal, beryllium is used in X-ray tube windows and in radium-beryllium neutron sources. The metal finds numerous applications in the atomic energy field as a moderator and reflector of neutrons, similar to graphite and heavy water. It has been estimated that about 100 tons of beryllium would be needed for a reactor of 100,000 kw. output, using enriched uranium as a fuel. Beryllium oxide was used as a neutron reflector in the Los Alamos "water boiler," which consisted essentially of a stainless steel sphere filled with an ordinary water solution of an enriched uranium salt. The high refractoriness of beryllium oxide, fusion point 2,520° C., together with its exceedingly low neutron absorption, excellent heat transmission, and resistance to thermal shock, suggest its possible use in nuclear-energy power-plant design. The use would apparently be a nonrecurring one for any given installation. Beryllium oxide has many special applications in the refractories field[12] and has been used experimentally as a liner for rocket combustion chambers.[13] Use of the oxide in phosphor compounds for fluorescent lamps and in television screens has been and continues to be of importance. However, cases of beryllium poisoning allegedly resulting from accidental inhalation of the oxide liberated from broken lamps indicate that beryllium oxide phosphors may soon be supplanted by nontoxic materials. Beryllium glasses have special characteristics, such as high light-transmission speed.[14] The mineral beryl is employed directly in

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[9] Eisenbud, M., Berghout, C. F., and Steadman, L. T., Environmental Studies in Plants and Laboratories Using Beryllium: Jour. Ind. Hyg. and Toxicol., vol. 30, No. 5, September 1948, pp. 281–285.
Beryllium Corp. (Reading, Pa.), Health Experiences in the Fields of Manufacture and Use of Beryllium Alloys and Beryllium Compounds: February 1948, 4 pp.
Titus, A. C., Air Contamination During Machining of Beryllium Stainless Steel: Jour. Ind. Hyg. and Toxicol., vol. 30, No. 1, January 1948, pp. 29–31.

[10] Street, A. C., Die-Casting Progress. IV. Pressure Die-Casting of Magnesium Alloys: Metallurgia, vol. 38, 1948, pp. 3–5.

[11] Harrington, H. R., New Wrought Zinc Alloys Containing Small Amounts of Beryllium: Trans. Am. Soc. Metals, vol. 39, 1947, pp. 773–783.

[12] Norton, F. H., Pure BeO as a Refractory: Jour. Am. Ceram. Soc., vol. 30, No. 8, Aug. 1947, pp. 242–245,

[13] Duwez, P., O'Dell, F., and Taylor, Jack L., Recrystallization of BeO Bodies at 2,000° C.: Jour. Am. Ceram. Soc., vol. 32, No. 1, Jan. 1, 1949, pp. 1–9.

[14] Scientific American, Unstable Glass Has High Light-Transmission Speed: Vol. 176, January 1947, p. 31.

the production of high-grade dielectrics for uses such as are used in airplane sparkplugs. Beryllium nitrate finds application as a strengthener in gas mantles, and various other compounds have value as catalytic agents.[15]

Stocks.—In 1948, imported and domestically produced beryl combined were again inadequate to meet processors' requirements. The shortage was alleviated by transfers to industry from the dwindling stock pile of the Office of Metals Reserve. In the absence of a marked upsurge in imports of beryl, stocks of the agency could become exhausted in 1949 if the 1948 consumption rate should continue. Beryl was actively sought for the National Strategic Stock Pile throughout 1948. This factor probably was important in keeping prices at a high level, aside from the normal market influence of increased consumer demand. Figures on beryl stocks in the strategic stock pile are not available for publication.

Stocks of beryllium metal, alloys, and compounds in producers' hands as of December 1948 were apparently below those of the equivalent 1947 period.

Prices.—E&MJ Metal and Mineral Markets quoted domestic beryl, f. o. b. mines, 10–12 percent BeO, in January 1948 at \$16–\$18 per short-ton unit; increases during the year raised prices as follows: July 8, \$18.75–\$22; July 15, \$20–\$24; September 16, \$20–\$26; and October 7, \$24–\$26. The last quotation remained unchanged the rest of the year and represented an all-time high. Imported beryl was quoted in November at \$22–\$23 per unit BeO, c. i. f. Atlantic ports. The master alloys beryllium-copper, 4 percent Be, and beryllium-aluminum, 5 percent Be, opened the year at \$20.50 and \$40, respectively, per pound of contained beryllium and increased to \$24.50 and \$52 in the fall. In the sale of these and other beryllium master alloys, usual practice is to quote a price per pound of beryllium contained, the current market price for the other alloy components being added at the time of sale. Master alloys of beryllium (50 percent Be) with nickel, iron, or cobalt were quoted at \$70 per pound contained beryllium. The low-beryllium copper alloys were quoted in August 1948 at a flat price per pound of alloy, in ton lots or more, at the following figures: 2.5 percent Be–1.1 percent Ni, \$1.00 per pound; 0.35 Be–1.5 Ni, \$0.60; 0.5 Be–2.5 Ni, \$0.70. Pure beryllium metal in the form of lumps, pebbles, chips, and turnings was quoted in May 1948 at prices ranging from \$65–\$85 per pound, pound lots, the price depending on purity. The powdered metal was priced at \$95–\$103 per pound. High-fired beryllium oxide, minus 200-mesh, was quoted near the end of 1948 at \$10–\$11.50 per pound, depending on quantity; same grade, minus 325-mesh was \$16, any quantity. The price of fluorescent-grade oxide was apparently a little below that for the minus 200-mesh high-fired type. Beryllium sulfate (tetrahydrate) quotations varied from \$0.85–\$1.45 per pound, depending on quantity and grade. The fluoride, double ammonium fluoride, and nitrate (trihydrate) were priced, respectively, per pound at \$7.50–\$12.00, \$2.50–\$4.65, and \$2.00–\$3.30, the price prevailing depending upon the quantity ordered.

Foreign Trade.—An encouraging rise in the volume of beryl imports was noted for 1948, in comparison with the meager receipts in 1947.

[15] Bond, George R., Jr., and Mills, George A. (assigned to Houdry Process Corp.), Cracking of Hydrocarbons with a Beryllium Phosphate Catalyst: U. S. Patent 2,435,196, Feb. 3, 1948.

Larger shipments from Brazil accounted for the over-all increase, but significant quantities were recorded from Mozambique, Argentina, and the Union of South Africa.

United States shipments of beryllium metal, alloys, and scrap to other countries in 1948 totaled 25,923 pounds with a value of $48,305, the quantity figure being less than one-tenth that for 1947. Principal recipient countries were United Kingdom, 9,207 pounds; Netherlands, 8,713; Canada, 2,302; Mexico, 2,212; Argentina, 1,618; Switzerland, 693; Australia, 672; Belgium, Italy, Sweden, and Philippine Republic combined, 506. Exports of ore were negligible, being only 185 pounds valued at $587.

Beryllium ore (beryl concentrates) imported for consumption in the United States by countries, 1944–48, in short tons

[U. S. Department of Commerce]

Country	1944	1945	1946	1947	1948
Anglo-Egyptian Sudan	1				
Argentina	229		53		55
Australia	518	105	20	45	
Brazil	1,453	572	906	722	1,162
British East Africa	15	7			
Chile					(1)
Hong Kong					18
India	892	484	119		
Madagascar		11			
Mozambique					55
Nigeria		22			
Southern Rhodesia	7				
Union of South Africa	(1)				47
Total: Short tons	3,115	1,201	1,098	767	1,337
Value	$286,091	$131,841	$105,708	[2] $114,667	$230,310

[1] Less than 1 ton.
[2] Revised figure.

On June 16, 1948, the Office of International Trade added beryllium alloys, scrap, ore, and concentrates to the positive list of products requiring export licenses to foreign destinations (excepting Canada). Beryllium metal and compounds were already included on the positive list.

Export restrictions continued in effect during 1948, notably in India and the French dependencies (principally Madagascar). The Indian embargo, established in June 1946, was not relaxed in 1948. Madagascan beryl was reserved for France. Complications which had hindered the export of beryl from Argentina in 1947 may have been resolved in part, judging from the shipments of 55 tons of beryl to the United States in 1948 compared with none in 1947.

Technology.—Several articles were published treating with methods for producing beryllium metal and alloys,[16] fabrication of beryllium

[16] Kjellgren, B. R. F., Production of Beryllium: Jour. Electrochem. Soc., vol. 93, No. 4, April 1948, pp. 122–128.
Andrieux, J. L. [Making Metallic Powders by Electrolysis of Fused Salts]: Rev. metal., vol. 45, 1948, pp. 49–59.
Williams, W. Lee, Heat Treatment and Properties of Some Beryllium-Nickel Alloys: Trans. Am. Soc. Metals, vol. 40, 1948, pp. 163–175.

metal shapes,[17] chlorination[18] and flotation[19] of beryl, and the spectrochemical analysis of beryllium metal, compounds,[20] and ores.[21]

WORLD REVIEW

South and Middle America.—The pegmatities of northeastern *Brazil* are reported to have yielded about 8,000 metric tons of beryl in 1937–44.[22] Most of the output came from the Picuí-Parelhas area in the states of Paraíba and Rio Grande do Norte. Another productive section is near Berilândia, southeast of Quixeramobim, in the central part of the state of Ceará. Exports of beryl ore during the first half of 1948 were about 75 percent of total 1947 exports; 100 metric tons of beryl were reported shipped in early 1948 to Produits Chimiques et Electro-Metallurgique, Marseilles, France.

World production of beryllium concentrates (beryl), by countries, 1940–48, in metric tons [1]

[Compiled by B. B. Mitchell]

Country	1940	1941	1942	1943	1944	1945	1946	1947	1948
Argentina	520	2, 186	925	881	342	190	130	10	[2] 50
Australia	2	3	------	534	417	47	19	54	44
Brazil (exports)	1, 472	1, 703	1, 634	2, 027	1, 185	510	1, 294	1, 027	[2] 1, 400
India	53	(3)	121	1, 486	508	108	112	(4)	(4)
Korea, South	(4)	(4)	(4)	(4)	17	9	(4)	(4)	------
Madagascar	(4)	(4)	(4)	[2] 67	50	[2] 10	(4)	(3)	(4)
Portugal	(4)	35	(4)	14	[5] 60	9	(4)	------	(4)
Portuguese East Africa	(4)	(4)	8	6	3	2	22	61	81
Spain	4	(4)	(4)	(4)	(4)	(4)	(4)	(3)	(4)
South-West Africa	(4)	20	39	36	1	5	------	52	90
Uganda	(4)	(4)	(4)	------	18	4	------	18	5
United States (mine shipments)	110	143	244	323	352	35	91	132	90
World total (estimate) [6]	2, 161	4, 090	2, 971	5, 374	2, 953	929	1, 700	1, 500	1, 900

[1] In addition to countries listed, beryllium concentrates may also be produced in Finland, France, Kenya, Norway, Rumania, and U. S. S. R. Canada has produced beryl but reported no sales.
[2] Estimate based on United States imports.
[3] Less than 1 ton.
[4] Data not available.
[5] Estimate.
[6] Exclusive of U. S. S. R. Production in other countries for which data are not available is believed to be negligible.

[17] Kaufmann, A. R., and Gordon, E., Vacuum Melting and Casting of Beryllium: Metal Progress, vol. 52, September 1947, pp. 387–390.
Schumar, J. F., Uranium, Thorium, and Beryllium Melting and Fabrication: U. S. Atomic Energy Commission, AECD–1851, Mar. 23, 1948, 9 pp.
Madsen, Borge, Note on the Soldering of Beryllium: Rev. Sci. Instr., vol. 18, February 1947, p. 135.
Bradner, H., Production of Thin Beryllium Foils: U. S. Atomic Energy Commission, AECD–1949 Mar. 18, 1948, 4 pp.
Anderson, H. L., and Feld, B. T., Preparation of Pressed Radium-Beryllium Neutron Sources: Rev. Sci. Instr., vol. 18, Mar. 1947, pp. 186–188.
[18] McTaggart, F. K., Mineral Chlorination Studies. III. The Chlorination of Australian Beryl: Jour. Council Sci. Ind. Research, vol. 20, 1947, pp. 564–584.
[19] Kennedy, J. S., and O'Meara, R. G., Flotation of Beryllium Ores: Bureau of Mines Rept. of Investigations 4166, 1948, pp. 18.
[20] Smith, A. Lee, and Fassel, Velmer A., Quantitative Spectrographic Analysis of Beryllium and Its Compounds: U. S. Atomic Energy Commission, AECD–2100, June 22, 1948, 9 pp.
[21] Marks, Graham W., and Jones, Betsy M., Method for the Spectrochemical Determination of Beryllium, Cadmium, Zinc, and Indium in Ore Samples: Bureau of Mines Rept. of Investigations 4363, 1948, 27 pp.
[22] Johnston, Jr., W. D., Beryl-Tantalite Pegmatites of Northeastern Brazil: Bull. Geol. Soc. America, vol. 56, No. 11, November 1945, pp. 1015–1070.

Beryl has been found in *British Guiana* [23] and with columbite occurs in pegmatite in the regions of Timotes and Chachopo, State of Merida, *Venezuela*.[24] Reserves of several thousand tons of beryl have been estimated in *Mexico* in pegmatite dikes of the Sierra de Oposura, Municipality of Moctezuma, State of Sonora.

Africa.—A large occurrence of beryl was discovered and mined in the Machokos district, *Kenya*, but such deposits are said to be rare.[25] Production of beryl ore on a commercial scale was expected to begin in *French Morocco* in 1949. Beryl occurs in a zone of pegmatite dikes about 120 miles long extending across central *Nigeria* from Jemaa in Plateau Province to the Egbe district in Kabba Province. Crystals up to 15 inches in diameter were recorded from a deposit near Okere, Kabba Province. An experimental shipment of 20 tons of beryl was made from a dike south of Okere.[26]

Producers of beryl in *Portuguese East Africa* are Boror Commercial, Lda., P. O. Box 26, Mozambique; and Esteveo Guerreiro A. Lima, Muiane, Alto Molocue, Quelimane.[27] Beryl is produced from pegmatite deposits of the Omaruru and Karabib districts, *South-West Africa*, and from the Oorlogskloof pegmatite deposits on the farm Border 155, 26 miles from Makop Siding, Warmbad district.[28] Beryl is recovered in *Tanganyika* in the mica-mining operations of Masasi in the Southern Province and in the Bundali Hills in the Southern Highlands Province;[29] 1½ long tons were produced in 1948. Beryl occurs in two pegmatites in the Buganda area, *Uganda*.[30]

Europe.—The beryllium industries of Germany and Italy were described in detail.[31] Beryllium alloys are produced by Beryllium Smelting Co., Ltd., London, from imported master alloys. Several British companies were reported giving serious consideration to the manufacture of beryllium metal, alloys, and salts.[32]

Asia and Australia.—The embargo in *India* on export of beryl ore, which was instituted in June 1946, continued throughout 1948. Beryl is produced principally in central and southern Rajputana, and a small quantity has come from Kashmir. Beryl ore is included by the interim government of *South Korea* on the new list of approved export commodities.[33] Beryl is mined at Ryukado, Shihori, Kogen-do. White alkali beryl occurs in eastern Kazakhstan, *U. S. S. R.* (see Cesium and Rubidium section of this chapter). New Metals (Aus-

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[23] Bracewell, Smith, The Geology and Mineral Resources of British Guiana: Bull. Imper. Inst., vol. 45, No. 1, March 1947, p. 62.

[24] Tello B., Manuel and Zuloaga, Guillermo, Geologia de los Yacimientos Metaliferos y Recursos Minerales de Venezuela: Proc. 8th Am. Sci. Cong. vol. 4, Geological Sciences, 1942 (Dept. of State, Wash., D. C.), pp. 681–691.

[25] Pulfrey, William, The Geology and Mineral Resources of Kenya: Bull. Imper. Inst., vol. 45, No. 3, July-September 1947, p. 290.

[26] Jacobsen, R., and Webb, J. S., The Pegmatites of Central Nigeria: Nigeria Geol. Survey, Bull. 17, 1946, 59 pp.

[27] Bureau of Mines, Mineral Trade Notes: Vol. 27, No. 1, July 1948, p. 5.

[28] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 1, January 1948, p. 4.

[29] Stockley, G. M., The Mineral Resources of Tanganyika: Bull. Imper. Inst., vol. 45, No. 4, October-December 1947, p. 397.

[30] Davies, K. A., and Bisset, C. B., The Geology and Mineral Deposits of Uganda: Bull. Imper. Inst, vol. 45, No. 2, April-June 1947, p. 170.

[31] Foster, E. M., Magnetic Materials and Beryllium: British Intelligence Objectives Subcommittee (BIOS) Final Rept. 36, Item 21, Rept. 2, August 1945, pp. 1–15.
West, H. W., and Others, Investigation of Beryllium Production in Germany and Italy, Including Production and Uses of Oxides and Alloys: British Intelligence Objectives Subcommittee (BIOS) Final Rept. 550, Item 21, 1945, 81 pp.
Sloman, H. A., and Sawyer, C. B., The Beryllium Industries of Germany and Italy 1939–45: Office of Military Govt. for Germany (U. S.) FIAT Final Rept. 522, August-September 1945, 108 pp.

[32] Mining Magazine (London), vol. 78, No. 5, May 1948, p. 260.

[33] Oil, Paint, and Drug Reporter, vol. 153, No. 19, May 10, 1948, p. 57.

tralia), Ltd., and Amalgamated Metallurgical Corp., Ltd., have been organized in *Australia* to produce beryllium and other metals and chemicals.[34]

BORON

Production.—Elemental amorphous boron is produced by the F. W. Berk Co., Inc., Woodridge, N. J., Cooper Metallurgical Associates, Cleveland, Ohio, and the Norton Co., Worcester, Mass. The last two concerns also produce the nitride and the carbide, respectively. Producers of various alloying agents are the Electro Metallurgical Co., New York, N. Y. (ferroboron, nickel-boron, manganese-boron, Silcaz); Molybdenum Corp. of America, Washington, Pa. (ferroboron, manganese boride); Vanadium Corp. of America, Bridgeville, Pa. (Grainal alloys); Titanium Alloy Mfg. Co., Niagara Falls, N. Y. (Bortam, Carbortam); and Ohio Ferro-Alloys Co., Philo, Ohio (Borosil). (For discussion of boron minerals, see Borates in the Salines—Miscellaneous chapter of this volume.)

Apparent consumption of boron alloys in 1948, based on producers' shipments, was up slightly over the previous year.

Uses.—Elemental boron finds its chief use in the metal industry as a degasifier in metallurgical reactions. Boron added to steel, usually in master-alloy form, markedly increases its hardenability.[35] The boron content of the final product can be exceedingly small, 0.0005–0.003 percent being sufficient in thoroughly deoxidized steels. Too much boron causes hot-shortness to such an extent that the steel will disintegrate upon rolling. Boron is employed in the production of malleable iron castings as well as wrought steel. Up to 0.05 percent boron is used to insure the chill-depth of rolls used in the steel industry and in grain milling. Certain alloys used for cutting tools and hard-facing contain boron in substantial percentages.

Boron carbide is the hardest known substance, other than diamond. It is used in powder form as an abrasive in lapping very hard materials and in molded form as parts for glass cutters, sand-blast nozzles and masks, mortars and pestles, plug, ring and snap gages, micrometers, grinding-wheel molds, rug-weaving needles, and extrusion dies. Its applications in metal-working have been described.[36] The abrading efficiency of boron carbide has been determined as 6.5 compared to 10 for diamond and 0.2 for silicon carbide.[37] Boron nitride is used as a ladle-lining and mold-coating in the casting of jet-engine turbine buckets. Being possessed of graphitic crystal structure, high refractoriness, and excellent dielectric properties at high temperature, the nitride has shown promise as a lubricant [38] both by itself and in a silicone base for the lubrication of moving parts exposed to high temperatures.

The high absorption capacity of boron for thermal neutrons has been responsible for many applications of the element in the atomic energy program. Boron^{10} is the neutron-absorbing isotope. Boron^{10}

[34] Metal Bulletin, No. 3285, Apr. 23, 1948, p. 12.
[35] Diggs, Thos. G., Irish, Carolyn R., and Carwile, Nesbit L., Effect of Boron on the Hardenability of High-Purity Alloys and Commercial Steels: National Bureau of Standards Jour. Research, vol. 41, No. 6, December 1948, pp. 545–574.
[36] American Machinist, Boron Carbide Applied to Metal-Working Operations: Vol. 91, No. 13, June 19 1947, pp. 122–124.
[37] Barberis, Nino, [Boron Carbide—the New Abrasive]: Ind. ceram. silicati, vol. 1, No. 3, 1946, pp. 6–8.
[38] Sumner, G. L., Heat-Resistant Lubricants: Mech. Eng., vol. 70, No. 1, January 1948, pp. 30–31.

constitutes only about 20 percent of natural boron; this isotope, 96 percent pure, is now produced by the Atomic Energy Commission.[39] Boron trifluoride is employed in neutron counters [40] but its most important applications are as a catalytic agent and raw material in the chemical industry. Boron steel is used for the control of nuclear reactors; however, the quantity of boron required is apparently small, only 100 pounds being estimated as the quantity required for the controls of an enriched 100,000-kw. reactor.[41] The presence of boron in a moderator such as graphite is undesirable even to the extent of 1 part in a million.

The borides of the ferro-alloy metals chromium, molybdenum, titanium, tantalum, and columbium are very hard and refractory, some being used in tools and dies; they have much in common with metals in electrical and thermal conductivity. The borides in pure form have melting points exceeding 5,000° F.; they may be used alone or cemented with ferro-alloy metals for applications in high-temperature installations, such as gas-turbine and jet-engine combustion chambers. Much attention has been accorded the borides and boron carbide in the NEPA (Nuclear Energy for Propulsion of Aircraft) program and related research.[42]

The hydrides of boron are colorless liquids or gases, easily oxidized with consequent large energy liberation. Boron hydride has been intensively studied under Office of Naval Research contracts because of its desirable characteristics as a rocket fuel. The highest jet velocities are attained with elements of low atomic weight, one of the best appearing to be boron. For a propellant combination of reasonably high bulk density, very high jet velocities may be expected from reacting boron hydride with fluorine oxide (F_2O) [43] or water; boron hydride is a water-reaction fuel being highly explosive when exposed to moist air or traces of water.[44]

Prices.—The price of amorphous boron (82–86 percent B) in 1947 and 1948 averaged about $13 per pound in 100-pound lots or more; high-purity material (98 percent) was about $250 per pound. Prices of boron additive alloys as quoted in Iron Age, f. o. b. plant, ton lots, were generally unchanged throughout 1948 as follows: Ferroboron (17.5 percent B), $1.21 per pound; Bortam, 45 cents per pound; Grainal 1, 2, and 3, 45, 63, and 93 cents per pound, respectively; Silcaz, 39 cents per pound; nickel boron, $1.82½ cents per pound, less than ton lots; Borosil, $6.25 per pound of contained boron; manganese-boron, $1.92 per pound, declining to $1.67 on October 7, unchanged thereafter; Carbortam, 8 cents per pound, increased slightly at midyear to cover augmented titanium and boron content. The isotope of boron, B^{10}, is sold by the Atomic Energy Commission for $15 per gram.

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[39] Science, U. S. Atomic Energy Commission Announces Boron [10] Available: Vol. 105, June 27, 1947, p. 662.

[40] Hodges, W., Loyd, M. I., and Weinstock, B., Preparation of Boron Trifluoride for Use in Neutron Counters: U. S. Atomic Energy Commission, AECD-2223, Aug. 9, 1948, 5 pp.

[41] Goodman, Clark (ed.), The Science and Engineering of Nuclear Power: Addison-Wesley Press, Inc., Cambridge, Mass., 1949, vol. 2, p. 15.

[42] Reed, E. L., Report on Tungsten Boride: U. S. Atomic Energy Commission, NEPA Rept., Feb. 11, 1948, 32 pp.
Bridges, Wm. L., Boron and Borides: U. S. Atomic Energy Commission, NEPA Rept., Mar. 30, 1948, 20 pp.
Goetzel, Claus G., High-Temperature Materials: Iron Age, vol. 161, No. 18, Apr. 29, 1948, pp. 78–81.

[43] Leonard, Arthur S., Some Possibilities for Rocket Propellants: Jour. Am. Rocket Soc., No. 68, 1946, pp. 12–16.

[44] Bell, R. P., and Emeléus, H. J., The Boron Hydrides and Related Compounds: Quarterly Revs. (London), No. 2, 1948, pp. 132–51.

Technology.—Boron carbide is made by fusing anhydrous boric acid with petroleum coke at 2,800° C.[45] Pilot-scale methods of preparing diborane were developed.[46] Techniques were described for the production of metallic borides by the electrolysis of the corresponding borates.[47]

Foreign Trade and World Review.—Boron carbide, boron carbide shapes, and calcium boride are produced in Canada. United States imports of the carbide from Canada in 1947 and 1948 were 18,427 and 29,644 pounds, valued at $23,228 and $30,822, respectively. Ferroboron imports from Canada in 1948 totaled 5,700 pounds, valued at $1,378. Ferroboron is produced at the Rainham Works of Murex, Ltd., Essex, United Kingdom.

CALCIUM

Production.—The Electro Metallurgical Co., Sault Ste. Marie, Mich., and the New England Lime Co., Canaan, Conn., produced calcium metal during the year. The hydride and nitride were made by Metal Hydrides, Inc., Beverly, Mass. The 1948 output of the metal, which amounted to several tens of thousands of pounds, declined sharply, being only slightly more than half that for 1947. Pure varieties of limestone constitute the basic raw material of calcium.

Consumption and Uses.—Apparent consumption of calcium metal for 1948 nearly equaled output and was almost double apparent consumption for 1947. Calcium has numerous uses, some important applications being debismuthizing of lead; preparation of lead alloys for battery grids and plates, bearings, and sheathing for telephone cable and electric lines; deoxidizing of copper, iron, and various alloys; decarburizing and desulfurizing of ferrous metals and alloys; grain refining of cast iron and steel; alloying of aluminum, copper, beryllium, and magnesium; dehydrating certain organic liquids; desulfurizing petroleum fractions; "gettering" (see Barium and Strontium section of this chapter) in the production of high vacuum; and in purifying argon gas.

Calcium metal or calcium hydride is used principally in producing metals such as uranium, vanadium, thorium, zirconium, tantalum, columbium, titanium,[48] and chromium. The hydride constitutes a convenient source of hydrogen because it is able to absorb 850 times its own volume of hydrogen; during World War II it was used by the armed forces in ton quantities for balloon inflation and similar purposes. The hydride also serves as a dehydrating agent and reduction catalyst. Calcium nitride has application in foundry work for introducing nitrogen into metal baths. Calcium-silicon is used as a deoxidizer in steel production. Calcium chemicals are discussed in the Lime, Salines—Miscellaneous, and Stone chapters of this volume.

Prices.—In January 1948, E&MJ Metal and Mineral Markets quoted calcium metal at $1.85 per pound in ton lots, cast in slabs and

[45] American Machinist, Hardest Man-Made Material: Vol. 91, No. 13, June 19, 1947, pp. 122–124.
[46] Carhart, H. W., and others, Pilot-Plant Preparation of Diborane: NRL–C–3405 (Naval Research Laboratory), Jan. 17, 1949, 13 pp.
[47] Andrieux, J. L., [Making Metallic Powders by Electrolysis of Fused Salts]: Rev. Métal., vol. 45, 1948, pp. 49–59.
[48] Chretien, Andre, and Wyss, Robert, Sur la reduction de l'oxyde titanique par le calcium et par le magnesium: Compt. rend., vol. 224, June 9, 1947, pp. 1642–1643.

small pieces. This price was increased on April 15 to $1.95 where it remained for the balance of the year. January prices for calcium turnings and distilled metal in 100-pound lots were $2.70 and $3.40 per pound, respectively. Iron Age for January 8, 1948, quoted calcium-silicon (28–35 percent Ca), carlots, f. o. b. at 16.25–18.80 cents per pound; similarly, calcium-manganese-silicon (16–20 percent Ca) was quoted at 17.50–20.05 cents. The quotations on Graphidox No. 4 alloy (5 percent Ca) in June 1948 was 17.9 cents per pound, ton lots.

Foreign Trade.—Calcium metal imported in 1948 came from Canada. Canada also accounted for 396,920 pounds of calcium-silicon ($51,599); 30,363 pounds ($492) were received from Australia and 2,205 pounds ($287) from France.

Calcium metal and calcium-silicon imported for consumption in the United States, 1944–48 [1]

[U. S. Department of Commerce]

Commodity	1945		1946		1947		1948	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Calcium metal	17,086	$15,845			354	$675	796	$2,483
Calcium-silicon	164	22	661,200	$87,647			429,488	52,378

[1] No transactions reported for 1944.

World Review.—Beginning in 1945, Dominion Magnesium Ltd., at Haley's Station near Ottawa, Ontario, Canada grew through 1948 to become one of the major calcium-metal producers of the world. Production in 1947 and 1948 easily eclipsed previous output. Metal production for the 4 years was as follows: 1945, 29,543 pounds; 1946, 53,548 ($68,720); 1947 (revised figures), 723,461 ($1,121,388); 1948, 1,104,562 ($1,779,405). Before World War II, most of the calcium metal and alloys consumed in the United States were produced in Europe, notably in France and Norway.

CERIUM AND OTHER RARE-EARTH METALS

Elements of the rare-earth group are monotonously similar in chemical behavior, a fact that long delayed thorough investigation of their properties. The approximate relative abundance of the various rare earths, in percent, is estimated as follows: Cerium 31, neodymium 18, lanthanum 7, samarium 7, gadolinium 7, dysprosium 7, ytterbium 7, erbium 6, praseodymium 5, lutecium 1.5, terbium 1, holmium 1, thulium 1, europium 0.2. Isotopes of samarium, and lutecium, Sa^{148} and Lu^{176}, are naturally radioactive. Several of the rare earths are excellent absorbers of slow neutrons, gadolinium having by far the largest cross section of all the elements in the periodic system. Over thirty rare-earth isotopes have been found to be produced in the course of uranium fission.[49] This fact, combined with the high degree of neutron absorption of the rare earths, has subjected the group as a whole to intensive scientific study by the

[49] Siegel, J. M., and others, Nuclei Formed in Fission: Jour. Am. Chem. Soc., vol. 68, No. 11, 1946, pp. 2411–2442.

Atomic Energy Commission because of their "poisoning" effect on the action of a nuclear-energy pile.

Production.—Several hundred thousand pounds of misch metal (cerium master alloy) and ferrocerium were produced in 1948. Misch metal producers are General Cerium Co., Edgewater, N. J., and Cerium Metals Corp., Niagara Falls, N. Y. Ferrocerium is made by Cigalite Flint Co., New York, N. Y., and by Kent Metal & Chemical Works, Edgewater, N. J. New Process Metals Co., Newark, N. J., and Matchless Metals Co., Flushing, N. Y., produce both misch metal and ferrocerium. Imported monazite sand constitutes the basic raw material source of the rare-earth metals.[50] (See Monazite section of Minor Nonmetals chapter.) Idaho became a monazite producer in 1948, a shipment of 40 tons being reported by Rare Earths, Inc., McCall, Idaho. Small quantities of monazite are recovered incident to the production of titanium and zirconium minerals from coastal sands of eastern Florida (see Zirconium, this chapter). Monazite is processed principally by Lindsay Light & Chemical Co., West Chicago, Ill.; Maywood Chemical Co., Maywood, N. J.; Wolff-Alport Chemical Corp., Brooklyn, N. Y.; and Rare Earths, Inc. (not connected with Idaho company), Paterson, N. J. Mixed chlorides of the various rare-earth metals are sold by the first three of these companies to the misch metal producers, the misch metal being deposited electrolytically from the anhydrous chlorides.

High-purity rare-earth compounds are produced by the monazite processors mentioned above and by F. A. Lewis, Hempstead, N. Y.; Research Chemicals Inc., Burbank, Calif.; and Edmond C. Botti, Brooklyn, N. Y. Cerium, lanthanum, neodymium, and praseodymium metal are produced by Cooper Metallurgical Associates, Cleveland, Ohio. The Ames Laboratory of the United States Atomic Energy Commission, Iowa State College, Ames, Iowa, has produced a number of the rare-earth salts and appreciable quantities of spectrographically pure lanthanum, cerium, neodymium, and praseodymium metal. Small quantities of pure lutecium and ytterbium metal, as well as various quantities of other heavy rare earths, have also been prepared. Basic raw materials used as sources of erbium, holmium, and yttrium have been the minerals risorite, blomstrandine, and gadolinite, respectively. The Ames Laboratory, under the supervision of F. H. Spedding, produces rare-earth metals and compounds incident to research projects undertaken for the Atomic Energy Commission; the laboratory's rare-earth products are for use only within the Commission and are not available for outside distribution or sale. Dr. Spedding and coworkers have made notable contributions to the chemistry of the rare earths in the development of ion-exchange methods for the separation and production of high-purity compounds.[51]

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[50] Pilkington, E. S., and Wylie, A. W., Production of Rare-Earth and Thorium Compounds from Monazite: Jour. Soc. Chem. Ind., vol. 66, No. 11, November 1947, pp. 387–394.

[51] Spedding, F. H., and others, The Separation of Rare Earths by Ion Exchange. I. Cerium and Yttrium: Jour. Am. Chem. Soc., vol. 69, No. 11, 1947, pp. 2777–2781; II. Neodymium and Praseodymium, vol. 69, No. 11, pp. 2786–2792; III. Pilot-Plant Scale Separations, vol. 69, No. 11, p. 2812.

Harris, Darwin H., and Tomkins, Edward R., Ion Exchange as a Separations Method, Separation of Several Rare Earths of the Cerium Group (La, Ce, Pr, and Nd): Jour. Am. Chem. Soc., vol. 69, No. 11, 1947, pp. 2792–2800.

Ketelle, B. H., and Boyd, G. E., The Exchange Absorption of Ions from Aqueous Solutions by Organic Zeolities. IV. The Separation of the Yttrium-Group Rare Earths: Jour. Am. Chem. Soc., vol. 69, No. 11, 1947, pp. 2800–2812.

Spedding, F. H., and others, Improved Ion-Exchange Method for Separating Rare Earths in Macro Quantities: Jour. Am. Chem. Soc., vol. 70, No. 4, April 1948, pp. 1671–1672.

Consumption and Uses.—Large quantities of rare-earth alloys and compounds are consumed annually in the United States. The important alloy, misch metal (a mixture of all the rare-earth elements with cerium predominating), is combined with iron (15–40 percent) to form pyrophoric alloys which find worldwide use as "flints" in devices such as cigarette lighters, miners' lamps and gas lighters. Ferrocerium and master alloys of misch metal combined with other elements are used in deoxidizing, grain refining, carbide stabilization, and in enhancing the creep and oxidation resistance of steels at high temperatures. An important new application showing much promise in the field of light metals is the use of about 3 to 5 percent cerium (aotually misch metal) to improve appreciably the strength and creep resistance of magnesium alloys in the temperature range up to 600° F. These cerium-magnesium alloys are readily weldable and have good machinability. Addition of 0.05–1.0 percent cerium to low-iron nickel-chromium alloys markedly prolongs their life at elevated temperatures. These alloys, as well as those of cerium-magnesium and cerium-aluminum, have numerous applications in the construction of jet planes, gas turbines, aircraft supercharger parts, and other equipment demanding great tensile strength at high temperatures.

Stocks.—Figures are not available on stocks of misch metal, alloys, or rare-earth compounds. Monazite is included among the minerals being acquired for the National Strategic Stock Pile. Quantities accumulated in the stock pile are confidential.

Prices.—Misch metal prices in 1948 averaged about $4 per pound and for ferrocerium flints about $8. Prices of cerium, lanthanum, neodymium, and praseodymium metal, per pound, were about $50, $175, $200, and $750, respectively. The most important rare-earth materials sold in quantities constitute mixed chlorides and oxides designated as "rare-earth chloride," "rare-earth oxide," and cerium hydrate and oxide. These products are priced from about $0.75–$2.00 per pound in large lots. Prices for high-purity oxides of the rare-earth group elements are approximately as follows: Lanthanum, 99.9 percent, $10 per pound, 100-pound lots; neodymium, 99, $75 per pound; praseodymium, 99.9 $3 per gram, 100-gram lots; samarium, 99.9, $7 per gram, 100-gram lots; yttrium, 99, $2.50 per gram, 100-gram lots; gadolinium, 99.9, $40 per gram; europium, 99.5, $400–$850 per gram. Oxalates of the remaining members of the rare-earth group have been quoted by F. A. Lewis, Hempstead, N. Y., at the following prices: Terbium, 99.7 percent, $75 per 50 mg.; holmium, 90, $65 per 100 mg.; erbium, 95, $500 per gram; lutecium, 99.8, $160 per 100 mg.; ytterbium, 99.8, $200 per gram; and thulium, 99.9, $1,500 per gram.

Foreign Trade.—1948 imports of ferrocerium and other alloys amounted to 1,600 pounds valued at $12,380 in comparison to 665 pounds in 1947 with a value of $3,708. Virtually all receipts originated in Canada.

Exports of misch metal and alloys in 1948 showed a precipitous drop in volume in contrast to the peak year 1947. Shipments for 1948 were 55,133 pounds with a value of $323,582, in sharp contrast to the 182,204 pounds in the previous year valued at $1,053,936. Exports in 1948 were distributed as follows: Canada, 2,190 pounds, value $10,260; United Kingdom, 4,630, $19,556; Belgium, 4,815, $28,049;

France, 275, $1,595; Czechoslovakia, 5,000, $29,000; Switzerland, 35,801, $222,406; Portugal, 2,422, $12,716.

On October 13, 1948, the Economic Cooperation Administration, under the European Recovery Program, authorized the expenditure by Austria of $20,000 in counterpart funds for the purchase of 5,000 pounds of misch metal in the United States.

World Review.—A steady demand for misch metal and alloys was reported in the United Kingdom.[52] Monazite is processed by Thorium, Ltd., London. Misch metal and pyrophoric alloys are made by Imperial Chemical Industries, Ltd., Liverpool; Chemo Metals, Ltd., London; British Flint and Cerium Mfrs., Ltd., Tonbridge, Kent; and Sibor Hard Metals, Ltd., London. Rare-earth compounds, miceh metal and alloys are produced in France by Société de Produits Chimiques des Terres Rares, Paris, and in Austria by Treibacher Chemische Werke, Treibach. Producers of misch metal and alloys in Germany, Belgium, and Portugal are, respectively, Promethus, A. G., Kempten, Bavaria; Société Anonyme de Pont Brulé, near Brussels; and Monocerium, Ltd., Lisbon. In Canada, misch metal is made by Shawinigan Chemicals, Ltd., Shawinigan Falls, Quebec; ferrocerium is produced by the Belgo Canadian Mfg. Co., Montreal. Results of combined laboratory and pilot-plant studies devoted to processing of Australian monazite were outlined in the 21st annual report of the Australian Council for Scientific and Industrial Research for the year ending June 1948.[53]

CESIUM AND RUBIDIUM

Cesium and rubidium are almost invariably found closely associated in nature; with one notable exception, rubidium usually predominates. The richest ore mineral of cesium is pollucite, a cesium-aluminum silicate resembling quartz, and containing about 34 percent Cs_2O; this mineral has been found in ton quantities in pegmatites in the Black Hills of South Dakota, in Maine, and in South-West Africa; its rubidium content is low—about 0.1–2.5 percent Rb_2O. Lepidolite mica carries an average Rb_2O content of about 1.5 percent with a variation of 0.24–3.0 percent being reported; Cs_2O content of lepidolite has been reported as 0.08–0.72 percent. Some varieties of beryl contain up to several percent cesium and rubidium. Cesium and rubidium also occur in feldspars, biotite and muscovite mica, carnallite, leucite, and sea water. Rubidium is one of the few naturally radioactive elements, the isotope Rb^{87} emitting beta radiation.

Production.—Cesium and rubidium metal and compounds are produced by De Rewal International Rare Metals Co., Philadelphia, Pa.; Maywood Chemical Works, Maywood, N. J. (Cs metal, Cs and Rb salts); City Chemical Corp., New York, N. Y. (Cs and Rb compounds); Foote Mineral Co., Philadelphia, Pa. (Cs compounds); Fairmount Chemical Co., Newark, N. J. (Cs and Rb metals and compounds); and Dow Chemical Co., Midland, Mich. (Cs bromide).

Uses.—Cesium and rubidium are used principally as the electron-emitting agent in photoelectric cells employed in alarm and signal systems, automatic counters, sorters, color matchers, time recorders,

[52] Metal Bulletin (London), No. 3306, July 9, 1948, p. 11.
[53] Chemical and Engineering News, vol. 26, No. 48, Nov. 29, 1948, p. 3581.

door openers, and in television equipment. During 1948 a comprehensive book on the practical applications of photoelectric cells was published.[54] An important electronic device being developed is the cesium vapor rectifier which is superior to the mercury vapor type for certain applications. Crystals of the various halide compounds of cesium and rubidium find application in infrared spectrometry, particularly in the longer wave-length bands. The range of sensitivity of cesium cells in visible light is said to correspond closely to that of the human eye. During World War II an infrared lamp employing cesium vapor was developed for ship-to-shore and ship-to-ship signaling.[55] Cesium and rubidium have been used as "getters" (see Barium and Strontium section of this chapter) and have been proposed as hydrogenation catalysts. Their salts are used as reagents in microchemistry. Rubidium iodide has been used for syphilis therapy and in certain cases as a substitute for potassium iodide in goiter treatment.

Prices.—Recent quotations on chemically pure cesium and rubidium metal, double distilled, in sealed glass ampoules were $3 and $4 per gram, respectively, in 10-gram lots; cesium chloride, 10-pound lots, $60 per pound; rubidium chloride, kilogram lots, about $135 per pound; cesium bromide, 500-pound lots, $27 per pound.

Technology.—Efforts to separate rubidium and cesium salts by ion exchange proved unsuccessful.[56] Methods for the separation and determination of cesium and rubidium [57] and for the preparation of the hydrides [58] were described.

World Review.—Pollucite occurs 18 miles south of Karabib, South-West Africa. Unsold stocks were reported as about 60 tons in 1947; it was estimated several hundred tons of ore could be produced. About 3 tons, averaging 28 percent Cs_2O were shipped to the United States, being sold at £140 per ton.[59] Cesium and rubidium metal and salts were produced in Germany, from pollucite and lepidolite, before World War II by E. Merck, Chemische Fabrik, Darmstadt.[60] Cesium and rubidium have been recovered as byproducts from the carnallite of the Solikamsk potash deposits, U. S. S. R.; Soviet production of cesium salts in 1937 was reported as 800 grams per month. Pollucite occurs 90 kilometers southeast of the city of Ust-Kamenogorsk, eastern Kazakhstan.[61] Associated minerals are lepidolite, amblygonite, spodumene, petalite, white alkali beryl, and microlite. Cs_2O content averages 26.61 percent. Important quantities of cesium and rubidium ores are reported at the Boliden mines, Varuträsk, Sweden. Plans were reportedly under way to produce cesium and other metals in Western Australia.[62]

[54] Walker, R. C., Photoelectric Cells in Industry: Sir Isaac Pitman & Sons, London, 1948, 517 pp.
[55] Beese, N. C., Cesium Vapor Lamp: Jour. Optical Soc. America, vol. 36, 1946, pp. 555–560.
[56] Cohn, W. E., and Kohn, H. W., Ion-Exchange Separation of the Alkali Metals: U. S. Atomic Energy Commission, AECD–1810, Mar. 16, 1948, 2 pp.
[57] Bassett, L. G., and Byerley, W., Lithium, Sodium, Potassium, Rubidium and Cesium Chemistry of the Manhattan Project: U. S. Atomic Energy Commission, MDDC–1132, April 1947, 19 pp.
[58] Lee, M. E., Other Saline Hydrides: U. S. Atomic Energy Commission, NEPA–669, July 13, 1948, 57 pp.
[59] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 1, January 1948, p. 4.
[60] Smatko, Joseph S., The Production of Some Rare Metals and Their Compounds as Practiced by E. Merck, Chemische Fabrik, Darmstadt: Office Military Govt. for Germany (U. S.), FIAT Final Rept. 738, Feb. 21, 1946, pp. 3–5.
[61] Ginsburg, A. I. [Pollucite in Pegmatites of the Kalbin Range]: Compt. rend., Acad. Sci. (U. R. S. S.), vol. 52, 1946, pp. 335–337.
[62] Work cited in footnote 34.

COLUMBIUM AND TANTALUM

The commercially important sources of columbium and tantalum are the minerals columbite and tantalite. Both minerals are normally recovered incident to other mining operations, principally tin in the case of columbite, and tin and beryl in the case of tantalite. The minerals microlite and simpsonite have occasionally been found in sufficient quantities to be used as tantalum ore.

Mine Production.—Operations at the Harding mine near Dixon, N. Mex., and at the Brown Derby mine, near Ohio City, Colo., were suspended in 1948, with the result that domestic tantalum-ore output was essentially at a standstill throughout the year. Either or both of these properties have operated since 1943, producing the tantalum mineral, microlite, in commercial quantities at the rate of several thousand pounds annually. A few hundred pounds of columbite and tantalite are accumulated each year in the United States in the mining of feldspar, quartz, mica, beryl, and lithium minerals.

Columbium and tantalum concentrates shipped from mines in the United States, 1944–48

[Compiled by R. W. Metcalf]

Year	Columbium concentrates		Tantalum concentrates	
	Pounds	Value	Pounds	Value
1944	3,208	$917	7,204	$23,317
1945	1,149	287	5,500	13,366
1946			3,475	8,793
1947			3,259	8,677
1948	100	(1)	500	(1)

1 Bureau of Mines not at liberty to publish figure.

Domestic Refiners.—Tantalum and columbium metals, chemicals and fabricated metal shapes, and equipment are produced by Fansteel Metallurgical Corp., North Chicago, Ill. Metal Hydrides, Inc., Beverly, Mass., produces tantalum and columbium metal powder and tantalum hydride powder. The Electro-Metallurgical Co. is the principal consumer of imported columbite and is the sole producer of ferrocolumbium alloys at its Niagara Falls, N. Y., plant and possibly other locations.

Consumption and Uses.—Figures on quantities of columbium and tantalum products consumed in the United States are not available. The major use for columbium is as a stabilizer in stainless steels, decreasing their susceptibility to intergranular corrosion, improving weldability, and increasing creep and impact strength. It is also becoming an increasingly important constituent of ferrous and nonferrous alloys being developed for parts exposed to high temperatures generated in jet engines, gas turbines,[63] and other equipment, imparting greater creep and fatigue strength.[64] The properties of columbium and tantalum alloys have been reviewed.[65] Tantalum

63 Schaefer, Adolf O. (assigned to Midvale Co.), Ferrous Alloys and Rotor Forgings for Gas Turbines: U. S. Patent 2,453,598, Nov. 9, 1948.
64 German, Howard M. (assigned to Driver-Harris Co.), Alloy: U. S. Patent 2,451,547, Oct. 19, 1948.
65 Myers, R. H., The Constitution and Properties of Alloys Containing Tantalum and Columbium: Metallurgia, vol. 39, December 1948, pp. 57–63.

finds use principally as the pure metal. It is readily shaped into various objects and is highly corrosion-resistant. Considerable quantities are used in the chemical industries for heat exchangers, condensers, absorption towers, and other devices subject to corrosive attack. Tantalum metal also finds wide application in surgery for skull plates and sutures and in electronics as a structural component in many types of vacuum tubes. Tantalum carbide is used for cutting tools, dies, and wear-resisting parts and is a component of the alloy Tantung. Potassium-tantalum fluoride was of critical importance during World War II as a catalyst in the production of synthetic rubber. Tantalum oxide is an important constituent of silica-free optical glass used for the lenses of aerial cameras.

Prices.—The Metal Bulletin (London) quoted columbite ore, 50–55 percent combined oxides, January 13, 1948, at 65s. per unit, c. i. f. Thereafter quotations increased as follows, February 13, 67s. 6d.–70s.; November 16, 67s. 6d.–72s. 6d.; and December 31, 70s.–75s. The successive increases in price apparently were due to the growing shortage of columbite created by strategic demands being superimposed upon normal industrial requirements, coupled with the fact that columbite was being actively purchased during the year for the United States Government strategic stock pile. E&MJ Metal and Mineral Markets for January 1, 1948, quoted tantalum ore, 60 percent Ta_2O_5, at $2–2.50 per pound contained Ta_2O_5; the quotation rose in August to $2.25–$2.75, then declined again in September to $2–$2.75, remaining unchanged thereafter. Prices for columbium metal per kilogram were $280 for rod and $250 for sheet, unchanged throughout 1948. Similarly, tantalum metal per kilogram was $160.60 for rod and $143 for sheet, also unchanged during the year. The American Metal Market quoted columbium and tantalum metal powder, per pound, at $62.75 and $65–$73, respectively, in 1948. Ferrocolumbium alloy, 50–55 percent Cb, Eastern Zone, per pound contained Cb, was $2.50–$2.60 in January 1948 increasing successively to $2.75–$2.80 on October 7 and $2.90 on December 23, the increments reflecting the rise in the price of columbite ore.

Stocks.—Inventory figures of tantalum and columbium ores, metal, alloys, and compounds in private and Government hands are not available for publication. Both columbite and tantalite are on the list of materials to be acquired for the National Strategic Stock Pile; however, tantalite was not in active demand in 1948.

Foreign Trade.—In 1948, for the first time since 1942, columbite imports fell below 2,000,000 pounds, this despite the fact that demand for columbite remained at a near-record level. Diversion of part of the total supply to consuming countries other than the United States was not a significant factor in explaining the decline; instead, it is believed that accumulated columbite-rich dumps, which had been worked in Nigeria during the war years to supplement the normal byproduct output from contemporary tin production, were becoming depleted.

Tantalite imports slumped to the lowest level since 1939, the decline being reflected strongly in United States-destined shipments from both the Belgian Congo and Brazil, the major producing countries. Annual imports from Brazil ranged from about 162,000 to 440,000 pounds in 1941–44 and about 68,000 to 98,000 in 1945–47, in marked contrast to 9,202 pounds in 1948. Imports from the Belgian Congo during the years 1941–47 varied from about 147,000 to 486,000 pounds annually as compared to 83,137 pounds in 1948. Despite the marked overall decline, imports were recorded from Argentina in 1948, the first year since 1944, and receipts of tantalite from Nigeria were nearly double those for 1947. Exports of columbium ore in 1948 totaled 660 pounds to Switzerland, valued at $1,980. Tantalum metal and alloys were shipped to the amount of 867 pounds, value $33,995; principal recipients were the United Kingdom, Germany, and Austria. Exports of columbium metal and alloys and of tantalum ore were negligible.

Columbium and tantalum ores (columbite and tantalite concentrates) imported for consumption in the United States, 1946–48, by countries, in pounds

[U. S. Department of Commerce]

Country	Columbium ore			Tantalum ore		
	1946	1947	1948	1946	1947	1948
Argentina						1,074
Australia				500	9,468	
Belgian Congo		2,734	113,813	263,097	311,526	83,137
Belgium-Luxembourg			27,125		3,199	
Bolivia [1]	6,834					
Brazil	7,717			98,072	71,634	9,202
Nigeria	2,411,695	2,818,900	1,822,843		7,998	14,559
Southern Rhodesia					14,928	8,914
Union of South Africa			1,821	1,884		
United Kingdom			1,200			
Total: Pounds	2,426,246	2,821,634	1,966,802	363,553	418,753	116,886
Value	$742,804	$857,550	$655,916	$302,397	$386,934	$79,189

[1] Classified by U. S. Department of Commerce as from Chile, which is believed to have been the country of transshipment rather than the country of origin.

Technology.—Patents were issued outlining methods for separating columbium and tantalum by chlorination,[66] and for determining columbium carbide in stainless steel.[67] A technique for plating tantalum and columbium on nonferrous and ferrous metals and ceramic bases was developed.[68] Principles of mechanically shaping tantalum were reviewed.[69]

WORLD REVIEW

Australia.—Under a recent decision of the Department of Commerce, exports of tantalite are to be reserved for the United Kingdom. Tantalite exports were brought under Commonwealth control early in May 1948, licensing to be administered under the Department of Supply and Development. Total Australian production of tantalite (65 percent Ta_2O_5) for the years 1905–47, inclusive, was 295 tons.[70] Two new companies were formed to produce tantalum and columbium

[66] Cuvelliez, Francois, Treatment of Materials Containing Tantalum and Niobium: U. S. Patent 2,429,671, Oct. 28, 1947.
Kroll, Wm. J., and Bacon, Frederick E. (assigned to Electro-Metallurgical Co.), Separation of Columbium and Tantalum Oxides: U. S. Patent 2,443,254, June 15, 1948.
[67] Maurer, Walter C. (assigned to Carnegie-Illinois Steel Corp.), Process for Determining Columbium Carbide in Stainless Steel: U. S. Patent 2,447,763, Aug. 24, 1948.
[68] Powell, C. F., and others, Deposition of Tantalum and Columbium from Their Volatilized Halides: Jour. Electrochem. Soc., vol. 93, June 1948, pp. 258–265.
[69] Myers, R. H., Mechanical Working of Tantalum: Metallurgia, vol. 39, November 1948, pp. 7–10.
[70] Sullivan, C. J., and Ludbrook, N. J., Bureau of Mineral Resources, Geology and Geophysics (Australia), Tantalum and Columbium: Mineral Resources of Australia, Summary Rept. 19, 1945, 24 pp.

metal, Amalgamated Metallurgical Corp., Ltd., and New Metals (Australia), Ltd.[71] The first company reportedly had acquired plant space at Finsbury, near Adelaide, while the second planned to operate at Welshpool, Western Australia (see Beryllium, Cesium and Rubidium, Zirconium—World Review, this chapter).

Belgian Congo.—Most of the world output of intermediate-grade tantalite (about 35 percent Ta_2O_5 and 30 percent Cb_2O_5) comes from the Belgian Congo. The main producing company is the Compagnie Geologique et Miniére des Ingenieurs et Industriels Belges Soc. Anon. (Geomines); tantalite is recovered as a byproduct in the mining of cassiterite which occurs in deeply decomposed pegmatite dikes. Output in 1948 was about 320,000 pounds, a 16-percent decline below the approximately 380,000 pounds of 1947. Tantalite concentrates were being stocked in 1948, there being virtually no market.

Belgium.—The Société Générale Métallurgique de Hoboken, near Antwerp, is a producer of tantalum and columbium alloys and carbides.

Brazil.—The world's principal production of high-grade tantalite (60 percent Ta_2O_5) is derived as a coproduct of beryl mining in the states of Paraiba and Rio Grande do Norte; production in 1937–44 totaled about 600 metric tons. Exports in 1948 were only 9,183 pounds, representing a decline of 87 percent below the 72,753 pounds reported for 1947. The sharp drop was attributed to lack of interest on the part of American consumers, who ordinarily constitute the principal market. Buyers indicated that attempts were being made by producers to dispose of tantalite by making its purchase contingent to that of beryl which remained in strong demand.

Canada.—Peg Tantalum Mines, Ltd., with properties and a 100-ton concentrating plant at Ross Lake northeast of Yellowknife, N. W. T., filed a bankruptcy petition in the summer of 1947 in the Edmonton courts. Consolidation with an affiliated company, Tantalum Refining & Mining Corp. of America, Ltd., was under consideration.[72] During 1948 the latter company acquired title to tantalite claims at Ross Lake and to a refining laboratory in Edmonton.

Germany.—The production of tantalum and columbium alloys and compounds [73] and tantalum metal [74] in Germany during World War II was described. Total output in Germany of ferrocolumbium during the war was about 1 ton per month. Two tantalum-refining plants were in operation, at least one of which was later dismantled and removed by the Russians.

A deposit of the columbium mineral, koppite, disseminated in limestone, was reported as occuring about 500 meters east of the village of Schelingen in the Kaiserstuhl, near Freiberg.[75] Reserves of 500,000 to 700,000 metric tons, containing under 0.50 percent columbium, were estimated. Experimental mining of columbium ore in the Kaiserstuhl, presumably from the above deposit, was reported.[76]

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[71] Metal Bulletin (London), No. 3285, Apr. 23, 1948, p. 12.
[72] The Precambrian, vol. 22, No. 11, November 1947, p. 27.
[73] Brewin, E., and others, The German Ferro-Alloy Industry: British Intelligence Objectives Subcommittee (BIOS) Final Rept. 798, Item 21, December 1945, 97 pp.
[74] Owen, E. R., Production of Tantalum at the Works of Siemens and Halske, A. G.: British Intelligence Objectives Subcommittee (BIOS) Final Rept. 232, Item 21, October 1945, 12 pp.
[75] Fischer, R. P., The Niobium Deposit in the Kaiserstuhl: Joint Intelligence Objectives Agency (U. S.) Rept. 16, Aug. 7, 1945, 2 pp.
[76] Metal Bulletin (London), No. 3311, July 27, 1948, p. 14.

Nigeria.—Nearly 99 percent of the world output of high-grade (65 percent Cb_2O_5) columbite concentrates originates as a byproduct of tin mining in northern Nigeria. Total Nigerian production in 1948 was 1,238 long tons, being essentially unchanged from 1947 output of 1,286 tons. The major producers were Amalgamated Tin Mines of Nigeria, Ltd., 347 long tons; Bisichi Tin Co., Ltd., 122 tons; and Jantar Nigeria Co., Ltd., 264 tons. The latter two companies reported, near the year end, proven columbite reserves of 811 and 2,439 tons, respectively. The columbite contract between Jantar Nigeria Co., Ltd., and American buyers was renewed for the calendar years 1949–50 at an increased price. Shipments were principally to the United States, as in past years, but exports to the United Kingdom rose from 269 tons in 1947 to 407 in 1948. Norway received 100 tons in 1947, none in 1948. Important deposits of high-grade tantalite occur [77] in central Nigeria.

Portuguese East Africa (Mozambique).—A uranium-bearing mineral resembling samarskite has been reported as occurring in quantity in the vicinity of Tete.[78] The mineral contains tantalum and columbium and other elements which may constitute its greatest value; 50 tons have been shipped to the United Kingdom and a permit obtained for shipment of 100 more.

Southern Rhodesia.—Production of tantalite was about 14 tons in 1947 and 8 in 1948. Energetic prospecting for tantalite was reported in the Bikita district, east of Salisbury.[79]

South-West Africa.—Total output of tantalite for a 20-year period through 1948 was about 20 tons.

United Kingdom.—Ferrocolumbium and ferrotantalum are produced at the Rainham Works of Murex, Ltd., Essex.[80]

Other Countries.—Uganda produced a few thousand pounds of high-grade columbite in 1948. A few tons of low-grade columbite-tantalite (25 percent Cb_2O_5, 12 percent Ta_2O_5) were recovered in Malaya [81] during the Japanese occupation as a byproduct of tin dredging in the states of Johore and Kedah. Columbite-tantalite concentrates are obtained as a byproduct from gold mining in the Mayoko region, French Equatorial Africa,[82] a few tons being recovered in 1945–46.

GALLIUM

Despite its great rarity in nature in concentrations of economic importance, gallium is one of the most widely distributed elements in the earth's crust. Granitic rocks almost invariably contain about 0.001 percent of the element. Traces of gallium are found in essentially all aluminum minerals, a high proportion of zinc minerals, in lepidolite, tourmaline, ores of iron, manganese, and tin, in coal, and in aluminum, iron, and zinc metal. Up to 1.85 percent gallium has been reported in germanite, the richest known gallium-bearing mineral (see Germanium in this chapter).

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77 Work cited in footnote 26.
78 Bureau of Mines, Mineral Trade Notes: Vol. 27, No. 1, July 1948, p. 23.
79 Mining Journal (London), vol. 231, No. 5893, July 31, 1948, p. 563.
80 Metal Industry, The Rarer Metals: Vol. 72, No. 13, Mar. 26, 1948, pp. 246–247.
81 Mining Journal (London), Mining in Malaya: Vol. 231, No. 5889, July 3, 1948, pp. 668–669.
82 Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 4, April 1948, p. 4.

Gallium becomes concentrated to a varying degree in intermediate products and residues formed in processing aluminum and zinc ores and in burning coal and is recovered commercially from these sources.

Production.—Gallium metal was produced in 1948 by the Eagle-Picher Lead Co., Joplin, Mo., from cadmium plant residues and lithopone sludge; by the Aluminum Ore Co. (Aluminum Co. of America subsidiary), East St. Louis, Ill., from Bayer process liquors; and by Saratoga Laboratories, Inc., Saratoga Springs, N. Y. The latter company began output late in the year and constituted a new producer. Total production of gallium metal by all producers for 1948 is estimated to have been about 200 pounds. Shipments probably did not exceed 100 pounds.

A great deal of public interest in gallium was evidenced in 1948 because of its rumored atomic energy applications. The Atomic Energy Commission and, to a lesser extent, the Office of Naval Research, sponsored several projects in 1947 and 1948 devoted to the study of gallium metal, alloys, and compounds. Under military auspices, the Bureau of Mines carried on an intensive survey of the naturally occurring and byproduct gallium resources of the United States and conducted research in the extractive metallurgy of gallium.

Prices.—Near the end of 1948, gallium metal, 99.9 percent pure, was offered by the Aluminum Co. of America at the prices below.

Quantity:	*Per gram*	Quantity—Continued:	*Per gram*
Less than 100 grams	$5.00	5,000–9,999 grams	$3.50
100–999 grams	4.50	10,000–24,999 grams	3.00
1,000–4,999 grams	4.00	25,000 grams and over	2.50

The above quotations, converted to dollars per pound, range from $2,270 downward to $1,135.

Uses.—The principal practical application for gallium metal has been as a component in the construction of direct-reading fused quartz thermometers[83] used for measurements up to 1,200° C., gallium filling the role played by mercury in lower range instruments. Small quantities of gallium have found use in dental amalgams, optical mirror backings, gallium-vapor lamps, and low-melting alloys. Some of the alloys of gallium with indium, tin, and aluminum are noteworthy in being liquid below room temperature.

The favorable range between its melting and boiling points (about 30°–2,000° C.), combined with low vapor pressure and other desirable properties, suggest that gallium metal would be a highly efficient heat-exchange medium. The principal deterrents to such use are its high cost and avidity for alloying with other metals. If these difficulties can be resolved, gallium metal may find bulk application as a heat-exchange fluid or coolant, in installations such as nuclear-energy power plants, which must operate at temperatures considerably transcending those of conventional steam-power plants if they are to make available even a small part of their potential energy.

World Review.—It has been estimated that as much as 1,000 tons of gallium per year may be lost in the British Isles through discard or dissipation into the air of gallium-rich flue dusts and ashes derived from burning British coals. Gallium is produced in the United

[83] Smithells, C. J., A German Thermometer for Use in the Range 400°–1200° C.: British Intelligence Objectives Subcommittee Final Rept. 345, February 1946, 11 pp.

Kingdom by the Chemical Research Laboratory, Teddington, Middlesex.

Several years before World War II, gallium was produced in Germany at the rate of about 300 pounds per year. Raw materials were germanite ore from the Tsumeb mine in South-West Africa and wastes from the treatment of the copper ores of Mansfeld in eastern Germany.

Gallium has been reported in flue dusts from the combustion of Australian coals, the coal ashes of Asturia, Spain, in Russian electrolytic zinc, and in Indian bauxite ores.

GERMANIUM

Germanium is found in significant traces in some zinc and tin ores, in enargite, topaz, beryl, lepidolite, spodumene, tourmaline, alkali feldspars, and in coal. The mineral germanite has been found to contain up to about 10 percent germanium. Bolivian pyrargyrite has shown 1 to 3 percent, and a few exceedingly rare minerals contain germanium to the extent of a few percent.

Commercial production of germanium has come from germanite ore on occasion, but its recovery as a byproduct of zinc smelters treating germaniferous ore has afforded the largest and most dependable supply. Ultimately the most important source of germanium may be the flue dusts and ashes saved from burning of germaniferous coals by industry.

Production.—The Eagle-Picher Lead Co., Joplin, Mo., which had been the sole domestic producer of germanium and its compounds, was joined by two newcomers in 1948—the American Steel & Wire Co. (subsidiary of U. S. Steel Corp.), Donora, Pa., and Saratoga Laboratories, Inc., Saratoga Springs, N. Y. Output of germanium in 1948, mostly as the oxide, exceeded 1,000 pounds and reached an all-time high mainly as a result of record output of zinc by the Eagle-Picher Lead Co. from the germaniferous zinc ores of the Tri-State district. With the exception of 1945, domestic production of germanium has shown an uninterrupted rise since its beginning in 1942.

Consumption and Uses.—Consumption, mainly by the electronics industry, kept closely abreast of production. Concern was expressed by consumers as to the adequacy of future supplies in view of probable expanding requirements, combined with the possibility that Tri-State district zinc output, from which most germanium comes as a byproduct, seemed certain to continue to decline.

Germanium is employed in the electronics industry as the key component in diminutive crystal units used for the rectification of radio-frequency currents ranging up to about 100 megacycles. The diode, or two-element type, was developed during World War II, together with similar silicon crystal rectifiers, for application in radar microwave circuits and was proven in several years service. Large numbers of germanium diodes are now used in the video detector circuits of television sets, electrical test equipment, Geiger counters, crystal sets, electronic computers, and telephone circuits. Several thousand diodes are used in some of the larger electronic computers. It is believed that the telephone industry is one of the largest potential users and that hundreds of thousands of units may eventually be required. The quantity of germanium metal needed in a single unit is exceedingly small, measuring only about 3 mm. by 3 mm. by 0.6 mm.

In 1948 Bell Telephone Laboratories, Princeton, N. J., announced development of a triode unit or transistor.[84] Similar in size to the diode, the transistor may be employed as an oscillator or amplifier, or for other purposes for which vacuum tubes are ordinarily used. Despite its apparently bright future, the transistor is still in the experimental stage, difficulty being experienced in producing units of uniform electrical characteristics. Nor is it yet competitive in price with the vacuum tubes it might displace. Its advantages over vacuum tubes center around its wide frequency range, small size, light weight, longevity, low current requirements, and freedom from hum. Basic research in the semiconductors, such as germanium and silicon, has been carried on for several years at Purdue University, South Bend, Ind., by K. Lark-Horovitz and associates. Cyclotron bombardment of germanium was employed recently by this group to produce new types of semiconducting crystals,[85] and a patent issued and assigned to the Purdue Research Foundation covering a germanium-helium "alloy" which, it is claimed, will resist higher voltages than untreated crystals.[86]

Germanium has been used in special optical glass and in phosphors.[87] Film resistors of germanium are made by depositing the metal on ceramic bodies from the volatile compound germanium hydride. Germanium (12 percent) and gold form a low melting eutectic that may have eventual applications in jewelry as a gold solder and in dentistry for inlays. The alloy melts at 673° F. compared with 1,945° F. for pure gold, expands slightly upon solidification, and resembles standard 18-carat gold in color.

Stocks and Prices.—Strong demand kept stocks pared to a low level. Demand and increased costs appeared to be the main factors in bringing about an increase in prices in 1948, the average for the year being about $65 a pound for the spectrographically pure oxide and $230 for high-purity metal. Averages for 1947 were $50 per pound for the oxide and $200 for the metal. Purchased in small lots, both metal and compounds bring appreciably higher prices.

World Review.—It has been estimated that up to 2,000 tons of germanium per year may be present in stack gases, flue dusts, and ashes of plants burning germaniferous coals in the United Kingdom (see Gallium, this chapter). The Chemical Research Laboratory, Teddington, Middlesex, produces germanium from such residues.[88] Germanium has been studied in the coal ashes and flue dusts of Spain, Australia, and the U. S. S. R. Germanite, the richest known ore of germanium, has been found only at the Tsumeb mine, South-West Africa. Very pure specimens of the mineral have shown a germanium content exceeding 10 percent. H. DeWitt Smith, managing director of Tsumeb Corp., Ltd., states:[89]

[84] Bardeen, J., and Brattain, W. H., The Transistor, a Semiconductor Triode: Phys Rev., vol. 74, ser. 2, July 15, 1948, pp. 230–231.
[85] Science News Letter, New Steps in Electricity: Vol. 53, No. 6, Feb. 7, 1948, p. 83.
[86] Whaley, Randall M. (assigned to Purdue Research Foundation), Germanium-Helium Alloys and Rectifiers Made Therefrom: U. S. Patent 2,447,829, Aug. 24, 1948.
[87] Williams, Fred E., Some New Aspects of Germanate and Fluoride Phosphors: Jour. Optical Soc. America, vol. 37, January 1947, pp. 37–41.
[88] Chemical Age (London), Using Germanium: Vol. 59, No. 1536. Dec. 18, 1948, p. 806.
[89] Letter to Bureau of Mines, June 16, 1949.

When Tsumeb Corporation took over the assets of the old German company, there were on hand at Tsumeb approximately 26 tons of germanium-gallium ore, which represented a pre-war accumulation by the old company from the upper levels. Three shipments, totalling 11 tons, have been made by Tsumeb Corporation . . . . , leaving a balance of 15 tons of material carrying approximately 38% copper, 8% lead, 9% zinc, 2 to 4% germanium, and .25–.50% gallium.

The old records indicate that this material was mined during the years 1922–23 from the 6th level, of which a careful inspection shows no indication of additional germanium-gallium ore.

Germanium metal has been produced in Germany and its use in high-frequency current rectification studied;[90] 50 tons of germanite ore were reported to have been in a Hanover warehouse at the beginning of World War II.

HAFNIUM

Hafnium metal is reported to be about as soft as copper and similar to zirconium in properties except for a higher melting point and specific gravity, being in the latter respect about as heavy as mercury. The metal can be hammered cold, drawn into wire, and rolled into sheet and is said to be superior to zirconium in cold-working properties. All commercial zirconium metal and compounds produced up to the present time contain hafnium, in amounts that may exceed 2 percent. Hafnium oxide and carbide are among the most refractory of compounds, with melting points of 2,664° and 3,787° C., respectively.

Hafnium is almost identical with zirconium in chemical behavior and is invariably found in zirconium minerals in nature; with the exception of the rare mineral, thortveitite, zirconium is always present in appreciably larger quantity than hafnium. The hafnium oxide content of commercial and potentially commercial zirconium minerals is approximately 0.5–2.0 percent for zircon, 0.5–1.2 in baddeleyite, and 0.17–0.7 in eudialyte. (See the Zirconium section of this chapter.) Certain altered varieties of zircon, such as alvite and cyrtolite, are the richest sources of hafnium, up to as high as 15 percent HfO_2 being positively reported; however, the average would probably not exceed a few percent. Minerals containing hafnium are radioactive owing to the presence of either uranium or thorium, or both. The quantity of hafnium in a mineral is apparently roughly proportional to the intensity of radioactivity of the mineral. Almost 4.5 percent of uranium oxide has been found in cyrtolite. It has been suggested that the fluorescence of some zirconium minerals may be related to the hafnium content.

The hafnium-rich mineral cyrtolite has been found in quantities of hundreds of pounds at a feldspar quarry near Bedford, Westchester County, N. Y., and at Baringer Hill, Llano County, Tex. The latter locality is no longer accessible, being flooded by a reservoir. Other less important cyrtolite occurrences in the United States are listed in comprehensive early publications.[91] Cyrtolite has also been recorded from India, Madagascar, Italy, Sweden, and from the Hybla and Parry Sound district, Ontario, Canada. The hafnium-rich mineral,

[90] Taylor, J. E., and others, German Research on Rectifiers and Semiconductors: British Intelligence Objectives Subcommittee (BIOS) Final Rept. 725, July 1, 1946, pp. 20–25.
[91] Lee, O. Ivan, The Mineralogy of Hafnium: Chem. Revs., vol. 5, No. 1, February 1928, 37 pp. Tyler, Paul M., Hafnium: Bureau of Mines Inf. Circ. 6457, 1931, 11 pp.

alvite, occurs in Norway. The occurrence of hafnium in zirconium minerals of the U. S. S. R. has been studied.[92]

Production.—Hafnium metal, oxide, and other compounds are produced by De Rewal International Rare Metals Co., Philadelphia, Pa. The Fairmount Chemical Co., Newark, N. J., produces hafnium oxide. Hafnium metal and compounds are available from Chemical Commerce Co., Newark, N. J., and from A. D. McKay, New York, N. Y. Hafnium-nickel alloy (50 percent Hf–50 percent Ni) has been prepared by Metal Hydrides, Inc., Beverly, Mass.

Uses.—To date, hafnium metal and compounds have found application only in chemical and physical research devoted to further study of their properties. In view of the current intense interest in the development of superrefractories for jet engines, nuclear reactors, and other high-temperature devices, the compounds of hafnium, such as the oxide and carbide, have received renewed attention. The absorption cross section of hafnium for thermal neutrons is substantially greater than that for zirconium (which is very low), suggesting that if zirconium metal or compounds are to be utilized effectively in any atomic energy applications where neutron conservation is critical, as in nuclear reactors, the hafnium content must first be removed.

Because of its high ductility, melting point, and electron emissivity hafnium shows promise in the electronics industry for filaments and cathode surfaces. The oxide and salts exhibit catalytic properties similar to the zirconium homologs in the dehydration and dehydrogenation of ethyl alcohol.

Should specific applications be developed for hafnium, requiring the element in quantity, it appears possible that 100 tons per year or more could be recovered from zircon concentrates. However, much more economical methods of separation from zirconium than those presently known would have to be developed to effect such large-scale output.

Prices.—Hafnium metal powder, 98 percent, was recently quoted at \$32 per gram in 100-gram lots; quotations for the oxide, 99 percent, were \$23 per gram, 100-gram lots; the basic nitrate of similar purity was offered at \$17 per gram, 10-gram lots.

Technology.—The application of ion-exchange [93] and other methods [94] to the problem of separating hafnium from zirconium give promise of supplanting the once tedious procedure of fractional crystallization. Hafnium metal is prepared by methods nearly identical to those employed for zirconium. In 1948 the Bureau of Mines investigated the ion-exchange method for hafnium separation and developed spectrochemical methods for its determination. In Australia the Division of Industrial Chemistry of the Council for Scientific and Industrial Research is reported to have investigated the problem of hafnium and zirconium separation for several years [95] and to have studied preliminary separations on a fairly large scale.

[92] Kostyleva, E. D. [The Geochemistry of Hafnium in the U. S. S. R.]: Trudy Inst. Geol. Nauk, No. 39, Mineral Geokhim. Ser. 3, 1940, pp. 41–47.

[93] Street, Jr., Kenneth, and Seaborg, G. T., Ion-Exchange Separation of Zirconium and Hafnium: Jour. Am. Chem. Soc., vol. 70, No. 12, December 1948, pp. 4268–4269.

[94] Huffman, E. H., and Beaufait, L. J., Separation of Zirconium and Hafnium by Extraction with Thenoyltrifluoroacetone: U. S. Atomic Energy Commission, AECD-2387, Oct. 7, 1948, 12 pp.

[95] Warner, H. W., Titanium and Zirconium, New Metals in Australian Metallurgy: Chem. Eng. and Min. Rev., vol. 40, No. 7, Apr. 10, 1948, p. 261.

INDIUM

Commercial indium is recovered as a byproduct in the production of zinc, cadmium, and lithopone.

Production.—Output of indium in 1948 tripled that for the low year 1947 but was still negligible in comparison with the late years of World War II, when annual production approached 100,000 troy ounces. Small quantities of the metal were produced during the year by National Zinc Co., Bartlesville, Okla., and the American Steel & Wire Co. (subsidiary of U. S. Steel Corp.), Donora, Pa.; the Perth Amboy, N. J., plant of the American Smelting & Refining Co., reported production of the chloride. Shipments of indium and compounds were made by the above-mentioned concerns and by Anaconda Copper Mining Co., Great Falls, Mont., and the Denver, Colo., plant of the American Smelting & Refining Co. The latter two plants, while inactive in 1948, are normally the largest producers. The indium content of 1948 shipments totaled 12,202 troy ounces compared to 13,908 in 1947 and 9,667 in 1946.

Uses.—The chief use of indium to date has been as a plating for lead-coated machinery bearings and gears, imparting improved corrosion resistance, better oil-film retention, and higher surface hardness and strength.[96] This application reached a peak during the last years of World War II in aircraft production but has declined since that time. Indium alloys with many of the nonferrous metals, indium-zinc alloy having been used to plate hollow-steel aircraft propeller blades, and indium-gold finds application in dentistry. As a backing for mirrors and headlights indium forms brilliant, nontarnishing reflecting surfaces. A tin-free indium-lead alloy has been developed to fill the demand for a solder with a melting point intermediate between that of tin-lead solders and brazing alloys.[97] A patent was granted for a tin-free silver-brazing alloy [98] containing indium. Indium foils have been employed for the measurement of neutron density in nuclear physics experimentation. The wide range between the melting point (157° C.) and boiling point of indium (2,000° C.),[99] plus other favorable characteristics, suggests its possible use, like gallium, as a liquid metal for high-temperature thermometry or as a heat-exchange medium in high-temperature devices. Indium forms alloys with gallium and tin that are liquid at room temperature and below (see Gallium, this chapter). Indium-bismuth alloy is sold commercially under the trade name Cerrolow; one type of this alloy melts at 46.8° C. and may be applied molten to the skin of the body without injury. Suggested uses are as casts replacing plaster of paris, and in the arts as facial casts which may be plated with copper and the underlying low-temperature alloy subsequently removed. Indium has been proposed as a plating metal for the manufacture of tarnish-proof silverware. The oxide imparts yellow and amber shades to glass.

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[96] Albin, Joseph, Indium-Plated Lead Bearings Withstand High Stresses: Materials and Methods, vol. 27, No. 6, June 1948, pp. 88–89.

[97] Chemical Industries, Indium-Lead Alloy Solder: Vol. 63, No. 4, October 1948, p. 672.

[98] Polak, Joseph F. (assigned to Monroe Sherman), Silver-Brazing Alloys Containing Indium: U. S. Patent 2,456,593, Dec. 14, 1948.

[99] Kohlmeyer, E. J., and Spandau, H., [The Boiling Point of Indium]: Ztschr. anorg. Chemie, vol. 253, Mar. 15, 1945, pp. 37–40.

Stocks.—With a negligible output of metal and compounds in 1948, the decline in producers' stocks at the year end, compared to the same period in 1947, was about equal to shipments reported. Large stocks of unprocessed indium-rich residues were believed to be held by producers who awaited signs of an upturn in the demand for indium before incurring the expense of extracting the metal.

Prices.—Indium metal, 99.9 percent, was quoted nominally at $2.25 per troy ounce. The continuing doldrums of the indium market is reflected by the fact that this price has remained unchanged since September 1945. Prior to that time, back to about 1940, indium prices ranged from $3–$15 per troy ounce, with figures in the higher range generally prevailing.

Technology.—A spectrochemical method for the determination of indium in ores was developed by the Bureau of Mines.[1] Methods for the recovery of indium [2] and for its electrodeposition [3] were published.

World Review.—Indium is produced in Peru as a byproduct of zinc smelting at the Oroya plant of the Cerro de Pasco Corp. Exports of Peruvian indium in 1948 totaled 500,000 grams,[4] most of which went to the United States. Peru's exports in previous years were: 1947, 304,000 grams; 1946, 155,000; 1945, 41,457. Indium is produced in Belgium by the Société Belgochimie and at Okar, near Goslar, in Germany.[5]

LITHIUM

The brines of Searles Lake, near Trona, Calif., are the most important commercial source of lithium. Lithium minerals of commercial importance are spodumene, lepidolite, amblygonite, and petalite. (Ores and compounds of lithium are discussed in the Minor Nonmetals chapter of this volume.)

Production and Consumption.—Lithium metal and alloys are produced by the Metalloy Corp. (subsidiary of Lithium Corp. of America), Minneapolis, Minn., and by the Maywood Chemical Works, Maywood, N. J. Output of metal in 1948 was less than one-third that of 1947, but production of lithium alloys remained essentially unchanged from the earlier level. A wide variety of lithium chemicals is prepared by the above mentioned companies and by the Foote Mineral Co., Philadelphia, Pa. A promising compound, lithium-aluminum hydride, is now produced in commercial quantities by Metal Hydrides, Inc., Beverly, Mass.

Consumption and Uses.—Apparent consumption of lithium metal and alloys in 1948 amounted to several thousand pounds each.

Metallic lithium is employed for removing sulfur, oxygen, and other gases from molten metals, particularly copper, and in addition, it has a grain-refining action. Lithium is finding expanded use in the light metals field, particularly in alloys of aluminum, zinc, and magnesium [6]

[1] Marks, Graham W., and Jones, Betsy M., Method for the Spectrochemical Determination of Beryllium, Cadmium, Zinc, and Indium in Ore Samples: Bureau of Mines Rept. of Investigations 4363, 1948, 27 pp.

[2] Last, O. A., Separation of Indium from Cadmium Plant Residues: Thesis, Univ. of Utah, 1947. Lebedeff, Yurii E. (assigned to American Smelting and Refining Co.), Process of Recovering Indium: U. S. Patent 2,433,770, Dec. 30, 1947.

[3] Moeller, T., and Hopkins, B. S., The Electrochemistry of Indium: Jour. Electrochem. Soc., vol. 93, No. 3, March 1948, pp. 84–93.

[4] Preliminary estimate based on Peruvian Customs' incomplete figures of exports for first 11 months.

[5] Aitkenhead, W. C., Vertical Retort Zinc and Byproducts: Off. Military Govt. for Germany (U. S.) FIAT Final Rept. 733, Mar. 6, 1946, 36 pp.

[6] Loonam, Alfred C. (assigned to Mathieson Chemical Corp.), Magnesium-Base Lithium Alloys: U. S. Patent 2,453,444, Nov. 9, 1948.

to which are conferred, variously, better tensile strength, ductility, and corrosion resistance. Lead-base bearing alloys are hardened with small additions of lithium.

Lithium amide and lithium-aluminum hydride are proving of increasing value in organic synthesis. The amide is reportedly used in the production of several allergy specifics of the antihistamine type; the double hydride offers many possibilities, among which are the reduction of carbon dioxide to derivatives of methanol [7] or formaldehyde.

Stocks and Prices.—Year-end producers' stocks of lithium metal and alloys for 1948 were substantially less than for the same period in 1947.

Published quotations for lithium metal, 98–99 percent in E&MJ Metal and Mineral Markets were $10–$15 per pound in January 1948, with increases in mid-March to $12–$15 and in early July to a flat $15, remaining unchanged thenceforth.

Technology.—Various methods for the production of lithium metal were described in 1948.[8]

RHENIUM

Molybdenite has proven to be the richest mineral source of rhenium, from less than 0.0001 percent of the element, up to 0.05 having been reported in domestic deposits. One isotope of rhenium, Re^{187}, is naturally radioactive, emitting beta particles.[9] The principal commercial source of rhenium is flue dust collected from plants engaged in the roasting of molybdenite concentrates; the rhenium content of such flue dusts may be as high as several percent.

Production.—Rhenium and potassium perrhenate have been produced since 1942 by the Chemistry Department of the University of Tennessee (Knoxville), under the supervision of A. D. Melaven, the raw material used being molybdenite roaster flue dust containing up to 1.5 percent rhenium. Anticipated output of 150 to 200 pounds of the perrhenate in the period 1947–48 fell far short of realization because of delays incurred in building a new pilot plant and a shortage of full-time employees to operate the facility. Production was resumed in mid-1948 and continued through the rest of the year. The new plant has an annual capacity of 30 to 50 tons of flue dust. A survey for new sources of rhenium is continuing.

Uses.—Being very similar to tungsten in physical and chemical characteristics, rhenium can be readily substituted for it in many applications. Rhenium wire has been used as filaments in incandescent lamps and thermionic tubes and is said to be less volatile in vacuum and to show greater emissivity than tungsten. Superior pen nibs, make-and-break electrical contact points, and thermocouples have been made from rhenium metal and alloys. Rhenium metal in powder or colloidal form has proved to be a valuable catalyst in the production of chloroform, ethane, and antiknock compounds. Aside

[7] Nystrom, Robert F., and others, Reduction of Carbon Dioxide to Methanol by Lithium Aluminum Hydride: Jour. Am. Chem. Soc., vol. 70, No. 1, January 1948, p. 441.

[8] Cunningham, J. B., and Gorski, C. H., Recovery of Lithium from Its Various Ores and Salts: Bureau of Mines Rept. of Investigations 4321, 1948, 35 pp.

Rogers, R. R., and Viens, G. E., The Production of Lithium Metal: Canadian Min. and Met. Bull., vol. 41, No. 439, November 1948, pp. 623–628.

[9] Sugarman, Nathan, and Richter, Harold, Note on the Natural Radioactivity of Rhenium: U. S. Atomic Energy Commission, AECD-1844, Feb. 26, 1948, 2 pp.

from its use as a catalyst, where recovery and reuse are possible, rhenium is obtainable in too small quantity to show much promise in any large-scale industrial application.

Prices.—The University of Tennessee Chemistry Department offered rhenium metal, 99.9 percent, and potassium perrhenate during 1947–48 at the following prices, per gram:

Quantity:	*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 at	1.00	1.75

These prices remained unchanged from the 1946 quotations. During 1948 an excellent résumé of rhenium technology was published [10] and a new method of colorimetric determination described.[11]

World Review.—Molybdenites from the Kounrad, Tyznyanz, and Chikok deposits in the Kazakh S. S. R. were studied and found to contain 0.00012–0.015 percent rhenium; 86–90 percent of rhenium contained in these ores is reported recovered in the roaster flue dusts.[12] Molybdenite from Lainejaur, Sweden, was reported to contain about 0.25 percent Re, this being easily the highest rhenium content ever reported for any mineral.[13] Before World War II, Germany was the only producer of rhenium; an output of several hundred pounds per year was reached in the mid-1930's. Raw materials consisted principally of molybdenum wastes from copper ore dressing and refining.

SCANDIUM

Scandium is a silvery metal with a melting point of 1,400° C. and a computed boiling point of 2,400° C.; its nitride is dark blue, is a good conductor, and melts at 2,600° C. Scandium weighs only slightly more than aluminum.

While scandium is sometimes classified with the rare-earth metals, it has many affinities in nature, as well as peculiar physical and chemical properties, which amply justify its being considered apart from the rare earths. The element is widely distributed in the earth's crust, being present in at least trace quantities in many rock-forming minerals. Pyroxenes and amphiboles average about 0.01 percent; muscovite, lepidolite, and beryl contain scandium, up to 1 percent being reported in the case of beryl.[14] Recent studies in which scandium oxide was artificially introduced into the mineral beryl suggest the blue varieties found in nature may be richest in scandium.[15] The mineral thortveitite, $(Sc, Y)_2 Si_2O_7$, is the only known species in which scandium is a major constituent, containing up to 42 percent Sc_2O_3; thortveitite has been reported in pegmatites at Satersdalen, Norway; Befanamo, Madagascar, and, possibly in Iceland. Monazite is reported to sometimes contain up to a few percent of the oxide. Titanite, columbite, tantalite, zircon and many of the less common rare-

[10] Druce, J. G. F., Rhenium: Cambridge University Press, 1948, 89 pp.

[11] Melaven, A. D., and Whetsel, K. B., Colorimetric Determination of Rhenium: Anal. Chem., vol. 20, No. 12, December 1948, pp. 1209–1211.

[12] Bibikova, V. I., [Rhenium in Dusts of the Molybdenum Division of Balkhash Works]: Tsvetnye Metal., vol. 19, No. 4, 1946, pp. 44–48.

[13] Aminoff, G., [A Molybdenite Rich in Rhenium]: Geol. Foren. Forh., vol. 65, No. 1, 1943, pp. 71–72.

[14] Oftedal, Ivor, [Scandium in Biotite as a Geologic Thermometer]: Norsk Geol. Tids., vol. 23, 1943, pp. 202–213.

[15] Borovik, S. A., [Laboratory Experiments on Introduction of Scandium into the Crystal Lattice of Beryl]: Compt. rend. acad. sci. (U. R. S. S.), vol. 53, 1946, pp. 65–66.

earth minerals contain scandium. Tin-tungsten ores are said to contain as much as 1 to 2 percent Sc_2O_3. Fergusonite from near Sappington and Laurin, south of Butte, Mont., is reported rich in scandium.[16]

Production and Uses.—At present, scandium and its compounds are of interest only in research; however, should commercial applications be developed, possibly several hundred pounds of the element per year might become available as a byproduct of other industries, notably those engaged in the processing of tungsten, beryllium, tantalum, columbium, and rare-earth minerals. Scandium compounds are produced in the United States by Fairmount Chemical Co., Newark, N. J., and F. A. Lewis, Hempstead, N. Y.

Prices.—Scandium oxide exceeding 99 percent in purity is quoted at $50 per gram; high-purity scandium sulfate has been recently offered in 10-gram lots at $17.50 per gram. The metal is not known to be procurable at present.

Technology.—Scandium is recovered from thortveitite, from residues left from the purification of tungstic oxide used in the preparation of high-purity tungsten metal, and from rare-earth processing residues. The metal is prepared by electrolysis of a fused bath of ScF_3 plus NaF, using a graphite anode and additions of Sc_2O_3 as a depolarizer. New methods applicable to the analysis of scandium and to the refining of its salts were described in 1948.[17]

SELENIUM AND TELLURIUM

Production.—The output of selenium in 1948 rose for the second successive year, being 89 percent above the average for the period 1935–39 but still 12 percent below the peak year 1943. Tellurium production also increased for the second year since 1946, showing a small gain over 1947.

Both selenium and tellurium are recovered for the most part from anode muds accumulated in the electrolytic refining of domestic and imported blister copper. Production of electrolytic copper was maintained at a high rate both in 1947 and 1948, assuring a large output of selenium- and tellurium-rich raw material during the same period.

Producers of refined selenium and tellurium in the United States are the American Smelting and Refining Co., Baltimore, Md.; United States Metals Refining Co., Chrome, N. J.; and the International Smelting & Refining Co., Perth Amboy, N. J. Tellurium is produced from lead bullion by the United States Smelting, Refining & Mining Co., East Chicago, Ind. Phelps Dodge Refining Corp., Laurel Hill, Long Island, N. Y., and El Paso, Tex., produces large quantities of selenium- and tellurium-bearing silver slimes, which are custom-refined for the company's account by the United States Metals Refining Co. The latter company produced selenium and tellurium alloys in 1948. Selenium alloys were produced by the American Smelting & Refining Co. and tellurium alloys by the United States Smelting, Refining & Mining Co.

[16] Cooke, S. R. B., and Perry, E. S., Columbium and Cerium Minerals in Montana: Am. Mineral., vol. 30, 1945, pp. 623–628.

[17] Ostroumor, E. A., Separation of Scandium by Means of Pyridine: Jour. Appl. Chem. (U. S. S. R.), vol. 3, May–June 1948, 3 pp.

Beck, G., The Biochemistry of Scandium and Its Precipitation as Phytate: Mikrochemie ver. Mikrochim. Acta, vol. 34, 1948, pp. 62–66.

Consumption and Uses.—Apparent domestic consumption (producers' domestic shipments plus imports) of selenium and tellurium in 1948 was 837,836 pounds and 78,788 pounds, respectively.

Salient statistics of elemental selenium and tellurium in the United States, 1944–48, 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			
1944	485,446	423,906	517,217	97,800	$170,582	69,025	45,323	163,105
1945	458,486	604,445	371,258	216,793	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
1947	512,648	[4] 489,415	280,368	529,175	893,171	45,248	71,300	122,717
1948	561,156	570,718	270,806	267,118	489,762	48,806	78,788	92,735

[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.

Large quantities of selenium are used yearly by the glass, rubber, and electronics industries for decolorizing, acceleration, and for rectifier components, respectively. Selenium rectifiers have been extensively used in industry for many years, but the period 1947–48 witnessed a phenomenal growth in their use, due principally to development by the Federal Telephone & Radio Corp., Harrison, N. J., of new miniature, inexpensive types ideally suited to radio and television circuits. These diminutive rectifiers used in voltage multiplier circuits of radio or television sets can deliver 200 to 500 volts d. c. from a 117-volt a. c. source, eliminating a heavy and bulky transformer and rectifier tube.[18] The newly introduced xerographic process of "dry" photography employs selenium-coated metal disks from which the photographic image is reported transferred by static electricity.[19] Selenium is used in ruby glass,[20] photoelectric cells, protective coatings for nonferrous metals, orange-red pigments, phosphor base materials,[21] lubricants,[22] and as an additive to steel for refining grain and improving ductility.[23] Selenium and tellurium added to steel or copper improve their machinability, a high degree of electrical conductivity being retained in the case of copper. Tellurium is extensively used as a core wash in foundries as a chill inducer for iron castings.[24]

Stocks.—Producers' stocks of metallic selenium and tellurium were down at the year end of 1948 compared to the same period in 1947. Selenium is included in group B of the list of strategic and critical

[18] Chadwick, E. W., Voltage Multiplier Circuits with Selenium Rectifiers: Communications, vol. 27, No. 1, January 1947, p. 14.
[19] Nature, Photography on Selenium: Vol. 161, Apr. 3, 1948, p. 522.
[20] Pavlish, A. E., and Austin, C. R., Selenium-Ruby and Other Glasses Colored by Selenium: Jour. Am. Ceram. Soc., vol. 30, No. 1, Jan. 1, 1947, pp. 1–11.
[21] Smith, Arthur L., and others, Preparation of Strontium Selenide and Its Properties as a Base Material for Phosphors Stimulated by Infrared: Jour. Am. Chem. Soc., vol. 69, No. 7, July 1947, pp. 1725–1729.
[22] Heiks, Ray E., and Croxton, Frank C., Selenium Dioxide as a Lubricant Additive: Ind. Eng. Chem., vol. 39, No. 11, November 1947, pp. 1466–1474.
[23] Gagnebin, Albert P., Selenium Additions to Cast Steel: Am. Foundryman, vol. 12, August 1947, pp. 43–52.
[24] Sullivan, W. P., Preventing a Shrinkage in Gray Iron Castings; Tellurium Core Washes as Chill Inducers: Am. Foundryman, vol. 12, August 1947, pp. 26–28.

materials to be procured for the National Strategic Stock Pile; materials in this category are recommended for acquisition only to the extent they may be available for transfer from nonstrategic stock piles of Government agencies. Data concerning quantities of selenium held in the strategic stock pile are confidential.

Prices.—In January 1948, E&MJ Metal and Mineral Markets quoted selenium, black, 99.5 percent, at $2.00 per pound and tellurium at $1.75 per pound, these prices remaining unchanged the balance of the year.

Foreign Trade.—Imports of selenium and compounds in 1948 totaled 267,118 pounds with a value of $489,762. Contributing countries were Canada, 265,118 pounds and Norway, 2,000. In 1947 receipts amounted to 529,175 pounds, Canada accounting for 526,970. No imports of tellurium were recorded. Export figures on selenium and tellurium are not available.

World Review.—Large quantities of selenium and tellurium are recovered as a byproduct of electrolytic copper-refining operations by the International Nickel Co. of Canada, Ltd., Copper Cliff, Ontario, and by Canadian Copper Refiners, Ltd., Montreal East, Quebec. The rated annual production capacity of the latter operation is 450,000 pounds for selenium and 50,000 pounds for tellurium. Production of selenium and tellurium in 1948 was 327,500 and 32,100 pounds, valued at C$655,000 and C$56,175, respectively. Output of both commodities was below that of the previous year, with selenium registering its second successive decline below the peak year 1946, when 521,867 pounds were produced. The lowered output of selenium and tellurium, at least in 1948, is believed to have been caused partly by the summer and autumn drought in eastern Canada, which resulted in a shortage of electric power for the production of electrolytic copper. The International Nickel Co. of Canada, Ltd., reported sales of selenium and tellurium in 1948 as 103,687 and 12,608 pounds, respectively, compared with 225,362 and 16,420 pounds in 1947.

Selenium is produced in Australia by the Electrolytic Refining & Smelting Co. of Australia Proprietary, Ltd., Melbourne; in Sweden by the Boliden Mining Co., and in Belgium by the Société Générale Métallurgique de Hoboken, near Antwerp. In the United Kingdom, copper alloys of selenium and tellurium are produced by British Copper Refiners, Ltd., Prescot, Lancashire.

THALLIUM

Traces of thallium are found in many zinc sulfide ores and in cupriferous pyrites, the roasting and subsequent treatment of which give rise to the commercial production of thallium as a byproduct. The bulk of the thallium in the earth's crust is contained as traces in the potash minerals, principally feldspars and micas;[25] however, thallium recovery is not economically feasible at present from these sources.

Production.—The Globe cadmium refinery of the American Smelting & Refining Co. at Denver, Colo., continues to be the sole producer of thallium metal in the United States, reporting an annual output of a few thousand pounds. Production of thallium increased for the third

[25] Ahrens, L. H., The Unique Association of Thallium and Rubidium in Minerals: Jour. Geology, vol. 56, No. 6, November 1948, pp. 578–590.

consecutive year, being about 30 percent higher than in 1947 but substantially below the average for the war years 1940–45.

A Bureau of Mines survey of domestic thallium resources, made at the request of the Army Engineer Corps, showed the existence of relatively large quantities of thallium in the ores, processing streams, and finished products of the Salt Lake Valley.[26] Methods were developed by the Bureau of Mines for the detection and determination of thallium in various raw materials and products. As a result of the Bureau of Mines survey, the American Smelting and Refining Co. began construction of a pilot plant for thallium recovery from Cottrell dust at its Murray, Utah, silver-lead smelter. The same company also had under construction in 1948 a new thallium recovery plant at its Globe smelter in Denver with an anticipated monthly production capacity of 2,000 pounds of thallium. The ores of the Mercur district near Marysvale, Utah, are rich in thallium, the tailings accumulations of the Mercur mill reportedly containing nearly 2,000,000 pounds of the element. The owners of the tailings were engaged in developing an effective means of recovery.

Consumption and Uses.—Producers' shipments of thallium metal and sulfate in 1948 indicate an apparent consumption of both commodities nearly twice that for 1947. Rodent control campaigns promoted by public agencies in 1948 are believed to have aroused some additional interest in rodenticides.

The major part of thallium metal produced is consumed in the preparation of thallium sulfate, which in turn is used principally as a rodenticide, being added to grain and other media for this purpose. A new use for thallium, developed during World War II, is based on the ability of thallium bromoiodide crystals to transmit infrared radiation of very long wave length.[27] Such crystals find important application in military equipment designed for sniper detection, signaling, and similar operations where visible radiation must be absent. Bromoiodide crystals, in the form of lenses, plates, and prisms, are of great importance in the optical systems of spectrometers used for fundamental research in molecular structure and for analysis of organic preparations by infrared absorption methods. Thallium oxysulfide is used in photoelectric cells [28] similar to selenium. Mercury–thallium (8.5 percent Tl) amalgam has a much lower freezing point than mercury alone, permitting temperature measurement with glass-type thermometers in the range of 2° to minus 60° C. Thallium has also found limited use in high-density liquids, special glasses, selenium rectifiers, silver-bearing alloys, corrosion-resistant and fusible lead alloys, and mold- and insect-proofing, and as a phosphor activator.

Prices.—Thallium sulfate was offered by the American Smelting & Refining Co. in 1947 at $18 per pound, 10-pound lots, up to November 1947, when the price declined to $15, remaining unchanged throughout 1948. Thallium metal, 99.9 percent, 10-pound lots, was quoted at $15 per pound by the same company in 1948.

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[26] Annual Report of the Secretary of the Interior for the Fiscal Year Ended June 30, 1947, pp. 186–187.

[27] Plyler, Earle J., Infrared Prism Spectrometry from 24 to 40 Microns: Nat. Bureau of Standards Jour. Research, vol. 41, No. 2, August 1948, pp. 125–128.

[28] Hewlett, C. W., High-Sensitivity Photoconductive Cell: General Electric Rev., vol. 50, No. 4, April 1947, pp. 22–25.

Foreign Trade.—Before World War II thallium and its compounds are believed to have been imported in significant quantities from Belgium, France, Germany, and Poland. In 1945 and 1946 several thousand pounds of thallium sulfate were received from Belgium and France but probably represented old stocks rather than new production. Imports and exports of thallium metal and chemicals are now included in a group classification by the United States Department of Commerce and can no longer be differentiated from other associated items.

World Review.—Thallium production at Okar near Goslar, Germany, has been described.[29] Thallium sulfate is produced as a byproduct of zinc smelting in Belgium by the Société des Mines et Fonderies de Zinc de la Vielle-Montagne, Liège, Belgium. Imperial Smelting Corp., Ltd., London, United Kindgom, produces thallium.

ZIRCONIUM

Production.—The most important zirconium mineral, zircon, is recovered in the United States, as in most other countries, as a coproduct or byproduct in the production of ilmenite, rutile, and monazite from the sands of present day or ancient elevated beaches. Ever-increasing demand in recent years for titanium minerals has, in consequence, greatly expanded the output of zircon. The principal producer of zircon in 1948 was the Humphreys Gold Corp., operating under contract for the Rutile Mining Company of Florida at a site near South Jacksonville, Fla. The plant, which commenced recoveries in April 1944, was reported to have processed about 9,000, 000 tons of sand since that time; current operations are said to be at the rate of 7,500 tons of sand per day. Combined weight of the monthly output of zircon, rutile, and ilmenite concentrates was reported as approximately 4,000 tons.[30]

In December 1948 E. I. du Pont de Nemours & Co. signed a long-term lease on State-owned ilmenite-bearing property near Starke, Fla. It was anticipated operations would begin early in 1949 at the rate of about 25,000 tons of sand per day. The heavy-mineral fraction of the sand was reported as 4 to 4.5 percent by weight, containing, in turn, 45 percent ilmenite and 14 percent zircon. Leucoxene (altered ilmenite and rutile) and rutile will be the principal minerals sought, with zircon being produced as a lesser coproduct. The Humphreys Gold Corp. will operate the property under contract to the du Pont firm and will recover the zircon for its own accouut in a separate plant designed to treat the ilmenite-free tailings.

Assets of the Riz Mineral Co., which had previously recovered zircon from contemporary beach sands near Vero Beach, Indian River County, Fla., were acquired by the Florida Ore Processing Co. in 1948. The latter company concentrated beach sands near Melbourne, Fla., for a period of about 3 months in 1948, recovering zircon, ilmenite, rutile, garnet, and monazite.

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[29] Aitkenhead, W. C., Vertical Retort Zinc and Byproducts: Off. Military Govt. for Germany (U.S.) FIAT Final Rept. 733, Mar. 6, 1946, 36 pp.

[30] Hubbard, Judson S., Ilmenite, Rutile, and Zircon: Mining World, vol. 10, No. 10, September, 1948, p. 41.

The Bureau of Mines published the results of its extensive investigations of the heavy-mineral sands near Trail Ridge, Fla.[31] Low-level airplane reconnaissance of the marine shoreline of the Carolinas and Georgia indicated a wider distribution of heavy mineral sands than previously recorded.[32]

A large prospective tonnage of zircon was reported available from stream placers at various localities in western Idaho, an estimated 45,000 tons being contained in recently dredged gravels.[33] Zircon occurs in the chromite-bearing black sands of the California-Oregon coast, a few tons of crude concentrate having been won in connection with experimental chromite recovery during World War II.

Interest in the production of zirconium metal was keen throughout 1948; however, the combined output of all producers probably did not exceed a few thousand pounds. The Bureau of Mines continued its pioneering investigations into the production and properties of zirconium at the Albany, Oreg., experiment station. Output of zirconium metal sponge, 99.5 percent pure (including hafnium content), in 1948, by the Bureau of Mines pilot plant was 2,150 pounds or about two-thirds capacity. An enlarged pilot plant was under construction, with an estimated annual capacity of about 15,000 pounds of metal. Zirconium metal and compounds are produced by the Foote Mineral Co., Philadelphia, Pa.; this company's output includes small quantities of very high purity, high-ductility zirconium metal produced by the iodide process. Powdered and fused metal, zirconium hydride and nitride, and a variety of zirconium master alloys are produced by Metal Hydrides, Inc., Beverly, Mass. Westinghouse Electric Corp., Pittsburgh, Pa., has produced zirconium metal.[34] The Titanium Alloy Manufacturing Division, National Lead Co., Niagara Falls, N. Y., makes zirconium alloys, stabilized-zirconia refractories, and a wide variety of zirconium compounds. Control of the Titanium Alloy Manufacturing Co. was acquired in October 1948 by the National Lead Co. The Electro Metallurgical Co. produces zirconium ferrosilicon alloy at its Sheffield, Ala., Niagara Falls, N. Y., and Alloy, W. Va., plants. Zirconium-copper, zirconium compounds, and zirconia refractories are produced by the Beryllium Corp., Reading, Pa.; Rohm & Haas Co., Philadelphia, Pa., and F. W. Berk & Co., Woodridge, N.J., are important producers of zirconium compounds. The last-named company entered the zirconium field as an integrated producer in 1948. The concern has its own raw material sources in Australia and eventually plans to make zirconium metal and alloys in addition to compounds. The Norton Co., Worcester, Mass., initiated production of fused stabilized-zirconia refractories in 1948 at its Chippawa plant, Ontario, Canada, and planned to expand capacity.

Consumption and Uses.—Annual consumers' requirements for zirconium minerals in the United States are estimated to range between 20,000 and 30,000 tons. The major share is used in the ceramics industries, an important, but lower percentage being required

[31] Spencer, Robert V., Titanium Minerals in Trail Ridge, Fla.: Bureau of Mines Rept. of Investigations 4208, 1948, 21 pp.
[32] McKelvey, V. E., and Balsley, Jr., J. R., Distribution of Coastal Black Sands in North Carolina, South Carolina and Georgia, as Mapped from an Airplane: Econ. Geol., vol. 43, No. 6, September–October 1948, pp. 518–524.
[33] Staley, W. W., Distribution of Heavy Alluvial Minerals in Idaho: Idaho Bureau of Mines and Geology Mineral Resources Rept. 5, March 1948, 12 pp.
[34] American Metal Market, Westinghouse Surveys Future of Zirconium in Industry Fields: Vol. 55, No. 5, January 8, 1948, p. 3.

for alloy production. Consumption of zirconium alloys amounts to several thousand tons a year. A few thousand pounds of zirconium metal were shipped in 1948.

The chief use of zirconium metal has been in powder form for flashlight powders, flares, fireworks, and detonators. The small quantity of ductile metal available to date has been used in the electronics industry for getters and vacuum-tube parts; however, when it becomes available in quantity as a result of improved processes recently developed, it is expected to find extensive use in surgery, corrosion-resistant chemical equipment, electrical parts, jewelry, and perhaps tableware. Zirconium master alloys have been used for many years in the steel industry as scavengers or for conferring desirable properties, such as refining the grain and increasing the strength of high-chromium steels. The zirconium stainless steels are creep- and corrosion-resistant at very high operating temperatures, and thus have been of peculiar interest in gas-turbine construction and analogous applications. An important new magnesium-zirconium alloy (0.5 percent Zr minimum), ZK-60, has been developed by the Dow Chemical Co., Midland, Mich.; the addition of zirconium confers added strength, impact toughness, creep resistance at high temperatures, and corrosion resistance.[35] Several binary zirconium alloys (usually 50–50) with magnesium, copper, titanium, and nickel are commercially available as ladle additions.

Ground zircon finds a multiplicity of applications wherever acid-type refractory materials are required for very high operating temperatures. The mineral is employed in the form of bricks, cements, molded objects, or as loose sand. The sand is used extensively for molding in foundries. Possessing a high degree of nonwettability, zircon refractories are widely used in aluminum-melting furnaces and in the electric furnace manufacture of calcium metaphosphate.[36] Baddeleyite likewise is used as a refractory but apparently is most important as a zirconium source for the production of alloys. Zirconia, the commercially prepared oxide, is a very refractory material, melting at 2,715° C., but has not been extensively used because of poor resistance to thermal shock; however, recent work has shown it may be stabilized with small additions of lime or magnesia with only slight loss in refractoriness. Zirconia and zircon are extensively employed in ceramics [37] for enamels, porcelains, and glazes. The one-time large use of zirconia as an opacifier in vitreous enamels has been reported partially supplanted by other materials, notably titanium dioxide; however, it continues to be important in porcelains and glazes. Zirconium nitride has found interest chiefly as a refractory, being extremely stable and impervious to attack by most metals and alloys. The unusual refractory nature of certain zirconium compounds combined with the low neutron absorption of zirconium is suggestive of their possible application in nuclear-energy-pile construction and in stationary parts of jet-engine and gas-turbine combustion chambers. Basic zirconyl sulfate is finding increasing use in tannage for the production of fine-

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[35] Iron Age, Rare Metals Improve Magnesium Alloys: Vol. 162, No. 4, July 22, 1948, p. 83.

[36] Baldwin, W. J., Zircon and Zircon Refractories: Chem. Eng. Progress, vol. 44, No. 11, November 1948, pp. 875–878.

[37] Gershuns, A. L., Use of Zircon in Ceramic Insulators for Spark Plugs: Jour. Am. Ceram. Soc., vol. 31, No. 1, January 1948, p. 16.

quality white leathers,[38] several million feet of leather per year reportedly being processed in this way. Zirconium compounds are used in the preparation of brilliant dyes,[39] water repellants, and catalytic agents. Zirconia is becoming important as an optical-glass polishing agent.

Stocks.—Inventories of zircon concentrates (65 percent ZrO_2) and baddeleyite, undifferentiated, held by importers and consumers totaled about 6,500 short tons at the end of 1948 compared with about 6,000 tons for the 1947 year-end. Similarly, stocks of mixed ilmenite-rutile-zircon concentrates were about 5,700 tons (zircon content, 4,100 tons) on December 31, 1948, against about 12,600 (zircon content, 9,300 tons) for the same date in 1947. Supplies of zirconium metal in producers' hands probably did not exceed 1,000 pounds.

Zircon and baddeleyite are included by the Munitions Board in the list of mineral commodities to be acquired for the National Strategic Stock Pile. Both minerals are in the group A classification, which includes those materials for which stock piling is deemed the only suitable means of insuring supplies for an emergency. The recent proving of very large reserves of zircon in Florida and the impending development of these deposits suggests that zircon may become relegated to a less urgent stock-piling classification. Data on quantities of zircon and baddeleyite in the strategic stock pile are confidential.

Prices.—Zircon concentrate, 55 percent ZrO_2 minimum, f. o. b. Atlantic seaboard was quoted by E&MJ Metal and Mineral Markets on January 1, 1948, at $45–$47 per ton. Increased quotations were registered later in the year as follows: August 5, $48–$52 per ton; August 12, $50–$52. On the latter date, concentrate of 65 percent minimum ZrO_2 content was quoted at $65.50–$67.50, rising on December 9 to $67.50–$70.50, only to be followed by a sharp drop December 23 to $45–$48. The decline at the year end is believed to have been caused by Australian companies reducing their prices to levels competitive with Florida producers, in view of lowering demand for zircon. Quotations on zirconium metal powder were unchanged in 1948 at $7–$8 per pound, depending on quantity; the ductile, iodide process metal was much more costly, being priced at up to $300 per pound. Iron Age listed zirconium-copper (6 percent Zr) on January 8, 1948, at $8.75 per pound of contained zirconium; on June 10, the same price prevailed, but for alloy of 20-percent zirconium content; November 1 figures indicated a price increase to $12 per pound of contained zirconium, but in alloy reported as containing 10–12 percent Zr. Zirconium-ferrosilicon alloys, 12–15 and 35–40 percent Zr, were quoted in January at 6 and 18.4 cents, respectively, per pound of alloy, f. o. b. plant, carlots; October prices were 6.6 and 21 cents delivered. The low-zirconium SMZ (Zr 0.75–1.75 percent, 45–56 Cr) and CMSZ (Zr 5–7 percent, 60–65 Si) alloys in January were quoted at 15.75–18.8 and 18–21.05 cents per pound, ton lots, f. o. b., changing to 17.25 and 19.75 cents in October, delivered. Oil, Paint and Drug Reporter listed zirconium compounds, carlots, works, at the following prices per pound which remained unchanged

[38] Turley, Harold G., Zirconium Tannage: Chem. Industries, vol. 63, No. 3, September 1948, p. 393.
[39] Chemical Engineering, Zirconium Produces Promising Pigments: Vol. 55, No. 10, October 1948, pp. 274–276.

throughout the year: Hydride, \$7.00; oxide, ground, 88–92 percent, \$0.25; oxide, 98½–99, ground, \$1.50; oxychloride, 5 ton lots, \$0.29½; basic sulfate, \$0.37½; basic carbonate, \$0.30½.

Foreign Trade.—Most of the zircon consumed in the United States has ordinarily been received from Australia in the form of mixed zircon (50–90 percent zircon)-ilmenite-rutile-monazite concentrates; however, further export of mixed concentrates was banned by the Commonwealth Government in March 1948 (see World Review) with the result that receipts of such material in the United States totaled only about 16,000 tons in 1948 compared to slightly over 36,000 tons in the year previous. Much-enlarged shipments of high-grade Australian zircon concentrates (65 percent ZrO_2) were received, compensating in part for the cessation of mixed sand imports.

Exports of zirconium ore and concentrates in 1948, principally to Canada, were 312 tons valued at \$24,137 compared to shipments of 330 tons in 1947. Zirconium metal and alloy exports in 1948 totaling 21,966 pounds, more than doubled those of 1947 and were valued at \$7,911. The United Kingdom was the major recipient.

Zirconium ore (concentrates) [1] imported for consumption in the United States, 1944–48, by countries, in short tons

Year	Australia [2]	Brazil	Canada	French West Africa (Senegal)	India	Total	
						Short tons	Value
1944	21,701	2,332				24,033	\$576,299
1945	25,672	792		6		26,470	554,400
1946	14,379	2,431	4			16,814	453,458
1947	21,894	4,619	3		4,181	30,696	891,161
1948	12,965	3,553	2		279	16,799	536,522

[1] Concentrates from Australia are zircon or mixed zircon-rutile-ilmenite, and those from Brazil are baddeleyite or zircon. All other imports are zircon.

[2] Imports of zircon, rutile, and ilmenite from Australia until early 1948 were generally in the form of mixed concentrates. These mixed concentrates were classified by the U. S. Department of Commerce arbitrarily as "zirconium ore," "rutile," or "ilmenite." Total zircon contents of the "zirconium ore" (as shown in this table) and of the "rutile" and "ilmenite" concentrates (see Titanium chapter) are estimated as follows: 1944, 11,317 tons; 1945, 17,138 tons; 1946, 11,535 tons; 1947, 22,727 tons; and 1948, 13,873 tons.

Technology.—Methods were described for the preparation of ductile zirconium,[40] beneficiation of zircon-bearing sands,[41] and the purification of zirconium compounds.[42] Several patents were issued in 1948 covering the preparation of magnesium-zirconium alloys,[43] zirconium lakes,[44] zirconium chloride,[45] and zirconia catalysts.[46]

[40] Kroll, W. J., and others, Large-Scale Laboratory Production of Ductile Zirconium: Jour. Electrochem. Soc., vol. 94, No. 1, July 1948, pp. 1–20.

[41] Fraas, F., and Ralston, O. C., The Electrostatic Separation of Several Industrial Minerals: Am. Inst. Min. and Met. Eng., Mining Technol., vol. 12, No. 4, Tech. Pub. 2408, July 1948, 11 pp.

[42] Ayres, John A., Purification of Zirconium by Ion Exchange Columns: Jour. Am. Chem. Soc., vol. 69, No. 11, November 1947, pp. 2879–2881.

[43] Ball, C. J. P., Jessup, A. C., and Wilson, J. B. (assigned to Magnesium Elektron, Ltd.), Process for Producing Magnesium-Zirconium Alloys: U. S. Patent 2,452,894, Nov. 2, 1948.

[44] Wainer, Eugene, and Van Mater, Henry L. (assigned to Titanium Alloy Mfg. Co.), Zirconium Lakes and Method of Making Same: U. S. Patent 2,452,616, Nov. 2, 1948.

[45] Kroll, W. J., and Bacon, F. E. (assigned to Electro-Metallurgical Co.), Process for Producing Zirconium Chloride: U. S. Patent 2,443,253, June 15, 1948.

[46] Bond, George R., Jr. (assigned to Houdry Process Corp.), Preparation of Zirconia-Containing Catalysts: U. S. Patent 2,444,913, July 13, 1948.

Thomas, C. L., and Lee, E. C. (assigned to Universal Oil Products Co.), Preparation of a Silica-Alumina-Zirconia Catalyst: U. S. Patent 2,439,994, Apr. 20, 1948.

Maresic, M. M., and Griest, E. M. (assigned to Socony-Vacuum Oil Co.), Preparation and Use of Zirconia Gels in the Conversion of Hydrocarbons: U. S. Patent 2,442,772, June 8, 1948.

WORLD REVIEW

Australia.—The world's richest and perhaps largest deposits of zirconiferous sands occur in Australia, particularly near the border of New South Wales and Queensland; important deposits also exist on the coast of Western Australia. During 1948 seven firms were reported mining on the east coast, with another temporarily shut down and two about ready to enter the field. The United States firm of E. I. du Pont de Nemours, Inc., was reported planning to work titaniferous sands at Cheyne Beach, east of Albany, Western Australia, from which zircon would presumably be recovered as a coproduct.[47] Rare Metals Pty., Ltd., began operations in 1948 in the Cheyne Beach area, recovering zircon and titanium minerals. New Metals, Ltd., a new company, plans to produce zirconium metal and salts at a proposed smelting works to be located at Welshpool, near Perth, Western Australia.[48]

Before the spring of 1948, most of the zircon exported from Australia was shipped as a black-sand mixture containing zircon (50–90 percent), ilmenite, rutile, and monazite. Such mixed concentrates were subsequently beneficiated in the importing country, mainly the United States. Upon the declared intent of the Commonwealth Government to purchase and stockpile monazite, the exportation of mixed concentrates was forbidden after March 1948 under the provisions of the Atomic Energy Act of 1946. Thereafter essentially all exports of zircon were shipped in the form of high-grade (65 percent ZrO_2) concentrates with the monazite and titanium minerals removed. The anticipated near-future self-sufficiency of the United States, their principal customer, with respect to zircon, caused much concern to Australian producers of the commodity. It was felt, however, that restoration of western European economies would provide enlarged demand in that area.

Brazil.—The only known commercial deposits of baddeleyite (natural zirconium oxide) in the world occur in the state of Minas Gerais.[49] Reserves were estimated at 2,000,000 tons in 1936. Important deposits of zircon occur in the beach sands of the States of Bahia, Espirito Santo, and Rio de Janeiro in association with monazite; the mineral is recovered as a coproduct in the production of monazite. In September 1948 the Economic Cooperation Administration, under the European Recovery Program, authorized the expenditure by France of about $17,000 for the purchase of 130 metric tons of baddeleyite from Brazil.

Ceylon.—The beach sands at Pulmoddai and Tirukkovil, eastern Ceylon, are estimated to have a heavy mineral content of about 4,000,000 tons, containing about 25 percent zircon. Deposits in the western part of the island are thought to contain equally large reserves of heavy minerals.[50]

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[47] Metal Industry, vol. 73, No. 14, Oct. 1, 1948, p. 274.
[48] Metal Bulletin, No. 3285, Apr. 23, 1948, p. 12.
[49] Instituto de Technologia Industrial-Belo Horizonte, Brazil, Ore Deposits of the Pocos de Caldas Plateau Brazil, and Zirconium Geochemistry: Bol. 6, 1948, 36 pp.
[50] Mining Journal (London), vol. 230, No. 5884, May 29, 1948, p. 398.

French West Africa (Senegal).—Production of 191 metric tons of zircon was reported in 1948; 71 tons were exported.

Malaya.—During the Japanese occupation 741 tons of zircon and 207 tons of mixed monazite and zircon concentrates were recovered as a byproduct of alluvial tin mining.[51]

Poland.—Zirconiferous black sand deposits of the Baltic seacoast were described.[52]

United Kingdom.—The new high-strength magnesium-zirconium alloys are made by Magnesium Elektron, Ltd., Clifton Junction, near Manchester. Zirconal, Ltd., formed in conjunction with Silicon Developments, Ltd., II Cavendish Place, London, reportedly will manufacture zircon refractories.[53] Murex, Ltd., Essex, produces zirconium hydride, hoping to fill domestic demands formerly met by imports from the United States.

U. S. S. R.—The potentially commercial zirconium mineral eudialyte (about 14 percent ZrO_2), occurs in large tonnages in the Kola Peninsula in conjunction with presently operated apatite deposits.

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[51] Bureau of Mines, Mineral Trade Notes: Vol. 25, No. 4, October 1947, p. 14.
[52] Zwierzyck, Jozef [Zirconium Deposits in Western Pomorze (Poland)]: Hutnik, vol. 14, 1947, pp. 150–152.
[53] Chemical Age, vol. 57, No. 1472, Sept. 27, 1947, p. 439.

Minor Nonmetals

By D. G. RUNNER and J. C. ARUNDALE[1]

GRAPHITE

PRODUCTION and sales of domestic graphite in 1948 increased substantially over the preceding year's totals. Due to greater demands of industry, production of crystalline and amorphous graphite totaled 9,949 short tons and shipments amounted to 9,871 short tons valued at $450,759. The figures on shipments and value represent increases of 90 and 104 percent, respectively, over those reported for the preceding year. Producers' stocks totaled 525 short tons at the end of 1948. The manufacture of artificial graphite increased considerably during the year, but the Bureau of Mines is not at liberty to publish detailed figures for graphite of this type. Manufactured material competes with natural graphite for many uses, including paints, polishes, pencils, and lubricating products. There are too few domestic producers to allow publication of separate statistics on natural crystalline and amorphous graphite. However, the accompanying table shows combined figures for the 1944–48 period.

Production and shipments of natural graphite in the United States, 1944–48

Year	Production (short tons)	Shipments		Year	Production (short tons)	Shipments	
		Short tons	Value			Short tons	Value
1944	5,408	5,768	$349,663	1947	4,387	5,207	$221,260
1945	4,888	5,334	289,207	1948	9,949	9,871	450,759
1946	5,575	4,844	252,596				

A report on the flake-graphite deposits in Alabama has recently been released.[2]

[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.

[2] Pallister, H. D., and Thoenen, J. R., Flake-Graphite and Vanadium Investigation in Clay, Coosa, and Chilton Counties, Ala.: Bureau of Mines Rept. of Investigations 4366, 1948, 84 pp.

As indicated in the accompanying table, imports of all kinds of graphite totaled 52,259 short tons valued at $2,046,248 in 1948, representing increases of 20 percent in quantity and 35 percent in value from 1947. As in 1947, natural amorphous shows the greatest change, increasing from 40,703 tons valued at $1,236,734 to 48,117 tons valued at $1,529,312. An increase in imports from Mexico was responsible for the bulk of this change.

Graphite (natural and artificial) imported for consumption in the United States, 1944–48

[U. S. Department of Commerce]

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
1944	6, 191	$663,231	1, 568	$251,832	18, 294	$345, 612	131	$10, 299	26, 184	$1, 270, 974
1945	2, 883	286, 532	5, 207	558, 242	28, 042	569, 600	154	6, 223	36, 286	1, 420, 597
1946	3, 337	253, 163	56	7, 990	29, 743	1, 065, 835	4	558	33, 140	1, 327, 546
1947:										
Canada	253	41, 013			1, 708	130, 246			1, 961	171, 259
Ceylon			198	16, 313	3, 707	432, 763	28	2, 660	3, 933	451, 736
China	56	4, 068							56	4, 068
Cuba					4	582			4	582
France	33	9, 090							33	9, 090
India					168	67, 060			168	67, 060
Italy					107	3, 300			107	3, 300
Madagascar	2, 388	201, 385	(1)	12					2, 388	201, 397
Mexico					34, 857	591, 473			34, 857	591, 473
Mozambique					135	7, 730			135	7, 730
Switzerland					11	3, 328			11	3, 328
Tangier					6	252			6	252
Total	2, 730	255, 556	198	16, 325	40, 703	1, 236, 734	28	2, 660	43, 659	1, 511, 275
1948:										
Brazil	2	173							2	173
Canada	364	52, 134	(1)	1	1, 576	132, 217	117	4, 153	2, 057	188, 505
Ceylon			532	78, 967	5, 187	676, 107			5, 719	755, 074
France	99	37, 210	22	4, 237					121	41, 447
India					115	16, 703			115	16, 703
Korea					29	565			29	565
Madagascar	3, 006	340, 040							3, 006	340, 040
Mexico					41, 043	693, 637			41, 043	693, 637
Morocco, French					55	2, 502			55	2, 502
Mozambique					78	4, 960			78	4, 960
Norway					34	2, 621			34	2, 621
United Kingdom			(1)	21					(1)	21
Total	3, 471	429, 557	554	83, 226	48, 117	1, 529, 312	117	4, 153	52, 259	2, 046, 248

[1] Less than 1 ton.

A canvass of graphite consumption has been started by the Bureau of Mines. The coverage of the canvass is not yet complete, but the statistics shown in the accompanying table give some conception of the use pattern of this mineral. The "amorphous" class comprises the largest percentage of total consumption and value. Foundry facings compose the largest single use, followed by lubricants, batteries, and crucibles in that order.

Consumption of natural graphite in the United States in 1948, by uses

Use	Short tons	Value	Use	Short tons	Value
Crucibles	2,308	$526,418	Pencils	1,144	$237,433
Retorts	407	99,747	Paints and polish	807	21,904
Stoppers, sleeves, and nozzles	940	183,529	Packings	133	50,107
Foundry facings	8,212	542,034	Bearings	26	10,568
Batteries	2,485	102,792	Other [1]	1,634	198,269
Lubricants	2,674	404,014	Total	20,770	2,376,815

[1] Includes brake lining, carbon brushes, electrodes, etc.

Before 1947 Madagascar could produce more than 12,000 metric tons a year of graphite of various grades, including about one-third in powder (fines). During 1947 internal disorders on the island closed most of the operations, so that production and shipments declined greatly. Labor troubles and lack of jute bags continued to plague the mine operators during 1947 and 1948; moreover, on March 7, 1949, a cyclone struck Tamatave and inland, doing untold damage to mine operations, bridges, and warehouses. Latest estimates state that it will take at least 3 years to replace some of the railroad bridges damaged during the cyclone. The fluctuation in prices that began in 1946 continued through 1948. A new schedule of minimum export prices for graphite was made effective October 1, 1948. The new prices f. o. b. Madagascar and the former prices are shown in an accompanying table.

Minimum export price of graphite, f. o. b. Madagascar, 1947–48, per metric ton

Carbon, percent	Flake			Carbon, percent	Powder (fines)		
	1947	1948 (effective January 17)	1948 (effective October 1)		1947	1948 (effective January 17)	1948 (effective October 1)
85.0–87.5	$110	$132	$150	72.5–77.5			$82
87.6–89.5	114	137	156	75.0–77.5	$60	$66	
89.6–92.5	120	144	164	77.6–82.5	70	77	96
92.6–94.9	135	165	185	82.6–87.5	85	100	116
95.0 and over	(1)	(1)	(1)	87.6–89.9	105	125	143
				90.0 and over	(1)	(1)	(1)

[1] No fixed price.

The continued need for certain types of graphite for the national stock-piling program and the uncertainty of obtaining this material from Madagascar have stimulated interest in graphite production in other areas. It has been reported that graphite of suitable quality for industrial uses and for stock-piling purposes has been found in Kenya Colony, British East Africa. Present indications are that graphite will be imported from Kenya beginning in 1950.

The United States tariff rates on graphite, effective January 1, 1948, are: Amorphous natural and artificial, 5 percent ad valorem;

crystalline flake, 15 percent ad valorem, with a specific minimum of 0.4125 cent per pound and a specific maximum of 0.825 cent per pound; crucible flake and dust and other crystalline lump and chip, 7½ percent ad valorem.

Exports of natural graphite, 1944–48, were: 1944, 2,230 tons, $248,257; 1945, 1,308 tons, $134,414; 1946, 2,313 tons, $267,137; 1947, 1,546 tons, $171,607. Data for 1948 are shown in an accompanying table.

Graphite exported from the United States in 1948

[U. S. Department of Commerce]

Country	Ceylon amorphous		Flake, crystal, lump and chip		Natural n. e. s.	
	Short tons	Value	Short tons	Value	Short tons	Value
Belgium					4	$437
Bolivia			1	$143	1	113
Brazil			(1)	(1)		
British Guiana			(1)	(1)		
Canada	7	$881	14	1,930	634	48,341
Chile	3	448	8	1,285	(1)	(1)
China	32	4,098	8	3,067	15	9,800
Cuba	4	574	5	1,385	13	1,277
Curacao			2	753		
Czechoslovakia					63	8,838
Denmark					11	4,641
Dominican Republic	4	498	(1)	(1)		
France					1	146
Germany					6	722
Greece	6	705	3	438		
Guatemala			(1)	(1)		
Honduras	(1)	(1)				
Hungary					3	464
India	25	8,326	(1)	(1)	1	134
Italy	1	288				
Mexico	13	4,730	2	382	12	1,314
Netherlands	1	590				
Peru	1	220	1	427	2	262
Philippines, Republic of	30	4,841				
Poland	5	3,049				
Portugal	6	1,054				
Saudi Arabia			(1)	(1)		
Sweden	1	281				
Switzerland					11	1,534
Union of South Africa	2	363				
United Kingdom					87	8,092
Venezuela	1	140				
Total	142	31,086	44	9,810	864	86,115

1 Less than 1 ton.

Price quotations for graphite varied some during 1948, and at the year end the trade-journal listings were as follows, f. o. b. New York: Ceylon lump, 10–14 cents per pound; carbon lump, 10–11 cents; chip, 8–9 cents; dust, 4–6 cents. Madagascar, c. i. f. New York, standard-grade, 85 to 87 percent carbon, $200 per ton; special mesh, $250–$300; special grade, 99 percent carbon, $700. Amorphous graphite, Mexican, f. o. b. point of shipment (Mexico), per metric ton, $9–$16, the price varying with grade.

Available statistics on the world production of graphite for 1942–48 are shown in the accompanying table. Comparable figures for 1915–39 were published in Minerals Yearbook, Review of 1940 (p. 1414), and for 1938–46 in Minerals Yearbook, 1946 (p. 1287).

World production of natural graphite, by countries, 1942–48, in metric tons [1]

[Compiled by Helen L. Hunt]

Country [1]	1942	1943	1944	1945	1946	1947	1948
Argentina	244	237	455	333	250	(2)	(2)
Australia:							
New South Wales	3	114	142	51	117	100	(2)
Queensland	225	360	52	58	234	187	83
South Australia	71	88	253	5	2	21	(2)
Tasmania	--------	7	--------	--------	--------	--------	(2)
Western Australia	6	11	--------	--------	--------	--------	--------
Austria	[3] 26,203	[3] 25,336	22,487	3,483	246	3,845	10,895
Brazil (exports)	72	19	199	131	92	129	83
Canada	1,081	1,726	1,435	1,733	1,792	2,175	2,341
Ceylon (exports)	28,180	20,397	12,461	7,946	4,623	9,150	14,221
China	16,800	(2)	(2)	(2)	(2)	(2)	(2)
Czechoslovakia	13,126	21,252	21,459	10,973	5,108	7,000	15,000
Egypt	--------	--------	260	152	--------	(2)	50
Germany: Bavaria	33,316	34,960	36,357	(2)	3,800	4,930	5,757
India	1,072	1,152	942	1,316	1,653	1,255	(2)
Indochina, French	14	25	30	--------	--------	--------	--------
Italy	5,483	6,309	3,008	2,276	2,593	4,151	6,500
Japan	2,866	7,791	10,382	12,449	11,339	9,595	12,790
Kenya	--------	(4)	10	3	--------	--------	(2)
Korea	96,054	96,471	103,306	32,407	6,204	11,030	[5] 15,454
Madagascar	9,562	12,949	14,478	9,185	6,315	8,717	8,056
Malaya, Federation of	[6] 163	[6] 163	[6] 163	(2)	(2)	(2)	(2)
Mexico	20,811	20,677	12,977	23,634	21,949	27,984	35,261
Morocco:							
French	1,067	265	213	262	637	440	284
Spanish	251	79	42	100	[6] 120	[6] 150	25
Norway	2,933	3,178	3,784	1,115	661	2,481	(2)
Portuguese East Africa	165	428	(2)	--------	200	126	120
Southern Rhodesia	--------	--------	5	6	--------	--------	--------
South-West Africa	181	1,758	1,973	1,318	1,193	1,639	1,627
Spain	--------	57	91	128	320	309	(2)
Sweden	174	171	--------	802	--------	--------	(2)
Union of South Africa	661	442	324	196	278	221	172
United States: Amorphous, Crystalline	6,459	9,016	4,906	4,434	5,058	3,980	9,026
Total (estimate) [1]	267,000	281,000	269,000	155,000	80,000	105,000	147,000

[1] In addition to countries listed, graphite has been produced in Bulgaria, Greenland, Nyasaland, and U. S. S. R., but production data are not available. No estimates for these countries are included in totals.
[2] Data not available; estimates by author of chapter included in total.
[3] Includes scrap.
[4] Less than 1 ton.
[5] South Korea only.
[6] Estimated figures.

GREENSAND

A total of 8,236 short tons of greensand were produced during 1948 by the following companies: Permutit Co., 330 West Forty-second St., New York 18, N. Y.; Zeolite Chemical Co., Medford, N. J.; Inversand Co., 226 Atlantic Ave., Clayton, N. J. All production was from open-pit operations in Burlington and Gloucester Counties, N. J., and was sold for use in water softening and water purification.

Price of refined greensand f. o. b. shipping point ranged from approximately $38–$114 per short ton.

Greensand marl sold or used by producers in the United States, 1944–48

Year	Short tons	Value	Year	Short tons	Value
1944	4,908	$505,651	1947	8,337	$432,980
1945	4,986	477,919	1948	7,269	392,959
1946	5,140	424,900			

KYANITE, ANDALUSITE, AND SILLIMANITE

Domestic production of kyanite in 1948 reached an all-time high, exceeding by a considerable margin the former record attained in 1946. Imports from India in 1948 increased 80 percent over those reported the previous year. Although the Indian Government reimposed control over the export of kyanite, effective September 9, 1948, future imports should not fall below the existing level indicated for 1948. The quantity of kyanite received from Kenya Colony, British East Africa, continued to increase and in 1948 totaled 8,108 short tons compared with 7,226 tons in 1947. The quality exhibited by Kenya kyanite has resulted in plans to increase imports to the United States during the next few years for industrial uses and for stockpiling purposes, although there is the possibility that slight changes may have to be made in the specifications for the latter purpose. The receipt of 1,619 short tons of sillimanite valued at $23,861 from Australia was also reported. The tonnage, value, and consumption

Consumption and stocks of imported kyanite in the United States, 1944–48

[Statistics for 1944–47 include data not previously published]

	Imports		Consumption (short tons)	Stocks Dec. 31 (short tons)
	Short tons	Value		
1944:				
Australia	298	$3,511	(1)	(1)
British East Africa	55	591	(1)	(1)
Canada	48	2,699	(1)	(1)
India	5,680	66,850	(1)	(1)
Total 1944	6,081	73,651	[2] 8,064	[2] 8,600
1945:				
Australia	341	3,867	(1)	(1)
British East Africa	560	7,000	(1)	(1)
Canada	179	10,276	(1)	(1)
India	13,994	160,997	(1)	(1)
Total 1945	15,074	182,140	[3] 15,000	[3] 8,000
1946:				
Australia	592	13,856	(4)	(4)
British East Africa	395	3,308	(4)	(4)
India	10,110	109,990	(4)	(4)
Union of South Africa	277	3,187	(4)	(4)
Total 1946	11,374	130,341	[3] 11,500	7,280
1947:				
Australia	1,163	14,588	(4)	(4)
British East Africa	7,226	82,921	(4)	(4)
British Guiana	(5)	65	(4)	(4)
India	3,793	53,057	(4)	(4)
United Kingdom	(5)	43	(4)	(4)
Total 1947	12,182	150,674	13,807	1,436
1948:				
Australia	1,619	23,861	(4)	(4)
British East Africa	8,108	105,676	(4)	(4)
India	6,823	122,544	(4)	(4)
Mozambique	203	2,098	(4)	(4)
Union of South Africa	338	4,876	(4)	(4)
Total 1948	17,091	259,055	11,770	5,538

[1] Data not available.
[2] Consumption and stocks as reported by War Production Board.
[3] Partly estimated.
[4] Bureau of Mines not at liberty to publish figure.
[5] Less than 1 ton.

of imported kyanite in recent years are shown in the accompanying table.

Detailed statistics on the domestic kyanite industry are not available for publication, because there are too few producers. Data on shipments of domestic kyanite were last published in 1943, and statistics for the 1940–43 period were published in Minerals Yearbook, 1943 (p. 1579).

Three companies reported production of kyanite in 1948. The A. P. Green Firebrick Co., Mexico, Mo., produced material from an operation in Habersham County, Ga., and used it for the manufacture of refractories. Kyanite Mining Corp., Cullen, Va., produced kyanite near Farmville, Prince Edward County, Va. Its material was sold to refractory, pottery, and brick manufacturers. Commercialores, Inc., 39 Cortlandt Street, New York, N. Y., began operations in September 1948 near Clover, York County, S. C. The entire output was sold for the manufacture of high-temperature fire brick, cement, etc. Kyanite, from an unworked deposit on Willis Mountain, Va., is being tested by the Bureau of Mines to determine its suitability as a superduty refractory. The Technical Porcelain & Chinaware Co., El Cerrito, Calif., produced a small amount of andalusite from its Mineral County, Nev., mine and used this material in the manufacture of chinaware. No dumortierite was produced during the year.

Investigations on the possibility of using domestic sillimanite for making high-grade aluminum silicate refractories are being conducted by the Norris, Tenn., station of the Bureau of Mines. A report on the sillimanite minerals of Montana has been released.[3]

The uncertainty of continued large imports of kyanite from India has focused attention on other sources, notably Kenya Colony, British East Africa. Latest reports indicate that Kenya kyanite is acceptable for high-duty refractories and for the national stock-piling program. The reserves of kyanite in India are substantial; and this source, together with Kenya Colony, should provide the United States with ample supplies for superduty refractories.

Trade-journal quotations for domestic kyanite in December 1948, per ton f. o. b. point of shipment Virginia, were: 35-mesh, carload lots, in bulk, $29; in bags, $32; for 200-mesh, in bags, carlots, $40. Imported kyanite, in bags, c. i. f. Atlantic ports, was $42 per ton, nominal.

Separate classification of exports of kyanite and associated minerals started in 1945. Exports for 1945 were 307 short tons valued at $20,205; 1946, 342 tons ($17,881); and 1947, 239 tons ($20,533). Data for 1948 are shown in the accompanying table.

Kyanite and allied minerals exported from the United States in 1948

[U. S. Department of Commerce]

	Short tons	Value
Canada	330	$15,001
Mexico	111	4,577
Nicaragua	1	135
Netherlands	20	2,100
Total	462	21,813

[3] Heinrich, W. E., Deposits of the Sillimanite Group of Minerals South of Ennis, Madison County, With Notes on Other Occurrences in Montana: Montana Bureau of Mines and Geology, Misc. Contrib. 10, 1948, 22 pp.

LITHIUM MINERALS

The lithium industry in 1948 was characterized by development of new lithium compounds and expansion of the industrial applications of those developed over the past few years. As a result of the favorable outlook for a considerable increase in the use of lithium and its compounds, exploration for new sources of ores was speeded, production facilities were expanded, and research was intensified.

Although the tonnage of lithium ores consumed was well below the peak during the war, it was several times the prewar average.

The Lithium Corp. of America constructed a new sink-and-float concentrator for beneficiating spodumene at its Edison mine, Keystone, S. Dak.[4]

The Black Hills-Keystone Corp. discontinued operations in October at its Ingersoll mine in Pennington County, S. Dak.

Lithium Corp. of America completed a new unit for production of lithium amide, reportedly an efficient and stable agent for certain organic reactions. Much of this material is reportedly used in the synthesis of antihistamine drugs.[5]

It was reported that lithium salts of fatty acids were finding a new market in the cosmetics industry for use in face and other types of powders. It is claimed that this material has low bulk density and high oil absorbency. Foote Mineral Co. offers a mixture of lithium fatty-acid salts to the industry.[6]

Northern Chemicals, Ltd., a subsidiary of the Lithium Corp. of America, is proceeding with development of its spodumene deposit in the Cat Lake area northeast of Winnipeg, Canada.

A preliminary report on the geology of the Cat Lake-Maskwa Lake area has been issued by the Manitoba Department of Mines and Natural Resources.[7]

Two papers on lithium were read at the meeting of the Canadian Institute of Mining.[8]

No sales of either lepidolite or amblygonite were reported by domestic producers.

A discussion of lithium compounds in porcelain enamels was published.[9]

The Bureau of Mines issued a report on the recovery of lithium from various ores and salts.[10]

The Bureau of Mines issued two reports on spodumene deposits in the Black Hills, S. Dak.[11]

It was reported that 1,716 long tons of lithium minerals (lepidolite, petalite, and amblygonite) were produced in South-West Africa during 1948. In all, 1,629 long tons of lepidolite and 183 tons of petalite were exported to the United States, according to the Union

[4] Mining Congress Journal, vol. 34, No. 5, May 1948, p. 61.
[5] Chemical Industries, vol. 62, No. 4, April 1948, p. 570.
[6] Chemical and Engineering News, vol. 26, No. 51, Dec. 20, 1948, p. 3789.
[7] Northern Miner (Toronto), vol. 34, No. 16, July 18, 1948, p. 24.
[8] Ellestad, R. B., The Lithium Industry.
Rogus, R. R., and Viens, G. E., The Production of Lithium Metal.
[9] Fentor, Walter M., Lithium Compounds in Porcelain Enamels: Am. Ceram. Soc. Bull., vol. 27, No. 12, Dec. 15, 1948, pp. 492–495.
[10] Cunningham, J. B., and Gorski, C. H., Recovery of Lithium From Its Various Ores and Salts: Bureau of Mines Rept. of Investigations 4321, 1948, 35 pp.
[11] Staff of the Minneapolis Branch, Mining Division, Investigation of the Mateen Spodumene Deposit, Pennington County, S. Dak.: Bureau of Mines Rept. of Investigations 4339, 1948, 20 pp.
Clarke, Fremont F., Zinner, Paul, and others, Edison Spodumene Mine, Pennington County, S. Dak.: Bureau of Mines Rept. of Investigations 4234, 1948, 23 pp.

Shipments of lithium ores and compounds from mines in the United States, 1935–39 (average) and 1944–48

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	1946	3,065	$303,892	323
1944	13,319	552,977	848	1947	2,441	151,113	199
1945	2,446	285,520	274	1948	3,191	185,952	246

of South Africa Department of Mines. Production was by Jooste Lithiumyne (Eiendoms), Beperk, Karibib.

Trade-journal quotations of prices for lithium ores were as follows: Amblygonite, per ton, air-floated, carlots $110; lepidolite, per ton, 4 percent Li_2O, powdered, carlots, $80 (increased from $56 early in 1948); spodumene, per unit lithium oxide contained, $6–$8 on 6-percent grade, carlots.

The American Potash & Chemical Corp., Trona, Calif., reported the price of dilithium sodium phosphate at about $191 per ton.

MINERAL-EARTH PIGMENTS

Although the mineral-earth pigments industry was generally active during the year, sales of most items, both synthetic and natural, were somewhat lower than in the previous year. A moderation of demand noted in the latter part of 1948 reflected the trend of construction activity. Sales of synthetic earth pigments accounted for more than one-third of the tonnage and more than 60 percent of total value.

Imports of the major mineral-earth pigments continued to decline,

Natural mineral pigments and manufactured iron-oxide pigments sold by processors in the United States, 1947–48, by kinds

Pigment	1947		1948	
	Short tons	Value	Short tons	Value
Mineral blacks	(1)	(1)	14,383	$225,129
Precipitated magnetic blacks	(1)	(1)	1,585	347,591
Natural brown oxides (metallic browns)	5,861	$308,440	5,862	312,163
Vandyke brown (finished pigment)	(1)	(1)	188	31,729
Sap brown			(1)	(1)
Pure browns (96 percent or better iron oxides)	1,016	219,686	910	222,712
Natural red oxides	20,524	946,997	20,902	874,110
Pure red oxides (98 percent or better Fe_2O_3)	17,331	3,481,083	17,345	3,939,317
Venetian reds	7,127	579,603	5,361	482,651
Pyrite cinder	1,682	110,863	1,697	121,560
Other red iron oxides	18,817	2,214,358	15,104	1,751,185
Natural yellow oxides (high Fe_2O_3)	(1)	(1)	(1)	(1)
Pure yellows (85 percent or better Fe_2O_3)	10,496	1,635,365	9,734	1,648,529
Ochers (low Fe_2O_3)	9,130	213,133	6,769	164,902
Siennas:				
Burnt	940	141,943	973	132,845
Not burnt	1,441	201,493	1,072	135,714
Umbers:				
Burnt	3,051	322,688	3,085	330,224
Not burnt	671	61,443	711	61,846
Other	17,280	730,066	5,636	175,215
Total	115,367	11,167,161	111,317	10,957,422

[1] Included with "Other."

and the supply situation in Spanish and Persian Gulf oxides was particularly tight.

The Minnesota Mining & Manufacturing Co. introduced a new synthetic red iron oxide pigment which is said to have exceptional properties.[11a]

In recent years the natural pigments industry in the Union of South Africa has become increasingly important. Ochers, umbers, other iron oxides, and graphitic shales are mined in the Union. Yellow and red ochers are recovered from deposits of altered shale in the Riversdale district of the Cape Province. The value of these deposits was first realized about 1922. Small-scale mining followed and gradually extended as the ocher gained favor in overseas markets. The ore is found at depths generally greater than 15 feet and mined by stripping and trenching the deposit. No estimate of reserves has been made because of the irregular size and scattered occurrence of the ocher bodies.

Umbers are mined periodically from deposits near Krugersdorp, Brits, and the village of Sabie in the Eastern Transvaal. The umber occurs in irregular pockets in dolomite and is a residual earth resulting from the removal of the more soluble calcium and magnesium carbonate of the dolomite.

Dry ocher, sienna, umber, and other forms of iron oxide for paint exported from the United States, 1945–48, by countries

[U. S. Department of Commerce]

Country	1945		1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Argentina	1	$721	55	$11,340	98	$21,522	9	$1,904
Belgian Congo	50	6,450	22	2,402			7	773
Belgium-Luxembourg			201	30,886	759	148,725	631	123,070
Bolivia	(1)	88	15	2,618	6	1,358	1	560
Brazil	139	18,054	304	58,265	396	94,122	103	25,665
Canada	3,484	285,177	3,279	327,323	3,234	337,037	2,974	259,540
Chile	30	10,962	28	4,980	95	22,563	110	25,664
China			147	25,219	158	34,873	87	27,044
Colombia	93	21,728	181	40,654	216	63,449	112	33,501
Cuba	386	55,859	410	48,649	307	53,716	269	50,643
Curacao (Netherlands West Indies)	5	893	6	1,398	11	2,683	14	3,754
France					157	27,569		
Greece			4	1,397	1	156	135	24,539
Hong Kong			25	4,738	89	22,748	62	15,400
India			(1)	75	10	3,616	88	59,611
Italy			2	3,234	14	6,905	71	20,713
Mexico	165	33,870	136	31,660	183	44,238	123	28,417
Netherlands			198	13,353	487	44,953	824	96,546
Panama, Republic of	71	7,584	45	6,420	13	3,598	94	6,770
Peru	23	5,653	41	7,957	29	8,732	19	3,057
Philippines, Republic of	13	906	53	6,411	89	17,839	62	11,919
Portugal	195	8,648	125	7,660	77	18,330	32	7,933
Sweden	131	9,006	103	18,468	145	26,577	11	2,887
Switzerland			69	9,247	47	10,618	56	12,059
Union of South Africa	11	2,841	52	25,742	50	10,244	94	25,672
United Kingdom	1	369	75	7,815	276	10,907	469	18,750
Uruguay	8	1,621	18	3,142	52	11,231	82	18,580
Venezuela	130	31,799	187	35,704	153	30,038	159	41,370
Other countries	280	49,657	306	57,360	461	108,966	231	55,386
Total	5,216	551,886	6,087	794,117	7,613	1,187,313	6,929	1,001,727

[1] Less than 1 ton.

[11a] Oil, Paint and Drug Reporter, vol. 154, No. 17, Oct. 25, 1948, p. 85.

Selected mineral pigments imported for consumption in the United States, 1945–48

[U. S. Department of Commerce]

Pigments	1945		1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Iron oxide pigments:								
Natural	2,853	$126,152	5,423	$318,239	3,755	$250,137	1,967	$138,169
Synthetic	439	58,380	759	106,302	595	94,937	705	112,363
Ocher, crude and refined	784	36,608	167	6,528	258	14,362	89	4,975
Siennas, crude and refined			755	73,129	725	65,787	251	22,064
Umber, crude and refined	1,989	57,281	3,134	95,815	2,206	59,524	1,695	45,130
Vandyke brown			101	10,432	253	23,955	222	20,198
Total	6,065	278,421	10,339	610,445	7,792	508,702	4,929	342,899

The demands for umber and graphitic pigments, which are obtained from the Zoutpansberg and the Pretoria districts, are small, and most sales are local. Most of the output of ochers is exported to United Kingdom.[12]

A deposit of red ocher in the Hammersley Range Australia, 40 miles southwest of Roy Hill, is being worked superficially. It is shoveled direct into bags and drums, and transported by truck to Meekatharra.[13]

Yellow, red, and gray varieties of ocher are found together in the districts of Cuddapah, Kurnool, and Bellary of the ceded districts, Madras Province, India. Large deposits of yellow ocher occur near Madhavaram (Cuddapah) and of gray ocher in Nallakonda (Kurnool). The annual production of red ocher from Bellary district is about 10,000 tons.[14]

Developments in the British pigment manufacturing and using industries during the war were reviewed in an article.[15]

A review of the iron oxides (ocher) industry in Canada during 1947 was published.[16]

Prices of some mineral pigments were moderately advanced during the year. According to the Oil, Paint and Drug Reporter, prices were quoted as follows during December 1948 (in cents per pound, bags, works, carlots, unless otherwise noted):

Synthetic iron brown (l. c. l.), 12½.
Metallic oxide brown, 3–3¼.
Sap brown, crystals, 12.
Sap brown, powdered, 13.
Sienna, burnt, 3¾–14¾.
Sienna, raw, 4–12½.
Umber, burnt, American (barrels), 4¾–5¾.
Umber, Turkey type, 5¾–7¾.
Vandyke (barrels), 9¾–12.
Synthetic red iron oxide, 5¼–9¼.
Special, high color, synthetic red iron oxide, $1.
Persian Gulf oxide, 6¾–7.
Spanish oxide, Grade 1 (barrels), ex dock, 5½–5¾.
Spanish oxide, Grade 2 (barrels), ex dock, 5¼–5½.

[12] Bureau of Mines, Mineral Trade Notes: Vol. 27, No. 3, September 1948, pp. 46–47.
[13] Bureau of Mines, Mineral Trade Notes: Vol. 27, No. 3, September 1948, p. 45.
[14] Bureau of Mines, Mineral Trade Notes: Vol. 27, No. 2, August 1948, p. 43.
[15] Oil and Colour Trades Jour., vol. 109, 1946, pp. 847–49; British Abs., BII, February 1948, p. 86.
[16] Department of Trade and Commerce, Dominion Bureau of Statistics, Mining, Metallurgical and Chemical Statistics, Ottawa, Canada. A13–17–8–48, 4 pp.

Natural yellow iron oxide, 1¾–2¾.
Natural yellow iron oxide, French type, 4½.
Synthetic yellow iron oxide, 9.
Golden American yellow ocher, 1¼–2¾.
Metallic red (barrels), 2½–2¾.
Synthetic iron oxide black, 10¾.
Mineral black, 1.6–6.75.
Venetian reds, 3.5–4.9.

MINERAL WOOL

Shipments of mineral wool—made from rock, slag, and glass—were valued at $79,094,000 in 1947, according to the Bureau of the Census. Details, by kind of product, are shown in an accompanying table. Estimates by the National Mineral Wool Association indicate that sales of structural insulation totaled $45,819,000 in 1948 as compared with $44,264,000 in 1947. The Industrial Mineral Wool Institute has estimated 1948 sales for "industrial power and process equipment and cold storage structures," and "domestic and commercial equipment, cargo, freight and passenger end uses" at about $21,000,000. No comparable figure for 1947 is available.

Some new plants and improved manufacturing techniques are still being added to the industry. Plants at Paul's Spur, Ariz.; Omaha, Nebr.; and Phoenix, Ariz., began operations in 1948. Expansion of the rock-wool plant at Mankato, Minn., was also reported.

The Bureau of Mines, Rolla, Mo., has done some cooperative re-

Mineral-wool shipments in the United States in 1947, by kinds

[U. S. Bureau of the Census]

Kind of product	Unit of area	Shipments and interplant transfers		
		In area units	Short tons	Value
Structural insulation (for insulating homes and commercial and industrial buildings):				
Loose wool (shipped as such)			101,525	$6,000,000
Granulated wool			490,973	20,001,000
Building batts, blankets, and rolls:				
Full thick (3 inches or more)	M sq. ft.	345,544	136,758	12,994,000
Less than 3 inches thick	do	198,055	44,090	5,269,000
Total			773,346	44,264,000
Industrial insulation (for insulating installed industrial equipment, such as boilers, hot ducts, etc.):				
Loose wool (shipped as such)			26,768	3,208,000
Granulated wool			3,167	134,000
Felts and felted products	M board ft.	24,973	6,480	658,000
Industrial batts	do	4,723	748	90,000
Industrial blankets (with wire mesh or other facings)	do	11,865	5,973	1,099,000
Blocks and boards	do	46,853	25,053	3,975,000
Pipe insulation				1,472,000
Acoustical pads and boards	M sq. ft.	13,378	(1)	2,061,000
Insulating cements			10,965	944,000
Total				13,641,000
Equipment insulation (for installation as integral part of such domestic and commercial equipment as refrigerators, hot-water heaters, etc.)			107,847	18,170,000
Mineral-wool insulation, not specified by use				3,019,000
Grand total				[2] 79,094,000

[1] Figure not available.
[2] For comparison, production in 1939 was valued at $10,469,000, of which $10,265,000 represented 332,792 short tons of rock-wool and slag-wool insulation.

search to determine methods of control of mineral-wool fiber size. The study included determining relationships of fiber size to viscosity, fusions of various compositions, and steam impact velocities. Factors influencing fiber length and fiber size distribution remain to be studied.[17] Experiments have indicated that rock wool made from copper slag has some advantageous properties.[18] A review of problems in rock-wool manufacture [19] and in preheating combustion air have been recently released.[20] A mineral-wool cement-base roofing, having high insulating qualities and ability to withstand tropical weather, has been developed. This prepared roofing material, reinforced with 12-gage wire mesh, is expected to outlast metal roofs when used for petroleum storage tanks in tropical areas.[21]

MONAZITE

For the first time in many years, production of an appreciable tonnage of monazite was reported by domestic producers. Rare Earths, Inc., is reported to have shipped 40 tons of monazite to Lindsay Light & Chemical Co., Chicago, Ill. This material was recovered from placer sands and gravels in central Idaho. The company has announced that several dredges in this area will be recovering heavy sands containing monazite for separation in its mill at McCall, Idaho, and production is expected to increase greatly during the next 2 years.[22]

On October 14, 1948, the United States Atomic Energy Commission described its current interest in monazite, the principal source of thorium, as follows:

> While a strict control of exports and a complete record of domestic movements of thorium-bearing materials, including monazite ore, is maintained by the Commission, pursuant to the Atomic Energy Act of 1946, the usefulness of thorium and its principal source in nature, monazite ore, so far as the Commission's program is concerned, is limited for the present time to research. Accordingly, the only thorium the Commission purchases is for experimental purposes, chiefly in the form of thorium salts, and the Commission has no purchase program for monazite ore as such.
>
> Thorium has long been recognized as a potential source of fissionable material. Consequently, like uranium, it was placed under the control of the Atomic Energy Commission by the Atomic Energy Act of 1946. Solving the many complex research problems in the way of the large-scale utilization of thorium may take a decade or two. The possibility, however, cannot be excluded that the time may be shorter. When the research problems are solved, thorium may become of great significance in the atomic energy program. Until these problems have been solved, however, thorium will not be in large demand for use in nuclear reactors.

Statistics on imports and consumption of monazite are considered confidential and cannot be published for 1948.

Brazil was the principal source of monazite for domestic consumers. Export restrictions were maintained by the Indian Government.

The University of Idaho is conducting experiments in the chemical separation and purification of the rare-earth metals from Idaho monazite, using ion-exchange methods. It is estimated that Idaho and Boise Counties contain 200,000,000 cubic yards of gravel containing 0.2 to 0.3 percent monazite.[23]

[17] Rock Products, vol. 51, No. 12, December 1948, p. 141.
[18] Rock Products, vol. 51, No. 1, January 1948, p. 82.
[19] Azbe, Victor J., Solution of Problems in Manufacturing Rock Wool: Rock Products, part I, vol. 51, No. 11, November 1948, pp. 97–98, 100, 102–104.
[20] Nordberg, Bror, Recover Waste Heat from Cupolas; Rock Products, vol. 51, No. 7, July 1948, pp. 88–94.
[21] Rock Products, vol. 51, No. 8, August 1948, p. 73.
[22] Idaho Sunday Statesman, Boise, Idaho, Apr. 10, 1949.
[23] Mining Congress Journal, vol. 34, No. 7, July 1948, p. 70.

A new cerium-magnesium alloy containing 6 percent Ce has been developed for use in jet engines.[24]

An article was published comparing the radioactive mineral policy of the Union of South Africa with those of other nations in the Commonwealth.[25]

OLIVINE

Shipments of olivine in 1948 totaled 4,766 short tons valued at $86,230, representing decreases of 56 and 33 percent, respectively, compared with 1947 figures. As in previous years, the bulk of this material shipped was consumed in refractories for furnace linings and in refractory cements, but some olivine was used in the production of calcium-magnesium phosphate fertilizer.

Olivine sold or used by producers in the United States, 1944–48

Year	Short tons	Value	Year	Short tons	Value
1944	3,270	$35,207	1947	10,838	$129,094
1945	(1)	(1)	1948	4,766	86,230
1946	7,649	92,868			

1 Data not available for publication.

Reports on olivine as a source of magnesium for fertilizers have recently been released.[26]

Aside from its use for refractory purposes, some utilization has been made of olivine as molding material. It is reported in Norway that olivine is superior to quartz sand in foundry work and in such practice does not induce silicosis.[27]

PERLITE

The production of perlite in 1948 amounted to 13,530 short tons compared with 10,810 tons in 1947. Shipments of crude and refined perlite in 1948 totaled 9,868 short tons valued at $184,306. Salient statistics covering the last 3 years are indicated in the accompanying table.

Production and shipments of perlite in the United States, 1946–48

Year	Production crude, (short tons)	Shipments (crude and refined)		
		Short tons	Value	Average value 1
1946	4,206	3,022	$46,103	$37.22
1947	10,810	9,265	94,309	24.11
1948	13,530	9,868	184,306	19.54

1 Refined material only.

24 Mines Magazine, vol. 38, No. 7, July 1948, p. 27.

25 Mining and Industrial Magazine, The Search for Radioactive Minerals: Vol. 38, No. 8, August 1948, p. 503.

26 Hardin, L. J., and MacIntire, W. H., The Forsterite Olivine Formations of North Carolina as a Source of Magnesium for Fertilizers: Jour. Tennessee Acad. Sciences, vol. 23, No. 3, July 1948, p. 180. Granberg, W. J., Electric Furnace Combines Olivine and Phosphate: Rock Products, vol. 51, No. 10, October 1948, pp. 108, 110.

27 Mine & Quarry Engineering, vol. 15, No. 1, January 1949, p. 2.

Nine companies reported production or sales in 1948: Chemi-Cote Perlite Corp., Phoenix, Ariz.; Western Perlite Corp., Phoenix, Ariz.; The Perlite Corp., Tempe, Ariz.; National Perlite Corp., Campbell, Calif.; AleXite Engineering, Colorado Springs, Colo.; Dant & Russell, Inc., Portland, Oreg. (quarry at Frieda, Oreg.); Perlite Mfg. Co., Carnegie, Pa. (processing plant); Christensen Construction Co., Salt Lake City, Utah (quarry at Delta, Utah); and Wilson Research, Engineering & Exploration Co., Veyo, Utah (quarry at Enterprise, Utah). In addition, the following companies reported experimental or developmental output: Standard Perlite Corp., 202 North Euclid Ave., Pasadena 1, Calif.; United States Perlite Co., 609 S. Grand Ave., Los Angeles 14, Calif.; F. E. Schundler Co., Joliet, Ill.; and Structolite Corp., 1825 San Pablo Ave., Berkeley, Calif. The Sno-Lite Products Co., Reno, Nev., successor to High Grade Products Co., has built a new plant and plans to produce in 1949.

Among the uses for expanded perlite are acoustical plaster, concrete aggregates, loose fill insulation, prefabricated industrial buildings, roofdecks, pipe covering, and plaster aggregate. In 1948, as in 1947, the principal use for perlite was for aggregates in plaster and concrete.

RADIO-GRADE QUARTZ

The most significant developments in the quartz-crystal industry during 1948 were the favorable progress in the synthesis of quartz crystals and other piezoelectric crystals and the improvement in utilization of the available natural crystals, which is reflected in the increased number of units produced per pound of crystal consumed.

Although the bulk of the quartz crystal imported during 1948 came from Brazil, small quantities were imported from Madagascar, India, and China. Recorded imports from United Kingdom and France probably originated in India and Madagascar.

The excess of imports over consumption is attributable to material rejected after inspection by consumers, stocks, and purchases for the National Strategic Stock Pile.

As a national defense measure, the Signal Corps Engineering Laboratories, Fort Monmouth, N. J., has launched a program to promote public interest in locating additional domestic (continental) sources for piezoelectric-grade quartz and other piezoelectric minerals. This program is intended to be coordinated with those of other

Imports of uncut quartz crystal, consumption of radio-grade quartz, and production of piezoelectric units in the United States, 1944–48

Year	Imports of uncut quartz crystal [1]		Consumption of radio-grade quartz (pounds)	Production of piezoelectric units [2] (number)
	Pounds	Value		
1944	2,300,506	$11,178,643	[3] 1,858,000	[3] 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
1947	473,788	1,815,468	[4] 68,100	[4] 1,052,400
1948	1,236,520	4,206,977	61,600	1,225,400

[1] Includes optical-grade quartz used in production of optical instruments.
[2] Includes oscillators, resonators, and other piezoelectric units.
[3] War Production Board.
[4] Revised figure.

Government organizations concerned, such as the Geological Survey and the Bureau of Mines. The Signal Corps is also involved in extensive sponsorship of synthesis of piezoelectric materials. Many colleges, companies, Government agencies, and other organizations are contributing to the synthesis program. In addition to the practical aspects, from the academic viewpoint these projects also are contributing to knowledge regarding crystal growth. This knowledge is potentially valuable in the study of ore deposits. The Frequency Control Branch, Squier Signal Laboratory, is the organization of Signal Corps Engineering Laboratories responsible for development of new and improved quartz or other piezoelectric frequency-control units. Geologists participate actively in the direction of planning and functioning of this branch.[28]

The need for piezoelectric crystalline quartz was outlined in an article.[29] The Bureau of Mines issued a report on a quartz crystal prospect in west-central Idaho.[30] Recent developments in the commercial synthesis of piezoelectric crystals were summarized in an article.[31]

A promising deposit of high-grade quartz crystal in the Hatlefjell Valley, Norway, was investigated.[32]

STRONTIUM MINERALS

No domestic production of strontium minerals was reported during 1948; however, imports for consumption were at a record rate for a peacetime year.

The discovery of an exceedingly high-grade deposit of celestite in the Mianwali district, Punjab, India, was reported. A reserve of 500,000 tons is reported proved with an average $SrSO_4$ content of 97 percent.[33] An estimated 1,000,000 long tons of celestite is said to be found in the Trichinopoly district of South India.[34] The Royal Institute of Science, Bombay, has studied the optimum conditions for the manufacture of strontium carbonate. The economics of the process have been investigated and the possibilities of utilizing local

Celestite imported for consumption in the United States, 1946–48, by countries, in short tons

[U. S. Department of Commerce]

Country	1946		1947		1948	
	Short tons	Value	Short tons	Value	Short tons	Value
Mexico	1,977	$24,165	3,937	$57,317	1,114	$14,963
Spain			5,836	110,884	14,614	440,318
United Kingdom	2,530	42,033	4,344	74,383	6,043	103,428
Total	4,507	66,198	14,117	242,584	21,771	558,709

28 Waesche, Hugh H., Importance and Application of Piezoelectric Minerals: Am. Inst. Min. and Met. Eng. Min. Trans., Min. Eng., vol. 1, No. 1, January 1949, pp. 12–16.

29 Waesche, Hugh H., Piezoelectric Crystalline Quartz Still Needed: Min. and Met., vol. 29. No. 493, January 1948, pp. 22–23.

30 Herdlick, J. A., BeVan Quartz Crystal Prospect, Lemhi County, Idaho: Bureau of Mines Rept. of Investigations 4209, 1948, 6 pp.

31 Kramer, Leonard, Synthetic Piezo Crystals Move Into Industry: Chem. Ind., vol. 63, No. 1, July 1948 pp. 40–42.

32 Chemical and Engineering News, vol. 26, No. 28, July 12, 1948, p. 2088.

33 Mining World, vol. 10, No. 10, September 1948, p. 52.

34 Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 1, January 1948, p. 36.

raw materials and the recovery of byproducts have been considered, and a pilot plant is reported under construction.[35]

Two articles were published on the conversion of celestite to strontium carbonate. The process involves fusing with sodium chloride, additions of sodium carbonate, and cooling and leaching to remove soluble salts, leaving a residue of pure strontium carbonate.[36]

Trade-journal quotations of prices for celestite, in carlots, 92 percent $SrSO_4$, finely powdered, advanced in 1948 to $54; crude, 90-percent grade, f. o. b. cars Calif., remained at $19. Strontianite, per ton lump, in carlots, minimum 84–86 percent $SrCO_3$, remained at $55, nominal.

TOPAZ

Shipments of topaz in 1948 by the Carolina Mining & Exploration Corp., Naples, N. C., were much lower than in the previous year (2,294 short tons). The material was sold as crude in lump or crushed form for use in refractories and as flux for thinning slag in open-hearth furnaces.

VERMICULITE

The construction industry in 1948 continued to place large demands on vermiculite producers. Sales reached 138,635 short tons valued at $1,387,233, representing a 6-percent increase over the previous high of 131,385 tons established in 1947.

Production in 1948 was reported by the following companies: Zonolite Co., 135 South LaSalle St., Chicago, Ill. (mines at Libby, Mont., and Travelers Rest, S. C.); Vercalite Industries, Inc., Franklin, N. C. (mine at Franklin, N. C.); Bee Tree Vermiculite Mines, Inc., Asheville, N. C. (mine at Tigerville, S. C.); Mikolite Mining & Development Co., office and mines at Encampment, Wyo.; Lewis Smith and H. B. Line, office and mine at Glenrock, Wyo. Building Materials, Inc., Canon City, Colo., acquired the Custer County, Colo., mine from the Consolidated Feldspar Corp., Trenton, N. J., in December 1948. This company manufactures "Insuplast," a plastic mineral cork made from vermiculite and other mineral ingredients. As in previous years, the bulk of vermiculite production came from the Zonolite Co. mine at Libby, Mont.

In addition to the record domestic output of vermiculite in 1948, considerable quantities of this material were imported from Transvaal, Union of South Africa. Large deposits of vermiculite have been discovered at Ponte Nova, State of Minas Gerais, Brazil, and numerous other deposits are known to exist. The Brazilian firm of Cepema, Importadora e Exportadora, Ltda., Rio de Janeiro, is reported to be the largest miner and exporter of vermiculite in Brazil.[37] Deposits of vermiculite have been reported in the Tumkur and Hassam districts of Mysore, South India, and in Kenya Colony, British East Africa. These two sources are potential suppliers of vermiculite to the industry of this country. Minor production of this material has been recorded from Western Australia, mainly from Young River, west of Esperance.[38]

[35] Bureau of Mines, Mineral Trade Notes: Vol. 26, No. 6, June 1948, p. 53.

[36] Booth, H. S., and Pollard, E. F., Conversion of Celestite to Strontium Carbonate: Ind. Eng. Chem., vol. 40, No. 10, October 1948, pp. 1986–88.

Busey, H. M., and Pollard, E. F., Conversion of Strontium Sulphate to Carbonate in Molten State: Ind. Eng. Chem., vol. 40, No. 10, October 1948, pp. 1988–90.

[37] Oil, Paint and Drug Reporter, vol. 153, No. 24, June 14, 1948, p. 2.

[38] Queensland Government Mining Journal, vol. 49, No. 561. July 1948. p. 222.

On the domestic scene, a recent report states that North Carolina has untapped vermiculite resources in at least six counties [39] and that vermiculite has been found associated with feldspar in a granite pegmatite dike in Kiowa County, Okla. Further exploration is in prospect.[40]

Among the uses for vermiculite are: Insulation, fireproofing, soundproofing, aggregate for lightweight plaster and concrete, pipe covering, boiler insulation, oilless bearings in large tanks, soil amendment, insulating firebrick, and insulation for subfloors. The use of vermiculite in the building industry has been discussed in recent literature.[41] Expanded vermiculite thermal insulating cement was advanced to a standard specification in 1948 by the American Society for Testing Materials.[42]

A new type of insulating brick for use up to temperatures of 2,100° F. has been reported. This brick is made from vermiculite bonded with clay, bentonite, or colloidal magnesium silicate and fired to a high temperature.[43] A British patent covering the manufacture of thermal insulation compound in which expanded vermiculite, asbestos, processed fuller's earth, and a small amount of ball clay are used has been released.[44] Pulverized vermiculite for foundry use has also been reviewed.[45]

The tonnage and value of screened and cleaned vermiculite shipped in recent years are shown in the accompanying table. Domestic screened and cleaned vermiculite in 1948 averaged $10 per short ton f. o. b. mines and South African crude vermiculite $28 to $30 per ton f. o. b. Atlantic seaports. Assuming an average price of $75 per ton for exfoliated material and a 5-percent loss of weight in exfoliating, the total value of exfoliated vermiculite sold in 1948 would be approximately $9,878,000.

Screened and cleaned vermiculite sold or used by producers in the United States, 1941–48

Year	Short tons	Value	Year	Short tons	Value
1941	23,438	$125,444	1945	64,808	$648,077
1942	57,848	319,931	1946	86,390	867,973
1943	46,645	471,595	1947	131,385	1,338,572
1944	54,116	541,744	1948	138,635	1,387,233

WOLLASTONITE

Production and sales of a small tonnage of wollastonite were reported from the Bristol Mountain open-pit operation of Northern Minerals, Inc., near Willsboro, N. Y. This material was used in various ceramics, pigments, fillers, and chemicals.

[39] Mining Congress Journal, vol. 34, No. 2, February 1948, p. 131.
[40] Engineering and Mining Journal, vol. 149, No. 6, June 1948, p. 133.
[41] Hanks, E. E., Vermiculite Reduces Construction Costs; Manufacturers Rec., vol. 117, No. 6, June 1948, pp. 40, 41, and 64.
Stearns, Myron M., Vermiculite, Strangest of Minerals: Reader's Digest, May 1948, pp. 117–119.
[42] American Society for Testing Materials, Standard Specification for Expanded or Exfoliated Vermiculite Thermal Insulating Cement: 1948 Supplement to Book of Standards, part II, A. S. T. M. Designation C 196–48, p. 16.
[43] Refractories Journal, No. 6, June 1948, p. 238.
[44] British Abstracts, BI, II, III, May 1948, p. 202.
[45] Willcox, Tony, Pulverized Vermiculite Has Foundry Applications: Refractories Jour., No. 11, November 1948, p. 402.

PART III. STATE REVIEWS

The Mineral Industry of Alaska

(MINE REPORT)

By ALFRED L. RANSOME

GENERAL SUMMARY

PRODUCTION of coal in Alaska reached an all-time high level in 1948, but an unexpected decline in output of gold—the leader as the mineral produced in greatest value—resulted in a decrease in the total value of all minerals produced in the Territory from $18,458,000 in 1947 to $13,201,000 in 1948. Thus an upward trend in progress since 1944, when the value of mineral output was at the wartime low point of $6,903,000, was reversed.

Mineral production of Alaska, 1946–48

	1946		1947		1948	
	Quantity	Value	Quantity	Value	Quantity	Value
Antimony ore short tons			40	$16,056	68	$29,336
Coal, bituminous do	366,809	$2,354,952	361,220	2,554,797	410,000	(1)
Copper do	2	648	12	5,040	16	6,944
Gold troy ounces	226,781	7,937,335	279,988	9,799,580	248,395	8,693,825
Lead short tons	115	25,070	264	76,032	329	117,782
Mercury flasks (76 pounds)	699	68,670	127	10,635	100	7,649
Platinum metals (crude) troy ounces	22,882	(1)	13,512	(1)	(1)	(1)
Silver do	41,793	33,769	66,150	59,866	67,341	60,947
Stone short tons	(1)	(1)	(1)	(1)	40,730	54,637
Tin do			1	2,200	6	(1)
Tungsten (60-percent concentrates)[2] short tons	19	(1)	13	(1)		
Zinc do			25	6,050	22	5,852
Miscellaneous[3]		2,005,241		5,927,319		4,224,112
Total		12,426,000		18,458,000		13,201,000

[1] Bureau of Mines not at liberty to publish separately; value included with "Miscellaneous."
[2] Shipments.
[3] Comprises value of sand and gravel, clay (1948), pumice (1948), and items indicated by "(1)."

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The steady rise and subsequent decline in over-all value is almost entirely a reflection of the partial recovery of the gold-mining industry since recision of War Production Board Limitation Order L-208 in 1945 followed by the unexpected slump in 1948. Gold mining, which maintains its position as the backbone of the mining industry in Alaska, has been seriously hampered in postwar development by adverse economic conditions, the principal factors being steadily rising costs, poor supply of labor available in areas with highly competitive wage scales, and the United States Treasury price for gold that has remained unchanged since 1934. A few operators took advantage of the limited market for "natural" gold and sold at least a portion of their output at prices that were several dollars in excess of the official buying price of $35 per fine ounce.

Lode metal mining in the Territory remained virtually at a standstill; and, with the exception of coal, limestone, and sand and gravel, nonmetalliferous activity was negligible.

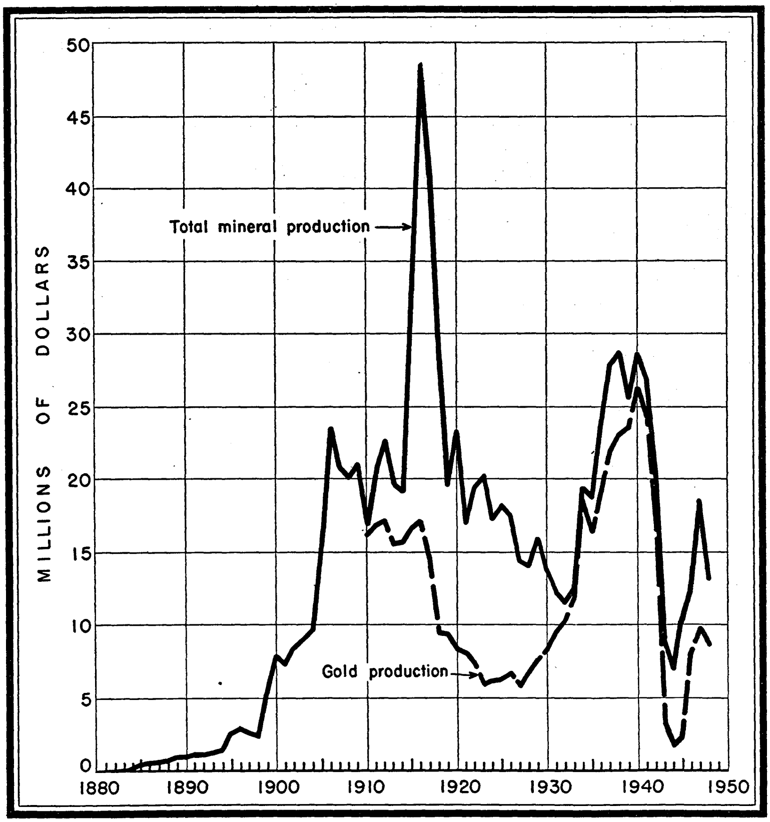

FIGURE 1.—Trends in value of total mineral production (1880–1948) and gold production (1910–48) in Alaska. From 1911 to 1931 copper production accounted for most of the value of minerals other than gold.

GOLD, SILVER, COPPER, LEAD, AND ZINC

The accompanying tables show the mine production of gold, silver, copper, lead, and zinc in Alaska, 1944–48, and 1880–1948, in terms of recovered metals; the gold production at placer mines, by classes of mines and methods of recovery; mine production of gold, silver, copper, lead, and zinc, by regions; ore and old tailings sold or treated and various metallurgical compilations based on output in 1948.

A small proportion of the production shown in the tables following was mined before 1948 but not shipped or sold until that year.

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, lead, and zinc production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1944–48

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1944	$35.00	$0.711+	$0.135	$0.080	$0.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122
1947	35.00	.905	.210	.144	.121
1948	35.00	.905+	.217	.179	.133

[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. 1944 to June 30, 1946; $0.71111111; July 1, 1946, to Dec. 31, 1947: $0.905; 1948: $0.9050505.
[3] Yearly average weighted price of all grades of primary metal sold by producers; 1944–47: price includes bonus payments by Office of Metals Reserve for overquota production.

Gold.—The recorded production of gold in Alaska in 1948 was 11 percent below the output in 1947, despite the fact that a greater number of bucket-lined dredges (which since the war produced the greater proportion of gold recovered from all types of mining, lode as well as placer) were in operation. Few new companies have entered the field of gold mining and a number of properties established before the war—which showed increasing activity during the past few years—either did not operate or curtailed operations during 1948. In an attempt to raise the economic cut-off point, some operators withheld sale of their gold in the hope of benefiting from an official price rise that did not materialize. Clarification of regulations governing sale of gold with regard to transactions in unprocessed or "natural" gold came late in 1948; and, although the over-all volume was relatively small, a number of placer operators legally made sales of natural gold through well-defined channels to buyers in the United States who wished to obtain gold on speculation at a price ranging from $37.50 to $43.00 per fine ounce of contained gold. Thirteen producers specifically reported that natural gold produced in 1948 had been sold for a price in excess of $35 per fine ounce. Included with the recorded production for 1948 are 6,095 fine ounces of gold and 971 fine ounces of silver contained in natural gold sold on the open market.

In addition, 2,501 ounces of natural gold bullion was reported sold by seven producers on the open market for prices ranging from $28 to $35 per ounce of bullion; information on fineness was insufficient for calculating the recoverable gold and silver content for inclusion with the 1948 statistical record. Available information indicated that an unknown quantity of natural gold was sold by 17 producers who did not report specifically, and an undetermined quantity of gold from six properties was reported produced but not sold. Assuming that the quantity of unreported natural gold bullion sold equaled the known quantity, the total involved would approximate 18,000 ounces, the probability being that the actual figure is somewhat less.

Mine production of gold, silver, copper, lead, and zinc in Alaska, 1944–48, and total, 1880–1948, 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
1944	9	198	381,574	49,296	$1,725,360	13,362	$9,502
1945	18	143	6,512	68,117	2,384,095	9,983	7,099
1946	16	256	10,798	226,781	7,937,335	41,793	33,769
1947	19	260	13,891	279,988	9,799,580	66,150	59,866
1948	24	274	6,014	248,395	8,693,825	67,341	60,947
1880–1948	----------	----------	(2)	26,611,811	644,427,987	19,923,789	14,202,404

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1944	4,000	$540	88,000	$7,040	----------	----------	$1,742,442
1945	10,000	1,350	22,000	1,892	----------	----------	2,394,436
1946	4,000	648	230,000	25,070	----------	----------	7,996,822
1947	24,000	5,040	528,000	76,032	50,000	$6,050	9,946,568
1948	32,000	6,944	658,000	117,782	44,000	5,852	8,885,350
1880–1948	[3] 685,894	226,575,848	[3] 25,519	2,968,447	[3] 47	11,902	888,186,588

[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.

Monthly production of gold in 1948, as shown in an accompanying table, is indicative of striking seasonal limitations to mining activity in the Territory. The data are based on mint and smelter receipts, and actual production is probably considerably less than shown for the first 4 months and the last 2 months of the year but correspondingly higher for the period May through October.

The 15 leading gold-producing mines (all placer) in Alaska in 1948, listed in the accompanying table, yielded 72 percent of the total recorded gold output of the Territory; the leading 5 mines produced 58 percent. The Fairbanks district in the Yukon River Basin region ranked first in gold production in the Territory by a wide margin, owing to the bucket-line dredging operations of the United States Smelting, Refining & Mining Co.

Active lode-gold mining was limited to a few relatively small-scale operations. The greatest proportion of gold recovered from lode sources was from mill clean-ups at mines that were inoperative during 1948.

Fifteen leading gold-producing mines in Alaska in 1948, in order of output [1]

Rank	Mine	District	Region	Rank in 1947	Operator	Source of gold
1	United States Smelting, Refining & Mining Co.	Fairbanks	Yukon River Basin	1	United States Smelting, Refining & Mining Co.	Dredge.
2	New York Alaska Gold Dredging Corp.	Tuluksak-Aniak.	Kuskokwim	2	New York Alaska Gold Dredging Corp.	Dredge and placer.
3	United States Smelting, Refining & Mining Co.	Nome	Seward Peninsula	(2)	United States Smelting, Refining & Mining Co.	Dredge.
4	Cripple Association	Innoko	Yukon River Basin.	3	Cripple Creek Mining Co.	Placer.
5	Brinker-Johnson Co	Fairbanks	do	(2)	Brinker-Johnson Co	Dredge.
6	Arctic Circle Exploration Co.	Fairhaven	Seward Peninsula	4	Arctic Circle Exploration Co.	Do.
7	Alder Creek Mining Co.	Fairbanks	Yukon River Basin.	9	Alder Creek Mining Co.	Placer.
8	Collinsville	Yentna-Cache Creek.	Cook Inlet-Susitna.	18	Collinsville Mine	Do.
9	Casa de Paga Gold Co.	Fairhaven	Seward Peninsula	(2)	Casa de Paga Gold Co.	Dredge.
10	Mohawk Association	Iditarod	Yukon River Basin.	8	North American Dredging Co.	Do.
11	C. J. Berry Dredging Co.	Circle	do	11	C. J. Berry Dredging Co.	Do.
12	Alluvial Golds, Inc	do	do	6	Alluvial Golds, Inc	Do.
13	Gold Placers, Inc	do	do	7	Gold Placers, Inc	Do.
14	Lammers Exploration Co.	Kiana	Northwestern Alaska.	13	Lammers Exploration Co.	Do.
15	Olive Creek Mines	Tolovana	Yukon River Basin.	(2)	Olive Creek Mines	Placer.

[1] Based on known output, including natural gold sales.
[2] Did not produce in 1947.

Gold produced at placer mines in Alaska, 1944–48, by classes of mines and by methods of recovery

Class and method	Mines producing	Washing plants (dredges)	Material treated (cubic yards)	Gold recovered: Fine ounces	Gold recovered: Value	Gold recovered: Average value per cubic yard
Surface placers:						
Gravel mechanically handled:						
Bucket-line dredges:						
1944	9	10	2,074,385	26,280	$919,800	$0.443
1945 [1]	11	14	3,112,000	34,404	1,204,140	.387
1946 [1]	20	26	9,810,000	149,382	5,228,370	.533
1947 [1]	22	28	8,395,000	188,800	6,608,000	.787
1948	22	30	11,165,000	169,299	5,925,465	.531
Dragline dredges:						
1944	(2)	(2)	(2)	(2)	(2)	(2)
1945 [1]	1	1	9,200	1,045	36,575	3.976
1946 [1]	1	1	65,000	2,713	94,955	1.461
1947 [1]	2	2	148,000	3,715	130,025	.879
1948						
Nonfloating washing plants: [3]						
1944	(2)	(2)	(2)	(2)	(2)	(2)
1945 [1]	24	24	518,500	8,349	292,215	.564
1946 [1]	66	66	2,091,000	37,519	1,313,165	.628
1947 [1]	75	75	2,905,000	45,990	1,609,650	.554
1948	107	107	4,305,000	57,938	2,027,830	.471

See footnotes at end of table.

Gold produced at placer mines in Alaska, 1944–48, by classes of mines and by methods of recovery—Continued

Class and method	Mines producing	Washing plants (dredges)	Material treated (cubic yards)	Gold recovered		
				Fine ounces	Value	Average value per cubic yard
Gravel hydraulically handled:						
Hydraulic:						
1944	(2)		(2)	(2)	(2)	(2)
1945	80		858,000	12,903	$451,605	$0.526
1946	116		2,123,000	30,390	1,063,650	.501
1947 [1]	114		2,371,000	36,769	1,286,915	.543
1948	82		1,220,000	14,493	507,255	.416
Small-scale hand methods:						
Wet:						
1944	(2)	(2)	(2)	(2)	(2)	(2)
1945	26		12,800	645	22,575	1.764
1946	51		18,800	688	24,080	1.281
1947	44		46,600	1,121	39,235	.842
1948	59		53,300	984	34,440	.646
Underground placers:						
Drift:						
1944	(2)	(2)	(2)	(2)	(2)	(2)
1945	1		1,500	362	12,670	8.447
1946	2		200	16	560	2.800
1947	3		400	48	1,680	4.200
1948	4		700	88	3,080	4.400
Other placers: [4]						
1944	189		(5)	7,331	256,585	(5)
1945–48						
Grand total placers:						
1944	198		(5)	33,611	1,176,385	(5)
1945	[6] 143		4,512,000	57,708	2,019,780	.448
1946	[6] 256		14,108,000	220,708	7,724,780	.548
1947	[6] 260		13,866,000	276,443	9,675,505	.698
1948	[6] 274		16,744,000	242,802	8,498,070	.508

[1] Data for 1945–47 revised owing to reclassification of several mines based on additional information received; totals of all placers remain unchanged.
[2] Data not available separately according to method; included with "Other placers."
[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] Includes all placer operations (dragline dredges, nonfloating washing plants, hydraulic, small-scale hand, and drift) for which separate figures are not available.
[5] Figure not available.
[6] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

Silver.—Of the silver produced in Alaska in 1948, 55 percent was a byproduct of gold mining (66 percent in 1947), and 38 percent came from lead ore (including a small quantity from zinc-lead and copper ores); 7 percent was credited from silver ore mined at some time before 1948, but not shipped until that year. The most important producer of silver in Alaska in 1948 was the J. H. Scott Co., which recovered silver as a byproduct from lead ore produced from the Riverside mine in the Hyder district, Southeastern Alaska region. The United States Smelting, Refining & Mining Co. (Fairbanks department), which dropped from first place in 1947 to second in 1948, recovered silver as a byproduct of bucket-line gold-dredging operations in the Fairbanks district.

Copper, Lead, and Zinc.—Production of the base metals (copper, lead, and zinc) was limited almost entirely to output from two mines in the Southeastern Alaska region. Of the total copper output, 28,000 pounds were recovered as a byproduct from lead concentrate shipped from the Riverside mine near Hyder, operated by J. H. Scott Co. Also credited to the Riverside mine were 634,000 pounds of the total lead produced and 21,000 pounds of zinc. The balance of the total zinc production was recovered from zinc-lead concentrate produced from ore mined from the Mahoney mine, on George Inlet, Ketchikan district, in 1947; the concentrate was shipped in 1948 to a smelter in Canada.

Mine production of gold, silver, copper, lead, and zinc in Alaska in 1948, by months, in terms of recoverable metals [1]

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	1,866	1,290	(2)	9	(2)
February	688	112			
March	317	41			
April	1,174	206			
May	5,372	985			
June	9,083	1,439			
July	37,445	12,426	4	[3] 86	[3] 12
August	39,212	8,900	2	25	1
September	51,389	11,916	2	42	2
October	35,586	11,987	4	78	3
November	38,063	11,420	3	64	2
December	28,200	6,619	1	25	2
Total: 1948	248,395	67,341	16	329	22
1947	279,988	66,150	12	264	25

[1] Based on mint and smelter receipts.
[2] Less than one-half ton.
[3] Includes 11 tons of lead and 11 tons of zinc recovered from concentrates produced in 1947.

Mine production of gold, silver, copper, lead, and zinc in Alaska in 1948, by regions, in terms of recovered metals [1]

Region	Mines producing [1]		Gold			Silver	Total value
	Lode	Placer	Lode (fine ounces)	Placer (fine ounces)	Total (fine ounces)	Lode and placer (fine ounces)	
Cook Inlet—Susitna	3	25	479	5,101	5,580	822	$196,044
Copper River	2	10	29	504	533	56	18,706
Kenai Peninsula	2	3	143	61	204	54	7,189
Kuskokwim	1	9	181	11,827	12,008	1,050	421,230
Seward Peninsula and Northwestern Alaska [2]	1	60	112	36,408	36,520	4,212	1,282,012
Southeastern Alaska	10	2	4,372	35	4,407	26,570	[3] 308,870
Yukon River Basin	5	165	277	188,866	189,143	34,577	6,651,299
Total Alaska: 1948	24	274	5,593	242,802	248,395	67,341	[3] 8,885,350
1947	19	260	3,545	276,443	279,988	66,150	[4] 9,946,568

[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 output.
[3] Includes value of 32,000 pounds of copper ($6,944), 658,000 pounds of lead ($117,782), and 44,000 pounds of zinc ($5,582).
[4] Includes value of 24,000 pounds of copper ($5,040), 528,000 pounds of lead ($76,032), and 50,000 pounds of zinc ($6,050).

MINING INDUSTRY

Bucket-line dredges (30 in 1948 compared with 28 in 1947) washed 67 percent of the total gravel mined in Alaska in 1948 and recovered 70 percent of the total placer gold and 68 percent of the total Alaska gold (lode and placer). No dragline dredges (which include all operations using a floating washing plant and a power excavator) were reported in operation during 1948; two (revised) were operated in 1947. Placer operations using combinations of bulldozer and hydraulic methods—in many cases supplemented with dragline equipment—are becoming more numerous in the Territory because of the distinct advantages of relatively low initial cost of equipment in proportion to the small labor crews necessary and the large volume of material that can be handled. In general, the mining method is to bulldoze the goldbearing material to bedrock sluice-boxes and use hydraulic giants to wash the gravel through. Dragline equipment—when used—is generally utilized for removing overburden or disposing of tailings, and in some cases for transporting gravel to elevated sluice boxes or washing plants. Combination methods of this type, in which the gravel is moved mechanically to the washing plant (classified as nonfloating washing plants), washed 26 percent of the total gravel mined and recovered 24 percent of the placer gold, an increase over comparable totals in 1947. Operations in which gold was recovered primarily by hydraulic methods showed a decrease in the number of mines (partly because of reclassification from hydraulic to nonfloating washing plant), gravel washed, and gold produced. Gold output from a larger number of small-scale hand operations was less than in 1947, whereas a minor quantity of gold recovered from four drift mines was nevertheless an increase over 1947. The total yardage of gravel washed at gold placer mines increased 21 percent, whereas production declined 12 percent. The average recoverable gold content of gravels decreased 27 percent.

The tonnage of material from lode mines (gold, silver, copper, lead, and zinc) in Alaska treated in 1948 decreased 57 percent. The output of lode gold increased 58 percent, largely because of mill clean-ups at inactive mines, but the gold from this source comprised only 2 percent of the Territory total.

ORE CLASSIFICATION

Of the 6,014 tons of ore (including 166 tons of old tailings) sold or treated in 1948, 29 percent was gold ore, 67 lead ore, and the remainder zinc-lead ore (including a negligible quantity of copper ore). Details of ore classification are given in the Gold and Silver chapter of this volume.

Ore and old tailings sold or treated in Alaska in 1948, with content in terms of recovered metals

Source	Material sold or treated: Ore (short tons)	Material sold or treated: Old tailings (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold ore	1,549	166	4,850	1,254	1,200	2,000	
Dry silver ore	[1] 80			4,640			
Copper ore	14		5	25	2,800		
Lead ore	4,005		736	25,290	28,000	634,000	21,000
Zinc-lead ore	[2] 200		2	167		22,000	23,000
Total lode mines	[3] 5,848	166	5,593	31,376	32,000	658,000	44,000
Placers			242,802	35,965			
Total: 1948	[3] 5,848	166	248,395	67,341	32,000	658,000	44,000
1947	7,891	6,000	279,988	66,150	24,000	528,000	50,000

[1] Produced before 1948.
[2] Estimated figure.
[3] Includes 80 tons of ore produced before 1948.

METALLURGIC INDUSTRY

During 1948, 71 percent of the total ore and old tailings handled was treated at concentration mills and 26 percent by amalgamation. Smelters in the United States and Canada received 965 tons of flotation concentrates, 40 tons of gravity concentrates, and 177 tons of ore for direct smelting from Alaska operations of mines producing gold, silver, copper, lead, or zinc. Of the total concentrates shipped, 91 percent was lead concentrate, and 97 percent came from Southeastern Alaska.

Mine production of metals in Alaska in 1948, 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	1,552	4,196	736			
Concentrates smelted:						
Flotation	965	802	25,466	28,000	656,000	44,000
Gravity	40	418	4,886		500	
Ore smelted	177	177	288	4,000	1,500	
Total lode mines		5,593	31,376	32,000	658,000	44,000
Placers		242,802	35,965			
Total: 1948		248,395	67,341	32,000	658,000	44,000
1947		279,988	66,150	24,000	528,000	50,000

Mine production of metals from mills in Alaska in 1948, by regions, in terms of recovered metals

Region	Material treated		Recovered in bullion		Concentrates smelted and recovered metal					
	Ore (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)
BY REGIONS										
Cook Inlet-Susitna	355		432	23	9	47	3			
Copper River	2		29	1						
Kenai Peninsula	224		126	35	2	17	6			
Kuskokwim	Clean-up		181	38						
Seward Peninsula	250		112	14						
Southeastern Alaska	4,413	15	3,039	572	978	1,156	25,703	28,000	656,500	44,000
Yukon River Basin	[1] 578		277	53	16		4,640			
Total: 1948	[1] 5,822	15	4,196	736	1,005	1,220	30,352	28,000	656,500	44,000
1947	7,891	6,000	2,688	592	993	857	22,544	24,000	528,000	50,000
BY CLASSES OF CONCENTRATES										
Dry gold					35	482	255		500	
Dry silver					16		4,640			
Lead					916	736	25,290	28,000	634,000	21,000
Zinc-lead					38	2	167		22,000	23,000
Total 1948					1,005	1,220	30,352	28,000	656,500	44,000

[1] Includes 80 tons of ore produced before 1948.

Gross metal content of concentrates produced from ores mined in Alaska in 1948, 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	35	482	255	65	989	
Dry silver	16		4,640	520	307	
Lead	916	736	25,290	33,488	647,798	28,343
Zinc-lead	38	2	167		23,381	23,704
Total: 1948	1,005	1,220	30,352	34,073	672,475	52,047
1947	993	857	22,544	26,399	556,430	51,115

Mine production of metals from Alaska crude ore and old tailings shipped to smelters in 1948, in terms of recovered metals

Class of material	Material treated: Ore (short tons)	Material treated: Old tailings (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Dry gold	12	151	172	263		1,500
Copper	14		5	25	4,000	
Total 1948 [1]	26	151	177	288	4,000	1,500

[1] All from southeastern Alaska. No production in 1947.

Gross metal content of Alaska crude ore and old tailings shipped to smelters in 1948, 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)
Dry gold	12	151	172	263	1,314	2,130
Copper	14		5	25	3,027	
Total: 1948	26	151	177	288	4,341	2,130
1947						

REVIEW BY REGIONS AND DISTRICTS

COOK INLET–SUSITNA REGION

Valdez Creek District.—Production from the Valdez Creek district in 1948 was limited to a relatively small quantity of placer gold recovered from two operations. H. L. Ernst and O. Nicklie operated a bulldozer-hydraulic combination on Valdez Creek during a 5-month period in the summer of 1948. John E. Carlson recovered a small quantity of gold from Valdez Creek.

Willow Creek District.—The Fern Exploration Co., Inc., Al Dodson, manager, operated the Fern mine on Archangel Creek throughout the year; 350 tons of gold ore were treated in a 60-ton amalgamation-flotation mill to recover 419 ounces of gold and 22 ounces of silver as bullion and an additional 47 ounces of gold and 3 ounces of silver contained in 9 tons of concentrate shipped to a smelter in the United States. Lloyd Hill recovered a small quantity of gold from gold ore treated by amalgamation at the Lonesome mine (Gold Mint property) on the Little Susitna River 22 miles north of Palmer. Development work was in progress during the 1948 season at the Snowbird mine on Reed Creek, the Webfoot mine on Archangel Creek, and the Gold Cord mine on Fishhook Creek, but no gold was reported recovered.

Mine production of gold, silver, copper, lead, and zinc in Alaska in 1948, by regions and districts, in terms of recovered metals [1]

Region and district	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)					
Cook Inlet-Susitna region:											
Willow creek	3	(4)	355	479	(4)	[5] 479	[5] 26	-----	-----	-----	[5] $16,789
Yentna-Cache Creek	-----	22	-----	-----	5,054	5,054	788	-----	-----	-----	177,603
Copper River region:											
Chistochina	-----	6	-----	-----	413	413	44	-----	-----	-----	14,495
Nizina	-----	2	-----	-----	(6)	(6)	-----	-----	-----	-----	(6)
Yakataga, including Icy Bay	-----	1	-----	-----	87	87	10	-----	-----	-----	3,054
Kenai Peninsula region: Nuka Bay-Homer	-----	1	-----	-----	(6)	(6)	-----	-----	-----	-----	(6)
Kuskokwim region:											
McGrath	1	2	(7)	181	26	207	41	-----	-----	-----	7,282
Tuluksak-Aniak	-----	5	-----	-----	11,445	11,445	1,009	-----	-----	-----	401,488
Northwestern Alaska region: Shungnak	-----	(8)	-----	-----	23	23	4	-----	-----	-----	809
Seward Peninsula region:											
Council-Bluff	-----	7	-----	-----	4,379	4,379	471	-----	-----	-----	153,691
Fairhaven	-----	12	-----	-----	9,756	9,756	1,322	-----	-----	-----	342,656
Kougarok	-----	13	-----	-----	2,965	2,965	324	-----	-----	-----	104,068
Koyuk	-----	5	-----	-----	2,159	2,159	220	-----	-----	-----	75,764
Nome	(4)	16	(4)	(4)	13,801	[9] 13,801	[9] 1,564	-----	-----	-----	[9] 484,451
Port Clarence	-----	5	-----	-----	309	309	33	-----	-----	-----	10,845
Serpentine River	-----	1	-----	-----	128	128	12	-----	-----	-----	4,491
Southeastern Alaska region:											
Hyder	1	-----	4,005	736	-----	736	25,290	28,000	634,000	21,000	171,004
Juneau	5	1	223	3,386	5	3,391	806	1,200	2,000	-----	120,032
Ketchikan	2	-----	367	242	-----	242	462	2,800	22,000	23,000	16,493
Windham Bay	(4)	1	(4)	(4)	30	[9] 30	[9] 6	-----	-----	-----	[9] 1,055

Yukon River Basin region:											
Bonnifield-Nenana	------	5	------	------	167	167	28	------	------	------	5,870
Circle	------	14	------	------	11,750	11,750	1,698	------	------	------	412,787
Eagle	------	7	------	------	315	315	40	------	------	------	11,061
Fairbanks	4	27	498	277	127,414	127,691	20,356	------	------	------	4,487,608
Fortymile	------	25	------	------	4,980	4,980	909	------	------	------	175,123
Hot Springs	------	16	------	------	3,838	3,838	792	------	------	------	135,047
Iditarod	------	13	------	------	9,480	9,480	1,408	------	------	------	333,074
Innoko	------	15	------	------	18,352	18,352	2,652	------	------	------	644,720
Kantishna	(4)	5	(4)	(4)	1,514	[9] 1,514	[9] 699	------	------	------	[9] 53,623
Koyukuk	------	14	------	------	2,288	2,288	215	------	------	------	80,275
Rampart	------	6	------	------	1,686	1,686	77	------	------	------	59,080
Ruby	------	8	------	------	2,776	2,776	565	------	------	------	97,671
Tolovana	------	7	------	------	4,218	4,218	477	------	------	------	148,062
Other districts [10]	8	12	[11] 566	292	3,444	3,736	4,993	------	------	------	135,279
Total Alaska	24	274	[11] 6,014	5,593	242,802	248,395	67,341	32,000	658,000	44,000	8,885,350

[1] Only those districts shown separately for which Bureau of Mines is at liberty to publish figures; others producing listed in footnote 10 and their output included with "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: 31,376 ounces from lode mines, and 35,965 from placers.
[4] Included with "Other districts."
[5] Exclusive of placer output, which is included with "Other districts."
[6] Gold not sold.
[7] Cleanup.
[8] Output from property not classed as a mine.
[9] Exclusive of lode output which is included with "Other districts."
[10] Includes following: Valdez Creek and Willow Creek (placer) districts in Cook Inlet-Susitna region; Nelchina (placer) and Prince William Sound (lode) in Copper River region; Moose Pass-Hope in Kenai Peninsula region; Goodnews Bay in Kuskokwim region; Kiana in Northwestern Alaska region; Nome (lode) in Seward Peninsula region; Windham Bay (lode) in Southeastern Alaska region; Chandalar, Chisana, Kantishna (lode) and Marshall in Yukon River Basin region.
[11] Includes 80 tons of ore produced before 1948.

Yentna-Cache Creek District.—The largest producer in the district in 1948 was Collinsville Mines (dry-land dredge with dragline equipment) operating on Twin Creek; 3,694 ounces of gold and 579 ounces of silver were recovered from 183,000 cubic yards of material handled during the period June 1 to September 15. A number of other smaller producers recovered placer gold by hydraulicking and the widely used bulldozer-hydraulic combination method.

COPPER RIVER REGION

Chistochina District.—The Slate Creek Gold Placers, operated by J. M. Elmer from June 20 to September 20, 1948, was the largest producer in the district; 316 ounces of gold and 30 ounces of silver were recovered by hydraulicking.

Nizina District.—Dan Creek Gold Mines hydraulicked 47,000 cubic yards on Dan Creek from May 1 to September 22 and recovered 741 ounces of gold bullion, which had not been sold by the end of 1948. The Chititu Mines reportedly was in operation during 1948 on Chititu Creek using hydraulic equipment; no record of production was received.

Yakataga District.—B. B. Watson recovered 87 ounces of gold and 10 ounces of silver from his placer operation on the beach at Cape Yakataga from April 27 to August 30, 1948.

KENAI PENINSULA REGION

Moose Pass—Hope District.—The greatest production of gold from the district came from two lode mines—the Skeen-Leckner (Falls Creek) mine, operated by the Falls Creek Mining Co., and the Marigold, by George Lindsay; gold ore from both mines was treated by amalgamation. Boe & Sorenson hydraulicked on Resurrection Creek during the summer of 1948.

KUSKOKWIM REGION

Goodnews Bay District.—The only gold produced in the district in 1948 was recovered as a byproduct from platinum mined by the Goodnews Bay Mining Co. on the Salmon River using a Diesel-electric bucket-line dredge (equipped with 93 8-cubic-foot buckets) and 2 1¼-cubic-yard dragline excavators. The Bristol Bay Mining Co., the largest producer of gold in the district in 1947, did not operate in 1948.

McGrath District.—Placer operations were almost nonexistent in the district during 1948. E. M. Whelen recovered 23 ounces of gold and 3 ounces of silver from his claim No. 1 in Holmes Gulch by small-scale operation from 700 cubic yards of gravel. A small quantity of gold was recovered in similar fashion from the John E. Strand placer during the summer of 1948. Although the Nixon Fork lode mine did not operate in 1948, R. A. Mespelt & Co. recovered 181 ounces of gold and 38 ounces of silver from a clean-up of the stamp mill.

Tuluksak-Aniak District.—The New York-Alaska Gold Dredging Corp., the largest gold producer in the region and the second largest in the Territory in 1948, operated 2 floating bucket-line dredges (electrically powered, equipped with 67 6½-cubic-foot and 66 2-cubic-foot buckets, respectively) and 2 dragline excavators with nonfloating washing plants on the Tuluksak River and Bear Creek. Two other important producers at placer properties were Marvel Creek Mining Co., using a dragline-bulldozer-hydraulic combination with nonfloating washing plant, on Marvel Creek, and the Canyon Creek Mining Co. (Jens Kvamme & Sons), using a bulldozer-hydraulic combination with a nonfloating washing plant to recover 377 ounces of gold and 46 ounces of silver from 18,666 cubic yards of gravel.

NORTHWESTERN ALASKA REGION

Kiana District.—The Lammers Exploration Co., the only gold producer in the district in 1948, operated its Diesel-electric bucket-line dredge (with 56 3-cubic-foot buckets) on Klery Creek from July 1 to October 5.

SEWARD PENINSULA REGION

In the Seward Peninsula region, 14 floating bucket-line dredges were in operation during 1948 (13 in 1947); in addition, numerous operations used hydraulic giants, bulldozers, and dragline excavators either separately or in combination. There was one producing lode gold mine.

Council-Bluff District.—The principal producers in the district were the Alaska Placer Co., which operated a bucket-line dredge (with 60 3-cubic-foot buckets) on the Niukluk River benches from June 11 to September 25, and the Sourdough Dredging Co., which operated a bucket-line dredge equipped with 62 3½-cubic-foot buckets on Ophir Creek (1,415 ounces of gold and 149 ounces of silver were recovered from 120,000 cubic yards of gravel washed during an 82-day operating period). C. L. Dempsey operated a small bucket-line dredge during the 1948 season on Casa de Paga River and Willow Creek. Other operators in the district who recovered a moderate quantity of gold, principally by hydraulicking, included B & T Mines (on Ophir Creek and Niukluk River), Chester Milligan (on Ophir Creek), L. E. Ost and Wallace McIver (on Crooked Creek), and Swanberg & Sons (Amocat claim on Niukluk River).

Fairhaven District.—The Arctic Circle Exploration Co., operating one of 2 dredges (each with 64 4-cubic-foot buckets) on Candle Creek, ranked first in production of gold in the district and sixth in the Territory with 4,711 ounces of gold and 648 ounces of silver recovered from 200,000 cubic yards of gravel. The Casa de Paga Gold Co. operated two bucket-line dredges on the Inmachuk River from July 4 to October 20 and recovered 3,638 ounces of gold and 434 ounces of silver from 168,000 cubic yards of gravel. The company had operated a dredge on Pajara Creek, Nome district, during the 1947 season. Other producers of a moderate quantity of gold from placers worked hydraulically and in combination with bulldozers, pumps, or other types of mechanical equipment included N. B. Tweet & Sons (hydraulic on Humboldt Creek), Wallace Porter (bulldozer-hydraulic combination on Bear Creek; 178 ounces of gold and 16 ounces of silver recovered from 8,000 cubic yards), M. J. Walsh (on Humboldt Creek), and Fred Weinard (hydraulic on Jump Creek).

Kougarok District.—The North Fork Dredging Co. operated its bucket-line dredge (with 2½-cubic-foot buckets) on Harris Creek, tributary of North Fork Kougarok River, June through September 1948, and Kougarok Consolidated Placers, Inc., operated a Diesel-powered dredge (with 76 2¼-cubic-foot buckets) on claims 31 and 32 above, Kougarok River, from August 2 to October 7. Other mining in the district in 1948 was limited to placer operations, principally by hydraulicking and with combinations of mechanical equipment using nonfloating washing plants. The large operators were Grant Mining Co. on Coffee Creek (hydraulic), Trinity Mining Co. on Kougarok River (bulldozer), Atlas Mines on Atlas Creek (hydraulic lift, bulldozer, and dragline), M. J. Walsh on Mascot Gulch, Lyman H. Madden on Garfield Creek (bulldozer-hydraulic; 115 ounces of gold and 11 ounces of silver recovered from 3,000 cubic yards), and Midnight Sun Mines, No. 2 Discovery on Boulder Creek (bulldozer-hydraulic; 104 ounces of gold and 17 ounces of silver recovered from 3,000 cubic yards).

Koyuk District.—The Ungalik Syndicate operated a bucket-line dredge on the Ungalik River during the 1948 season and was the largest producer of gold in the district.

Nome District.—The United States Smelting, Refining & Mining Co., operating one of its fleet of four bucket-line dredges in the vicinity of Nome from June 21 to November 6, was the largest producer of gold in the district and the Seward Peninsula region and ranked third in the Territory; all operations of the company in the Nome area had been idle—with the exception of maintenance—since 1942. The dredge in operation was equipped with 134 9-cubic-foot buckets. Lee Bros. Dredging Co., the second largest gold producer in the district in 1948, operated 2 bucket-line dredges (equipped with 75 5-cubic-foot and 65 3½-cubic-foot buckets) on the Solomon River and Little Hurrah Creek during the 1948 season. A dredge was operated also by Gold Beach Dredging Co. on the Childberg claim (Nome Beach), and one by Tolbert Scott & Son on Iron Creek; the latter was a Kimball-type open-link dredge equipped with 2½-cubic-foot buckets.

Among the larger producers of gold from placers worked by hydraulic giants and in combination with bulldozers and pumping equipment were: Glacier Creek Mines, Rainbow claim on Glacier Creek (hydraulic), Herbert Engstrom on Basin Creek (bulldozer-hydraulic), Earl Towner on Buster Creek, Rocky Mountain Mining Co. on Rocky Mountain Creek (hydraulic), and E. W. Quigley on Solomon River (hydraulic).

C. O. Roberts operated the Big Hurrah mine on Hurrah Creek—the only active lode gold mine in the region in 1948—and recovered a moderate quantity of gold by amalgamation.

Port Clarence District.—Placer gold mining in the district during 1948 was limited to a few operations, largely hydraulic; the output from no one property exceeded 100 ounces. Cannon & Washburn operated on Burke Creek, H. H. Mining Co. worked the Lone Wolf claims on Million Creek, Rice & Muncy used hydraulic-bulldozer equipment on Sunset Creek, and Benard Vogen operated a bulldozer and washing plant on Quartz Creek.

Serpentine River District.—George Bodis worked the Dick Creek Placers (No. 11 above Discovery) from June 10 to September 30.

Using a bulldozer-hydraulic combination with a bed-rock flume; 128 ounces of gold and 12 ounces of silver were recovered from 5,000 cubic yards of gravel.

SOUTHEASTERN ALASKA REGION

Three-fourths of the total Alaska lode-gold output came from five operations in the Hyder, Juneau, and Ketchikan districts; a few other lode-gold mines were active, but output was relatively small. Nearly all of the lode silver and all of the copper, lead, and zinc came from this region. Placer mining during 1948 was virtually nonexistent.

Hyder District.—The J. H. Scott Co. operated the Riverside mine from May 15 to June 15 and again from August 1 to December 15, treating lead ore (containing scheelite) in its increased-capacity 100-ton combination flotation-gravity concentration mill. From 4,005 tons of lead ore milled, 916 tons of lead concentrate (containing 736 ounces of gold, 23,290 ounces of silver, 33,488 pounds of copper, 647,798 pounds of lead, and 28,343 pounds of zinc) were produced and shipped to a smelter in the United States. These shipments were made almost entirely during the latter half of the year.

Juneau District.—Although the Alaska Juneau mine remained inactive during 1948, a large proportion of the gold from the district came from a clean-up of the Alaska Juneau mill. Howard Hayes & Stan Whitely recovered a substantial quantity of gold from the retreatment of Alaska Juneau mill tailings, and George A. Fleek similarly recovered a small quantity of gold from the Thane mill tailings.

Ketchikan District.—The Mahoney mine, 15 miles northeast of Ketchikan at the mouth of Mahoney Creek on George Inlet, was purchased in June from the Big Four Mining Co. by Arthur J. Theis, trustee, for the Montana Zinc & Lead Co. Although neither the mine nor mill was operated in 1948 after the change in ownership, 38 tons of zinc-lead concentrate, previously milled from ore mined for the most part in 1947, was shipped by Theis to a smelter in Canada. The material contained 1 ounce of gold, 167 ounces of silver, 23,381 pounds of lead, and 23,704 pounds of zinc. Wendell Dawson worked the Dawson mine on Prince of Wales Island during 1948; gold ore was treated by amalgamation, and a small tonnage of concentrate was shipped to a smelter in the United States.

Windham Bay District.—Kloss & Davis worked the K & D mine during 9 months of 1948 and recovered a small quantity of gold from ore treated by amalgamation in a 2-ton mill. Antimony, which occurred with the gold, was not recovered. A small tonnage of gold ore was shipped to a smelter in the United States by Don Thomas from a property in the Thomas Bay area. Stan Price recovered 30 ounces of gold and 6 ounces of silver from a placer operation on Spruce Creek; 6,000 cubic yards of gravel were moved to sluice boxes by a bulldozer.

YUKON RIVER BASIN REGION

Of the total Alaska gold produced in 1948, the Yukon River Basin region accounted for 76 percent from 165 placer mines and 5 lode mines in 16 districts. Sixty-nine percent of the 188,866 ounces of placer gold produced in the region came from 12 bucket-line dredges. Five percent of the total Alaska gold from lode mines came from the region. The Fairbanks district continued to be the most important.

Bonnifield-Nenana District.—Only a few placer operations were active in the district during 1948, and individual output was under 100 ounces of gold. Nels Jackson operated on the Totatlanika River (bulldozer-hydraulic), Wagers Bros. on Gold King Creek (hydraulic), and Arthur B. and M. O. Wise on Thistle Creek (bulldozer).

Circle District.—Three bucket-line dredges were active in the district in 1948. Alluvial Golds, Inc., operated its Diesel-powered dredge equipped with 72 4½-cubic-foot buckets on Woodchopper Creek. Gold Placers, Inc., ran a dredge with 60 4½-cubic-foot buckets on Coal Creek. The C. J. Berry Dredging Co., operating its dredge on Mammoth Creek, washed 362,000 cubic yards of gravel to recover 3,186 ounces of gold and 680 ounces of silver. The output from these dredges accounted for nearly four-fifths of the gold from the district (80 percent in 1947) and placed the district third in gold produced in the Yukon River Basin region. The larger producers of placer gold in the district by other methods were the Deadwood Mining Co. operating on Deadwood Creek (hydraulic with dragline and bulldozer equipment); Kelly & Wilkinson, on Miller Creek (bulldozer-hydraulic); Frasca & Gibson, on Eagle Creek (bulldozer-hydraulic); Hedla Bros., on Kethum Creek (dragline-bulldozer); and A. A. Zimmerman, on Independence Creek (hydraulic).

Eagle District.—The Crooked Creek Placer Co. (Bauer & Celich) hydraulicked on Crooked Creek from April 15 to September 20, and Amund L. Hagen similarly worked his property on Fox Creek from May 15 to September 26, recovering 26 ounces of gold and 3 ounces of silver from 2,000 cubic yards of gravel. Yukon Placer Mining Co. and Hansen & Hendricksen, using bulldozer equipment, worked placer ground on Fourth of July Creek and Alder Creek, respectively.

Fairbanks District.—There is no official record for a considerable quantity of natural gold produced in the district in 1948 and sold on the open market, inasmuch as some producers did not submit reports and the purchasers are holding such gold on speculation. The recorded production of gold from the Fairbanks district in 1948 is probably lower than the actual output by several thousand ounces, and there is some question as to the relative rank in production.

The United States Smelting, Refining & Mining Co., operating six bucket-line dredges in the Fairbanks district, was—as in previous years—by far the largest producer of gold, not only in the district but in the Territory. The company operated 3 6-cubic-foot Bethlehem dredges (1 with 68 buckets and 2 with 78 buckets each), 2 10-cubic-foot Bethlehem dredges (with 93 and 111 buckets, respectively), and 1 10-cubic-foot Yuba dredge (with 106 buckets); all dredges are electrically operated. Other equipment used (chiefly for removing overburden) included 200 Joshua Hendy hydraulic giants, a Bucyrus 10–W power shovel, and 4 Caterpillar bulldozers and carry-alls.

The Brinker-Johnson Co., the second-largest producer in the Fairbanks district, recovered 5,272 ounces of gold and 629 ounces of silver from 606,170 cubic yards of gravel handled by a Walter Johnson Diesel-powered bucket-line dredge equipped with 78 4½-cubic-foot buckets on Caribou Creek.

Of those producers of gold from placers worked hydraulically and in combination with bulldozers, draglines, and pumping equipment, the Alder Creek Mining Co. was the largest with 4,165 ounces of gold and

667 ounces of silver from 305,555 cubic yards of gravel and overburden handled. Two dragline excavators and three bulldozers were used by the company during the 1948 season on Fairbanks Creek from April 21 to October 5. Other producers of a substantial quantity of placer gold in the district using similar combinations of equipment were F. C. Bleecker on First Chance Creek, Four A. Mining Co. on Pedro Creek, Helmer Johnson on Cleary Creek, Ernest Maurer on First Chance Creek, P. R. H. Mining Co. on Ester Creek, A. B. Richardson & G. B. Martin on Pedro Creek, Russel Williams & Milo Jackovich on Gilmore Creek, and Wolf Creek Mining Co. on Wolf Creek.

Kaye Bros., operating the Sanford mine on Ester Dome under a program of development during 1948, was the leading producer of lode gold in the district. The Cleary Hill Mines Co., the largest producer in 1947, did not operate the Cleary Hill mine during the 1948 season. Also on Ester Dome, Earl H. Beistline & Associates worked the Irishman No. 1 lode gold mine (O. M. Grant property) on Happy Creek during a 3-month period. The Cheechako Mining Co. operated its mine (Greenback claims) at the head of Little Eldorado Creek from July to October 1948; 59 ounces of gold and 10 ounces of silver were recovered from 38 tons of ore treated by amalgamation at the Cleary Hill Mines Co. mill on Cleary Creek. A small quantity of gold was recovered by J. H. Martin from operations at the Tolovana mine on Willow Creek, Pedro Dome, during a short period in 1948; the ore was treated by amalgamation.

Fortymile District.—Of the placer gold reported recovered in the district during 1948 (excluding natural gold concerning which records are incomplete), 64 percent came from properties operated by the Yukon Placer Mining Co. on Walker's Fork (bulldozers and sluice boxes), Poker Creek, and Canyon Creek (bucket-line dredge), the Wade Creek Dredging Co. on Jack Wade Creek (bulldozers and sluice boxes), and George E. King on Turk Creek. A substantial quantity of gold also was produced by Attwood & Granger on Stonehouse Creek (bulldozer-hydraulic), Franklin Mining Co. on Franklin Creek (bulldozer), and Uhler Creek Mining Co. on Jack Wade Creek (bulldozer-hydraulic). Several other producers in the area, using similar equipment, reported outputs of less than 200 ounces of gold.

Hot Springs District.—The largest producer of gold in the district in 1948 (on the basis of reported output for all producers excluding natural gold sold; quantity unreported) was the Iditarod Operating Co., which recovered 1,372 ounces of gold and 193 ounces of silver from 85,000 cubic yards of gravel, using bulldozers and bedrock sluice boxes, on Golden Creek, 30 miles south of Tanana during a period from May to October. Others of the larger producers of placer gold using various combinations of bulldozers, hydraulic equipment, and draglines with bedrock sluice boxes were Cleary Hill Mines on Tofty and Sullivan Creeks, Enstrom & McDougal on American Creek, Pioneer Mining Co. on Pioneer Creek, Johnson & Johnson (Breakoff claim) on Glenn Gulch, Cable & Francis on lower Eureka Creek, and A. W. Pringle on Eureka Creek. Tom Dean worked a small drift mine on Miller Gulch during a 40-day period in 1948.

Iditarod District.—The North American Dredging Co.—operating its Diesel-powered bucket-line dredge equipped with 70 3½-cubic-foot buckets on the Mohawk Association property on Flat Creek—was the largest producer of gold in the Iditarod district in 1948. Retaining its rank as second largest producer of gold in the district, the Awe Mining Co., recovered 2,330 ounces of gold and 355 ounces of silver from 125,000 cubic yards washed on Chicken Creek from May 22 to October 2, 1948; equipment included three bulldozers, two dragline excavators (for moving overburden and disposing of tailings), and two hydraulic giants. Uotila & Ogriz and Hatton & Turner operated on Slate Creek and Willow Creek, respectively, using similar placer mining methods and equipment; the last-named operator recovered 986 ounces of gold and 143 ounces of silver from 95,000 cubic yards of gravel. The Alpha Mining Co. operated on the Alpha Association property on Flat Creek using a hydraulic-bulldozer-dragline combination, and Pete Miscovich hydraulicked on Otter Creek. Five giants and two hydraulic elevators were used; mechanical equipment included three bulldozers and a dragline excavator.

Innoko District.—In 1948, as in the previous year, the Cripple Creek Mining Co. (Strandberg & Sons), operating a dragline and moveable dry-land washing plant in conjunction with bulldozers on Cripple and Utopia Creeks, was the largest producer of gold in the district. Rosander & Reed, using similar equipment, operated on Yankee Creek from April 20 to October 1 and was the second-largest producer in the district. Uotila & Hard (Gus Uotila, manager) recovered a substantial quantity of gold from lower Ophir Creek from April 12 to September 30, and Hard & Uotila (Eric Hard, manager) operated on Forgotten Bench, Cripple Creek, from April 16 to September 30; similar equipment, including hydraulic giants, dragline, and bulldozers, was used at both operations. Beaton, Zaiser & McFarland operated a nonfloating washing plant on Spruce Creek during a 4-month period in 1948 and produced a substantial quantity of gold. Claims on Helena Gulch, Fifteen Pup, a tributary of Little Creek, were worked by Hubbard & McFarland, under lease from Robert Jacquemi, during a 4-month period in 1948. The Goodnews Bay Mining Co., one of the district's principal gold producers in 1948, operated a dragline in conjunction with bulldozers and elevated sluice boxes on Colorado Creek from July 26 to October 1. With the use of similar equipment, Savage & Matheson recovered 794 ounces of gold and 103 ounces of silver from 115,000 cubic yards of gravel washed on Spruce Creek, and N. J. Vibe operated on Little Creek (Discovery and Gold Run Association). Also, by the use of the widely utilized hydraulic-bulldozer-dragline combination, smaller quantities of gold were reported produced in 1948 by Anvil Creek Mining Co., on Anvil Creek, J. A. Degnan on Little Creek, and Waino F. Puntila on Little Creek (No. 15 above Gold Run, leased from Robert Jacquemi).

Kantishna District.—Caribou Mines, again as in 1947, was the largest producer of gold in the district. The company continued to operate on Caribou Creek using a 1½-cubic-yard dragline, bulldozer, and a dry-land washing plant. Hosler Mines operated on Moose Creek during a short period in 1948, and Hunter & Burnett recovered a moderate quantity of gold from its property on Crooked Creek; bulldozer-hydraulic combinations were used at both localities.

Koyukuk District.—The South Fork Mining Co. operated its dragline-bulldozer combination on the South Fork, Koyukuk River, from April 15 to September 20; 1,561 ounces of gold and 153 ounces of silver were recovered from 200,000 cubic yards of gravel washed through bedrock sluice boxes. Using the same type of equipment, the Myrtle Creek Mining Co. operated on Myrtle Creek in 1948. Among other producers of smaller quantities of gold in the district were Midnight Sun Gold Mining Co. on Smith Creek (Hugh Boyle claims—bulldozer-hydraulic), Frank J. Miller on Sheep Creek (bulldozer-hydraulic), R. H. Jones on Nolan and Smith benches (hydraulic), and J. B. Blundell, who recovered 52 ounces of gold and 4 ounces of silver by drift mining on the Beaver Association property on Wakeup Creek.

Marshall District.—The Yukon Mining Co. operated a dragline-bulldozer combination on Buster Creek during a short period in 1948. Production from the district was relatively small.

Rampart District.—The Little Minook Mining Co. operated on Little Minook Creek during the 1948 season and recovered 1,331 ounces of gold and 45 ounces of silver from 103,000 cubic yards of gravel, using a dragline-bulldozer-hydraulic combination. The Hunter Creek Mining Co. recovered gold as a result of hydraulic stripping operations on Hunter Creek during 1948. Frank J. Dinan recovered a small quantity of gold from claim No. 2 below on Florida Creek by drift mining.

Ruby District.—Peter Miscovich & Sons, hydraulicking on Flat Creek, June through September, was the largest gold producer in the district in 1948; mechanical equipment used included a dragline excavator and bulldozers. Other producers of substantial quantities of gold in the district using this or similar type of equipment were Coyle & Rassmussen, operating the Midnight claim on Midnight Creek (Fox Association); Iver M. Johnson & Co., on Trail Creek; and the Long Creek Mining Co., on Long Creek.

Tolovana District.—Olive Creek Mines, the largest producer in the Tolovana district in 1948, operated a dragline-bulldozer combination on the N. R. Hudson property on Olive Creek near Livengood from May 15 to September 13. Warwick Mines, using a bulldozer-hydraulic combination on the Lucky Strike claim on Glenn Gulch, tributary of Gertrude Creek, from May 10 to September 17, recovered 504 ounces of gold and 48 ounces of silver from 100,000 cubic yards of gravel. The left limit of Amy Creek bench was worked by the Amy Creek Mining Co. from April 15 to October 5; gravel was handled by a bulldozer-hydraulic combination and washed in bedrock sluice boxes; the tailings were moved with a dragline. Wilbur Mines hydraulicked on Wilbur Creek in conjunction with bulldozers during a 4-month period. Hydraulicking was used by Jurich & Car on Lillian Creek and by John Radok on Ruth Creek.

OTHER MINERALS

Antimony.—Stampede Mines, Inc., operated the Stampede mine in Kantishna district and was the only company reporting shipments of antimony ore or concentrates from Alaska during 1948. Shipments were 68 tons of concentrates containing 88,359 pounds of antimony. Near Rampart the Sawtooth Mining Co. was active in developing an antimony occurrence, and a considerable tonnage of ore was reportedly ready for shipment. In the Fairbanks district the Alaska Antimony Mining Co. was developing a lode property on Boulder Creek near Tok-Salinas Road.

Clays.—Small quantities of clay suitable for local manufacture of common brick and fire brick were produced in 1948 from deposits near Anchorage and at Sheep Mountain east of Palmer on the Glenn Highway. A small-capacity brick plant was operated at Anchorage in 1948 by Clay Products Co., Inc.

Coal.—Alaska mined 410,000 short tons (preliminary figure) of bituminous coal and lignite in 1948—a new record production. The output was 14 percent greater than in 1947 and 12 percent higher than the previous record production of 366,809 tons in 1946, due largely to full-scale stripping operations at three properties in the Nenana field, about 75 miles southwest of Fairbanks. Of interest in connection with these operations—of which the Usibelli mine was the largest—was the removal of gravel and sandstone overburden by the use of bulldozers and hydraulic giants before extraction of coal by the usual power shovels. The principal underground mines include the Suntrana in the Nenana field operated by the Healy River Coal Corp., and the Evan Jones Coal Co. Jonesville mine in the Matanuska field, 45 miles northeast of Anchorage.

Gem Stones.—No jade (nephrite) was reported produced in the Kobuk River area in 1948. Arctic Circle Exploration Co., Inc., has been the principal producer and fabricator of this material.

Graphite.—Although no production was reported, a graphite deposit on the south shore of Imuruk Basin was prospected and sampled in 1948 by the Alaska Graphite Syndicate.

Limestone.—The Permanente Cement Co. made regular shipments of limestone during 1948 from its quarry on Dall Island in the Ketchikan District, Southeastern Alaska, to Washington State for the manufacture of cement.

Mercury.—The Decoursey Mountain mine, 24 miles from Crooked Creek, was the only producer of mercury in Alaska in 1948. A total of 50 tons of ore was treated in two D retorts, and 100 flasks of metal were recovered. About 450 feet of development drift were driven with low-grade showings along most of the distance. Backs of 140 to 190 feet, all unmined, exist above this development drift.

A report [1] on the Rainy Creek mercury prospect, which lies at the western base of the Kilbuck Mountains, about 80 miles southeast of Bethel, in southwestern Alaska, was published in 1948. The deposits are believed to have been discovered between 1910–20. Production of mercury from the area has been solely from cinnabar concentrates recovered as a result of gold placer operations. About 2,000 pounds of high-grade concentrate were said to have been shipped.

Platinum Metals.—Placer deposits in the Goodnews Bay district in the Kuskowim region in 1948 continued to yield a substantial quantity of crude platinum containing a small percentage of gold.

[1] Rutledge, F. A., Investigation of the Rainy Creek Mercury Prospect,' Bethel District, Kuskowim Region, Southwestern Alaska: Bureau of Mines Rept. of Investigations 4361, 1948, 7 pp.

Pumicite.—The Alaska Katmalite Corp. was active during 1948 in the manufacture of building blocks at its small plant at Anchorage. The pumicite raw material used as aggregate in the blocks was mined from deposits developed on Augustine Island, Iliamna district, on the west side of Cook Inlet.

Sand and Gravel.—Production of sand and gravel in Alaska was reported by R. J. Sommers Construction Co., Juneau, Alaska; the Alaska Road Commission; and the Corps of Engineers, Department of the Army.

Tin.—The Arctic Tin Co. developed tin placers in the York area (Port Clarence district) near the western tip of the Seward Peninsula in 1948, using dragline-bulldozer equipment. The Cleary Hill Mines Co. recovered a small quantity of tin concentrate as a byproduct of its placer-gold operations near Tofty in the Hot Springs district.

Tungsten.—The J. H. Scott Co., operating the Riverside mine near Hyder, Southeastern Alaska, produced a small quantity of concentrate from ore mined chiefly for its lead content in 1948.

Miscellaneous Minerals.—There was no recorded production of asbestos, chromite, or petroleum in Alaska in 1948.

Arizona
Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By C. E. NEEDHAM AND PAUL LUFF

GENERAL SUMMARY

THE MINING of copper ore, the most important part of Arizona's mining industry, rose to 39,072,204 tons in 1948, the largest annual output in the history of the State, exceeding the record established in 1947 by 1,261,756 tons (3 percent). The State also made a record output (664,603 tons—40,206 tons more than in 1947) of zinc-lead ore. These increases in ore output in 1948 resulted in a record production of lead, the greatest output of silver and copper since 1943, and the greatest yield of gold since 1944; the output of zinc declined only 332,000 pounds from the record output of 1947. The State remained the largest producer of copper in the United States, ranked third in zinc, and again ranked first in total value of the five metals. Production in 1948 (in terms of recoverable metals) was 109,487 fine ounces of gold, 4,837,740 fine ounces of silver, 750,242,000 pounds of copper, 59,798,000 pounds of lead, and 108,956,000 pounds of zinc, indicating increases over 1947 of 14 percent in gold, 6 percent in silver, 2 percent in copper, and 5 percent in lead; zinc declined slightly (about 0.3 percent). The total value of the five metals was $196,207,948 in 1948, the highest value since 1918 and a 7-percent gain over 1947. The total value of the gold was $3,832,045—2 percent of the State total value; silver, $4,378,399—2 percent; copper $162,802,514—83 percent; lead $10,703,842—6 percent; and zinc, $14,491,148—7 percent. The value of the metals recovered from copper ore was $166,494,997 in 1948 ($157,260,992 in 1947) or 85 percent of the State total. About 90 percent of the State gold production and 75 percent of the silver in 1948 came from six districts—Ajo, Big Bug, Copper Mountain (Morenci), Pioneer (Superior), Verde (Jerome), and Warren (Bisbee); 99 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 five districts—Big Bug, Harshaw, Old Hat, Pima, and Warren (Bisbee); and 94 percent of the zinc came from seven districts—Big Bug, Cochise (Dragoon), Eureka (Bagdad), Harshaw, Old Hat, Pima, and Warren (Bisbee).

Outstanding features of Arizona's mining activities in 1948 were completion in March of open-pit development and construction at the Inspiration copper property at Inspiration in Gila County, development and construction of an open pit at the Ray copper property of the Kennecott Copper Corp. in Pinal County, and installation of a power plant and construction of other facilities by the Magma Copper Co. for underground exploration at the San Manuel property, also in Pinal 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, 1944–48

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1944	$35.00	$0.711+	$0.135	$0.080	$0.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122
1947	35.00	.905	.210	.144	.121
1948	35.00	.905+	.217	.179	.133

[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. 1944 to June 30, 1946: $0.71111111; July 1, 1946, to Dec. 31, 1947: $0.905; 1948: $0.9050505.
[3] Yearly average weighted price of all grades of primary metal sold by producers; 1944-47: price includes bonus payments by Office of Metals Reserve for overquota production.

Mine production of gold, silver, copper, lead, and zinc in Arizona, 1944–48, and total, 1860–1948, in terms of recovered metals

Year	Mines producing: Lode	Mines producing: Placer	Ore (short tons)	Gold (lode and placer): Fine ounces	Gold (lode and placer): Value	Silver (lode and placer): Fine ounces	Silver (lode and placer): Value
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
1947	315	30	38,636,280	95,860	3,355,100	4,569,084	4,135,021
1948	360	39	39,925,686	109,487	3,832,045	4,837,740	4,378,399
1860–1948	-------	-------	(1)	11,073,506	275,067,865	302,094,238	225,778,119

Year	Copper: Pounds	Copper: Value	Lead: Pounds	Lead: Value	Zinc: Pounds	Zinc: Value	Total value
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
1947	732,436,000	153,811,560	57,132,000	8,227,008	109,288,000	13,223,848	182,752,537
1948	750,242,000	162,802,514	59,798,000	10,703,842	108,956,000	14,491,148	196,207,948
1860–1948	[2] 11,919,431	3,625,890,876	[2] 432,522	67,291,982	[2] 386,592	81,088,917	4,275,117,759

[1] Figure not available.
[2] Short tons.

The average price of copper, lead, and zinc rose in 1948—copper to \$0.217 per pound, lead to \$0.179 per pound, and zinc to \$0.133 per pound. The price of gold remained at \$35 per fine ounce and silver at \$0.905+ per fine ounce. The average price of copper in 1948 was the highest since the war year 1918, when it was 24.7 cents per pound;

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1948, by months, in terms of recovered metals

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	8,942	383,900	31,335	2,095	3,960
February	8,340	362,750	29,430	2,285	4,370
March	9,370	410,975	31,565	2,735	5,050
April	9,045	419,250	31,750	2,410	4,440
May	9,285	429,400	30,920	2,385	4,170
June	9,240	417,750	31,820	2,475	4,223
July	9,025	381,750	30,570	2,510	4,370
August	8,430	394,600	30,225	2,605	4,925
September	8,550	375,200	28,470	2,405	4,330
October	9,240	406,165	32,396	2,536	4,510
November	9,440	415,500	32,375	2,638	4,945
December	10,580	440,500	34,265	2,820	5,185
Total: 1948	109,487	4,837,740	375,121	29,899	54,478
1947	95,860	4,569,084	366,218	28,566	54,644

Gold produced at placer mines in Arizona, 1944–48, by classes of mines and methods of recovery

Class and method	Mines producing	Material treated (cubic yards)	Gold recovered: Fine ounces	Gold recovered: Value	Gold recovered: Average per cubic yard
Surface placers:					
Gravel mechanically handled:					
Dragline dredges:					
1944–45					
1946	1	160,000	185	\$6,475	\$0.04
1947–48					
Nonfloating washing plants:[1]					
1944–45					
1946	2	6,000	116	4,060	.68
1947	2	2,700	34	1,190	.44
1948	3	97,800	637	22,295	.23
Small-scale hand methods:					
Wet and dry:					
1944	16	3,000	238	8,330	2.78
1945	16	3,500	535	18,725	5.35
1946	26	2,000	81	2,835	1.42
1947	19	6,500	241	8,435	1.30
1948	25	2,960	185	6,475	2.19
Underground placers:					
Drift:					
1944	1	70	4	140	2.00
1945	2	80	5	175	2.19
1946	4	200	16	560	2.80
1947	9	200	39	1,365	6.83
1948	11	135	16	560	4.15
Grand total placers:					
1944	17	3,070	242	8,470	2.76
1945	18	3,580	540	18,900	5.28
1946	33	168,200	398	13,930	.08
1947	30	9,400	314	10,990	1.17
1948	39	100,895	838	29,330	.29

[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."

the average price of lead was the highest of any year since average metal prices were established in 1850; and the average price of zinc was virtually the same as that in 1916 (13.4 cents per pound), when it was the highest average price ever recorded.

Gold.—Most of the gold produced in Arizona is a byproduct of copper ore and zinc-lead ore; and due to a substantial increase in both classes of ore in 1948, the State output of gold rose to 109,487 ounces, a 14-percent gain over 1947. In 1948, 77 percent of the State gold output was recovered from copper ore, 14 percent from zinc-lead ore, 6 percent from siliceous ores, and most of the remainder from lead ore and zinc-copper ore and from placers. Gold from copper ore increased 8,680 ounces, that from siliceous ores 2,326 ounces, and that from zinc-lead ore 1,722 ounces. Gold from placers increased from 314

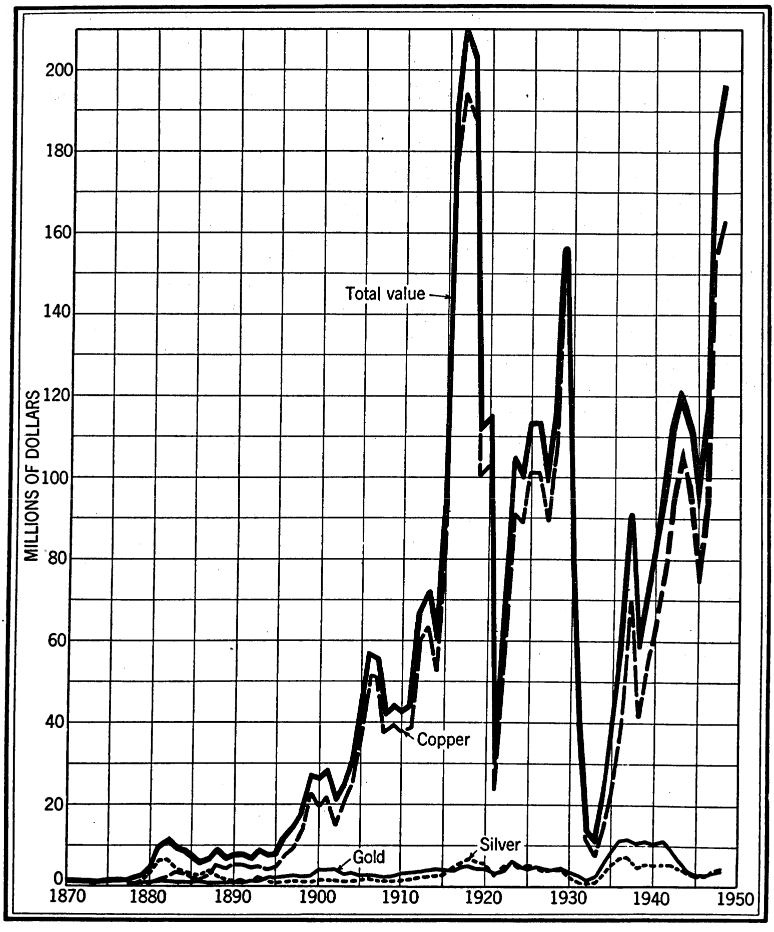

FIGURE 1.—Value of mine production of gold, silver, and copper and total value of gold, silver, copper, lead, and zinc in Arizona, 1870–1948. The value of lead and zinc has been less than $2,000,000 annually, except in a few years.

ounces to 838 ounces. The New Cornelia mine of the Phelps Dodge Corp. in Pima County continued to be the leading gold producer in Arizona; it was followed by the Copper Queen (Bisbee) branch of the Phelps Dodge Corp. in Cochise County, the Iron King mine in Yavapai County, the Magma mine in Pinal County, the Morenci branch of the Phelps Dodge Corp. in Greenlee County, the United Verde branch of the Phelps Dodge Corp. in Yavapai County, and the Verde Exploration property, also in Yavapai County; these seven properties (all copper mines except the Iron King and Verde Exploration) produced 90 percent of the State total gold.

Silver.—Most of the silver produced in Arizona is a byproduct of copper ore and zinc-lead ore, and in 1948 these two classes of ore yielded 4,358,986 ounces of silver (90 percent of the State total) compared with 4,181,916 ounces in 1947. Copper ore yielded 2,814,833 ounces of silver (58 percent of the State total) and zinc-lead ore 1,544,153 ounces (32 percent); the remainder came principally from siliceous ores, lead ore, zinc-copper ore, and zinc-lead-copper ore. Silver from copper ore increased 231,569 ounces or 9 percent, but that from zinc-lead ore declined 54,499 ounces or 3 percent; silver from siliceous ores increased 93,999 ounces or 43 percent. The Phelps Dodge Corp. continued to be the chief silver producer in Arizona, and its output was about 100,000 ounces more than in 1947; its four properties (Copper Queen, Morenci, New Cornelia, and United Verde) produced 67 percent of the State gold output, more than 59 percent of the silver, and 63 percent of the copper; and its Copper Queen branch also produced nearly 38 percent of the State's lead and 51 percent of the zinc. Other large silver producers in Arizona in 1948 were Iron King, Magma, Flux-January-Norton, and San Xavier (Eagle-Picher Mining & Smelting Co.) properties.

Copper.—With no work stoppages and a rise in the price of copper in 1948, Arizona's output of recoverable copper rose to 750,242,000 pounds, the largest output since 1943 and a 2-percent gain over 1947. The Copper Mountain (Morenci) district, with an output of 296,632,000 net pounds of copper, remained the leading copper-producing area in the State; it was followed by the Globe-Miami district with 176,956,200 pounds, Ajo with 111,230,400, Warren (Bisbee) with 38,407,300, Mineral Creek (Ray) with 37,505,400, Pioneer (Superior) with 37,440,700, Verde (Jerome) with 29,087,800, and Eureka (Bagdad) with 14,494,000. Substantial increases in copper output were made in each of these districts except the Globe-Miami, Mineral Creek (Ray), and Verde (Jerome). Copper ore and its products yielded 741,906,998 pounds of copper as follows: 34,632,227 tons of copper ore treated by concentration yielded 80.1 percent; 686,780 tons of copper ore shipped crude to smelters 8.2 percent; and 3,753,197 tons of copper ore leached and 11,783 tons of cement copper (from mine-water precipitates and underground leaching operations) 11.7 percent. The Morenci branch of the Phelps Dodge Corp. was again the largest copper producer in Arizona; it was followed in order by the New Cornelia branch of the Phelps Dodge Corp., Inspiration, Castle Dome, Miami, Copper Queen branch of the Phelps Dodge Corp., Magma, Ray (Kennecott Copper Corp.), United Verde branch of the Phelps Dodge Corp., and Bagdad properties.

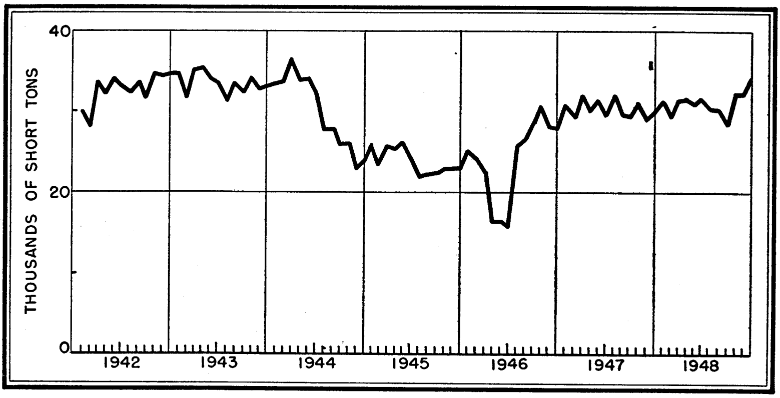

FIGURE 2.—Mine production of copper in Arizona, 1942–48, by months, in terms of recovered metal.

Lead and Zinc.—In 1948 Arizona exceeded its 1947 record output of lead and nearly equaled its 1947 record output of zinc. The production of lead in 1948 (59,798,000 pounds) was the largest for any year in the history of the State, and the production of zinc (108,956,000 pounds) was only 332,000 pounds less than the record output in 1947; the lead output exceeded that of 1947 by 2,666,000 pounds or nearly 5 percent. Arizona mines have succeeded in setting a record lead output each year since 1944. Despite a 16-percent decrease in lead production and 15-percent in zinc production, the Copper Queen mine of the Phelps Dodge Corp. at Bisbee remained by far the largest producer of lead and zinc in Arizona in 1948. 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 Flux-January-Norton group near Patagonia. Other large producers of zinc, in order of output, were the Iron King, San Xavier, St. Anthony, Republic & Mammoth (Coronado Copper and Zinc Co.), Flux-January-Norton, and Old Dick properties. Of the State total, 38 percent of the lead and 51 percent of the zinc came from the Warren (Bisbee) district in Cochise County. Other large producing districts of both lead and zinc were the Old Hat in Pinal County, Big Bug in Yavapai County, Pima in Pima County, Harshaw in Santa Cruz County, Aravaipa in Graham County, and Wallapai in Mohave County. About 90 percent of the total lead and 88 percent of the total zinc came from zinc-lead ore; 9 percent of the total lead came from lead ore, and most of the remainder of the lead from zinc-lead-copper ore and zinc-copper ore; and 10 percent of the total zinc came from zinc-copper ore, and nearly all the rest from zinc-lead-copper ore and zinc ore.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1948, 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	29		20,385	$713,475	1,557,818	$1,409,904
Coconino	1		4	140	1,264	1,144
Gila	29		2,819	98,665	155,757	140,968
Graham	7		197	6,895	17,251	15,613
Greenlee	6		9,337	326,795	740,520	670,208
Maricopa	16	5	108	3,780	20,317	18,388
Mohave	34		778	27,230	34,997	31,674
Pima	31	1	39,219	1,372,665	631,810	571,820
Pinal	47		12,188	426,580	506,374	458,294
Santa Cruz	25		156	5,460	235,672	213,295
Yavapai	94	17	24,099	843,465	926,534	838,560
Yuma	41	16	197	6,895	9,426	8,531
Total: 1948	360	39	109,487	3,832,045	4,837,740	4,378,399
1947	315	30	95,860	3,355,100	4,569,084	4,135,021

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Cochise	40,441,600	$8,775,827	25,089,600	$4,491,038	61,852,000	$8,226,316	$23,616,560
Coconino	299,000	64,883					66,167
Gila	178,418,100	38,716,728	587,000	105,073	2,600	346	39,061,780
Graham	106,000	23,002	2,283,200	408,693	2,196,000	292,068	746,271
Greenlee	296,632,000	64,369,144	4,800	859			65,367,006
Maricopa	307,000	66,619	10,900	1,951			90,738
Mohave	728,400	158,063	1,055,300	188,899	1,457,000	193,781	599,647
Pima	112,470,800	24,406,164	8,077,600	1,445,890	11,712,000	1,557,696	29,354,235
Pinal	75,661,000	16,418,437	11,810,400	2,114,062	7,600,400	1,010,853	20,428,226
Santa Cruz	273,000	59,241	4,551,600	814,736	6,534,400	869,075	1,961,807
Yavapai	44,887,200	9,740,522	6,036,400	1,080,516	17,598,000	2,340,534	14,843,597
Yuma	17,900	3,884	291,200	52,125	3,600	479	71,914
Total: 1948	750,242,000	162,802,514	59,798,000	10,703,842	108,956,000	14,491,148	196,207,948
1947	732,436,000	153,811,560	57,132,000	8,227,008	109,288,000	13,223,848	182,752,537

MINING INDUSTRY

The upward trend of Arizona's mining industry that began in 1947 continued throughout 1948 at an accelerated pace; with no work stoppages at the mines in 1948 and with substantial increases in the prices of copper, lead, and zinc, mining of all classes of ore reached a record output of 39,925,686 tons, 1,289,406 tons more than the record output of 1947. The outputs of copper ore (39,072,204 tons) and zinc-lead ore (664,603 tons) were the highest in the history of the State; copper ore increased 3 percent from 37,810,448 tons in 1947 and zinc-lead ore 6 percent from 624,397 tons. Zinc-copper ore increased to 101,405 tons—a 23-percent gain; but siliceous ores declined to 56,090 tons—a 23-percent loss; lead ore to 23,231 tons—a 5-percent loss; and zinc ore and zinc-lead-copper ore to 7,911 tons—a 63-percent loss. Of the State total ore, 38,967,623 tons (97.6 percent) was copper ore mined in the Copper Mountain (Morenci), Globe-Miami, Ajo, Mineral Creek (Ray), Eureka (Bagdad), Verde

(Jerome), Warren (Bisbee), and Pioneer (Superior) districts, and 656,763 tons (98.8 percent) of the State total zinc-lead ore was mined in the Warren (Bisbee), Big Bug, Old Hat (Oracle), Pima, Harshaw, Aravaipa, and Wallapai (Chloride) districts. Mining operations at five open pits—Ajo, Bagdad, Inspiration, Miami (Castle Dome), and Morenci—produced 29,638,873 tons of copper ore in 1948 compared with four open pits in 1947, which produced 26,818,513 tons. Labor was more plentiful in 1948 than in 1947, but at the close of the year a shortage still existed at some of the underground copper mines and at some zinc-lead mines.

ORE CLASSIFICATION

Details of ore classification are given in the Gold and Silver chapter of this volume.

Ore sold or treated in Arizona in 1948, 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	67	13,117	5,523	22,254	138,874	27,521	23,320
Dry and siliceous gold-silver ore	9	15,265	770	38,205	51,517	2,091	----------
Dry and siliceous silver ore	36	27,708	605	251,826	29,889	19,373	----------
	112	56,090	6,898	312,285	220,280	48,985	23,320
Copper ore	104	39,072,204	84,391	[1]2,814,833	[2]741,906,998	----------	----------
Lead ore	123	23,231	1,045	80,464	119,720	5,518,805	78,991
Lead-copper ore	6	242	10	1,607	11,922	49,728	2,035
Zinc ore	4	3,966	17	2,895	19,450	19,350	518,750
Zinc-copper ore	9	101,405	926	65,811	3,585,415	207,037	11,270,128
Zinc-lead ore	52	664,603	15,361	1,544,153	4,288,582	53,713,595	96,339,476
Zinc-lead-copper ore	3	3,945	1	15,556	89,633	240,500	723,300
Total lode mines	[3]360	39,925,686	108,649	[1]4,837,604	[2]750,242,000	59,798,000	108,956,000
Placers	39	----------	838	136	----------	----------	----------
Total: 1948	399	39,925,686	109,487	[1]4,837,740	[2]750,242,000	59,798,000	108,956,000
1947	345	38,636,280	95,860	[4]4,569,084	[5]732,436,000	57,132,000	109,288,000

[1] Includes 80 ounces recovered from underground mine-water precipitates.
[2] Includes 86,709,683 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 255 ounces recovered from underground mine-water precipitates.
[5] Includes 83,310,570 pounds recovered from ore leached and mine-water precipitates.

METALLURGIC INDUSTRY

Of the 39,925,686 tons of ore produced in 1948 in Arizona, 35,412,392 tons (89 percent) were treated at 34 milling plants and 3,753,197 tons (9 percent) at 2 leaching plants; the remainder, 760,097 tons (2 percent), was shipped crude to smelters.

Ore treated at milling plants in 1948 comprised chiefly 34,632,227 tons of copper ore, 659,936 tons of zinc-lead ore, and 101,405 tons of zinc-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 mine was treated by straight leaching. The large copper-concentration plants at Morenci (45,000-ton a day), Ajo (25,000-ton), Miami (18,000-ton), Inspiration (18,000-ton), Castle Dome (10,000-ton), Hayden (10,000-ton), Bagdad (3,000-ton), Clarkdale (2,100-ton), and Superior (1,150-

ton); the copper-leaching plants at Inspiration (9,000-ton) and Miami (3,000-ton); and the zinc-lead concentration mills at Bisbee (Copper Queen 900-ton and Shattuck Denn 150-ton), Sahuarita (Eagle-Picher 500-ton), Humboldt (Iron King 470-ton), Tiger (St. Anthony 500-ton), Patagonia (Trench 200-ton), and Chloride (Tennessee 150-ton) were operated continuously in 1948, most of them at a higher rate than in 1947. The copper smelters of the Phelps Dodge Corp. at Clarkdale, Douglas, and Morenci, the International Smelting & Refining Co. copper smelter at Miami, the American Smelting & Refining Co. copper smelter at Hayden, and the Magma Copper Co. copper smelter at Superior operated continuously throughout the year. 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 1948 were shipped to the smelter at El Paso, Tex., and all the zinc concentrates were shipped to smelters at Amarillo and Dumas, Tex.; Fort Smith, Ark.; Henryetta, Okla.; and Great Falls, Mont.

The following tables give details of the treatment of ores produced in Arizona in 1948.

Mine production of metals in Arizona in 1948, 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	213	46	22			
Concentrates smelted	1,502,513	78,047	3,314,406	602,299,717	53,994,566	108,771,346
Ore smelted	760,097	30,556	1,523,096	61,232,600	5,803,434	184,654
Copper precipitates smelted	11,783		80	[1] 16,874,713		
Copper ore leached	[2] 3,753,197			69,834,970		
Placer		838	136			
Total: 1948		109,487	4,837,740	750,242,000	59,798,000	108,956,000
1947		95,860	4,569,084	732,436,000	57,132,000	109,288,000

[1] Distributed as follows: Cochise County, 423,470 pounds; Gila County, 8,220,218 pounds; Greenlee County, 1,115,730 pounds; Mohave County, 581,268 pounds; Pinal County, 6,342,027 pounds; and Yavapai County, 192,000 pounds.
[2] Treated by straight leaching at 1 plant in Gila County and 1 plant in Mohave County.

Gross metal content of Arizona ore treated at mills in 1948, by classes of ore[1]

Class of ore	Ore (short tons)	Gross metal content of mill feed				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	1,813	230	3,954	3,150	30,350	50,000
Dry and siliceous silver	20		600		500	1,500
Copper	34,632,227	78,049	2,110,968	704,753,920		6,210,200
Lead	8,975	345	23,524	14,317	1,266,023	129,021
Lead-copper	105	8	1,176	5,217	11,018	2,880
Zinc	3,966	25	3,840	29,451	28,205	697,066
Zinc-copper	101,405	1,054	83,255	4,131,549	352,225	16,745,137
Zinc-lead	659,936	23,091	1,877,432	5,750,629	60,714,067	126,725,914
Zinc-lead-copper	3,945	2	17,982	139,892	275,416	896,241
Total: 1948	35,412,392	102,804	4,122,731	714,828,125	62,677,804	151,457,959
1947	34,253,711	91,825	4,048,770	711,011,939	60,898,992	148,392,996

[1] Exclusive of copper ore by leaching.

Gross metal content of concentrates produced from ores mined in Arizona in 1948, 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	59	118	1,948	947	5,827	8,885
Dry silver	4	-----	523	-----	391	1,055
Copper	1,328,187	63,630	1,800,783	611,839,927	4,692	5,756,290
Lead	55,923	11,611	1,155,506	3,351,796	50,543,705	10,711,603
Lead-copper	1,057	29	24,614	216,406	456,565	400,181
Zinc	107,136	2,615	416,157	2,264,742	5,626,620	113,355,097
Zinc-lead	135	23	5,426	9,565	106,951	133,918
Zinc-lead-copper	176	34	4,887	29,379	46,056	63,534
Iron	9,836	1,462	25,718	19,989	228,880	1,543,007
Total: 1948	1,502,513	79,522	3,435,562	617,732,751	57,019,687	131,973,570
1947	1,268,436	67,436	3,343,851	608,981,612	54,867,954	131,626,715

Mine production of metals from mills in Arizona in 1948, by counties and by classes of concentrates smelted, in terms of recovered metals

	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)
				BY COUNTIES					
Cochise	297,221	-----	-----	85,981	2,416	634,766	4,461,343	23,552,849	61,852,000
Gila	8,343,639	2	-----	140,738	2,546	140,600	98,686,247	4,010	2,600
Graham	25,708	-----	-----	2,549	6	5,918	23,226	818,592	2,041,000
Greenlee	15,567,480	-----	-----	560,897	8,635	600,000	293,975,000	-----	-----
Mohave	18,276	1	-----	2,341	494	26,846	57,383	842,925	1,442,700
Pima	7,809,950	-----	-----	210,586	38,649	622,272	111,804,496	7,924,704	11,712,000
Pinal	1,911,139	-----	-----	347,976	10,932	384,388	64,052,599	10,756,773	7,591,400
Santa Cruz	66,621	29	20	10,034	73	223,592	243,073	4,225,393	6,531,646
Yavapai	1,368,902	2	1	141,230	14,296	672,948	28,996,350	5,724,043	17,598,000
Yuma	3,456	12	1	181	-----	3,076	-----	145,277	-----
Total: 1948	35,412,392	46	22	1,502,513	78,047	3,314,406	602,299,717	53,994,566	108,771,346
1947	34,253,711	1,284	7,090	1,268,432	65,526	3,190,574	593,765,129	51,614,538	109,268,900
				BY CLASSES OF CONCENTRATES					
Gold				59	118	1,948	805	5,593	-----
Silver				4	-----	523	-----	375	-----
Copper				1,328,187	62,508	1,722,765	597,296,750	1,112	108,240
Lead				55,923	11,611	1,155,506	2,848,236	48,525,161	2,417,278
Lead-copper				1,057	29	24,614	191,017	438,479	23,200
Zinc				107,136	2,267	373,701	1,912,197	4,667,874	105,739,414
Zinc-lead				135	18	4,744	8,010	93,261	111,757
Zinc-lead-copper				176	34	4,887	25,693	43,362	49,670
Iron				9,836	1,462	25,718	17,009	219,349	321,787
Total 1948				1,502,513	78,047	3,314,406	602,299,717	53,994,566	108,771,346

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Gross metal content of Arizona crude ore shipped to smelters in 1948, 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	11,304	5,324	18,867	144,292	7,283	4,300
Dry and siliceous gold-silver	15,265	770	38,205	88,860	3,611	
Dry and siliceous silver	27,688	605	251,303	33,991	27,852	3,085
Copper	686,780	22,712	1,138,923	63,891,522	8,000	7,142,584
Lead	14,256	856	61,695	131,311	4,695,177	259,825
Lead-copper	137	5	578	9,328	42,109	
Zinc-lead	4,667	284	13,525	88,792	1,288,599	973,491
Total: 1948	760,097	30,556	1,523,096	64,388,096	6,072,631	8,383,285
1947	710,769	28,711	1,371,127	58,328,146	5,743,649	5,403,387

Mine production of metals from Arizona crude ore shipped to smelters in 1948, in terms of recovered metals

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES						
Cochise	325,213	17,969	922,972	35,556,787	1,536,751	
Coconino	2,140	4	1,264	299,000		
Gila	40,007	271	15,157	1,676,665	582,990	
Graham	5,448	191	11,333	82,774	1,464,608	155,000
Greenlee	85,403	702	140,520	1,541,270	4,800	
Maricopa	3,677	98	20,317	307,000	10,900	
Mohave	1,752	283	8,151	89,749	212,375	14,300
Pima	12,125	35	9,433	666,304	152,896	
Pinal	65,580	1,256	121,986	5,266,374	1,053,627	9,000
Santa Cruz	1,665	54	12,060	29,927	326,207	2,754
Yavapai	216,424	9,535	253,554	15,698,850	312,357	
Yuma	663	158	6,349	17,900	145,923	3,600
Total: 1948	760,097	30,556	1,523,096	61,232,600	5,803,434	184,654
1947	710,769	28,711	1,371,127	55,360,282	5,517,462	19,100
BY CLASSES OF ORE						
Dry and siliceous gold	11,304	5,324	18,867	137,029	6,609	
Dry and siliceous gold-silver	15,265	770	38,205	51,517	2,091	
Dry and siliceous silver	27,688	605	251,303	29,889	18,998	
Copper	686,780	22,712	1,138,923	60,820,312		
Lead	14,256	856	61,695	110,561	4,498,271	2,754
Lead-copper	137	5	578	7,952	40,179	
Zinc-lead	4,667	284	13,525	75,340	1,237,286	181,900
Total 1948	760,097	30,556	1,523,096	61,232,600	5,803,434	184,654

REVIEW BY COUNTIES AND DISTRICTS

COCHISE COUNTY

California District.—Portal Mines Development Co. operated the King-Ainsworth group near Portal and shipped 501 tons of ore, containing 4 ounces of gold, 800 ounces of silver, 2,400 pounds of copper, 60,000 pounds of lead, and 110,000 pounds of zinc, to custom flotation mills in Arizona. The rest of the district output was mainly 208 tons of zinc-lead ore produced from the Pine-Zinc mine and 166 tons of lead ore from the Leadville group.

Cochise District.—The Republic and Mammoth mines of the Coronado Copper & Zinc Co. near Dragoon were the only producers in the Cochise district in 1948. The company reported that 67,150 tons of zinc-copper ore were treated in its 150-ton flotation mill, which yielded 3,095 tons of copper concentrate and 6,042 tons of zinc concentrate.

Dos Cabezas and Tevis District.—Output in 1948 was 36 tons of zinc-lead ore produced from the LeRoy Consolidated Mines.

Hartford (Huachuca Mountains) District.—Short Bros. worked the Armistice group nearly all year and shipped 156 tons of lead ore to the smelter at El Paso, Tex.

Swisshelm (Elfrida) District.—Edwin Larson operated the Scribner mine throughout the year and shipped 6,148 tons of lead ore containing 409 ounces of gold, 22,198 ounces of silver, 12,366 pounds of copper, 1,388,413 pounds of lead, and 163,043 pounds of zinc. Similar ore (1,230 tons) was produced also from the Chance mine by the Chance Mining Co. In addition, the company shipped 267 tons of zinc-lead ore to a custom flotation mill at Bisbee, Ariz.

Tombstone District.—The output of the Tombstone district in 1948 was 19,229 tons of ore and old tailings containing 686 ounces of gold, 68,820 ounces of silver, 96,784 pounds of copper, 260,072 pounds of lead, and 140,000 pounds of zinc. The largest output was 13,865 tons of old tailings (containing 595 ounces of gold, 33,375 ounces of silver, and 76,361 pounds of copper) shipped from the Grand Central dump near Fairbank. Lessees worked the Tombstone group, shipped 892 tons of silver ore and 558 tons of gold-silver ore, and milled 730 tons of lead ore. The rest of the district output was principally 1,500 tons of zinc-lead ore produced from the Mary Jo mine by the Charleston Lead Mines Co. and 1,369 tons of silver ore produced from the San Pedro mine by the Allison Mines, Inc.

Turquoise (Courtland, Pearce, Gleeson) District.—Nearly all the output of the Turquoise district in 1948 was 3,798 tons of zinc ore containing 3 ounces of gold, 3,720 ounces of silver, 26,775 pounds of copper, 27,215 pounds of lead, and 668,018 pounds of zinc. The Billingsley Machinery Co. worked the San Juan group and milled 2,584 tons of zinc ore, and the Shattuck Denn Mining Corp. worked the Abril group and hauled 1,214 tons of similar ore to its custom flotation mill at Bisbee.

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1948 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	8		922	2		2	1,074		1,074	2,400	155,600	89,000	$41,252
Cochise	1		67,150				15,777		15,777	1,936,700		5,749,300	1,199,200
Dos Cabezas and Tevis	1		36	13		13	180		180	300	5,000	8,600	2,722
Golden Rule	1		1								200		36
Hartford	2		157	6		6	1,054		1,054	300	59,400		11,862
Smelter			1,376	236		236	8,277		8,277	8,400	474,600		102,527
Swisshelm	3		7,646	363		363	28,246		28,246	13,600	1,653,900	90,700	349,331
Tombstone	9		19,229	681		681	68,225		68,225	52,000	217,000	80,700	146,442
Turquoise	3		3,815	1		1	2,813		2,813	20,600	18,800	496,600	76,464
Warren	1		522,102	19,083		19,083	1,432,172		1,432,172	38,407,300	22,505,100	55,337,100	21,686,724
Coconino County: Jacob Canyon	1		2,140	4		4	1,264		1,264	299,000			66,167
Gila County:													
Banner and Dripping Springs	8		34,583	246		246	11,164		11,164	1,455,800	499,800	2,600	424,433
Globe-Miami	14		12,068,163	2,564		2,564	143,887		143,887	176,956,200	87,200		38,635,069
Green Valley	2		6	6		6	32		32	100			261
Pioneer [1]	3		69	3		3	664		664	800			880
Summit	2		22				10		10	5,200			1,137
Graham County:													
Aravaipa	5		31,146	195		195	17,240		17,240	105,600	2,283,200	2,196,000	746,104
Clark	2		10	2		2	11		11	400			167
Greenlee County:													
Ash Peak	2		14,768	530		530	135,356		135,356				141,054
Copper Mountain (Morenci)	3		15,638,084	8,804		8,804	605,153		605,153	296,632,000	700		65,225,103
Metcalf	1		31	3		3	11		11		4,100		849
Maricopa County:													
Big Horn	2		53	2		2	116		116	4,000	4,600		1,866
Cave Creek and Camp Creek	3		106	6		6	19,242		19,242	33,600			24,916
Gila Bend Mountains	1		3	1		1							35
Goldfields	1		7	3		3	31		31				133
New River	1		3,436	36		36	833		833	266,400			59,823
Osborn	1		32				52		52	2,900			676
Pikes Peak	1	1	3		1	1	11		11		900		206
San Domingo		3			8	8							280
Vulture	4	1	27	2	1	3	32		32	100	5,400		1,123
Wickenburg	1		6	12		12							420
White Picacho [2]	1		4	36		36							1,260
Mohave County:													
Bentley	2		38				31		31	9,400			2,068
Cedar Valley	3		1,647	9		9	1,211		1,211	95,600	800	112,300	37,235
Maynard	2		47	47		47	758		758	400	2,400		2,848
Music Mountain	1		7	1		1	42		42		1,000		252
Owens	9		554	27		27	874		874	1,600	158,400		30,437
Wallapai	16		51,734	694		694	32,059		32,059	621,400	891,100	1,344,700	526,501
Weaver	1		1				22		22		1,600		306

Pima County:													
Ajo	1		7,734,952	38,647		38,647	455,411		455,411	111,230,400			25,901,812
Arivaca	1		87	8		8	643		643	300	8,400		2,431
Cababi	2		15	1		1	242		242	200			297
Cerro Colorado	1		1				231		231		200		245
Empire	1		91	2		2	263		263	700	40,700		7,745
Greaterville		1			535	535		105	105				18,820
Helvetia	9		11,695	14		14	5,466		5,466	606,400	27,300	27,600	145,584
Old Hat [3]	3		737	9		9	2,423		2,423	72,400	59,600	33,600	33,356
Pima (Sierritas, Papago, Twin Buttes)	9		72,976	3		3	162,224		162,224	536,100	7,834,800	11,515,100	3,197,197
Quijotoa	1		33				63		63	4,300			990
Silver Bell	3		1,488				4,739		4,739	20,000	106,600	135,700	45,758
Pinal County:													
Bunker Hill	3		322	4		4	1,011		1,011	4,200	43,600		9,770
Casa Grande	4		8,180	20		20	62,759		62,759	2,400	7,400		59,346
Cottonwood	1		193				1,495		1,495	400			1,440
Martinez Canyon	1		21				32		32		9,300		1,694
Mineral Creek	8		1,554,618	489		489	30,985		30,985	37,505,400	932,400		8,350,730
Mineral Hill	12		546	144		144	1,317		1,317	9,300	64,600	9,000	21,010
Old Hat [3]	6		111,449	1,474		1,474	99,621		99,621	669,600	10,753,100	7,591,400	3,221,516
Owl Head	3		172	3		3	348		348	8,000			2,156
Picacho	1		21							1,200			260
Pioneer [1]	5		300,693	10,054		10,054	308,448		308,448	37,440,700			8,755,683
Riverside	2		502				337		337	19,800			4,602
Saddle Mountain	1		2				21		21				19
Santa Cruz County:													
Harshaw	7		62,205	62		62	210,533		210,533	161,000	3,997,600	5,750,000	1,707,970
Nogales	2		2	1		1	11		11		200		81
Oro Blanco	5		803	42		42	2,602		2,602	7,000	56,600	68,400	24,572
Patagonia (Duquesne)	4		4,178	4		4	16,018		16,018	77,600	302,600	699,400	178,661
Redrock	1		47				200		200	400	7,400	3,000	1,992
Tyndall	6		1,051	47		47	6,308		6,308	27,000	187,200	13,600	48,531
Yavapai County:													
Agua Fria	3		1,277	138		138	548		548	157,800			39,569
Ash Creek	1		1				21		21				19
Big Bug	5	3	146,633	10,871	187	11,058	425,058	21	425,079	346,300	5,352,100	11,663,000	3,356,100
Black Canyon	6	1	80	32	4	36	1,821		1,821		2,000		3,266
Black Hills	2		569				253		253	8,200			2,008
Black Rock	5	1	284	76	1	77	189		189	11,300			5,318
Blue Tank	1		84	1		1	10		10	7,100			1,585
Bullard (Pierce)	1		3							400			87
Castle Creek	3	1	8	10	1	11							385
Cherry Creek	1		8	9		9							315
Copper Basin	4	3	13,860	38	5	43	854		854	611,000	29,400	19,700	142,748
Copper Creek	1		594	2		2	222		222	29,000			6,564
Eureka (Bagdad)	11		1,054,725	246		246	53,629		53,629	14,494,000	251,400	4,642,800	3,864,838
Hassayampa	15	2	1,402	364	5	369	7,541		7,541	12,600	325,300	32,200	84,986
Humbug	2	3	11	13	5	18	210		210		700		945

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1948 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				
Yavapai County—Continued													
Lynx Creek		2			56	56		10	10				$1,969
Martinez			2	36		36	126		126				1,374
Peck	3		330	1		1	6,098		6,098	900	100		5,767
Pine Grove	3		4,087	242		242	12,575		12,575	64,400	27,200	252,400	72,264
Silver Mountain	1		21	10		10	21		21		100		387
Tiger	3		1,885	109		109	5,119		5,119	14,600	33,900	65,700	26,422
Turkey Creek	2		44				2,781		2,781	900	600		2,819
Verde (Jerome)	4		358,491	11,374		11,374	408,669		408,669	29,087,800		917,000	7,201,970
Walker	5		97	146		146	526		526	600	13,600	5,200	8,842
Walnut Grove	6		727	35		35	148		148	40,100			10,061
Weaver	4	1	98	78	2	80	74		74				2,867
White Picacho [2]	2		5	2		2	10		10	200			122
Yuma County:													
Castle Dome	7		3,430				3,212		3,212	100	178,000		34,791
Cienega	3		57	7		7	11		11	5,000			1,340
Dome (Gila City)		1			3	3							105
Ellsworth (Harqua Hala)	11		159	23		23	147		147	11,100	3,000		3,884
Eureka	6		118	1		1	1,168		1,168	400	39,800		8,303
Kofa Mountains	3	1	13	83	2	85	53		53		1,000		3,202
LaPaz		6			9	9							315
Middle Camp		3			4	4							140
Never Sweat	1		1				11		11		400		82
Plomosa	10	2	341	56	3	59	4,824		4,824	1,300	69,000	3,600	19,542
Trigo		3			6	6							210
Total 1948	360	39	39,925,686	108,649	838	109,487	4,837,604	136	4,837,740	750,242,000	59,798,000	108,956,000	196,207,948

[1] Pioneer district lies in both Gila and Pinal Counties.
[2] White Picacho district lies in both Maricopa and Yavapai Counties.
[3] Old Hat district lies in both Pima and Pinal Counties.

Warren (Bisbee) District.—Despite a decrease of 6 percent in silver output, 16 percent in lead, and 15 percent in zinc in 1948 compared with 1947, the Warren district continued to be the largest producer of silver, lead, and zinc in Arizona, and in 1948 ranked second in gold and fourth in copper; the gold output declined 5 percent, but the copper output increased 13 percent. The value of the metal output of the district increased from $20,988,948 in 1947 to $21,686,724 in 1948, owing principally to a rise in copper output. The only producer in the district in 1948 was the Copper Queen mine of the Phelps Dodge Corp. The corporation reported that the Copper Queen branch produced 302,941 tons of copper ore and 218,466 tons of zinc-lead ore in 1948 compared with 270,719 and 286,730 tons, respectively, in 1947. In addition, 402 tons of copper precipitates and 570 tons of waste-dump ore were shipped to smelters. The zinc-lead ore was treated in the corporation 900-ton flotation mill at Bisbee, and the copper ore was shipped direct to the corporation smelter at Douglas.

According to the corporation annual report for 1948, a shortage of underground miners continued at the Copper Queen branch; however, the copper produced in 1948 totaled 36,587,178 net pounds compared with 32,304,614 net pounds in 1947; lead produced totaled 17,550,887 net pounds compared with 21,241,846 net pounds; and zinc produced totaled 46,868,961 net pounds compared with 56,572,604 net pounds.

The Shattuck Denn Mining Corp. 150-ton flotation mill at Bisbee continued to be used entirely for treating custom ores; in 1948 it handled 8,338 tons of ore containing 482 ounces of gold, 21,208 ounces of silver, 90,183 pounds of copper, 1,226,736 pounds of lead, and 855,459 pounds of zinc. About 53 percent of the material treated was lead ore produced from the Scribner mine near Elfrida in Cochise County.

COCONINO COUNTY

Leasing operations at the open pit of the Petoskey mine in the Jacob Canyon (Warm Springs) district produced 2,140 tons of carbonate copper ore containing 4 ounces of gold, 1,264 ounces of silver, and 307,170 pounds of copper.

GILA COUNTY

Banner and Dripping Springs District.—High-lime fluxing ore (32,715 tons), containing an average of 2.22 percent copper, was shipped throughout the year to the smelter at Hayden from the Christmas mine near Winkelman by the Sam Knight Mining Lease, Inc. The remainder of the district output was principally 1,716 tons of lead ore (containing 6 ounces of gold, 4,193 ounces of silver, 41,151 pounds of copper, and 516,487 pounds of lead), produced from the "79" mine by the 79 Lead-Copper Co.

Globe-Miami District.—The Globe-Miami district, with a production of 176.956,200 net pounds of copper in 1948 (182,064,100 net pounds in 1947), 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 76,705,570 net pounds of copper (73,812,725 net pounds in 1947) was the leading copper producer in the district and ranked third in the State. The Inspiration Consolidated Copper Co.

reported that 3,978,373 tons of copper ore were treated in 1948 compared with 3,926,772 tons in 1947. Of the total ore, 3,719,197 tons, averaging 1.063 percent copper—0.622 percent copper as oxide and 0.441 percent as sulfide—from which the slimes had been removed, were treated by acid ferric sulfate in the main leaching plant. Slimes (255,766 tons averaging 1.608 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 the operation were leached by sulfuric acid solution for extraction of oxide copper content. In addition, 3,410 tons of crude copper ore were sent direct to the smelter at Miami. The total copper production per ton of ore treated in 1948 was 19.193 pounds.

According to the annual report of the company for 1948, the outstanding feature of the year's mining activities was the completion, late in March, of the open-pit development and construction program. Open-pit mining began in March and continued throughout the year—2,652,084 tons of ore were mined from underground and 1,338,440 tons from the open pit. Preparations are being made to institute leaching in place certain mined-out and caved areas in the property to recover part of the remaining copper. Production from this source is expected to begin in a small way in the latter part of 1949.

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 99,004,662 net pounds of copper were produced from the two properties in 1948 (49,585,565 net pounds from the Castle Dome mine and 49,419,097 net pounds from the Miami mine) compared with 106,796,369 net pounds in 1947.

According to the annual report of the Miami Copper Co. for 1948, the Castle Dome open pit and 10,000-ton concentrator were operated continuously throughout the year. The mill treated 3,890,126 tons of ore averaging 0.724 percent copper. In addition to copper, the concentrate contained 1,219 ounces of gold and 80,075 ounces of silver. Operations were also carried on in preparation for mining approximately 6,000,000 tons of ore underlying Red Hill. Ore reserves, as of January 1, 1949, were estimated to be 13,610,594 tons, including the 6,000,000 tons at Red Hill, averaging 0.713 percent copper. In addition, a block of approximately 3,665,000 tons averaging 0.54 percent copper is known to lie between the 4,040- and 4,085-foot levels of the Castle Dome ore body.

The Miami Copper Co. 18,000-ton concentrator and 3,000-ton leaching plant at the Miami mine treated 4,197,695 tons of ore averaging 0.679 percent copper, and 1,771 tons of copper precipitates were produced from leaching of ore in place. In addition to copper, the concentrate contained 1,292 ounces of gold and 58,704 ounces of silver, and the re-treatment of copper concentrate recovered 385,606 pounds of molybdenum. The cost of production continued to increase during the year, largely because of additional wage increases, rising costs of materials and supplies, and higher charges for smelting, refining, and transportation. Ore reserves, as of January 1, 1949, were estimated to be 27,279,000 tons averaging 0.893 percent copper.

The rest of the district output was mainly 1,297 tons of copper ore produced from the Carlota, Copper Hill, Hoosier & Grey, and Superior & Boston properties and 453 tons of silver ore from the Rescue mine.

GRAHAM COUNTY

Aravaipa District.—Operations in 1948 at the Aravaipa group of the Athletic Mining Co. near Klondyke included construction of a 100-ton flotation plant. During the year 25,708 tons of ore were treated, which contained 50 ounces of gold, 25,000 ounces of silver, 100,000 pounds of copper, 1,249,409 pounds of lead, and 3,213,500 pounds of zinc. In addition, 4,417 tons of similar ore were shipped direct to the smelter at El Paso. The remainder of the district output was 1,021 tons of lead ore produced principally from the Sein Fein mine.

GREENLEE COUNTY

Ash Peak District.—Fluxing ore (14,768 tons), averaging 0.036 ounce of gold and 9.165 ounces of silver to the ton and 81 percent silica, were shipped in 1948 to the International copper smelter at Miami from the Ash Peak mine and Hardy mine dump near Duncan by the Ash Peak Lease.

Copper Mountain (Morenci) District.—The Copper Mountain district, with a production of 296,632,000 net pounds of copper in 1948 (295,798,000 net pounds in 1947), remained the chief copper-producing area in Arizona, as the Morenci mine of the Phelps Dodge Corp. continued to be the outstanding producer of copper in the State. The corporation reported that 15,567,480 tons of copper ore from the Morenci mine were treated in the 45,000-ton concentrator and that 560,897 tons of copper concentrate, 70,448 tons of crude copper ore, and 995 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, and progress was made in 1948 in experimental work in commercial recovery of the small quantity of molybdenite in Morenci ore.

According to the annual report of the Phelps Dodge Corp. for 1948, full-scale operations prevailed at the Morenci branch throughout the year. Copper ore mined totaled 15,637,928 tons, and waste and leach material removed 20,368,908 tons, or a waste-to-ore ratio of 1.30 : 1. Copper produced in 1948 totaled 296,030,696 net pounds compared with 296,504,460 net pounds in 1947.

The remainder of the district output was 150 tons of gold-silver ore produced from the Climax Lode claim and 6 tons of copper ore from the X. I. V. claim.

MARICOPA COUNTY

Big Horn District.—Output in 1948 was 44 tons of copper ore produced from the Silver King mine 15 miles south of Aguila and 9 tons of lead ore from the Lead Dike group.

Cave Creek and Camp Creek District.—The principal output in 1948 was 97 tons of ore (containing 19,199 ounces of silver and 34,080 pounds of copper) shipped to a smelter from the Red Rover mine by Red Rover Copper Co.

New River District.—The Orizaba Copper Co. worked the Orizaba mine, 45 miles north of Phoenix, nearly all year and shipped 3,436 tons of copper ore to the smelter at Hayden.

MOHAVE COUNTY

Bentley (Grand Wash) District.—Lessees operated the Grand Gulch and Savannic claims in 1948 and shipped 38 tons of copper ore.

Cedar Valley District.—Development at the Antler mine, 12 miles east of Yucca, by the Faire Mining Corp. produced 910 tons of ore containing 9 ounces of gold, 951 ounces of silver, 67,979 pounds of copper, 9,021 pounds of lead, and 144,091 pounds of zinc. The rest of the district output was mainly 715 tons of similar ore produced from the Copper World mine by the Omega Metals Co.

Maynard District.—Leasing operations at the Gold King group south of Kingman produced 32 tons of gold ore and 11 tons of lead ore rich in gold, and 4 tons of silver-lead ore were produced from the Mary Nevada claim.

Owens (McCracken and Potts Mountain) District.—A. M. Short worked the old McCracken mine, 45 miles southeast of Yucca, in 1948 and shipped 404 tons of ore averaging 1.82 ounces of silver to the ton and 18 percent lead. The rest of the district output was principally 73 tons of gold ore produced from the Esperanza mine and 60 tons of lead ore from the Double Cross and Lead Pill properties.

Wallapai (Cerbat, Chloride, Mineral Park, Stockton Hill) District.—Sixteen mines in the Wallapai district produced 51,734 tons of ore containing 874 ounces of gold, 38,733 ounces of silver, 761,488 pounds of copper, 1,030,695 pounds of lead, and 2,032,296 pounds of zinc. The most important output was zinc-lead ore produced from the Tennessee mine at Chloride by the Miners Cooperative Association. The company reported that 13,231 tons of ore, containing an average of 0.024 ounce of gold and 1.48 ounces of silver to the ton, 2.74 percent lead, and 6.04 percent zinc, were treated in its 150-ton flotation mill; however, the mine was closed in December. The open pit at the Emerald Isle mine was worked by Lewin-Mathes Co. until June 1, when operations ceased. During the period of operation, 34,000 tons of copper ore were treated by sulfuric acid in a 300-ton leaching plant, which yielded 411 tons of copper precipitates. The 100-ton flotation mill at Mineral Park, owned by the Mineral Park Milling Co., was taken over in April by the Mohave Lead & Zinc Co. During the year the company treated 3,660 tons of zinc-lead ore—1,724 tons from the El Oro mine, 1,001 tons from the Kane and Silver Hill mine dumps, 620 tons from the Summit group, and 315 tons from the New Moon mine. The Arizona Metals Co., operator of the Summit group, also shipped 277 tons of zinc-lead ore to a custom mill in Utah. The remainder of the district output was largely 361 tons of zinc-lead ore from the Mary Bell, Manzanita, St. Louis, and Samoa properties and 101 tons of gold ore from the Golden Gem mine.

PIMA COUNTY

Ajo District.—The New Cornelia copper mine of the Phelps Dodge Corp. was, as usual, the only producer in the Ajo district. The district continued to rank first in gold and third in copper output in the State, and in 1948 it ranked third in silver. According to the annual report of the Phelps Dodge Corp. for 1948, full-scale operations prevailed at the New Cornelia branch throughout the year, except for the usual 2-week vacation shut-down in August. Production in 1948 was 7,733,070 tons of copper ore and 5,970,732 tons of waste, or a waste-to-ore ratio of 0.77:1. The New Cornelia 25,000-ton concentrator treated 7,734,952 tons of copper ore in 1948 compared with 7,095,446 tons in 1947, and smelter production from the concentrate totaled 110,062,421 pounds of copper compared with 101,105,513 pounds. Site preparation and preliminary work were done in connection with a smelter that is to be constructed at Ajo.

Arivaca District.—Output in 1948 was 87 tons of silver-lead ore produced from the Tiger claim.

Empire District.—Two cars (91 tons) of lead ore were shipped in 1948 from the Lone Mountain group, 38 miles southeast of Tucson.

Greaterville District.—The Pima Placers worked the Hummel and Richardson properties on Louisiana Gulch from January to October 29, when operations terminated. During the year a dragline and dry-land washing plant treated 90,000 cubic yards of gravel.

Helvetia (Rosemont) District.—The output of the Helvetia district in 1948 comprised 11,324 tons of copper ore, 218 tons of zinc-copper ore, 107 tons of lead ore, and 46 tons of zinc-lead ore. The copper ore, averaging 0.43 ounce of silver to the ton and 2.73 percent copper, came largely from the Rosemont (6,641 tons) and Narragansett Bay (3,197 tons) properties. Other producers of copper ore were the Helvetia (725 tons), Daylight (316 tons), Mohawk (313 tons), and Newman (132 tons) properties. Lessees at the King in Exile mine shipped 218 tons of zinc-copper ore to the Eagle-Picher custom mill near Sahuarita. Lead ore (107 tons) was produced from the Crown and Dimple claims and zinc-lead ore (46 tons) from the Daylight mine.

Old Hat (Oracle) District.—The Hartman mine, 25 miles south of Oracle, was worked most of the year by Shanklin & Adams—109 tons of copper and 38 tons of lead-copper ore were shipped to smelters, and 390 tons of zinc-lead-copper ore were hauled to the Eagle-Picher mill for custom treatment. The rest of the district output in Pima County was 200 tons of copper ore produced from the Giant and Leatherwood mines.

Pima (Sierritas, Papago, Twin Buttes) District.—The Pima district again ranked third in output of lead and zinc in Arizona, owing to the large production of zinc-lead ore from the San Xavier mine near Sahuarita. This mine and its 500-ton flotation mill were operated continuously by the Eagle-Picher Mining & Smelting Co. The mill treated 76,539 tons of ore, of which 72,314 tons, averaging 2.44 ounces of silver to the ton, 0.48 percent copper, 5.96 percent lead, and 10.28 percent zinc, came from the San Xavier mine, and the remainder—4,225 tons—comprised various classes of ore received from custom shippers. The rest of the district output consisted largely of 349 tons of zinc-lead ore produced from the Marconi mine and 123 tons of lead ore and 61 tons of zinc-lead ore from the Whitcomb property.

Silver Bell District.—The principal output of the Silver Bell district in 1948 was 1,392 tons of zinc-lead ore (containing 7,066 ounces of silver, 36,929 pounds of copper, 139,127 pounds of lead, and 228,664 pounds of zinc) produced from the Arizona-Indiana mine by the Indiana-Arizona Mining Co.

PINAL COUNTY

Bunker Hill District.—T. P. Lane operated the Red Bird mine in 1948 and milled 288 tons of lead ore. The remainder of the district output was 27 tons of copper ore produced from the Battle Ax claim and 7 tons of lead-copper-silver ore from the Blue Bird mine.

Casa Grande District.—Sherwood B. Owens operated under lease the Silver Reef mine near Casa Grande and shipped 8,079 tons of ore containing 10 ounces of gold, 62,169 ounces of silver, and 1,664 pounds of copper. The rest of the district output was mainly 83 tons of silver-lead ore produced from the El Camino claim.

Cottonwood District.—Output in 1948 was 193 tons of silver ore shipped from the Old Sample mine 2 miles southeast of Romero Wash.

Mineral Creek (Ray) District.—Output of copper ore from the Ray property of the Kennecott Copper Corp. increased from 1,493,309 tons in 1947 to 1,535,015 tons in 1948. The crude ore, averaging 1.181 percent copper, was hauled by rail 26 miles to the corporation 10,000-ton flotation mill at Hayden, where it was reduced to 66,112 tons of concentrate containing 396 ounces of gold, 22,516 ounces of silver, and 30,578,849 pounds of copper. In addition, 3,963 tons of copper precipitates were produced, which contained 6,470,567 pounds of copper. According to the annual report of the Kennecott Copper Corp. for 1948, good progress was made in stripping the Ray ore body preparatory to mining the larger part of it by open-pit methods. The crushing plant at the mine was increased to 12,000 tons of ore a day, and more grinding units were installed in the mill to prepare for the extra tonnage, which will come from the pit.

The remainder of the district output was principally 16,401 tons of oxide copper ore produced from an open pit at the Copper Butte property, 2,319 tons of oxide lead ore from the Ray Silver-Lead mine, and 739 tons of silver-copper ore from the Monitor group.

Mineral Hill District.—Twelve mines in the Mineral Hill district produced 546 tons of ore in 1948; most of it was 239 tons of lead ore from the Galena, Gorham & Hall, Pacific Lead, Iron Wood, Victor Lamb, and Woodpecker properties, 132 tons of gold-copper ore from the Tom Thumb mine, 76 tons of gold-silver ore from the Woodpecker mine, and 59 tons of gold ore from the Herring and Thanksgiving properties.

Old Hat (Oracle) District.—The Mammoth-Collins group at Tiger, one of the most important producers of zinc-lead ore in Arizona, was operated throughout the year by the St. Anthony Mining & Development Co. The company reported that 109,801 tons of ore, averaging 0.016 ounce of gold and 1.00 ounce of silver to the ton, 0.50 percent copper, 5.54 percent lead, and 5.60 percent zinc, were treated in its 500-ton gravity-flotation mill in 1948 compared with 88,975 tons in 1947. The property ranked second in production of lead in Arizona in 1948 and fourth in zinc. The rest of the district output was mainly 904 tons of copper ore produced from the Copper Rose mine, 331 tons of zinc-lead ore from the Stove Lid claim, and 227 tons of silver ore and 44 tons of silver-lead ore from the Amphitheater group. No ore was produced in 1948 from the San Manuel property south of Tiger, owned by the Magma Copper Co.; but, according to the company annual report for 1948, the program for underground exploration is well under way. No. 1 shaft had been sunk to a depth of 125 feet and No. 2 shaft to a depth of 190 feet by the end of the year. Twenty-one dwelling houses, two dormitories, and a mess hall have been completed for the employees, and shops, office, warehouse, and change rooms have been erected. Estimated ore reserves, calculated from drill-hole data, are 462,784,500 tons averaging 0.782 percent copper. The ore body is probably the second largest tonnage of copper ore in any known deposit in the United States.

Owl Head District.—Output in 1948 was 172 tons of copper ore produced from the Blue Copper, Busy Bee, and Copper Glance claims south of Florence.

Pioneer (Superior) District.—The Magma mine, one of the most important producers of gold, silver, and copper in Arizona, was operated continuously in 1948 and at a greater rate than in 1947. During the year 265,766 tons of copper ore were milled in the company 1,150-ton concentrator, and 34,833 tons of similar ore were sent direct to the company 450-ton smelter at Superior. The total ore averaged 0.028 ounce of gold and 1.04 ounces of silver to the ton and 6.38 percent copper. According to the company annual report for 1948, the net metal produced from Magma crude ore and concentrates comprised 10,318 ounces of gold, 310,755 ounces of silver, and 37,766,405 pounds of copper. The average cost of producing copper (after gold and silver values were deducted) was 18.11 cents a pound in 1948 compared with 16.74 cents in 1947. The labor supply continued to improve during the year, but additional men are still needed for full production and development. The major construction work at the property was completed during the year—the new mine-cooling plant began operating in October, but operations at the new milling plant were delayed until January 1949.

The remainder of the district output was principally 83 tons of copper ore produced from the Junction mine.

Riverside District.—Output in 1948 was chiefly 472 tons of copper ore shipped from the Peg Leg waste dump near Kelvin.

SANTA CRUZ COUNTY

Harshaw District.—In 1948 seven properties in the Harshaw district produced 62,205 tons of ore containing 83 ounces of gold, 240,567 ounces of silver, 252,038 pounds of copper, 4,420,213 pounds of lead, and 7,242,660 pounds of zinc. Most of the output was 61,653 tons of zinc-lead-silver ore produced from the Flux-January-Norton group, near Patagonia, by the American Smelting & Refining Co. This tonnage, along with 3,855 tons of ore received from custom shippers, was treated in the company 200-ton flotation mill, which yielded 3,321 tons of lead concentrate and 6,541 tons of zinc concentrate. The remainder of the district output was principally 342 tons of lead ore produced from the Hardshell and Worlds' Fair mines and 106 tons of zinc-lead ore from the Humboldt mine.

Oro Blanco (Ruby) District.—Output in 1948 comprised 594 tons of zinc-lead ore produced from the Lucky Shot, Montana, and Choctaw properties, 155 tons of gold ore from the Oro Blanco mine, and 31 tons of zinc-copper ore and 23 tons of copper ore from the Horn Gold claim.

Patagonia (Duquesne) District.—A. R. Byrd, Jr., worked the Duquesne group all year and hauled 3,298 tons of ore, averaging 4.72 ounces of silver to the ton, 1.50 percent copper, 3.07 percent lead, and 11.92 percent zinc, to the flotation mill of the American Smelting & Refining Co. near Patagonia. Similar ore (257 tons) was produced also from the Pride of the West mine and treated in the same mill. The rest of the district output was 451 tons of lead ore and 86 tons of zinc ore produced from the Mowry mine and 86 tons of lead ore from the Golden Gate claim.

Redrock District.—Output in 1948 was 47 tons of zinc-lead ore produced from the Frisco Fair claim 10 miles east of Patagonia.

Tyndall District.—In 1948 six mines in the Tyndall district produced 1,051 tons of ore containing 53 ounces of gold, 6,589 ounces of silver, 31,013 pounds of copper, 200,570 pounds of lead, and 17,901 pounds of zinc. Lead ore (425 tons) was produced from the Amado and Wilkins properties; zinc-lead ore (333 tons) from the Bland, Braathen, and Jefferson mines; and copper ore (161 tons), lead-copper ore (105 tons), and silver-lead ore (27 tons) from the Royal Blue mine.

YAVAPAI COUNTY

Agua Fria District.—High-silica copper ore shipped direct to smelters continued to be the output of the Agua Fria district. In 1948 nearly all (1,249 tons) of it came from the Stoddard mine, 5 miles southeast of Mayer.

Big Bug District.—In 1948 the Big Bug district ranked second in zinc production in the State, fourth in gold and silver, and third in lead. The Iron King mine of the Shattuck Denn Mining Corp. continued to be the principal producer; output was 145,824 tons of zinc-lead-iron ore and 85 tons of copper ore. The zinc-lead-iron ore, which averaged 0.117 ounce of gold and 3.709 ounces of silver to the ton, 0.155 percent copper, 2.350 percent lead, 6.526 percent zinc, and 21.850 percent iron, was treated in the company 470-ton flotation mill as well as 490 tons of custom ore. The mill yielded 12,027 tons of lead concentrate, 12,428 tons of zinc concentrate, and 9,810 tons of iron-gold concentrate.

The rest of the district lode output was mainly 613 tons of copper ore produced from the Henrietta and Lone Pine mines and 82 tons of zinc ore from the Up Shot claim. Placer gold (187 ounces) and silver (21 ounces) were recovered from three properties—Jane, Shanks, and O. K. No. 1.

Black Canyon District.—Output in 1948 was principally 42 tons of gold ore produced from the Golden Turkey, Gray Goose, and Richinbar properties and 28 tons of silver ore from the Thunderbolt claim.

Black Hills District.—High-silica silver-copper ore (566 tons) was shipped from the Yeager Canyon dump, and a small lot of copper ore was produced from the Skyline claim.

Black Rock District.—Output in 1948 was principally 226 tons of gold-copper ore produced from the Monte Cristo mine 13 miles northeast of Wickenburg.

Blue Tank District.—E. Nutter continued working the Camp B. mine near Wickenburg and shipped 84 tons of copper ore to a smelter.

Copper Basin District.—Fred D. Schemmer continued to operate the Commercial mine near Skull Valley and shipped 13,676 tons of high-silica copper ore to the smelter at Clarkdale. The rest of the district output was mainly 162 tons of zinc-lead ore produced from the Silver Gulch and "U. S. Navy" properties.

Copper Creek District.—Lessees worked the Copper Queen mine in 1948 and shipped 594 tons of copper ore to the smelter at Clarkdale.

Eureka (Bagdad) District.—Eleven mines in the Eureka district produced 1,054,725 tons of ore in 1948; 98 percent (1,037,427 tons) was copper ore produced from the open pit at the Bagdad property by the Bagdad Copper Corp. The ore, averaging 0.883 percent copper, was treated in the company 3,000-ton flotation mill, which yielded 25,406 tons of copper concentrate. The Old Dick mine was worked the first 2 months of the year by the Hillside Mining & Milling Co. and the remaining 10 months by the Goodwin Mining Co.; total output was 15,034 tons of zinc-copper ore, most of which was shipped to custom mills in Arizona and Utah. The rest of the district output was largely 1,500 tons of gold-lead-zinc ore produced from the Hillside mine and 512 tons of zinc-lead ore from the Copper King mine.

Hassayampa (Groom Creek, Hassayampa River, Senator, Prescott) District.—The principal output of the Hassayampa district in 1948 was 736 tons of lead ore produced from the Bodie mine in Crook Canyon; the ore averaged 0.14 ounce of gold and 4.67 ounces of silver to the ton, 0.72 percent copper, 19.55 percent lead, and 0.50 percent zinc. The remainder of the district output was largely 269 tons of gold ore produced from the Gold Charm and Sacramento mines, 208 tons of zinc-lead ore from the Sacramento and Sun Dance mines, and 109 tons of lead ore from the Buzzard, Lead Queen, P. K., and Ruth properties.

Lynx Creek District.—Dragline dredging at the Fitzmaurice placer near Prescott by the Minona Mining Co. recovered 55 ounces of gold and 10 ounces of silver.

Peck District.—In 1948 three mines in the Peck district produced 330 tons of ore containing 1 ounce of gold, 6,098 ounces of silver, 948 pounds of copper, and 129 pounds of lead; most of it was 302 tons of silver ore produced from the Swastika mine near Cleator.

Pine Grove (Crown King) District.—Mining and milling zinc-copper ore from the Crown King mine by the Golden Crown Mining Co. were continuous until April 30, when the mine was closed. During the remainder of the year the company worked the Tiger mine in the Tiger district. From the Crown King mine, the company 75-ton flotation mill treated 4,070 tons of ore, averaging 0.055 ounce of gold and 4.11 ounces of silver to the ton, 1.00 percent copper, 0.61 percent lead, and 4.48 percent zinc. The rest of the district output was mainly 12 tons of high-grade gold ore produced from the Del Pasco group.

Tiger District.—The Tiger mine, 5 miles southwest of Crown King, was worked in 1948 by the Golden Crown Mining Co.; 1,825 tons of zinc-lead ore were treated in the Crown King flotation mill. The remainder of the district output was 60 tons of gold ore produced from the Arizona Mascot and Oro Belle properties.

Turkey Creek District.—Output in 1948 was 44 tons of silver ore produced from the Domicile and Trinity claims near Cleator.

Verde (Jerome) District.—For the first time in its history, zinc was produced in 1948 in the Verde district; it came from the United Verde mine of the Phelps Dodge Corp. However, copper ore from the mine remained by far the most important output in the district, although production declined 3 percent from that in 1947. The corporation reported that 147,862 tons of copper ore and 14,235 tons of zinc-copper ore were treated in its 2,100-ton concentrator in 1948 and that 185,062 tons of copper ore and 136 tons of copper precipitates were shipped direct to its smelter at Clarkdale. Production of gold was about the same as in 1947, but production of silver and copper increased slightly.

According to the annual report of the corporation for 1948, the United Verde branch produced 348,048 tons of ore. Prospecting and development comprised 4,060 feet of drifting and raising, 633 feet of calyx drilling, and 13,468 feet of diamond drilling. This work proved generally disappointing, and unless new discoveries are made the outlook is that the mine will have to be shut down in a year or two because of ore exhaustion.

The remainder of the district output was chiefly 10,322 tons of siliceous ore shipped to the smelter at Clarkdale from the Verde Exploration property; the ore averaged 0.43 ounce of gold and 1.61 ounces of silver to the ton and 0.677 percent copper.

Walker District.—Output in 1948 was principally 60 tons of high-grade gold-lead ore produced from the Oro Plata mine and 27 tons of zinc-lead ore from the Pine Mountain claim.

Walnut Grove (Kirkland) District.—The Continental Engineering & Mining Co. worked the Zonia mine in 1948 and shipped 708 tons of copper ore to smelters in Arizona. The rest of the district output was chiefly 12 tons of high-grade gold ore produced from the Bale and Stud claims.

Weaver (Octave) District.—Output in 1948 was principally 96 tons of gold ore shipped to smelters from the Monica and Octave mines.

YUMA COUNTY

Castle Dome District.—All the output of the Castle Dome district in 1948 was 910 tons of oxide lead ore and 2,520 tons of old lead tailings. The old tailings, treated by gravity concentration, came from the Rialto waste dump; and most of the crude ore, treated also by gravity concentration, came from the DeLuce, Sonora, Big Jim, and "81" properties.

Cienega District.—Output in 1948 was 57 tons of copper ore produced from the Black Mesa, Mammon, and Yarlanda claims near Parker.

Ellsworth (Harqua Hala) District.—Two cars (68 tons) of gold-lead ore were shipped in 1948 from the Rio Del Monte property and one car (49 tons) of copper ore from the Yuma Copper mine. The remainder of the district output was numerous small lots of ore sold to the Wickenburg Ore Market.

Eureka (Silver Camp) District.—Output in 1948 was 114 tons of lead ore and 4 tons of copper. The principal producers were the Silver King, Red Cloud, and Hardscrable properties, 50 miles north of Yuma.

Kofa Mountains District.—The most important output in the Kofa Mountains district in 1948 was 4 tons of ore (containing 73 ounces of gold and 21 ounces of silver) produced from the Oakland claim.

Plomosa District.—Lessees continued working the R. & A. mine near Vicksburg and shipped 103 tons of siliceous silver ore and 33 tons of silver-lead ore. The rest of the district output was largely 79 tons of lead ore produced from the Leadville group, 51 tons of gold ore from the Mohave Mining Co. property, and 28 tons of zinc-lead ore from the Surprise claim.

883326—50——90

California
Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By R. B. MAURER

GENERAL SUMMARY

CALIFORNIA zinc production in 1948, rallying after virtual cessation of output late in 1947, was slightly below the previous year's yield in quantity but 8 percent higher in value. Gold output in 1948 was down 2 percent compared with 1947, owing to curtailed placer mining. Despite the stimuli of a strong demand and a higher average price for lead in 1948, its production was substantially below the 1947 output in quantity, although the value of the lower yield exceeded the corresponding 1947 figure. Silver and copper, both largely byproduct metals in 1948, were, respectively, 55 and 80 percent below the 1947 outputs. The total value of the five metals in 1948 was $20,294,093, or 7 percent below 1947.

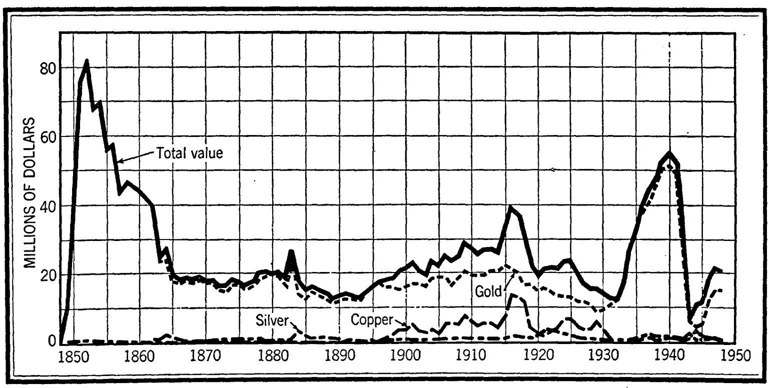

FIGURE 1.—Value of mine production of gold, silver, and copper, and total value of gold, silver, copper, lead, and zinc in California, 1848–1948. The value of lead and zinc has exceeded $1,000,000 in only a few years.

Comparing 1948 with 1947, gold decreased 2 percent in quantity and value; silver decreased 55 percent in quantity and value; copper decreased 80 percent in quantity and 79 percent in value; lead decreased 10 percent in quantity but advanced 12 percent in value; and zinc decreased 2 percent in quantity, whereas it increased 8 percent in value. Due largely to lead and zinc production, as well as to noteworthy quantities of gold, silver, and copper, Inyo County was the largest contributor to metal-mining output in California by a substantial margin; the county supplied 25 percent of the State total value of the five metals. Sacramento County ranked second in 1948 as the result of large-scale gold dredging and produced 20 percent of the total value of the five metals. Nevada County (largely from gold ore) contributed 18 percent of the total value of the five metals. Thus almost two-thirds of the State's output was centered in 3 of the 58 counties.

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, 1944–48

Year	Gold (per fine ounce) [1]	Silver (per fine ounce) [2]	Copper (per pound) [3]	Lead (per pound) [3]	Zinc (per pound) [3]
1944	$35.00	$0.711+	$0.135	$0.080	$0.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122
1947	35.00	.905	.210	.144	.121
1948	35.00	.905+	.217	.179	.133

[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. 1944 to June 30, 1946: $0.71111111; July 1, 1946, to Dec. 31, 1947: $0.905; 1948: $0.9050505.
[3] Yearly average weighted price of all grades of primary metal sold by producers; 1944–47: price includes bonus payment by Office of Metals Reserve for overquota production.

Gold.—Production of 421,473 ounces of gold (including a relatively small quantity in "natural gold" sold in the open market) from California mines in 1948 was 2 percent below the 1947 output, owing to lower production from placer operations—principally bucket-line dredging and dragline dredging. In contrast, gold from lode mines in 1948 registered a moderate gain over 1947. In Nevada County the Empire Star Mines, Ltd., successfully operated the Empire Star group under a system of leasing in 1948, and the neighboring Idaho-Maryland Mines Corp. instituted leasing on a limited scale late in the year. Revival of large-scale lode mining in Amador County was initiated with the reopening in 1948 of the Central Eureka Mining Co. property (inactive since 1942).

The 25 leading gold-producing mines in California in 1948, listed in an accompanying table, yielded 88 percent of the total gold.

Mine production of gold, silver, copper, lead, and zinc in California, 1944–48, and total, 1848–1948, 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
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
1947	210	210	648, 789	431, 415	15, 099, 525	1, 597, 442	1, 445, 685
1948	241	195	526, 776	421, 473	14, 751, 555	724, 771	655, 954
1848–1948			(2)	102, 734, 107	2, 297, 797, 397	110, 522, 301	89, 242, 581

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
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
1947	4, 814, 000	1, 010, 940	20, 160, 000	2, 903, 040	10, 830, 000	1, 310, 430	21, 769, 620
1948	962, 000	208, 754	18, 220, 000	3, 261, 380	10, 650, 000	1, 416, 450	20, 294, 093
1848–1948	[3] 628, 712	202, 513, 558	[3] 178, 842	26, 807, 437	[3] 90, 947	18, 585, 276	2, 634, 946, 249

[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, 1944–48, and total, 1848–1948 [1]

Class and method	Mines producing [2]	Washing plants (dredges)	Materials treated (cubic yards)	Gold recovered: Fine ounces	Gold recovered: Value	Gold recovered: Average value per cubic yard
Surface placers:						
Gravel mechanically handled:						
Bucket-line dredges:						
1944	5	7	21,524,000	64,925	$2,272,375	$0.106
1945	16	26	30,738,000	88,318	3,091,130	.101
1946	22	32	78,175,000	244,679	8,563,765	.110
1947	22	35	95,478,000	271,165	9,490,775	.099
1948	22	35	94,747,200	257,171	9,000,985	.095
Dragline dredges:						
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
1947	41	35	5,718,000	26,617	931,595	.163
1948	27	27	3,033,000	17,029	596,015	.197
Suction dredges: [3]						
1944–45	------	------	------	------	------	------
1946	1	1	22,900	112	3,920	.171
1947	7	5	60,000	485	16,975	.283
1948	5	6	83,000	453	15,855	.191
Nonfloating washing plants: [4]						
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
1947	25	25	261,000	3,916	137,060	.525
1948	15	15	261,700	1,159	40,565	.155
Gravel hydraulically handled:						
Hydraulic:						
1944	13	------	212,000	838	29,330	.138
1945	17	------	282,300	922	32,270	.114
1946	17	------	442,300	1,147	40,145	.091
1947	23	------	332,000	1,194	41,790	.126
1948	28	------	363,000	1,784	62,440	.172
Small-scale hand methods: [5]						
Wet:						
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
1947	86	------	682,000	8,931	312,585	.458
1948	83	------	211,300	7,704	269,640	1.276
Dry:						
1944	(6)	------	200	3	105	.525
1945	------	------	------	------	------	------
1946	1	------	100	3	105	1.050
1947	3	------	600	6	210	.350
1948	2	------	600	27	945	1.688
Underground placers:						
Drift:						
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
1947	3	------	1,400	224	7,840	5.600
1948	13	------	14,100	229	8,015	.569
Grand total placers:						
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
1947	210	------	102,533,000	312,538	10,938,830	.107
1948	195	------	98,713,900	285,556	9,994,460	.101
1848–1948 [1]	------	------	(7)	66,130,888	1,450,318,726	(7)

[1] For historical 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 plants except those producing less than 100 ounces of gold, which are included with "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, plans, rockers, dry washers, etc.
[6] From property not classed as a "mine."
[7] Complete data not available.

Twenty-five leading gold-producing mines in California in 1948, in order of output

Rank	Mine	District	County	Rank in 1947	Operator	Source of gold
1	Natomas Co	Folsom	Sacramento	1	Natomas Co	Dredge.
2	Yuba unit	Yuba River	Yuba	2	Yuba Consolidated Gold Fields	Do.
3	New Brunswick-Idaho Maryland	Grass Valley-Nevada City	Nevada	3	Idaho Maryland Mines Corp	Gold ore.
4	Empire-Star group	do	do	4	Empire Star Mines, Ltd	Do.
5	Capital dredge	Folsom	Sacramento	6	Capital Dredging Co	Dredge.
6	Butte unit	Oroville	Butte	5	Yuba Consolidated Gold Fields	Do.
7	Snelling dredge	Snelling	Merced	12	Snelling Gold Dredging Co	Do.
8	Siskiyou unit	Callahan	Siskiyou	33	Yuba Consolidated Gold Fields	Do.
9	Kister dredge	Oroville	Butte	16	Gold Hill Dredging Co	Do.
10	Thurman dredge	Redding	Shasta	15	Thurman Gold Dredging Co	Do.
11	Merced dredge No. 1	Snelling	Merced	11	Merced Dredging Co	Do.
12	La Grange dredge No. 4	La Grange	Stanislaus	8	La Grange Gold Dredging Co	Do.
13	Indian Creek placers	Deadwood	Siskiyou	17	French Gulch Dredging Co	Do.
14	Cosumnes dredge	Cosumnes River	Sacramento	39	Cosumnes Gold Dredging Co	Do.
15	Tuolumne gold dredge	La Grange	Stanislaus	10	Tuolumne Gold Dredging Co	Do.
16	Original Sixteen to One	Alleghany	Sierra	14	Original Sixteen to One Mine, Inc	Gold ore.
17	General dredge	Folsom	Sacramento	23	General Dredging Co	Dragline.
18	Thurman & Wright dredge No. 4	Cosumnes River	do	7	Thurman & Wright	Dredge.
19	Lancha Plana dredge No. 5	Butte Creek	Butte	30	Lancha Plana Gold Dredging Co	Do.
20	Mount Gaines	Hunter Valley	Mariposa	19	Mount Gaines Mining Co	Gold ore.
21	Ancho and Erie groups	Washington	Nevada	13	Ancho-Erie Mining Co	Do.
22	Tropico, Cactus Queen, Trailer Wheel	Mojave	Kern	20	Burton Bros	Do.
23	Yreka gold dredge	Klamath River (Seiad)	Siskiyou	24	Yreka Gold Dredging Co	Dredge.
24	Lancha Plana dredge No. 4	Folsom	Sacramento	22	Lancha Plana Gold Dredging Co	Do.
25	Brush Creek	Downieville	Sierra	21	Alfred L. Merritt	Gold ore.

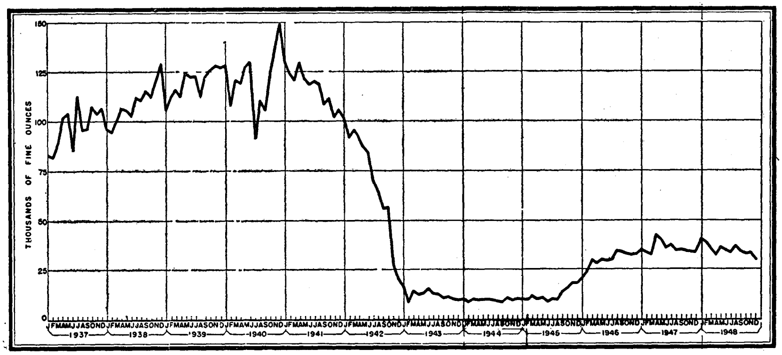

FIGURE 2.—Mine production of gold in California, 1937–48, by months, in terms of recovered gold.

Silver.—The 10 leading silver-producing mines listed in the accompanying table yielded 83 percent of the State total recoverable silver in 1948; the 3 leading mines yielded 65 percent. Of the 10 leading silver-producing mines, 5 derived their silver from argentiferous base-metal ores, 2 from gold ore, and 1 each from gold-silver ore (including some lead ore), gold-silver ore, and tungsten ore.

Output from the Anaconda Copper Mining Co. Darwin group of mines, Coso district, Inyo County, establishes the trend in State silver production as shown by months in 1948.

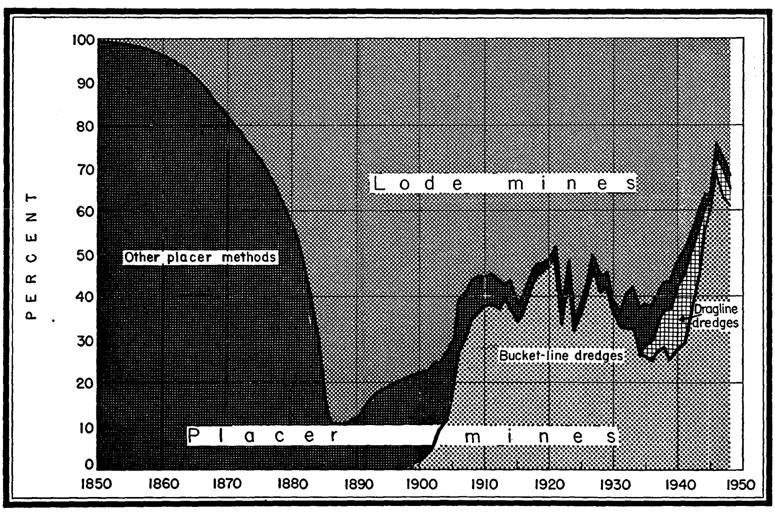

FIGURE 3.—Percentage of total California gold produced at lode and placer mines and by various methods of placer mining, 1850–1948.

Ten leading silver-producing mines in California in 1948, in order of output

Rank	Mine	District	County	Rank in 1947	Operator	Source of silver
1	Darwin group	Coso	Inyo	1	Anaconda Copper Mining Co	Zinc-lead and lead ores.
2	Shoshone group (Columbia No. 2).	Resting Springs	do	3	do	Gold-silver and lead ores.
3	Defense	Modoc	do	21	Foreman & Skinner	Lead ore.
4	Pine Creek	Bishop Creek	do	18	United States Vanadium Corp	Tungsten ore.
5	Santa Rosa	Cerro Gordo	do	7	Santa Rosa Mining Co. and Louis Warnken, Jr.	Lead ore.
6	Mohawk	Clark Mountain	San Bernardino	14	Mohawk Mines, Inc	Do.
7	New Brunswick-Idaho Maryland.	Grass Valley-Nevada City	Nevada	10	Idaho Maryland Mines, Corp	Gold ore.
8	Kelly	Randsburg	San Bernardino	4	F. W. Royer	Gold-silver ore.
9	Empire-Star group	Grass Valley-Nevada City	Nevada	12	Empire Star Mines, Ltd	Gold ore.
10	Carbonate King Zinc	Clark Mountain	San Bernardino	6	Crystal Cave Mining Co. and J. Q. Little.	Zinc ore.

Mine production of gold, silver, copper, lead, and zinc in California in 1948, by months, in terms of recovered metals

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	40,752	68,921	40	842	85
February	39,074	65,315	42	703	95
March	35,467	64,112	41	822	70
April	32,213	69,021	21	871	100
May	36,377	48,285	19	663	348
June	35,164	60,706	50	802	523
July	33,850	49,186	52	624	547
August	37,165	61,007	30	832	687
September	34,689	45,380	40	545	533
October	33,042	48,285	32	673	596
November	33,567	64,112	42	723	806
December	30,113	80,441	72	1,010	935
Total: 1948	421,473	724,771	481	9,110	5,325
1947	431,415	1,597,442	2,407	10,080	5,415

Copper.—The copper produced in California in 1948 was largely a byproduct of ores mined primarily for other metals. Output for the year was 80 percent below the 1947 production. The leading producers of copper in the State were the United States Vanadium Corp., Pine Creek mine, Bishop Creek district, Inyo County (tungsten ore); Anaconda Copper Mining Co., Darwin group, Coso district, Inyo County (zinc-lead and lead ores); and Coronado Copper & Zinc Co., Afterthought mine, Cow Creek district, Shasta County (zinc ore).

Lead.—Lead continued to be the second most valuable of the five metals in California in 1948, although the output was 1,940,000 pounds (10 percent) below 1947. Maximum monthly output for lead—1,010 tons—was attained in December, and the monthly lead-production figures given in the accompanying table follow a trend which is allied to the two leading lead-producing mines in the State—the Anaconda Copper Mining Co., Darwin and Shoshone properties, Inyo County, respectively in the Coso district and the Resting Springs district. Other important producers of lead in California, in order of output, were Foreman & Skinner, Defense mine, Modoc district, Inyo County; Mohawk Mines, Inc., Altana Corp., and Huston Mining Co., operators of the Mohawk group (including the Wilshire mine), Clark Mountain district, San Bernardino County; and Santa Rosa Mining Co., and Louis Warnken, Jr., lessee, Santa Rosa mine, Cerro Gordo district, Inyo County.

Zinc.—Zinc output of 10,650,000 pounds in 1948 was only 2 percent below the 1947 yield, despite continued suspension of operations by the State's two leading zinc-producing mines of the previous year. The year's lowest monthly output of 85 tons in January was followed throughout the remainder of the year by progressively greater production, which reached the 1948 maximum monthly yield (935 tons) in December—improved metallurgical methods at existing mills in the State were a factor. The four leading producers of zinc in the State (which in 1948 supplied 99 percent of the total output) were: The Darwin group of mines, Coso district, Inyo County (Anaconda Copper Mining Co.); the Afterthought mine, Cow Creek district, Shasta County (Coronado Copper & Zinc Co.); the Carbonate King Zinc mine, Clark Mountain district, San Bernardino County (J. Q. Little under contract from Crystal Cave Mining Co.); and the Shoshone group, Resting Springs district, Inyo County (Anaconda Copper Mining Co.).

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in California in 1948, 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
Alpine	2		8	$280			8	$280
Amador	8	6	5,399	188,965	1,215	$42,525	6,614	231,490
Butte	1	15	1	35	26,136	914,760	26,137	914,795
Calaveras	18	5	1,017	35,595	179	6,265	1,196	41,860
Colusa	1		2	70			2	70
El Dorado and Humboldt [2]	10	6	1,006	35,210	1,660	58,100	2,666	93,310
Imperial	4		171	5,985			171	5,985
Inyo and Fresno [2]	36	3	1,771	61,985	284	9,940	2,055	71,925
Kern	32	4	5,661	198,135	515	18,025	6,176	216,160
Lassen	2		121	4,235			121	4,235
Los Angeles	1	2	9	315	206	7,210	215	7,525
Madera and Merced [2]	1	5			19,279	674,765	19,279	674,765
Mariposa	16	5	5,470	191,450	2,055	71,925	7,525	263,375
Modoc	1		141	4,935			141	4,935
Mono	6		63	2,205			63	2,205
Monterey	2		24	840			24	840
Napa	1		2	70			2	70
Nevada	13	19	100,451	3,515,785	1,360	47,600	101,811	3,563,385
Placer	7	17	436	15,260	894	31,290	1,330	46,550
Plumas	3	13	77	2,695	622	21,770	699	24,465
Riverside	3		4	140			4	140
Sacramento		12			118,152	4,135,320	118,152	4,135,320
San Bernardino and San Joaquin [2]	28	4	1,356	47,460	2,091	73,185	3,447	120,645
San Diego	3		8	280			8	280
Shasta and Stanislaus [2]	9	8	796	27,860	24,142	844,970	24,938	872,830
Sierra	6	14	9,687	339,045	743	26,005	10,430	365,050
Siskiyou	11	30	221	7,735	21,005	735,175	21,226	742,910
Trinity	3	19	722	25,270	7,208	252,280	7,930	277,550
Tuolumne	12	2	1,285	44,975	29	1,015	1,314	45,990
Yuba	1	6	8	280	57,781	2,022,335	57,789	2,022,615
Total: 1948	241	195	135,917	4,757,095	285,556	9,994,460	421,473	14,751,555
1947	210	210	118,877	4,160,695	312,538	10,938,830	431,415	15,099,525

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1948, by counties, in terms of recovered metals—Continued

County	Silver					
	Lode		Placer		Total	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Alpine	2	$2			2	$2
Amador	2,085	1,887	167	$151	2,252	2,038
Butte			1,990	1,801	1,990	1,801
Calaveras	617	558	23	21	640	579
Colusa	1	1			1	1
El Dorado and Humboldt [2]	1,203	1,089	201	182	1,404	1,271
Imperial	93	84			93	84
Inyo and Fresno [2]	573,282	518,849	47	43	573,329	518,892
Kern	13,419	12,145	90	81	13,509	12,226
Lassen	102	92			102	92
Los Angeles	3	3	33	30	36	33
Madera and Merced [2]	42	38	1,852	1,676	1,894	1,714
Mariposa	1,741	1,576	425	384	2,166	1,960
Modoc	73	66			73	66
Mono	788	713			788	713
Monterey	6	5			6	5
Napa	29	26			29	26
Nevada	29,583	26,774	161	146	29,744	26,920
Placer	1,362	1,233	141	127	1,503	1,360
Plumas	12	11	54	49	66	60
Riverside	101	91			101	91
Sacramento			6,491	5,875	6,491	5,875
San Bernardino and San Joaquin [2]	57,514	52,053	226	205	57,740	52,258
San Diego	3	3			3	3
Shasta and Stanislaus [2]	17,601	15,930	2,350	2,127	19,951	18,057
Sierra	2,316	2,096	89	81	2,405	2,177
Siskiyou	53	48	2,704	2,447	2,757	2,495
Trinity	149	135	862	780	1,011	915
Tuolumne	1,108	1,003	5	4	1,113	1,007
Yuba	1	1	3,571	3,232	3,572	3,233
Total: 1948	703,289	636,512	21,482	19,442	724,771	655,954
1947	1,573,428	1,423,952	24,014	21,733	1,597,442	1,445,685

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Alpine	6,000	$1,302					$1,584
Amador							233,528
Butte							916,596
Calaveras			2,000	$358			42,797
Colusa							71
El Dorado and Humboldt [2]	72,000	15,624					110,205
Imperial							6,069
Inyo and Fresno [2]	598,000	129,766	17,240,000	3,085,960	9,320,000	$1,239,560	5,046,103
Kern							228,386
Lassen							4,327
Los Angeles							7,558
Madera and Merced [2]	10,000	2,170					678,649
Mariposa							265,335
Modoc							5,001
Mono			4,000	716			3,634
Monterey							845
Napa							96
Nevada							3,590,305
Placer							47,910
Plumas							24,525
Riverside			2,000	358			589
Sacramento							4,141,195
San Bernardino and San Joaquin [2]	118,000	25,606	838,000	150,002	438,000	58,254	406,765
San Diego							283
Shasta and Stanislaus [2]	156,000	33,852	106,000	18,974	892,000	118,636	1,062,349
Sierra	2,000	434	28,000	5,012			372,673
Siskiyou							745,405
Trinity							278,465
Tuolumne							46,997
Yuba							2,025,848
Total: 1948	962,000	208,754	18,220,000	3,261,380	10,650,000	1,416,450	20,294,093
1947	4,814,000	1,010,940	20,160,000	2,903,040	10,830,000	1,310,430	21,769,620

[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 output.

MINING INDUSTRY

The tonnage of material from lode mines in California treated in 1948 decreased 19 percent compared with 1947, and the yardage at placer mines decreased 4 percent. The output of lode gold advanced 14 percent; but the gold from this source comprised only 32 percent of the State total, whereas production from placer mines decreased 9 percent and represented 68 percent of the total. The drop in gold-ore output was less than the decrease in base-metal ore production. The average recoverable gold content of gravel decreased 6 percent.

Dredges of the bucket-line type washed 96 percent of the total gravel mined in the State in 1948 and recovered 90 percent of the total placer gold. Dragline dredging declined in 1948; equipment of this type (used at 27 properties) washed 3 percent of the total gravel handled and recovered 6 percent of the placer gold. Six suction dredges operated in 1948. A greater number of hydraulic mines were operated in 1948 compared with 1947, and 49 percent more gold was recovered in 1948 than in the previous year. More drift mines were operated in 1948 than in 1947; however, the larger quantity of gravel yielded only 2 percent more gold than in 1947.

ORE CLASSIFICATION

Of the 526,776 tons of ore (including 10,883 tons of old tailings) sold or treated in 1948, more than 76 percent was gold ore and old tailings, 14 percent zinc-lead ore, 4 percent lead ore and old tailings, 3 percent gold-silver ore, 1 percent zinc ore, 1 percent silver ore and old tailings, and less than 1 percent copper ore. 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 1948, with content in terms of recovered metals

Source	Material sold or treated: Ore (short tons)	Material sold or treated: Old tailings (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	395,640	7,220	133,927	61,854	218,000	30,800	----------
Dry and siliceous gold-silver ore	16,680	--------	680	45,788	3,800	1,278,700	102,300
Dry and siliceous silver ore	1,074	3,613	103	25,521	7,200	331,300	----------
	413,394	10,833	134,710	133,163	229,000	1,640,800	102,300
Copper ore	[1] 152	--------	[3 4] 61	[3 4] 34,616	[2 3 4] 443,700	----------	----------
Lead ore	21,955	50	837	201,399	97,400	6,720,300	383,600
Zinc ore	5,233	--------	66	23,330	91,000	125,200	1,320,300
Zinc-lead ore	75,159	--------	243	310,781	100,900	9,733,700	8,843,800
Total lode mines	[1] 515,893	10,883	[3 4] 135,917	[3 4] 703,289	[2 3 4] 962,000	18,220,000	10,650,000
Placers	--------	--------	285,556	21,482	----------	----------	----------
Total: 1948	[1] 515,893	10,883	[3 4] 421,473	[3 4] 724,771	[2 3 4] 962,000	18,220,000	10,650,000
1947	[1] 628,224	20,565	[3 4] 431,415	[3 4] 1,597,442	[3 4] 4,814,000	[3 4] 20,160,000	[4] 10,830,000

[1] Excludes tungsten ore.
[2] Includes 52,000 pounds from precipitates.
[3] Includes metal recovered from pyritic ore (residue).
[4] Includes metal recovered from tungsten ore.

METALLURGIC INDUSTRY

During 1948, 93 percent of the total ore and old tailings handled was treated at mills, and 7 percent was shipped for direct smelting. Of the 22,156 tons of concentrates received by smelters, more than 53 percent was lead concentrate, nearly 38 percent zinc and zinc-lead-copper together, nearly 6 percent copper, and about 3 percent gold concentrate. A negligible quantity of gold-silver concentrate was shipped. The tonnage of crude ore and old tailings smelted decreased 55 percent, whereas the quantity of ore and old tailings milled decreased 14 percent.

Companies producing most of California's lode gold in 1948 owned and operated their own metallurgical plants. Included with the few mills that did receive custom ore were: Burton Bros., Inc., Rosamond (treatment by cyanidation), and Butte Lode Mining Co., Randsburg (cyanidation and amalgamation), both in Kern County. The Empire Star Mines Co., Ltd., Grass Valley, Nevada County, cyanided some lots of concentrates. The lead plant of the American Smelting & Refining Co. at Selby, Contra Costa County—the State's only smelter treating principally nonferrous primary material—operated throughout the year.

Mine production of metals in California in 1948, 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	307, 280	73, 921	13, 304			
Ore, old tailings and concentrates cyanided	80, 276	52, 572	36, 532			
Concentrates smelted:						
Flotation	22, 046	5, 045	385, 634	688, 100	10, 946, 700	9, 748, 300
Gravity	110	404	174			
Ore and old tailings smelted	35, 371	3, 975	267, 645	273, 900	7, 273, 300	901, 700
Total lode mines		135, 917	703, 289	962, 000	18, 220, 000	10, 650, 000
Placers		285, 556	21, 482			
Total: 1948		421, 473	724, 771	962, 000	18, 220, 000	10, 650, 000
1947		431, 415	1, 597, 442	4, 814, 000	20, 160, 000	10, 830, 000

Mine production of metals from mills in California in 1948, by counties and classes of concentrates smelted, in terms of recovered metals

	Material treated		Recovered in bullion		Concentrates smelted and recovered metal[2]					
	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)
BY COUNTIES										
Alpine	20		8	2						
Amador	14,722	4,524	4,444	1,897	49	365	72			
Butte	1		1							
Calaveras	7,405		708	253	71	288	351		2,000	
Colusa	18		2	1						
El Dorado	18,133		484	89	359	512	1,107	72,000		
Imperial	41		19	36						
Inyo and Shasta[3]	95,078		576	912	21,105	732	382,321	614,100	10,916,700	9,748,300
Kern	13,366	445	5,610	13,406						
Lassen	9,002		100	86						
Los Angeles	10		9	3						
Mariposa	12,296		3,376	983	214	2,092	758			
Mono	359		58	87						
Monterey	4		22	6						
Nevada	276,854		[4]100,417	[4]29,548	2	12	7			
Placer	2,008		365	685	44	56	308			
Plumas	92		77	12						
Riverside	1		1							
San Bernardino	158		161	65						
San Diego	58		8	3						
Sierra	27,199	150	9,015	1,600	147	668	715	2,000	28,000	
Siskiyou	7,365		221	53						
Trinity	891		62	13	79	574	113			
Tuolumne	1,174	31	749	96	86	150	56			
Total: 1948	486,255	5,150	[4]126,493	[4]49,836	22,156	5,449	385,808	688,100	10,946,700	9,748,300
1947	569,117	558	[4]103,235	[4]36,765	22,159	11,063	376,716	2,551,100	5,279,750	6,608,800
BY CLASSES OF CONCENTRATES										
Dry gold					632	4,087	1,620		2,000	
Dry gold-silver					13	11	295			
Copper					1,294	345	35,403	496,300		
Lead					11,879	917	316,761	66,500	10,392,200	1,223,400
Zinc and zinc-lead-copper[3]					8,338	89	31,729	125,300	552,500	8,524,900
Total 1948					22,156	5,449	385,808	688,100	10,946,700	9,748,300

[1] Figures under "ore" include both raw ore and concentrates amalgamated or cyanided.
[2] Includes concentrates and gold, silver, and copper from tungsten ore not included with material treated.
[3] Combined to avoid disclosure of individual output.
[4] Includes gold and silver recovered and sold as "natural gold."

Gross metal content of concentrates produced from ores mined in California in 1948, 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	632	4,087	1,620	759	3,889	
Dry gold-silver	13	11	295	67		
Copper	1,294	345	35,403	507,739		
Lead	11,879	917	316,761	78,684	10,577,163	1,700,844
Zinc and zinc-lead copper[1]	8,338	89	31,729	139,170	596,225	8,729,461
Total: 1948	22,156	5,449	385,808	726,419	11,177,277	10,430,305
1947	22,159	11,063	376,716	2,640,498	5,544,361	7,033,463

[1] Combined to avoid disclosure of individual output.

Gross metal content of California crude ore and old tailings shipped to smelters in 1948, by classes of material

Class of ore	Material shipped		Gross metal content [1]				
	Ore (short tons)	Old tailings (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	4,305	2,070	2,752	6,517	81,250	1,453	----------
Dry gold-silver	1,051	----------	284	14,665	76	----------	----------
Dry silver	852	3,613	46	22,589	8,398	340,150	----------
Copper [1]	152	----------	41	5,513	[2] 91,543	222	----------
Lead	21,955	50	837	201,399	120,475	6,885,678	692,327
Zinc	783	----------	8	12,016	----------	21,255	599,465
Zinc-lead	540	----------	7	4,946	7,098	203,655	118,261
Total: 1948	29,638	5,733	3,975	267,645	[2] 308,840	7,452,413	1,410,053
1947	59,107	20,007	4,579	1,159,947	[3] 2,392,693	15,195,937	5,826,860

[1] Content of copper ore includes gold, silver, and copper from pyritic ore (residue) not included with material treated.
[2] Includes 53,072 pounds contained in precipitates.
[3] Includes 8,959 pounds contained in precipitates.

Mine production of metals from California crude ore and old tailings shipped to smelters in 1948, in terms of recovered metals

	Material shipped		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
	Ore (short tons)	Old tailings (short tons)					
BY COUNTIES							
Alpine	87	--------	--------	--------	6,000	--------	--------
Amador	(1)	--------	590	116	--------	--------	--------
Calaveras	18	--------	21	13	--------	--------	--------
El Dorado	1	--------	10	7	--------	--------	--------
Imperial	472	--------	152	57	--------	--------	--------
Inyo	19,855	3,663	845	201,764	74,900	6,427,600	459,100
Kern	(1)	--------	51	13	--------	--------	--------
Lassen	3	--------	21	16	--------	--------	--------
Madera	28	--------	--------	42	10,000	--------	--------
Mariposa	1	--------	2	--------	--------	--------	--------
Modoc	11	--------	141	73	--------	--------	--------
Mono	54	--------	5	701	--------	4,000	--------
Monterey	2	--------	2	--------	--------	--------	--------
Napa	13	--------	2	29	--------	--------	--------
Nevada	49	--------	22	28	--------	--------	--------
Placer	37	--------	15	369	--------	--------	--------
Riverside	6	--------	3	101	--------	2,000	--------
San Bernardino	8,840	--------	1,195	57,449	118,000	838,000	438,000
Shasta [2]	62	--------	414	5,886	[3] 65,000	1,700	4,600
Sierra	1	--------	4	1	--------	--------	--------
Trinity	13	--------	86	23	--------	--------	--------
Tuolumne	76	2,070	386	956	--------	--------	--------
Yuba	9	--------	8	1	--------	--------	--------
Total: 1948	29,638	5,733	3,975	267,645	[3] 273,900	7,273,300	901,700
1947	59,107	20,007	4,579	1,159,947	[4] 2,262,900	14,880,250	4,221,200

See footnotes at end of table.

Mine production of metals from California crude ore and old tailings shipped to smelters in 1948, in terms of recovered metals—Continued

	Material shipped		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
	Ore (short tons)	Old tailings (short tons)					
BY CLASSES OF MATERIAL							
Dry gold	4,305	2,070	2,752	6,517	79,000	800	----------
Dry gold-silver	1,051	--------	284	14,665	----------	----------	----------
Dry silver	852	3,613	46	22,589	7,200	331,300	----------
Copper [2]	152	--------	41	5,513	[3] 84,400	----------	----------
Lead	21,955	50	837	201,399	97,400	6,720,300	383,600
Zinc	783	--------	8	12,016	----------	20,900	432,900
Zinc-lead	540	--------	7	4,946	5,900	200,000	85,200
Total 1948	29,638	5,733	3,975	267,645	[3] 273,900	7,273,300	901,700

[1] Clean-up.
[2] Content of copper ore from Shasta County includes gold, silver, and copper from pyritic ore (residue) not included with material treated.
[3] Includes 52,000 pounds contained in precipitates.
[4] Includes 8,800 pounds contained in precipitates.

REVIEW BY COUNTIES AND DISTRICTS

AMADOR COUNTY

East Belt District.—Belden Amador Mines, Inc., worked the Belden mine throughout 1948. A substantial tonnage of gold ore was amalgamated, and flotation concentrate was shipped to a custom cyanide mill for treatment. Earnest L. Lilly operated a dragline dredge (with 2½ cubic-yard bucket) on the Cosumnes River 7 miles northwest from Plymouth from March 17 to November 15, 1948.

Mother Lode District.—The Central Eureka Mining Co. resumed operation of the Old Eureka mine in 1948 (inactive except for maintenance work since late in 1942); the gold ore treated by amalgamation and cyanidation in the company 200-ton mill yielded a substantial quantity of gold and some silver. The Alpine Gravel Plant operated a dragline dredge from June to December 1948 on the middle fork and north fork of Jackson Creek, and McDonald, Ordway & McDonald washed gravel with similar equipment during May 1948 on Dry Creek. F. L. Shevlin and Frank Fuller treated the Kennedy mine tailings during 1948; flotation concentrate, yielding gold and some silver, was shipped to a smelter.

Mine production of gold, silver, copper, lead, and zinc in California in 1948, 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)					
Alpine County: Monitor	2		107	8		8	2	6,000			$1,584
Amador County:											
Camanche [4]		3			127	127	13				4,457
East Belt [5]	3	(6)	2,702	2,602	(6)	[7] 2,602	[7] 1,469				[7] 92,400
Ione		(8)			39	39	8				1,372
Mother Lode [9]	5	(6)	16,544	2,797	(6)	[7] 2,797	[7] 616				[7] 98,452
Butte County:											
Bangor		(8)			10	10					350
Butte Creek		5			5,226	5,226	466				183,332
Cherokee		(8)			33	33	5				1,160
Enterprise	1		1	1		1					35
Magalia		1			26	26	3				913
Oroville		7			20,800	20,800	1,503				729,360
Yankee Hill		(6)			(6)	(6)	(6)				(6)
Calaveras County:											
Camanche [4]		1			10	10	1				351
Copperopolis	2		560	85		85	49				3,019
East Belt [5]	10	3	6,492	751	110	861	428		2,000		30,881
Jenny Lind	1		298	125		125	147				4,508
Mother Lode [9]	5	1	73	56	59	115	15				4,038
Colusa County: Willow Springs	1		18	2		2	1				71
El Dorado County:											
East Belt [5]	3	1	512	298	215	513	189				18,126
Mother Lode [9]	7	3	17,622	708	432	1,140	1,099	72,000			56,519
West Belt		1			939	939	103				32,958
Fresno County: Friant		(6)			(6)	(6)	(6)				(6)
Humboldt County: Orleans		(6)			(6)	(6)	(6)				(6)
Imperial County:											
Cargo Muchacho	3		481	155		155	58				5,477
Mesquite Diggings	1		32	16		16	35				592
Inyo County:											
Big Pine		(6)			(6)	(6)	(6)				(6)
Bishop Creek	(6)		(6)		(6)	(6)	(6)	(6)			(6)
Cerro Gordo	4		5,707	93		93	23,251	26,000	580,900		133,921
Chidago [10]	1		38	65		65	20				2,293
Chloride Cliff	1		2	1		1	2				37
Coso	8		84,279	488		488	393,761	118,800	12,155,800	8,994,100	3,771,337
Fish Springs	5		55	20		20	233		15,600		3,703

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1948, 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			Silver (ode 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											
Le Moyne	1		3				19		2,700		$500
Modoc	4		5,435	64		64	61,194	8,300	2,121,300		439,138
Resting Springs	4		17,753	740		740	53,088	17,000	2,192,300	271,400	506,154
Slate Range	1		109	21		21	486	300	19,400	11,300	6,216
South Park	1		7	19		19	16				679
Ubehebe	2		277	3		3	1,667	900	114,000	43,200	27,961
Union	1		193	149		149	5,083	2,400	38,000		17,138
Wild Rose	2		64	49		49	40				1,751
Kern County:											
Clear Creek	(6)		(6)	(6)		(6)	(6)				(6)
Green Mountain	1		150	23		23	12				816
Keyes (Pioneer)	3	(6)	27	3	(6)	[7] 3	[7] 2				[7] 107
Mojave	11	1	12,084	5,207	2	5,209	13,258				194,314
Randsburg [11]	15	(6)	1,517	426	(6)	[7] 426	[7] 118				[7] 15,017
Lassen County: Hayden Hill	2		9,005	121		121	102				4,327
Los Angeles County:											
Cedar	1		10	9		9	3				318
San Gabriel		2			206	206	33				7,240
Madera County:											
Daulton	1		28				42	10,000			2,208
Dennis		1			290	290	85				10,227
Raymond		(6)			(6)	(6)	(6)				(6)
Mariposa County:											
East Belt [5]	5		202	155		155	22				475
Hunter Valley	1	(6)	10,382	4,975	(6)	[7] 4,975	[7] 1,637				[7] 175,607
Mother Lode [9]	10	3	1,713	340	274	614	119				26,567
Merced County:											
Chowchilla River		1			311	311	30				10,912
Snelling		(6)			(6)	(6)	(6)				(6)
Modoc County: Hi Grade	1		11	141		141	73				5,001
Mono County:											
Bodie	1		1	10		10	45				391
Chidago [10]	2		47	5		5	442		1,900		915
Homer	(6)		(6)	(6)		(6)	(6)				(6)
Masonic	1		30	18		18	35				662
West Walker River	1		7				259		2,100		610
Monterey County: Los Burros	2		6	24		24	6				845
Napa County: Calistoga	1		13	2		2	29				96

Nevada County:											
French Corral	1	(6)	10	9	(6)	[7] 9	[7] 2				[7] 317
Graniteville	1	3	25	16	22	38	11				1,340
Grass Valley-Nevada City	8	5	244,741	94,112	286	94,398	28,338				3,329,577
North Bloomfield		5			679	679	52				23,812
Washington	3		32,127	6,314		6,314	1,285				222,153
You Bet		4			173	173	26				6,079
Placer County:											
Auburn		(6)			(6)	(6)	(6)				(6)
Blue Canyon		1			1	1					35
Dutch Flat	1	4	100	8	159	167	22				5,865
Forest Hill	2	4	280	48	47	95	21				3,344
Iowa Hill	3	3	1,174	38	52	90	747				3,825
Last Chance		2			10	10					350
Lincoln		1			133	133	22				4,675
Penryn	1		491	342		342	604				12,517
Plumas County:											
Crescent Mills	1		5	1		1					35
Genesee	1	1	1	2	72	74	5				2,594
La Porte		6			458	458	43				16,069
Paradise		1			6	6					210
Quincy		1			31	31	1				1,086
Rich		3			43	43	4				1,509
Sawpit Flat		1			2	2					$70
Seneca		(8)			10	10	1				351
Virgilia	1		86	74		74	12				2,601
Riverside County:											
Desert Center	1		1	1		1					35
Eagle Mountain	2		6	3		3	101		2,000		554
Sacramento County:											
Cosumnes River		3			13,956	13,956	1,068				489,427
Folsom		9			104,196	104,196	5,423				3,651,768
San Bernardino County:											
Buckeye	1		3,532	821		821	5,055	78,000			50,236
Calico	2		11	12		12	10	100			451
Clark Mountain	7		4,070	61		61	30,313	38,400	825,800	432,900	243,297
Dale	3		6	8		8	7				286
Holcomb Valley		1			4	4					140
Ivanpah	1		30	5		5	70				238
Kingston	1		34				54		6,600	5,100	1,908
New York Mountain	1		35	26		26	67	300	800		1,179
Randsburg [11]	2	1	984	268	158	426	13,871				27,464
Shadow Mountain	1		33	1		1	397		4,300		1,164
Silurian	1		145	1		1	7,625	600	500		7,156
Slate Range	1		5	78		78	23				2,751
Solo	3		97	62		62	31				2,198
Whipple Mountain	4		16	13		13	15	600			599
San Diego County:											
El Cajon	1		8	1		1					35
Julian	(6)		(6)	(6)		(6)	(6)				(6)
San Joaquin County: Camanche [4]		(6)			(6)	(6)	(6)				(6)

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1948, 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			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)					
Shasta County:											
Buckeye	1		10	16		16	1				$561
Cow Creek	(6)		(6)	(6)		(6)	(6)	(6)	(6)	(6)	(6)
Flat Creek	(6)		(6)	(6)		(6)	(6)	(6)			(6)
French Gulch	2	(8)	180	22	99	121	13				4,247
Igo	2		67	375		375	392		100		13,498
Redding	1	4	16	4	7,752	7,756	844				272,224
Shasta		1			2,891	2,891	481				101,620
Sierra County:											
Alleghany	(6)	5	(6)	(6)	339	339	[12] 32				[12] 11,894
American Hill	1		150	7		7	1				246
Downieville	2	4	11,996	3,504	182	3,686	1,257	2,000	28,000		135,593
Forest	1	1	1	4	17	21	4				739
Pike	1	1	120	21	10	31	12				1,096
Poker Flat		2			191	191	25				6,708
Sierra City		(6)			(6)	(6)					(6)
Siskiyou County:											
Callahan		(6)			(6)	(6)	(6)				(6)
Cottonwood	2		3,001	13		13	2				457
Deadwood		1			6,651	6,651	903				233,602
Green Horn		1			47	47	7				1,651
Humbug	4	2	44	44	47	91	17				3,200
Klamath River		10			5,033	5,033	684				176,774
Liberty	2	8	300	70	205	275	46				9,666
Salmon River		4			68	68	5				2,385
Scott Bar	3	(8)	4,020	94	3	97	26				3,419
Yreka		2			3	3					105
Stanislaus County: La Grange		(6)			(6)	(6)	(6)				(6)
Trinity County:											
Big Bar		1			6	6	1				211
Cinnabar		1			18	18					630
Coffee Creek		2			1,897	1,897	310				66,676
Hayfork	2		109	153		153	36				5,388
Junction City		5			3,316	3,316	322				116,351
Lewiston	(6)		(6)	(6)		(6)	(6)				(6)
Minersville		1			7	7	1				246
New River		(6)			(6)	(6)	(6)				(6)
Salyer		2			1,404	1,404	174				49,297
Weaverville		6			555	555	53				19,473

Tuolumne County:											
East Belt [5]	9	-------	307	633	-------	633	147	-------	-------	-------	22,288
Mother Lode [9]	3	2	3,044	652	29	681	966	-------	-------	-------	24,709
Yuba County:											
Camptonville	-------	3	-------	-------	86	86	16	-------	-------	-------	3,024
Dobbins	1	(8)	9	8	16	24	2	-------	-------	-------	842
Smartville	-------	(6)	-------	-------	(6)	(6)	(6)	-------	-------	-------	(6)
Strawberry Valley	-------	1	-------	-------	103	103	9	-------	-------	-------	3,613
Yuba River	-------	(6)	-------	-------	(6)	(6)	(6)	-------	-------	-------	(6)
Other districts [13]	11	32	20,752	7,197	104,974	112,171	61,234	580,300	105,900	892,000	4,244,922
Total California	241	195	[14] 526,776	[15 16] 135,917	285,556	[15 16] 421,473	[15 16] 724,771	[15 16 17] 962,000	18,220,000	10,650,000	20,294,093

[1] Only those districts shown separately for which Bureau of Mines is at liberty to publish figures; other producing districts listed in footnote 13 and their output grouped as "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: 703,289 from lode mines and 21,482 ounces from placer mines.
[4] Camanche district lies in Amador, Calaveras, and San Joaquin Counties.
[5] East Belt district lies in Amador, Calaveras, El Dorado, Mariposa, and Tuolumne Counties.
[6] Included with "Other districts."
[7] Exclusive of placer output which is included with "Other districts."
[8] From property not classed as a mine.
[9] Mother Lode district lies in Amador, Calaveras, El Dorado, Mariposa, and Tuolumne Counties.
[10] Chidago district lies in Inyo and Mono Counties.
[11] Randsburg district lies in Kern and San Bernardino Counties.
[12] Exclusive of lode output which is included with "Other districts."
[13] Includes following: East Belt [5] and Mother Lode [9] districts in Amador County: Yankee Hill in Butte County; Friant in Fresno County; Orleans in Humboldt County; Big Pine and Bishop Creek in Inyo County; Clear Creek, Keyes (Pioneer), and Randsburg [11] in Kern County; Raymond in Madera County; Hunter Valley in Mariposa County; Snelling in Merced County; Homer in Mono County; French Corral in Nevada County; Auburn in Placer County: Camanche [4] in San Joaquin County; Julian in San Diego County; Cow Creek and Flat Creek in Shasta County; Alleghany and Sierra City in Sierra County; Callahan in Siskiyou County; La Grange in Stanislaus County; Lewiston and New River in Trinity County; Smartville and Yuba River in Yuba County.
[14] Excludes tungsten ore.
[15] Includes metal recovered from tungsten ore.
[16] Includes metal recovered from pyritic ore (residue).
[17] Includes 52,000 pounds contained in precipitates.

BUTTE COUNTY

Butte Creek District.—Lancha Plana Gold Dredging Co. operated its bucket-line dredge No. 5 (with 65 4½ cubic-foot buckets, electrically powered) 8 miles southeast of Chico for 363½ days of 1948. Shawnee Mines worked the Shawnee drift mine throughout 1948; 53 ounces of gold and 7 ounces of silver were recovered.

Oroville District.—Yuba Consolidated Gold Fields, Butte unit, operated two bucket-line dredges (Biggs No. 1 and Biggs No. 3) on land adjoining the Feather River throughout 1948; both dredges were of the Yuba type and electrically powered, one having 84 and the other 87 9-cubic-foot buckets. The Gold Hill Dredging Co. worked its Kister dredge on the east side of the Feather River about 7 miles south of Oroville throughout the year; the electrically powered, bucket-line dredge has 72 9-cubic-foot buckets.

CALAVERAS COUNTY

Copperopolis District.—Sky Rocket Mine and J. E. Boland worked the Sky Rocket mine during 1948 amalgamating gold ore. A small quantity of concentrate was shipped to a smelter for treatment.

East Belt District.—Blackstone Mine (L. A. Sanchez), operating the Blackstone mine throughout 1948, treated 5,421 tons of gold ore by amalgamation at the company 30-ton mill; flotation concentrate and slimes were shipped to a smelter. Other lode-gold mines worked during 1948 included the Best, Louise Margaret, Dubois, and Robert A. mines; Centennial (New Champion); Fine Gold; Lockwood; Mexican; and Never Sweat. John O. Cleveland operated a dragline and trommel at the Ohio mine for 97 days of 1948; 31 ounces of gold and 2 ounces of silver were recovered from 2,207 cubic yards of gravel handled.

Jenny Lind District.—Allen W. Doe (deceased) and Jose Paltor, lessees, treated gold ore from the Royal mine by amalgamation and flotation during 1948; concentrate was shipped to a smelter.

EL DORADO COUNTY

East Belt District.—Cosumnes Mines, Inc., operated the Cosumnes mine from January 1 to December 1, 1948, and treated gold ore in a 60-ton flotation mill; concentrate was shipped to a smelter.

Mother Lode District.—The Morning Star Mining Corp. worked the Pioneer-Lilyama mine in 1948; flotation copper concentrate from gold ore treated was shipped to a smelter. Volo Mining Co., operating the Shaw mine during 1948, recovered gold and silver by amalgamation. Knight Placer Mining Co. operated a dragline dredge on the Baldwin and Burks properties during 2 months of 1948.

West Belt District.—El Dorado Placer Mining Corp. operated a Northwest Diesel dragline excavator (with 2-cubic-yard bucket) and a Bodinson washing plant on the north fork of the American River from August 16 to November 20, 1948; 150,000 cubic yards of gravel washed yielded 939 ounces of gold and 103 ounces of silver.

FRESNO COUNTY

Friant District.—Gold and some silver was recovered in 1948 as byproducts from commercial sand and gravel operations by Pacific Coast Aggregates, Inc., from its Rockfield plant.

HUMBOLDT COUNTY

Orleans District.—The Pearch hydraulic mine was operated from January 1 to June 1, 1948, by Pearch Mine.

IMPERIAL COUNTY

Cargo Muchacho District.—Holmestake Mining Co. worked the Padre and Madre mine during 1948, shipping gold ore to a smelter.

INYO COUNTY

Bishop Creek District.—The United States Vanadium Corp. produced, by flotation, a copper concentrate containing a substantial quantity of silver and some gold as a byproduct from ore treated primarily for tungsten.

Cerro Gordo District.—Santa Rosa Mining Co., operating the Santa Rosa mine, and Louis Warnken, Jr., under lease agreement, working the Santa Rosa dump together, shipped lead ore and dump material (5,539 tons containing 93 ounces of gold, 21,678 ounces of silver, 25,900 pounds of copper, and 541,100 pounds of lead) to smelters in 1948. C. W. James operated the Old Timer mine from January to April 1948, shipping lead ore to a smelter.

Coso District.—The Darwin group of mines (the largest producer of silver, lead, and zinc in the State) was operated by the Anaconda Copper Mining Co. throughout 1948. The 300-ton mill (enlarged from a 140-ton plant) was equipped to treat sulfide zinc-lead ore by differential flotation and has provisions for alteration with oxide treatment. The lead concentrate and zinc concentrate produced were shipped to smelters. In addition, lead ore was shipped direct to a smelter for treatment. Joe-McCulley, operating the Empress group under lease and bond, shipped 136 tons of zinc-lead ore containing 2 ounces of gold, 2,824 ounces of silver, 5,000 pounds of copper, 61,300 pounds of lead, and 16,000 pounds of zinc to a smelter. L. D. Foreman & Co. shipped to smelters silver ore, containing substantial quantities of lead, from the Custer, Lane-Eagle, and Last Chance mines.

Modoc District.—Foreman & Skinner operated the Defense mine (third-largest producer of silver and lead in California) during 1948, shipping lead ore to a smelter. Finley & Vignich operated the Minnietta mine from January 15 to December 31, 1948, and shipped lead ore (1,020 tons containing 5 ounces of gold, 5,086 ounces of silver, 1,000 pounds of copper, and 256,800 pounds of lead) to smelters. Foss & Osborne shipped lead ore, containing values in gold, silver, and copper, to smelters from the Surprise mine in 1948.

Resting Springs District.—Anaconda Copper Mining Co. worked the Shoshone group of mines (second-largest producer of silver and lead in the State) the entire year. Gold-silver ore (including dump material) containing substantial quantities of lead and zinc and some copper was shipped direct to a smelter. Lead ore treated at the company 90-ton flotation mill yielded a lead concentrate (with some values in gold, silver, copper, and zinc), which was shipped to a smelter.

Ubehebe District.—Ubehebe Mines, Inc., Ralph Liole, lessee, operated the Ubehebe mine during 1948 and shipped zinc-lead ore to a smelter. George Lippincott worked the Lippincott mine in 1948 and shipped lead and zinc-lead ores to smelters.

KERN COUNTY

Mojave District.—Burton Bros., Inc., operated its cyanide mill on ore from the Cactus Queen, Tropico, and Trailer Wheel mines and, in addition, treated ores from other mines in the Mojave district (including the Standard, Whitmore, Hilltop, Elephant-Eagle, and Bob Tail) and outlying districts on a custom basis.

Randsburg District.—Butte Lode Mining Co. operated the Butte Lode mine in 1948 and treated gold ore and old tailings by amalgamation and cyanidation in the company mill, which also handled small tonnages of custom ore from neighboring mines, including the Double 13 (Milmax Mining Co.), G. B. (M. J. Edsall), and Minnesota (Harris Hall Quick). Hatton & Lamley operated the K. C. N. claim from January 1 to March 31, 1948; 212 tons of gold ore treated at the Butte Lode Mining Co. mill yielded 127 ounces of gold and 31 ounces of silver. Foley Bros., Inc., operated a dragline excavator and floating washing plant at Kern Placers from January 1 to August 7, 1948.

LASSEN COUNTY

Hayden Hill District.—The Lassen Eagle Co. operated the Hayden Hill mine from January 1 to August 25, 1948; 9,002 tons of dump ore cyanided at the company 25-ton plant and 1 ton of slag shipped to a smelter together yielded 105 ounces of gold and 92 ounces of silver.

LOS ANGELES COUNTY

San Gabriel District.—Consolidated Rock Products Co. recovered 151 ounces of gold and 26 ounces of silver as byproducts of its commercial sand and gravel plant on the San Gabriel River. The Azusa Rock & Sand Co. similarly recovered 53 ounces of gold and 7 ounces of silver.

MADERA COUNTY

Raymond District.—Howell Bros. operated a suction dredge on the Chowchilla River from November 20 to December 31, 1948.

MARIPOSA COUNTY

East Belt District.—Schroeder Mines worked the Schroeder group throughout 1948; 52 tons of ore treated by amalgamation yielded 142 ounces of gold and 19 ounces of silver.

Hunter Valley District.—Mount Gaines Mining Co. operated the Mount Gaines mine the entire year and amalgamated 10,382 tons of gold ore, from which were recovered bullion (containing 2,883 ounces of gold and 879 ounces of silver) and 214 tons of flotation concentrate (including a small quantity of table concentrate) containing 2,092 ounces of gold and 758 ounces of silver. Thurman & Wright operated Dredge No. 3 (an electrically powered Bucyrus-Erie dragline excavator and Bodinson floating washing plant) on Burns Creek from March 19 to August 18, 1948.

Mother Lode District.—James H. Henry worked the Upper Bear Creek mine from April 26 to June 16, 1948, using Diesel dragline dredging equipment. Gold ore from a number of mines worked in the district during 1948 (including the Texas Gulch, Speciman, Malone, Lonesome Pine, French, and Diltz Oro Grande) was treated by amalgamation.

MERCED COUNTY

Chowchilla River District.—Midstate Equipment & Dredging Co. operated a dragline dredge on Mariposa Creek from January to July 1948.

Snelling District.—Merced Dredging Co. operated its dredge No. 1 (electrically powered and equipped with 60 9½-cubic-foot buckets) on the Merced River bottom ¾ mile from Snelling throughout 1948. The Snelling Gold Dredging Co. operated its two Yuba-type, electric, bucket-line dredges (each with 7-cubic-foot buckets) the entire year.

MODOC COUNTY

Hi-Grade District.—Wellman M. Smith and J. H. Causten, lessee (deceased), worked the Moonlight mine during 1948 and shipped to a smelter 11 tons of gold ore which yielded 141 ounces of gold and 73 ounces of silver.

MONO COUNTY

West Walker River District.—Topaz Lead-Silver Mines operated the Topaz Lead-Silver mine during January 1948; 7 tons of antimonial lead ore shipped to a smelter yielded 259 ounces of silver and 2,100 pounds of lead.

NEVADA COUNTY

Grass Valley-Nevada City District.—The Idaho-Maryland Mines Corp. worked the New Brunswick-Idaho-Maryland property throughout 1948; 196,232 tons of ore treated by amalgamation, followed by cyanidation of concentrates, yielded 49,024 ounces of gold and 14,212 ounces of silver. The Empire Star Mines Co., Ltd., operated the company 500-ton mill and cyanide plant the entire year treating ore from the Empire, North Star, and Pennsylvania mines at Grass Valley and the company properties at Browns Valley in Yuba County by amalgamation and cyanidation; concentrates from several neighboring mines also were treated at the plant. Other mines worked in the district included the Aetna, Baltic, Spring Hill, Gates-Stockton Hill, and Sugarloaf.

North Bloomfield District.—Mellott & Mellott, lessees, hydraulicked the Waukashau mine from February 15 to June 15, 1948; 8,000 cubic yards of material washed yielded 88 ounces of gold and 8 ounces of silver. Landburg, Massera, and Swazey hydraulicked the Relief Hill mine 72 days of 1948 under lease from Western Gold Co.

Washington District.—The Ancho Erie Mining Co. operated the Ancho and Erie groups throughout 1948. A substantial tonnage of gold ore was treated at the company 200-ton flotation mill and 6-ton cyanide plant. Tonopah Divide Mining Co. worked the Gaston mine from January 1 to October 25, 1948, amalgamating gold ore and shipping concentrate to a custom-cyanide mill for treatment.

PLACER COUNTY

Auburn District.—Virginia Town Placer Mine operated a dragline dredge in Auburn Ravine from May to November 1948.

Penryn District.—Mary Len Mine (a partnership) worked the Mary Len mine throughout 1948; 491 tons of ore amalgamated and a small quantity of concentrate cyanided at a custom mill together yielded 342 ounces of gold and 604 ounces of silver.

PLUMAS COUNTY

La Porte District.—R. & M. Mining Co. operated a dragline dredge at the First Chance mine on Slate Creek from June to December 1948.

Virgilia District.—Klau Mine, Inc., (R. S. Croxen, lessee) worked the Virgilia mine intermittently in 1948; 86 tons of ore amalgamated yielded 74 ounces of gold and 12 ounces of silver.

SACRAMENTO COUNTY

Cosumnes River District.—Thurman & Wright operated dredge No. 4 (electrically powered, bucket-line, equipped with 86 6-cubic-foot buckets) 3 miles southeast of Sloughhouse from January 1 to December 24, 1948. Mountain Gold Dredging Co. worked the Van Veck property at Michigan Bar, using dragline dredging equipment, during 9 months of 1948; 160,000 cubic yards of gravel washed yielded 655 ounces of gold and 66 ounces of silver. The Cosumnes Gold Dredging Co. operated its bucket-line dredge near Sloughhouse during 1948.

Folsom District.—Capital Dredging Co. operated its Yuba electric bucket-line dredges No. 4 and No. 3 south of Folsom. Dredge No. 4 was worked the entire year, and dredge No. 3, shut down since October 14, 1942, operated from May 15 to December 31, 1948. Dredge No. 4 of the Lancha Plana Gold Dredging Co. worked for 364 days of 1948 on the American River 5 miles south of Folsom; the dredge has 84 6-cubic-foot buckets. The General Dredging Co. operated its 3-cubic-yard Diesel dragline excavator and electrically powered Bodinson floating washing plant on the south side of the American River intermittently during 1948. The Natomas Co., leading California gold producer in 1948, operated seven bucket-line dredges (six units the full year and one unit 2 months) in 1948 on property near the American River. The Fair Oaks Gravel Co. recovered as a byproduct of gravel-washing operations 144 ounces of gold and 11 ounces of silver from 52,620 cubic yards of material handled.

SAN BERNARDINO COUNTY

Buckeye District.—Donald F. Love shipped gold ore containing substantial quantities of gold, silver, and copper from the Bagdad-Chase mine to a smelter during 1948.

Clark Mountain District.—The Carbonate King Zinc mine was operated in 1948 by J. Q. Little under contract from the Crystal Cave Mining Co.; zinc ore containing some gold, silver, and lead was shipped to a smelter. Mohawk Mines, Inc., worked the Mohawk mine throughout the year; 1,951 tons of lead ore shipped to a smelter yielded 19 ounces of gold, 14,170 ounces of silver, 27,500 pounds of copper, and 489,900 pounds of lead. Huston Mining Co. and the Altana Corp., operating the Wilshire claim of the Mohawk group from April 1 to December 31, 1948, together shipped to smelters 1,087 tons of lead ore from which was recovered 7 ounces of gold, 3,447 ounces of silver, 6,200 pounds of copper, and 244,300 pounds of lead.

Randsburg District.—Frank W. Royer operated the Kelly mine during 1948 and shipped gold-silver ore to smelters. Surcease Mining Co. recovered 158 ounces of gold and 24 ounces of silver from 125,686 cubic yards of gravel, handled chiefly for scheelite, at the Spud Patch mine by dryland dredging throughout 1948.

SAN JOAQUIN COUNTY

Camanche District.—The Gold Hill Dredging Co., working on low benches along the Mokelumne River, operated its Lower Camanche bucket-line dredge (with 76 8½-cubic-foot buckets) from January through April and its Upper Camanche dredge (with 64 7½-cubic-foot buckets) approximately 2 months of 1948.

SHASTA COUNTY

Cow Creek District.—The Coronado Copper & Zinc Co., second largest producer of zinc in the State, operated the Afterthought mine from October through December 1948. Zinc concentrate and zinc-lead-copper concentrate produced from the complex zinc ore milled at the company plant were shipped to smelters for treatment.

Flat Creek District.—The Mountain Copper Co., Ltd., made final clean-up at the Iron Mountain mine cyanide plant which yielded gold and silver. Some gold, silver, and copper were recovered from smelting cinder derived from burning pyrites in sulfuric acid plants; the pyrites was produced at the Hornet-Richmond mine.

Redding District.—The Thurman Gold Dredging Co. operated its bucket-line dredge (with 72 9-cubic-foot buckets) on Clear Creek throughout 1948. Roy S. Olson worked the Williamson property on Newton Creek, using dragline dredging equipment, from January 5 to May 1, 1948.

Shasta District.—The Lincoln Gold Dredging Co. operated its 2-cubic-yard Diesel dragline excavator and floating washing plant on Clear Creek from January 1 to October 6, 1948; 338,733 cubic yards of gravel washed yielded 2,841 ounces of gold and 476 ounces of silver.

SIERRA COUNTY

Alleghany District.—The Original Sixteen to One Mine, Inc., operated its Original Sixteen to One mine throughout 1948, recovering a substantial quantity of gold and some silver by amalgamation and from gold concentrate shipped to a smelter.

Downieville District.—Best Mines Co. worked the Gold Point mine from January 1 to December 27, 1948, when its option was canceled. Gold and silver was produced from concentrate shipped to a smelter, and a small quantity of bullion was recovered by amalgamation of ore. Alfred L. Merritt operated the Brush Creek mine in 1948 and treated a substantial tonnage of gold ore by amalgamation.

SISKIYOU COUNTY

Callahan District.—Yuba Consolidated Gold Fields (Siskiyou unit) operated its Callahan dredge (Yuba electric bucket-line, equipped with 72 9-cubic-foot buckets) throughout the year on Scott River.

Deadwood District.—The French Gulch Dredging Co. operated its Washington Iron Works electric bucket-line dredge throughout 1948; 1,227,632 cubic yards of gravel handled yielded 6,651 ounces of gold and 903 ounces of silver.

Klamath River District.—Reeves Ranch Dredging Co. operated its bucket-line dredge (equipped with 68 4-cubic-foot buckets) on the Klamath River 1 mile east of Happy Camp from July 25 through December 1948. Scandia Mines operated a Diesel dragline dredge on Horse Creek during January 1948; 80,000 cubic yards of gravel treated yielded 328 ounces of gold and 55 ounces of silver. Yreka Gold Dredging Co. operated its Johnson electric bucket-line dredge (with 67 6-cubic-foot buckets) in Seiad Valley from January 1 to September 1, 1948.

Liberty District.—Hydraulicking was carried on during 1948 at the Boulder Gulch group by Vest Mining Co. and Alfred W. Peeler and at the Joubert mine by Alex Markon, lessee.

Scott Bar District.—R. B. McGinnis and the Quartz Hill Mining Co. worked the Quartz Hill open-pit mine sporadically in 1948, treating gold ore by amalgamation.

STANISLAUS COUNTY

La Grange District.—The La Grange Gold Dredging Co. operated its bucket-line dredge No. 4 (with 62 10-cubic-foot buckets) on the Tuolumne River bottom throughout 1948. The Tuolumne Gold Dredging Corp. operated its bucket-line dredge throughout the year; the dredge is equipped with 100 12-cubic-foot buckets.

TRINITY COUNTY

Coffee Creek District.—Arthur B. Ferl recovered 30 ounces of gold and 2 ounces of silver from 2,600 cubic yards of gravel handled by dragline dredging on Buckeye Creek during November 1948.

Hayfork District.—The Thomas Kelly Co. worked the Kelly mine intermittently in 1948; gold and silver were recovered by amalgamating the high-grade ore and from concentrate shipped to a smelter.

Junction City District.—The Goldfield Consolidated Mines Co. hydraulicked the Northern California Mines Co. placer claims at Junction City throughout 1948. The Junction City Mining Co. operated its bucket-line dredge on the same property in 1948.

Lewiston District.—Brown Bear Gold Mines, Inc., worked the Brown Bear mine during 1948, recovering a substantial quantity of gold and some silver from concentrate shipped to a smelter.

Salyer District.—Thomson Divide Mining Co. operated the Long Bar mine, using dragline dredging equipment, in 1948. Salyer Syndicate hydraulicked the Swanson mine during the year and recovered a moderate quantity of gold and some silver.

Weaverville District.—Perry T. Bennett hydraulicked the Rex mine from January 4 to June 20, 1948; 7,000 cubic yards of gravel washed yielded 146 ounces of gold and 13 ounces of silver. Other properties hydraulicked during the year included the Browns Creek (C. O. Arbuckle), Democrat Gulch (A. V. Tindell), and Dry Placer (Indian Creek Industries, Inc., and S. L. Kimball).

TUOLUMNE COUNTY

East Belt District.—Tapley & Tapley, lessees, worked the Ford Pocket mine throughout 1948 and recovered 169 ounces of gold and 9 ounces of silver, reducing the ore by hand mortar. Gibson & Keenan operated the Hidden Treasure mine from January 4 to December 30, 1948; a small tonnage of ore amalgamated and approximately 1 ton of tailing shipped to a smelter together yielded 342 ounces of gold and 81 ounces of silver. Several other lode mines (mostly pocket mines) were worked on a small scale during 1948, including the Eureka, Fidelity, Golden Star, Indian Girl, Lucky Strike, and Wind Wheel; most of the gold from each property was recovered by amalgamation.

Mother Lode District.—Louis Warnken, Jr., worked the Eagle-Shawmut mill tailings during 1948, recovering gold and silver from material shipped to a smelter. Transierra Gold Mining Co. operated the North Star-Laura mine and Mohawk claim the first 6 months of 1948; flotation concentrate was shipped to a smelter.

YUBA COUNTY

Camptonville District.—J. E. Clark, lessee, operated a dragline dredge on Willow Creek during 4 months of 1948; 5,000 cubic yards of gravel washed yielded 46 ounces of gold and 9 ounces of silver.

Smartville District.—Rose Bar Development Co. hydraulicked the Blue Point mine from July 1 to December 31, 1948.

Yuba River District.—Yuba Consolidated Gold Fields (Yuba unit) operated dredges Nos. 14, 15, 17, 19, and 20 in the Yuba River Basin throughout 1948. 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; 1 with 87 18-cubic-foot buckets; 1 with 126 18-cubic-foot buckets; and 1 with 135 18-cubic-foot buckets.

Colorado
Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By A. J. MARTIN

GENERAL SUMMARY

UNDER stimulus of the highest yearly average price on record for lead and the second highest for zinc, the Colorado output of these metals rose sharply in 1948. The value of the lead output was higher than in any previous year and exceeded that of gold for the first time since 1891. The value of the zinc was the highest since 1917. There were large increases in production of lead and zinc in Summit and San Miguel Counties and smaller increases in most of the other producing counties. The State output of gold decreased, owing mainly to lower output from lode mines in the Cripple Creek, Animas, and Sneffels districts and placer mines in Park County, which more than offset substantial increases in Lake, Eagle, and Clear Creek Counties. Silver production was the highest since 1942 but was still only slightly more than half the annual average for the 10-year period, 1932–41. The copper output, largely a by-product or accessory product of the mining of other metals, increased 7 percent over 1947. The total value of the 1948 output of the five metals was $30,155,337—a 26-percent increase over 1947 and the highest since 1918.

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, 1944–48

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1944	$35.00	$0.711+	$0.135	$0.080	$0.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122
1947	35.00	.905	.210	.144	.121
1948	35.00	.905+	.217	.179	.133

[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. 1944 to June 30, 1946: $0.71111111; July 1, 1946, to Dec. 31, 1947: $0.905; 1948: $0.9050505.
[3] Yearly average weighted price of all grades of primary metal sold by producers; 1944–47: Price includes bonus payments by Office of Metals Reserve for overquota production.

Colorado ranked second among the States in total production of both gold and silver from the time of first recorded output through 1948; California ranked first in gold and Montana first in silver.

Mine production of gold, silver, copper, lead, and zinc in Colorado, 1944–48, and total, 1858–1948, 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
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
1947	290	33	1, 544, 694	168, 279	5, 889, 765	2, 557, 653	2, 314, 676
1948	271	23	1, 438, 119	154, 802	5, 418, 070	3, 011, 011	2, 725, 117
1858–1948			(1)	39, 381, 024	872, 212, 804	735, 995, 342	572, 609, 918

Year	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
1944	1, 048	$282, 960	17, 698	$2, 831, 680	39, 955	$9, 109, 740	$17, 724, 473
1945	1, 485	400, 950	17, 044	2, 931, 568	35, 773	8, 227, 790	16, 676, 521
1946	1, 754	568, 296	17, 036	3, 713, 848	36, 147	8, 819, 868	19, 903, 509
1947	2, 150	903, 000	18, 696	5, 384, 448	38, 745	9, 376, 290	23, 868, 179
1948	2, 298	997, 332	25, 143	9, 001, 194	45, 164	12, 013, 624	30, 155, 337
1858–1948	255, 159	68, 185, 701	2, 505, 721	253, 297, 505	1, 423, 107	224, 650, 302	1, 990, 956, 230

[1] Figure not available.

Gold.—The mine production of gold in Colorado was 154,802 fine ounces in 1948 compared with 168,279 in 1947. The output in 1948 came largely from the Cripple Creek, Upper San Miguel, California (Leadville), Animas, and Fairplay districts. Dry gold and silver ores yielded 66 percent of the State total gold, placers 9 percent, zinc-lead ore 15 percent, and other classes of ore 10 percent. The leading gold-producing properties, in order of rank, were: The Smuggler Union group (Telluride Mines, Inc.) at Telluride; Cresson mine at Cripple Creek; United Gold Mines Co. Portland-Vindicator group, Cripple Creek; Resurrection Mining Co. group at Leadville; and Golden Cycle Corp. Ajax mine, Cripple Creek.

Silver.—Colorado mines produced 3,011,011 fine ounces of silver in 1948—an increase of 453,358 ounces over 1947. The yearly average output during the five prewar years 1937–41 was 7,940,336 ounces. In 1948 dry gold and silver ores yielded 41 percent of the State total silver, zinc-lead ore 33 percent, lead ore 6 percent, and other classes of base-metal ores and placers 20 percent. The leading producers of silver were the Eagle mine at Gilman; Idarado Mining Co. Treasury Tunnel-Black Bear group, San Miguel County; Shenandoah-Dives group near Silverton; Emperius group at Creede; and Kokomo unit of the American Smelting & Refining Co., Summit County.

Gold and silver produced at placer mines in Colorado, 1944–48, in fine ounces in terms of recovered metals

Year	Small-scale hand methods [1]		Hydraulic		Gravel mechanically handled						Total	
					Nonfloating washing plants [2]		Dragline dredges		Bucket-line dredges			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
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	(3)	(3)	[3] 19,036	[3] 3,514	20,172	3,698
1947	243	52			930	156	(3)	(3)	[3] 16,400	[3] 3,243	17,573	3,451
1948	106	29			662	103	(3)	(3)	[3] 12,479	[3] 2,680	13,247	2,812

[1] Includes all operations in which hand labor is principal factor in delivering gravel to sluices, long toms, dip boxes, pans, rockers, dry washers, etc.
[2] 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."
[3] Production by dragline dredges included with that by bucket-line dredges; Bureau of Mines not at liberty to publish separately.

Copper.—The Colorado output of copper in 1948 was recovered largely as a byproduct or accessory product of the mining of lead, zinc, and precious metals; the quantity recovered was 2,298 short tons compared with 2,150 tons in 1947. Only 8 percent of the State total was derived from copper ore. The only substantial producer of copper in the State was the Idarado Mining Co., which makes a copper concentrate from its complex gold-silver-copper-lead-zinc ore mined in San Miguel County.

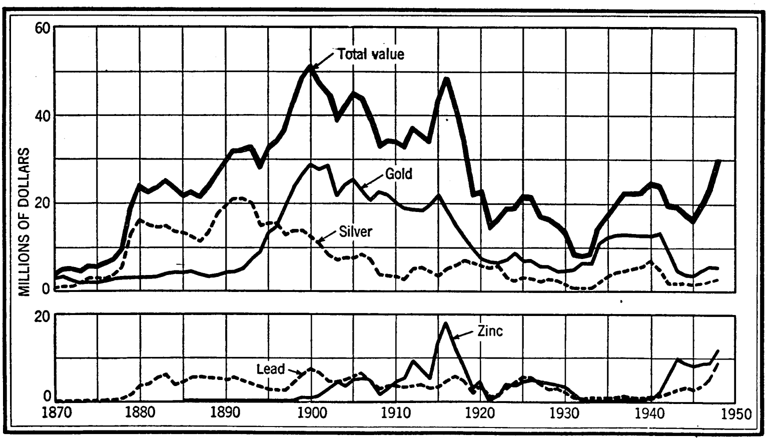

FIGURE 1.—Value of mine production of gold, silver, lead, and zinc and total value of gold, silver, copper, lead, and zinc in Colorado, 1870–1948. The value of copper has been less than $2,000,000 annually, except in a few years.

Lead.—The price of lead, which was 15 cents a pound (New York) January 1, 1948, advanced to 17.5 cents April 5, to 19.5 cents July 28, and to 21.5 cents November 1. Each advance set a new high price record. With the assistance of high market prices, the State output of recoverable lead rose to 25,143 short tons (largest since 1928) from

18,696 tons in 1947. Production in Summit County increased 197 percent over 1947 and represented 19 percent of the State total. Other large producing counties included Lake (19 percent), San Miguel (15 percent), San Juan (12 percent), and Dolores (10 percent). Zinc-lead ore yielded 63 percent of the State total lead; dry gold and silver ores 15 percent; lead, lead-copper, and zinc-lead-copper ores 17 percent; and copper and zinc ores 5 percent. The larger lead-producing mines, in order of rank, were: American Smelting & Refining Co. Kokomo unit; Resurrection group at Leadville; Rico Argentine at Rico; Smuggler Union group at Telluride; and Callahan Zinc-Lead Co. Akron-Erie group, White Pine.

Zinc.—During 1948 the market price of zinc rose by stages from 10.5 cents a pound (East St. Louis) January 1 to 17.5 cents November 13 and averaged 13.3 cents; in 1947 the average price (including Federal premiums paid to mine operators until June 30) was 12.1 cents. The advances in price stimulated production, and the State output of zinc increased from 38,745 short tons in 1947 to 45,164 tons in 1948. The principal producing counties, in order of output, were Eagle, Summit, Lake, San Miguel, Dolores, Gunnison, San Juan, and Ouray. Zinc and zinc-lead ores yielded 91 percent of the State total zinc. The leading zinc-producing mines, in order of rank, were: Eagle mine at Red Cliff, American Smelting & Refining Co. Kokomo unit, Resurrection group at Leadville, Rico Argentine group at Rico, and Idarado Mining Co. Treasury Tunnel-Black Bear group, San Miguel County.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1948 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	480	$16,800	75	$68
Boulder	17		1,377	48,195	21,232	19,216
Chaffee	8	1	275	9,625	1,243	1,125
Clear Creek	32	1	3,646	127,610	127,162	115,088
Custer	3		16	560	9,047	8,188
Dolores	5		108	3,780	132,312	119,749
Douglas		1	3	105		
Eagle	3		3,298	115,430	416,032	376,530
Fremont	3		11	385	1,074	972
Gilpin	6	5	83	2,905	716	648
Gunnison	10		162	5,670	78,863	71,375
Hinsdale	2				284	257
Jefferson	1	2	7	245	63	57
Lake	29	1	20,881	730,835	214,450	194,088
La Plata	5		176	6,160	537	486
Mineral	6		247	8,645	297,926	269,638
Montrose		1	4	140	2	2
Ouray	18		2,466	86,310	172,713	156,314
Park	11	5	9,120	319,200	7,867	7,120
Pitkin	5		9	315	35,618	32,236
Saguache	10		60	2,100	19,473	17,624
San Juan	30		16,471	576,485	542,490	490,981
San Miguel	8	2	39,669	1,388,415	582,266	526,980
Summit	31	1	2,664	93,240	344,427	311,724
Teller	28		53,569	1,874,915	5,139	4,651
Total: 1948	271	23	154,802	5,418,070	3,011,011	2,725,117
1947	290	33	168,279	5,889,765	2,557,653	2,314,676

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Mine production of gold, silver, copper, lead, and zinc in Colorado in 1948 by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Adams							$16,868
Boulder	4	$1,736	93	$33,294			102,441
Chaffee			50	17,900	1	$266	28,916
Clear Creek	13	5,642	749	268,142	283	75,278	591,760
Custer			59	21,122	41	10,906	40,776
Dolores	74	32,116	2,430	869,940	3,180	845,880	1,871,465
Douglas							105
Eagle	222	96,348	1,120	400,960	16,355	4,350,430	5,339,698
Fremont	18	7,812	7	2,506	63	16,758	28,433
Gilpin			11	3,938	1	266	7,757
Gunnison	13	5,642	1,797	643,326	1,991	529,606	1,255,619
Hinsdale	1	434	5	1,790	1	266	2,747
Jefferson	3	1,302					1,604
Lake	104	45,136	4,753	1,701,574	5,726	1,523,116	4,194,749
La Plata			1	358			7,004
Mineral	18	7,812	451	161,458	88	23,408	470,961
Montrose							142
Ouray	167	72,478	1,472	526,976	1,260	335,160	1,177,238
Park	1	434	52	18,616	140	37,240	382,610
Pitkin			109	39,022	30	7,980	79,553
Saguache	9	3,906	331	118,498	241	64,106	206,234
San Juan	327	141,918	3,002	1,074,716	1,666	443,156	2,727,256
San Miguel	1,269	550,746	3,892	1,393,336	3,486	927,276	4,786,753
Summit	55	23,870	4,759	1,703,722	10,611	2,822,526	4,955,082
Teller							1,879,566
Total: 1948	2,298	997,332	25,143	9,001,194	45,164	12,013,624	30,155,337
1947	2,150	903,000	18,696	5,384,448	38,745	9,376,290	23,868,179

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1948, by months, and in terms of recovered metals

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	13,425	249,206	196	1,964	3,460
February	11,845	219,650	179	1,777	3,858
March	12,516	258,939	190	1,819	4,098
April	14,383	248,165	205	1,844	3,874
May	10,613	218,750	171	1,974	3,741
June	13,367	233,879	165	1,906	3,443
July	12,125	238,227	176	2,147	3,524
August	13,243	289,336	200	2,447	3,981
September	13,520	279,492	192	2,291	3,954
October	13,782	279,506	221	2,332	3,902
November	13,262	263,146	206	2,326	3,750
December	12,721	232,715	197	2,316	3,579
Total: 1948	154,802	3,011,011	2,298	25,143	45,164
1947	168,279	2,557,653	2,150	18,696	38,745

MINING INDUSTRY

New activity in mining and exploration in Colorado in 1948 centered mainly in the districts producing base metals along with gold and silver. Interest in straight gold mining waned because of the high cost of labor and materials compared with the fixed price of gold. The quantity of gold ore mined, including that from dumps in the Cripple Creek district, decreased from 804,673 tons in 1947 to 430,178 tons in 1948. The total for other classes of ore increased from 740,021 tons in 1947 to 1,007,941 tons in 1948. Individual mines averaging more than 500 tons of ore daily (6 days a week) comprised the Smuggler Union, Shenandoah-Dives, and Eagle mine groups. Placer gravel washed (excluding minor quantities handled at small operations for which figures were not reported) totaled 4,560,000 cubic yards, a 17-percent decrease from 1947.

The Bureau of Mines and Geological Survey continued to investigate sources of strategic minerals. The work done on copper, lead, and zinc included exploratory drilling in the Aspen (Pitkin County), Monarch (Chaffee County), and Kokomo (Summit County) districts; road work preparatory to drilling in the Ross Basin area (San Juan County); field examinations in these and other counties; and metallurgical tests.

ORE CLASSIFICATION

Details of ore classification are given in the Gold and Silver chapter of this volume.

Ore sold or treated in Colorado in 1948, 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 gold ore	70	430,178	85,769	190,704	166,620	3,848,190	1,887,550
Dry gold-silver ore	8	215,023	16,829	605,048	404,814	2,587,265	614,145
Dry silver ore	22	38,842	365	424,982	37,223	988,130	173,272
Total	100	684,043	102,963	1,220,734	608,657	7,423,585	2,674,967
Copper ore	3	5,831	538	123,877	364,748	36,107	262
Lead ore	73	69,601	2,467	181,857	73,257	4,673,081	241,214
Lead-copper ore	2	15	1	686	1,909	2,781	----------
Zinc ore	14	168,365	1,948	131,800	79,108	2,453,090	34,885,593
Zinc-lead ore	74	363,179	22,977	988,184	992,445	31,772,322	47,316,042
Zinc-lead-copper ore	5	147,085	10,661	361,061	2,475,876	3,925,034	5,209,922
Total	171	754,076	38,592	1,787,465	3,987,343	42,862,415	87,653,033
Total lode mines	[1] 271	1,438,119	141,555	3,008,199	4,596,000	50,286,000	90,328,000
Placers	23	----------	13,247	2,812	----------	----------	----------
Total: 1948	294	1,438,119	154,802	3,011,011	4,596,000	50,286,000	90,328,000
1947	323	1,544,694	168,279	2,557,653	4,300,000	37,392,000	77,490,000

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

METALLURGIC INDUSTRY

Thirty-seven mills, with daily capacities ranging from 25 to 1,500 tons and averaging 200 tons, operated in Colorado all or part of 1948 on ores of gold, silver, copper, lead, and zinc. Ore treated in these mills totaled 1,416,321 tons, mostly complex ores treated by flotation to produce a lead and a zinc concentrate and in some mills a copper or an iron concentrate also, all carrying gold and silver. Some Colorado ore was milled in Utah. A number of the Colorado mills used supplementary gravity concentration, including small jigs in the ball mill-classifier circuit, to recover gold for amalgamation and shipment direct to the mint. The Camp Bird mill (Ouray County) continued to amalgamate ore on plates before flotation. The 1,500-ton Golden Cycle custom mill, handling largely Cripple Creek sulfotelluride gold ore, treated average-grade crude ore by the roast-amalgamation-cyanidation process and flotation concentrates produced from low-grade ore.

Because in the early days of mining a large proportion of the ore was treated in straight amalgamation or amalgamation-cyanidation mills, reports of this series in Mineral Resources and Minerals Yearbook from 1909 through 1947 contained tables showing ore treated in these mills separate from that treated in straight concentrating mills. As amalgamation and cyanidation mills now generally have concentrating equipment and many concentrating mills recover part of the gold by amalgamating high-grade jig concentrates, the distinctive features of the two types of mills have largely disappeared. Therefore, beginning with 1948, a consolidated table showing production of metals from all mills has replaced the separate tables giving output by types of mills.

The Arkansas Valley smelter at Leadville purchases most of the State gold-silver and lead concentrates and silver, lead-copper, and lead ores shipped to smelters. The Golden Cycle mill at Colorado Springs offered a market for gold ores shipped for treatment. This mill is to be dismantled in 1949 and a new mill built in the Cripple Creek district. Smelters and custom mills in the Salt Lake Valley, Utah, are important as a market for Colorado zinc-lead ores and concentrates. Amarillo and Dumas, Tex.; Depue, Ill.; Palmerton, Pa.; and Anaconda and Great Falls, Mont., offer markets for zinc concentrates.

Mine production of metals in Colorado in 1948, 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 [1]	208,277	33,665	10,177			
Sands and slimes cyanided	229,074	41,087	5,286			
Concentrates smelted	168,025	62,492	2,534,908	4,137,078	47,721,254	89,969,765
Ore smelted	21,798	4,311	457,828	458,922	2,564,746	358,235
Placer		13,247	2,812			
Total: 1948		154,802	3,011,011	4,596,000	50,286,000	90,328,000
1947		168,279	2,557,653	4,300,000	37,392,000	77,490,000

[1] Includes estimates for gold jig concentrates amalgamated at some mills, for which complete data are not available.

Mine production of metals from Colorado ore milled in 1948, in terms of recovered metals

	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)
BY COUNTIES									
Boulder	6,801	1,292	472	240	54	20,361	7,757	182,332	----------
Chaffee	13	--------	--------	2	--------	18	--------	889	2,000
Clear Creek	30,970	1,687	478	2,823	1,902	124,653	24,573	1,443,685	566,000
Custer	752	--------	--------	171	11	4,764	--------	62,812	82,000
Dolores	34,782	--------	--------	10,045	95	125,467	145,294	4,492,465	6,360,000
Eagle	151,656	--------	--------	39,123	350	108,134	36,000	2,148,588	32,710,000
Fremont	3,050	--------	--------	227	10	918	35,893	8,110	117,000
Gilpin	399	8	--------	33	23	327	--------	11,979	2,000
Gunnison	18,680	7	--------	6,959	111	78,682	26,000	3,589,192	3,982,000
Hinsdale	21	--------	--------	10	--------	243	1,934	5,693	2,000
Jefferson	80	--------	--------	15	4	63	6,000	----------	----------
Lake	158,658	6,086	3,305	25,243	10,304	189,861	207,943	8,884,872	11,452,000
Mineral	27,719	--------	--------	2,374	230	265,577	34,104	841,068	176,000
Ouray	44,347	930	268	5,420	1,528	166,820	333,846	2,670,395	2,520,000
Park	2,082	12	585	375	569	3,058	--------	39,322	280,000
Pitkin	5,107	--------	--------	327	1	34,015	--------	167,617	52,468
Saguache	3,111	--------	--------	1,273	58	16,757	6,065	625,163	482,000
San Juan	225,417	--------	--------	9,927	16,308	490,796	625,858	5,443,520	2,990,297
San Miguel	358,396	11,156	5,215	31,512	28,432	576,866	2,537,464	7,779,259	6,972,000
Summit	118,531	5	1	31,926	2,502	327,528	108,347	9,324,293	21,222,000
Teller	225,749	53,569	5,139	--------	--------	--------	--------	----------	----------
Total: 1948	1,416,321	74,752	15,463	168,025	62,492	2,534,908	4,137,078	47,721,254	89,969,765
1947	1,507,729	80,969	16,315	146,366	66,451	2,188,742	3,412,617	35,436,379	77,399,865
BY CLASSES OF ORE TREATED									
Dry gold	429,918	63,481	10,023	18,525	21,928	180,099	166,135	3,845,669	1,887,550
Dry gold-silver	212,661	12	585	5,065	14,385	418,992	342,814	2,532,333	614,145
Dry silver	37,571	--------	--------	2,606	264	374,089	35,327	917,007	173,272
Copper	177	--------	--------	34	4	223	13,480	215	262
Lead	58,404	212	108	3,977	1,469	95,149	51,931	2,496,839	241,214
Zinc	168,365	--------	--------	42,129	1,948	131,800	79,108	2,453,090	34,885,593
Zinc-lead	362,140	6,547	3,380	82,487	16,333	974,862	972,407	31,551,067	46,957,807
Zinc-lead-copper	147,085	4,500	1,367	13,202	6,161	359,694	2,475,876	3,925,034	5,209,922
Total 1948	1,416,321	74,752	15,463	168,025	62,492	2,534,908	4,137,078	47,721,254	89,969,765

Mine production of metals from Colorado ore milled in 1948, in terms of recovered metals—Continued

	Concentrates smelted and recovered metal					
	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY CLASSES OF CONCENTRATES SMELTED						
Dry gold	66	196	1,188		2,830	
Dry silver	7	7	1,270		156	
Copper	4,554	3,515	108,057	2,117,774	211,535	9,607
Lead	51,341	34,596	1,424,342	465,879	35,744,308	5,255
Lead-copper	10,875	14,273	743,793	939,065	9,062,010	242,291
Dry iron [1]	984	4,863	32,852	7,375	660,868	2,231
Total to copper and lead plants	67,827	57,450	2,311,502	3,530,093	45,681,707	259,384
Zinc	94,986	4,908	195,508	563,091	1,411,311	85,286,232
Zinc-lead	5,212	134	27,898	43,894	628,236	4,424,149
Total to zinc plants	100,198	5,042	223,406	606,985	2,039,547	89,710,381
Total 1948	168,025	62,492	2,534,908	4,137,078	47,721,254	89,969,765

[1] From zinc-lead, lead, silver, and gold-silver ores.

Gross metal content of concentrates produced from ores mined in Colorado in 1948, 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	66	196	1,188	89	2,948	
Dry silver	7	7	1,270		163	
Copper	4,554	3,515	108,057	2,179,454	346,838	513,987
Lead	51,341	34,596	1,424,342	590,752	37,231,631	4,539,752
Lead-copper	10,875	14,273	743,793	1,189,435	9,406,623	1,083,320
Dry iron [1]	984	4,863	32,852	9,373	689,688	67,922
Total to copper and lead plants	67,827	57,450	2,311,502	3,969,103	47,677,891	6,204,981
Zinc	94,986	6,825	258,887	672,827	2,089,452	95,021,203
Zinc-lead	5,212	154	36,968	51,652	949,970	5,014,780
Total to zinc plants	100,198	6,979	295,855	724,479	3,039,422	100,035,983
Total: 1948	168,025	64,429	2,607,357	4,693,582	50,717,313	106,240,964
1947	146,366	67,928	2,255,183	3,982,169	37,406,872	92,652,971

[1] From zinc-lead, lead, silver, and gold-silver ores.

Gross metal content of Colorado crude ore shipped to smelters in 1948, 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 gold ore	260	360	582	931	2,970	
Dry gold-silver ore	2,362	2,432	185,471	77,510	57,221	
Dry silver ore	1,271	101	50,893	3,982	74,921	16,829
Copper ore	5,654	534	123,654	378,016	53,862	
Lead ore	11,197	786	86,600	27,991	2,269,046	28,326
Lead-copper ore	15	1	686	2,297	2,897	
Total to copper and lead plants	20,759	4,214	447,886	490,727	2,460,917	45,155
Zinc-lead ore to zinc plants	1,039	97	9,942	23,574	225,081	494,994
Total: 1948	21,798	4,311	457,828	514,301	2,685,998	540,149
1947	36,965	3,286	349,145	1,006,654	2,052,684	153,315

Mine production of metals from Colorado crude ore shipped to smelters in 1948, in terms of recovered metals

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES						
Boulder	60	31	399	243	3,668	
Chaffee	362	133	1,205		99,111	
Clear Creek	145	53	2,030	1,427	54,315	
Custer	315	5	4,283		55,188	
Dolores	560	13	6,845	2,706	367,535	
Eagle	7,931	2,948	307,898	408,000	91,412	
Fremont	69	1	156	107	5,890	9,000
Gilpin	33	19	381		10,021	
Gunnison	14	44	181		4,808	
Hinsdale	7		41	66	4,307	
Lake	5,954	442	20,127	57	621,128	
La Plata	44	176	537		2,000	
Mineral	895	17	32,349	1,896	60,932	
Ouray	544	8	5,625	154	273,605	
Park	337	39	2,686	2,000	64,678	
Pitkin	210	8	1,603		50,383	7,532
Saguache	255	2	2,716	11,935	36,837	
San Juan	2,969	163	51,694	28,142	560,480	341,703
San Miguel	24	58	176	536	4,741	
Summit	1,070	151	16,896	1,653	193,707	
Total: 1948	21,798	4,311	457,828	458,922	2,564,746	358,235
1947	36,965	3,286	349,145	887,383	1,955,621	90,135
BY CLASSES OF ORE						
Dry gold ore	260	360	582	485	2,521	
Dry gold-silver ore	2,362	2,432	185,471	62,000	54,932	
Dry silver ore	1,271	101	50,893	1,896	71,123	
Copper ore	5,654	534	123,654	351,268	35,892	
Lead ore	11,197	786	86,600	21,326	2,176,242	
Lead-copper ore	15	1	686	1,909	2,781	
Total to copper and lead plants	20,759	4,214	447,886	438,884	2,343,491	
Zinc-lead ore to zinc plants	1,039	97	9,942	20,038	221,255	358,235
Total 1948	21,798	4,311	457,828	458,922	2,564,746	358,235

REVIEW BY COUNTIES AND DISTRICTS

ADAMS COUNTY

In 1948 gold and silver were recovered by Kerkling & Slensker as byproducts from the Brannan Sand & Gravel Co. washing plants Nos. 8 and 10 and the Superior Sand & Gravel Co. pit, all on gravel bars of Clear Creek northwest of Denver.

BOULDER COUNTY

Central (Jamestown) District.—A car of high-grade gold ore from the John Jay-Last Chance group and a ton of gold ore from the Kicking Horse mine were shipped to the Golden Cycle mill at Colorado Springs. Harrison S. Cobb shipped several cars of gold-silver ore from an old millsite. The Ozark-Mahoning Co. mill at Jamestown recovered lead-silver-gold-copper concentrates as a byproduct in the beneficiation of fluorspar.

Gold Hill District.—Shippers of ore to the Golden Cycle mill in 1948 included Harrison S. Cobb (Ingram mine), James Pastore (American), Henna Mines, Inc. (Cash), Fred Magor (Great Britain), and Ross L. Benson (Parker No. 1).

Grand Island District.—The Consolidated Caribou Silver Mines, Inc., continued developing the Caribou mine and milled several thousand tons of dump ore for testing. The mill product was silver-lead-gold concentrates, shipped to the Leadville smelter. In December the company announced that a vein containing pitchblende was encountered on the bottom or 1,040-foot level of the mine. The Red Wing and Straight Flush claims produced some silver-lead ore.

Magnolia District.—A 3-ton lot of gold ore was shipped from the Keystone mine in 1948.

Sugar Loaf District.—Gold ore was shipped from the Melvina, Poorman, and Wood Mountain mines to the Golden Cycle mill.

CHAFFEE COUNTY

Chalk Creek District.—Small tonnages of lead-silver-zinc ore were shipped from the Stonewall group and Polly No. 4 claim.

Granite District.—The Gold Basin placer was operated by the Good Hope Mining Co., Ltd., from June 1 to September 23; the equipment used included a power shovel, bulldozer, and sluices.

Monarch District.—S. E. & W. E. Burleson continued development at the Garfield mine and shipped 292 tons of ore containing 133 ounces of gold, 864 ounces of silver, 86,563 pounds of lead, 11,854 pounds of zinc, and 317 pounds of copper. The Lilly and Fraction mines were worked under lease by C. C. Carathers part of 1948 and yielded lead-silver ore. Some ore was shipped from the Neglected claim and another property.

CLEAR CREEK COUNTY

Alice District.—Lombard Mines, Inc., operated the Lombard mine and 100-ton flotation mill most of 1948. The mill product was gold-silver-lead-copper concentrates, shipped to the Leadville smelter.

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1948, 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	------	------	480	480	------	75	75	------	------	------	$16,868
Boulder County:													
Central (Jamestown)	4	------	193	405	------	405	5,467	------	5,467	7,000	168,000	------	50,714
Gold Hill	6	------	2,209	481	------	481	398	------	398	------	------	------	17,195
Grand Island	3	------	3,634	35	------	35	15,364	------	15,364	1,000	18,000	------	18,569
Magnolia	1	------	3	14	------	14	1	------	1	------	------	------	491
Sugar Loaf	3	------	822	442	------	442	2	------	2	------	------	------	15,472
Chaffee County:													
Chalk Creek	2	------	32	------	------	------	72	------	72	------	6,000	2,000	1,405
Granite	------	1	------	------	142	142	------	20	20	------	------	------	4,988
Monarch	6	------	343	133	------	133	1,151	------	1,151	------	94,000	------	22,523
Clear Creek County:													
Alice	1	------	9,079	506	------	506	1,044	------	1,044	2,000	33,000	------	24,996
Argentine	2	------	6,854	361	------	361	13,479	------	13,479	13,000	784,000	70,000	177,301
Cascade and Ute Creek	2	------	170	10	------	10	441	------	441	------	2,000	------	1,107
Dailey and Atlantic	1	------	60	------	------	------	40	------	40	------	1,000	------	215
Empire	3	------	760	192	------	192	168	------	168	1,000	------	------	7,089
Griffith	6	------	6,826	76	------	76	94,947	------	94,947	5,000	376,000	328,000	200,605
Idaho Springs	11	1	5,705	2,285	4	2,289	10,279	1	10,280	3,000	174,000	129,000	138,373
Montana	3	------	542	2	------	2	1,445	------	1,445	------	10,000	17,000	5,429
Trail Creek	3	------	1,119	210	------	210	5,318	------	5,318	2,000	118,000	22,000	36,645
Custer County: Hardscrabble	3	------	1,067	16	------	16	9,047	------	9,047	------	118,000	82,000	40,776
Dolores County: Pioneer	5	------	35,342	108	------	108	132,312	------	132,312	148,000	4,860,000	6,360,000	1,871,465
Douglas County: Newlin Gulch	------	1	------	------	3	3	------	------	------	------	------	------	105
Eagle County: Red Cliff	3	------	159,587	3,298	------	3,298	416,032	------	416,032	444,000	2,240,000	32,710,000	5,339,698
Fremont County	3	------	3,119	11	------	11	1,074	------	1,074	36,000	14,000	126,000	28,433
Gilpin County:													
Southern	4	5	196	26	33	59	380	8	388	------	6,000	------	3,490
Northern	2	------	236	24	------	24	328	------	328	------	16,000	2,000	4,267
Gunnison County:													
Elk Mountain	3	------	74	7	------	7	1,325	------	1,325	------	2,000	------	1,802
Gold Brick	3	------	410	85	------	85	539	------	539	------	12,000	------	5,611
Quartz Creek	1	------	21	------	------	------	273	------	273	------	3,000	5,000	1,449
Rock Creek	1	------	26	------	------	------	87	------	87	------	------	11,000	1,542
Taylor Park	1	------	5	------	------	------	61	------	61	------	1,000	1,000	367
Tomichi	1	------	18,158	70	------	70	76,578	------	76,578	26,000	3,576,000	3,965,000	1,244,848
Hinsdale County: Galena	2	------	28	------	------	------	284	------	284	2,000	10,000	2,000	2,747
Jefferson County	1	2	80	4	3	7	63	------	63	6,000	------	------	1,604

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1948, by counties and districts, in terms of recovered metals—Con.

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				
Lake County:													
Box Creek	------	1	------	------	4,049	4,049	------	1,157	1,157	------	------	------	$142,762
California (Leadville)[1]	28	------	164,510	16,831	------	16,831	213,208	------	213,208	208,000	9,490,000	11,452,000	4,049,011
Weston Pass	1	------	102	1	------	1	85	------	85	------	16,000	------	2,976
La Plata County: California	5	------	44	176	------	176	537	------	537	------	2,000	------	7,004
Mineral County: Creede	6	------	28,614	247	------	247	297,926	------	297,926	36,000	902,000	176,000	470,961
Montrose County: San Miguel River	------	1	------	------	4	4	------	2	2	------	------	------	142
Ouray County:													
Red Mountain	8	------	4,358	92	------	92	13,988	------	13,988	81,000	429,000	343,000	155,867
Sneffels	6	------	31,032	2,261	------	2,261	101,683	------	101,683	217,000	1,511,000	1,630,000	705,511
Uncompahgre	4	------	9,501	113	------	113	57,042	------	57,042	36,000	1,004,000	547,000	315,860
Park County:													
Alma Placers-Fairplay	------	4	------	------	8,489	8,489	------	1,535	1,535	------	------	------	298,504
Beaver Creek	------	1	------	------	11	11	------	3	3	------	------	------	388
Buckskin	6	------	2,038	554	------	554	4,458	------	4,458	2,000	66,000	254,000	69,455
Consolidated Montgomery	2	------	87	20	------	20	609	------	609	------	------	------	1,251
Horseshoe	2	------	179	3	------	3	1,033	------	1,033	------	36,000	------	7,484
Mosquito	1	------	115	43	------	43	229	------	229	------	2,000	26,000	5,528
Pitkin County:													
Independence	1	------	2	7	------	7	12	------	12	------	------	------	256
Roaring Fork	4	------	5,315	2	------	2	35,606	------	35,606	------	218,000	60,000	79,297
Saguache County: Kerber Creek	10	------	3,366	60	------	60	19,473	------	19,473	18,000	662,000	482,000	206,234
San Juan County:													
Animas	17	------	200,066	13,428	------	13,428	417,887	------	417,887	412,000	3,771,000	1,495,000	1,811,437
Eureka	12	------	28,181	3,033	------	3,033	123,465	------	123,465	241,000	2,214,000	1,826,000	909,358
Ice Lake Basin	1	------	139	10	------	10	1,138	------	1,138	1,000	19,000	11,000	6,461
San Miguel County:													
Iron Springs	2	------	27,894	1,464	------	1,464	55,483	------	55,483	48,000	175,000	------	143,196
Lower San Miguel	1	1	4	1	16	17	33	8	41	------	1,000	------	811
Upper San Miguel	5	1	330,522	38,181	7	38,188	526,741	1	526,742	2,490,000	7,608,000	6,972,000	4,642,746
Summit County:													
Breckenridge	10	1	2,209	116	6	122	4,475	2	4,477	2,000	290,000	341,000	106,019
Green Mountain	1	------	409	89	------	89	14,765	------	14,765	------	22,000	28,000	24,140
Montezuma	13	------	6,739	26	------	26	53,241	------	53,241	8,000	853,000	177,000	227,060
Ten Mile	7	------	110,244	2,427	------	2,427	271,944	------	271,944	100,000	8,353,000	20,676,000	4,597,863
Teller County: Cripple Creek	28	------	225,749	53,569	------	53,569	5,139	------	5,139	------	------	------	1,879,566
Total Colorado	271	23	1,438,119	141,555	13,247	154,802	3,008,199	2,812	3,011,011	4,596,000	50,286,000	90,328,000	30,155,337

[1] Includes St. Kevin district.

Argentine District.—The Grizzly Gulch mine, operated by the Lupton Mining Co. throughout 1948, was the principal producer of lead in Clear Creek County. The ore, which also carries gold, silver, zinc, and copper, was treated in the company mill near Georgetown. Some ore was shipped from the Hamill Tunnel, and some development was done on the Stephens group.

Cascade District.—Ore was shipped from the Tyone prospect and the Kitty Emmet mine in 1948.

Dailey and Atlantic District.—A truckload of silver-lead ore was shipped from the Doctor Lode.

Empire District.—The Conqueror mine, operated by Chas. T. Worthington from January 1 to April 6, 1948, shipped 650 tons of gold-silver ore to a custom mill. Other small producers were the Gold Fissure and Minnesota groups.

Griffith District.—The Smuggler mine (C. O. Parker, agent) operated throughout 1948 and was again the principal silver producer in Clear Creek County, as well as a substantial producer of lead and zinc. The ore was treated in the nearby Silver Leaf mill. The old Terrible-Dunderberg group, under rehabilitation and development since 1945, was put in steady operation in August 1948 by Gold Mines Consolidated, Inc. The ore, containing silver, lead, and zinc as the principal metals, was concentrated in the Silver Spruce mill at Idaho Springs. Small lots of direct-smelting ore were shipped from the Anglo Saxon, Capital Prize, and Teagarden groups. Some ore from the Zero dump was treated in the John A. Smith mill.

Idaho Springs District.—The Dixie mine of LeRoy Giles & Co. was again the leading gold producer in Clear Creek County. During 1948 the company acquired and remodeled the Idaho Springs custom mill (renamed the Dixie mill) on Clear Creek east of Idaho Springs. An unusually rich pocket of ore encountered during the year raised the output above that in 1947. The Franklin Mining Co., operating the Mary F.-Oro Fino-Franklin group, shipped 2,483 tons of lead-zinc-silver-gold ore to custom mills. Other small producers included the Consolidated Park, Lexington, and Oregon mines and the Williams dump. Colorado Minerals, Inc., reopened the Black Eagle mine and mill late in the year. Arthur Portenier operated the Clear Creek-Gilpin mill part of the year, mostly on custom ore.

Montana District.—Shipments in 1948 included several lots of ore from the Bellevue-Hudson mine, small lots of concentrates from the Red Elephant property, and clean-up material from the Joe Reynolds mine.

Trail Creek District.—The Harrison-Croesus Mining Co. continued to operate the Ben Harrison mine until May 15, 1948. The ore produced was shipped to custom mills at Leadville. The Victoria Mining Co. worked most of 1948 on reconditioning the Victor Lode group but also mined and shipped 730 tons of lead-silver-gold-copper ore.

CUSTER COUNTY

Hardscrabble District.—Output from this district in 1948 totaled 1,067 tons of lead-silver-zinc and lead-silver ores, shipped to the smelter or custom mills at Leadville. Nearly all the ore came from the Defender and Lady Franklin mines.

DOLORES COUNTY

Pioneer (Rico) District.—In 1948 the Rico Argentine Mining Co. group of mines continued to be the principal producer of metals in Dolores County and one of the major zinc-lead-silver producers in the State. Output was approximately the same as in 1947. Mine development during the year totaled 7 feet of shaft, 4,556 feet of drifts, 1,312 feet of raises, and 6,995 feet of diamond drilling. The mine is equipped with a 135-ton selective-flotation mill. Other producers at Rico shipped ore to custom mills in Utah; they comprised the Badger and Hidden Treasure tunnels, Forest mine, Wellington group, and Woods Hole mine.

DOUGLAS COUNTY

Three ounces of gold were recovered from a placer in Newlin Gulch.

EAGLE COUNTY

Red Cliff (Battle Mountain) District.—Every year from 1937 through 1948 the Red Cliff district ranked first among Colorado districts in total value of its production of the five metals; the Cripple Creek gold district previously ranked first. The Red Cliff output was predominantly silver and copper in the first years of the period and zinc and lead after 1941. The Eagle mine group of the New Jersey Zinc Co. Empire Zinc Division, equipped with a 600-ton underground selective-flotation mill, operated continuously in 1948. Some ore from the Gold Park claim was shipped to the Leadville smelter.

EL PASO COUNTY

The Golden Cycle mill at Colorado Springs treated 229,074 tons of ore in 1948 compared with 420,026 tons in 1947. The mill feed in 1948 comprised 225,749 tons of company and custom gold sulfotelluride ore from mines and dumps in the Cripple Creek district (Teller County) and 3,325 tons of gold and gold-silver ores from various shippers in Boulder, Clear Creek, Gilpin, Park, and Summit Counties.

During the year the Golden Cycle Corp. decided to transfer its milling operations from Colorado Springs to the Cripple Creek district and abandon the Midland Terminal Railway, which hauled ore from the district to the Golden Cycle mill. The mill continued to receive ore over the railroad until February 20, 1949. Work then began on dismantling the mill and railroad and constructing a new custom mill in the Cripple Creek district.

FREMONT COUNTY

The Horseshoe Mining Co. operated its 75-ton flotation mill on the Arkansas River at Parkdale 2 months in 1948 on stockpiled ore from the Cotopaxi and Horseshoe mines. Other county output included a truckload of copper-silver ore from the Guffey property and 69 tons of old zinc-lead slag shipped from the former River smelter site at Florence.

GILPIN COUNTY

Southern (Blackhawk, Central City, Nevadaville, Russell Gulch) Districts.—The Federal Mining & Milling Co. drove 500 feet of drifts on its Federal-Santiago group and installed more equipment in its mill. About 150 tons of dump material put through the mill for testing equipment yielded lead-gold-silver concentrates. Small tonnages of ore were shipped from the Elesinore (Globe), Central Mining & Development Corp., and West Notaway properties. Individuals recovered some placer gold on Clear Creek. Chain O'Mines Operators, Inc., nearly completed construction of a 1,000-ton unit of a proposed 6,000-ton mill, designed to treat low-grade ore from the old "Patch" glory hole.

Northern Districts.—The Cliff mine, under development during 1948, produced 188 tons of lead and zinc-lead ores, of which 172 tons were milled in the Gold Ridge mill at Central City and 16 tons were shipped crude to smelters. Some gold ore was shipped from the We Got Em mine.

GUNNISON COUNTY

Elk Mountain District.—A 3-ton sample of silver-lead ore was shipped from the Red Cloud group, and several tons of silver-gold concentrate were shipped from the Forest Queen mill.

Gold Brick District.—A little ore was shipped from the Climax and Gold Links properties, and some gold-silver-lead concentrate was shipped from the Raymond group, which is equipped with a mill.

Quartz Creek District.—Twenty-one tons of zinc-lead-silver ore previously stock-piled at the Complex mine were shipped in 1948.

Rock Creek District.—About a car of zinc-silver ore was shipped from the Lead King mine.

Taylor Park (Tin Cup) District.—A truckload of zinc-lead-silver ore was shipped from the Thunderbird claim.

Tomichi District.—The Callahan Zinc-Lead Co. operated its Akron-Erie mines at White Pine at an expanded production rate in 1948. The company flotation mill, built in 1947, operated continuously. Ore treated totaled 18,158 tons yielding 2,511 tons of lead concentrates containing 34 ounces of gold, 60,359 ounces of silver, 9,108 pounds of copper, 3,235,389 pounds of lead, and 649,278 pounds of zinc; and 4,379 tons of zinc concentrates containing 55 ounces of gold, 24,953 ounces of silver, 22,360 pounds of copper, 780,904 pounds of lead, and 4,504,407 pounds of zinc. Development during 1948 totaled 1,966 feet of drifts, 610 feet of crosscut, 1,198 feet of raises, and 2,724 feet of diamond drilling.

HINSDALE COUNTY

Galena District.—At the old Yellow Medicine mine near the Hinsdale-Ouray County line J. R. Brown drove 200 feet of drifts in 1948 and shipped 22 tons of lead-zinc-copper-silver ore. Rowland Ewart worked on development at the Independence mine and shipped a truckload of lead-silver ore.

JEFFERSON COUNTY

Some copper ore was shipped from the Malachite mine, and 3 ounces of placer gold were recovered from gravel bars of Clear Creek in 1948.

LAKE COUNTY

Box Creek District.—The General Gold Corp. operated its Hayden-Mount Elbert group of placers during 1948 from April 20 to November 7, the end of the placer-mining season. Equipment used included two dragline dredges and a caterpillar bulldozer.

California (Leadville) District.—In 1948, as in other recent years, the Resurrection Mining Co. group was the principal producer of metals in the Leadville district. The mine is opened by a 1,323-foot vertical shaft, six levels, and a 4-mile tunnel (old Yak) which intersects the shaft. The company 600-ton flotation mill continued to operate largely on company ore but also treated custom ores from Lake, Clear Creek, Park, Saguache, and Summit Counties.

The American Smelting & Refining Co. operated the Ibex-Garbutt-Cora-Sunday group. Mine development included 2,310 feet of tunnel and 3,710 feet of diamond drilling. The ore produced was treated in the company 400-ton Leadville milling unit flotation mill. The mill also handled ore from the company Kokomo unit in Summit County and custom ore from mines in Chaffee, Clear Creek, Custer, Gilpin, Gunnison, Lake, Mineral, Saguache, San Juan, and Summit Counties.

The John Hamm Mining & Milling (Ltd.) mill continued to operate on dump ore, mostly from the New Monarch, Henriett, Hibschle, and Fortune dumps, until it was closed in October. The Cloud City mill operated part of the year on ore from the Rock & Dome dumps.

Among the larger shippers of newly mined ore to smelters or custom mills were the Dolly B (McCaughan & Co.), Fanny Rawlings (Dahl-Shirk Lease), Fortune Mine, New Monarch (New Monarch Lease, Triple "J" Lease, Harry Sundstrom), Valley, and Winnie mines. Other small-scale mining and dump operations shipped a substantial aggregate tonnage of ore.

The Arkansas Valley smelter of the American Smelting & Refining Co. at Leadville operated throughout 1948. The smelter treats lead, lead-copper-gold-silver, and gold and silver ores and concentrates purchased from operators in nearly all the active mining districts of Colorado, and ores, concentrates, residues from zinc smelters, and other material from various States and foreign countries. Receipts in 1948 totaled 97,150 tons compared with 113,929 tons in 1947.

St. Kevin District.—The Lakewood mine, operated by Markus Thuren during the summer of 1948, shipped gold-silver ore.

Weston Pass District.—The Little Ruby mine shipped 102 tons of ore containing 1 ounce of gold, 85 ounces of silver, and 16,504 pounds of lead.

LA PLATA COUNTY

California (La Plata, Hesperus) District.—The Bessie G. mine, a small-scale gold producer each year since 1939, continued to operate in 1948. The Muldoon, Neglected, and Nonpariel claims produced small lots of gold and silver ores, and the Tip Top shipped a truckload of silver-lead ore.

MINERAL COUNTY

Creede District.—The groups of mines operated by the Emperius Mining Co. contributed the bulk of the output of metals from the Creede district from 1941 through 1948. Most of the ore was treated in the 100-ton flotation mill acquired by Emperius from Creede Mills, Inc., September 1, 1940. The producing groups in 1948 included the Amethyst, Equinox, Del Monte-Aspen (Volunteer), New York, and Commodore. The mill was operated steadily except for a shutdown of several weeks required to replace a broken main bearing in the Diesel engine. While the mill was shut down ore was shipped to a custom mill at Leadville. High-grade ore mined during the year was shipped direct to the Leadville smelter. The Ridge mine (Mexico group) was under development in 1948 and shipped ore to the Leadville smelter late in the year.

MONTROSE COUNTY

Placer miners on San Miguel River produced a little gold in 1948.

OURAY COUNTY

Red Mountain District.—In 1948 the American Zinc, Lead & Smelting Co. operated the Koehler-San Antonio property in Ouray and San Juan Counties from January 1 to September 20 and the Mountain King in Ouray County from June through December. The ore was treated in the company flotation mill at Ouray and yielded zinc-lead-copper, lead-silver, and zinc concentrates. Other producers included the Beaver-Belfast, Ida L., Lost Day, and Monte Cristo mines. The Idarado mill treated ore from the claims of the Treasury Tunnel property in San Miguel County.

Sneffels District.—The Camp Bird mine, operated by King Lease, Inc., was again the leading producer of the five metals in Ouray County. Development in 1948 included 621 feet of raises, 718 feet of drifts, and 1,342 feet of diamond drilling. A new skip cable was installed, 2,000 feet of ditch sprags were replaced, and a battery locomotive and generator set were put on the twelfth level. The ore, treated in the company 125-ton amalgamation-flotation mill (changed to selective-flotation in 1948), yielded gold-silver bullion, lead-silver-gold-copper concentrates, and zinc concentrates. Lessees on the Atlas group shipped mine and dump ore. Other small producers included the Atomic Silver, Monster Lode, and Tom Patterson properties.

Uncompahgre District.—The American Zinc, Lead & Smelting Co. operated its custom mill at Ouray and the Bachelor group of mines throughout 1948. Mine development on the Bachelor, largest individual shipper to the mill, included 761 feet of raises, 47 feet of drifts, and 574 feet of diamond drilling. The Mickey Breen mine, operated steadily by Southwest Metals, was the second-largest district shipper. Other Uncompahgre district shippers to the mill were the Connie and Ideal claims. The mill also received ore from mines in San Juan, San Miguel, and Hinsdale Counties. The Mineral Farm mine at Ouray shipped 74 tons of direct-smelting ore. The Silver Shield

Mining & Milling Co. acquired the Wanakah group and worked on building a 200-ton custom mill near Ouray.

PARK COUNTY

Alma Placers-Fairplay District.—The South Platte Dredging Co. operated its electrically powered bucket-line dredge (108 12-cubic-foot buckets) on the Black Forest and Gold Pan placers from January 1 to December 21. Gravel washed totaled more than 3,800,000 yards. Charles M. Hambelton washed 20,000 cubic yards of bench gravel in a stationary washing plant on the P. & H. placer. Individuals using hand methods produced some gold from the Snowstorm placer.

Beaver Creek District.—Detwiler Bros. recovered small lots of gold from the Beaver Creek placer.

Buckskin District.—Operations of the Buckskin Joe Mines, Ltd., on the Phillips group of mines in 1948 comprised mostly cleaning up ore in old workings and drifting along known veins exploring for other commercial ore shoots. The drifting totaled 1,000 feet. The ore shipped (1,887 tons) contained gold and zinc as the principal minerals, with accessory values in lead and silver. The American Flag, Criterion, and Sweet Home mines each shipped small tonnages of ore.

Consolidated Montgomery District.—The 4H Mine Lease (Star-Cresskill group) shipped 80 tons of gold-silver ore to the Golden Cycle mill at Colorado Springs for testing. A 7-ton lot of gold-silver ore was shipped from the Magnolia mine.

Horseshoe District.—The Leadville Lead Corp. built roads, constructed surface buildings, installed machinery, and reopened and examined old lead-silver-zinc mine workings on the Hilltop and other properties acquired and consolidated from 1945 to 1948. The company also shipped some ore in 1948. The other district producer was the Peerless Maud mine.

Mosquito District.—M. J. Krolicki shipped 115 tons of zinc-gold-silver-lead ore from the Orphan Boy mine. The London Butte property was under development.

PITKIN COUNTY

Independence District.—Two tons of gold-silver ore were shipped from the Mount Hope property in 1948.

Roaring Fork (Aspen) District.—The Midnight Mining Co. operated its Midnight silver-lead mine and 50-ton flotation mill at the same daily average ore production rate as in 1947. General mining operations were moved from areas below the main tunnel level to the older upper workings between the seventh and third levels. The original 500-foot Midnight shaft extending from the surface to the seventh level was rehabilitated and equipped with an electric hoist. The Herron Bros. operated its gravity-concentration mill on material from the Smuggler dumps, which were being sampled by other companies. J. C. Bray and F. Swerengen each shipped some silver-lead ore. The Bureau of Mines did exploratory drilling near Aspen.

RIO GRANDE COUNTY

Summitville District.—In 1948 the Summitville mine and mill were idle until September, when Jones & Nylene reopened the flotation section of the mill to treat gold-copper ore from surface outcrops and dumps. Some ore was milled but the concentrate produced was not shipped in 1948. Underground development was also carried on and resulted in finding another good vein of copper ore.

SAGUACHE COUNTY

Kerber Creek (Bonanza) District.—Mines near Bonanza shipped 3,366 tons of ore to smelters and custom mills outside the county in 1948. The largest producer was the Antoro mine, operated by S. E. & W. E. Burleson, which shipped 1,979 tons of ore containing 41 ounces of gold, 12,081 ounces of silver, 450,380 pounds of lead, 455,954 pounds of zinc, and some copper. The Rawley mine (Costello Lease) shipped 737 tons of ore containing 11 ounces of gold, 10,408 ounces of silver, about 20,000 pounds of copper, 349,596 pounds of lead, and 186,537 pounds of zinc. Other shippers were the Bonanza mine (Nicholas Keserich), Brighton (Earl Wise), Cora group (Walter Timney), Superior (P. M. Wallin), Little Jenny (Tom Raymond & Sons), Josephine (Marvisa Mining Co.), Silver Creek (John D. Bird), and Warwick group (Warwick Mines, Inc.).

SAN JUAN COUNTY

Animas District.—Operations of the Shenandoah-Dives Mining Co. on the Shenandoah-Dives-Mayflower and Silver Lake groups were continuous in 1948. Mine development during the year included 859 feet of raises, 1,732 feet of drifts, 968 feet of crosscuts, and 663 feet of diamond drilling. Ore produced from the two groups and milled totaled 165,283 tons yielding 3,317 tons of combined lead-copper, iron, and zinc concentrates containing altogether 11,241 ounces of gold, 302,686 ounces of silver, 336,966 pounds of copper, 2,198,225 pounds of lead, and 829,017 pounds of zinc. Besides company ore, the mill (capacity 700 tons daily) treated 17,509 tons of custom ore containing 501 ounces of gold, 62,774 ounces of silver, 191,951 pounds of copper, 2,122,340 pounds of lead, and 2,215,725 pounds of zinc.

The Highland Mary mine, equipped with a 100-ton flotation mill, was the second-largest district producer of gold and silver and a substantial producer of lead. The Osceola mine operated from August through December; the ore was trucked to the Lackawana mill at Silverton for treatment. The principal Animas district shippers of custom ore to the Shenandoah-Dives mill were the Lark Lease of the United States Oil & Development Corp., Little Nation Lease, and Sterling claim of the Gary Owen group. Other shippers included the Little Ida, Silver Ledge, Mighty Monarch, May Day, Trilby, Little Fannie, King, Mystery, South Mineral, and Tennyson mines.

Eureka District.—The Lead Carbonate mine and 40-ton flotation mill operated throughout 1948 except about 6 weeks when heavy winter snows and slides interfered. Other important producers (more than 1,000 tons of ore) were the Foursome Mining Co. (Columbus and

Silver Coin mines), Great Eastern Mining Co. (Great Eastern-Sioux City-Klondike group), Koehler-San Antonio group (partly in Ouray County), and Harry G. Knapp (Burrows and Caledonian mines). The Sunbank Corp., which purchased the Sunnyside properties in July, shipped concentrates, ore, and other material obtained in cleaning up the ore bins and dismantling the mill. Other producers included the Hermes, London, Lucky Jacks, Mountain Queen, Queen Ann, and Silver Wing mines.

Ice Lake Basin District.—The Esmeralda Lease (Bandora mine) shipped 139 tons of ore containing 15 ounces of gold, 1,462 ounces of silver, 2,082 pounds of copper, 24,026 pounds of lead, and 19,565 pounds of zinc.

SAN MIGUEL COUNTY

Iron Springs District.—The Silver Bell Mines Co. operated its Silver Bell group and 150-ton flotation mill throughout 1948. The mill product was bulk gold-silver-lead-copper concentrates. The mine development and exploration program was expanded. A new vein (called the Lookout Vein) was discovered by diamond drilling and was opened by extending the main tunnel and drifting. Another vein was discovered by a short crosscut into the hanging wall. A. A. McCluskey shipped several tons of clean-up material containing silver, lead, and gold.

Lower San Miguel District.—A 4-ton trial shipment of lead-silver-gold ore was made from the Champion-Robin Red Breast group near Placerville. Some gold and silver were recovered from the Verna Lois placer on San Miguel River.

Upper San Miguel District.—In 1948 the Upper San Miguel district again ranked second among Colorado districts in gold production and had a large gain in output of silver, copper, lead, and zinc. Much of the gain was due to an increase in the output of the Idarado Mining Co. Treasury Tunnel-Black Bear group of mines. The portal of the tunnel and the Idarado mill are in Ouray County; the ore is hauled 12,000 feet through the tunnel from mine workings (mostly on the Black Bear vein) in San Miguel County. During the year the company completed a 1,100-foot raise on the Black Bear vein and did other extensive development work, and enlarged the capacity of the mill from 300 tons daily to 500 tons. The mill products were gold-silver amalgam (recovered mostly from gold jig concentrate), flotation copper-gold-silver concentrate, lead-silver-gold-copper concentrate, and zinc concentrate.

The Smuggler Union-Montana group and 550-ton mill of Telluride Mines, Inc., operated continuously. Work progressed on driving and equipping the new mill-level adit from the mill to the Pandora-Smuggler Union veins; the adit (about a mile long) tapped the veins at an elevation of 9,070 feet, or 1,100 feet below the lowest workings of present mining operations. Development during the year totaled 450 feet of raises, 6,116 feet of drifts, 2,148 feet of tunnel, and 500 feet of diamond drilling. Part of the company gold output was recovered by amalgamating concentrates from jigs in the ball mill-classifier circuit, and part was recovered in iron gravity concentrate and lead-copper and zinc flotation concentrates shipped to smelters.

The Alta-St. Louis mine and mill operated from January to June; the mill was destroyed by fire in November. The Tomboy Gold Mines, Inc., and the Nordlander lease on the Japan Flora mine shipped some zinc-lead-silver-gold ore to the American custom mill at Ouray.

SUMMIT COUNTY

Breckenridge District.—W. L. Davenport worked the Wellington mine and shipped to custom mills at Leadville 1,478 tons of ore averaging 16.8 percent zinc, 9.16 percent lead, and 3.15 ounces of silver and 0.03 ounce of gold per ton. The Monte Cristo mine, producing lead ore and operated from July 2 to November 25, was the second largest district shipper. Other small producers included the Bowery-Chatham, Fredonia, Juno, Laurium, Morning Star, and Mountain Pride lode mines and the B. & B. placer.

Green Mountain District.—Mrs. Frances L. McDaniel worked her Big Four mine all of 1948 and shipped zinc-lead-silver-gold ore.

Montezuma District.—The Florado Mining Co. operated its Pinnicle mine and 100-ton flotation mill. Ore treated totaled 4,200 tons yielding 430 tons of lead concentrates containing 1 ounce of gold, 42,914 ounces of silver, 6,673 pounds of copper, and 541,853 pounds of lead; and 39 tons of zinc concentrates containing 433 ounces of silver, 223 pounds of copper, 228 pounds of lead, and 46,294 pounds of zinc. The Summit Mining & Milling Co. mill treated 450 tons of lead-silver-zinc ore from the Silver King Mine. Substantial tonnages of ore were shipped to custom mills at Leadville from the Ida Bell (Ulibarri & Jeffrey) and New York (Teller Basin) mines. Small shippers included the Rose, Bell of California, Cross, Erickson, Mohawk, Radical, Silver Wing, and Wauneita mines.

Ten Mile (Kokomo, Robinson) District.—Mining in this district in 1948 was featured by gains over 1947 of 258 percent in lead production, 125 percent in zinc, 155 percent in silver, 47 percent in gold, and 116 percent in copper. Higher output by the Kokomo Unit (Victory-Wilson-McKinley group) of the American Smelting & Refining Co. led to the exceptionally large gains. This group was among the five leading Colorado producers of lead and zinc in both 1947 and 1948 and of silver in 1948. The ore was trucked to the company Leadville milling unit for concentration. The company continued its exploration and development campaign; the work done during the year included sinking a new 435-foot shaft and extensive diamond drilling and drifting.

The Wilfley Leasing Co. operated the Wilfley mine throughout 1948 and shipped to custom mills at Leadville 3,437 tons of ore averaging 15.81 percent zinc, 0.86 percent lead, and 2.20 ounces of silver and 0.027 [1] ounce of gold a ton. The company reconditioned the Wilfley mill and made test runs on dump ore. The Clark-Mackey Development Co., operating the Michigan-Snowbank group, and lessees on the Kimberly and Colonel Sellers mines were substantial shippers of zinc-lead-silver-gold ore to custom mills at Leadville. Some ore was shipped from the Queen of the West and Silver Cloud properties. The Bureau of Mines continued its exploratory drilling project near Kokomo.

[1] Owing to a misplaced decimal point, the 1947 report of this series (Minerals Yearbook, 1947, p. 1373) gives the gold assay for that year as 0.62 ounce a ton, rather than 0.062 ounce, the correct figure.

TELLER COUNTY

Cripple Creek District.—The Cripple Creek district contributed 35 percent of the State total gold output in 1948, the same percentage as in 1947 and the prewar years 1940 and 1941. The bulk of the district output in 1948 came from the Cresson mine, United Gold Mines Co. group (Vindicator and Portland shafts), Golden Cycle Corp. Ajax mine, and Markley Mining & Exploration Co. Tenderfoot group. All the ore produced from these and other Cripple Creek mines was shipped to the Golden Cycle mill for treatment. (See El Paso County.)

An important event of 1948 affecting the future of mining in the Cripple Creek district was the announcement by the Golden Cycle Corp. that it would abandon the Midland Terminal Railway and move the Golden Cycle mill from Colorado Springs to the Cripple Creek district. The reasons for the move and a review of operations in 1948 are given in the company annual report to stockholders. The following data are abstracted from the report:

The Golden Cycle mill was originally built in Colorado Springs in 1905. The reason for locating it 50 miles by rail from the ore-production area was that large tonnages of coal and other heavy materials were needed to operate the mill and to treat the ore. It was more economical to transport ore down hill than to transport coal and other supplies up hill to the Cripple Creek district. Metallurgical changes in the treatment process developed during the past 5 years eliminated the need for large quantities of coal and other heavy supplies.

The new mill will be located midway between Cripple Creek and Victor and called the Carlton mill. New types of equipment will be used to obtain maximum efficiency and to reduce manual labor to the minimum. The daily capacity will be 600 tons; enough space will be provided to increase the capacity to 1,000 tons if future conditions warrant. The final product will be gold bullion, as in our present operation.

The tonnage and value of ore treated at the Golden Cycle mill during 1948 were less than in 1946 and 1947 because of a decrease in the quantity of dump ore handled. Since it was decided in the early part of 1948 to move the mill to the Cripple Creek district, it seemed advisable to save dump ore to treat at a later date more economically and efficiently in the new mill. Cripple Creek ore handled comprised 129,730 tons of dump ore, with an average per ton gross value of $3.45, and 96,019 tons of mine ore, with an average per ton value of $16.08. Other Colorado districts shipped to the mill 3,325 tons, with an average per ton value of $15.05. Wrecking of the mill began the latter part of 1948 and should be completed in 1949.

Ajax Mine.—Company and lessees shipped 22,758 tons of ore, with a total gross value of $462,211. A total of 2,310 feet of drifts, crosscuts, and raises was completed during 1948, and several ore bodies were opened. Hoisting from the Carlton drainage tunnel level began about March 1.

Anchoria Leland Mine.—This mine operated until May 1, when it was closed because of a shortage of split-check lessees. Ore shipped totaled 1,588 tons with a total gross value of $15,621.

Index Mine.—Lessees shipped 287 tons of dump ore, with a total gross value of $1,300.

During construction of the new Carlton mill all mining operations in the Cripple Creek district will be suspended.

The annual report to stockholders of the Cresson Consolidated Gold Mining & Milling Co. for the calendar year 1948 includes the following data on mining operations:

Net gain for the year was $16,548 against a net loss of $37,719 for 1947. Experienced and capable miners are still lacking in the Cripple Creek district. The company employed about 25 men underground during the year, and 24 sets of lessees accounted for an additional 30 to 40 men. The Cresson lateral of the Carlton tunnel was driven 1,437 feet during the year.

Production of Cresson Consolidated Gold Mining & Milling Co., 1903–48

Period	Dry short tons	Gross value [1]	Freight and treatment	Net value	Dividends
1903–47	3,283,325	$47,226,216	$15,645,267	$31,580,949	$13,564,673
1948:					
Company ore	15,986	184,004	75,905	108,099	
Lessee ore	34,617	545,811	196,011	[2] 349,800	
1903–48	3,333,928	47,956,031	15,917,183	32,038,848	[3] 13,564,673

[1] Settlement value.
[2] Lessees received $167,149 as their share.
[3] Represents 28.29 percent of gross value and 42.34 percent of net value.

Data abstracted from the annual report of the United Gold Mines Co. for the year ended December 31, 1948, follow:

Net loss for 1948 was $7,127 against a net gain in 1947 of $528. Mining costs increased considerably over 1947, owing mainly to higher prices for labor and materials. The selling price of gold remains at $35 a fine ounce. It is impossible to operate profitably unless we have a large number of lessees working the entire area; we had too few lessees in 1948 to make a profit. A lateral was begun on the Carlton tunnel level at the Portland shaft heading towards the Vindicator-Cycle group of mines and was driven 1,298 feet during the year. About 3,700 feet remain to be driven to prospect and drain this group.

Production of properties of United Gold Mines Co. in 1948, and before and after organization of the company (May 15, 1902) to Dec. 31, 1948

Mine	Net tons	Gross value [1]	Company ore cash receipts	Royalties received	Lessees' receipts
1948:					
Vindicator:					
Company ore	122,382	$413,325	$62,048		
Lessee ore	10,956	106,831		$22,537	$27,598
Portland: Lessee ore	2,422	57,257		22,850	22,127
Rose Nicol: Lessee ore	100	1,743		257	870
Miscellaneous	473	7,377		971	3,669
Total 1948	136,333	586,533	62,048	46,615	54,264
Ore mined before consolidation	26,310	456,806	(2)	(2)	(2)
Production under operation of United Gold Mines Co.	3,166,710	28,381,004	(2)	(2)	(2)
Total to Dec. 31, 1948	3,193,020	28,837,810	(2)	(2)	(2)

[1] Settlement value.
[2] Figure not available.

The Markley Mining & Exploration Co., operating the Tenderfoot-Sangre de Cristo-Mollie Kathleen group, shipped 3,048 tons of ore containing 2,597 ounces of gold and 149 ounces of silver; the gross value was $87,050; the net value after deductions for freight and treatment was $63,232.

The Free Coinage, Jerry Johnson, El Paso, Elkton, LeClair, and Front Range mines were among the other producers. All operations on the Stratton estate were suspended in March 1948; the only output during the year was 40 tons of ore from the Proper mine.

East of the Mississippi River Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By SAMUEL A. GUSTAVSON

GENERAL SUMMARY

PRODUCTION of gold, silver, copper, lead, and zinc was reported from mines in 11 of the States east of the Mississippi River during 1948. Virtually all the major producing mines in the region reported continuous operations during the year. The cessation of operations in the latter part of 1947 and in 1948 caused by the expiration of the Premium Price Plan June 30, 1947, was confined chiefly to marginal mines in Northern Illinois and Wisconsin. Demand for copper, lead, and zinc was strong throughout 1948, and prices rose from opening quotations of 21.2 cents per pound, domestic refinery, to 23.2 cents for copper; 15.0 cents per pound, New York, to 21.5 cents for lead; and 10.5 cents per pound to 17.5 cents for zinc, establishing a record high price for lead, the highest price for copper since 1918, and the highest price for zinc since 1916.

Production of the five metals (recoverable) in the region was 2,479 fine ounces of gold, 101,171 fine ounces of silver, 42,025 tons of copper, 10,706 tons of lead, and 177,787 tons of zinc, with a total value of $69,946,807. The region's output represented only a minor share of the United States production of gold and silver but accounted for about 3 percent of the lead, 5 percent of the copper, and 28 percent of the zinc.

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 zinc recoverable as metal and oxide after freight, haulage, smelting, and manufacturing charges are added.

Prices of gold, silver, copper, lead, and zinc, 1944–48

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1944	$35.00	$0.711+	$0.135	$0.080	$0.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122
1947	35.00	.905	.210	.144	.121
1948	35.00	.905+	.217	.179	.133

[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, 1944 to June 30, 1946: $0.71111111; July 1, 1946, to Dec. 31, 1947: $0.905; 1948: $0.9050505.

[3] Yearly average weighted price of all grades of primary metal sold by producers; 1944–47: Price includes bonus payments by Office of Metals Reserve for overquota production.

Annual figures for the 5 years ended with 1948 and data showing the production of gold, silver, copper, lead, and zinc by months in terms of recoverable metal are given in the accompanying tables. The figures for tonnage of ore sold or treated do not include magnetite ore

Mine production of gold, silver, copper, lead, and zinc in States east of the Mississippi River, 1944–48, in terms of recovered metals

Year	Mines producing		Material sold or treated [1]		Gold (lode and placer) [2]		Silver (lode) [3]	
	Lode	Placer	Crude ore (short tons)	Old tailings (short tons)	Fine ounces	Value	Fine ounces	Value
1944	123	2	7, 162, 687	3, 256, 812	2, 595	$90, 825	180, 661	$128, 470
1945	111	--------	6, 335, 831	3, 820, 946	1, 857	64, 995	106, 044	75, 409
1946	108	5	5, 451, 340	3, 763, 871	1, 432	50, 120	79, 266	64, 047
1947	120	--------	6, 293, 007	3, 411, 070	1, 997	69, 895	137, 780	124, 691
1948	110	--------	6, 544, 541	2, 349, 877	2, 479	86, 765	101, 171	91, 565

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1944	114, 940, 000	$15, 516, 900	19, 644, 000	$1, 571, 520	398, 958, 000	$41, 256, 192	$58, 563, 907
1945	85, 712, 000	11, 571, 120	20, 138, 000	1, 731, 868	360, 644, 000	37, 052, 932	50, 496, 324
1946	69, 026, 000	11, 182, 212	22, 254, 000	2, 425, 686	323, 752, 000	35, 472, 314	49, 194, 379
1947	73, 750, 000	15, 487, 500	18, 052, 000	2, 599, 488	363, 584, 000	42, 810, 934	61, 092, 508
1948	84, 050, 000	18, 238, 850	21, 412, 000	3, 832, 748	355, 574, 000	47, 696, 879	69, 946, 807

[1] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.
[2] Includes placer gold as follows: 1944, 5 ounces; 1945, none; 1946, 22 ounces; 1947–48, none.
[3] No placer silver was produced during 1944–48.

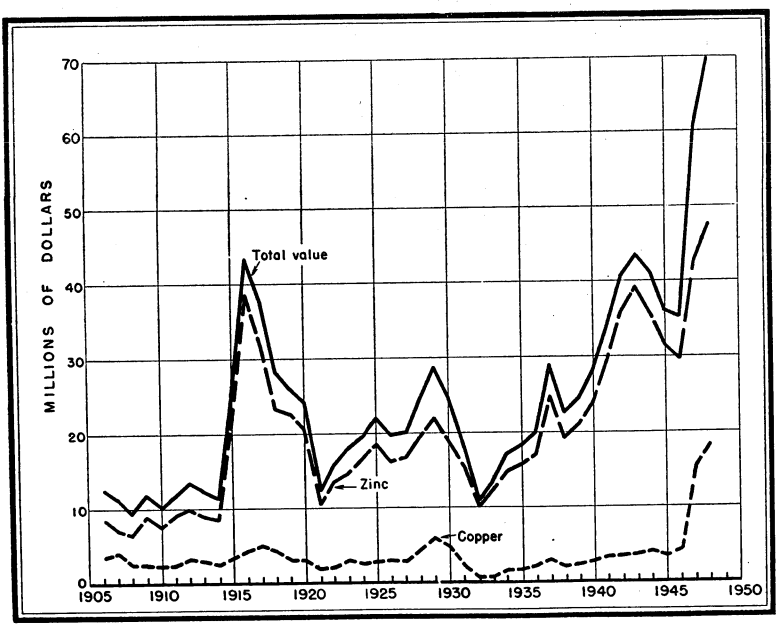

FIGURE 1.—Value of mine production of zinc and copper and total value of gold, silver, copper, lead, and zinc in States east of the Mississippi River, 1906–48.

containing pyrite and chalcopyrite, from which copper, gold, and silver were recovered as byproducts. Minerals Yearbook, 1947, page 1379, contains a historical table showing mine production of gold, silver, copper, lead, and zinc in States east of the Mississippi River by years for the period 1906 through 1947. The 1947 volume also contains a table (p. 1380) showing production of gold, silver, copper, lead, and zinc by months for the years 1943 through 1947. Monthly production data for earlier years are not available.

Mine production of gold, silver, copper, lead, and zinc in States east of the Mississippi River, 1948, by months, in terms of recoverable metals

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	188	7,662	3,243	913	14,285
February	195	7,680	3,103	858	14,032
March	257	8,486	3,467	869	15,770
April	210	7,210	3,208	1,204	15,529
May	196	8,506	3,929	954	14,622
June	201	9,150	4,286	989	15,387
July	183	9,080	3,710	866	14,538
August	270	8,867	3,769	813	14,304
September	201	8,178	3,553	777	14,821
October	169	7,679	3,322	836	14,545
November	220	9,866	3,352	769	14,947
December	189	8,807	3,083	858	15,007
Total: 1948	2,479	101,171	42,025	10,706	177,787
1947	1,997	137,780	36,875	9,026	181,792

Gold.—Gold was recovered from mines in Georgia, Pennsylvania, Tennessee, and Vermont during 1948. In Georgia, two mines—the Calhoun and the Brand Estate—produced 19 ounces from gold ore. All other gold was a byproduct from copper-bearing ores and was recovered from slimes from the electrolytic refining of the copper. Sources during 1948, as in 1947, were: Magnetite-pyrite-chalcopyrite ore from the Cornwall mine, Lebanon County, Pa.; copper ore from the Elizabeth mine, Orange County, Vt.; and copper-iron-zinc ore from the Tennessee Copper Co. mines, Polk County, Tenn. Total gold recovered during 1948 from mines in the region was 2,479 fine ounces valued at $86,765 compared with 1,997 fine ounces valued at $69,895 in 1947. No placer gold was reported in 1948 or 1947.

Mine production of gold in the Southern Appalachian States, 1799–1948

State	Period	Fine ounces	Value	State	Period	Fine ounces	Value
Alabama	1830–1948	49,495	$1,198,985	South Carolina	1829–1948	318,801	$7,562,125
Georgia	1830–1948	870,642	18,088,317	Tennessee	1831–1948	21,424	497,470
Maryland	[1] –1948	6,102	163,940	Virginia	1828–1948	167,558	3,577,509
North Carolina	1799–1948	1,164,588	24,327,843				
				Total	1799–1948	2,598,610	55,416,189

[1] Year of first production not recorded.

Silver.—All silver produced from mines in States east of the Mississippi River was recovered as a byproduct. Output in 1948 totaled 101,171 fine ounces compared with 137,780 ounces in 1947. Production was from mines in Georgia, Illinois, New York, Pennsylvania, Tennessee, and Vermont. Michigan copper producers usually recover some silver, but reported no output in 1948. Considerable silver in Michigan copper ores not reported as mine production is retained in copper bullion to raise annealing temperatures, prevent brittleness, facilitate soldering, and increase hardness and conductivity. The quantity of silver in this bullion ranges from about 16 to 26 ounces per ton, or as specified, of which about 10 ounces is derived from the ore.

Copper.—Copper was produced from 18 mines and at 3 tailings reclamation operations in 4 States east of the Mississippi River during 1948. Output was 14 percent more than in 1947 and totaled 84,050,000 pounds valued at $18,238,850. The producing States in order of output were Michigan, Tennessee, Pennsylvania, and Vermont. Mines in these four States accounted for about 5 percent of the output for the United States.

Lead.—Mines in States east of the Mississippi River produce lead chiefly as a byproduct of zinc or fluorspar mining. In 1948 output for the region totaled 21,412,000 pounds valued at $3,832,748, an increase of 19 percent in output and 47 percent in value over 1947.

The principal producers were the Austinville mine in Virginia, Ozark Mahoning Co. mines in Hardin County, Ill., and the Balmat mine, New York. Together, these mines accounted for 75 percent of the total lead produced in the region in 1948.

Zinc.—Zinc production in States east of the Mississippi River was 177,787 tons in 1948, a decrease of 4,005 tons from the 1947 production of 181,792 tons. However, the value of the zinc produced in 1948 was 11 percent higher than in 1947. Mines in the region accounted for 28 percent of the total United States mine output of recoverable zinc. States reporting production in the region include Illinois, Kentucky, New Jersey, New York, Tennessee, Virginia, and Wisconsin. New Jersey was the leading zinc-producing State in the region and New York, second. Increases in zinc output over the 1947 rate were reported for New York, Illinois, and Kentucky. Expiration of the Premium Price Plan in June 1947 did not greatly reduce the zinc output or the number of mines operating in 1948 except in Wisconsin and in the Northern Illinois district.

MINING INDUSTRY

Prices for copper, lead, and zinc were higher in 1948 than in 1947, as were also labor, material, and freight costs.

Virtually the same mines as in the preceding year were operated in Michigan, New Jersey, New York, Pennsylvania, Tennessee, Vermont, and Virginia in 1948, the first year since the ending (June 30, 1947) of the Premium Price Plan for copper, lead, and zinc. Exceptions include the Gaither Chemical Co. operations in Tennessee and the Toncrae Mining Co. operation of the Toncrae mine in Virginia; both of these companies ceased operations in 1947. The Isle Royal Copper Co. in Michigan ceased operations for lack of ore in December 1948. Lead and zinc output from mines in Southern Illinois and Kentucky depends chiefly on demand for and the price of fluorspar. Output from this area was larger in 1948 than in 1947, and there was little change in the number of mines reporting production. In Wisconsin fewer mines (11 less) reported shipments in 1948, and current output of lead and zinc decreased 45 and 67 percent, respectively, from that of 1947. Tri-State Zinc, Inc., operated three properties in 1948 compared with two in 1947 and, except for shipments totaling 28 tons from four other operators, accounted for all the reported production from the Northern Illinois district in 1948.

ORE CLASSIFICATION

Details of ore classification are given in the Gold and Silver chapter of this volume.

Ore sold or treated in States east of the Mississippi River in 1948, with content in terms of recovered metals

Source	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Gold ore: Georgia	36	19	3			
Total	36	19	3			
Copper ore:						
Michigan	4,490,236			55,554,000		
Tennessee	1,086,810	156	39,692	[1] 28,496,000		(2)
Vermont	144,914	104	24,910	(1)		
Total	5,721,960	260	64,602	[3] 84,050,000		(2)
Magnetite-pyrite-chalcopyrite ore: Pennsylvania	(4)	2,200	13,731	(1)		
Total	(4)	2,200	13,731	(1)		
Zinc ore:						
Illinois	74,567				24,000	5,214,000
Kentucky	10,351				124,000	378,000
New Jersey	488,701					152,664,000
New York	154,361		1,903		242,000	21,672,000
Tennessee	1,078,356					[2] 59,048,000
Wisconsin	32,040				14,000	2,950,000
Total	1,838,376		1,903		404,000	[2] 241,926,000
Zinc-lead ore:						
Illinois	313,950		4,047		7,366,000	20,746,000
Kentucky	35,323				308,000	900,000
New York	309,688		16,885		2,220,000	47,460,000
Virginia	519,899				9,406,000	31,764,000
Wisconsin	155,186				1,708,000	12,778,000
Total	1,334,046		20,932		21,008,000	113,648,000
Grand total:						
1948	[5] 8,894,418	2,479	101,171	84,050,000	21,412,000	355,574,000
1947	[5] 9,704,077	1,997	137,780	73,750,000	18,052,000	363,584,000

[1] Data for copper in Pennsylvania and Vermont included with Tennessee; Bureau of Mines not at liberty to publish separate figures.
[2] Zinc from copper ore included with that from zinc ore; Bureau of Mines not at liberty to publish separate figures.
[3] Includes copper produced in Pennsylvania from magnetite-pyrite-chalcopyrite ore.
[4] Bureau of Mines not at liberty to publish separate figures for ore.
[5] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.

METALLURGIC INDUSTRY

During 1948, as in former years, most of the ore and virtually all of the old tailings were treated at concentrating mills at or near the mines and the product shipped to smelters, refineries, or oxide plants. Of the 8,894,418 tons of ore (6,544,541 tons) and tailings (2,349,877 tons) mined in 1948, exclusive of pyrite ore from Pennsylvania, only 9,910 tons were shipped for direct smelting. All ore mined in Pennsylvania was concentrated. Comparable figures for 1947 were 9,704,077 tons of ore and tailings mined, of which 16,420 tons were shipped for direct smelting. In 1948 about 36 tons of gold ore was treated by amalgamation.

The methods of treatment used in the mills and other operating details, including the tonnage and grade of concentrates produced at some mills, are given in the Review by States that follows.

Active smelters and refineries in States east of the Mississippi River that treated primary materials include copper plants at Hubbell and Hancock, Mich., Carteret, N. J., Laurel Hill, N. Y., Copperhill, Tenn., Baltimore, Md., and Barber, N. J.; lead plants at Barber, N. J., East Chicago, Ind., and Federal Hill, Ill.; zinc plants at Hillsboro, Fairmont City, La Salle, East St. Louis, and Depue, Ill., Donora, Palmerton, and Josephtown, Pa., Columbus, Ohio, and Meadowbrook, W. Va.

REVIEW BY STATES

GEORGIA

The Calhoun Mines, Inc., operating the Calhoun mine in Lumpkin County, and the Cooperative Mining & Developing Co., operating its property in Cherokee County, were the only producers of gold and silver in Georgia during 1948. No production of copper, lead, or zinc was reported.

State output, all sold to the Philadelphia Mint, was 19 fine ounces of gold and 3 fine ounces of silver.

A report on diamond drilling at the Tallapoosa copper mine, Haralson County, Ga., was published.[1]

ILLINOIS

Zinc and lead are produced in Jo Daviess County, northern Illinois; and silver, lead, and zinc are produced as a byproduct or coproduct with fluorspar in southern Illinois, principally in Hardin County. During 1948 recoverable output of all three metals in Illinois increased—silver 126 percent, lead 59 percent, and zinc 29 percent—both districts contributing to the increase.

Northern Illinois.—During 1948 production was reported from seven mines and from ore previously stock-piled by the Office of Metals Reserve (OMR). Total output in terms of recoverable metal was 946 short tons of lead and 6,197 tons of zinc. This compares with 650 tons of lead and 4,853 tons of zinc in 1947.

OMR stock-piled ore from northern Illinois and Wisconsin mines is credited as production only after it has been milled. The Vinegar Hill Zinc Co. reported milling the remainder of this stock pile during 1948, and 6,975 tons of ore yielding 30 tons of lead and 463 tons of zinc have been credited to mines in Illinois. This is somewhat less than the calculated balance shown in the 1947 chapter; the loss can be attributed chiefly to the difference between initial and final assay and to physical and oxidation losses resulting from storage and handling.

[1] Ballard, T. J., and McIntosh, F. K., Diamond Drilling at the Tallapoosa Copper Mine, Haralson County, Ga.: Bureau of Mines Rept. of Investigations 4316, 1948, 8 pp.

Mine production of gold, silver, copper, lead, and zinc in States east of the Mississippi River in 1948, by States, in terms of recovered metals

State	Mines producing (lode)	Ore and tailings (short tons)	Gold (all lode)		Silver (all lode)	
			Fine ounces	Value	Fine ounces	Value
Georgia	2	36	19	$665	3	$3
Illinois	23	[1] 388, 517			4, 047	3, 663
Kentucky	14	[1] 45, 674				
Michigan	11	4, 490, 236				
New Jersey	2	488, 701				
New York	3	464, 049			18, 788	17, 004
Pennsylvania	1	(2)	2, 200	77, 000	13, 731	12, 427
Tennessee	11	2, 165, 166	156	5, 460	39, 692	35, 923
Vermont	1	144, 914	104	3, 640	24, 910	22, 545
Virginia	1	519, 899				
Wisconsin	41	187, 226				
Total: 1948	110	[2] 8, 894, 418	2, 479	86, 765	101, 171	91, 565
1947	120	[2] 9, 704, 077	1, 997	69, 895	137, 780	124, 691

State	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Georgia							$668
Illinois			7, 390, 000	$1, 322, 810	25, 960, 000	$3, 452, 680	4, 779, 153
Kentucky			432, 000	77, 328	1, 278, 000	169, 974	247, 302
Michigan	55, 554, 000	$12, 055, 218					12, 055, 218
New Jersey					152, 664, 000	[3] 20, 709, 849	[3] 20, 709, 849
New York			2, 462, 000	440, 698	69, 132, 000	9, 194, 556	9, 652, 258
Pennsylvania	(4)	(4)					[4] 89, 427
Tennessee	[4] 28, 496, 000	[4] 6, 183, 632			59, 048, 000	7, 853, 384	[4] 14, 078, 399
Vermont	(4)	(4)					[4] 26, 185
Virginia			9, 406, 000	1, 683, 674	31, 764, 000	4, 224, 612	5, 908, 286
Wisconsin			1, 722, 000	308, 238	15, 728, 000	2, 091, 824	2, 400, 062
Total: 1948	84, 050, 000	18, 238, 850	21, 412, 000	3, 832, 748	355, 574, 000	47, 696, 879	69, 946, 807
1947	73, 750, 000	15, 487, 500	18, 052, 000	2, 599, 488	363, 584, 000	42, 810, 934	61, 092, 508

[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.
[2] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania from which gold, silver, and copper are recovered; Bureau of Mines not at liberty to publish figures for ore and copper separately.
[3] Estimated smelting value of recoverable zinc content of ore after freight, haulage, smelting, and manufacturing charges are added.
[4] Data for copper in Pennsylvania and Vermont included with Tennessee; Bureau of Mines not at liberty to publish separate figures.

Tri-State Zinc, Inc., accounted for most of the current production of Illinois during 1948. It operated the Bautsch, Heer, and Black Jack mines. The Bautsch and Heer were operated throughout the year, whereas the Black Jack, last worked in 1927, was dewatered during the year and produced only in November and December.

The Bautsch mine was operated through two shafts, one 282 feet and the other 291 feet deep. Development at this property during the year included 3,932 feet of churn drilling. The Heer mine was operated through one shaft 278 feet deep; development included 1,315 feet of churn drilling. The Black Jack mine was operated through one shaft 158 feet deep; development included 565 feet of diamond drilling and 3,190 feet of churn drilling. Ore from all three mines was treated in the company's Gray mill. Small shipments to the Vinegar Hill Zinc Co. custom mill were reported from four other properties.

Reports on the Blewett zinc-lead deposit [2] and the Skene zinc mine[3] were published.

Southern Illinois.—Production from Southern Illinois, in terms of recoverable metal, in 1948 was 4,047 fine ounces of silver, 2,749 short tons of lead, and 6,783 tons of zinc compared with 1,790 ounces of silver, 1,675 tons of lead, and 5,220 tons of zinc in 1947.

The Ozark-Mahoning Co., with fluorspar-zinc-lead mines near Cave in Rock, was the largest producer of silver, lead, and zinc in the district. Producing shafts (1948 depths in parentheses) were the Deardorff No. 2 (310), Mahoning mine shaft No. 2 (161), Mahoning mine shaft No. 3 (146), East Green (230), and West Green (363). During the year the company began sinking the North Green shaft and did 12,623 feet of churn drilling. The company mill at Rosiclare operated continuously throughout the year, treating company and custom ores from Illinois and Kentucky. Ore treated totaled 137,660 tons. Mill products were fluorspar, zinc and lead concentrates. Zinc concentrates were shipped to Fort Smith, Ark., and lead concentrates to Federal, Ill.

The Minerva Oil Co. operated its fluorspar-zinc mine and 200-ton mill throughout 1948 except for the period of a labor strike, June 10–27. Development of the property included 320 feet of drifts, 46 feet of raise, 1,478 feet of diamond drilling, and 21,757 feet of churn drilling. Improved loading and drilling equipment were added to the mine. No major changes were made in milling operations. Zinc concentrates were shipped to Fort Smith, Ark. Among other producers in Southern Illinois were the Alcoa Mining Co., Crystal Fluorspar Co., and the Rosiclare Lead & Fluorspar Mining Co. Most of the ore produced by these companies from which zinc and lead were recovered was treated in the Ozark Mahoning Co. mill. The Bureau of Mines published a report giving the results of ore-dressing tests on oxidized ore from the Alco Lead Co., Golconda, Ill.[4]

KENTUCKY

Lead and zinc are produced chiefly as a byproduct or coproduct with fluorspar in Kentucky. The fluorspar-lead-zinc operations are situated principally in Crittenden and Livingston Counties. One zinc-lead mine was operated in Owen County. Production (in terms of recoverable metal) reported from 14 mines was 216 short tons of lead and 639 tons of zinc, an increase of 1 percent for lead and 26 percent for zinc over the 1947 totals. The Ozark-Mahoning Mining Co. operated the Babb and Commodore mines in Crittenden and Livingston Counties. Development at these properties during 1948 included 250 feet of shaft, 150 feet of drifts, and 4,234 feet of diamond drilling. The Alco Lead Co. operated the Mineral Ridge and Babb mines. The United States Coal & Coke Co., fluorspar division, operated the Tabb No. 1 and treated the ore produced in its fluorspar mill at Mexico, Ky. The K. T. Dome Mining Syndicate operated its zinc-lead mine and mill in Owen County. Other fluorspar producers shipped material containing zinc, lead, and fluorspar to the Ozark-Mahoning mill at Rosiclare, Ill.

[2] Holt, Stephen P., Investigation of the Blewett Zinc-lead Deposit, Jo Daviess County, Ill.: Bureau of Mines Rept. of Investigations 4350, 1948, 36 pp.

[3] Terry, O. W., and Lincoln, Francis C., Investigation of the Skene Zinc Mine, Jo Daviess County, Ill.: Bureau of Mines Rept. of Investigations 4320, 1948, 5 pp.

[4] Fine, M. M., Ore-Dressing Investigation of Oxidized Lead Ores from Missouri and Illinois: Bureau of Mines Rept. of Investigations 4301, 1948, 10 pp.

MICHIGAN

The output of recoverable copper from mines in Michigan was 15 percent larger in 1948 than in 1947. No silver recovery was reported in 1948. Of the total material treated during the year, 2,165,112 short tons was ore and 2,325,124 tons was old tailings. Copper recoverable from ore averaged about 18.7 pounds per ton and from tailings about 6.5 pounds per ton. Producing companies included the Calumet & Hecla Consolidated Copper Co., Copper Range Co., Isle Royal Copper Co., and the Quincy Mining Co.

Calumet & Hecla Consolidated Copper Co. operated the Ahmeek, Douglass, Iroquois, Kearsarge, Peninsula, Allouez, Centennial, and Seneca No. 2 mines throughout 1948. Ore from these properties was treated in the company Ahmeek 6,000-ton concentration mill. Old tailings were treated throughout the year at the Tamarack reclamation plant, and from May through December at the Lake Linden reclamation plant. All concentrates were shipped to the company smelter.

The Isle Royal Copper Co. operated its mine and 2,000-ton stamp mill from January until the early part of December, when all operations ceased. During the year the company mined and treated 264,949 tons of copper ore, which yielded 3,349 tons of copper concentrates containing 2,604 tons of copper from which 2,578 tons of fine copper were recovered. The copper was refined for the Isle Royal Copper Co. by Calumet & Hecla Consolidated Copper Co.

The Copper Range Co. operated the Champion mine throughout the year. The White Pine mine was operated from January to August 1, when operations were suspended. All ore was concentrated at the company Freda 2,000-ton flotation mill. Extracts from the company annual report follow:

> This year marks the fiftieth anniversary of the company and of its subsidiary the Copper Range Railroad Company. Space prevents even a brief outline of the history and growth of the Copper Range Company since its beginning, and it will not be covered in this report. There are, however, several significant accomplishments that are appropriate to mention at this time.
>
> The Copper Range Company was organized on January 20, 1899, and throughout the fifty years of its existence has continued to follow the concepts of its founders—the production of copper and development of the natural resources of the Upper Peninsula of Michigan, together with the construction and operation of a railroad and other services necessary for these objectives and for the public welfare.
>
> Since incorporation, several important properties have been acquired, and extensive mineral timber lands have been added to our ownership either by purchase or merger. Among these acquisitions was the C. G. Hussey & Company, fabricators of copper. This division of the company was founded in 1848 and celebrated its centennial anniversary last year with appropriate ceremonies.
>
> A total of 1,233,570,000 pounds of copper have been produced from our mines in Northern Michigan, for which the company received an over-all average price of 15.7 cents per pound, and the company has paid a total of $34,590,000.00 in dividends to its stockholders.
>
> The acquisition and exploration of the White Pine ore body is an outstanding development which will play an important part in the future of the company and Northern Michigan. The total estimated positive plus probable ore reserves of the White Pine mine stand to date at 199,610,000 tons of ore carrying 22.3 pounds of copper per ton. This includes 106,770,000 tons of parting shale ore averaging 25.3 pounds per ton. Plans for the development of this ore body are progressing satisfactorily. * * *
>
> The net income of the company for the year 1948 was $1,016,559.22 after depre-

ciation and provision for all taxes. This compares with a net income of $991,052.43 for the preceding year. Dividends were paid during the year in the amount of $423,696 equivalent to 75 cents per share. * * *

The program of exploration, development and mining initiated last year has been continued in the East Vein of the Champion mine. The work in the early part of the year consisted largely of stoping on the 12th level south of No. 4 shaft. During the latter part of the year stoping was started on the 9th level in the No. 1 shaft area. Development work was carried on throughout the year at a rate sufficient to balance the tonnage of ore broken. A total of 119,912 tons of ore were mined during the year and produced 1,885,603 pounds of copper. Approximately 106,000 tons of ore were held in broken ore reserves at the close of the year. Although the grade of ore from the East Vein has proved disappointing, this work has carried its full share of the costs, and prospects for improvement justify the work being continued. This success was due in great measure to the excellent over-all operating efficiencies obtained by the management under the disadvantage of a power shortage during the last half of the year as well as of higher labor, material, and supply costs.

There was no drilling or development work at the White Pine property during the year, as no immediate advantage was to be gained by adding to the proven ore reserves. We have sufficient information and data to indicate the important structural features of the ore body as well as to confirm the continuity and grade of ore.

Tailings were treated by the Quincy Mining Co. at its reclamation plant at Mason, Mich., throughout 1948. Concentrates were shipped to the Calumet & Hecla Consolidated Copper Co. smelter during the early part of the year, then to the Quincy Mining Co. smelter at Hancock, Mich. First production of refined copper from the rehabilitated Quincy smelter was reported in October.

NEW JERSEY

The output of recoverable zinc as metal or oxide from mines in New Jersey was virtually the same in 1948 as in 1947. However, the value in 1948 was 19 percent greater. New Jersey contributed 43 percent of the recoverable zinc produced in States east of the Mississippi in 1948.

Mines operated were the Mine Hill at Franklin and the Sterling Hill at Ogdensburg, both in Sussex County. The ore minerals are chiefly franklinite, willemite, and some zincite. In beneficiating the ore the franklinite is removed from the crushed ore by magnetic separators, and the willemite and zincite are concentrated on jigs and tables. Franklinite concentrates are used in the manufacture of zinc oxide and spiegeleisen, and the willemite-zincite concentrate is smelted to produce high-grade zinc. Concentrates are refined in smelting and manufacturing plants at Palmerton, Pa.

The value of the New Jersey output of zinc given in the tables of this chapter is the combined value of the zinc recoverable in both metal and oxide after freight, haulage, smelting, and manufacturing charges have been added.

NEW YORK

New York mines produced and treated 464,049 tons of ore, an increase of 6 percent over 1947. However, the output of recoverable zinc increased only 1 percent, and silver and lead output decreased 16 and 18 percent, respectively. State production in 1948 in terms of recoverable metal was 18,788 fine ounces of silver, 1,231 short tons of lead, and 34,566 tons of zinc.

The producing mines were the Balmat and the Edwards, operated by the St. Joseph Lead Co., and the Hyatt, operated by the Universal Exploration Co.—all in St. Lawrence County. Both companies operated throughout 1948. The Balmat mine is worked through a single inclined shaft, and the ore is concentrated in a 1,200-ton flotation mill. Lead, zinc, and iron concentrates are made. Zinc concentrates were sent to the American Steel & Wire Co., Donora, Pa., and to the St. Joseph Lead Co., Josephtown, Pa. Lead concentrates were shipped to the St. Joseph Lead Co., Herculaneum, Mo. Development in the mine during 1948 included 1,753 feet of drift and 51,166 feet of diamond drilling. The Edwards mine is worked through one vertical shaft 1,560 feet deep and one underground shaft 1,538 feet on a 42° slope. Development in the mine in 1948 included 312 feet of shaft, 583 feet of drifts, and 8,132 feet of diamond drilling. A zinc flotation concentrate was made in the 600-ton mill and was shipped to the Josephtown smelter.

The Hyatt mine is worked through an inclined shaft 450 feet deep and has approximately 8,500 feet of drifts. During 1948 development included 250 feet of drift. The ore is treated in a flotation mill, which has a daily capacity of 200 tons. The lead concentrate is shipped to Herculaneum, Mo., and the zinc concentrate to Donora, Pa., or Josephtown, Pa.

PENNSYLVANIA

The output of gold, silver, and copper in Pennsylvania increased 45, 39, and 48 percent, respectively, in 1948 over 1947. Production was from the Cornwall mine of the Bethlehem Steel Co. in Lebanon County. The ore (magnetite-pyrite-chalcopyrite) is treated in the company combined magnetic concentration and flotation plant at Lebanon, which operated on a 24-hour schedule 6 days per week during the year.

Pennsylvania zinc mines have been idle for many years. However, the New Jersey Zinc Co. of Pennsylvania was rehabilitating and developing its property in the Friedensville district and contemplates production in 1949. A report on the Bamford zinc mine was published by the Bureau of Mines.[5]

Zinc smelters at Donora, Josephtown, and Palmerton, Pa., treat most of the zinc concentrates produced in New York, Pennsylvania, and Tennessee as well as large tonnages from other States and from foreign countries.

TENNESSEE

During 1948 Tennessee mines produced gold, silver, copper, and zinc, but no lead. The gold and silver outputs, byproducts of copper ores, were only about half those of 1947; copper production decreased 2 percent and zinc 5 percent. Production was reported from 11 mines operated by 3 companies.

The American Zinc Co. of Tennessee operated the Grasselli, Jarnagin, and Mossy Creek mines in Jefferson County and the Mascot No. 2 in Knox County during the entire year. Development in the Gras-

[5] Mosier, McHenry, Bamford Zinc Mine, Lancaster County, Pa.: Bureau of Mines Rept. of Investigations 4247, 1948, 3 pp.

selli mine included 1,830 feet of drifts, 527 feet of incline shaft, 35,149 feet of diamond drilling, and 12,573 feet of churn drilling; in the Jarnagin mine, 549 feet of drift, 5,635 feet of diamond drilling, and 3,264 feet of churn drilling; in the Mascot No. 2 mine, 2,177 feet of drift, 235 feet of incline shaft, 20,407 feet of diamond drilling, and 425 feet of churn drilling; and in the Mossy Creek mine, 503 feet of drifts. All ore was concentrated at the Mascot mill. Concentrates were shipped to several smelters and oxide plants.

All producing mines of the Tennessee Copper Co. in Polk County were operated at capacity throughout 1948. They were the Burra Burra, Boyd, Calloway, Eureka, and Mary. Development during the year included 819 feet of shaft, 13,087 feet of drift, 3,374 feet of raises, and 6,573 feet of diamond drilling. The ore produced—a sulfide containing iron, copper, zinc, and small quantities of gold and silver—was concentrated in the London and Isabella mills. Copper, iron, and zinc concentrates are made. Zinc concentrates were sent to the New Jersey Zinc Co., Palmerton, Pa., and to the American Zinc Co., East St. Louis, Ill. Copper concentrates are reduced to blister copper in the company smelter at Copperhill, Tenn. Part of the copper blister is shipped to the electrolytic plant of the Phelps Dodge Copper Corp., Laurel Hill, N. Y., and the remainder is used to manufacture copper sulfate. The Bureau of Mines published a report giving data on blast-hole drilling with diamond drills at the Tennessee Copper Co. mines.[6]

The Davis-Bible group of claims and 800-ton flotation mill near Jefferson City in Jefferson County were operated throughout 1948 by Universal Exploration Co. A total of 208,499 tons of ore was mined in 1948, from which 10,380 tons of zinc concentrates were made. Development in the mine included 188 feet of shaft, 1,553 feet of drift, 6,312 feet of diamond drilling, and 2,336 feet of churn drilling. Concentrates were shipped to the American Steel & Wire Co., Donora, Pa., and to the St. Joseph Lead Co., Josephtown, Pa.

The Bureau of Mines published reports on the Howard Lynch [7] and the D. W. Harris (O'Dell)[8] zinc prospects, both in Claiborne County, Tenn.

VERMONT

The Vermont Copper Co. produced gold, silver, and copper from the Elizabeth mine in Orange County throughout 1948. The ore, carrying chalcopyrite and pyrrhotite with a small quanity of gold and silver, is concentrated in the company 500-ton flotation mill. During the year 144,914 tons of ore were treated, and 9,679 tons of copper concentrates were made. The concentrates made are shipped chiefly to the Phelps Dodge Corp. smelter and refinery at Laurel Hill, N. Y. The output of recoverable copper during 1948 was about 2 percent less than in 1947.

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[6] Beck, William A., Blast-Hole Drilling with Diamond Drills at the Tennessee Copper Co. Mines, Ducktown, Tenn.: Bureau of Mines Inf. Circ. 7452, 1948, 17 pp.

[7] Hickman, Robert C., Howard Lynch Zinc Prospect, Claiborne County, Tenn.: Bureau of Mines Rept. of Investigations 4204, 1948, 3 pp.

[8] Hickman, Robert C., D. W. Harris (O'Dell) Zinc Prospect, Claiborne County, Tenn.: Bureau of Mines Rept. of Investigations 4206, 1948, 3 pp.

VIRGINIA

Mines in Virginia recorded an increase of 24 percent in output of recoverable lead and a decrease of 5 percent in output of zinc in 1948 compared with 1947. No copper production was recorded in 1948.

The Austinville zinc-lead mine operated continuously during 1948; the ore is treated in a 2,000-ton flotation mill at the mine.

The Bureau of Mines published reports on the Sutherland copper prospect [9] and the Toncrae-Howard copper deposits,[10] both in Floyd County, Va.

WISCONSIN

During 1948 Wisconsin mines produced and treated 97,595 tons of ore and tailings containing, in terms of recoverable metal, 577 short tons of lead and 3,224 tons of zinc. In addition, 89,631 tons of ore from the stock pile of the Office of Metals Reserve (OMR), mined prior to 1947, was treated and credited to 1948 production from Wisconsin mines. This ore contained in terms of recoverable metal, 284 tons of lead and 4,640 tons of zinc. This output compares with 454,659 tons of ore produced and treated in 1947, which yielded 1,054 tons of lead and 9,883 tons of zinc, and 43,351 tons of OMR stock-piled ore treated in 1947, which yielded 112 tons of lead and 2,341 tons of zinc. There were 41 producing mines compared with 52 in 1947.

The OMR reported that all lead-zinc and zinc ores purchased from mines in Northern Illinois and Wisconsin on hand at the beginning of 1948 were sold to the Vinegar Hill Zinc Co. during the year. This ore, totaling 96,606 tons containing 533,548 pounds of lead and 12,289,026 pounds of zinc, was treated by the Vinegar Hill Zinc Co. during the year, and the quantity of metal recovered was prorated according to records of purchases, to Illinois or Wisconsin mines and was credited as part of the 1948 output for each State. The difference between the calculated balance shown in the 1947 chapter and the actual balance can be attributed chiefly to the difference between the initial and final assay and to physical and oxidation losses from storage.

Most of the ore produced in Wisconsin in 1948 and some ore from Northern Illinois was beneficiated at the Vinegar Hill Zinc Co. custom mill at Cuba City. The mill operated throughout the year and treated current and stock-piled ore totaling 114,125 tons, and 3,353 tons of tailings. Galena concentrates made averaged 72.01 percent lead, and sphalerite concentrates averaged 62 percent zinc. Principal shippers to the mill were Kittoe Mining Co., Cuba Mining Co., Meekers Grove Mining Co., Little Mullen Mining Co., William A. Reed, and Frank Mullikin—all in Wisconsin. The Dodgeville Mining Co., the largest producer in the State, and the mentioned shippers accounted for 89 percent of the value of the current output from lead and zinc mines in Wisconsin during 1948.

The Dodgeville Mining Co. operated its mine and 50-ton flotation mill throughout 1948 and mined and concentrated 49,023 tons of ore

[9] Grosh, Wesley A., Investigation of the Sutherland Copper Prospect, Floyd County, Va.: Rept. of Investigations 4357, 1948, 2 pp.

[10] Grosh, Wesley A., Investigation of the Toncrae-Howard Copper Deposits, Floyd County, Va.: Rept of Investigations 4362, 1948, 4 pp.

producing 375 tons of galena concentrates, which averaged 69.213 percent lead, and 1,932 tons of sphalerite concentrates which averaged 61.814 percent zinc. Development during the year included sinking the Dodgeville No. 2 shaft 122 feet, 281 feet of drifts, and 17,000 feet of churn drilling.

Development and exploration by the Calumet Corp. (subsidiary of Calumet & Hecla Consolidated Mining Co.) continued on its properties near Shullsburg. Reports of investigations of several mines and mining areas made prior to 1948 were published by the Bureau of Mines during the year.[11]

OTHER STATES

No production of gold, silver, copper, lead, or zinc was reported from mines in other States in the region during 1948. Reports of investigations of mines in Alabama, Maine, New Hampshire, and North Carolina made by the Bureau of Mines prior to 1948 were published.[12]

[11] Cummings, Alvin M., Trego Lead-zinc Mine, Grant County, Wis.: Bureau of Mines Rept. of Investigations 4211, 1948, 8 pp.
Lincoln, Francis C., Investigation of Coker and Buckford Zinc Deposits, Iowa County, Wis.: Bureau of Mines Rept. of Investigations 4226, 1948, 20 pp.
Terry, Owen W., Churn Drilling at the McIlhon Zinc Deposit, Iowa County, Wis.: Bureau of Mines Rept. of Investigations 4307, 1948, 8 pp.
Berliner, Howard M., Investigation of the Crescent Lead and Zinc Mine, Iowa County, Wis.: Bureau of Mines Rept. of Investigations 4317, 1948, 6 pp.
Kelly, James V., Investigation at the Fairplay Zinc and Lead Area, Grant County, Wis.: Bureau of Mines Rept. of Investigations 4327, 1948, 5 pp.
Berliner, Howard M., Investigation of the Argall (Baggaley) Zinc-lead Mine, Iowa County, Wis.: Bureau of Mines Rept. of Investigations 4340, 1948, 5 pp.

[12] Pallister, Hugh D., and Thoenen, J. R., Stone Hill Copper Mine, Cleburne and Randolph Counties, Ala.: Bureau of Mines Rept. of Investigations 4221, 1948, 29 pp.
Levin, S. B., and Sanford, Robert S., Investigation of the Cape Rosier Zinc-copper-lead Mine, Hancock County, Maine: Bureau of Mines Rept. of Investigations 4344, 1948, 8 pp.
Hermance, H. P., and Mosier, McHenry, Investigation of the Ore Hill Zinc-lead-Mine, Grafton County, N. H.: Bureau of Mines Rept. of Investigations 4328, 1948, 13 pp.
Hickman, Robert C., Cline Copper and Tungsten Mine, Cabarrus County, N. C.: Bureau of Mines Rept. of Investigations 4203, 1948, 5 pp.
Ballard, T. J., and Clayton, Austin B., Conrad Hill Copper and Gold Deposit, Davidson County, N. C.: Bureau of Mines Rept. of Investigations 4290, 1948, 7 pp.
Ballard, T. J., and Clayton, A. B.; Investigation of the Ore Knob Copper Mine, Ashe County, N. C.: Bureau of Mines Rept. of Investigations 4341, 1948, 8 pp.
Ballard, T. J., and Clayton, A. B., Diamond Drilling at Union Copper Mine, Cabarrus and Rowan Counties, N. C.: Bureau of Mines Rept. of Investigations 4364, 1948, 9 pp.

Idaho

Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By C. E. NEEDHAM AND PAUL LUFF

GENERAL SUMMARY

SILVER and lead outputs in Idaho in 1948 were the highest since 1943, and for the first time since 1943 the lead output exceeded the zinc output, despite the fact that the latter was the highest since 1944. The silver output increased from 10,345,779 fine ounces in 1947 to 11,448,875 in 1948 (an 11-percent gain); lead from 157,888,000 pounds to 177,088,000 (a 12-percent gain); and zinc from 166,138,000 pounds to 172,534,000 (a 4-percent gain). However, the gold output dropped from 64,982 fine ounces to 58,454 (a 10-percent loss) and copper from 3,280,000 pounds to 3,248,000 (a 1-percent loss). The total value of the five metals rose from $55,164,670 in 1947 to $67,758,290 in 1948—the greatest value in any year in the State's history and a 23-percent gain over 1947. The total value of the gold was $2,045,890—3 percent of the State total value; silver, $10,361,810—15 percent; copper $704,816—1 percent; lead, $31,698,752—47 percent; and zinc, $22,947,022—34 percent. In 1948 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). More than 92 percent of the State silver production, 85 percent of the copper, 93 percent of the lead, and 97 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 and the Bayhorse and Alder Creek districts in Custer County.

More than 46 percent of the State gold production in 1948 came from a lode mine in the Yellow Pine district, Valley County; the remainder came largely from dredging operations in the Boise Basin district, Boise County; Elk City district, Idaho County; and Yankee Fork district, Custer 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, 1944–48

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1944	$35.00	$0.711+	$0.135	$0.080	$0.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122
1947	35.00	.905	.210	.144	.121
1948	35.00	.905+	.217	.179	.133

[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. 1944 to June 30, 1946: $0.71111111; July 1, 1946, to Dec. 31, 1947: $0.905; 1948: $0.9050505.
[3] Yearly average weighted price of all grades of primary metal sold by producers; 1944–47: price includes bonus payments by Office of Metals Reserve for overquota production.

Mine production of gold, silver, copper, lead, and zinc in Idaho, 1944–48, and total, 1863–1948, 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
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
1947	183	99	3,717,697	64,982	2,274,370	10,345,779	9,362,930
1948	194	78	3,981,846	58,454	2,045,890	11,448,875	10,361,810
1863–1948			(1)	7,964,185	181,885,878	542,280,066	378,756,733

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
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
1947	3,280,000	688,800	157,888,000	22,735,872	166,138,000	20,102,698	55,164,670
1948	3,248,000	704,816	177,088,000	31,698,752	172,534,000	22,947,022	67,758,290
1863–1948	[2] 111,051	34,350,695	[2] 6,107,872	710,312,892	[2] 1,463,008	254,278,345	1,559,584,543

[1] Figure not available.
[2] Short tons.

Gold produced at placer mines in Idaho, 1944–48, 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:					
Bucket-line dredges:					
1944					
1945	1	250,000	1,593	$55,755	$0.223
1946	7	3,766,746	17,448	610,680	.162
1947	8	3,381,351	14,112	493,920	.146
1948	5	3,139,168	14,969	523,915	.167
Dragline dredges:					
1944–45					
1946	6	364,260	2,272	79,520	.218
1947	4	577,000	2,939	102,865	.178
1948	2	400,000	1,071	37,485	.094
Suction dredges:					
1944–46					
1947	5	19,590	103	3,605	.184
1948	3	1,200	20	700	.583
Nonfloating washing plants: [1]					
1944–46					
1947	8	444,490	2,232	78,120	.176
1948	5	457,570	4,204	147,140	.322
Gravel hydraulically handled:					
Hydraulic:					
1944	3	3,600	41	1,435	.399
1945	6	14,600	109	3,815	.261
1946	10	37,100	248	8,680	.234
1947	9	32,560	152	5,320	.163
1948	4	32,600	189	6,615	.203
Small-scale hand methods: Wet:					
1944	16	10,167	77	2,695	.265
1945	17	5,000	59	2,065	.413
1946	43	7,350	133	4,655	.633
1947	58	10,607	218	7,630	.719
1948	54	11,087	307	10,745	.969
Underground placers:					
Drift:					
1944	4	2,100	18	630	.300
1945	3	933	8	280	.300
1946	5	2,567	22	770	.300
1947	7	2,333	20	700	.300
1948	5	620	16	560	.903
Grand total placers:					
1944	[2] 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
1947	99	4,467,931	19,776	692,160	.155
1948	78	4,042,245	20,776	727,160	.180

[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."
[2] A mine using more than one method of recovery is counted but once in arriving at total for all methods.

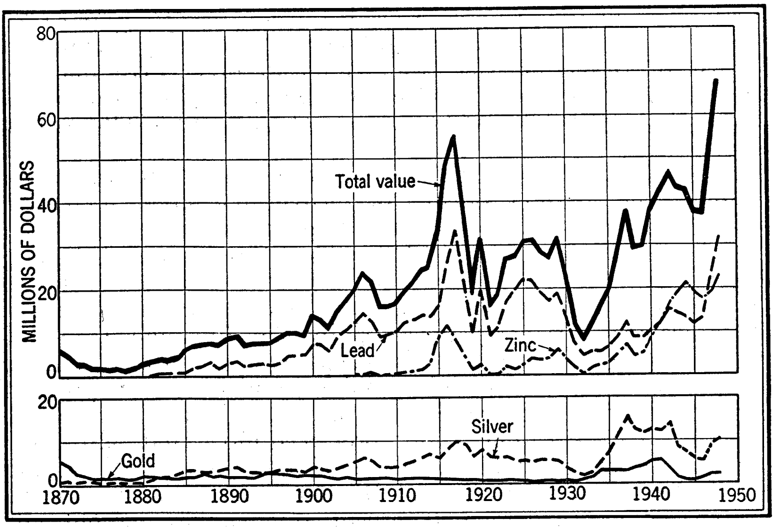

FIGURE 1.—Value of mine production of gold, silver, lead, and zinc and total value of gold, silver, copper, lead, and zinc in Idaho, 1870–1948. The value of copper has been less than $2,000,000 annually, except in a few years.

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1948, by months, in terms of recovered metals

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	5,809	1,055,110	144	8,020	7,140
February	4,595	890,095	133	7,325	6,420
March	4,614	1,070,600	160	7,875	7,841
April	4,248	1,110,110	149	7,345	7,302
May	4,247	974,305	128	6,970	7,162
June	4,823	889,500	123	6,825	7,273
July	4,677	885,990	128	6,755	7,252
August	6,054	955,490	133	7,300	7,573
September	4,788	964,400	129	7,335	7,247
October	5,260	829,685	131	7,330	6,927
November	5,964	901,890	135	7,620	7,327
December	3,375	921,700	131	7,844	6,803
Total: 1948	58,454	11,448,875	1,624	88,544	86,267
1947	64,982	10,345,779	1,640	78,944	83,069

Gold.—The output of recoverable gold in Idaho declined 10 percent in 1948, owing to a decrease of 7,528 ounces from lode mines, especially from the Boise-Rochester-Monarch group at Atlanta and from the Yellow Pine mine at Stibnite. Gold recovered from placer properties increased from 19,776 ounces to 20,776. The Yellow Pine lode mine in Valley County worked by the Bradley Mining Co. continued to be by far the largest producer of gold in Idaho, although its output declined 12 percent; it was followed by a bucket-line dredge at Idaho City worked by the Idaho-Canadian Dredging Co., a dragline dredge on Jordan Creek worked by Jordan Placers, Inc.; a bucket-line dredge near Elk City worked by the Warren Dredging Corp.; a lode property at Atlanta worked by Talache Mines, Inc.; and a bucket-line dredge near Centerville worked by Baumhoff-Marshall, Inc. Of the total gold produced in Idaho in 1948, 54 percent came from gold ore, 25 percent from bucket-line dredging, 9 percent from dragline dredging, and most of the remainder from zinc-lead ore. Five bucket-line dredges and 7 dragline dredges treated 3,996,738 cubic yards of gravel in 1948 and recovered 20,244 fine ounces of gold and 5,769 fine ounces of silver.

Silver.—Stimulated by higher prices for lead and zinc and a steady price for silver, Idaho's output of recoverable silver increased to 11,448,875 fine ounces in 1948, the largest output since 1943 and 1,103,096 ounces more than in 1947. The State remained the largest producer of silver in the United States—a place it has held since 1933. The gain in 1948 resulted mainly from a substantial increase in output of silver ore from property operated by the Sunshine Mining Co., from an increase in output of zinc-lead-silver ore from the Bunker Hill & Sullivan, Page, and Sidney mines, and from new production of silver ore from the Silver Summit mine, all in the Coeur d'Alene region. The Coeur d'Alene region produced more than 92 percent of the State total silver in 1948; the remainder came largely from the Warm Springs, Yellow Pine, and Bayhorse districts. Of the State total silver, silver ore yielded 50 percent, zinc-lead ore and old tailings 39 percent, lead ore 8 percent, and gold ore most of the remainder. The recovery of silver from silver ore increased 614,725 ounces, owing chiefly to the rise in output of ore from property operated by the Sunshine Mining Co.; the recovery of silver from lead ore increased 302,085 ounces and that from zinc-lead ore 246,610 ounces, but that from gold ore declined 49,244 ounces.

Eleven mines—the Sunshine, Bunker Hill & Sullivan, Polaris, Silver Dollar, Page, Osburn tailing dump, Sherman, Triumph, Sidney, Yellow Pine, and Star—produced 81 percent of the silver output of the State in 1948. Six properties near Kellogg, operated by the Sunshine Mining Co., produced 5,726,863 ounces of silver in 1948, or 50 percent of the State total.

Copper.—The output of copper in Idaho declined slightly to 3,248,000 pounds in 1948, a 1-percent loss from 1947. About 82 percent of the State copper output in 1948 was recovered as a byproduct in the treatment of zinc-lead ore and silver ore from mines in the Coeur d'Alene region; the remainder was recovered largely from zinc-lead ore produced in the Warm Springs district.

The Sunshine mine near Kellogg in the Coeur d'Alene region continued to be the largest producer of copper in Idaho. It was followed by the Bunker Hill & Sullivan, Polaris, Silver Dollar, and Triumph properties.

Lead.—In 1948 the mines in Idaho produced 177,088,000 pounds of recoverable lead, the largest output since 1943 and the first time since 1943 that the lead output exceeded the zinc output; however, it was only 3 percent greater, but the value of the lead in 1948 was 38 percent greater than the value of the zinc, owing principally to the difference in price. Higher prices for lead and zinc in 1948 and a steady price for silver caused a greater output of silver-lead ore and zinc-lead-silver ore from mines in the Coeur d'Alene region, the chief source of silver, lead, and zinc in Idaho. In 1948, 93 percent of the

State total lead came from the Coeur d'Alene region; most of the remainder was produced in the Bayhorse, Warm Springs, Alder Creek, and Clark Fork districts. Zinc-lead ore and old tailings (2,751,561 tons) from the Coeur d'Alene region yielded more than 77 percent of the State total lead; and lead ore and silver ore, chiefly from the Coeur d'Alene region, yielded 18 percent. The remainder came largely from lead ore in the Bayhorse, Alder Creek, and Clark Fork districts, zinc-lead ore in the Warm Springs district, and old zinc slag in the Coeur d'Alene region. Lead recovered from lead ore increased 8,410,043 pounds, that from zinc-lead ore and old tailings 8,310,464 pounds, and that from silver ore 2,729,456 pounds.

The Bunker Hill & Sullivan mine at Kellogg was by far the largest producer of lead in Idaho in 1948, and its output increased nearly 52 percent over 1947. In 1948 the combined lead output of the six largest producing mines (each producing more than 7,600,000 pounds—the Bunker Hill & Sullivan, Page, Star, Sherman, Sidney, and Morning—was 106,897,467 pounds or 60 percent of the State total. Other important producers in 1948 were the Osburn tailing dump, Tamarack, Bunker Hill & Sullivan mill tailing dump, Frisco, Dayrock, and Sunshine properties.

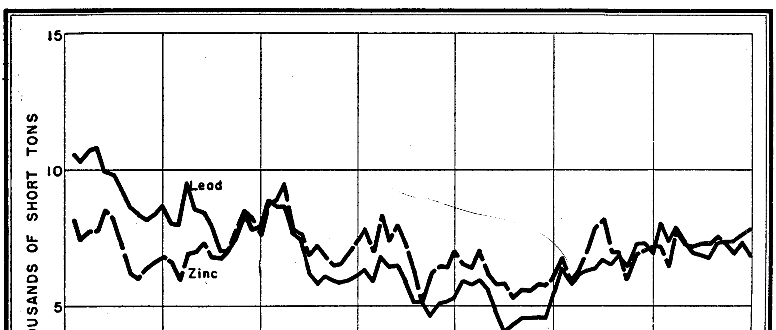

FIGURE 2.—Mine production of lead and zinc in Idaho, 1942–48, by months, in terms of recovered metals.

Zinc.—Idaho's output of recovered zinc increased to 172,534,000 pounds in 1948, the largest output since 1944, when the State reached its peak production of 182,744,000 pounds. Most of the increase in 1948 came from four mines—Sidney, Highland-Surprise, Spokane-Idaho, and Page—in the Pine Creek area of the Coeur d'Alene region. About 97 percent of the State total zinc in 1948 came from the Coeur d'Alene region and most of the remainder from the Warm Springs district. Zinc-lead ore and old tailings concentrated yielded nearly 91 percent of the State total zinc; old zinc slag smelted and fumed, 5 percent; and zinc ore concentrated, lead ore concentrated, silver ore concentrated, zinc-lead ore smelted, and zinc ore smelted, nearly all the remainder.

Twelve properties (each producing more than 7,000,000 pounds of zinc)—the Star, Page, Sidney, Bunker Hill & Sullivan, Bunker Hill smelter slag dump, Frisco, Highland-Surprise, Osburn tailing dump, Morning, Amazon-Carlisle, Spokane-Idaho, and Tamarack—produced 84 percent of the State total zinc in 1948.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1948, 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
Ada		2	4	$140		
Adams	1		2	70	95	$86
Blaine	18		2,132	74,620	275,220	249,088
Boise	5	14	11,855	414,925	4,697	4,251
Bonner	8		12	420	44,034	39,853
Bonneville		1	22	770		
Boundary	1		10	350	15,040	13,612
Butte	9		2	70	1,390	1,258
Camas	5	1	187	6,545	1,200	1,086
Cassia	1					
Clark	2				21	19
Clearwater	1	3	329	11,515	43	39
Custer	29	3	4,031	141,085	238,707	216,042
Elmore	3	2	2,620	91,700	11,248	10,180
Gem	2		34	1,190	526	476
Idaho	11	23	5,455	190,925	1,126	1,019
Jerome		5	14	490		
Lemhi	26	8	1,051	36,785	17,693	16,013
Nez Perce		2	13	455		
Owyhee	2	3	31	1,085	759	687
Shoshone	65	7	3,362	117,670	10,598,338	9,592,031
Twin Falls		2	4	140		
Valley	4	2	27,284	954,940	237,274	214,745
Washington	1				1,464	1,325
Total: 1948	194	78	58,454	2,045,890	11,448,875	10,361,810
1947	183	99	64,982	2,274,370	10,345,779	9,362,930

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Ada							$140
Adams	6,400	$1,389					1,545
Blaine	224,400	48,695	2,746,400	$491,606	3,138,600	$417,434	1,281,443
Boise			1,800	322			419,498
Bonner	3,400	738	1,187,300	212,527	68,000	9,044	262,582
Bonneville							770
Boundary	7,600	1,649	745,400	133,427	51,000	6,783	155,821
Butte	900	195	253,000	45,287	23,400	3,112	49,922
Camas	900	195	35,000	6,265	2,700	359	14,450
Cassia			100	18			18
Clark	10,300	2,235					2,254
Clearwater							11,554
Custer	94,100	20,420	5,768,000	1,032,472	1,359,600	180,827	1,590,846
Elmore							101,880
Gem	200	43	7,800	1,396	3,700	492	3,597
Idaho							191,944
Jerome							490
Lemhi	121,800	26,431	1,168,000	209,072	286,000	38,038	326,339
Nez Perce							455
Owyhee							1,772
Shoshone	2,775,000	602,175	165,174,000	29,566,146	167,601,000	22,290,933	62,168,955
Twin Falls							140
Valley			600	107			1,169,792
Washington	3,000	651	600	107			2,083
Total: 1948	3,248,000	704,816	177,088,000	31,698,752	172,534,000	22,947,022	67,758,290
1947	3,280,000	688,800	157,888,000	22,735,872	166,138,000	20,102,698	55,164,670

MINING INDUSTRY

The upward trend of Idaho's mining industry continued throughout 1948, especially during the last quarter of the year when the price of copper, lead, and zinc advanced and a greater supply of labor became available. However, gold mining was far below what it was during the years before World War II. The increase in the price of copper, lead, and zinc and the improvement in the labor supply during the year stimulated greater activity at mines in the Coeur d'Alene region, Shoshone County—the chief source of silver, copper, lead, and zinc in Idaho. As a result, the State had the highest value of the five metals and the greatest output of ore in its history. Although the State made a record output of ore in 1948, production was retarded owing to a lack of experienced miners and to a large labor turn-over. The output of zinc-lead ore and old tailings (by far the chief ore output of the State) increased from 2,716,251 tons to 2,824,758, gold ore from 618,877 tons to 672,681, lead ore from 165,218 tons to 253,648, silver ore from 146,259 tons to 149,691, and zinc ore and old slag from 67,133 tons to 79,674. More than 97 percent of the gold ore mined in Idaho in 1948 came from the Yellow Pine mine at Stibnite, Valley County, where the output increased from 584,483 tons in 1947 to 655,682 tons in 1948. About 99 percent of the silver ore, 99 percent of the zinc ore and old slag, 97 percent of the zinc-lead ore and old tailings, and 74 percent of the lead ore came from various properties in the Coeur d'Alene region. Placer mining indicated greater activity in the Boise Basin, Elk City, and Yankee Fork districts, where dredges were operated, but activity in the Gibbonsville and Kirtley Creek districts declined considerably owing to suspension of dredging operations. Fifteen dredges (7 dragline, 5 bucket-line, and 3 suction) recovered 20,264 fine ounces of gold in Idaho in 1948, compared with 25 dredges (12 dragline, 8 bucket-line, and 5 suction) in 1947 that recovered 19,386 fine ounces of gold.

ORE CLASSIFICATION

Details on ore classification are given in the Gold and Silver chapter of this volume.

Ore sold or treated in Idaho in 1948, 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	34	672,681	31,905	250,298	594	4,704	172
Dry and siliceous gold-silver ore	1	6	3	80	----------	----------	----------
Dry and siliceous silver ore	17	149,691	188	5,735,954	1,371,582	7,427,305	468,238
	52	822,378	32,096	5,986,332	1,372,176	7,432,009	468,410
Copper ore	11	1,383	38	2,464	170,674	600	----------
Lead ore	73	253,648	717	939,500	160,335	24,483,704	1,966,307
Lead-copper ore	1	5	----------	21	300	1,000	----------
Zinc ore	4	[1] 79,674	20	24,021	11,546	2,161,236	13,235,447
Zinc-lead ore	75	2,824,758	4,807	4,490,618	1,532,969	143,009,451	156,863,836
Total lode mines	[2] 194	[1] 3,981,846	37,678	11,442,956	3,248,000	177,088,000	172,534,000
Placers	78	----------	20,776	5,919	----------	----------	----------
Total: 1948	273	[1] 3,981,846	58,454	11,448,875	3,248,000	177,088,000	172,534,000
1947	282	[3] 3,717,697	64,982	10,345,779	3,280,000	157,888,000	166,138,000

[1] Includes 48,131 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 65,409 tons of old lead smelter slag.

METALLURGIC INDUSTRY

Of the 3,981,846 tons of ore produced in 1948 in Idaho, 3,903,183 tons (98 percent) were treated at milling plants, and the remainder, 78,663 tons (2 percent), was shipped crude to smelters.

Milling plants in 1948 treated principally zinc-lead ore and old tailings (2,813,534 tons), gold ore (672,404 tons), lead ore (236,470 tons), silver ore (149,585 tons), and zinc ore (30,832 tons). Current hot zinc slag totaling 126,885 tons was fumed, and 48,131 tons of old dump lead-smelter slag were delivered for smelting and fuming in 1948. 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.

The Bunker Hill & Sullivan Mining & Concentrating Co. operated its Bradley lead smelter and refinery at a greater rate than in 1947 on ore and concentrates, chiefly from mines and mills in the Coeur d'Alene region. The company also operated its antimony and cadmium plants, 2,000-ton flotation mill (including a sink-and-float unit), 300-ton tailing-treatment plant for recovery of silver, iron, lead, and zinc from old jig tailings, and 450-ton zinc slag-fuming plant at Bradley. According to the company annual stockholders' report for 1948, the smelter produced 7,928 ounces of gold, 10,266,544 ounces of silver, 150,577 pounds of cadmium, 1,166 tons of copper, 1,297 tons of antimony, 14,365 tons of zinc, and 61,151 tons of lead. The slag-fuming plant yielded 21,491 dry tons of deleaded zinc fume and 2,931 dry tons of lead fume; the production of lead and zinc in 1948 was about the same as that in 1947. The Sullivan Mining Co. operated at capacity throughout the year its 100-ton electrolytic zinc plant near Bradley, producing 42,065 tons of high-grade slab zinc. This is the largest yield for any of its 21 years of continuous operation, according to the annual report of the Bunker Hill & Sullivan Mining & Concentrating Co. During the year the Sullivan Mining Co. completed 150 additional electrolytic cells and other necessary facilities for increasing the capacity of its zinc plant from 100 to 150 tons of slab zinc a day. The Bradley Mining Co. operated its 2,000-ton flotation mill at Stibnite, Valley County, continuously on gold-silver-antimony ore from the Yellow Pine mine and proceeded during the year to construct a smelter at Stibnite for reduction of the antimony and gold concentrates.

Mine production of metals in Idaho in 1948, 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	13,719	1,608	923			
Concentrates smelted	313,663	34,863	11,254,623	3,032,365	169,744,626	162,562,361
Ore smelted	78,663	1,207	187,410	215,635	7,343,374	9,971,639
Placer		20,776	5,919			
Total: 1948		58,454	11,448,875	3,248,000	177,088,000	172,534,000
1947		64,982	10,345,779	3,280,000	157,888,000	166,138,000

Gross metal content of Idaho ore treated at mills in 1948, by classes of ore

Class of ore	Ore (short tons)	Gross metal content of mill feed				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	672,404	53,576	331,947		2,300	
Dry and siliceous gold-silver	6	4	100			
Dry and siliceous silver	149,585	255	5,840,246	1,704,250	7,833,000	850,000
Copper	352	7	20	12,500		
Lead	236,470	560	873,230	174,526	22,208,902	3,665,649
Zinc	30,832	31	14,969	17,000	812,945	5,507,797
Zinc-lead	2,813,534	8,093	5,245,009	2,487,225	170,385,870	189,480,571
Total: 1948	3,903,183	62,526	12,305,521	4,395,501	201,243,017	199,504,017
1947	3,621,791	62,128	11,267,241	4,243,845	182,449,075	186,179,062

Gross metal content of concentrates produced from ores mined in Idaho in 1948, 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	21,243	29,494	246,869		2,099	30
Dry gold-silver	1	2	76			
Dry silver	1	1	79			
Copper	728	60	348,907	222,728	6,694	5,153
Lead	115,027	2,230	4,582,473	1,194,365	146,998,412	16,501,831
Lead-copper	13,667	116	5,373,193	1,317,084	7,528,193	580,521
Zinc	148,817	1,347	526,474	584,844	9,642,515	152,076,824
Zinc-lead	11,098	324	162,629	88,832	8,589,953	2,840,254
Dry iron (from zinc-lead ore)	3,081	1,289	13,923	16,098	129,742	120,499
Total: 1948	313,663	34,863	11,254,623	3,423,951	172,897,608	172,125,112
1947	290,878	41,039	10,127,129	3,335,053	152,949,027	162,203,757

Mine production of metals from mills in Idaho in 1948, by counties and by classes of concentrates smelted, in terms of recovered metals

	Material treated (short tons)	Recovered in bullion: Gold (fine ounces)	Recovered in bullion: Silver (fine ounces)	Concentrates smelted and recovered metal: Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES									
Blaine	37,029			8,230	2,112	269,655	221,762	2,650,777	3,131,417
Boise	121	127	56						
Bonner	21,355			837	7	39,480	2,298	1,027,600	63,890
Boundary	28,997			410	7	9,126	6,000	462,000	43,000
Butte	781			204	2	808	630	215,804	17,608
Camas	196			77	128	699	631	21,029	2,506
Clearwater	6	9							
Custer	31,829	39	27	3,126	102	115,158	20,823	2,103,977	1,057,540
Elmore	10,370	991	677	258	1,572	10,550			
Gem	25			14	8	452	68	7,800	3,700
Idaho	564	337	93	2	4	82			
Lemhi	3,364	2		53	765	298	10,700	1,400	
Owyhee	4	10	9	1	2	76			
Shoshone	3,110,360			279,493	2,996	10,572,208	2,769,453	163,254,239	158,242,700
Valley	658,182	93	61	20,958	27,158	236,031			
Total: 1948	3,903,183	1,608	923	313,663	34,863	11,254,623	3,032,365	169,744,626	162,562,361
1947	3,621,791	3,235	1,912	290,878	41,039	10,127,129	2,976,621	150,142,254	153,793,944
BY CLASSES OF CONCENTRATES SMELTED									
Dry gold				21,243	29,494	246,869		1,400	
Dry gold-silver				1	2	76			
Dry silver				1	1	79			
Copper				728	60	348,907	207,990	6,500	
Lead				115,027	2,230	4,582,473	1,015,297	144,559,558	13,028,315
Lead-copper				13,667	116	5,373,193	1,173,581	7,401,380	458,617
Zinc				148,817	1,347	526,474	545,055	9,236,668	146,808,468
Zinc-lead				11,098	324	162,629	75,556	8,443,047	2,262,882
Dry iron (from zinc-lead ore)				3,081	1,289	13,923	14,886	96,073	4,079
Total 1948				313,663	34,863	11,254,623	3,032,365	169,744,626	162,562,361

Gross metal content of Idaho crude ore shipped to smelters in 1948, 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	277	803	2,431	690	4,285	1,342
Dry and siliceous silver	106	14	4,779	746	4,319	2,697
Copper	1,031	34	2,451	164,389	1,052	
Lead	17,178	335	147,454	65,719	4,956,472	410,205
Lead-copper	5		21	364	1,026	100
Zinc	[1] 48,842	6	16,429	2,460	1,756,543	12,556,907
Zinc-lead	11,224	20	14,034	8,610	927,254	527,597
Total: 1948	[1] 78,663	1,212	187,599	242,978	7,650,951	13,498,848
1947	[2] 95,906	932	212,[illegible]33	326,601	8,121,341	16,335,969

[1] Includes 48,131 tons of old lead-smelter slag smelted and fumed.
[2] Includes 65,409 tons of old lead-smelter slag smelted and fumed.

Mine production of metals from Idaho crude ore shipped to smelters in 1948, in terms of recovered metals

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES						
Adams	13	2	95	6,400	----	----
Blaine	550	20	5,565	2,638	95,623	7,183
Boise	30	567	2,113	----	1,800	----
Bonner	224	5	4,554	1,102	159,700	4,110
Boundary	278	3	5,914	1,600	283,400	8,000
Butte	150	----	582	270	37,196	5,792
Camas	113	58	501	269	13,971	194
Cassia	1	----	----	----	100	----
Clark	37	----	21	10,300	----	----
Custer	15,713	226	121,194	73,277	3,664,023	302,060
Elmore	7	15	11	----	----	----
Gem	32	26	74	132	----	----
Idaho	30	26	35	----	----	----
Lemhi	5,983	157	17,385	111,100	1,166,600	286,000
Owyhee	32	9	653	----	----	----
Shoshone	[1] 55,420	70	26,067	5,547	1,919,761	9,358,300
Valley	10	23	1,182	----	600	----
Washington	40	----	1,464	3,000	600	----
Total: 1948	[1] 78,663	1,207	187,410	215,635	7,343,374	9,971,639
1947	[2] 95,906	932	212,633	303,379	7,745,746	12,344,056
BY CLASSES OF ORE						
Dry and siliceous gold ore	277	803	2,431	594	3,304	172
Dry and siliceous silver ore	106	14	4,779	642	4,020	438
Copper ore	1,031	34	2,451	159,974	600	----
Lead ore	17,178	335	147,454	47,036	4,739,450	23,887
Lead-copper ore	5	----	21	300	1,000	----
Zinc ore	[1] 48,842	1	16,240	----	1,684,800	9,569,062
Zinc-lead ore	11,224	20	14,034	7,089	910,200	378,080
Total 1948	[1] 78,663	1,207	187,410	215,635	7,343,374	9,971,639

[1] Includes 48,131 tons of old lead-smelter slag smelted and fumed.
[2] Includes 65,409 tons of old lead-smelter slag smelted and fumed

REVIEW BY COUNTIES AND DISTRICTS

ADAMS COUNTY

About 13 tons of carbonate copper ore were produced in 1948 from the Helena claim north of Cuprum in the Seven Devils district.

BLAINE COUNTY

Little Wood River (Muldoon) District.—The Garfield Silver-Lead Mines, Inc., worked the Eagle Bird mine most of the year and shipped 411 tons of zinc-lead ore and 302 tons of lead-silver ore to reduction plants in Utah. Lead-silver ore (64 tons) was also shipped from the Idaho-Muldoon property 7 miles northeast of Muldoon.

Mineral Hill and Camas District.—Lessees worked the Snoose mine near Hailey in 1948 and shipped 137 tons of zinc-lead ore and 36 tons of lead-silver ore to reduction plants in Utah. The rest of the district output was 88 tons of lead-silver ore from the Apache, Croesus, Edres, Fourth of July, Memorial, and Ohio properties, and 25 tons of gold ore from the Bellevue mine.

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1948, 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				
Ada County:													
Highland		1			3	3							$105
Snake River		1			1	1							35
Adams County: Seven Devils	1		13	2		2	95		95	6,400			1,545
Blaine County:													
Lava Creek	1		5				21		21	300	1,000		263
Little Wood River (Muldoon)	2		777	4		4	7,340		7,340	3,200	115,400	43,400	33,906
Mineral Hill and Camas	8		286	19		19	1,633		1,633	800	22,600	5,600	7,107
Warm Springs	7		36,511	2,109		2,109	266,226		266,226	220,100	2,607,400	3,089,600	1,240,167
Boise County:													
Boise Basin	2	11	58	574	11,158	11,732	1,938	2,528	4,466		1,700		414,966
Boise River		1			1	1							35
Garden Valley		1			1	1							35
Grimes Pass		1			1	1							35
North Fork	1		2				178		178		100		179
Summit Flat	2		91	120		120	53		53				4,248
Bonner County:													
Clark Fork	3		20,339	3		3	32,933		32,933	1,900	1,162,300	56,400	245,876
Lakeview	1		1,200	5		5	9,384		9,384	800	21,400	9,600	13,950
Pend d'Oreille	4		40	4		4	1,717		1,717	700	3,600	2,000	2,756
Bonneville County: Mount Pisgah		1			22	22							770
Boundary County: Port Hill	1		29,275	10		10	15,040		15,040	7,600	745,400	51,000	155,821
Butte County:													
Dome	4		840	2		2	1,011		1,011	900	235,800	22,600	46,394
Hamilton	4		71				221		221		13,800		2,670
Lava Creek	1		20				158		158		3,400	800	858
Comas County:													
Beaver Creek	1		296	186		186	1,053		1,053	900	33,400	2,000	13,903
Little Smoky	4	1	13		1	1	147		147		1,600	700	547
Cassia County: Stokes	1		1								100		18
Clark County: Birch Creek	2		37				21		21	10,300			2,254
Clearwater County:													
Moose and Independence Creek		1			302	302		43	43				10,609
Pierce	1	2	6	9	18	27							945
Custer County:													
Alder Creek	4		6,474	95		95	49,258		49,258	60,400	1,552,400	270,000	374,803
Alta	2		46				495		495		3,000	3,700	1,477
Bayhorse	12		38,159	112		112	166,246		166,246	28,800	3,760,000	760,600	934,831
Boulder	1		2,172	24		24	12,333		12,333	2,900	363,000	206,600	105,086
East Fork	1		7				137		137		5,000		1,019
Seafoam	4		524	79		79	6,920		6,920	2,000	84,600	118,700	40,392
Yankee Fork	5	3	160	57	3,664	3,721	990	2,328	3,318				133,238

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Elmore County:													
Bear Creek	2		7	15		15	11		11				535
Middle Boise	1	1	10,370	2,563	15	2,578	11,227		11,227				100,391
School House Gulch		1			27	27		10	10				954
Gem County: West View	2		57	34		34	526		526	200	7,800	3,700	3,597
Idaho County:													
Burgdorf-Marshall Lake	2	3	13	5	166	171		31	31				6,013
Camp Howard		2			11	11							385
Dewey-Harpster	1		21	6		6	10		10				219
Dixie	1		135	233		233	64		64				8,213
Elk City	1	4	10	2	4,254	4,256		738	738				149,628
Florence and French Creek		1			1	1							35
Lower Salmon River		1			2	2							70
Orogrande	1	1	4	14	2	16	10		10				569
Robbins	1		4	4		4	11		11				150
Salmon River		1			8	8							280
Simpson		5			7	7							245
Ten Mile	2	1	400	98	617	715	31	126	157				25,167
Warren	2	4	7	5	20	25	84	21	105				970
Jerome County: Snake River		5			14	14							490
Lemhi County:													
Birch Creek	1		50				115		115	400	14,400		2,769
Blackbird	2		381	4		4	53		53	15,300			3,508
Boyle Creek	1		3	2		2							70
Eureka	2	1	482	18	1	19	263		263	97,000	200		21,988
Gibbonsville		1			104	104		10	10				3,649
Junction	4		242	1		1	1,685		1,685	1,200	59,600		12,488
Mackinaw		4			14	14							490
Mineral Hill	2	1	3,001	760	1	761	285		285	100	1,200		27,130
Nicholia	5		4,044	11		11	4,613		4,613	1,600	714,700	284,400	170,663
Spring Mountain	1		84				148		148		9,300		1,799
Texas	7		1,054	127		127	10,385		10,385	6,100	364,000	1,600	80,537
Yellow Jacket	1	1	6	1	7	8	136		136	100	4,600		1,248
Nez Perce County: Snake River		2			13	13							455
Owyhee County: Carson or French	2	3	36	21	10	31	738	21	759				1,772
Shoshone County:													
Beaver	6	2	144,145	154	257	411	96,282	53	96,335	83,300	4,668,400	10,963,200	2,413,399
Coeur d'Alene		1			1	1							35
Eagle		1			4	4							140
Evolution	21		1,082,457	433		433	6,423,741		6,423,741	1,667,000	19,095,000	12,475,400	11,267,937
Hunter	7		367,452	317		317	520,066		520,066	173,000	25,668,000	44,768,600	11,068,118
LeLande	7		213,381	300		300	449,870		449,870	105,000	15,374,200	12,526,100	4,858,393
Placer Center	5		185,520	231		231	231,407		231,407	62,000	9,882,600	9,208,000	3,224,623
Saint Joe	1	2	7		5	5	11		11		800	900	448
Summit	5	1	1,728	77	29	106	1,664	10	1,674	2,300	117,000	90,800	38,743
Yreka	13		1,171,090	1,554		1,554	2,875,234		2,875,234	682,400	90,368,000	77,568,000	29,297,119
Twin Falls County: Snake River		2			4	4							140

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1948, by counties and districts, in terms of recovered metals—Continued

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				
Valley County:													
Hurdy Creek	1		1				10		10				$9
South Fork of Salmon River		1			3	3							105
Thunder Mountain	1	1	2, 501	116	7	123	74		74				4, 372
Unorganized (Knox)	1		8				1, 159		1, 159		600		1, 156
Yellow Pine	1		655, 682	27, 158		27, 158	236, 031		236, 031				1, 164, 150
Washington County: Washington	1		40				1, 464		1, 464	3, 000	600		2, 083
Total Idaho	194	78	3, 981, 846	37, 678	20, 776	58, 454	11, 442, 956	5, 919	11, 448, 875	3, 248, 000	177, 088, 000	172, 534, 000	67, 758, 290

Warm Springs District.—Despite a substantial decline in output of zinc-lead-silver ore from the Triumph Mining Co. property at Triumph in 1948, the company remained the most important producer of gold, silver, copper, lead, and zinc in southern Idaho. The company reported that 35,552 tons of ore (52,169 tons in 1947), containing 3,645 ounces of gold, 320,633 ounces of silver, 296,396 pounds of copper, 2,947,888 pounds of lead, and 3,982,649 pounds of zinc, were shipped to milling plants in Utah. In addition, lessees shipped 744 tons of zinc-lead ore from the Triumph mine dumps. The rest of the district output comprised 124 tons of zinc-lead ore and 34 tons of zinc ore from the Lucky Boy mine, 51 tons of zinc-lead-silver ore from the Blue Kitten and Homestake mines, and 6 tons of lead-silver ore from the New Hope, Duquette, and Blue Kitten properties.

BOISE COUNTY

Boise Basin District (Centerville, Placerville, Idaho City, Pioneerville, Quartzburg).—Increased activity in 1948 at both lode and placer properties in the Boise Basin district pushed the output of gold to 11,732 ounces and silver to 4,466 ounces. The most important output was 11,109 fine ounces of gold and 2,514 fine ounces of silver recovered by two bucket-line dredges; the Idaho-Canadian Dredging Co. operated its 6-cubic-foot bucket dredge all year on Moores Creek near Idaho City, treating 1,800,000 cubic yards of gravel, and Baumhoff-Marshall, Inc., operated its 6-cubic-foot bucket dredge the first 7 months of the year on Granite Creek near Centerville, treating about 550,000 cubic yards of gravel. Ground sluicing recovered 32 fine ounces of gold and 10 fine ounces of silver from the Elliott, Fountain Spring, Gold Hill, Ophir Creek, and Taku properties. The lode output was mainly 28 tons of high-grade gold ore produced from the Come-Back mine near Pioneerville by the American Mining & Refining Corp.

Summit Flat District.—Gold ore (91 tons) was produced in 1948 from the Jessie and Rock Creek mines and treated in amalgamation mills.

BONNER COUNTY

Clark Fork District.—The Hope Silver-Lead Mines, Inc., operated its mine and 150-ton flotation mill throughout the year. The company reported that 18,665 tons of ore were treated containing 27,000 ounces of silver, 1,500 pounds of copper, 1,045,500 pounds of lead, and 85,000 pounds of zinc. Leasing operations at the Whitedelf mine produced 1,524 tons of lead ore; most of it (1,490 tons) was treated in a 50-ton flotation mill. Lessees also worked the Lawrence mine and shipped 150 tons of lead-silver ore to a smelter.

Lakeview District.—About 1,200 tons of silver ore, containing a little copper, lead, and zinc, were produced in 1948 from the Idaho-Lakeview mine and treated by flotation.

Pend d'Oreille District.—Output in 1948 was 24 tons of silver ore produced from the Katherine and Peak claims, 9 tons of zinc-lead ore from the Gold Coin claim, and 7 tons of lead ore from the Silver Fox claim.

BOUNDARY COUNTY

The Continental Mining Co. operated its 500-ton heavy-medium separation plant and 100-ton flotation mill 5 months of the year on crude lead ore and old jig tailings from the Idaho-Continental property 27 miles west of Porthill. The company reported that 28,667 tons of old tailings and 330 tons of crude ore were treated containing 12,000 ounces of silver, 9,000 pounds of copper, 600,000 pounds of lead, and 90,000 pounds of zinc. In addition, 278 tons of lead-silver ore were shipped direct to a lead smelter.

BUTTE COUNTY

Dome District.—Leasing operations at the Wilbert mine near Howe produced 773 tons of ore containing 3 ounces of gold, 776 ounces of silver, 876 pounds of copper, 243,886 pounds of lead, and 21,762 pounds of zinc. The rest of the district output was virtually all zinc-lead ore (35 tons) from the Sentinel mine and lead ore (31 tons) from the Great Western mine.

Hamilton District.—Lead ore (71 tons) was produced in 1948 from the Badger, Big Horn, Cliff Ridge, and Whitebird properties north of Howe.

CAMAS COUNTY

Beaver Creek District.—J. R. Davies & Sons operated the Princess-Blue Ribbon mine near Fairfield most of the year, treated 191 tons of zinc-lead-gold ore in a gravity concentration mill, and shipped 105 tons of gold-lead ore to smelters in Utah.

CLARK COUNTY

In 1948 the Valley View and Pocahontas properties in the Birch Creek district produced 37 tons of copper ore.

CLEARWATER COUNTY

The principal output in Clearwater County in 1948 was placer gold recovered by dragline dredging on Moose and Independence Creeks by Painter & Vincent; 150,000 cubic yards of gravel were treated, which yielded 302 fine ounces of gold and 43 fine ounces of silver. However, operations ceased August 31.

CUSTER COUNTY

Alder Creek District.—In 1948 four mines in the Alder Creek district produced 6,474 tons of ore, which contained 100 ounces of gold, 49,447 ounces of silver, 75,493 pounds of copper, 1,634,683 pounds of lead, and 556,162 pounds of zinc. The principal output was 5,082 tons of lead-silver ore and 711 tons of zinc ore from the Homestake mine near Mackay operated by the White Knob Mining Co. The rest of the district output was 431 tons of copper ore from the Empire mine and 250 tons of lead-silver ore from the Champion and Horseshoe properties.

Alta District.—Zinc-lead-silver ore (46 tons) was produced in 1948 from the Alta Silver and Phi Kappa claims north of Hailey.

Bayhorse District.—The output of the Bayhorse district in 1948 was 38,159 tons of ore containing 132 ounces of gold, 179,785 ounces of silver, 40,641 pounds of copper, 4,027,965 pounds of lead, and 1,097,906 pounds of zinc. Zinc-lead ore from the Clayton mine, owned by the Clayton Silver Mines, continued to be the most important production in the district. The company reported that 29,077 tons of ore were treated in 1948 in its 120-ton flotation mill, which yielded 1,306 tons of lead concentrate and 892 tons of zinc concentrate. The concentrates contained 40 ounces of gold, 96,461 ounces of silver, 18,524 pounds of copper, 1,751,723 pounds of lead, and 848,273 pounds of zinc. According to the annual stockholders' report of the company for 1948, all known ore above the 300-foot level had been broken at the end of the year. By the time this ore is depleted, shaft sinking to the 400-foot level will be under way. It is expected that a large tonnage of new ore in the south end will be developed through the deeper shaft.

The remainder of the district output comprised 7,213 tons of lead ore from the Red Bird mine and waste dumps, 1,439 tons of lead-silver ore from the Beardsley, Clayton View, Ellis, McGregor, Red Top, Rob Roy, and South Butte properties, 356 tons of zinc-lead ore from the Saturday and Silver Rule groups, and 74 tons of high-grade lead-copper-silver ore from the Ramshorn mine.

Boulder District.—The Livingston Mines, Inc., operated its mine throughout the year and shipped 2,172 tons of ore containing 29 ounces of gold, 13,949 ounces of silver, 4,400 pounds of copper, 404,837 pounds of lead, and 264,751 pounds of zinc to reduction plants in Utah. Toward the end of the year, the company purchased a 100-ton flotation mill, which will be operated in 1949.

Seafoam (Greyhound) District.—Lessees operated the Mountain King mine 4 months in 1948 and shipped 467 tons of ore containing 58 ounces of gold, 6,734 ounces of silver, 2,426 pounds of copper, 91,594 pounds of lead, and 136,241 pounds of zinc. The rest of the district output comprised 32 tons of gold ore from the Parkin group, 24 tons of zinc-lead-silver ore from the Hopeful claim, and 1 ton of lead ore from the Hard Scrabble claim.

Yankee Fork District.—Placer gold and silver continued to be the most important output in the Yankee Fork district. Jordan Placers, Inc., operated its dragline on Jordan Creek 5 months and treated 200,000 cubic yards of gravel, which yielded 3,603 fine ounces of gold and 2,285 fine ounces of silver. The 8-cubic-foot bucket dredge of the Snake River Mining Co., a large producer of gold in 1947, was idle in 1948. The remainder of the district output in 1948 was mainly placer gold recovered by sluicing at the Horse Trail claim, lode gold recovered by amalgamation from Lucky Boy dump ore, and silver recovered by smelting ore from the Mulcahy claim.

ELMORE COUNTY

As a result of a marked decline in the output of gold ore in 1948 from the Boise-Rochester-Monarch group in the Middle Boise (Atlanta) district, the production of gold and silver in Elmore County was much less than that in 1947. The Talache Mines, Inc., operator of the group, reported that 10,370 tons of gold ore were treated in its 400-ton amalgamation and concentration mill in 1948 compared with 27,539 tons in 1947; recovered gold dropped to 2,563 fine ounces and silver to 11,227 fine ounces. The remainder of the county output was largely 42 fine ounces of placer gold recovered from claims along the Boise River and School House Gulch.

GEM COUNTY

Two mines in the West View (Pearl) district produced 57 tons of ore in 1948; 32 tons of gold ore were produced from the Black Pearl mine and 25 tons of zinc-lead ore from the Checkmate-Hecla group.

IDAHO COUNTY

Burgdorf-Marshall Lake District.—Hydraulicking and sluicing at the Golden Rule and Laughing Water properties recovered 165 fine ounces of gold and 31 fine ounces of silver. The rest of the district output was principally small lots of gold ore produced from the Golden Queen and Treasure Knob claims.

Dixie District.—George Grebe continued to work the Mammoth mine and recovered 233 fine ounces of gold and 64 fine ounces of silver from treating 135 tons of ore in a 15-ton amalgamation mill.

Elk City District.—In 1948 two dragline and two bucket-line dredges recovered 4,254 fine ounces of gold and 738 fine ounces of silver. The principal producers were the Warren Dredging Corp., which operated a 4-cubic-foot bucket-line dredge on American River from July 6 to November 3, and the H. & H. Mines, which operated a 2-cubic-foot bucket-line dredge on Red Horse Creek from January 1 to December 9. The two bucket dredges recovered 3,752 fine ounces of gold and 650 fine ounces of silver from treating 779,168 cubic yards of gravel. Draglines were operated on American River by the Tyee Mining Co., and on Deadwood Gulch by the Hawk Placer. The two dredges recovered 502 fine ounces of gold and 88 fine ounces of silver from treating 207,000 cubic yards of gravel.

Ten Mile District.—The South Fork Placers operated a dragline and floating washing plant on the South Fork of the Clearwater River from June to November; the plant treated 200,000 cubic yards of gravel, which yielded 617 fine ounces of gold and 126 fine ounces of silver. The rest of the district output was 98 ounces of gold and 31 ounces of silver recovered from treating 400 tons of gold ore from the Bob and Lone Pine mines near Golden.

LEMHI COUNTY

Birch Creek District.—Frank G. Worthing worked his Cabin claim and shipped 50 tons of lead-silver ore to a smelter in Utah.

Blackbird District.—The Blackbird mine on Meadow Creek was operated continuously by the Calera Mining Co., a wholly owned subsidiary of the Howe Sound Co. The company reported that 352 tons of copper-cobalt ore were treated in 1948 in a 25-ton pilot flotation mill for testing purposes. The rest of the district output was 29 tons of copper ore produced from the Victory group.

Eureka District.—The principal output of the Eureka district in 1948 was 473 tons of copper ore produced from the old Pope Shenon mine near Salmon.

Gibbonsville District.—The output of gold in the Gibbonsville district dropped from 3,441 ounces in 1947 to 104 ounces in 1948, owing to suspension early in 1948 of all dredging operations. The Idaho-Warren Dredging Co., a large producer of gold in 1947, ceased operating its 4-cubic-foot bucket dredge on Hughes Creek, February 5, 1948, and Smith Bros. & Courtis, Inc., also a large producer of gold from dredging operations in 1947, was idle throughout 1948. During the spring the 4-cubic-foot bucket dredge on Hughes Creek was dismantled by the Warren Dredging Corp. and moved to approperty near Elk City in Idaho County.

Junction District.—Lessees worked the Plymouth group near Leadore and shipped 175 tons of lead ore to a smelter in Utah. Lead ore (61 tons) was produced also from the Blue Lead and Galena claims and copper ore (6 tons) from the Blue Jay claim.

Mineral Hill District.—Gregor Mines, Inc., operated its Monolith mine and 50-ton concentration mill near Shoup during the summer months and shipped 23 tons of concentrate containing 760 ounces of gold, 284 ounces of silver, and 1,876 pounds of lead.

Nicholia District.—The output of the Nicholia district in 1948 was 2,273 tons of old smelter slag and 1,771 tons of ore. All the smelter slag, containing 1,303 ounces of silver, 386,210 pounds of lead, and 165,472 pounds of zinc, came from the dump at Nicholia, and 1,753 tons of zinc-lead ore came from the Clear Grit, Good Luck, Nicholia, and Viola properties. The Viola mine also produced 18 tons of lead ore.

Spring Mountain District.—Three cars (84 tons) of oxide lead ore were shipped in 1948 from the Lemhi Union mine south of Gilmore.

Texas District.—Oxide lead-silver ore (589 tons) was produced in 1948 from the Alex Stevens mine near Gilmore, and similar ore (430 tons) was produced also from the Green Meadow, Lady Franklin, Latest Out, Mountain Boy, and Valley View properties.

OWYHEE COUNTY

The output in Owyhee County in 1948 comprised 29 tons of silver ore from the Hope claim, 7 tons of rich gold ore from the Perseverance claim, and 10 ounces of placer gold and 21 ounces of placer silver from the Blue Gulch, Jordan Creek, and Orofino properties—all in the Carson (Silver City) district.

SHOSHONE COUNTY—COEUR D'ALENE REGION

Although the output of each metal, except zinc, in the Coeur d'Alene region (Shoshone County)—the chief source of silver, copper, lead, and zinc in Idaho—was greater in 1948 than in any year since 1943, most of the large producers reported that production was retarded, owing to a shortage of underground miners and to high labor turn-over. However, during the last quarter of the year, more labor became available, and prices of lead and zinc advanced, resulting in capacity production by some of the principal producers. In 1948 the output of gold increased 20 percent over 1947, silver 15, copper 6, lead 13, and zinc 6. The value of the metal output of the region was $62,168,955 (92 percent of the State value), the highest ever recorded for any year and a 26-percent gain over 1947. The region remained the largest silver-producing area in the United States and ranked second in lead and zinc; it produced more than 92 percent of Idaho's silver, 85 percent of the copper, 93 percent of the lead, and 97 percent of the zinc. The chief producers of zinc in the region in 1948, according to rank, were the Star, Page, Sidney, Bunker Hill & Sullivan, Bunker Hill smelter-slag dump, Frisco, Highland-Surprise, Osburn tailing dump, and Morning properties. The chief producers of lead, according to rank, were the Bunker Hill & Sullivan, Page, Star, Sherman, Sidney, Morning, and Osburn tailing properties. The chief producers of silver, according to rank, were the Sunshine, Bunker Hill & Sullivan, Polaris, Silver Dollar, and Page properties.

Of the total material (3,165,780 tons—a record output) produced in 1948 in the Coeur d'Alene region, 87 percent was zinc-lead ore and old tailings, 6 percent silver-lead ore, 5 percent silver ore, and 2 percent zinc ore and slag. Thirty-one mills, with an aggregate capacity of 13,700 tons of ore a day, operated in the region in 1948.

Mine production of gold, silver, copper, lead, and zinc in the Coeur d'Alene region, Shoshone County, 1947–48, and total 1884–1948, 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							
1947	61	4	2,957,143	2,808	9,234,906	2,624,000	146,120,000	158,502,000	$49,226,932
1948	65	7	3,165,780	3,362	10,598,338	2,775,000	165,174,000	167,601,000	62,168,955
Total 1884–1948			(1)	399,236	452,120,668	(2) 68,064	(2) 5,687,714	(2) 1,359,918	1,234,321,269

(1) Figures not available.
(2) Short tons.

Beaver District.—The output of the Beaver district in 1948 was 144,145 tons of ore containing 254 ounces of gold, 121,704 ounces of silver, 124,300 pounds of copper, 5,638,582 pounds of lead, and 12,920,584 pounds of zinc. In addition, 257 fine ounces of placer gold and 53 fine ounces of silver were recovered mainly by a dragline and dry-land washing plant at the Potosi property. The principal output was 92,989 tons of ore—containing an average of 0.71 ounce of silver to the ton, 1.74 percent lead, and 4.81 percent zinc—produced from the Amazon-Carlisle groups by Day Mines, Inc.; the ore was treated in the Carlisle 500-ton flotation mill. Lessees worked the Parrott and Silver Tip mines, owned by Day Mines, Inc., and hauled 3,834 tons of zinc-lead ore to the Hercules custom flotation mill near Wallace. According to the annual stockholders' report of Day Mines, Inc., for 1948, production increased over 1947 because more underground workers were available, and exploration and development continued at a high rate. However, that portion of the Carlisle mine below the 2,800 main haulage level yielded only low-grade ore, and its operation was terminated at the end of the year. The Sunset Lease operated the Sunset mine throughout the year and hauled 25,611 tons of ore—averaging 1.25 ounces of silver to the ton, 2.93 percent lead, and 5.63 percent zinc—to the Golconda custom flotation mill near Wallace. Late in the year a majority interest in the Sunset Lease was acquired by Day Mines, Inc. Zanetti Bros. worked the Interstate and Callahan mine dumps and hauled 21,634 tons of low-grade zinc-lead-silver ore to the Rex flotation mill.

Evolution District.—The output of the Evolution district in 1948 comprised 919,268 tons of zinc-lead old tailings, 143,715 tons of silver-lead ore, 10,171 tons of silver ore, 5,257 tons of silver-copper-antimony ore, 3,886 tons of lead ore, and 160 tons of zinc-lead ore. Most (719,068 tons) of the old tailings came from the Osburn dump, operated by the Hecla Mining Co. and Zanetti Bros.; all the silver-lead ore and 4,624 tons of silver ore from the Chester vein, Silver Syndicate fault zone, Yankee Girl vein, and Sunshine vein, operated by the Sunshine Mining Co.; all the silver-copper-antimony ore from the Mineral Point mine, operated by the Coeur d'Alene Mines Corp., and virtually all the lead ore from the Western Union mine. The Chester vein and Silver Syndicate fault zone (known as Rambo, Omega, and Rotbart areas) include property owned by the Sunshine Mining Co., Polaris Mining Co., Silver Dollar Mining Co., and Silver Syndicate, Inc., and the Yankee Girl vein includes property owned by the Sunshine Mining Co., Sunshine Consolidated Mining Co., and the Metropolitan Mines Corp.; 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 1948 was 148,339 tons (84,588 tons for Sunshine account and 63,751 tons for account of Polaris, Silver Dollar, Silver Syndicate, Sunshine Consolidated, and Metropolitan) compared with 114,878 tons in 1947; the ore averaged 39.13 ounces of silver to the ton, 3.06 percent lead, and a little copper and zinc. The tailings averaged 0.64 ounce of silver to the ton and 0.08 percent lead; lead recovery was 97.9 percent and silver 98.6 percent. Lead-silver concentrates (16,297 tons) contained 5,725,545 ounces of silver, 1,418,036 pounds of copper, 8,892,447 pounds of lead, and 631,867 pounds of zinc, of which the net for Sunshine account was 2,818,348 ounces of silver, 748,208 pounds of copper, and 3,690,321 pounds of lead. The average operating costs for the year per ton were $11.32 for mining, $1.00 for ore treatment, $0.17 for depreciation, and $4.06 for general expense—a total of $16.55 compared with $14.74 in 1947. According to the annual report of the Sunshine Mining Co., a seasonal reduction in underground man-shifts during the spring, summer, and early fall, caused by a flow of workers to other employment, held down production in 1948, with a corresponding decrease in expected earnings. A return of workers during the late fall raised the number of employees to the extent that at the end of the year it was the largest since March 1943. Development in 1948 comprised 2,905 feet of drifting, 903 feet of raising, and 2,744 feet of crosscutting. Work in general was directed toward further development of three important geological subdivisions of the Sunshine mine—the Silver Syndicate fault zone north of the Jewell shaft, the south side of the mine including the Yankee Girl vein, and the eastern extensions at depth of the Sunshine-Polaris vein system. Developed ore reserves are estimated at 1,147,000 tons above the 3,700-foot level. This estimate includes the total estimated reserves in areas in which other companies share the production.

The Hecla Mining Co. operated its Osburn tailing plant (2,500-ton sink-and-float plant and 500-ton flotation mill) continuously until December 26, when it was destroyed by fire. The company reported that there was not enough tailings left in the deposit to justify rebuilding. During the year the plant treated 596,068 tons of old tailings, containing an average of 0.66 ounce of silver to the ton, 0.88 percent lead, 0.78 percent zinc, and a little copper. Zanetti Bros. worked another part of the Osburn tailing deposit and hauled 123,000 tons of zinc-lead old tailings to the Polaris and Galena (Zanetti) flotation mills. Zanetti Bros. also worked the DeBlock tailing deposit at the mouth of Lake Gulch and hauled about 60,000 tons of zinc-lead old tailings to the Galena mill. About 63,000 tons of similar tailings from the Burlett-Heller property were treated in the Mineral Point flotation mill near Osburn by the Shoshone Leasing Co. The Federal Mining & Smelting Co. worked a tailing deposit along Big Creek and hauled 37,290 tons of material, containing 36,000 ounces of silver, 870,000 pounds of lead, and 970,000 pounds of zinc, to the Polaris mill at Osburn. Several thousand tons of zinc-lead old tailings were treated also from the Cove, Winter, Inland Power, and Pastore properties.

Development and exploration at the Silver Summit mine of the Silver Summit Mining Co. were done in 1948 by the Polaris Mining Co. on a cooperative basis between the two companies. During the year 5,547 tons of silver ore were produced from the mine and treated in the Hecla mill, which yielded 201 tons of concentrate containing 51 ounces of gold, 156,290 ounces of silver, 81,557 pounds of copper, and 5,153 pounds of zinc.

The Coeur d'Alene Mines Corp. worked its Mineral Point mine near Osburn throughout the year, but the company 600-ton flotation mill treated only 5,257 tons of silver-copper-antimony ore, which yielded 140 tons of concentrate containing 2 ounces of gold, 48,330 ounces of silver, 80,443 pounds of copper, and 49,467 pounds of antimony. According to the corporation annual report, operations in 1948 resulted in a loss of $22,371. During the first part of the year 3,702 tons of ore were mined from stopes on the 2,000- and 2,200-foot levels, but no stoping was done after April 30, and during the remainder of the year the work done was confined to development, exploration, and maintenance. The rest of the district output was principally 3,880 tons of lead ore from the Western Union mine dump treated in the Silver Crescent flotation mill.

Hunter District (Mullan).—The output of the Hunter district in 1948 was 325,830 tons of zinc-lead ore, 36,716 tons of lead ore, and 4,906 tons of old zinc-lead tailings. The Star mine of the Sullivan Mining Co. continued to be the principal producer, and in 1948 it remained the largest producer of zinc in Idaho and ranked third in lead. The company operated the mine and its 1,000-ton flotation mill continuously during the year; the mill treated 237,098 tons of zinc-lead ore, yielding 9,514 tons of lead concentrate and 36,388 tons of zinc concentrate, which together contained 221 ounces of gold, 229,612 ounces of silver, 117,000 pounds of copper, 16,023,575 pounds of lead, and 37,829,285 pounds of zinc.

The Morning mine of the Federal Mining & Smelting Co. was operated continuously, but operations were still handicapped by a shortage of labor. The company reported that 71,261 tons of mine ore and 5,774 tons of waste-dump ore were treated in its 1,250-ton flotation mill at Mullan; the mine ore contained an average of 1.8 ounces of silver to the ton, 5.9 percent lead, and 6.3 percent zinc. According to the annual stockholders' report of the company for 1948, the Morning mine operated at a loss of $124,583 during the first 9 months of the year, but at a profit of $68,255 during the last 3 months of the year, when more labor became available and prices of lead and zinc advanced. Development and exploration in 1948 proved disappointing; when known ore reserves above the 4,850-foot level are exhausted, operation of the Morning mine probably will be limited to ore that may be mined below the 4,850 level. Ore reserves at the end of the year—above the 4,850 level—were estimated at 305,444 tons.

Gold Hunter Mines, Inc., worked the Gold Hunter mine and its 500-ton flotation mill throughout 1948. The company reported that 38,097 tons of mine ore and 3,980 tons of waste-dump ore were treated in the mill in 1948; the content averaged 1.83 ounces of silver to the ton, 1.95 percent lead, and 0.35 percent zinc.

Development at the Lucky Friday mine near Mullan produced 8,146 tons of zinc-lead-silver ore, which was hauled to the Golconda custom flotation mill for treatment. Zinc-lead-silver ore (3,525 tons) was produced also from the Golconda mine and treated in the Golconda mill. The rest of the district output was 4,906 tons of zinc-lead old tailings from the Hirte and Hultner properties.

Lelande District (Burke, Mace, Frisco).—The output of the Lelande district in 1948 comprised 70,740 tons of zinc-lead old tailings, 55,812 tons of zinc-lead ore, 54,910 tons of lead ore, 30,798 tons of zinc ore, 1,011 tons of lead old tailings, and 110 tons of old mill cleanings. The principal producer was the Frisco mine of the Federal Mining & Smelting Co. at Gem; the lower levels of the mine were worked by the company and the upper levels by the Hull Lease. From the lower levels, 49,033 tons of zinc-lead ore (containing an average of 1.39 ounces of silver to the ton, 4.31 percent lead, and 5.82 percent zinc) were hauled to the Morning mill at Mullan for treatment. From the upper levels, the Hull Lease treated in its own 90-ton flotation mill 30,798 tons of ore, containing an average of 0.4 ounce of silver to the ton, 1.3 percent lead, and 8.9 percent zinc. The Federal Mining & Smelting Co. estimated the ore reserves at the Frisco mine at the end of 1948 to be 193,766 tons.

Day Mines, Inc., operated its Sherman mine and 300-ton flotation mill near Burke continuously in 1948; the mill treated 54,535 tons of ore containing an average of 6.52 ounces of silver to the ton, 9.66 percent lead, and 1.70 percent zinc. About 60,000 tons of zinc-lead old tailings from the Elgin property above Wallace were treated in the 140-ton Formosa flotation mill by the Small Leasing Co.; however, the company ceased operations at the end of the year. The rest of the district output was mainly 10,740 tons of zinc-lead old tailings from the Hercules dump and 6,779 tons of zinc-lead ore from the Hercules and Mace mines.

Placer Center District.—The output of the Placer Center district in 1948 comprised 91,223 tons of zinc-lead-silver ore, 56,587 tons of lead ore, and 37,710 tons of zinc-lead old tailings. Nearly all the zinc-lead-silver ore was produced from the Tamarack mine, all the lead ore from the Dayrock mine, and nearly all the zinc-lead old tailings from the Tomsche property. Day Mines, Inc., operated its Tamarack mine and 400-ton flotation mill at Dorn continuously; the mill treated 87,595 tons of ore containing an average of 1.07 ounces of silver to the ton, 3.22 percent lead, and 4.53 percent zinc. Day Mines, Inc., also operated its Dayrock mine at Bunn continuously and increased the capacity of the flotation mill to 350 tons of ore a day. The mill treated 56,587 tons of ore containing an average of 2.32 ounces of silver to the ton, 3.81 percent lead, and 0.38 percent zinc. Old tailings (36,210 tons), containing an average of 1.43 ounces of silver to the ton, 1.95 percent lead, and 2.80 percent zinc, from the Tomsche property above Wallace, were hauled to the Hercules custom flotation mill at Wallace for treatment. The remainder of the district output was principally 3,628 tons of zinc-lead ore from the Success and Tamarack No. 5 mines operated by lessees.

Summit District (Murray).—Leasing operations at the Anchor and Silver Strike mines produced 1,107 tons of zinc-lead ore and 370 tons of lead ore respectively. High-grade gold ore (55 tons) and lead ore (80 tons) were shipped from the Golden Chest mine; in addition, 29 fine ounces of gold and 10 fine ounces of silver were recovered from sluicing 330 cubic yards of gravel. The rest of the district output was chiefly 110 tons of zinc-lead ore from the Black Horse claim.

Yreka District (Kellogg).—The value of the metal output of the Yreka district was $29,297,119 in 1948, the highest ever recorded and more than double that of any other district in Idaho The district remained by far the chief lead- and zinc-producing area in Idaho and ranked second in silver. In 1948 material produced from the district comprised 760,413 tons of zinc-lead-silver ore, 267,511 tons of old zinc-lead tailings, 72,647 tons of old zinc-lead-iron tailings, 48,131 tons of old zinc slag, 22,383 tons of lead ore, and 5 tons of old mill cleanings—a total of 1,171,090 tons compared with 1,054,629 tons in 1947. Of the total ore, old tailings, and old slag, 431,047 tons (containing 1,761 ounces of gold, 1,023,435 ounces of silver, 479,470 pounds of copper, 38,976,438 pounds of lead, and 63,565,817 pounds of zinc) were zinc-lead-silver ore from eight mines in the Pine Creek area of the district—the greatest output by far ever recorded in the area; the Page and Sidney mines were the chief producers. However, the Bunker Hill & Sullivan mine at Kellogg, with an output of 329,360 tons of zinc-lead-silver ore and 22,228 tons of lead ore in 1948, continued to be the most important producer of ore in the district and the largest producer of lead in the State. The company main 2,000-ton (increased from 1,700-ton) flotation mill, equipped with a sink-and-float unit, treated 329,366 tons of zinc-lead-silver ore from the Bunker Hill & Sullivan mine and 259,279 tons of old zinc-lead tailings from the Bunker Hill & Sullivan mill tailing dump. The ore contained an average of 5.475 ounces of silver to the ton, 7.463 percent lead, and 1.886 percent zinc, and the old tailings 0.746 ounce of silver to the ton, 1.384 percent lead, and 0.691 percent zinc. John George continued leasing operations in the upper levels of the Bunker Hill & Sullivan mine and treated about 22,000 tons of lead ore in his mill. The Bunker Hill & Sullivan Mining & Concentrating Co. also treated 72,647 tons of old jig tailings (containing 0.68 ounce of silver to the ton, 1.65 percent lead, 1.16 percent zinc, and some iron) in its 300-ton gravity-flotation plant and shipped 48,131 tons of old Bunker Hill smelter slag (containing 0.35 ounce of silver to the ton, 1.81 percent lead, and 12.68 percent zinc) to its lead smelter at Bradley. The resulting hot slag was sent to the company 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) 1,723,131 ounces of silver, 48,600,000 pounds of lead, and 10,064,000 pounds of zinc. An improvement in the supply of mine labor during the year resulted in more metals being produced in 1948 than in any year since 1943. During 1948 ore reserves were substantially increased by the extension of the Truman ore shoot. This major ore body has been opened but not fully developed. Ore reserves fully developed and ready for mining January 1, 1949, totaled 3,026,884 tons of zinc-lead-silver ore, an increase of 155,939 tons over January 1, 1948. With the exception of 3 weeks in October when it was closed for repairs, the zinc slag-fuming plant of the Bunker Hill & Sullivan Mining & Concentrating Co. at Bradley ran continuously. In 1948 the plant received 126,885 tons of current hot slag from the lead furnaces of the Bunker Hill smelter at Bradley; the resulting lead fume (2,931 tons) was sent to the Bunker Hill lead smelter, and the zinc fume (21,491 tons) was shipped to a smelter at Coffeyville, Kans. All of the lead and zinc produced at the plant in 1948 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 129,276 tons in 1947 to 158,179 tons in 1948. The ore, treated in the Page 500-ton flotation mill, contained an average of 3.53 ounces of silver to the ton, 5.98 percent lead, and 6.10 percent zinc. The mine ranked second in lead and zinc production in Idaho in 1948 and fifth in silver. According to the company annual report to stockholders, operations at the Page mine were maintained at near capacity despite a shortage of experienced miners and a large labor turn-over. Development in 1948 included sinking the main shaft an additional 114 feet and exploring the Tony vein on the 2,770-foot level. Ore reserves at the end of the year were estimated at 852,682 tons, an increase of 366,682 tons over the estimated tonnage at the end of 1947.

Output of zinc-lead-silver ore from the Sidney mine of the Sidney Mining Co. on Denver Creek increased from 70,865 tons in 1947 to 89,724 tons in 1948. The ore, treated in the company 250-ton flotation mill, contained an average of 2.78 ounces of silver to the ton, 5.69 percent lead, and 10.51 percent zinc. The mine ranked third in zinc production in Idaho in 1948 and fifth in lead. The flotation mill of the Highland-Surprise Consolidated Mining Co. on Stewart Creek was increased during the year to 300 tons of ore a day. In

1948 the mill treated 72,925 tons of Highland-Surprise ore (40,888 tons in 1947), containing an average of 0.77 ounce of silver to the ton, 2.17 percent lead, and 6.85 percent zinc. Mining and milling of zinc-lead ore from the Spokane-Idaho mine on Pine Creek were continuous throughout the year. The company 175-ton flotation mill treated 54,917 tons of zinc-lead ore in 1948 compared with 38,468 tons in 1947. The Sunset Minerals, Inc., operated the Liberal King mine and its 100-ton flotation mill also on Pine Creek continuously; the mill treated 24,586 tons of zinc-lead ore, which yielded 1,072 tons of zinc-lead concentrate and 2,466 tons of zinc concentrate. Mining and milling of zinc-lead ore from the Little Pittsburg mine on Denver Creek were continuous by the Denver Development Co.; but the output of ore declined from 43,626 tons in 1947 to 22,139 tons in 1948. The rest of the district output was mainly 8,120 tons of zinc-lead ore produced from the Douglas mine on Pine Creek by the Douglas Leasing Co.

VALLEY COUNTY

Thunder Mountain District.—The Dewey mine near Stibnite was operated 3 months in 1948 by the Gateway Gold & Copper Co., Inc. The company reported that 2,500 tons of gold ore were treated by amalgamation and concentration and that the concentrates produced were treated by amalgamation. The remainder of the district output was principally 23 ounces of gold recovered from old mill cleanings.

Yellow Pine District.—The 2,000-ton flotation mill at the Yellow Pine mine of the Bradley Mining Co. operated all year. The company reported that in 1948 the mill treated 655,682 tons of ore containing 0.075 ounce of gold and 0.485 ounce of silver to the ton, and 1.211 percent antimony. The antimony concentrates and gold concentrates contained 27,158 ounces of gold, 236,031 ounces of silver, and 12,678,776 pounds of antimony. The mine was again by far the largest producer of gold and antimony in the State. Work of constructing a smelter at Stibnite, Idaho, for reduction of the antimony and gold concentrates, proceeded during the year.

WASHINGTON COUNTY

All the output in Washington County in 1948 was 40 tons of copper-silver ore produced from the Silver Still mine near Still in the Washington (Iron Mountain) district.

Missouri, Oklahoma, Kansas, and Arkansas
Silver, Copper, Lead, and Zinc

(MINE REPORT)

By A. J. MARTIN

GENERAL SUMMARY

DESPITE the impetus to mining afforded by advances in market prices of lead and zinc during 1948, the output of these metals in Missouri, Oklahoma, Kansas, and Arkansas as a whole again decreased in quantity. This annual decrease was the sixth in succession for lead and the seventh for zinc; lead production was the lowest since 1934 and zinc since 1896. The decline in 1948 from 1947, amounting to 17 percent for lead and 22 percent for zinc, was due mainly to work stoppages and idleness of marginal mines previously supported by Federal premium payments, but the most important factors in the recent continuous yearly declines were the depletion of high-grade ore reserves and the necessity for carrying on large development campaigns to restore and maintain reserves of commercial grade. Increases in the price of zinc concentrate at Joplin in January, July, October, and November 1948 enabled some of the mines and tailing mills that had closed when the Premium Price Plan expired June 30, 1947, to resume operations, and production rates of both lead and zinc in November and December were the highest of the year. The value of the lead output, enhanced by the record high lead price, exceeded that in any year since 1926.

Silver and copper were recovered as byproducts in smelting lead concentrates from Southeastern Missouri, and copper and a little silver were recovered from lead-copper ore mined in the same region.

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, 1944–48

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1944	$35.00	$0.711+	$0.135	$0.080	$0.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122
1947	35.00	.905	.210	.144	.121
1948	35.00	.905+	.217	.179	.133

[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. 1944 to June 30, 1946: $0.71111111; July 1, 1946, to Dec. 31, 1947: $0.905; 1948: $0.9050505.
[3] Yearly average weighted price of all grades of primary metal sold by producers; 1944–47: price includes bonus payments by Office of Metals Reserve for overquota production.

Mine production of silver, copper, lead, and zinc in Arkansas, Kansas, Missouri, and Oklahoma in 1944–47 and, by States, in 1948, in terms of recovered metals

	Mines producing	Material sold or treated		Silver	
		Crude ore (short tons)	Old tailings (short tons)	Fine ounces	Value
1944	289	15, 730, 407	12, 293, 010	92, 243	$65, 595
1945	247	14, 163, 065	11, 271, 347	94, 822	67, 429
1946	269	13, 831, 590	10, 178, 620	69, 401	56, 076
1947	254	11, 837, 403	6, 041, 783	93, 600	84, 708
1948					
Arkansas	6	1, 101			
Kansas	79	1, 788, 298	471, 498		
Missouri	90	4, 520, 103	1, 178, 751	114, 187	103, 345
Oklahoma	119	2, 228, 294	2, 110, 010		
Total 1948	294	8, 537, 796	3, 760, 259	114, 187	103, 345

	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
1944	3, 302	$891, 540	198, 021	$31, 683, 360	191, 797	$43, 729, 716	$76, 370, 211
1945	3, 399	917, 730	196, 610	33, 816, 920	140, 172	32, 239, 560	67, 041, 639
1946	1, 857	601, 668	159, 256	34, 717, 808	139, 574	34, 056, 056	69, 431, 608
1947	1, 760	739, 200	153, 838	44, 305, 344	109, 651	26, 535, 542	71, 664, 794
1948							
Arkansas			22	7, 876	31	8, 246	16, 122
Kansas			8, 386	3, 002, 188	35, 577	9, 463, 482	12, 465, 670
Missouri	2, 370	1, 028, 580	102, 288	36, 619, 104	6, 463	1, 719, 158	39, 470, 187
Oklahoma			16, 918	6, 056, 644	43, 821	11, 656, 386	17, 713, 030
Total 1948	2, 370	1, 028, 580	127, 614	45, 685, 812	85, 892	22, 847, 272	69, 665, 009

Mine production of silver, copper, lead, and zinc in Arkansas, Kansas, Missouri, and Oklahoma in 1948, by months, in terms of recovered metals

Month	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	11, 235	280	12, 111	6, 448
February	10, 788	195	11, 848	6, 921
March	12, 271	226	13, 407	7, 819
April	12, 668	210	13, 125	7, 883
May	11, 517	230	12, 370	8, 295
June	12, 102	234	13, 116	7, 145
July	2, 338	20	2, 870	4, 276
August	257	70	1, 184	4, 270
September	3, 885	140	5, 826	7, 139
October	12, 255	245	13, 215	8, 199
November	12, 280	250	13, 963	8, 707
December	12, 591	270	14, 579	8, 790
Total 1948	114, 187	2, 370	127, 614	85, 892

Silver.—Silver was recovered as a byproduct by smelters treating Southeastern Missouri lead concentrates. These concentrates usually contain 1 to 2 ounces of silver a ton. A large part of the lead derived from the concentrates is not desilverized, and this silver is not recorded as recoverable production. The copper concentrates made from lead-copper ore also contain a little silver. The total silver recovered in 1948 was 114,187 fine ounces, compared with 93,600 ounces in 1947.

Copper.—The increase in the Missouri output of copper from 1,760 tons in 1947 to 2,370 tons in 1948 resulted from a larger production of copper concentrates by the Madison mill at Fredericktown, Madison County, which treated lead-copper ore. The quantity of copper contained in byproduct matte shipped from smelters treating lead concentrates was a little less than in 1947.

Lead.—Production of recoverable lead in the Southeastern Missouri region was 100,654 tons in 1948, the lowest since 1935 but still considerably higher than that of any other domestic region or State. The decrease from 1947 (22 percent) was due mainly to work stoppages. The Tri-State zinc-lead district (Southwestern Missouri, Oklahoma, Kansas) produced 26,901 tons of lead in 1948, an increase of 11 percent over 1947 despite a low output in July and August caused by a work stoppage. The Central Missouri district produced 37 tons of lead and Arkansas 22 tons in 1948.

Zinc.—The Tri-State district produced 84,839 tons of recoverable zinc in 1948 compared with 109,338 tons in 1947. The decrease resulted from a work stoppage and the idleness of some of the marginal mines and tailing mills that contributed to the output in 1947 until Federal premium payments ceased June 30. A general review of mining and milling in this district is in the Tri-State District section of this chapter. The Southeastern Missouri region produced 1,022 tons of zinc in 1948 (part recovered from zinc concentrates and part from lead-smelter slag) and Arkansas 31 tons.

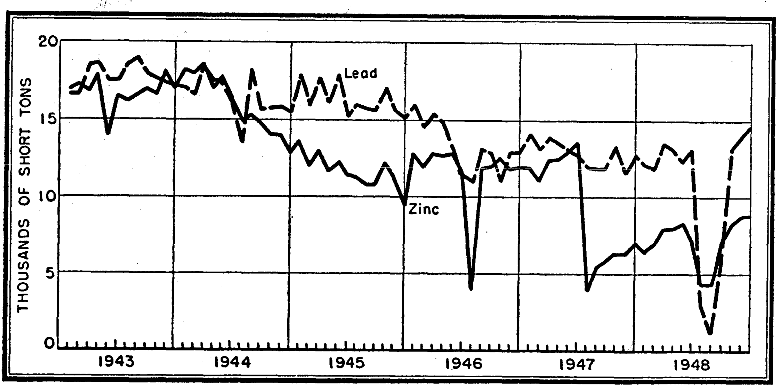

FIGURE 1.—Mine production of lead and zinc in Arkansas, Kansas, Missouri, and Oklahoma, 1943–48, by months, in terms of recoverable metals.

MINING AND METALLURGIC INDUSTRY

The extraordinary rise in the price of lead before the Premium Price Plan expired June 30, 1947, enabled the straight lead mines to readjust operations within that year to competitive open-market conditions. The readjustment period for the zinc and zinc-lead mines, however, continued through 1948. The moderate increase in the price of zinc concentrates at Joplin in January and further substantial advances in July and November led to reopening of many of the Tri-State mines that had closed when premium payments ceased. The extent of the renewed activity was not reflected in production figures until the last 3 months of the year, owing to the time required to reopen the mines, and the work stoppage in July and August at the mines and mills of the Eagle-Picher Mining & Smelting Co. The high lead price stimulated selective mining of Tri-State ore bodies relatively high in lead and revived small-scale shallow lead mining by individuals. In the Southeastern Missouri region there was a large increase in the quantity of old lead tailings re-treated, but the tonnage of crude ore milled decreased materially because of labor strikes and continued demands on manpower and equipment for development work postponed during the war.

The Bureau of Mines, in cooperation with the Geological Survey, continued exploratory drilling, field examinations, and metallurgical tests on copper, lead, and zinc ores.

Fifty-two mills (5 less than in 1947) operated all or part of 1948 on lead and zinc ores and old tailings in the four States. The daily capacity of the mills ranged from 25 to 15,000 tons and averaged 1,457 tons. Most of the mills used gravity concentration and flotation. Flotation concentrates comprised 46 percent of the total lead concentrates and 64 percent of the zinc concentrates produced. The active smelters were the lead smelters at Galena, Kans., and Herculaneum, Mo.; the zinc smelters at Bartlesville, Blackwell, and Henryetta, Okla., and Fort Smith, Ark.; and the oxide plant at Coffeyville, Kans. Waelz plants were operated in conjunction with the zinc smelters at Henryetta and Fort Smith.

ORE CLASSIFICATION

The following table classifies the combined ore and old tailings produced in Arkansas, Kansas, Missouri and Oklahoma in a manner comparable to the classes shown in the tables on ore classification in the chapters devoted to mining in the Western States. The basis for classification is given in the Gold and Silver chapter of this volume. Additional details of the tenor of ore and old tailings milled and the concentrates produced in Kansas, Missouri, and Oklahoma are given in tables in the Review by States section that follows. Such tables for Arkansas are omitted because only small-scale intermittent mining of lead and zinc was done there from 1918 through 1948.

Ore and old tailings sold or treated in Arkansas, Kansas, Missouri, and Oklahoma in 1948, with content in terms of recoverable metals

Source	Mines producing	Ore, etc. (short tons)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lead ore [1]	51	5,586,683	114,187	2,370	104,010	1,540
Zinc ore [2]	73	3,980,436			2,904	38,385
Zinc-lead ore	170	2,730,936			20,700	45,967
Total: 1948	294	12,298,055	114,187	2,370	127,614	85,892
1947	254	17,879,186	93,600	1,760	153,838	109,651

[1] Includes lead-copper ore from 1 mine; also 1,166,456 tons of old tailings remilled, concentrates from which were mixed with those from crude ore.
[2] Includes 2,593,803 tons of old tailings yielding 6,116 tons of recoverable zinc and 65 tons of lead.

TRI-STATE DISTRICT

The output of zinc concentrate in the Tri-State district totaled 159,609 tons valued at $13,929,151 in 1948 compared with 204,068 tons valued at $21,792,921 (including $8,463,806 in Federal premiums) in 1947. The quantity of zinc produced in 1948 was the lowest since 1896, but the value was slightly higher than the average for the 5 years 1935–39. The sharp decrease in production in 1948 was due mainly to the idleness of some of the marginal mines and tailing mills that operated while Federal premiums were being paid the first half of 1947, and a 9-week work stoppage at the mines and mills of the Eagle-Picher Mining & Smelting Co.

Production of lead concentrate, stimulated by the record high price, increased from 32,006 tons valued at $6,090,622 in 1947 to 35,862 tons valued at $8,302,564 (highest since 1927) in 1948. The district production, in terms of recoverable metals, was 84,839 tons of zinc and 26,901 tons of lead in 1948 compared with 109,338 and 24,239 tons, respectively, in 1947.

Production of lead and zinc concentrates in the Tri-State district (Kansas, Oklahoma, and Southwestern Missouri), 1944–48

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
FROM CRUDE ORE									
1944	9,118,388	36,544	301,854	0.40	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
1947	6,229,702	31,842	181,662	.51	2.92	77.41	59.68	190.72	107.42
1948	4,314,190	35,706	147,989	.83	3.43	76.64	59.09	231.85	87.10
FROM OLD TAILINGS REMILLED									
1944	12,293,010	390	53,547	0.003	0.44	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
1947	5,740,459	164	22,406	.003	.39	45.12	58.31	107.09	101.69
1948	2,595,903	156	11,620	.006	.45	51.28	58.47	155.14	89.50
DISTRICT TOTAL									
1944	21,411,398	36,934	355,401	0.17	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
1947	11,970,161	32,006	204,068	.27	1.70	77.25	59.53	190.30	106.79
1948	6,910,093	35,862	159,609	.52	2.31	76.53	59.04	231.51	87.27

The weekly quoted price for 60-percent zinc concentrates at Joplin in 1948 was $70.35 a ton from January 3 through January 17, $78 from January 24 through July 24, $95 from July 31 through October 16, $98 from October 23 to November 13, and $110 from November 20 through December. The quoted price for 80-percent lead concentrates was $195.65 a ton from January 3 to April 3, $231.65 from

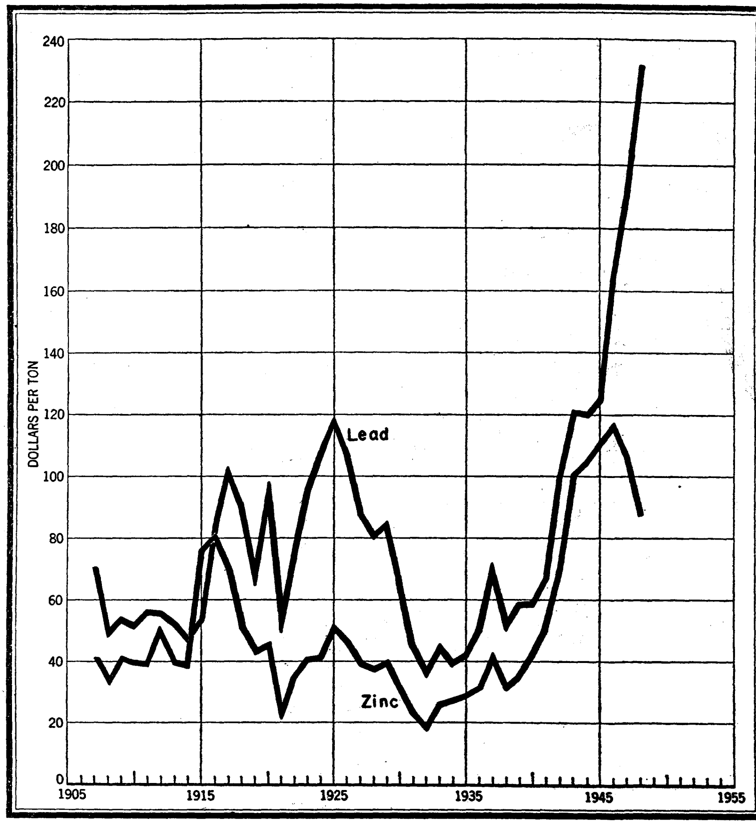

FIGURE 2.—Average prices received by sellers per ton of concentrates in the Tri-State district, 1907–48

FIGURE 3.—Quantity of crude ore milled in the Tri-State district, 1907–48.

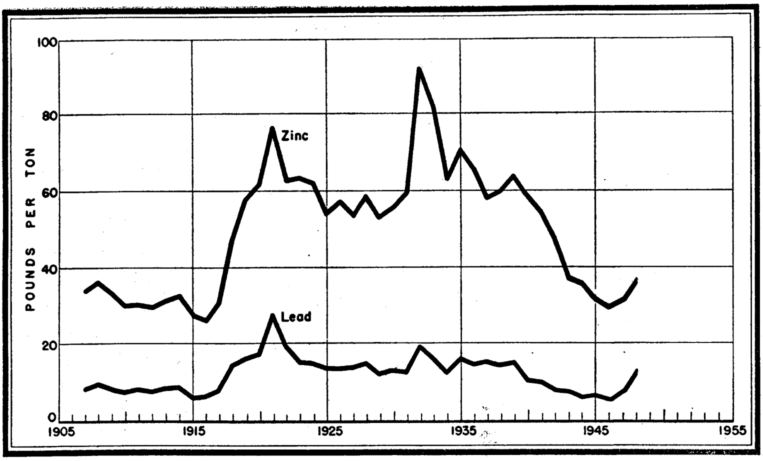

FIGURE 4.—Metal recovered per ton of crude ore (rock) milled in the Tri-State district, 1907–48.

April 10 to July 24, $257.37 from July 31 to October 30, $286.17 from November 6–27, and $290.92 the rest of the year.

The advances in prices of lead and zinc concentrates during 1948 resulted in the reopening of many Tri-State mines that had closed when the Premium Price Plan expired, as well as other old mines, particularly those that had produced considerable lead in the past. There were numerous small-scale, shallow lead operations by individuals. Hand jigs were seen in operation for the first time in recent years. In December about 120 mines, 29 mine mills, 4 tailing mills, and 3 slime and clean-up mills were operating compared with 75, 22, 3, and 1, respectively, in December 1947. These mines do not include many small intermittent producers; the total producing mines, gouges, and mill and dump clean-ups active all or part of 1948 was 270 compared with 234 in 1947. The depth of the operating shafts ranged from 30 to 450 feet; open-pits, worked at depths ranging from a few feet to 90 feet, yielded 165,000 tons of ore or 4 percent of the district total output of crude ore from mines and dumps.

There was less activity in exploratory drilling in the Tri-State district and nearby areas in 1948 than in most past years when metal prices were high. The Anaconda Mining Co. did considerable drilling in Crawford County, Kans., north of the areas that have been productive in the past. The Bureau of Mines had drilling projects in the South Carthage, Lone Elm, Canyon Diggings, and North Empire areas. Data on certain drilling projects were published during the year.[1]

[1] Brichta, Louis C., and Needham, A. B., Churn Drilling at the Capital and Greenland Zinc Mines, Lawrence County, Mo.: Bureau of Mines Rept. of Investigations 4318, 1948, 24 pp.
Ballinger, Homer J., Mon-Ark Zinc-Lead Mines, Christian County, Mo.: Bureau of Mines Rept. of Investigations 4297, 1948, 16 pp. Churn Drilling at Mary Arnold Zinc-Lead Mines, Christian County, Mo.: Bureau of Mines Rept. of Investigations 4313, 1948, 8 pp. Investigation of Rex Zinc Mine, Howell County, Mo.: Bureau of Mines Rept. of Investigations 4325, 1948, 11 pp.
Knox, Clinton C., Investigation of Melrose Zinc-Lead District, Ottawa County, Okla., and Cherokee County, Kans.: Bureau of Mines Rept. of Investigations 4337, 1948, 92 pp. Investigation of Zinc-Lead Deposits on Extensions of the Miami Trough, Ottawa County, Okla., and Cherokee County, Kans.: Bureau of Mines Rept. of Investigations 4415, 1949, 35 pp.
Ruhl, Otto, and Ballinger, Homer J., Investigation of the Zinc-lead Deposits in Horizons below the Grand Falls Chert, Galena District, Cherokee County, Kans.: Bureau of Mines Rept. of Investigations 4398, 1949, 119 pp.

REVIEW BY STATES

MISSOURI

Missouri has been the chief lead-producing State for 41 consecutive years and until 1918 had ranked first in zinc production for many years. In 1948 operations at the principal lead mines were interrupted about 11 weeks by work stoppages, and the output of recoverable lead decreased to 102,288 tons compared with 132,246 tons in 1947. Zinc production decreased heavily after Federal premium payments ceased June 30, 1947, and was only 6,463 tons in 1948 compared with 17,074 tons in 1947. 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 1944–48) from lead-copper-(cobalt-nickel-iron) ore mined in Madison County. Silver recovered in 1948 totaled 114,187 fine ounces and copper 2,370 tons compared with 93,600 and 1,760 tons, respectively, in 1947. 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 largely from zinc-lead mines in Southwestern Missouri. The Central district of Missouri had a small output of lead in 1947 and 1948 and of both zinc and lead in 1944–45; the figures are included with those of Southeastern Missouri in the table that follows.

Southeastern and Central Missouri.—The mine production of recoverable lead in Southeastern Missouri decreased from 129,516 tons in 1947 to 100,654 in 1948. Most of the decrease resulted from work stoppages at the mines of the St. Joseph Lead Co., largest producer of lead in the United States, and the Madison mine of the National Lead Co. St. Louis Smelting & Refining Division. Zinc production totaled 1,022 tons, part of which was recovered from zinc concentrates derived from lead ore and part from lead-smelter slag.

In St. Francois County the St. Joseph Lead Co. operated its Bonne Terre, Desloge, Federal (including Doe Run), and Leadwood mine groups and mills. The daily capacity of the four mills at the end of 1948 ranged from 2,800 to 14,000 tons and totaled 26,400 tons. Treatment is by table concentration followed by flotation. Each mine group has an underground, electrified, rail haulage system, which moves the ore from the working faces to a central ore-hoisting shaft. The four ore-hoisting shafts at the mills are 326, 276, 497, and 541 feet deep; the Doe Run shaft is 160 feet deep. Other shafts are used for men, supplies, and poor rock. Development on the four groups in 1948 totaled 179 feet of shaft, 64,390 feet of drifting, 2,134,945 feet of diamond drilling, and 63,789 feet of churn drilling. The following information was extracted from the company's eighty-fifth annual report to stockholders.

The expanded exploration program initiated in 1947 was aggressively carried forward [in 1948]. The lag in development which had resulted from forced curtailment during the depression and war years has now been largely overcome, and continued maintenance of a proper balance between the rate of mining and development work in the mines of this Division can now be foreseen. Good progress has also been made in modernizing underground equipment and facilities, which will contribute to greater over-all efficiency in present and future operations.

The Desloge mill operated during the entire year on tailings, and a total of 1,164,000 tons of old tailings were milled at this, and at the company's other Lead Belt plants; thus fully utilizing the installed mill capacity of the district during a period when the demands on both manpower and equipment for the development program resulted in some curtailment in the rate of underground mining.

The lead bonus of 25 cents per shift worked for each one cent increase in the price of lead above 12 cents per pound New York remains in effect at this division, and each employee receives the same amount of lead bonus per shift.

At Herculaneum, one-third of the company's lead concentrates was smelted, with satisfactory recovery and at a reasonable cost; the balance of the production will continue, until 1953, to be smelted at East Alton, Illinois when the present toll contract terminates with the American Smelting & Refining Company. * * *. The operation of the electrothermic furnace for the recovery of zinc and lead from blast furnace slag supports the belief that the system has considerable promise. * * *.

The 2½ months' Lead Belt strike contributed materially to the lower lead production. * * *.

In Madison County the St. Joseph Lead Co. operated the Mine La Motte mine and mill. The daily capacity of the mill was increased from 1,500 to 2,000 tons, a 75-foot shaft was reopened, and the 136-foot shaft sunk in 1947 was put in operation. Two other shafts, 307 and 116 feet deep, were operated. Mine development in 1948 included 4,570 feet of drifts, 68,024 feet of diamond drilling, and 24,675 feet of churn drilling.

The National Lead Co. St. Louis Smelting & Refining Division operated its Madison mine and all-flotation mill continuously in 1948, except during a work stoppage in July and part of August. Four shafts, averaging 400 feet in depth, were used. Equipment was added to raise the capacity of the mill from 800 tons daily to 1,200. The mine contains ore bodies that yield considerable iron, cobalt, and nickel with lead and copper, but operations in 1948 were confined chiefly to the mining of lead-copper ore; the output of copper increased sharply over 1947, and that of lead increased slightly.

The Park City Consolidated Mines Co. operated its Ruth mine from January 1 to July 14 and the adjoining St. Louis No. 3 from January 1 to May 15. In August the company leased the Fleming-Catherine group from the Fredericktown Lead Co. and operated that group from September 1 through December. The ore was trucked to the Park City 400-ton all-flotation mill for treatment. The Fredericktown Lead Co. operated the Fleming-Catherine from January 1 until the miners went out on strike February 25.

In Jefferson County the Fredericktown Lead Co. continued underground development work on the Valle Mine group and operated the 200-ton jig and table mill on lead ore from the mine and dumps; the recovery from 41,587 tons milled was 356 tons of concentrates assaying 72.48 percent lead, valued at $82,178. Some lead ore was shipped from the Casey mine, and 188 tons of galena were shipped from barite diggings in Washington and Jefferson Counties. Certain data on drilling by the Bureau of Mines in previous years were published in 1948.[2]

[2] McMillan, W. D., Churn Drilling at the McGregor Zinc-Lead Mine, Washington County, Mo.: Bureau of Mines Rept. of Investigations 4308, 1948, 6 pp.
Ballinger, Homer J., Investigation of the Krueger Zinc Deposit, Washington County, Mo.: Bureau of Mines Rept. of Investigations 4292, 1948, 49 pp.
McMillan, W. D., Fine, M. M., and Kenworthy, H., Investigation of the Dempsey Zinc-Lead Mine, Washington County, Mo.: Bureau of Mines Rept. of Investigations 4332, 1948, 16 pp.

The Central district of Missouri produced 37 tons of recoverable lead in 1948 and 65 tons in 1947. The depth of mining at the Glover open-pit mine at Russellville, Cole County, was below the lead-bearing clay in 1948; and the ore contained only a small percentage of lead, with barite the principal product.

Mine production of lead and zinc in Southeastern and Central Missouri, 1944–48

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
1944	243,279	$19,920,200	3,206	$112,485	169,962	$27,193,920	[4] 1,508	$343,824
1945	245,805	21,870,243	1,335	45,706	173,053	29,765,116	[5] 595	136,850
1946	189,401	21,677,221	1,731	61,147	135,891	29,624,238	451	110,044
1947	183,084	31,762,029	560	15,996	129,581	37,319,328	[6] 295	71,390
1948	145,364	30,396,488	567	55,231	100,691	36,047,378	[6] 1,022	271,852

[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 776 tons recovered from lead-smelter slags and byproduct matte from lead smelting.
[5] Includes 240 tons recovered from byproduct matte from lead smelting.
[6] Includes zinc recovered from lead-smelter slag.

Tenor of lead ore and concentrates in Southeastern Missouri disseminated-lead district, 1944–48

	1944	1945	1946	1947	1948
Total lead ore [1] short tons	6,535,874	6,675,767	5,491,239	5,856,334	5,384,861
Galena concentrates in ore percent	3.72	3.68	3.44	3.12	2.70
Average lead content of galena concentrates do	71.02	71.66	73.09	72.22	70.60
Average value per ton of galena concentrates	$81.78	$88.95	$114.39	$173.49	$209.11

[1] Includes lead-copper ore. Includes old tailings remilled: 1944–46—none; 1947—301,324 tons; 1948—1,164,356 tons.

Southwestern Missouri.—The Tri-State district, which includes Southwestern Missouri, is described in an earlier section of this chapter.

In Southwestern Missouri production of zinc concentrates decreased 67 percent and lead concentrates 40 percent in 1948 compared with 1947. The principal producers (combined zinc and lead concentrates), in order of output, were the Kansas Explorations (Inc.) Buckingham mine north of Oronogo (closed in August); the Goldfield Consolidated Mines Co. Navy Bean and other properties in the Wentworth area acquired from the Century Lead & Zinc Co. during the year; the Dale Mining Co. Dungy mine at Stark City (company also operated the Ryder mine at Pioneer); the Federal Mining & Smelting Co. Duenweg mine; the Little Ben Mining Co. High Five mine at Waco; and the Glen Richey Shinn mine at Stark City. All the foregoing mines produced more than 500 tons of concentrates each and were served by mills at or near the mine. The Federal Granby-American mill treated 26,071 tons of lead ore from the mine and an open pit. The St. Louis Mining & Milling Co. mill at Thoms Station treated custom ore. The Northside mill at Chitwood, acquired by the Wildwood Mining Co., treated some company ore. The Kansas Explorations (Inc.) Jasper mill west of Joplin was reopened in December to treat custom ore. The Swartz mill at Lone Elm ran part time from May to December. The Playter mill at Waco handled ore from the Reynolds group at Waco and the Quick Seven near Neck City until June, when it was leased to Glen Richey and used to treat ore from the Grasselli Mine in Kansas. The Magajupa mine at Duenweg operated during January and February. Ore was shipped from the Oronogo Circle dump to the Central mill at Cardin, Okla. Other shippers to custom mills included the Big Cave west of Joplin, Crawford near Seneca, Little Beaver near Diamond, N. Y. C. at Lone Elm, O'Keefe near Thoms Station, Olson (I. N. Clark) near Spurgeon, and Rex (1,000-acre tract) at Joplin. Numerous small-scale operations (mostly lead mining) in the Jasper and Newton County areas produced a considerable aggregate tonnage of concentrates. In Christian County Jones & Webster worked the Mary Arnold mine at Ozark part of the year. In Greene County the H. & H. Mining Co., working the Two Sons mine at Ash Grove, washed and hand-jigged 350 tons of ore that yielded 14 tons of 81-percent lead concentrates worth $3,446.

Mine production of lead and zinc in Southwestern Missouri, 1944–48

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
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
1947	3, 412	655, 080	168	23, 866	31, 480	3, 402, 384	763	49, 235	2, 665	767, 520	16, 779	4, 060, 518
1948	2, 004	474, 233	130	21, 465	10, 475	913, 538	60	3, 212	1, 597	571, 726	5, 441	1, 447, 306

[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 and zinc ore and old tailings milled and concentrates produced in Southwestern Missouri, 1947–48

	1947		1948	
	Crude ore	Old tailings and slimes	Crude ore	Old tailings and slimes
Total ore, etc., milled .... Short tons..	1, 157, 917	240, 270	297, 598	14, 395
Total concentrates produced:				
Lead .... do....	3, 577	3	2, 109	25
Zinc .... do....	30, 138	2, 105	10, 393	142
Ratio of concentrates to ore, etc.:				
Lead .... percent..	0. 31	0. 001	0. 71	0. 17
Zinc .... do....	2. 60	0. 88	3. 49	0. 99
Metal content of ores, etc.:[1]				
Lead .... do....	0. 23	0. 001	0. 54	0. 10
Zinc .... do....	1. 51	0. 48	2. 01	0. 51
Average lead content of galena concentrates .... do....	76. 68	66. 67	77. 72	56. 00
Average lead content of lead carbonate .... do....	58. 93	----------	56. 92	----------
Average zinc content of sphalerite concentrates .... do....	58. 51	54. 35	57. 54	51. 41
Average zinc content of silicates and carbonates .... do....	40. 50	----------	38. 33	----------
Average value per ton:				
Galena concentrates	$192. 04	$134. 33	$237. 29	$185. 52
Lead carbonate concentrates	$142. 06	----------	$165. 12	----------
Sphalerite concentrates	$109. 34	$90. 48	$87. 39	$74. 49
Zinc silicates and carbonates	$64. 53	----------	$53. 53	----------

[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.

OKLAHOMA

Mines and tailing mills in Oklahoma produced 52 percent of the total Tri-State output of zinc and 63 percent of the lead in 1948 compared with 47 percent and 59 percent, respectively, in 1947. Only three Oklahoma tailing mills were in operation in 1948 compared with nine when Federal premium payments ceased June 30, 1947. The State output of recovered zinc decreased 14 percent and lead increased 18 percent from 1947. Details of the Tri-State district, which includes Oklahoma, are presented in an earlier section of this chapter.

Mine production of lead and zinc in Oklahoma, 1944–48, and total, 1891–1948

Year	Lead concentrates (galena)		Zinc concentrates (sphalerite)		Metal content[1]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
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
1947	18, 857	3, 600, 407	95, 126	10, 699, 593	14, 289	4, 115, 232	51, 062	12, 357, 004
1948	22, 638	5, 214, 366	82, 734	7, 178, 960	16, 918	6, 056, 644	43, 821	11, 656, 386
1891–1948	1, 491, 395	130, 214, 029	9, 045, 032	420, 092, 108	1, 149, 998	154, 232, 783	4, 766,117	670, 545, 088

[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 and zinc ore, old tailings, and slimes milled and concentrates produced in Oklahoma, 1947–48

	1947		1948	
	Crude ore	Old tailings and slimes	Crude ore	Old tailings and slimes
Total ore, etc., milled ... short tons	2,818,476	4,104,851	2,228,294	2,110,010
Total concentrates produced:				
Galena ... do	18,743	114	22,507	131
Sphalerite ... do	81,804	13,322	73,899	8,835
Ratio of concentrates to ore, etc.:				
Lead ... percent	0.67	0.003	1.01	0.006
Zinc ... do	2.90	.32	3.32	0.42
Metal content of ore, etc.:[1]				
Lead ... do	.52	.001	.77	.003
Zinc ... do	1.74	.19	1.95	.24
Average lead content of galena concentrates ... do	77.54	39.47	76.40	50.38
Average zinc content of zinc concentrates ... do	59.78	58.73	58.91	58.25
Average value per ton:				
Galena concentrates	$191.54	$90.87	$230.81	$149.34
Zinc concentrates	$111.73	$117.07	$86.61	$88.13

[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.

Operations at the mines and mills of the Eagle-Picher Mining & Smelting Co., largest producer of zinc and lead in Oklahoma and the Tri-State district, were interrupted by a labor strike from July 1 to September 5, 1948, and a number of other mines that shipped ore to the company Central mill could not operate during this period. During the rest of the year the Central mill (capacity 15,000 tons daily) operated at one-half to two-thirds capacity. The mill is equipped with differential-density (sink-and-float) preliminary-concentration units, which furnish an enriched product for treatment by jigging and flotation. Of the 2,138,093 tons of ore treated in 1948, 62 percent came from Oklahoma. Eagle-Picher mines in Oklahoma shipping to the mill were the Blue Goose mines, Buffalo, Crawfish, Goodeagle No. 3, Goodwin, Gordon, Grace Walker, Hum-bah-wat-tah mines, John Beaver No. 2, Kenoyer No. 1 (formerly American Zinc No. 7), Lottson No. 2, Netta, Piokee, Royal, See Sah, Slim Jim-Bankard, Southside No. 2, Swift, Vantage, Wilson, and White. Other large Oklahoma shippers to the mill (in order of tonnage) included the Federal Mining & Smelting Co. (Gordon, Lucky Syndicate-Howe-Ohimo), F. W. Evans (Shorthorn-Craig), and the Mahutska (Jeff City No. 2, Eudora), W. M. & W. (Velie, Little Greenback), Carpenter (New York, Oko, Grace Walker), C. G. & C. (Lucky Bill), Jake Dryer (Southside), Tongaha (Anna Beaver, Tongaha), Hunt (Netta), Frank Hudson (Bingham), Little Bill (DeWitt), Cardinal, Hudson (Craig), and Bob White (Little Greenback-Mehunka) mining companies. The Eagle-Picher Bird Dog mill operated from May through December on slimes.

The Nellie B. Mining Co., a new operating company in the Tri-State district, became the second-largest district producer of zinc and lead during the last few months of 1948. In January the company acquired the Marcia K (Lawyers) and Davis-Big Chief (Skelton) properties, in July the Rialto Mining Corp. properties, and in September the Evans-Wallower properties, comprising altogether about two sections of mining property and three active mills with a total capacity of 2,500 tons daily.

The American Zinc Co. No. 7 mine and mill operated until July 30, when the mill was struck by lightning and burned; in October the mining lease and equipment were sold to the Eagle-Picher Mining & Smelting Co. The C. & M. Mining Co. operated its No. 4 (Imbeau) mine and mill throughout the year. The Harris Mining Co. Oklahoma operations included the Lucky Jenny mill and the Farmington mine. Cameron & Henderson, Inc., continued to operate the Admiralty mine and Romo mill. The Scott Mining Co. operated its mill and the Scott and Mary Ann mines from August through December. The Mission mill treated custom ore. The United Zinc Smelting Corp. Royal mill handled mostly custom ore but also treated company ore from the Waxahachie mine. The Melrose Mining Co. Park Walton mine continued to operate. Other important shippers of ore to custom mills were the Federal Mining & Smelting Co. Quapaw-Davenport mine, Baird (Admiralty Douthat), Blackhawk, Dobson, Pelican (Dewey Sims), Shallow Mineral, Gray Wolf (Golden Hawk), and Wesa Greenback, The small Lancaster mill near Lincolnville ran intermittently. The Big Chief and Sooner tailing mills operated nearly all the year and the Britt & Britt mill a few months.

KANSAS

The mine output of recovered zinc in Kansas decreased 14 percent and lead increased 15 percent in 1948 from 1947. Conditions affecting production in the Tri-State district as a whole, which includes the Kansas zinc-lead mining areas, are reviewed in a foregoing section.

Mine production of lead and zinc in Kansas, 1944–48, and total, 1876–1948

Year	Mines producing	Lead concentrates		Zinc concentrates		Metal content [1]			
						Lead		Zinc	
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
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
1947	79	9,569	1,811,269	76,699	7,641,709	7,285	2,098,080	41,497	10,042,274
1948	79	11,090	2,592,500	66,340	5,833,441	8,386	3,002,188	35,577	9,463,482
1876–1948		758,910	58,194,092	5,060,452	226,215,539	579,238	69,737,057	2,624,538	352,918,664

[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 and zinc ore and old tailings milled and concentrates produced in Kansas, 1947–48

	1947		1948	
	Crude ore	Old tailings	Crude ore	Old tailings
Total ore and old tailings milled ... short tons	2,253,309	1,395,338	1,788,298	471,498
Total concentrates produced:				
Galena ... do	9,522	47	11,090	----------
Sphalerite ... do	69,720	6,979	63,697	2,643
Ratio of concentrates to ore, etc.:				
Lead ... percent	0.42	0.003	0.62	----------
Zinc ... do	3.09	.50	3.56	0.56
Metal content of ore, etc.: [1]				
Lead ... do	.33	.002	.48	----------
Zinc ... do	1.86	.29	2.12	.33
Average lead content of galena concentrates ... do	[2] 77.76	58.50	77.16	----------
Average zinc content of sphalerite concentrates ... do	60.25	58.70	59.56	59.60
Average value per ton:				
Galena concentrates	$189.51	$144.68	$233.77	----------
Sphalerite concentrates	$102.03	$75.73	$87.64	$94.89

[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.
[2] Revised figure.

The Baxter Springs-Blue Mound-Treece area produced 91 percent of the total Kansas output of zinc concentrates and 88 percent of the lead concentrates in 1948 compared with 90 and 92 percent, respectively, in 1947. About 43 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 princial ore-hoisting shafts. Producing Eagle-Picher mines in this area were the Big John, Foley Mullen, Leopard-Youse Slaughter, Webber, Westside No. 2, and Wilbur.

The Walter Hartley mine of the National Lead Co. St. Louis Smelting & Refining Division near Baxter Springs was again the largest individual producer of zinc concentrates in Kansas and the Tri-State district. The ore was milled in the company No. 8 (Ballard) central mill, which also handled other company ore from the Ballard, Moore, and Shanks mines.

The Dines Mining Co., operating its mill and the Hartley No. 1 and Stoskopf mines, was a large producer. Besides company ore, the mill treated custom ore from the Blue Mound, C. K. & E. (Stebbins, Karcher), and Roanoke (Homestake) mines. The Harris Mining Co. operated the Golden Rod (E. W. No. 24) mine throughout the year. The MacArthur mines, the Swalley (Beck) mine, and the Beck No. 3 mill—all closed the latter part of 1947—were reopened and operated a large part of 1948. Other important producers shipping ore to custom mills included the Bilharz (Muncie), Contact, Grace Jarrett (Wright), Mark Twain (Blue Mound, Naylor), Robinson (Douthit, Jarrett), Bob White (Chubb), A. & H. (Bendelari), and Linda Lou (Northern). The Captain tailing mill operated seven months, the Barr Cleanup (Lucky Seven) mill ran most of the year, and the Wade-Rea mill operated on company and custom ore all the year. The M. & W. Mill operated intermittently, mostly on ore from the F. & G. (Lindsey) mine. The Vanatta mine near Melrose remained idle. The Lavrion Mining Co. installed pumps in the Garrett shaft and nearly completed unwatering it during the year.

In the Crestline area F. W. Evans unwatered extensive old mine workings on the Crutchfield and American properties and installed mining equipment, including hoists on three shafts. Ore shipments to the F. W. Evans mill at Waco began in August and continued through December. In the Badger-Peacock area some ore was shipped from the Peacock and Williams properties.

At Galena the principal producer was the Murphy open-pit mine, operated most of the year by the Childress-Murphy Mines, Inc. The L. & S. Mining Co. shipped considerable ore from the Cooper Hollow open pit. Other producers included the Oliphant & Abbey, Rummery, Shaw-Davis, Owens-Turner, and Alexander leases and many small-scale individual operations. All the Galena output of milling ore was shipped to custom mills in other areas. 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 Waco the Little Ben Mining Co. operated the Oscar Bennett mine from April 1 through December, shipping the ore to the F. W. Evans mill. Glen Richey shipped ore from the Grasselli mine to the Playter mill in Missouri.

ARKANSAS

Shipments of crude zinc ore and concentrates from mines in Arkansas in 1948 totaled 98 tons of combined carbonate and sulfide averaging 33.67 percent zinc and yielding 31 tons of recovered zinc. Lead ore and concentrates shipped totaled 30 tons averaging 71.70 percent lead and yielding 22 tons of recovered lead. In 1947 the output (in terms of recovered metals) was 18 tons each of zinc and lead. In 1948 the Lucky Dog Mining Co. shipped five truckloads of zinc concentrates from its mill at the Lucky Dog mine in Searcy County. C. W. Allen & Co. worked the Brewer mine near Ponca, Newton County, on a small scale and shipped both lead and zinc ore. Small lots of ore were shipped from four other mines and prospects in Marion County. The results of investigation of several zinc deposits in Northern Arkansas by the Bureau of Mines during the war were published in 1948.[3]

[3] McElwaine, R. B., Romslo, T. M., and Thoenen, J. R., Investigation of the North Arkansas Zinc Mines, Searcy, Boone, and Newton Counties, Ark.: Bureau of Mines Rept. of Investigations 4343, 1948, 25 pp.

Montana
Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By C. E. NEEDHAM and PAUL LUFF

GENERAL SUMMARY

OUTPUTS of zinc, lead, and silver in Montana in 1948 continued the uptrends established in 1947—zinc yield rose 29 percent, lead 14, and silver nearly 10; copper output, after declining for five consecutive years, rose less than 1 percent; gold fared badly, and yield dropped 19 percent. Advances in the average prices of base metals, coupled with gains in production of zinc, lead, silver, and copper, pushed the total value of the five metals to the highest figure since 1942. Lead and zinc each rose 42 percent in value, silver nearly 10, and copper 4; the value of gold dropped 19 percent, to give an over-all gain of 15 percent in total value—from $48,890,964 in 1947 to $56,422,609 in 1948. Of the total value in 1948, copper contributed 45 percent, zinc 28, lead 12, silver 11, and gold 4.

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, 1944–48

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1944	$35.00	$0.711+	$0.135	$0.080	$0.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122
1947	35.00	.905	.210	.144	.121
1948	35.00	.905+	.217	.179	.133

[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. 1944 to June 30, 1946: $0.71111111; July 1, 1946, to Dec. 31, 1947: $0.905; 1948: $0.9050505.
[3] Yearly average weighted price of all grades of primary metal sold by producers; 1944–47: price includes bonus payments by Office of Metals Reserve for overquota production.

Mine production of gold, silver, copper, lead, and zinc in Montana in 1944–48 and total, 1862–1948, 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
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
1947	243	54	3,100,013	90,124	3,154,340	6,326,190	5,725,202
1948	250	34	3,020,307	73,091	2,558,185	6,930,716	6,272,648
1862–1948			(1)	17,215,336	386,989,972	762,406,729	559,073,902

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
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
1947	115,800,000	24,318,000	32,216,000	4,639,104	91,358,000	11,054,318	48,890,964
1948	116,504,000	25,281,368	36,822,000	6,591,138	118,190,000	15,719,270	56,422,609
1862–1948	[2] 6,694,505	1,951,400,042	[2] 729,519	88,494,878	[2] 1,967,062	316,196,430	3,302,155,224

[1] Figure not available.
[2] Short tons.

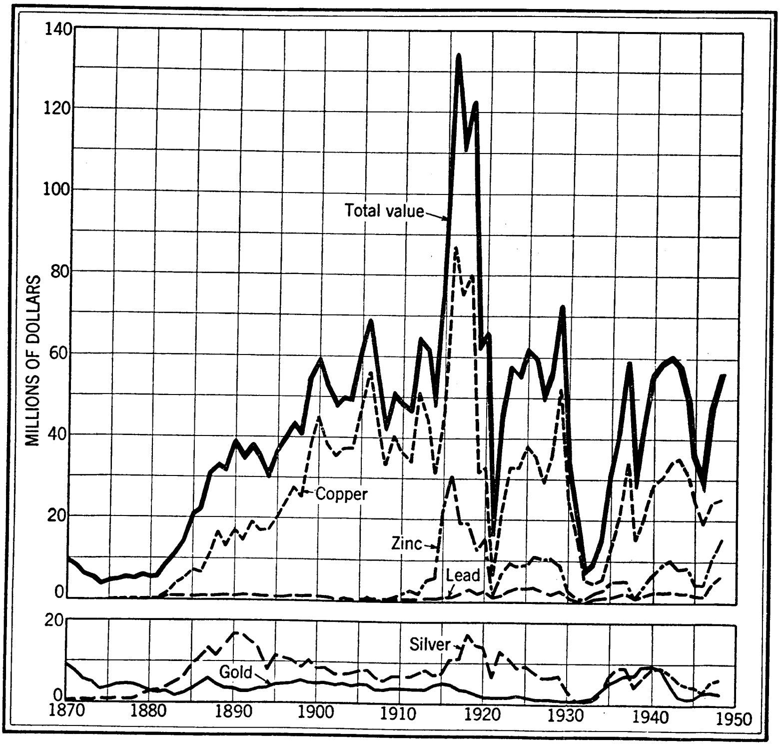

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value in Montana 1870–1948.

Gold produced at placer mines in Montana, 1944–48, 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:					
1944	2	1, 197, 600	5, 887	$206, 045	$0. 172
1945	2	1, 497, 646	9, 181	321, 335	. 215
1946	4	4, 621, 073	21, 609	756, 315	. 164
1947	5	5, 398, 575	21, 749	761, 215	. 141
1948	4	3, 523, 306	13, 932	487, 620	. 138
Dragline dredges:					
1944					
1945	2	33, 500	359	12, 565	. 375
1946	4	808, 100	4, 706	164, 710	. 204
1947	3	478, 194	2, 329	81, 515	. 170
1948	3	57, 850	299	10, 465	. 181
Becker-Hopkins dredges:					
1946 [1]	1	5, 000	32	1, 120	. 224
1947–48					
Nonfloating washing plants: [2]					
1944					
1945	1	3, 000	30	1, 050	. 350
1946	2	320, 000	1, 354	47, 390	. 148
1947	6	185, 050	2, 883	100, 905	. 545
1948	8	707, 700	2, 177	76, 195	. 108
Gravel hydraulically handled:					
Hydraulic:					
1944	3	3, 750	16	560	. 149
1945	2	420	8	280	. 667
1946	6	6, 950	87	3, 045	. 438
1947	1	15, 680	195	6, 825	. 435
1948	1	750	48	1, 680	2. 240
Small-scale hand methods:					
Wet:					
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
1947	37	13, 795	155	5, 425	. 393
1948	16	3, 805	66	2, 310	. 607
Underground placers:					
Drift:					
1944	1	25	2	70	2. 800
1945					
1946	2	2, 540	102	3, 570	1. 406
1947	2	2, 315	123	4, 305	1. 860
1948	2	200	19	665	3. 325
Grand total placers:					
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
1947	54	6, 093, 609	27, 434	960, 190	. 158
1948	34	4, 293, 611	16, 541	578, 935	. 135

[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 1948, by months, in terms of recovered metals

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	6,576	472,296	4,866	1,351	3,998
February	7,310	525,641	4,856	1,408	4,073
March	7,547	606,512	5,629	1,479	4,938
April	8,462	596,251	5,353	1,535	4,815
May	6,576	602,333	5,268	1,513	4,572
June	7,214	531,398	4,857	1,449	4,545
July	5,807	527,642	4,461	1,352	4,614
August	5,610	613,884	4,376	1,541	4,953
September	5,180	592,178	4,466	1,577	5,161
October	4,476	593,369	4,546	1,561	5,371
November	4,137	642,186	4,506	1,802	6,001
December	4,196	627,026	5,068	1,843	6,054
Total: 1948	73,091	6,930,716	58,252	18,411	59,095
1947	90,124	6,326,190	57,900	16,108	45,679

Gold.—Yields of both placer and lode gold declined sharply in 1948, but placer output proportionately more than lode. These marked drops resulted mainly from curtailment or closing of operations at a number of lode and placer properties, among which were the Jardine mine in Park County, Canusco, Inc., dredge in Missoula County, Douglas Placers dredge in Broadwater County, Granite-Bimetallic tailings operation at Philipsburg, Winston Bros. dredge in Jefferson County, and Perry & Schroeder dredge in Lewis and Clark County. The Drumlummon mine at Marysville and the U. S. Grant mine near Virginia City were the only major gold producers in the State that reported increases over 1947 figures. Of Montana's gold in 1948, 40 percent was derived from gold and silver ores (38 percent in 1947), 37 percent from base-metal ores (32 percent in 1947), and 23 percent from placers (30 percent in 1947). Ores milled yielded 59 percent of the State gold, and ores shipped to smelters 18 percent.

Gold producers in Montana that produced 2,000 ounces or more in 1948 were the properties of the Anaconda Copper Mining Co. (copper ore and waste materials and zinc-lead ore and dumps) at Butte, Porter Bros. (dredge) at Helena, Jardine mine (gold ore) at Jardine, Drumlummon mine (gold ore) at Marysville, Estelle-New Year's Gift group (copper ore) in Park County, Ruby mine (gold ore) in Phillips County, Winston Bros. (dredge) in Jefferson County, Golden Sunlight mine (gold ore) near Whitehall, H. & H. Mines (dredge) in Granite County, and U. S. Grant mine (gold-silver ore) near Virginia City. From these 10 properties came 79 percent of the State gold in 1948.

Silver.—The Butte Hill mine and dumps of the Anaconda Copper Mining Co. supplied the greater part of the State increase of 604,526 ounces of silver in 1948; yield was greater from both copper ore and zinc-lead ore. The Butte Hill mine and dumps contributed 81 percent of the State silver in 1948, followed in order by the Emma mine at Butte and the Mike Horse mine at Flesher. These three furnished nearly 88 percent of the total silver.

Zinc-lead ore supplied 63 percent of the State silver in 1948, copper ore 27, gold and silver ores 8, and lead and zinc ores together 2 percent. Ores milled yielded 91 percent of the total silver and smelting ores nearly 9 percent; minor sources were placers and old slag fumed.

Copper.—After declining for 5 consecutive years, copper output in Montana reversed the trend in 1948 and rose 0.6 percent above the 1947 level. Yield of the metal increased from both copper ore and zinc-lead ore produced at the Butte Hill mine and dumps of the Anaconda Copper Mining Co. and was great enough to balance the losses at a number of smaller operations. This company contributed 98 percent of the State copper in 1948.

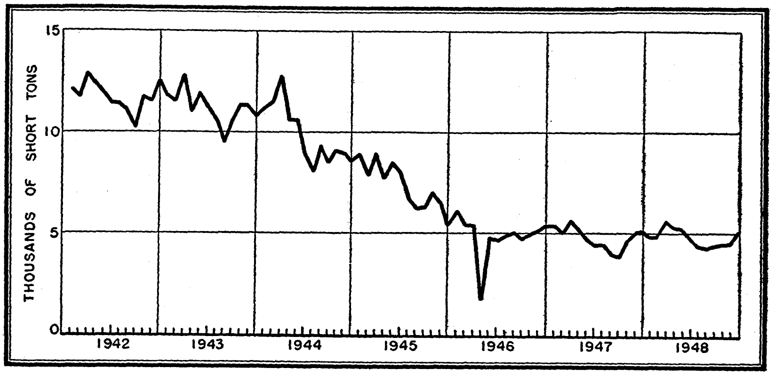

FIGURE 2.—Mine production of copper in Montana, 1942–48, by months, in terms of recovered metal.

Lead.—Lead output in Montana in 1948 was the highest since 1942. The bulk of the increase over 1947 yield was supplied by zinc-lead ore from the Butte Hill mine and dumps, the Emma mine, also at Butte, and the Jack Waite mine in Sanders County; lead output from the Mike Horse mine was 7 percent less than in 1947. The Anaconda Copper Mining Co. produced 53 percent of the State lead in 1948; other operations that produced more than a million pounds of recoverable lead each were the Emma, Mike Horse, and Jack Waite mines. These four furnished almost 84 percent of the total lead in 1948. Of the State total lead, 89 percent was recovered from zinc-lead ore, over 6 percent from lead ore, 2 percent from gold and silver ores, and over 2 percent from zinc ore and slag.

Zinc.—Production of recoverable zinc in Montana in 1948 passed 100,000,000 pounds for the first time since 1942 and for the second year in State history exceeded copper in output. Virtually all of the increase over 1947 yield came from the Butte Hill mine and dumps, the Emma mine, and old zinc slag from the East Helena dumps. Production of the metal declined at the Poulin mine at Butte and at the Mike Horse mine at Flesher. Leading State zinc producers in 1948, each producing more than a million pounds of recoverable metal, were the Butte Hill mine and dumps (72 percent of the State total), Emma mine, East Helena old slag dumps, and the Mike Horse, Poulin, and Travona mines, which together furnished 97 percent of the total zinc. Of Montana zinc in 1948, 93 percent was derived from zinc-lead ore, 6 percent from zinc ore and old slag, and nearly all of the remainder from lead ore and gold and silver ores.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Montana in 1948, 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	27	2	2,477	$86,695	89,932	$81,393
Broadwater	26	5	1,612	56,420	17,789	16,100
Cascade	5		88	3,080	44,328	40,119
Deer Lodge	2		1	35	94	85
Fergus	2		9	315	53	48
Flathead	1		1	35	32	29
Granite	14	2	2,850	99,750	54,767	49,567
Jefferson	44	2	7,953	278,355	79,084	71,575
Judith Basin	3		6	210	4,592	4,156
Lewis and Clark	32	9	15,845	554,575	173,923	157,409
Lincoln	1				221	200
Madison	36	4	5,685	198,975	251,240	227,385
Meagher		2	7	245		
Mineral	3	1	60	2,100	33,429	30,255
Missoula	5	1	110	3,850	589	533
Park	7	1	12,314	430,990	36,314	32,866
Phillips	1		3,697	129,395	8,846	8,006
Powell	13	5	1,083	37,905	25,414	23,001
Ravalli	2		11	385	2,328	2,107
Sanders	4		119	4,165	7,509	6,796
Silver Bow	22		19,163	670,705	6,100,232	5,521,018
Total: 1948	250	34	73,091	2,558,185	6,930,716	6,272,648
1947	243	54	90,124	3,154,340	6,326,190	5,725,202

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaverhead	42,600	$9,244	931,200	$166,685	207,600	$27,611	$371,628
Broadwater	5,800	1,259	326,900	58,515	115,400	15,348	147,642
Cascade	4,700	1,020	431,800	77,292	526,500	70,024	191,535
Deer Lodge	2,000	434					554
Fergus	100	22	11,800	2,112	500	67	2,564
Flathead	200	43	1,200	215	5,200	692	1,014
Granite	20,600	4,470	142,000	25,418	103,100	13,712	192,917
Jefferson	48,700	10,568	757,300	135,557	508,600	67,644	563,699
Judith Basin	1,000	217	99,700	17,846	48,100	6,397	28,826
Lewis and Clark	287,700	62,431	4,970,000	889,630	9,878,400	1,313,827	2,977,872
Lincoln			8,200	1,468	2,100	279	1,947
Madison	36,300	7,877	509,200	91,147	450,900	59,970	585,354
Meagher							245
Mineral	43,200	9,374	338,600	60,609	308,900	41,084	143,422
Missoula	2,900	629	27,600	4,940	300	40	9,992
Park	410,500	89,078	180,500	32,310	207,200	27,558	612,802
Phillips							137,401
Powell	9,800	2,127	386,500	69,183	270,100	35,923	168,139
Ravalli	600	130	46,100	8,252	54,100	7,195	18,069
Sanders	163,800	35,545	1,204,500	215,606	252,200	33,543	295,655
Silver Bow	115,423,500	25,046,900	26,448,900	4,734,353	105,250,800	13,998,356	49,971,332
Total: 1948	116,504,000	25,281,368	36,822,000	6,591,138	118,190,000	15,719,270	56,422,609
1947	115,800,000	24,318,000	32,216,000	4,639,104	91,358,000	11,054,318	48,890,964

MINING INDUSTRY

No work stoppages affected the mining industry in Montana in 1948; but many mines, especially those at Butte, needed more man-wer to reach capacity production. Under the stimulus of higher -s for base metals, active lode mines in the State in 1948 increased -ent over the number in 1947; the number of placer mines de- -7 percent. Copper ore mined in the State in 1948 declined -t, but the loss was nearly balanced by increased output of -e, chiefly from the Butte Hill mine and dumps. Of the

3,020,307 tons of ore treated during the year (3,100,013 tons in 1947), 50 percent was copper ore (59 percent in 1947), 43 percent was zinc-lead, zinc, and lead ores (32 percent in 1947), and 7 percent was gold and silver ores (9 percent in 1947).

Of much significance to the mining industry of Montana was the starting of the Kelly shaft at Butte on April 17, marking the beginning of the "Greater Butte project" of the Anaconda Copper Mining Co. to develop at least 130,000,000 tons of low-grade copper ore for future mining.

ORE CLASSIFICATION

Details of ore classification are given in the Gold and Silver chapter of this volume.

Ore sold or treated in Montana in 1948, 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	56	156, 296	23, 148	59, 794	14, 890	21, 745	33, 833
Dry and siliceous gold-silver ore	26	32, 200	5, 813	283, 816	88, 025	290, 438	144, 779
Dry and siliceous silver ore	46	28, 752	445	190, 117	161, 770	473, 873	560, 602
	128	217, 248	29, 406	533, 727	264, 685	786, 056	739, 214
Copper ore	19	1, 511, 069	10, 888	1, 894, 759	[1] 111, 143, 134	222	295
Lead ore	102	25, 398	1, 282	136, 135	97, 364	2, 365, 869	432, 715
Zinc ore	6	[2] 34, 048	32	14, 520	53, 336	808, 253	7, 045, 946
Zinc-lead ore	42	1, 232, 544	14, 942	4, 348, 858	4, 945, 481	32, 861, 600	109, 971, 830
Total lode mines	[3] 250	3, 020, 307	56, 550	6, 927, 999	[1] 116, 504, 000	36, 822, 000	118, 190, 000
Placers	34		16, 541	2, 717			
Total: 1948	284	3, 020, 307	73, 091	6, 930, 716	[1] 116, 504, 000	36, 822, 000	118, 190, 000
1947	297	3, 100, 013	90, 124	6, 326, 190	[4] 115, 800, 000	32, 216, 000	91, 358, 000

[1] Includes 5,503,688 pounds recovered from precipitates.
[2] Includes 22,727 tons of zinc slag fumed.
[3] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[4] Includes 6,004,223 pounds recovered from precipitates.

METALLURGIC INDUSTRY

The 3,020,307 tons of ore produced from Montana lode mines in 1948 were treated as follows: 2,893,171 tons (96 percent) at mills (2,939,293 tons in 1947); 104,409 tons (3 percent) shipped to smelters (153,317 tons in 1947); and 22,727 tons (1 percent) of old lead-smelter slag fumed (7,403 tons in 1947).

The 12,320-ton copper concentrator and the 2,000-ton zinc concentrator of the Anaconda Copper Mining Co. at Anaconda operated continuously in 1948. 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 511,119 tons of zinc concentrates containing 543,164,009 pounds of zinc, compared with 429,756 tons containing 453,575,671 pounds of zinc in 1947. The concentrates were received from Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and several foreign countries. The company slag-fuming plant at East Helena was operated throughout the year and treated 221,754 tons of hot slag and old cold slag compared with 226,668 tons in 1947 output of zinc-lead fume decreased from 38,229 tons in 1947 to 35,781 tons in 1948; nearly all of it was treated at the Great Falls electrolytic zinc plant.

The lead smelter of the American Smelting & Refining Co. at East Helena operated throughout 1948 and treated chiefly lead-silver concentrates from Idaho, 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 1948, 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	54, 447	9, 867	4, 415			
Ore cyanided	90, 160	3, 661	8, 060			
Concentrates smelted [1]	425, 768	29, 557	6, 318, 126	110, 049, 541	33, 146, 727	110, 143, 059
Copper precipitates smelted	4, 267			5, 503, 688		
Ore smelted	104, 409	13, 465	588, 597	950, 771	3, 167, 203	3, 290, 733
Old slag fumed	22, 727		8, 801		508, 070	4, 756, 208
Placer		16, 541	2, 717			
Total: 1948		73, 091	6, 930, 716	116, 504, 000	36, 822, 000	118, 190, 000
1947		90, 124	6, 326, 190	115, 800, 000	32, 216, 000	91, 358, 000

[1] Includes zinc concentrates treated at electrolytic plants.

Gross metal content of Montana ore treated at mills in 1948, by classes of ore[1]

Class of ore	Ore (short tons)	Gross metal content of mill feed				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	139, 657	18, 243	47, 811	15, 200	15, 000	42, 500
Dry and siliceous gold-silver	4, 500	830	7, 000	64, 000		
Copper	1, 500, 008	14, 188	1, 978, 605	113, 692, 875		
Lead	16, 232	243	. 79, 900	76, 850	541, 200	153, 290
Zinc	758	2	732	2, 000	28, 500	240, 000
Zinc-lead	1, 232, 016	23, 651	5, 637, 529	6, 607, 258	40, 402, 347	126, 834, 401
Total: 1948	2, 893, 171	57, 157	7, 751, 577	120, 458, 183	40, 987, 047	127, 270, 191
1947	2, 939, 293	62, 701	6, 562, 308	119, 803, 953	35, 000, 019	100, 392, 798

[1] Exclusive of copper ore by leaching.

Mine production of metals from mills in Montana in 1948, by counties and by classes of concentrates smelted, in terms of recovered metals

	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)
BY COUNTIES									
Beaverhead	1,575	19	-------	110	2	467	1,231	34,958	18,468
Broadwater	2,540	296	73	193	241	5,217	1,928	56,029	27,724
Cascade	9,952	-------	-------	1,012	85	43,882	4,231	424,778	522,590
Granite	525	-------	-------	75	2	5,069	3,822	28,888	29,755
Jefferson	200	30	1	-------	-------	-------	-------	-------	-------
Lewis and Clark	66,621	4,876	3,458	5,881	1,302	129,956	212,795	3,896,914	2,883,777
Lincoln	93	-------	-------	15	-------	221	-------	8,200	2,100
Madison	14,360	133	92	983	352	19,179	31,982	394,918	403,605
Mineral	13,156	-------	-------	630	59	33,429	43,200	338,600	308,900
Missoula	207	-------	-------	13	-------	40	-------	16,711	-------
Park	69,331	4,522	791	3,864	7,779	28,814	408,794	115,236	173,367
Phillips	90,115	3,652	8,060	-------	-------	-------	-------	-------	-------
Powell	8,488	-------	-------	1,606	725	19,364	4,413	312,403	241,438
Ravalli	750	-------	-------	84	11	2,307	569	45,527	53,552
Sanders	4,374	-------	-------	1,037	96	5,660	98,268	1,076,764	245,010
Silver Bow	2,610,884	-------	-------	410,265	18,903	6,024,521	114,741,996	26,396,801	105,232,773
Total: 1948	2,893,171	13,528	12,475	425,768	29,557	6,318,126	115,553,229	33,146,727	110,143,059
1947	2,939,293	17,040	11,033	367,367	31,372	5,607,199	113,972,837	29,065,614	88,001,314
BY CLASSES OF CONCENTRATES SMELTED									
Dry gold				1,245	2,651	835	4,700	-------	-------
Copper				218,248	10,319	1,845,555	110,035,930	1,353	901
Lead				19,786	3,877	1,134,709	1,621,422	21,854,784	2,217,697
Zinc				108,078	9,748	2,842,289	2,755,405	11,259,166	107,914,435
Zinc-lead				41	4	1,359	606	29,543	10,026
Dry iron (from copper and zinc-lead ore)				78,370	2,958	493,379	1,135,166	1,881	-------
Total 1948				425,768	29,557	6,318,126	115,553,229	33,146,727	110,143,059

Gross metal content of concentrates produced from ore mined in Montana in 1948, 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	1,245	2,651	835	5,508	-------	19,438
Copper	218,248	10,319	1,845,555	113,381,891	1,376	1,106
Lead	19,786	3,877	1,134,709	1,907,546	22,231,998	2,725,343
Zinc	108,078	9,748	2,842,289	2,900,416	11,851,478	110,122,816
Zinc-lead	41	4	1,359	699	30,011	12,475
Dry iron (from copper and zinc-lead ore)	78,370	2,958	493,379	1,170,324	1,917,159	5,784,486
Total: 1948	425,768	29,557	6,318,126	119,366,384	36,032,022	118,665,664
1947	367,367	31,372	5,607,199	111,532,183	30,908,529	93,066,293

Gross metal content of Montana crude ore shipped to smelters in 1948, 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	16,639	6,495	15,090	6,386	10,781	26,524
Dry and siliceous gold-silver	27,700	5,107	277,898	35,118	325,213	187,267
Dry and siliceous silver	28,752	445	190,117	172,810	508,768	982,951
Copper	11,061	211	16,847	664,823	276	390
Lead	9,166	1,152	75,444	66,168	2,010,426	499,769
Zinc	10,563	31	5,007	61,554	278,697	2,559,864
Zinc-lead	528	24	8,194	2,725	158,009	159,017
Total: 1948	104,409	13,465	588,597	1,009,584	3,292,170	4,415,782
1947	153,317	14,278	701,334	1,918,997	3,787,455	2,451,743

Mine production of metals from Montana crude ore shipped to smelters in 1948, in terms of recovered metals

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES						
Beaverhead	10,847	2,259	89,434	41,369	896,242	189,132
Broadwater	1,378	301	12,414	3,872	270,871	87,676
Cascade	55	3	446	469	7,022	3,910
Deer Lodge	15	1	94	2,000	----------	----------
Fergus	24	9	53	100	11,800	500
Flathead	30	1	32	200	1,200	5,200
Granite	4,283	428	49,539	16,778	113,112	73,345
Jefferson	21,966	4,247	77,683	48,700	757,300	508,600
Judith Basin	218	6	4,592	1,000	99,700	48,100
Lewis and Clark	14,910	677	30,740	74,905	565,016	2,238,415
Madison	21,873	4,896	231,916	4,318	114,282	47,295
Missoula	77	15	549	2,900	10,889	300
Park	446	10	6,709	1,706	65,264	33,833
Phillips	18	45	786	----------	----------	----------
Powell	1,203	284	6,029	5,387	74,097	28,662
Ravalli	4	----------	21	31	573	548
Sanders	467	23	1,849	65,532	127,736	7,190
Silver Bow	26,595	260	75,711	681,504	52,099	18,027
Total: 1948	104,409	13,465	588,597	950,771	3,167,203	3,290,733
1947	153,317	14,278	701,334	1,827,163	3,032,219	1,861,486
BY CLASSES OF ORE						
Dry and siliceous gold	16,639	6,495	15,090	5,761	9,393	21,654
Dry and siliceous gold-silver	27,700	5,107	277,898	31,150	290,438	144,779
Dry and siliceous silver	28,752	445	190,117	161,770	473,873	560,602
Copper	11,061	211	16,847	644,712	222	295
Lead	9,166	1,152	75,444	52,687	1,963,715	350,013
Zinc	10,563	31	5,007	52,336	273,966	2,086,306
Zinc-lead	528	24	8,194	2,355	155,596	127,084
Total 1948	104,409	13,465	588,597	950,771	3,167,203	3,290,733

REVIEW BY COUNTIES AND DISTRICTS

BEAVERHEAD COUNTY

Argenta District.—Ida B. Hand and John Hand, owners, and Ellis & Cummins, lessees, worked the Louis Phillip mine and shipped to smelters 221 tons of gold-silver ore containing 16 ounces of gold, 611 ounces of silver, 2,877 pounds of copper, 12,140 pounds of lead, and 8,129 pounds of zinc; and 2,198 tons of lead ore containing 227 ounces of gold, 10,322 ounces of silver, 23,189 pounds of copper, 593,467 pounds of lead, and 72,000 pounds of zinc. Shafer Bros. and lessees produced 2,604 tons of gold smelting ore from the Shafer group; the ore contained 1,752 ounces of gold and 9,079 ounces of silver. Several other properties produced smaller tonnages of lead ore and zinc-lead ore.

Bald Mountain District.—Lessees produced 133 tons of lead smelting ore from the Alice claim.

Bryant District.—Output from the Hecla mine and dumps comprised 2,306 tons of old silver slag, 152 tons of gold-silver ore, and 38 tons of lead ore.

Horse Prairie Creek (Colorado) District.—W. C. McLeod operated a dragline dredge and nonfloating washing plant on the Golden Leaf placer from May to October and recovered 194 ounces of gold and 31 ounces of silver from about 90,000 cubic yards of gravel.

Vipond District.—Quartz Hill Mines group was operated all year and produced 2,713 tons of silver smelting ore containing 28 ounces of gold and 57,578 ounces of silver.

BROADWATER COUNTY

Backer District.—White's Gulch Placer Co. operated a dragline excavator and nonfloating washing plant from May through September and washed 4,000 cubic yards of gravel. Howard Perkins worked the Superior mine and treated several hundred tons of gold ore by amalgamation and concentration.

Beaver District.—Largest output came from lessees' operations at the East Pacific and No. 4 Tunnel claims—about 1,800 tons of zinc-lead milling ore and 82 tons of lead smelting ore. Production from the Little Bonanza mine was 138 tons of lead smelting ore containing 6 ounces of gold, 3,562 ounces of silver, 1,188 pounds of copper, 108,318 pounds of lead, and 12,804 pounds of zinc.

Cedar Plains District.—William Zimmerman operated the North Home mine from March to August and shipped 362 tons of lead smelting ore containing 5 ounces of gold, 2,413 ounces of silver, 824 pounds of copper, 41,178 pounds of lead, and 25,446 pounds of zinc. Remaining district production was mainly lead ore from several small properties.

Mine production of gold, silver, copper, lead, and zinc in Montana in 1948, 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	17	-------	6,854	2,130	-------	2,130	22,865	-------	22,865	20,600	680,600	29,900	$225,518
Bald Mountain	1	1	133	7	3	10	653	-------	653	1,700	35,900	3,100	8,148
Bannack	1	-------	16	4	-------	4	1,043	-------	1,043	200	2,200	700	1,614
Bryant	1	-------	2,496	87	-------	87	6,771	-------	6,771	18,800	185,600	163,800	68,260
Chinatown	3	-------	119	19	-------	19	358	-------	358	-------	11,500	1,200	3,208
Elkhorn	1	-------	41	4	-------	4	527	-------	527	1,200	4,200	3,700	2,121
Horse Prairie Creek (Colorado)	-------	1	-------	-------	194	194	-------	31	31	-------	-------	-------	6,818
Medicine Lodge	2	-------	49	-------	-------	-------	106	-------	106	100	11,200	5,200	2,815
Vipond	1	-------	2,714	29	-------	29	57,578	-------	57,578	-------	-------	-------	53,126
Broadwater County:													
Backer	1	2	400	281	194	475	179	32	211	-------	-------	-------	16,816
Beaver	12	-------	2,195	486	-------	486	10,848	-------	10,848	3,800	186,800	51,300	67,913
Cedar Plains	9	-------	1,003	21	-------	21	6,550	-------	6,550	2,000	137,400	59,900	39,659
Park or Indian Creek	4	3	320	50	580	630	127	53	180	-------	2,700	4,200	23,254
Cascade County:													
Montana	5	-------	9,965	85	-------	85	43,960	-------	43,960	4,600	427,700	525,500	190,208
Smelter	[1]	-------	42	3	-------	3	368	-------	368	100	4,100	1,000	1,327
Deer Lodge County:													
Georgetown	1	-------	12	1	-------	1	-------	-------	-------	2,000	-------	-------	469
Oro Fino	1	-------	3	-------	-------	-------	94	-------	94	-------	-------	-------	85
Fergus County:													
Cone Butte	1	-------	3	1	-------	1	10	-------	10	-------	-------	-------	44
Warm Springs	1	-------	21	8	-------	8	43	-------	43	100	11,800	500	2,520
Flathead County: Hog Heaven	1	-------	30	1	-------	1	32	-------	32	200	1,200	5,200	1,014
Granite County:													
Boulder and South Boulder	4	-------	1,418	204	-------	204	20,189	-------	20,189	6,500	43,300	44,500	40,491
Dry Gulch	1	-------	38	-------	-------	-------	85	-------	85	100	6,900	8,400	2,451
Dunkleberg	1	-------	88	2	-------	2	748	-------	748	300	13,400	700	3,304
First Chance	1	-------	72	80	-------	80	32	-------	32	-------	-------	-------	2,829
Flint Creek	5	-------	3,082	137	-------	137	31,858	-------	31,858	12,300	74,300	48,400	56,034
Gold Creek and South Gold Creek	-------	1	-------	-------	61	61	-------	11	11	-------	-------	-------	2,145
Henderson	1	1	96	3	2,359	2,362	1,580	148	1,728	1,300	1,800	700	84,931
Maxville	1	-------	14	4	-------	4	116	-------	116	100	2,300	400	732
Jefferson County:													
Big Foot and State Creek	1	-------	343	62	-------	62	1,853	-------	1,853	2,200	47,200	5,900	13,558
Boulder and Little Boulder	2	-------	1,179	44	-------	44	8,426	-------	8,426	4,300	74,600	100,400	36,805
Cataract	13	1	560	82	3	85	4,939	-------	4,939	2,700	29,000	29,100	17,092
Clancey	1	1	64	-------	3,673	3,673	432	1,400	1,832	100	900	500	130,463
Colorado	6	-------	2,654	185	-------	185	19,074	-------	19,074	12,000	197,200	78,400	72,068
Elkhorn	3	-------	3,882	409	-------	409	34,019	-------	34,019	7,900	111,900	199,400	93,368
Golconda	1	-------	5	2	-------	2	63	-------	63	100	2,100	900	645

Montana City	1		50	2		2	126		126	200			227
Smelter	1		460	16		16	2,253		2,253	3,600	26,800	29,000	12,034
Warm Springs	1		119	36		36	1,022		1,022	500	18,400	4,600	6,200
Whitehall	12		12,708	3,411		3,411	5,435		5,435	15,000	246,900	59,300	179,641
Whitetail	1		12				42		42	100	2,300	1,100	618
Wilson and Ticer Creeks	1		130	28		28							980
Judith Basin County:													
Barker	2		206	6		6	4,339		4,339	900	99,600	47,900	28,531
Running Wolf	1		12				253		253	100	100	200	295
Lewis and Clark County:													
Blue Cloud	1		5	12		12							420
Dry Gulch		1			3	3							105
Heddleston	3		51,468	27		27	95,788		95,788	207,000	3,891,300	2,874,600	1,211,422
Helena	3	4	1,138	141	7,410	7,551	1,264	747	2,011	1,800	2,100	18,500	269,333
Lincoln		1			966	966		137	137				33,934
Madison Gulch	1		37	14		14							490
Marysville	6		15,542	6,142		6,142	35,829		35,829	16,200	54,800	45,100	266,719
Missouri River (Canyon Ferry)		3			611	611		84	84				21,461
Rimini	8		1,856	304		304	18,947		18,947	7,100	214,000	95,300	80,310
Scratch Gravel	3		611	19		19	3,054		3,054	1,100	11,000	9,000	6,834
Smelter	2		33,317	40		40	14,050		14,050	52,000	792,300	6,834,800	1,076,250
Stemple-Gould	4		283	156		156	4,023		4,023	2,500	3,800	1,100	10,469
Wolf Creek	1		1								700		125
Lincoln County: Cabinet (Fisher River)	1		93				221		221		8,200	2,100	1,947
Madison County:													
Black Tail	1		3							400		100	100
Cherry Creek	1		1	1		1	10		10				44
McCarthy Mountain	2		52	4		4	369		369	100	13,900	800	3,091
Norris and Norwegian	3		21	51		51	31		31		700	300	1,978
Pony and South Boulder	2		86	38		38	127		127	100	200	700	1,596
Renova	2		7	2		2	10		10		800	1,100	368
Rochester	5		1,308	36		36	3,371		3,371	900	89,500	12,300	22,163
Sheridan	5	3	13,100	350	109	459	19,915	21	19,936	17,700	379,500	402,600	159,426
Silver Star	4		795	225		225	927		927	17,100	21,900	32,800	20,707
Tidal Wave	4		257	293		293	675		675		1,800	100	11,201
Virginia City	7	1	20,603	4,381	195	4,576	225,752	32	225,784		900	100	364,680
Meagher County: Beaver, Elk and Thomas Creeks		2			7	7							245
Mineral County:													
Cedar and Trout Creeks		1			1	1							35
Hunter	1		1,006	1		1	1,116		1,116	1,400	39,900	255,200	42,432
Iron Mountain	1		150				443		443	100	4,300	900	1,312
Keystone	1		12,000	58		58	31,870		31,870	41,700	294,400	52,800	99,643
Missoula County:													
Coloma	1		7	14		14	10		10				499
Copper Cliff	1		214				53		53		25,000	100	4,536
Elk Creek	1		2				31		31	100	500		139
Nine Mile		1			95	95							3,325
Wallace	2		61	1		1	495		495	2,800	2,100	200	1,493

All production credited to district came from smelter cleanings.

Mine production of gold, silver, copper, lead, and zinc in Montana in 1948, 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				
Park County:													
Emigrant Creek	------	1	------	------	3	3	------	------	------	------	------	------	$105
Mill Creek	1	------	92	5	------	5	717	------	717	600	1,500	800	1,329
New World	5	------	36,269	5,808	------	5,808	34,176	------	34,176	405,200	179,000	206,400	381,632
Sheepeater	1	------	33,416	6,498	------	6,498	1,421	------	1,421	4,700	------	------	229,736
Phillips County: Little Rockies	1	------	90,133	3,697	------	3,697	8,846	------	8,846	------	------	------	137,401
Powell County:													
Big Blackfoot	1	1	1	1	48	49	10	21	31	------	700	------	1,868
Blossburg	1	------	2	3	------	3	------	------	------	------	------	------	105
Finn	------	2	------	------	15	15	------	------	------	------	------	------	525
Nigger Hill	6	------	918	60	------	60	4,834	------	4,834	1,100	64,000	23,000	21,229
Ophir Gulch	1	------	53	12	------	12	43	------	43	4,200	------	------	1,370
Pioneer	1	1	1	2	2	4	------	------	------	------	------	------	140
Willow Creek	------	1	------	------	9	9	------	------	------	------	------	------	315
Zozell	3	------	8,716	931	------	931	20,506	------	20,506	4,500	321,800	247,100	142,587
Ravalli County: Curlew	2	------	754	11	------	11	2,328	------	2,328	600	46,100	54,100	18,069
Sanders County:													
Eagle	1	------	3,997	13	------	13	5,824	------	5,824	16,000	1,199,500	251,800	257,399
Plains	1	------	139	1	------	1	1,075	------	1,075	15,000	------	------	4,263
Revais Creek	1	------	694	105	------	105	526	------	526	132,800	------	------	32,969
Thompson River	1	------	11	------	------	------	84	------	84	------	5,000	400	1,024
Silver Bow County:													
Melrose	1	------	12	------	------	------	442	------	442	------	14,900	200	3,094
Summit Valley (Butte)	21	------	2,637,467	19,163	------	19,163	6,099,790	------	6,099,790	115,423,500	26,434,000	105,250,600	49,968,288
Total Montana	250	34	3,020,307	56,550	16,541	73,091	6,927,999	2,717	6,930,716	116,504,000	36,822,000	118,190,000	56,422,609

Park or Indian Creek District.—Douglas Placers operated its dragline dredge and nonfloating washing plant from April until June and recovered 574 ounces of gold and 53 ounces of silver from 100,000 cubic yards of gravel. Palmer Engh operated the Diamond Hill mine for 5 months and treated several hundred tons of gold ore by amalgamation.

CASCADE COUNTY

Montana District.—The Bennett Mining Co. worked the Dacotah group throughout the year and treated 4,237 tons of zinc-lead ore in the company 75-ton flotation mill. The Lexington Silver-Lead Mines, Inc., produced about 2,865 tons of lead milling ore from the Tom Hendricks claim. Remaining district output was zinc-lead ore from the Galt, Star, and Silver Dyke properties.

GRANITE COUNTY

Boulder and South Boulder District.—The Brooklyn group of the Saranac Mining Co. was the source of several hundred tons of zinc-lead ore, which was treated in the company 150-ton flotation mill; in addition, 11 tons of zinc-lead ore, 10 tons of zinc ore, and 9 tons of lead ore were shipped to smelters. Sanderson Bros., lessees, shipped 170 tons of gold smelting ore from the Gold King claim.

Flint Creek District.—American Machine & Metals Co., Inc., operated its Trout group throughout the year and shipped to smelters 245 tons of silver ore containing 4 ounces of gold and 3,723 ounces of silver; and 146 tons of lead ore containing 3 ounces of gold, 1,558 ounces of silver, 398 pounds of copper, 28,732 pounds of lead, and 16,200 pounds of zinc. Remaining district production was mainly 2,105 tons of old gold-silver tailings from the Granite-Bimetallic dump and 368 tons of silver smelting ore from the Silver Prince claim.

Henderson District.—H. & H. Mines operated its bucket-line dredge on Henderson Creek until November 21, when the dredge was lost through accidental sinking. During its period of operation the dredge washed 701,978 cubic yards of gravel. Remaining district output was small.

JEFFERSON COUNTY

Big Foot and State Creek District.—The Mountain Queen claim produced 343 tons of lead smelting ore.

Boulder and Little Boulder District.—District output was mainly 623 tons of silver smelting ore from the Ida claim.

Clancey District.—Winston Bros. operated its bucket-line dredge on Prickly Pear Creek until June 26 and washed 604,480 cubic yards of gravel. Remaining district production was 64 tons of silver ore from the Free Coinage dump.

Colorado District.—Minah Development Co. operated its Minah mine during all of 1948 and shipped 849 tons of gold-silver smelting ore containing 93 ounces of gold, 9,168 ounces of silver, 3,570 pounds of copper, 54,885 pounds of lead, and 22,602 pounds of zinc. Remaining district output was principally 907 tons of gold-silver smelting ore from the Mount Washington mine.

Elkhorn District.—The Elkhorn mine was operated for a month by the Elkhorn Mining Co., then for the remainder of the year by the Associated Mines Development Co. Output for the year was 1,188 tons of gold-silver ore containing 223 ounces of gold, 14,831 ounces of silver, 1,859 pounds of copper, 21,364 pounds of lead, and 46,644 pounds of zinc. Other district production included 2,361 tons of old silver tailings from the Elkhorn property and 333 tons of lead ore from the Elkhorn Queen claim.

Warm Springs District.—District output was 119 tons of lead smelting ore from the Nellie Grant claim.

Whitehall District.—Lester Lindquist operated the Carbonate mine all year and shipped 567 tons of lead smelting ore containing 14 ounces of gold, 1,121 ounces of silver, 1,556 pounds of copper, 119,919 pounds of lead, and 36,206 pounds of zinc. Marvin Riebhoff shipped 10,840 tons of gold ore from the Golden Sunlight mine. Albert Critchfield operated the Iron Side mine for 6 months and shipped 168 tons of lead smelting ore containing 2 ounces of gold, 544 ounces of silver, 545 pounds of copper, 34,589 pounds of lead, and 6,104 pounds of zinc. George Wolfe worked the Lucky Hit claim throughout 1948 and shipped 315 tons of gold smelting ore containing 189 ounces of gold, 483 ounces of silver, 2,026 pounds of copper, 1,010 pounds of lead, and 2,520 pounds of zinc. Other district production was mainly 247 tons of lead ore from the Perhaps mine, 144 tons of gold-silver ore from the Parrott claim, and 88 tons of copper ore, also 48 tons of gold-silver ore, from the Inspiration claim.

JUDITH BASIN COUNTY

Barker District.—Thorson & Brazee worked the Wright-Edwards group all year and shipped 146 tons of zinc-lead smelting ore containing 6 ounces of gold, 4,000 ounces of silver, 605 pounds of copper, 79,710 pounds of lead, and 47,136 pounds of zinc. Remaining district output was 47 tons of lead ore and 13 tons of zinc-lead ore from the Glendennin (Tiger) group.

LEWIS AND CLARK COUNTY

Heddleston District.—The Mike Horse Mining & Milling Co. operated the Mike Horse mine for a full year and treated in the company 230-ton flotation mill 51,375 tons of zinc-lead ore containing 33 ounces of gold, 107,888 ounces of silver, 503,400 pounds of copper, 4,336,050 pounds of lead, and 3,483,225 pounds of zinc. Remaining district production was small.

Helena District.—Porter Bros. Corp. operated its 6-cubic-foot Yuba bucket-line dredge on Last Chance Gulch throughout 1948 and washed 2,128,848 cubic yards of gravel. O. A. Barnes operated a dragline excavator and nonfloating washing plant on the Caswell placer from June 1 to October 20, and washed 4,000 cubic yards of gold-bearing gravel. Remaining district production was principally siliceous gold and gold-silver material from the Peck Concentrator dump, Springhill property, and Whitlatch Union tailing pile.

Lincoln District.—Otis Williams & Co. operated a dragline dredge and nonfloating washing plant on Poorman and McClellan Creeks and washed about 500,000 cubic yards of gravel.

Marysville District.—The Montana Rainbow Mining Co. operated the Drumlummon mine and treated 15,106 tons of gold ore in its 150-ton amalgamation-flotation mill. Operations were largely halted after August because of damage to the shaft, caused by the caving of heavy ground. Remaining district production was mainly lead ore—48 tons from the Larson claim, 60 tons from the Towsley mine, and 172 tons, as well as 82 tons of silver ore, from the Shakopee mine.

Missouri River District.—Perry & Schroeder Mining Co. operated its 6-cubic-foot bucket-line dredge on French Bar only in January; 88,000 cubic yards of gravel were washed. Two other placer operations in the district reported production during the year.

Rimini District.—Lessees operated the Red Mountain Consolidated Mining Co. group and shipped dump and crude ore to smelters—265 tons of gold-silver ore and 776 tons of lead ore. Finnish-American Mining Co. operated the Armstrong mine and shipped 285 tons of gold-silver smelting ore. Remaining output from the district was mainly dump ore—188 tons of gold-silver ore from the Eureka dump and 228 tons of lead ore from the Stanton and Little Sampson dumps.

Scratch Gravel District.—Principal production was dump ore from the Silver Coin property—553 tons of silver ore and 3 tons of lead ore.

Smelter District.—Nearly all the metals credited to the Smelter district came from 33,250 tons of old zinc slag, 22,727 tons of which went direct to the East Helena slag-fuming plant of the Anaconda Copper Mining Co.; the remainder went to the East Helena lead smelter.

MADISON COUNTY

Rochester District.—Jacobson & Keene, lessees, worked the Calvin mine and shipped 211 tons of lead smelting ore containing 15 ounces of gold, 2,040 ounces of silver, 758 pounds of copper, 61,065 pounds of lead, and 11,838 pounds of zinc. Lessees operated the Emma group part of the year; 22 tons of lead ore were shipped to a smelter, and about 1,060 tons of lead dump ore were milled. Remaining district output was small.

Sheridan District.—Victoria Mines, Inc., treated a substantial tonnage of zinc-lead ore in the company mill and produced 418 tons of lead concentrate, 358 tons of zinc concentrate, and 73 tons of copper concentrate; in addition, 150 tons of gold-silver ore were shipped to a smelter. Considerable gold was recovered from the Ihde placer. Remaining district output included small shipments of lead ore and silver ore from various properties.

Silver Star District.—Bulk of production was about 450 tons of copper ore from the Victoria and American Pit claims, 110 tons of zinc-lead ore from the Robin claim, and 232 tons of old tailings from the Schmidt property.

Tidal Wave District.—Lessees operated the Corncracker group throughout the year and shipped 98 tons of gold ore containing 178 ounces of gold and 131 ounces of silver. Remaining district production likewise was nearly all gold ore—86 tons from the High Ridge and High Ridge Fraction claims, 8 tons from the Smith claim, and 55 tons (as well as 10 tons of lead ore) from the Granger group.

Virginia City District.—The U. S. Grant Mining Co. operated its U. S. Grant mine and shipped to smelters 12,431 tons of gold-silver ore containing 2,168 ounces of gold and 147,017 ounces of silver. The company also operated the Easton-Pacific group and shipped 3,033 tons of gold-silver ore containing 531 ounces of gold and 20,820 ounces of silver. Henry Shute operated the Cornucopia mine and shipped 4,933 tons of gold-silver smelting ore. Remaining lode production was mainly 152 tons of gold ore from the Garrison group. Russell Unrue operated a dragline dredge on the Barton Gulch placer from late June to the middle of October and washed 31,400 cubic yards of gravel.

MINERAL COUNTY

Hunter District.—Dykstra & Johnson, lessees, operated the Silver Cable mine and produced 758 tons of zinc ore and 248 tons of zinc-lead ore.

Keystone District.—Lessees milled a substantial tonnage of lead ore from the Nancy Lee mine, which yielded 367 tons of lead concentrate.

MISSOULA COUNTY

Copper Cliff District.—The Hecla Mining Co. operated the Blacktail mine and produced 207 tons of lead milling ore and 7 tons of lead smelting ore.

Nine Mile District.—Canusco, Inc., operated a dragline dredge on the Imperial placer during May, then turned the property back to the owners. During the period of its operation, the dredge recovered 95 ounces of gold from 26,000 cubic yards of gravel.

PARK COUNTY

New World District.—McLaren Gold Mines Co. operated the Estelle-New Year's Gift group and milled a large quantity of copper ore, which yielded 2,070 tons of copper-gold concentrate and 2 tons of gold concentrate. Ex-Cello Mines, lessee, worked the Homestake mine until February 15; on April 1 the property was sold to the Parkmont Corp., which operated it from July 15 to October 15. During the year, the mine produced 4,500 tons of gold-silver ore treated by flotation-amalgamation and shipped 27 tons of lead smelting ore. Irma Mines, Inc., milled zinc-lead ore from the Irma mine and produced 89 tons of lead concentrate and 194 tons of zinc concentrate. In addition, 324 tons of lead dump ore were shipped to a smelter. Other district production was small.

Sheepeater District.—The Jardine Mining Co. closed its Jardine mine on July 15, following a fire that destroyed the cyanide plant of the cyanidation-flotation mill on May 8. During the period of its operation, the mill treated 33,416 tons of gold ore, which yielded 6,498 ounces of gold and 1,421 ounces of silver.

PHILLIPS COUNTY

Little Rockies District.—The Ruby Gulch Mining Co. operated the Ruby group until November 20 and treated in the company 300-ton cyanide leaching plant 90,115 tons of gold ore containing 4,300 ounces of gold and 9,400 ounces of silver. In addition, 18 tons of gold-silver ore were shipped to a smelter.

POWELL COUNTY

Big Blackfoot District.—John B. Hopkins & Associates conducted hydraulicking and drift mining on the Hopkins group and recovered 48 ounces of gold from about 750 cubic yards of gravel.

Nigger Hill District.—Hopkins & Sons Mining Co. operated the Charter Oak mine throughout 1948 and produced 735 tons of zinc-lead ore containing 33 ounces of gold, 3,853 ounces of silver, 827 pounds of copper, 52,430 pounds of lead, and 15,500 pounds of zinc. Part of the ore was treated in the company 35-ton flotation mill. Remaining district output was principally 36 tons of gold-silver ore and 34 tons of zinc-lead ore from the Lilly group, 42 tons of lead ore from the Negros claim, and 49 tons of gold-silver ore from the Blackfoot claim.

Zozell District.—The Bonanza Leasing Co. operated the Bonanza group from May through December and produced 556 tons of gold ore and 5 tons of lead ore. The gold ore contained 208 ounces of gold, 1,185 ounces of silver, 93 pounds of copper, 7,768 pounds of lead, and 4,533 pounds of zinc. The Deer Lodge Mining Co. worked the Emery group until June 30, then liquidated the operation. During the period of operation, 8,070 tons of zinc-lead ore were treated by flotation. Remaining district output was small.

RAVALLI COUNTY

Curlew District.—The Victor Development Co. worked the Whippoorwill mine and milled zinc-lead ore, which yielded 32 tons of lead concentrate and 36 tons of zinc concentrate. Remaining district output was small lots of lead and zinc-lead ore shipped from the Curlew claim.

SANDERS COUNTY

Eagle District.—The American Smelting & Refining Co. operated the Jack Waite mine throughout 1948 and produced 3,904 tons of zinc-lead milling ore and 93 tons of lead smelting ore. The milling ore contained 15 ounces of gold, 6,442 ounces of silver, 23,000 pounds of copper, 1,162,600 pounds of lead, and 294,360 pounds of zinc.

Plains District.—F. R. Walkley shipped 139 tons of copper smelting ore from the Mascot claim.

Revais Creek District.—The Drake group was operated all year by the Green Mountain Mining Co. Production was 694 tons of copper ore containing 121 ounces of gold, 590 ounces of silver, and 151,637 pounds of copper. Part of the ore was treated in the company flotation mill.

SILVER BOW COUNTY

Ore production in Silver Bow County in 1948 was 12,564 tons greater than in 1947, and outputs of silver, copper, lead, and zinc gained 16, 1, 24, and 29 percent, respectively; gold production declined 3 percent. The total value of the five metals in 1948 was 18 percent greater than in 1947 and represented nearly 89 percent of the State total value. The following table gives the output of mines in the County, which includes the Summit Valley (Butte) district, in 1947–48 and the total from 1882 to the end of 1948.

Production of gold, silver, copper, lead, and zinc in Silver Bow County, Montana, 1947–48, and total, 1882–1948, 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
1947	32	2,624,915	19,801	5,252,011	114,374,000	21,269,500	81,425,000	$42,379,878
1948	22	2,637,479	19,163	6,100,232	115,423,500	26,448,900	105,250,800	49,971,332
1882–1948		(1)	2,065,161	557,137,222	(2) 6,658,718	(2) 258,721	(2) 1,664,107	2,691,763,222

[1] Figure not available.
[2] Short tons.

Summit Valley (Butte) District.—Company material treated at the copper concentrator of the Anaconda Copper Mining Co. at Anaconda comprised 1,277,349 tons of copper ore from the main Butte Hill mine (1,178,845 tons in 1947), 15,164 tons from the Greater Butte project (none in 1947), 95,579 tons of Adams ore (286,550 tons in 1947), 63,327 tons of special waste (59,926 tons in 1947), and 7,308 tons from the Tramway dump (none in 1947). Direct smelting ore totaled 10,859 tons (21,391 tons in 1947), and mine-water precipitates 4,267 tons (4,050 tons in 1947).

Production of zinc-lead ore from the Butte Hill mine of the Anaconda Copper Mining Co. reached 748,957 tons in 1948 (465,385 tons in 1947) and that from the Butte Hill dumps 345,539 tons (298,654 tons in 1947). This marked increase in ore production was the main factor in pushing State yield of zinc to the highest level in recent years, as well as supplying important increases in lead, copper, gold, and silver from this operation. The company-operated Emma mine had an output of 36,150 tons of zinc-lead dump ore, mine ore, and middling from the treatment of manganese ore (27,254 tons in 1947). Zinc-lead middling (4,548 tons) was also produced in milling manganese ore from the Travona mine; the middling was treated further at the Anaconda zinc concentrator. The Poulin mine, operated under lease from the Anaconda Copper Mining Co., was the remaining large zinc producer in the district; output was 6,497 tons of zinc-lead milling ore and 573 tons of copper smelting ore. From the Montana Ore Purchasing Co. dump near Butte, 10,361 tons of old copper tailings were shipped to a concentrator and 1,740 tons of old silver tailings to a smelter.

Remaining district production was nearly all siliceous silver ore shipped to smelters; 10,138 tons came from the Bluebird tailing dump, 231 tons from the Burlington mine, 1,483 tons from the Amazon mine, 73 tons from the Fredonia mine, 377 tons from the Little Darling dump, 175 tons from the Magna Charta mine, 487 tons from the Maria claim, and 447 tons from the Nettie mine.

Nevada
Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By R. B. MAURER

GENERAL SUMMARY

STIMULATED by a strong demand combined with higher average prices for the base metals, zinc and lead production in Nevada in 1948 rose substantially over the 1947 output. In contrast, the production of copper in 1948 dropped below the level attained the previous year, owing largely to lower yield of the metal from ore mined in the principal copper-producing district in the State. Gains in both gold and silver output in 1948 reflected to some degree the larger production of the two precious metals as byproducts from lead, zinc, and fluxing ores, but important increases were attained at open-cut mines that produced ores solely for their gold and silver values. The total value of gold, silver, copper, lead, and zinc recovered from ores, old tailings, and gravels mined at 350 lode and 36 placer properties in Nevada in 1948 was $34,055,480 compared with $31,366,282, the output of 276 lode and 31 placer mines in 1947—an increase of 9 percent.

Comparing 1948 with 1947, gold output increased 25 percent in quantity and value; copper decreased 9 percent in quantity but only 6 percent in value; silver increased 30 percent in quantity and value; lead increased 37 percent in quantity and 70 percent in value; and zinc increased 20 percent in quantity and 31 percent in value. Of the total value of the five metals, copper comprised 58 percent; zinc, 16 percent; gold, 11 percent; lead, 10 percent; and silver, 5 percent.

As in 1947, White Pine County led the other counties by producing 63 percent of the State total value of the five metals in 1948; it stood first in output of copper and gold, second in silver and lead, and third in zinc. Lincoln County ranked second to White Pine County, with 25 percent of the State total value, and 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, 1944–48

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1944	$35.00	$0.711+	$0.135	$0.080	$0.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122
1947	35.00	.905	.210	.144	.121
1948	35.00	.905+	.217	.179	.133

[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. 1944 to June 30, 1946: $0.71111111; July 1, 1946, to Dec. 31, 1947: $0.905; 1948: $0.9050505.
[3] Yearly average weighted price of all grades of primary metal sold by producers; 1944–47: price includes bonus payments by Office of Metals Reserve for overquota production.

Mine production of gold, silver, copper, lead, and zinc in Nevada, 1944–48, and total, 1859–1948, 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
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
1947	276	31	6,541,635	89,063	3,117,205	1,377,579	1,246,709
1948	350	36	7,172,611	111,532	3,903,620	1,790,020	1,620,058
1859–1948 [2]			(3)	25,717,596	578,677,536	592,771,311	543,593,369

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
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
1947	99,206,000	20,833,260	14,322,000	2,062,368	33,940,000	4,106,740	31,366,282
1948	90,484,000	19,635,028	19,554,000	3,500,166	40,576,000	5,396,608	34,055,480
1859–1948 [2]	[4] 1,877,513	546,171,810	[4] 564,118	65,810,051	[4] 384,746	64,991,864	1,799,244,630

[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 1948, inclusive, the output was as follows: Gold, 13,910,719.51 ounces valued at $334,194,303; silver, 304,358,462 ounces, $206,435,146; copper, 1,875,587 tons, $545,525,182; lead, 326,327 tons, $43,173,489; zinc, 384,746 tons, $64,991,864; total value, $1,194,319,984.
[3] Figure not available.
[4] Short tons.

Gold.—Gold production in Nevada in 1948 rose 25 percent over the 1947 output and was the highest in quantity and value since 1944. Despite the established and unchanged price of gold and the continuing high costs of mine operation, there was increased activity in the exploitation of gold ore in 1948. The output from placer mines increased 17 percent above the total for 1947, owing principally to dragline dredging. Gold from lode mines—which accounted for 93 percent of the State total gold production—increased 26 percent. Monthly production of gold, as shown in the accompanying table, was fairly uniform and slightly above the 1947 average from January through July, but increased sharply in August, and a higher rate of production was maintained through December. Reversing the pattern of the previous year, byproduct gold from base-metal ores comprised only 38 percent of the output of gold in 1948 whereas gold recovered from precious-metal ores was 55 percent of the total.

The 10 leading gold-producing mines in 1948 contributed 84 percent of Nevada's output, the 3 leaders producing 48 percent.

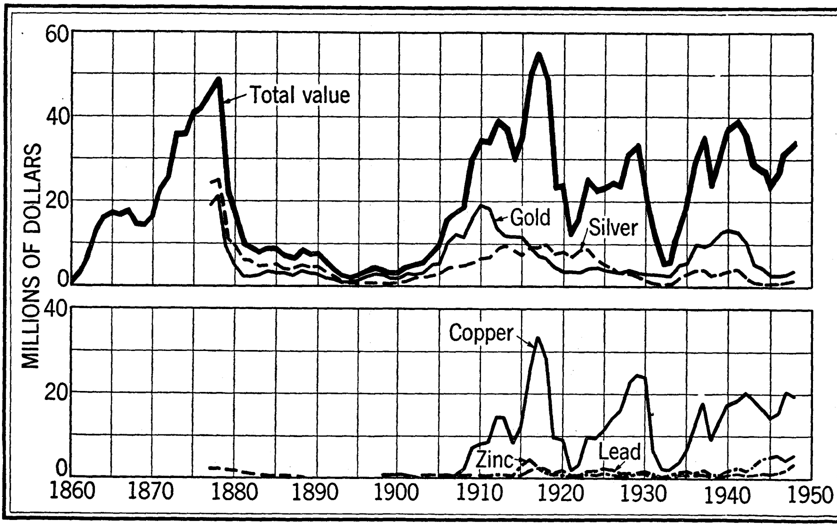

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value of Nevada, 1860–1948.

Silver.—Production of silver in Nevada in 1948 was up 30 percent compared with 1947; as in preceding years, a large percentage of the silver output was a byproduct of ore mined chiefly for other metals. Base-metal ores were the source of 52 percent of the State silver production in 1948 (71 percent in 1947), whereas 21 percent (13 percent in 1947) was from straight silver ore. The monthly production figures in the accompanying table follow closely the pattern set by lead and zinc output in 1948—a gradual increase in production the first 10 months followed by successive sharp drops in November and December occasioned by severe late fall and winter weather.

Ten leading gold-producing mines in Nevada in 1948, in order of output

Rank	Mine	District	County	Rank in 1947	Operator	Source of gold
1	Ruth and Copper Flat	Robinson	White Pine	1	Kennecott Copper Corp. (Nevada Mines Division).	Copper ore.
2	Goldacres	Bullion	Lander	2	Consolidated Goldacres Co. and London Extension Mining Co.	Gold ore.
3	Coppermines group	Robinson	White Pine	3	Consolidated Coppermines Corp	Copper ore.
4	Getchell and Pinson & Ogee	Potosi	Humboldt	(1)	Getchell Mines, Inc	Gold ore.
5	Overman	Comstock	Storey	4	Consolidated Chollar, Gould, and Savage Mining Co.	Gold-silver ore.
6	Greenan Placers	Battle Mountain	Lander	9	Natomas Co	Dredge.
7	Standard (Lally)	Echo (Rye Patch)	Pershing	5	Standard Cyaniding Co	Gold ore.
8	Pioche group	Pioche	Lincoln	6	Combined Metals Reduction Co	Zinc and zinc-lead ores.
9	Summit King group	Sand Springs	Churchill	(1)	Summit King Mines, Ltd	Gold-silver ore.
10	Jumbo (Austin)	Awakening	Humboldt	14	Austin Bros. Gold Mining Co. and Red Ledge Mining Co.	Gold ore.

[1] Did not produce in 1947.

Ten leading silver-producing mines in Nevada in 1948, in order of output

Rank	Mine	District	County	Rank in 1947	Operator	Source of silver
1	Pioche group	Pioche	Lincoln	1	Combined Metals Reduction Co	Zinc and zinc-lead ores.
2	Summit King group	Sand Springs	Churchill	(1)	Summit King Mines, Ltd	Gold-silver ore.
3	Overman	Comstock	Storey	4	Consolidated Chollar, Gould, and Savage Mining Co.	Do.
4	Prince	Pioche	Lincoln	10	Prince Consolidated Mining Co	Zinc-lead, lead, and silver ores.
5	Bristol Silver	Jack Rabbit	do	3	Bristol Silver Mines Co	Silver ore.
6	Ruth and Copper Flat	Robinson	White Pine	2	Kennecott Copper Corp. (Nevada Mines Division).	Copper ore.
7	Apex	Pioche	Lincoln	9	Salt Lake Pioche Mining Co	Silver ore.
8	Cleveland	Delano	Elko	7	McFarland & Hullinger	Lead ore.
9	Protection	Cope	do	11	Knowles Bros	Gold-silver ore.
10	Mizpah and Valley View	Tonopah	Nye	5	Tonopah Mining Co. of Nevada and lessees	Do.

[1] Did not produce in 1947.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1948, by months, in terms of recovered metals

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	8,364	92,791	4,330	630	1,299
February	7,036	99,396	3,077	640	1,320
March	7,026	109,555	3,607	754	1,309
April	8,794	155,114	3,617	713	1,250
May	8,023	172,488	3,614	682	1,486
June	8,042	139,536	3,535	609	1,417
July	8,140	151,370	3,230	702	1,408
August	12,132	167,199	4,697	940	1,979
September	12,269	175,801	3,717	795	1,989
October	10,824	210,933	3,581	1,260	2,756
November	10,102	171,435	4,307	1,064	2,432
December	10,780	144,402	3,930	988	1,643
Total 1948	111,532	1,790,020	45,242	9,777	20,288

Copper.—Nevada copper production was centered in the Robinson (Ely) district, White Pine County, where the State's two leading producers supplied a preponderant percentage of the total 1948 output; these were: The Kennecott Copper Corp. (Nevada Mines Division), working the Ruth and Copper Flat mines, and the Consolidated Coppermines Corp., working the Coppermines group at Kimberly. Other producers of copper in Nevada included the Bristol Silver Mining Co., Bristol Silver mine, Jack Rabbit district, and the Ely Valley Mine, Ely Valley mine, Pioche district, both in Lincoln County; and lessees of the Copper Canyon Mining Co., Copper Basin mine, Battle Mountain district, Lander County.

Lead.—Of the recoverable lead produced in Nevada in 1948, 57 percent was mined in the Pioche district, Lincoln County, where the leading properties were: The Combined Metals Reduction Co., working the Pioche groups; the Ely Valley mine, operated by Ely Valley Mine; and the Prince Consolidated Mining Co. Prince mine. Other important lead producers in the State were: R. K. Hamilton and L. F. Jacobson, operating the Yellow Pine mine, Yellow Pine district, Clark County (second largest producer of lead in Nevada); Fred C. Farnsworth, Farnsworth mine, Ward district, White Pine County; McFarland & Hullinger, Cleveland mine (Delano district, Elko County); Bristol Silver Mines Co., Bristol Silver mine (Jack Rabbit district, Lincoln County); and Lee H. Bayliss, Delno mine (Delano district, Elko County).

Zinc.—In 1948, as in recent years, zinc production in Nevada was centered in the Pioche district, Lincoln County, where 92 percent of the State total for the year was mined. The Combined Metals Reduction Co., Ely Valley Mine and Prince Consolidated Mining Co., were the State's leading producers, in the order named; all are in the Pioche district. Other important zinc producers in the State were the Comet Mining Co., Comet mine, Comet district, Lincoln County, and R. K. Hamilton and L. F. Jacobson, Yellow Pine mine, Yellow Pine district, Clark County.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1948, 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	10	------	2,739	$95,865	------	------	2,739	$95,865	167,195	$151,320
Clark	26	------	1,668	58,380	1	$35	1,669	58,415	23,443	21,217
Elko	36	2	546	19,110	562	19,670	1,108	38,780	156,653	141,779
Esmeralda	19	------	92	3,220	------	------	92	3,220	15,017	13,591
Eureka	12	3	92	3,220	55	1,925	147	5,145	41,688	37,730
Humboldt	16	------	12,767	446,845	------	------	12,767	446,845	12,089	10,941
Lander	22	2	19,995	699,825	6,402	224,070	26,397	923,895	45,010	40,736
Lincoln	36	------	5,038	176,330	------	------	5,038	176,330	844,681	764,479
Lyon	12	1	1,916	67,060	26	910	1,942	67,970	12,727	11,519
Mineral	25	------	872	30,520	------	------	872	30,520	24,473	22,149
Nye	38	14	1,351	47,285	525	18,375	1,876	65,660	60,379	54,646
Pershing	15	12	5,506	192,710	565	19,775	6,071	212,485	23,296	21,084
Storey	14	------	11,591	405,685	------	------	11,591	405,685	176,882	160,087
Washoe	7	------	277	9,695	------	------	277	9,695	241	218
White Pine	62	2	38,904	1,361,640	42	1,470	38,946	1,363,110	186,246	168,562
Total: 1948	350	36	103,354	3,617,390	8,178	286,230	111,532	3,903,620	1,790,020	1,620,058
1947	276	31	82,062	2,872,170	7,001	245,035	89,063	3,117,205	1,377,579	1,246,709

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Churchill	100	$22	2,400	$430	------	------	$247,637
Clark	41,400	8,984	1,504,600	269,323	867,300	$115,351	473,290
Elko	79,700	17,295	1,827,000	327,033	141,500	18,820	543,707
Esmeralda	5,400	1,172	245,900	44,016	35,000	4,655	66,654
Eureka	11,900	2,582	576,300	103,158	81,700	10,866	159,481
Humboldt	8,300	1,801	43,100	7,715	8,800	1,170	468,472
Lander	255,600	55,465	471,500	84,399	158,600	21,094	1,125,589
Lincoln	978,000	212,226	12,422,800	2,223,681	38,567,700	5,129,504	8,506,220
Lyon	30,900	6,705	------	------	------	------	86,194
Mineral	5,000	1,085	351,700	62,954	------	------	116,708
Nye	3,100	673	132,200	23,664	7,600	1,011	145,654
Pershing	400	87	24,800	4,439	6,400	851	238,946
Storey	------	------	100	18	------	------	565,790
Washoe	------	------	------	------	------	------	9,913
White Pine	89,064,200	19,326,931	1,951,600	349,336	701,400	93,286	21,301,225
Total: 1948	90,484,000	19,635,028	19,554,000	3,500,166	40,576,000	5,396,608	34,055,480
1947	99,206,000	20,833,260	14,322,000	2,062,368	33,940,000	4,106,740	31,366,282

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

MINING INDUSTRY

The 10-percent increase in total tonnage of ores and old tailings sold or treated in 1948 compared with 1947 reflects an increase in total dry and siliceous ores and an increase in all the base-metal ores except zinc-lead ore and zinc-lead-copper ore. Higher average prices for the base metals permitted exploitation of larger tonnages of lower-grade copper ore and stimulated the production of zinc and lead ores. Increased demand for fluxing ores at base-metal smelters and renewed interest ...ld and silver mining accounted for the rise in output of dry and ...s ores.

...8, the dragline dredge of the Natomas Co., in the Battle

Mountain district, Lander County, produced 78 percent of Nevada's placer gold and was the sixth largest producer of gold in the State. Except for this dredge, Nevada placer mines were almost entirely limited to operations that handled gravel on a relatively small scale.

ORE CLASSIFICATION

The accompanying table classifying ores sold or treated in Nevada in 1948 shows that 87 percent of the tonnage (including old tailings) was copper ore, 7 percent gold ore and old tailings, nearly 3 percent zinc ore, 2 percent gold-silver ore and old tailings, and the remainder silver ore and old tailings, lead ore and old tailings, zinc-lead ore, and lead-copper ore.

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 1948, 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	487,148	13,065	46,954	73,682	26,000	3,400	----------
Dry and siliceous gold-silver ore	165,276	93	13,093	414,157	9,000	40,100	----------
Dry and siliceous silver ore	32,033	939	609	370,756	432,900	1,469,000	680,500
Total	684,457	14,097	60,656	858,595	467,900	1,512,500	680,500
Copper ore	6,209,049	--------	37,385	142,435	[1] 89,305,200	200	----------
Lead ore	32,143	455	973	245,239	91,900	6,176,400	201,400
Lead-copper ore	102	--------	1	1,053	8,100	52,600	----------
Zinc ore	186,286	--------	1,332	140,081	517,400	1,490,600	32,989,200
Zinc-lead ore	45,923	99	3,007	401,154	93,500	10,321,700	6,704,900
Total lode mines	7,157,960	14,651	103,354	1,788,557	[1] 90,484,000	19,554,000	40,576,000
Placers	----------	--------	8,178	1,463	----------	----------	----------
Total: 1948	7,157,960	14,651	111,532	1,790,020	[1] 90,484,000	19,554,000	40,576,000
1947	6,524,803	16,832	89,063	1,377,579	[2] 99,206,000	14,322,000	33,940,000

[1] Includes 2,055,200 pounds of copper from precipitates.
[2] Includes 2,607,400 pounds of copper from precipitates.

METALLURGIC INDUSTRY

Of the 7,172,611 tons of lode material (including 14,651 tons of old tailings) from Nevada mines sold or treated during 1948, 99 percent went to mills and 1 percent to smelters.

The 1,500-ton selective-flotation mill operated by the Combined Metals Reduction Co. at Pioche, Lincoln County, treated zinc and zinc-lead ores on a custom basis for several neighboring mines and also milled company zinc and zinc-lead ores. 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 at the McGill 20,000-ton concentrator. It also operated the McGill copper smelter, Nevada's only smelter, treating in addition to copper ore and copper concentrate, siliceous gold and silver ores used for fluxing. Custom ores were treated by W. F. Donovan at his 100-ton cyanide mill in the Silver City district, Lyon County, and at the Dayton Consolidated Mining Co. 150-ton cyanide plant, operated in conjunction with a 200-ton flotation mill in the Comstock district, Storey County.

Mine production of metals in Nevada in 1948, 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	39,152	3,816	2,790	----------	----------	----------
Ore and old tailings cyanided	610,196	50,033	384,384	----------	----------	----------
Concentrates smelted:						
Flotation	212,971	43,772	688,011	86,479,600	11,539,800	38,234,600
Gravity	818	176	13,098	2,700	731,200	52,300
Ore and old tailings smelted	103,598	5,557	700,274	1,946,500	7,283,000	2,289,100
Precipitates smelted	----------	----------	----------	2,055,200	----------	----------
Total lode mines	----------	103,354	1,788,557	90,484,000	19,554,000	40,576,000
Placers	----------	8,178	1,463	----------	----------	----------
Total: 1948	----------	111,532	1,790,020	90,484,000	19,554,000	40,576,000
1947	----------	89,063	1,377,579	99,206,000	14,322,000	33,940,000

Mine production of metals from mills in Nevada in 1948, by counties, in terms of recovered metals

	Material treated		Recovered in bullion		Concentrates smelted and recovered metal					
	Ore (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)
BY COUNTIES										
Churchill	12,000	-------	2,709	164,972	9	29	441	100	500	---------
Clark	5,498	13,000	409	1,714	614	1,172	5,587	2,000	502,900	46,900
Elko	925	20	62	45	112	28	5,249	---------	76,100	43,200
Esmeralda	140	-------	28	6	24	2	320	700	7,400	8,100
Eureka	212	-------	-------	-------	44	21	3,620	300	23,600	21,100
Humboldt	111,375	-------	12,683	4,966	122	56	3,890	500	30,500	8,800
Lander	172,939	-------	17,765	2,003	1,300	1,468	25,018	74,000	393,000	158,600
Lincoln	227,910	-------	-------	-------	48,977	4,229	509,473	556,300	11,011,900	37,991,600
Lyon	15,536	4	1,916	12,701	-------	-------	-------	---------	---------	---------
Mineral	1,119	-------	268	988	66	7	2,085	100	46,900	---------
Nye	1,204	-------	726	1,115	13	36	308	100	4,500	3,400
Pershing	174,693	-------	5,420	21,680	1	80	575	---------	---------	---------
Storey	166,412	134	11,586	176,743	1	4	126	---------	100	---------
Washoe	461	-------	277	241	-------	-------	-------	---------	---------	---------
White Pine	6,165,332	99	-------	-------	162,506	36,816	144,417	85,848,200	173,600	5,200
Total: 1948	7,055,756	13,257	53,849	387,174	213,789	43,948	701,109	86,482,300	12,271,000	38,286,900
1947	6,386,736	13,084	30,462	152,414	220,924	45,920	595,629	92,099,200	7,319,800	30,926,900
BY CLASSES OF CONCENTRATES										
Dry gold	-------	-------	-------	-------	440	2,526	2,965	12,300	2,400	---------
Dry silver	-------	-------	-------	-------	2	3	170	---------	---------	---------
Copper	-------	-------	-------	-------	162,502	36,939	138,000	85,894,700	---------	---------
Lead	-------	-------	-------	-------	14,241	3,109	383,764	413,600	10,532,300	1,762,600
Zinc	-------	-------	-------	-------	35,435	1,228	149,158	145,100	974,600	36,319,000
Zinc-lead	-------	-------	-------	-------	1,169	143	27,052	16,600	761,700	205,300
Total 1948	-------	-------	-------	-------	213,789	43,948	701,109	86,482,300	12,271,000	38,286,900

Gross metal content of concentrates produced from ores mined in Nevada in 1948, by classes of concentrates

Class of concentrates	Concentrates produced (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	440	2,526	2,965	12,790	3,575	------------
Dry silver	2	3	170	1	11	------------
Copper	162,502	36,939	138,000	86,988,521	------------	------------
Lead	14,241	3,109	383,764	423,686	10,724,480	2,164,669
Zinc	35,435	1,228	149,158	151,474	1,059,249	37,062,484
Zinc-lead	1,169	143	27,052	19,632	774,946	282,999
Total: 1948	213,789	43,948	701,109	87,596,104	12,562,261	39,510,152
1947	220,924	45,920	595,629	94,377,319	7,677,868	31,793,186

Gross metal content of Nevada crude ore and old tailings shipped to smelters in 1948, 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	5,287	--------	2,344	4,029	145	1,482	----------
Dry and siliceous gold-silver	4,610	--------	1,210	96,829	9,330	65,955	----------
Dry and siliceous silver	18,818	939	452	342,060	490,759	1,103,006	711,343
Copper	44,174	--------	573	4,750	[1] 3,465,150	436	----------
Lead	24,347	455	894	229,140	119,143	5,579,263	311,953
Lead-copper	102	--------	1	1,053	9,599	54,817	----------
Zinc	883	--------	3	565	5,021	15,241	736,281
Zinc-lead	3,983	--------	80	21,848	58,448	838,296	1,393,632
Total: 1948	102,204	1,394	5,557	700,274	[1] 4,157,595	7,658,496	3,153,209
1947	138,067	3,748	5,680	626,799	[2] 7,464,882	7,324,744	4,166,568

[1] Includes 2,079,218 pounds of copper from precipitates.
[2] Includes 2,671,498 pounds of copper from precipitates.

Mine production of metals from Nevada crude ore and old tailings shipped to smelters in 1948, in terms of recovered metals

	Material treated		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
	Ore (short tons)	Old tailings (short tons)					
BY COUNTIES							
Churchill	45	--------	1	1,782	------------	1,900	---------
Clark	3,373	--------	87	16,142	39,400	1,001,700	820,400
Elko	7,631	--------	456	151,225	79,700	1,750,900	98,300
Esmeralda	861	244	62	14,691	4,700	238,500	26,900
Eureka	4,950	--------	71	38,065	11,600	552,700	60,600
Humboldt	211	--------	28	3,233	7,800	12,600	---------
Lander	4,348	--------	762	17,045	181,600	78,500	---------
Lincoln	20,269	--------	809	335,208	421,700	1,410,900	576,100
Lyon	175	--------	--------	12	30,900	---------	---------
Mineral	1,776	1,005	597	21,400	4,900	304,800	---------
Nye	2,727	28	589	58,799	3,000	127,700	4,200
Pershing	125	56	6	836	400	24,800	6,400
Storey	28	--------	1	13	------------	---------	---------
White Pine	55,685	61	2,088	41,823	[1] 3,216,000	1,778,000	696,200
Total: 1948	102,204	1,394	5,557	700,274	[1] 4,001,700	7,283,000	2,289,100
1947	138,067	3,748	5,680	626,799	[2] 7,106,800	7,002,200	3,013,100
BY CLASSES OF MATERIAL							
Dry and siliceous gold	5,287	--------	2,344	4,029	100	1,000	---------
Dry and siliceous gold-silver	4,610	--------	1,210	96,829	9,000	39,500	---------
Dry and siliceous silver	18,818	939	452	342,060	417,500	1,018,900	509,800
Copper	44,174	--------	573	4,750	[1] 3,424,100	200	---------
Lead	24,347	455	894	229,140	89,500	5,322,500	164,500
Lead-copper	102	--------	1	1,053	8,100	52,600	---------
Zinc	883	--------	3	565	4,300	14,900	604,600
Zinc-lead	3,983	--------	80	21,848	49,100	833,400	1,010,200
Total 1948	102,204	1,394	5,557	700,274	[1] 4,001,700	7,283,000	2,289,100

[1] Includes 2,055,200 pounds of copper from precipitates.
[2] Includes 2,607,400 pounds of copper from precipitates.

REVIEW BY COUNTIES AND DISTRICTS

CHURCHILL COUNTY

Broken Hills District.—The Broken Hills Mining & Milling Co., incorporated May 23, 1948 (formerly Broken Hills Mine), developed the Broken Hills mine during 1948; 43 tons of silver ore shipped to a smelter yielded 1,759 ounces of silver and 1,900 pounds of lead.

Sand Springs District.—Summit King Mines, Ltd. (second-largest producer of silver in Nevada in 1948) worked the Summit King Group during 10 months of the year; 2,633 ounces of gold and 163,313 ounces of silver was recovered from 11,763 tons of ore cyanided at the company 60-ton mill.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1948, 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, fine ounces) [3]	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total					
Churchill County:											
Broken Hills	1		43				1,759		1,900		$1,932
Eastgate	1		98	56		56	455				2,372
Fairview	2		16	9		9	3				318
Holy Cross	3		117	37		37	470	100	500		1,832
Sand Springs	2		11,770	2,637		2,637	164,413				241,097
Wonder	1		1				95				86
Clark County:											
Gold Butte	1		3	3		3	28		600		237
Searchlight	9		13,436	1,581	1	1,582	1,487	7,800	100		58,427
Yellow Pine (Goodsprings)	15		8,132	77		77	21,089	33,600	1,503,900	867,300	413,622
Elko County:											
Cope	4		1,200	418		418	45,688	27,400	11,800		64,038
Delano	4		4,552	20		20	97,181	19,900	1,390,100		341,800
Gold Circle	3		31	23		23	216		100		1,018
Jarbidge	3		161	62		62	45				2,211
Merrimac	4		833	7		7	5,394		126,000	45,700	33,759
Railroad	4		234	1		1	1,929	16,700	21,500		9,254
Ruby Valley	5		625	5		5	2,263	4,600	120,400	1,700	24,999
Spruce Mountain	6		773	7		7	3,338	9,400	128,600	93,900	40,814
Tecoma	1		134	2		2	383		25,800		5,035
Van Duzer		2			562	562	134				19,791
Esmeralda County:											
Divide	2		62	43		43	374				1,843
Klondyke	2		7				23	300	300		140
Lone Mountain	5		320	4		4	1,768	2,100	62,900	23,200	16,541
Montezuma	3		322	13		13	8,480	1,100	112,800	11,800	30,129
Palmetto	1		57				266	200	17,200		3,363
Railroad Springs	1		4					800			174
Silver Peak	3		185	32		32	2,407				3,298
Sylvania	1		244				1,214	200	50,800		10,235
Eureka County:											
Cortez	5		858	40		40	26,716	2,200	50,700	21,100	37,937
Eureka	4		161	44		44	197	5,400	12,500	37,500	10,116
Lynn		3			55	55	3				1,928
Roberts	1		38				44		10,400	10,400	3,285

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1948, 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, fine ounces) [3]	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total					
Humboldt County:											
Awakening	3		34,356	1,916		1,916	4,388	400	20,300		$74,752
Barrett Springs	1		62	20		20	1,948	300	3,700		3,190
Gold Run	4		209	17		17	1,255	300	13,200	3,100	4,571
Red Butte	1		44				616		5,800	5,700	2,354
Varyville	1		55	4		4	94	2,600	100		807
Warm Springs	3		235	40		40	17	300			1,480
Winnemucca	1		17				108	4,400			1,053
Lander County:											
Battle Mountain	10	2	21,690	1,580	6,402	7,982	33,805	254,400	468,500	157,500	469,980
Birch Creek	1		4	23		23	38				839
Bullion	3		151,522	16,676		16,676	1,901	100			585,403
Lewis	2		362	7		7	8,144	900	700		7,936
New Pass	2		2,838	1,414		1,414	648		1,100		50,273
Reese River	3		811	273		273	452	200	1,200	1,100	10,368
Lincoln County:											
Chief (Caliente)	1		24				51		2,700		529
Comet	2		4,965	114		114	27,499	29,700	158,600	821,100	172,918
Eagle Valley	1		70	2		2	1,077				1,045
Freiburg	1		5				32		1,500		298
Ferguson	2		47	111		111	203		500		4,159
Groom	2		1,911	2		2	3,484	1,700	318,600		60,621
Jack Rabbit	4		8,316	97		97	125,025	404,300	707,700	523,500	400,586
Pahranagat	1		94				1,107	1,400	7,300		2,613
Pioche	21		231,657	4,508		4,508	684,321	540,900	11,225,900	37,223,100	7,854,608
Lyon County:											
Silver City	8	1	15,218	1,894	26	1,920	12,522				78,533
Talapoosa	1		33	10		10	183				516
Yerington	2		457	8		8	14	30,900			6,998
Mineral County:											
Columbus (Candelaria)	5		2,175	526		526	16,566	1,800	300,300		87,548
East Walker (Mount Grant)	1		56	18		18	4				634
Fitting	1		5	20		20	2				702
Hawthorne	5		403	63		63	1,175		1,000		3,447
Pilot Mountain	2		494	11		11	2,258	300	43,000		10,191
Regent (Rawhide)	1		57	13		13	23				476
Silver Star	7		668	210		210	4,326	2,900			11,894
Walker Lake	2		40				81		6,800		1,290
Nye County:											
Bruner	1		147	177		177	454				6,606
Bullfrog	2		157	53		53	37				1,888
Cloverdale	2		58	42		42	132		1,600	200	1,902

Fairplay (Goldyke)	1	-------	6	-------	-------	-------	62	300	1,300	-------	354
Hannapah	3	-------	77	2	-------	2	1,001	-------	-------	-------	976
Jackson	1	-------	cleanup	6	-------	6	3	-------	-------	-------	213
Johnnie	-------	1	-------	-------	35	35	4	-------	-------	-------	1,229
Mammoth	6	-------	557	49	-------	49	4,405	2,100	60,500	-------	16,988
Manhattan	9	13	281	292	490	782	414	-------	2,000	100	28,115
Tonopah	4	-------	1,723	468	-------	468	45,938	200	3,900	-------	58,697
Troy	3	-------	620	230	-------	230	414	-------	900	-------	8,586
Tybo	2	-------	236	25	-------	25	2,782	-------	30,000	-------	8,763
Washington	2	-------	72	4	-------	4	4,318	500	32,000	7,300	10,856
Willow Creek	1	-------	22	3	-------	3	371	-------	-------	-------	441
Pershing County:											
Antelope Springs	2	-------	56	1	-------	1	163	-------	9,800	-------	1,937
Echo (Rye Patch)	1	-------	174,220	5,365	-------	5,365	21,629	-------	-------	-------	207,350
Imlay	1	4	65	1	252	253	256	300	6,100	-------	10,244
Placeritas	-------	3	-------	-------	22	22	3	-------	-------	-------	773
Rochester	3	4	319	25	290	315	132	-------	-------	-------	11,144
Seven Troughs	3	1	28	80	1	81	149	-------	2,600	-------	3,435
Sierra	5	-------	186	34	-------	34	964	100	6,300	6,400	4,063
Storey County: Comstock	14	-------	166,574	11,591	-------	11,591	176,882	-------	100	-------	565,790
Washoe County:											
Jumbo	1	-------	4	5	-------	5	141	-------	-------	-------	303
White Horse (Olinghouse)	6	-------	457	272	-------	272	100	-------	-------	-------	9,610
White Pine County:											
Aurum	5	-------	345	4	-------	4	842	2,200	84,600	20,000	19,182
Black Horse	1	-------	21	-------	-------	-------	203	-------	10,400	-------	2,046
Cherry Creek	5	-------	854	75	-------	75	2,844	2,300	10,300	4,700	8,167
Duck Creek	1	-------	2	-------	-------	-------	3	-------	1,600	-------	289
Ellison	1	-------	17	-------	-------	-------	86	-------	4,200	1,400	1,016
Granite (Steptoe)	4	-------	373	1	-------	1	202	-------	94,600	300	17,191
Newark	2	-------	43	-------	-------	-------	1,829	-------	-------	-------	1,655
Osceola	1	2	2,802	1,264	42	1,306	692	-------	-------	-------	46,336
Robinson (Ely)	25	-------	6,207,554	37,453	-------	37,453	144,015	88,982,500	169,000	563,700	20,855,622
Shoshone	1	-------	37	-------	-------	-------	249	-------	11,600	-------	2,301
Taylor	3	-------	102	-------	-------	-------	897	1,300	17,100	7,200	5,113
Ward	2	-------	6,841	82	-------	82	19,479	38,500	1,052,800	21,100	220,111
White Cloud	2	-------	110	-------	-------	-------	134	-------	29,800	-------	5,455
White Pine (Hamilton)	7	-------	1,975	24	-------	24	14,142	37,200	449,300	83,000	113,175
Other districts [4]	15	-------	82,353	11,028	-------	11,028	22,420	6,900	524,200	12,900	503,315
Total Nevada	350	36	7,172,611	103,354	8,178	111,532	1,790,020	90,484,000	19,554,000	40,576,000	34,055,480

[1] Only those districts shown separately for which Bureau of Mines is at liberty to publish figures; other producing districts listed in footnote 4 and their output included with "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: 1,788,557 ounces from lode mines and 1,463 ounces from placers.

[4] Includes following districts: El Dorado Canyon in Clark County; Contact (Salmon River) and White Horse in Elko County; Goldfield in Esmeralda County; Diamond in Eureka County; Potosi in Humboldt County; Hilltop in Lander County; Atlanta in Lincoln County; Pilot Range in Lyon County; Garfield in Mineral County; Reveille in Nye County; and Eagle and Hunter in White Pine County.

CLARK COUNTY

Searchlight District.—The Desert Milling Co. recovered 380 ounces of gold and 870 ounces of silver from 13,000 tons of old tailings and dump material cyanided at the Quartette mine 100-ton mill from January 1 to June 20 and from October 10 through December 31, 1948. Morse & Graves, operating the Valley mine during 1948, shipped concentrate containing a substantial amount of gold and some silver to a smelter.

Yellow Pine District.—J. W. Stewart worked the Anchor mine throughout 1948 and shipped 478 tons of lead ore containing 3 ounces of gold, 1,679 ounces of silver, 900 pounds of copper, 325,900 pounds of lead, and 38,700 pounds of zinc to a smelter. R. K. Hamilton and L. F. Jacobson worked the Yellow Pine mine in 1948. Zinc-lead concentrate and zinc-lead ore containing some gold, silver, and copper were shipped to a smelter.

ELKO COUNTY

Cope (Mountain City) District.—Knowles Bros. operated the Protection mine throughout 1948 and shipped 1,107 tons of gold-silver ore containing 412 ounces of gold, 44,776 ounces of silver, 1,600 pounds of copper, and 11,800 pounds of lead to a smelter.

Delano District.—Lead ore was shipped to smelters during 1948 by McFarland & Hullinger (Cleveland mine) and Lee H. Bayliss (Delno mine).

Merrimac District.—Rip Van Winkle Consolidated Mining Co. operated the Rip Van Winkle mine throughout 1948; 484 tons of zinc-lead ore shipped to a concentrator-smelter yielded 3 ounces of gold, 4,944 ounces of silver, 43,400 pounds of lead, and 41,400 pounds of zinc.

Railroad District.—Gregory Bros. & R. A. Kinne, lessees, developing the Sweepstakes mine from January 1 to November 10, 1948, shipped to smelters 131 tons of copper and lead ores together containing 1 ounce of gold, 1,067 ounces of silver, 11,900 pounds of copper, and 4,900 pounds of lead.

Spruce Mountain District.—Nevada Monarch Consolidated Mines Corp. completed 3,572 feet of diamond drilling at its claims during 1948; lessees (Cleghorn & Boundy, E. C. Gibson, and M. Woodward) shipped lead ore from the Monarch and Black Forest mines and silver ore from the Spruce Standard mine to smelters for treatment.

Van Duzer District.—The M. P. M. Mining Co. operated a Diesel dragline and Judson-Pacific washing plant on Van Duzer Creek and Cobb Creek from January 1 to November 6, 1948; 60,000 cubic yards of gravel washed yielded 548 ounces of gold and 132 ounces of silver.

ESMERALDA COUNTY

Divide (Gold Mountain) District.—Lessees working the Tonopah Divide mine during 1948 shipped gold ore to smelters.

Goldfield District.—The Deep Mines Operation continued development of the Florence, White Rock, and Laguna mines (the latter owned by Goldfield Consolidated Mines Co.) and constructed a 100-ton flotation and cyanidation plant during 1948.

Lone Mountain District.—Wells & Fabbi and Stewart & Leid operated the Sally Louise, Gossin Prince, and Nevada Silver claims during 1948; 198 tons of lead and zinc-lead ores shipped to various smelters yielded 3 ounces of gold, 1,467 ounces of silver, 1,900 pounds of copper, 41,300 pounds of lead, and 3,200 pounds of zinc.

Montezuma District.—E. S. Perry, working the Bullion and Benton claims from June 15 to October 15, 1948, shipped silver, lead, and zinc-lead ores totaling 176 tons to smelters; 8 ounces of gold, 3,439 ounces of silver, 300 pounds of copper, 22,000 pounds of lead, and 11,800 pounds of zinc were recovered.

EUREKA COUNTY

Cortez District.—The Cortez Lease Co. operated the Queen (Cortez) mine during 6 months of 1948, shipping 640 tons of silver ore containing 19 ounces of gold, 22,838 ounces of silver, 1,700 pounds of copper, and 26,700 pounds of lead to a smelter.

Diamond District.—Lowell Thompson shipped a substantial quantity of lead ore containing some silver, copper, and zinc to smelters during 1948. Steel Galena Mine operated the Steel Galena mine throughout 1948; lead ore yielding some silver and copper was shipped to a smelter.

Eureka District.—The Lone Mountain Lease operated the Mountain View, the No. 1, and No. 2 claims from October 1 to December 31, 1948; 91 tons of zinc ore shipped to a smelter yielded 9 ounces of silver, 8,200 pounds of lead, and 37,500 pounds of zinc.

HUMBOLDT COUNTY

Awakening District.—The Austin Bros. Gold Mining Co. and its successor, the Red Ledge Mining Co., treated a substantial tonnage of gold ore from the Jumbo (Austin) open-pit mine by amalgamation during 1948.

Potosi District.—Getchell Mine, Inc. (fourth largest producer of gold in Nevada in 1948), operated its mill during the year principally as an experimental plant to work out a carbon cyanidation process; doré bullion and carbon concentrates produced from Getchell mine and Pinson & Ogee open-pit lease gold ores yielded a substantial quantity of gold and some silver.

LANDER COUNTY

Battle Mountain District.—The Copper Canyon Mining Co. opened for production the Hornfels ore body of the Copper Canyon mine in August 1948 after an extensive development program, treating 11,621 tons of silver ore (including development ore) in the company 350-ton revamped flotation mill; 737 tons of zinc-lead concentrate containing 135 ounces of gold, 22,949 ounces of silver, 14,500 pounds of copper, 389,600 pounds of lead, and 157,500 pounds of zinc was shipped to a smelter. From January to March 1948 ores from company leases and other neighboring mines were treated experimentally on a custom basis at the mill. Lessees worked the Copper Canyon Mining Co. Copper Basin property during 1948, shipping gold and copper ores to the company concentrating mill and copper, gold, and gold-silver ores directly to a smelter for treatment. The Natomas Co. (largest producer of placer gold in Nevada in 1948) operated a dragline dredge at Greenan Placers from January 1 to September 28, 1948; 602,833 cubic yards of gravel treated yielded 6,376 ounces of gold and 940 ounces of silver.

Bullion District.—The Consolidated Goldacres Co. and its successor, the London Extension Mining Co., operated the Goldacres mine during 1948. Gold ore was treated in the company 300-ton cyanide plant.

New Pass District.—The Reorganized Silver King Mining Co. operated the New Pass and Thomas W. mines during 1948. Gold and some silver were recovered from gold ore amalgamated at the company mill and from gold ore and gold concentrate shipped to smelters.

LINCOLN COUNTY

Comet District.—Comet Mines, Inc., operated the Comet mine (fourth-largest producer of zinc in Nevada) throughout 1948 and shipped zinc-lead ore (4,960 tons containing 114 ounces of gold, 27,282 ounces of silver, 29,700 pounds of copper, 155,500 pounds of lead, and 821,100 pounds of zinc) to the Combined Metals Reduction Co. mill at Pioche for treatment.

Groom District.—Dan Sheahan, lessee, operated the Groom mine throughout 1948. Lead ore and lead concentrate containing some gold, silver, and copper were shipped to a smelter for treatment.

Jack Rabbit District.—The Bristol Silver Mines Co. worked the Bristol mine the entire year, shipping silver ore containing some gold and substantial quantities of copper, lead, and zinc to a smelter.

Pioche District.—The Combined Metals Reduction Co. operated its 1,500-ton flotation mill on company and custom ore throughout 1948. Company zinc-lead and zinc ores were derived from the Abe Lincoln group, the Pioche 802 mine, and the Pan American, Pioche, and Wenlock Free leases. Custom zinc and zinc-lead ores came principally from the Ely Valley Mine Ely Valley mine and the Prince Consolidated Mining Co. Prince mine (respectively second- and third-largest producers of zinc in Nevada in 1948). The mill products were lead and zinc concentrates, which were shipped to smelters. In addition, the Prince Consolidated Mining Co. shipped substantial tonnages of silver ore and lead ore for direct smelting. The Salt Lake-Pioche Mining Co. shipped silver ore from the Apex mine and lead ore from the Financier mine to smelters during 1948.

LYON COUNTY

Silver City District.—W. M. Donovan operated his custom cyanide mill in Silver City during 1948 on ores from his own open-pit mines—the Silver Hill and the Hartford (Storey County) and from a number of small neighboring properties. The Dayton Consolidated Mines Co. and lessees worked the Dayton, Wedge, and Oest open-pit mines during the year; ore was treated at the company mill in Storey County. A number of small mines in the district were active during 1948.

MINERAL COUNTY

Columbus (Candelaria) District.—G. A. Peterson operated the New Potosi mine throughout 1948 and shipped 1,054 tons of lead ore containing 488 ounces of gold, 10,907 ounces of silver, 400 pounds of copper, and 202,500 pounds of lead to a smelter.

Silver Star District.—F. Williams and J. Cantwell operated the Mindoro group throughout 1948; 165 tons of gold-silver ore shipped to a custom cyanide mill yielded 52 ounces of gold and 725 ounces of silver.

NYE COUNTY

Bruner District.—Erwin & Chisholm operated the Golden Eagle group from March 15 to December 31, 1948; 147 tons of gold ore cyanided at a custom mill yielded 177 ounces of gold and 454 ounces of silver.

Mammoth District.—Obie LeFavor shipped lead ore containing some gold, silver, and copper to a smelter from the San Rafael mine on Quartz Mountain during the year.

Manhattan District.—C. H. Fehn and R. E. Johnson, operating a power shovel and stationary washing plant in Manhattan Gulch in 1948, recovered 170 ounces of gold and 60 ounces of silver from 4,000 cubic yards of gravel washed.

Tonopah District.—The Tonopah Mining Co. of Nevada and lessees operated the Mizpah and Valley View mines during 11 months of 1948, shipping gold-silver ore to a smelter.

Troy District.—The Old English Gold Corp. worked the Old English mine throughout 1948; 500 tons of gold ore amalgamated yielded 180 ounces of gold and 25 ounces of silver. In addition, gold ore (18 tons containing 12 ounces of gold and 15 ounces of silver) and concentrate (5 tons containing 36 ounces of gold and 47 ounces of silver) were shipped to smelters.

PERSHING COUNTY

Echo (Rye Patch) District.—The Standard Cyaniding Co. treated ore from its Standard (Lally) open-pit mine in the company 600-ton cyanide plant throughout 1948, recovering substantial quantities of gold and silver.

Rochester District.—The Southwest Dredging Co. operated two dragline excavators, two power shovels, and a dryland washing plant at Spring Valley Placers from October 1, to December 31, 1948; 42,000 cubic yards of gravel washed yielded 221 ounces of gold and 59 ounces of silver.

STOREY COUNTY

Comstock District.—The Consolidated Chollar Gould & Savage Mining Co. worked the Overman open-pit mine throughout 1948 treating 147,210 tons of gold-silver ore (containing 8,938 ounces of gold and 146,647 ounces of silver) in the company 500-ton cyanide plant. In addition, a small quantity of concentrate was shipped to a smelter. Dayton Consolidated Mines Co. operated its cyanide plant and flotation mill from August 1 to December 31, 1948, on custom ores from nearby mines, in addition to treating ore from the company Keystone open-pit mine and the Dayton, Wedge, and Oest mines in Lyon County. W. M. Donovan worked the Hartford and Silver Hill open-pit mines during 1948 and treated the ore by cyanidation in his mill at Silver City.

WASHOE COUNTY

White Horse (Olinghouse) District.—Emile Cabanne, lessee, operated the Hutchinson mine throughout 1948; 30 tons of ore amalgamated yielded 55 ounces of gold and 20 ounces of silver.

WHITE PINE COUNTY

Aurum (Silver Mountain) District.—The Grand Deposit Mining Co. operated the Grand Deposit mine throughout 1948 and shipped 268 tons of lead ore containing 3 ounces of gold, 646 ounces of silver, 1,600 pounds of copper, 76,200 pounds of lead, and 18,800 pounds of zinc to smelters.

Osceola District.—The Gilded Age Mining Co. shipped from the Gilded Age mine 2,802 tons of gold ore containing 1,264 ounces of gold and 686 ounces of silver to a smelter during 1948.

Robinson (Ely) District.—The Kennecott Copper Corp. (Nevada Mines Division) operated the Ruth and Copper Flat pit throughout the year and worked the Ruth underground mine from January to August 1948. The ore from these mines and the copper ore produced by the Consolidated Coppermines Corp. was treated at Kennecott's McGill flotation concentrator and copper smelter. Kennecott was the leading producer of copper and gold in the State. The Consolidated Coppermines Corp., second-largest copper and third-largest gold producer in Nevada in 1948, worked the Coppermines group throughout 1948. In addition to the copper ore produced, substantial quantities of lead ore and zinc ore were shipped to smelters by lessees.

Ward District.—M. A. Crafts, operating the Ward mine from April 10, to December 1, 1948, shipped 1,111 tons of lead ore containing 8 ounces of gold, 2,764 ounces of silver, 2,800 pounds of copper, 215,600 pounds of lead, and 21,100 pounds of zinc to a smelter. Fred Farnsworth shipped a substantial quantity of lead ore containing some gold, silver, and copper to a smelter during the year from the Farnsworth property.

White Pine District.—P. C. Fraser, working the Seligman Lead-Zinc mine from June through December 1948, shipped zinc-lead and lead ores (143 tons containing 2 ounces of gold, 606 ounces of silver, 800 pounds of copper, 33,400 pounds of lead, and 5,500 pounds of zinc) to a concentrator-smelter for treatment. Nevada Sunshine Silver Mines, Inc., shipped zinc-lead, lead-copper, and copper ores to smelters from the Grand Prize mine during 1948.

New Mexico
Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By A. J. MARTIN

GENERAL SUMMARY

METAL mining in New Mexico in 1948 was featured by increases in production of copper and lead and further advances in base-metal prices, which together raised the total value of the State output of gold, silver, copper, lead, and zinc to a new record high of $46,799,576. The previous high was $38,374,269 in 1947. Zinc production decreased 6 percent in quantity but rose slightly in value because of the advance in the metal price. The output of gold and silver—nearly all a byproduct of the mining of base metals—varied little from 1947 and represented only 1 percent of the total value of the five metals. As usual, the Central district, Grant County, produced most of the State output of copper, lead, and zinc and also considerable silver. The Magdalena zinc-lead-silver district, the Lordsburg copper-silver-gold-lead district, and the Burro Mountain copper district were important producers. Other districts together contributed a small part of the State total output of the five metals.

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, 1944–48

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1944	$35	$0.711+	$0.135	$0.080	$0.114
1945	35	.711+	.135	.086	.115
1946	35	.808	.162	.109	.122
1947	35	.905	.210	.144	.121
1948	35	.905+	.217	.179	.133

[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. 1944 to June 30, 1946: $0.71111111; July 1, 1946, to Dec. 31, 1947: $0.905; 1948: $0.9050505.
[3] Yearly average weighted price of all grades of primary metal sold by producers; 1944–47: price includes bonus payments by Office of Metals Reserve for overquota production.

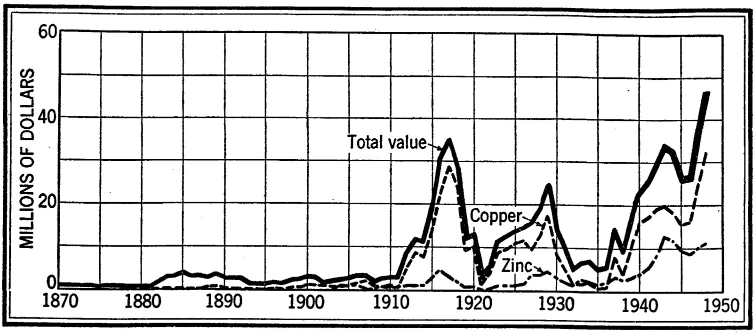

FIGURE 1.—Value of mine production of copper and zinc and total value of gold, silver, copper, lead, and zinc in New Mexico, 1870–1948. The value of gold, silver, and lead produced annually has been relatively small.

Mine production of gold, silver, copper, lead, and zinc in New Mexico, by months, in 1948, in terms of recovered metals

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	249	41, 030	6, 331	524	3, 306
February	283	40, 450	5, 953	499	3, 274
March	219	41, 330	6, 100	605	3, 425
April	238	40, 130	6, 394	616	3, 553
May	244	46, 526	6, 449	603	3, 220
June	186	44, 372	7, 227	638	3, 336
July	374	48, 689	6, 172	676	3, 155
August	362	45, 033	5, 992	734	3, 002
September	298	44, 563	6, 070	684	3, 880
October	316	48, 302	5, 908	693	3, 716
November	354	49, 634	6, 260	685	3, 742
December	291	47, 615	5, 831	696	3, 893
Total: 1948	3, 414	537, 674	74, 687	7, 653	41, 502
1947	3, 146	515, 833	60, 205	6, 383	44, 103

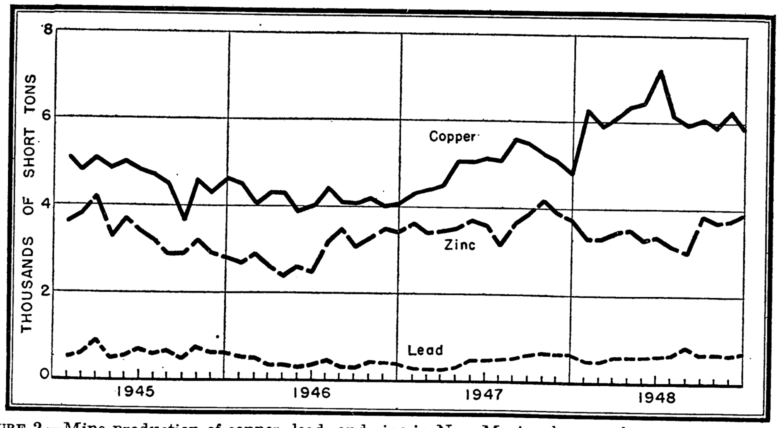

FIGURE 2.—Mine production of copper, lead, and zinc in New Mexico, by months, 1945–48, in terms of recovered metals.

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 1944 to 1948, as well as the total production from 1848 to 1948. 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, 1944–48, and total, 1848–1948, 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
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
1947	82	3	7, 352, 945	3, 146	110, 110	515, 833	466, 829
1948	91	2	7, 733, 163	3, 414	119, 490	537, 674	486, 622
1848–1948	-----------	-----------	(1)	2, 189, 395	49, 963, 018	68, 808, 238	53, 898, 649

Year	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
1944	69, 730	$18, 827, 100	7, 265	$1, 162, 400	50, 727	$11, 565, 756	$32, 178, 026
1945	56, 571	15, 274, 170	7, 662	1, 317, 864	40, 295	9, 267, 850	26, 386, 781
1946	50, 191	16, 261, 884	4, 899	1, 067, 982	36, 103	8, 809, 132	26, 552, 417
1947	60, 205	25, 286, 100	6, 383	1, 838, 304	44, 103	10, 672, 926	38, 374, 269
1948	74, 687	32, 414, 158	7, 653	2, 739, 774	41, 502	11, 039, 532	46, 799, 576
1848–1948	1, 485, 091	456, 128, 975	288, 877	33, 133, 977	930, 545	147, 740, 650	740, 865, 269

[1] Figure not available.

Gold and silver produced at placer mines in New Mexico, 1944–48, 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	
1944	8	$280	--------	--------	$280	1947	23	$805	10	$9	$814
1945	15	525	7	$5	530	1948	9	315	2	2	317
1946	10	350	2	2	352						

Gold.—Of the 3,414 fine ounces of gold produced in New Mexico in 1948, only 6 percent was recovered from straight gold and silver ores and placer gravel. Copper ore yielded 59 percent of the total gold, zinc ore 25 percent, and lead and zinc-lead ores 10 percent. The Atwood mine in Hidalgo County was the only producer of more than 1,000 ounces of gold in the State.

Silver.—The output of silver in New Mexico in 1948—537,674 fine ounces—came largely from base-metal mines. Zinc and zinc-lead ores yielded 63 percent and copper ore 31 percent of the State total silver. The principal producers of silver were the Atwood mine in Hidalgo County, the Ground Hog and Bayard in Grant County, and the Waldo in Socorro County.

Copper.—The increase in copper production in New Mexico from 60,205 tons in 1947 to 74,687 tons in 1948 was due mainly to expanded mining and dump leaching operations at the Chino open-pit mine of the Kennecott Copper Corp. in Grant County. This property was much the largest producer in the State. Other important producers, in order of output, were the Bonney-Miser's Chest group in Hidalgo County, the leaching operation of the Phelps Dodge Corp. at its Burro Mountain mine at Tyrone, Grant County, and the Atwood mine in Hidalgo County. The foregoing four mines produced 99 percent of the State total production of copper in 1948.

Lead.—Most of the New Mexico output of lead in 1948 was recovered from zinc and zinc-lead ores mined in the Central and Magdalena districts. The high price of lead stimulated small-scale mining of scattered lead deposits that had not been commercial at prices prevailing in previous years. The quantity of lead ore mined (12,671 tons) was slightly larger than in 1947, but the average grade of the ore was lower, and lead ore yielded only 7 percent of the State total lead output compared with 13 percent in 1947. The principal producers of lead, in order of output, were the Bayard and Ground Hog groups in the Central district and the Kelly group (including Lynchburg mine) and Waldo mine in the Magdalena district.

Zinc.—Zinc production in New Mexico in 1948 did not pace the rise in copper and lead. Output from the Central district, which produced 85 percent of the State total zinc, decreased 8 percent from 1947. The decline in output was due, in part, to utilization in 1948 of considerable labor and equipment in developing deep zinc-lead ore bodies found in the district in recent years. In addition the Pewabic mine, closed August 12, 1947, was not reopened until July 31, 1948. Production in the Magdalena district, which contributed 12 percent of the State total zinc, decreased slightly from 1947. The State output of recoverable zinc was 41,502 tons compared with 44,103 tons in 1947. The five leading zinc producers, in order of output, were: American Smelting & Refining Co. Ground Hog unit, Kennecott Copper Corp. Oswaldo mine, United States Smelting, Refining & Mining Co. Bayard group, Empire Zinc Co. Hanover mine unit, and Peru Mining Co. (and subsidiary) Pewabic and Kearney mines.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in New Mexico, by counties, in 1948, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Dona Ana	4	----------	2	$70	1,548	$1,401
Grant	24	----------	1,490	52,150	249,047	225,400
Hidalgo	20	----------	1,700	59,500	178,853	161,871
Lincoln	1	1	1	35	854	773
Luna	10	----------	2	70	958	867
Otero	2	----------	----------	----------	72	65
Sandoval	1	----------	9	315	451	408
Santa Fe	3	1	43	1,505	1,139	1,031
Sierra	13	----------	13	455	7,689	6,959
Socorro	11	----------	154	5,390	97,061	87,845
Valencia	2	----------	----------	----------	2	2
Total: 1948	91	2	3,414	119,490	537,674	486,622
1947	82	3	3,146	110,110	515,833	466,829

County	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Dona Ana	1	$434	16	$5,728	9	$2,394	$10,027
Grant	72,820	31,603,880	4,310	1,542,980	36,442	9,693,572	43,117,982
Hidalgo	1,713	743,442	177	63,366	161	42,826	1,071,005
Lincoln	5	2,170	37	13,246	8	2,128	18,352
Luna	----------	----------	41	14,678	----------	----------	15,615
Otero	10	4,340	19	6,802	----------	----------	11,207
Sandoval	----------	----------	----------	----------	----------	----------	723
Santa Fe	1	434	29	10,382	19	5,054	18,406
Sierra	8	3,472	72	25,776	----------	----------	36,662
Socorro	127	55,118	2,952	1,056,816	4,863	1,293,558	2,498,727
Valencia	2	868	----------	----------	----------	----------	870
Total: 1948	74,687	32,414,158	7,653	2,739,774	41,502	11,039,532	46,799,576
1947	60,205	25,286,100	6,383	1,838,304	44,103	10,672,926	38,374,269

MINING INDUSTRY

The bulk of the ore mined in New Mexico in 1948 was copper ore produced at a daily rate of 20,000 to 22,500 tons from the Chino open-pit mine in the Central district. None of the underground metal mines averaged more than 400 to 500 tons of ore daily. During the year good progress was made in developing several zinc-lead deposits in the Central district at greater depth. Shafts sunk by the individual companies are described briefly, along with other operating details, in the following Review by Counties and Districts. The high price of lead stimulated activity in districts containing lead deposits. The districts producing chiefly gold or gold and silver generally remained idle. The Bureau of Mines continued its exploratory drilling, field examinations, and metallurgical tests on ores of copper, lead, and zinc. Certain data on drilling were published.[1]

[1] Mullen, Donald H., and Storms, Walter R., Copper Flat Zinc Deposit, Central Mining District, Grant County, N. Mex.: Bureau of Mines Rept. of Investigations 4228, 1948, 9 pp.
Soulé, John H., West Pinos Altos Zinc-Lead Deposits, Grant County, N. Mex.: Bureau of Mines Rept. of Investigations 4237, 1948, 10 pp.

ORE CLASSIFICATION

Details of ore classification are given in the Gold and Silver chapter of this volume.

Ore sold or treated in New Mexico in 1948, 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 gold ore	5	662	185	1,757	2,000	3,351	2,000
Dry gold-silver ore	4	33	18	726	71	43	
Dry silver ore	7	735	6	12,201	4,434	4,481	
	16	1,430	209	14,684	6,505	7,875	2,000
Copper ore	8	7,139,147	1,998	166,018	[1] 147,952,805	76,645	
Lead ore	39	12,671	48	15,396	33,088	1,124,130	25,650
Lead-copper ore	1	103		236	5,823	17,482	
Zinc ore	8	454,891	861	201,259	1,064,539	7,560,869	70,705,551
Zinc-lead ore	19	124,921	289	140,079	311,240	6,518,999	12,270,799
	75	7,731,733	3,196	522,988	[1] 149,367,495	15,298,125	83,002,000
Total lode mines	[2] 91	7,733,163	3,405	537,672	[1] 149,374,000	15,306,000	83,004,000
Placers	2		9	2			
Total: 1948	93	7,733,163	3,414	537,674	[1] 149,374,000	15,306,000	83,004,000
1947	85	7,352,945	3,146	[1] 515,833	[1] 120,410,000	12,766,000	88,206,000

[1] Silver and copper contained in precipitates recovered from mine water and leached dumps are included with that in copper ore as follows: 1948, 38,937,830 pounds of copper; 1947, 55 ounces of silver and 30,306,293 pounds of copper.
[2] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

METALLURGIC INDUSTRY

Twelve flotation mills were operated in New Mexico all or part of 1948. The largest mill was the 20,000- to 22,500-ton concentrator of the Kennecott Copper Corp. Chino Mines Division at Hurley, Grant County, which treated copper ore from the company open-pit mine at Santa Rita. The other mill treating copper ore was the 500-ton Banner Mining Co. plant near Lordsburg, Hidalgo County. The 10 flotation mills that treated zinc and lead ores had capacities ranging from 35 to 1,000 tons daily and averaged 321 tons. Of these mills, four are in Grant County, two in Socorro County, and one each in Hidalgo, Luna, Santa Fe, and Sierra Counties. A 25-ton amalgamation and gravity concentration mill was run a few months in Santa Fe County.

Because, in the early days of mining, a large proportion of the ore was treated in straight amalgamation or amalgamation-cyanidation mills, reports of this series in Mineral Resources and Minerals Yearbook from 1909 through 1947 contained tables showing ore treated in these mills separate from that treated in straight concentrating mills. As amalgamation and cyanidation mills now generally have concentrating equipment and many concentrating mills recover part of the gold by amalgamating high-grade jig concentrates, the distinctive features of the two types of mills have largely disappeared. Therefore, beginning with 1948, a consolidated table showing production of metals from all mills has replaced the separate tables giving output by types of mills.

The only smelter operating in the State was the Chino smelter of the Kennecott Copper Corp. at Hurley, which treats concentrates and siliceous copper ore (used as a flux) from the Chino mill and mine and copper precipitates from company operations at Chino and at Ray, Ariz. The smelter produces fire-refined copper. Direct-smelting ore and lead and copper concentrates from other New Mexico operations were shipped to smelters in Texas, Arizona, and Kansas. Zinc concentrates were shipped to smelters in Illinois, Montana, Pennsylvania, and Texas.

Mine production of metals in New Mexico in 1948, 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	230	25	8	----------	----------	----------
Sands cyanided	12	3	97	----------	----------	----------
Concentrates smelted	329, 341	1, 718	389, 652	[1] 147, 334, 768	14, 591, 603	83, 004, 000
Ore smelted	117, 944	1, 659	147, 915	2, 039, 232	714, 397	----------
Placer	----------	9	2	----------	----------	----------
Total: 1948	----------	3, 414	537, 674	[1] 149, 374, 000	15, 306, 000	83, 004, 000
1947	----------	3, 146	[1] 515, 833	[1] 120, 410, 000	12, 766, 000	88, 206, 000

[1] Silver and copper contained in precipitates recovered from mine water and leached dumps are included with that in copper concentrates as follows: 1948, 38,937,830 pounds of copper; 1947, 55 ounces of silver and 30,306,293 pounds of copper.

Mine production of metals from New Mexico ores milled in 1948, in terms of recovered metals

	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)
BY COUNTIES									
Dona Ana	204	--------	--------	49	1	393	1, 197	12, 036	18, 000
Grant	7, 458, 231	9	100	305, 871	1, 353	245, 352	[1] 144,534, 871	8, 583, 898	72, 884, 000
Hidalgo	46, 338	--------	--------	5, 374	217	47, 521	2, 547, 299	207, 300	322, 000
Lincoln	844	--------	--------	86	--------	603	6, 997	49, 552	16, 000
Luna	350	--------	--------	35	--------	182	--------	32, 939	--------
Santa Fe	1, 338	19	5	91	16	1, 132	2, 000	58, 000	38, 000
Sierra	120	--------	--------	12	--------	3	63	7, 860	--------
Socorro	107, 794	--------	--------	17, 823	131	94, 466	242, 341	5, 640, 018	9, 726, 000
Total: 1948	7, 615, 219	28	105	329, 341	1, 718	389, 652	[1] 147,334, 768	14, 591, 603	83, 004, 000
1947	7, 243, 290	14	1	302, 472	1, 090	[1] 341,887	[1] 118,401, 593	10, 895, 991	88, 206, 000
BY CLASSES OF ORE TREATED									
Dry gold	335	25	8	9	36	575	559	3, 000	2, 000
Dry gold-silver	12	3	97	--------	--------	--------	--------	--------	--------
Copper	7, 025, 421	--------	--------	229, 354	525	44, 582	[1] 145,948, 896	--------	--------
Lead	9, 639	--------	--------	511	7	3, 157	9, 534	508, 735	25, 650
Zinc	454, 891	--------	--------	77, 940	861	201, 259	1, 064, 539	7, 560, 869	70, 705, 551
Zinc-lead	124, 921	--------	--------	21, 527	289	140, 079	311, 240	6, 518, 999	12, 270, 799
Total: 1948	7, 615, 219	28	105	329, 341	1, 718	389, 652	[1] 147,334, 768	14, 591, 603	83, 004, 000

[1] Silver and copper contained in precipitates recovered from mine water and leached dumps are included with that in copper concentrates as follows: 1948, 38,937,830 pounds of copper; 1947, 55 ounces of silver and 30,306,293 pounds of copper.

Gross metal content of concentrates produced from ores mined in New Mexico in 1948, 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	4	7	6	213		
Copper	229,576	6,276	137,355	[1] 148,807,667	7,843	27,734
Lead	12,078	553	206,675	432,779	12,511,817	1,518,901
Lead-copper	1,279	214	42,691	95,348	1,097,139	62,333
Dry iron [2]	3,431		768	13,723		80,264
Zinc	82,973	437	113,307	968,339	1,845,427	91,370,136
Total: 1948	329,341	7,487	500,802	[1] 150,318,069	15,462,226	93,059,368
1947	302,472	6,831	[1] 442,183	[1] 126,946,432	11,587,832	99,277,453

[1] Silver and copper contained in precipitates recovered from mine water and leached dumps are included with that in copper concentrates as follows: 1948, 39,698,539; 1947, 66 ounces of silver and 31,289,919 pounds of copper.

[2] From zinc and zinc-lead ores.

Gross metal content of New Mexico crude ore shipped to smelters in 1948, 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 gold	327	124	1,174	2,882	366	
Dry gold-silver	21	15	629	341	71	
Dry silver	735	6	12,201	7,031	5,639	
Copper	113,726	1,516	122,344	2,651,351	127,878	
Lead	3,032	41	12,239	29,872	642,522	
Lead-copper	103		236	6,324	18,210	
Total: 1948	117,944	1,702	148,823	2,697,801	794,686	
1947	109,655	2,054	174,867	2,407,260	2,095,543	1,921,733

Mine production of metals from New Mexico crude ore shipped to smelters, by counties, in 1948, in terms of recovered metals

County	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Dona Ana	108	1	1,155	803	19,964
Grant	89,640	128	3,595	1,105,129	36,102
Hidalgo	24,864	1,483	131,332	878,701	146,700
Lincoln	171		251	3,003	24,448
Luna	246	2	776		49,061
Otero	644		72	20,000	38,000
Sandoval	9	9	451		
Sierra	723	13	7,686	15,937	136,140
Socorro	1,460	23	2,595	11,659	263,982
Valencia	79		2	4,000	
Total: 1948	117,944	1,659	147,915	2,039,232	714,397
1947	109,655	2,019	173,935	2,008,407	1,870,009

REVIEW BY COUNTIES AND DISTRICTS

DONA ANA COUNTY

Organ District.—From June 1 through December 1948, J. H. Brown unwatered and equipped the Merrimac mine and shipped 104 tons of zinc-lead-silver ore to the Peru mill at Deming; he also shipped some surface clean-up material from the Stephenson-Bennett group, which was under development by E. J. Longyear and the Empire Zinc Co. until November 1. Some silver-lead ore mined in development was shipped to the El Paso smelter. Small lots of lead-silver ore were shipped from the Barahoni and Morning Star properties.

GRANT COUNTY

Burro Mountain (Tyrone) District.—The leaching operations of the Phelps Dodge Corp. at the Burro Mountain mine continued to yield a substantial tonnage of copper. Water is percolated through subsided areas of former mine workings, and copper is precipitated from the return solutions in wooden precipitating tanks that can handle about 600 gallons per minute. The Malone Darhasana Mining Co. did development work on its properties from April through December and recovered some gold-silver bullion in an experimental cyanide leaching plant. Some gold ore was amalgamated at the Osmer mine.

Central (Bayard, Fierro, Georgetown, Hanover, Santa Rita) District.—In 1948, as usual, the open-pit mining and dump-leaching operations of the Kennecott Copper Corp. Chino Mines Division at Santa Rita yielded the bulk of the State production of copper. The output increased materially over 1947. The company flotation mill at Hurley, with a rated daily capacity of 22,500 tons, was operated 6 days a week at daily rates ranging from 20,000 to 22,500 tons. Molybdenite is recovered in the mill as a byproduct. The copper concentrates produced were smelted in the company smelter adjacent to the mill. The smelter also treated the precipitates derived from dump leaching and siliceous copper ore used in the converter as a flux. The copper bullion contains minor quantities of gold and silver, which are not recovered from fire-refined copper, the normal product of the smelter; in 1948, however, some blister copper was shipped to an electrolytic refinery which recovered gold and silver. The company continued to operate its Oswaldo zinc mine, shipping the ore to the Empire Zinc Co. mill at Hanover. The mine was one of the major zinc producers in the State. Development in 1948 included 568 feet of drifts, 45 feet of raises, and 620 feet of sinking on a new 850-foot shaft. Total development at the end of the year (not including the new shaft) was a 475-foot vertical shaft, 7,768 feet of drifts, and 595 feet of raises.

The American Smelting & Refining Co. operated its Ground Hog zinc-lead mine group and the leased 400-ton Hanover (formerly Combination-Blackhawk) mill; the mill treated company ore from the Ground Hog, Ivanhoe, and Lucky Bill claims and custom ore from other mines in Grant and Santa Fe Counties. Development at the Ground Hog group in 1948 included 3,852 feet of drifts, 13,787 feet of diamond drilling, and 1,729 feet of sinking on a new 2,000-foot four-compartment vertical shaft. The new shaft will tap additional ore bodies proved by diamond drilling. The present shaft is vertical to the 600-foot level and has a winze from there to the 1,800-foot level.

The Bayard mine group of the United States Smelting, Refining & Mining Co. was a large producer of zinc and a substantial producer of lead and silver. The ore was treated in the company selective-flotation mill (capacity 25 tons an hour in 1948). Articles on the geology and mining and milling practice at the Bayard property were published.[2] Besides its mining operations, the company carried on extensive exploration and development work, which included sinking on the new 1,800-foot Princess shaft, the sixth shaft on the Bullfrog section of the property.

The Empire Zinc Co. Hanover mine group, a large producer of zinc for many years, operated steadily throughout 1948. The ore was treated in the company mill, which also handled custom ore from the Kelly-Lynchburg group in Socorro County and the Oswaldo mine in Grant County.

Mine production of gold, silver, copper, lead, and zinc in New Mexico, by counties and districts, in 1948, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)		
	Lode	Placer		Lode	Placer	Total
Dona Ana County: Organ	4		312	2		2
Grant County:						
Central [1]	10		7,524,768	1,202		1,202
Eureka	2		4,093	6		6
Pinos Altos	8		16,519	133		133
Steeple Rock	1		428	149		149
Swartz	2		2,059			
Telegraph	1		4			
Hidalgo County:						
Eureka	3		535	2		2
Fremont	1		90	2		2
Lordsburg	11		68,481	1,683		1,683
San Simon	5		2,096	13		13
Lincoln County:						
Jicarilla		1			1	1
Red Cloud (Gallinas Mountains)	1		1,015			
Luna County:						
Cooks Peak	3		408			
Florida Mountains	1		2			
Tres Hermanas	4		67	1		1
Victorio	2		119	1		1
Otero County: Sacramento	2		644			
Sandoval County: Cochiti	1		9	9		9
Santa Fe County:						
Cerrillos	2		1,133	9		9
San Pedro (New Placers)	1	1	205	26	8	34
Sierra County:						
Chloride	5		248	1		1
Hermosa	1		6			
Kingston	3		531	8		8
Las Animas	2		6	4		4
Pittsburg and Caballos Mountains	2		52			
Socorro County:						
Hansonberg	3		6,087			
Magdalena	6		102,786	153		153
Salinas Peak	2		381	1		1
Valencia County	2		79			
Total New Mexico	91	2	7,733,163	3,405	9	3,414

See footnotes at end of table.

[2] Mining and Metallurgy, U. S. Smelting Co. issue, vol. 29, No. 502, October 1948, pp. 559-566.

Mine production of gold, silver, copper, lead and zinc in New Mexico, by counties and districts, in 1948, in terms of recovered metals—Continued

County and district	Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer	Total				
Dona Ana County: Organ	1,548	--------	1,548	2,000	32,000	18,000	$10,027
Grant County:							
Central [1]	197,056	--------	197,056	[2] 145,568,000	7,480,000	70,279,000	42,494,699
Eureka	17,998	--------	17,998	4,000	225,000	208,000	85,306
Pinos Altos	30,573	--------	30,573	61,000	756,000	2,111,000	461,649
Steeple Rock	1,735	--------	1,735	2,000	3,000	2,000	8,022
Swartz	1,652	--------	1,652	5,000	154,000	284,000	67,918
Telegraph	33	--------	33	------------	2,000	------------	388
Hidalgo County:							
Eureka	9,185	--------	9,185	4,000	2,000	------------	9,609
Fremont	53	--------	53	------------	4,000	------------	834
Lordsburg	165,256	--------	165,256	3,415,000	158,000	138,000	996,161
San Simon	4,359	--------	4,359	7,000	190,000	184,000	64,401
Lincoln County:							
Jicarilla	--------	--------	--------	------------	------------	------------	35
Red Cloud (Gallinas Mountains)	854	--------	854	10,000	74,000	16,000	18,317
Luna County:							
Cooks Peak	326	--------	326	------------	58,000	------------	10,677
Florida Mountains	12	--------	12	------------	2,000	------------	369
Tres Hermanas	273	--------	273	------------	4,000	------------	998
Victorio	347	--------	347	------------	18,000	------------	3,571
Otero County: Sacramento	72	--------	72	20,000	38,000	------------	11,207
Sandoval County: Cochiti	451	--------	451	------------	------------	------------	723
Sante Fe County:							
Cerrillos	1,126	--------	1,126	2,000	58,000	38,000	17,204
San Pedro (New Placers)	11	2	13	------------	------------	------------	1,202
Sierra County:							
Chloride	400	--------	400	6,000	30,000	------------	7,069
Hermosa	1	--------	1	1,000	------------	------------	218
Kingston	7,213	--------	7,213	9,000	107,000	------------	27,914
Las Animas	65	--------	65	------------	------------	------------	199
Pittsburg and Caballos Mountains	10	--------	10	------------	7,000	------------	1,262
Socorro County:							
Hansonberg	106	--------	106	------------	237,000	4,000	43,051
Magdalena	96,776	--------	96,776	254,000	5,651,000	9,712,000	2,451,285
Salinas Peak	179	--------	179	------------	16,000	10,000	4,391
Valencia County	2	--------	2	4,000	------------	------------	870
Total New Mexico	537,672	2	537,674	[2] 149,374,000	15,306,000	83,004,000	46,799,576

[1] Includes Burro Mountain district gold, silver, and copper, figures for which Bureau of Mines is not at liberty to publish separately.
[2] Includes copper recovered from precipitates.

The Peru Mining Co. operated the Pewabic mine from July 31 through December, and the New Mexico Consolidated Mining Co. (subsidiary of the Peru Mining Co.) worked the Kearney group all the year. Development during the year included 60 feet of drifts and 1,217 feet of diamond drilling on the Pewabic and 1,655 feet of drifts and 5,374 feet of diamond drilling on the Kearney. Ore from the two mines, totaling 98,864 tons, was treated in the Peru 1,000-ton selective-flotation mill at Wemple, near Deming, Luna County.

Eureka District (see also Hidalgo County).—Mineral Operations, Inc., operated the Hornet mine throughout 1948. The ore was treated in the company 100-ton mill completed in January. The mill products were zinc concentrate and lead-silver concentrate. The American mine produced a car of silver-lead ore.

Pinos Altos District.—The Houston-Thomas mine, operated by Mathis & Mathis, shipped 13,185 tons of zinc-lead ore containing also gold, silver, and copper to custom mills at Deming and Hanover. The Langston mine shipped ore of a similar type. The Cleveland mine was operated under lease by Douglas B. White from October through December. Five other properties shipped small tonnages of ore.

Steeple Rock District.—The Carlisle group was worked by L. A. & Ben F. Billingsley from March to September and by Liberty Mines, Inc., the rest of the year. The ore produced was shipped to smelters and custom mills outside the district.

Swartz (Carpenter, Camp Monarch) District.—Shipments of ore from the Royal John mine in 1948 totaled 1,308 tons containing 1,427 ounces of silver, 2,972 pounds of copper, 100,036 pounds of lead, and 213,353 pounds of zinc. The operators were A. L. Owen the first few months of the year, Strong & Harris for a short period, and L. Yacomo, Inc., from May 8 to December 2. Strong & Harris operated the Grand Central mine 3½ months and the Grand View 8 months; the ore was shipped to a custom mill at Hanover.

Telegraph District.—The Tracer mine shipped 4 tons of ore containing 33 ounces of silver and 2,541 pounds of lead.

HIDALGO COUNTY

Eureka (Sylvanite) District.—Shipments of ore in 1948 comprised 454 tons (silver-copper ore) from the Rincon mine, 80 tons from the Lone Tree-Last Chance group, and 1 ton from the Tunnel property.

Fremont District.—Juan Pacheco shipped 90 tons of silver-lead ore from the Yucca claim 20 miles southeast of Hachita.

Lordsburg District.—Operations at the Banner Mining Co. Bonney-Miser's Chest group, principal producer of copper in the Lordsburg district since 1936, were interrupted about 2 months in 1948 by a work stoppage, but the output of copper was larger than in 1947. The mine is opened by a 1,500-foot vertical shaft and a 1,000-foot incline shaft and equipped with a 500-ton flotation mill. C. H. & S. A. McIntosh continued to operate the Atwood group,[3] second-largest district producer of copper and the principal producer of gold and silver; the ore was shipped crude to smelters. The Lordsburg Mining Co. shipped 1,615 tons of zinc-lead-silver ore from the Millsite group to the Peru mill at Deming. Small tonnages of ore were shipped from the Ruth mine dump, Tom group, and other properties.

San Simon District.—Still Bros. shipped zinc-lead-silver-ore from the Silver Hill mine to the Peru mill at Deming in 1948. The McGhee mine and mill were operated intermittently, until June 17, when the shaft head frame and timbers and adjacent surface buildings burned, stopping underground work for several months. Some ore was shipped from the Clark, Crystal, and Lost Boy properties.

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[3] Storms, Walter R., Mining Methods and Costs At the Atwood Copper Mine, Lordsburg Mining District, Hidalgo County, N. Mex.: Bureau of Mines Inf. Circ. 7502, 1949, 11 pp.

LINCOLN COUNTY

Jicarilla District.—A prospector panning on the Rico No. 3 placer recovered 1.33 fine ounces of gold in 1948.

Red Cloud (or Gallinas Mountains) District.—Drunzer and Casner, leasing on the Red Cloud group, shipped ore containing lead, zinc, copper, and silver from the mine and dumps.

LUNA COUNTY

Cooks Peak District.—Output from this district in 1948 totaled 408 tons of lead-silver ore, shipped from the Good Will, Rimrock, and Montezuma mines.

Deming District.—The 1,000-ton selective-flotation mill of the Peru Mining Co. at Wemple, 5 miles north of Deming, operated throughout 1948. The ore treated comprised 98,864 tons from the company's Kearney and Pewabic mines in Grant County and 22,366 tons of custom ore from other mines in Grant, Hidalgo, Sierra, Socorro, and Dona Ana Counties.

Florida Mountains District.—Rhea & Moore shipped a 2-ton lot of lead-silver ore in 1948.

Tres Hermanas District.—Lessees at the Calumet mine shipped 55 tons of silver ore. Milton Benjamin (Blackhawk mine), John W. Clark, and Jesus Numez each shipped a truckload of lead-silver ore.

Victorio District.—Some lead-silver-copper ore was shipped from dumps on the Mahoney property, and a small tonnage of lead-silver ore was produced from the Victorio mine.

OTERO COUNTY

Sacramento District.—Drunzer & Casner shipped 335 tons of copper ore from the Courtney mine, and M. F. Drunzer shipped 309 tons of lead-copper ore from the Warnock.

SANDOVAL COUNTY

Cochiti District.—The Cochiti Mining Co. shipped 9 tons of gold-silver ore from the Iron King mine.

SANTA FE COUNTY

Cerrillos District.—Lessees operated the Cash Entry-Franklin group intermittently. About 1,000 tons of lead-silver-gold ore were treated in the 35-ton mill on the property, and 24 tons were shipped to the American Smelting & Refining Co. mill at Magdalena. Some ore was shipped from the Bonanza Trust group.

San Pedro or New Placers District.—The Shamrock Gold Mining Co. treated 205 tons of gold ore in its 25-ton amalgamation and gravity-concentration mill. A lessee at the Golden placer recovered a little gold.

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SIERRA COUNTY

Chloride (Apache, Cuchillo Negro) District.—The Deming Mining Co. shipped 117 tons of lead-silver-copper ore from the Denver-Little Bonanza group. Some lead-silver ore was shipped from the Alta Vista, Carbonate, M. S. Hall, and United States Treasury properties.

Hermosa (Lower Palomas Creek) District.—A truckload of copper ore was shipped from the Vulture claim in 1948.

Kingston District.—The producing mines were the Dove, Iron King, and Miner's Dream, all of which shipped ore direct to smelters.

Las Animas (Hillsboro) District.—Small lots of gold-silver ore were shipped from the Bonanza and Snake mines.

Pittsburg and Caballos Mountains District.—Lead ore was shipped from the Adobe and Badger mines in 1948.

SOCORRO COUNTY

Hansonberg District (17 miles southeast of Carthage).—The Portales Mining Co. operated the Portales lead mine throughout 1948. The ore produced (5,725 tons containing 239,151 pounds of lead) was trucked 30 miles to the company mill at San Antonio for treatment. The Royal Flush mine shipped 354 tons of lead ore. The Mex-Tex Mining Co. shipped some lead-silver ore from the Mountain Canyon group.

Magdalena District.—The American Smelting & Refining Co. operated continuously its Waldo zinc-lead-silver mine and 200-ton selective-flotation mill. In June the mill began treating custom ore in addition to company ore. The custom ore included much oxidized dump material (mostly from the Kelly group), from which lead was floated by using a sulfidization method. Lessees at the Kelly group (including the Lynchburg mine) shipped a large tonnage of newly mined zinc-lead ore to the Empire Zinc Co. mill at Hanover (Grant County) for treatment. McDonald & Dobson continued to ship zinc-lead-silver ore from the Nitt group. Other shippers were the Juanita, Queen, and Old Soldier mines.

Salinas Peak District.—Latham & Chenowth shipped 331 tons of lead and lead-silver ores from the Night Hawk claim. Some lead ore from the Harding mine was milled at the Hanson mill at Hot Springs.

VALENCIA COUNTY

A car each of copper ore was shipped from the Belvidere and Senora de Milagros groups in Hell Canyon in the Manzano Mountains 16 miles southeast of Albuquerque.

Oregon
Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By R. B. MAURER

GENERAL SUMMARY

PRODUCTION of gold, silver, copper, lead, and zinc in Oregon in 1948 each failed to equal output in 1947; gold production was off 23 percent, and silver output dropped 55 percent in 1948 compared with 1947. Copper and lead production was not stimulated by the rise in prices of the base metals in 1948, and the output—byproducts of ores mined primarily for the precious metals—fell below the relatively small production attained the previous year. The small output of zinc in 1947 did not continue in 1948.

The total value of the gold, silver, copper, and lead (in terms of recovered metals) produced in Oregon was $527,064 in 1948 compared with $701,336 (including a small quantity of zinc) in 1947 and $4,148,271 in the peak year 1940. It was divided among the metals as follows: Gold, 97 percent; silver, 2 percent; and copper and lead combined, 1 percent. Baker County continued to be the leading metal producer, owing largely to placer operations, and contributed 56 percent of the State total value. Grant County was again in second place and, with Curry County, supplied 35 percent.

Placer mines contributed 86 percent and lode mines 14 percent of the gold produced in Oregon in 1948. In 1947 the ratio was placer mines 93 percent and lode mines 7 percent.

Oregon and California Railroad revested lands and reconveyed Coos Bay Wagon Road grant lands, comprising about 2½ million acres in western Oregon and closed to exploration, location, entry, and disposal under the mineral land laws of the United States since August 28, 1937 (50 Stat. 874), were reopened April 8, 1948 (Public Law 477). Notices were filed during 1948 with the Oregon District Land Office for 344 lode claims and 456 placer claims located before 1948—a total of 27,607 acres in 12 counties; 104 lode and 118 placer claims, comprising 2,951 acres in 6 counties and located during 1948, also were filed.[1]

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.

[1] Data from Bureau of Land Management, U. S. Department of the Interior.

The value of metal production herein reported has been calculated at the prices in the accompanying table.

Prices of gold, silver, copper, lead, and zinc, 1944–48

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1944	$35.00	$0.711+	$0.135	$0.080	$0.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122
1947	35.00	.905	.210	.144	.121
1948	35.00	.905+	.217	.179	.133

[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 of newly mined silver. 1944 to June 30, 1946: $0.71111111; July 1, 1946, to Dec. 31, 1947: $0.905; 1948: $0.9050505.
[3] Yearly average weighted price of all grades of primary metal sold by producers; 1944–47: price includes bonus payments by Office of Metals Reserve for over-quota production.

Mine production of gold, silver, copper, lead, and zinc in Oregon, 1944–48, and total 1852–1948, 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
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
1947	20	49	3,277	18,979	664,265	30,379	27,493
1948	23	38	3,119	14,611	511,385	13,596	12,305
1852–1948			(2)	5,725,142	128,343,013	5,269,287	4,834,233

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
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
1947	28,000	5,880	24,000	3,456	2,000	242	701,336
1948	4,000	868	14,000	2,506			527,064
1852–1948	[3] 12,359	4,647,311	[3] 767	82,743	[3] 142	14,318	137,921,618

[1] Excludes itinerant prospectors, snipers, high-graders, and others who have no evidence of legal right to property.
[2] Figures not available.
[3] Short tons.

Gold.—Production of gold in Oregon in 1948 (including a small quantity in "natural gold" sold on the open market) was down 23 percent compared with 1947. Placer mines contributed 86 percent of the gold output; of the placer total, bucket-line dredges and nonfloating washing plants (with mechanical excavators) recovered 79 percent, dragline dredges 16 percent, hydraulicking 3 percent, and small-scale hand methods and drift mining together 2 percent. All the lode gold was derived from dry and siliceous ores, and most of it was from one mine. A large part of the gold came from a relatively few mines, although 61 properties produced in 1948 (69 in 1947);

the following 4 producers, listed in order of output, supplied 85 percent of the State total: Baker Dredging Co. (successors to Sumpter Valley Dredging Co.) and Porter & Co. (bucket-line dredges); Calhoun & Howell of Oregon Ltd. (dragline dredge); and R. G. Amidon, Buffalo mine (lode).

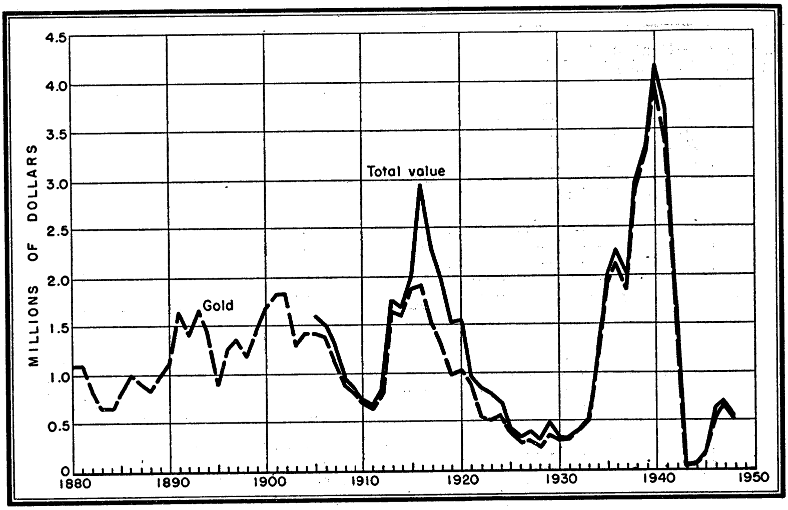

FIGURE 1.—Value of mine production in Oregon of gold, 1880–1948, and total value of gold, silver, copper, lead, and zinc, 1905–48.

Gold produced at placer mines in Oregon, 1944–48, by classes of mines and by methods of recovery

Class and method	Mines producing [1]	Material treated (cubic yards)	Gold recovered: Fine ounces	Gold recovered: Value	Gold recovered: Average per cubic yard
Surface placers:					
Gravel mechanically handled:					
Bucket-line dredges:					
1944	----------	----------	----------	----------	----------
1945	3	1,895,000	3,763	$131,705	$0.070
1946	4	5,116,000	13,793	482,755	.094
1947	2	[2] 3,976,500	[2] 12,164	[2] 425,740	[2] .107
1948	2	[2] 3,525,300	[2] 9,842	[2] 344,470	[2] .098
Dragline: [3]					
1944–45	----------	----------	----------	----------	----------
1946	9	252,000	1,910	66,850	.265
1947	12	1,093,000	4,984	174,440	.160
1948	6	393,900	2,048	71,680	.182
Suction dredges: [5]					
1944–45	----------	----------	----------	----------	----------
1946	2	15,000	155	5,425	.362
1947–48	----------	----------	----------	----------	----------
Nonfloating washing plants: [6]					
1944	([4])	----------	71	2,485	----------
1945	----------	----------	----------	----------	----------
1946	1	4,200	45	1,575	.375
1947	5	([2])	([2])	([2])	([2])
1948	3	([2])	([2])	([2])	([2])

See footnotes at end of table.

Gold produced at placer mines in Oregon, 1944–48, by classes of mines and by methods of recovery—Continued

Class and method	Mines producing [1]	Material treated (cubic yards)	Gold recovered: Fine ounces	Value	Average per cubic yard
Surface placers—Continued					
Gravel hydraulically handled:					
Hydraulic:					
1944	4	22,700	99	$3,465	$0.153
1945	5	43,000	170	5,950	.138
1946	8	114,000	406	14,210	.125
1947	19	72,200	325	11,375	.158
1948	21	84,300	412	14,420	.171
Small-scale hand methods: [7]					
Wet:					
1944	6	7,500	123	4,305	.574
1945	2	3,000	53	1,855	.618
1946	10	16,800	174	6,090	.363
1947	11	8,300	175	6,125	.738
1948	5	8,900	210	7,350	.826
Underground placers:					
Drift:					
1944–45					
1946	3	1,000	19	665	.665
1947					
1948	1	350	10	350	1.000
Grand total placers:					
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
1947	49	5,150,000	17,648	617,680	.120
1948	38	4,012,750	12,522	438,270	.109

1 Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
2 Data for nonfloating washing plants included with those for bucket-line dredges to avoid disclosure of individual output.
3 Includes all placer operations using dragline excavator for delivering gravel to floating washing plant.
4 Gold from terminal clean-up; property and equipment not counted as producing.
5 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 with "small-scale hand methods."
6 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."
7 Includes all operations in which hand labor is principal factor in delivering gravel to sluices, long toms, dip boxes, pans, etc.

The monthly production figures given in the accompanying table show a relatively high output for January and February, despite winter conditions, with fairly constant production through October followed by a sharp drop in output in November and December, owing to unusually severe fall and winter weather.

Mine production of gold and silver in Oregon in 1948, by months, in fine ounces of recovered metal

Month	Gold	Silver	Month	Gold	Silver
January	1,380	464	August	1,249	333
February	1,007	1,785	September	1,410	1,513
March	1,228	1,432	October	1,531	1,997
April	1,430	1,755	November	906	746
May	1,218	232	December	705	333
June	1,178	1,634			
July	1,369	1,372	Total	14,611	13,596

Silver.—Oregon silver production in 1948 decreased 55 percent compared with 1947. More than four-fifths of the State total came from Grant County and most of the remainder from Baker County; 80 percent was yielded by lode mines (largely from one mine) principally from dry gold ore. Monthly output for 1948—shown in the accompanying table—was variable, reflecting the sporadic yield from the major mine.

Copper, Lead, and Zinc.—The small output of copper in 1948 came from ores mined at two properties primarily for their gold and silver content. The entire lead output was from one mine and was recovered from gold ore. No zinc was produced from Oregon ores in 1948.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Oregon in 1948 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	8	5	345	$12,075	8,019	$280,665	8,364	$292,740
Curry and Grant [2]	3	8	1,412	49,420	3,557	124,495	4,969	173,915
Jackson	7	10	121	4,235	290	10,150	411	14,385
Josephine and Wheeler [2]	5	12	211	7,385	299	10,465	510	17,850
Malheur		3			357	12,495	357	12,495
Total: 1948	23	38	2,089	73,115	12,522	438,270	14,611	511,385
1947	20	49	1,331	46,585	17,648	617,680	18,979	664,265

County	Silver (lode and placer) [3]		Copper		Lead		Zinc		Total value
	Fine ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
Baker	2,277	$2,061							$294,801
Curry and Grant [2]	11,109	10,054	2,000	$434	14,000	$2,506			186,909
Jackson	66	60							14,445
Josephine and Wheeler [2]	85	77	2,000	434					18,361
Malheur	59	53							12,548
Total: 1948	13,596	12,305	4,000	868	14,000	2,506			527,064
1947	30,379	27,493	28,000	5,880	24,000	3,456	2,000	$242	701,336

[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 output.
[3] Sources of total silver as follows—1948: 10,939 ounces from lode mines and 2,65 from placers; 1947: 26,852 ounces from lode mines and 3,527 from placers.

MINING INDUSTRY

Only one lode mine operated consistently during 1948, and that on a small scale. Of the 3,119 tons of ore (including 16 tons of old tailings) sold or treated in 1948, Grant County produced 1,652 tons or about 53 percent, Baker County produced 1,187 tons or 38 percent, Josephine County 130 tons or 4 percent, Jackson County 107 tons (including all the old tailings) or nearly 4 percent, and Wheeler County 43 tons or about 1 percent. Ninety-seven percent of the total (including old tailings) was dry gold ore and 3 percent was dry gold-silver ore.

The two properties worked by bucket-line dredge had one dredge each; one operated throughout the year, and the other was idle 3 months of 1948. Six dragline dredges washed gravel during various periods in 1948, but only one operated at the close of the year.

Ore and old tailings sold or treated in Oregon in 1948, 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	3,003	16	2,065	10,490	4,000	14,000	
Dry and siliceous gold-silver ore	100		24	449			
Total lode mines	3,103	16	2,089	10,939	4,000	14,000	
Placers			12,522	2,657			
Total: 1948	3,103	16	14,611	13,596	4,000	14,000	
1947	2,407	870	18,979	30,379	28,000	24,000	2,000

METALLURGIC INDUSTRY

Of the State total ore and old tailings (3,119 tons), about 53 percent was treated in concentration mills, 42 percent (including all the old tailings) was amalgamated and cyanided, and 5 percent was shipped crude to smelters. Ultimate recovery of 48 percent of the total lode gold was from smelting of concentrates, 26 percent was as bullion from amalgamation and cyanidation of ore, and 26 percent was from the smelting of ore. Of the lode silver recovered, 86 percent was from concentrates smelted, 13 percent from the direct smelting of ore, and 1 percent from ore amalgamated and cyanided. All material requiring smelting was shipped out of the State, as Oregon has no smelters.

Mine production of metals in Oregon, by methods of recovery, in 1948, 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 and cyanided	1, 296	546	116			
Concentrates smelted:						
Flotation	157	981	8, 940	1, 700	11, 000	
Gravity	19	28	450			
Ore smelted	153	534	1, 433	2, 300	3, 000	
Total lode mines		2, 089	10, 939	4, 000	14, 000	
Placers		12, 522	2, 657			
Total: 1948		14, 611	13, 596	4, 000	14, 000	
1947		18, 979	30, 379	28, 000	24, 000	2, 000

Mine production of metals from mills in Oregon, by counties, in 1948, in terms of recovered metals

	Material treated		Recovered in bullion		Concentrates smelted and recovered metal				
	Ore (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)
BY COUNTIES									
Baker	1, 156		286	59	18	24	449		
Grant	1, 582		10	2	157	981	8, 940	1, 700	11, 000
Jackson	84	16	41	10	1	4	1		
Josephine and Wheeler [1]	128		209	45					
Total: 1948	2, 950	16	546	116	176	1, 009	9, 390	1, 700	11, 000
1947	274	870	328	100	108	270	2, 975		2, 900
BY CLASSES OF CONCENTRATES									
Dry gold					158	985	8, 941	1, 700	11, 000
Dry gold-silver					18	24	449		
Total: 1948					176	1, 009	9, 390	1, 700	11, 000

[1] Combined to avoid disclosure of individual output.

Gross metal content of concentrates produced from ores mined in Oregon, by classes of concentrates, in 1948

Class o concentrates	Concentrates (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	158	985	8, 941	1, 933	11, 446	12, 917
Dry gold-silver	18	24	449	62		
Total: 1948	176	1, 009	9, 390	1, 995	11,446	12, 917
1947	108	270	2, 975	509	3, 000	

Mine production of metals from Oregon crude ore shipped to smelters in 1948, in terms of recovered metals

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES						
Baker	31	35	52			
Grant	70	421	1,364	300	3,000	
Jackson	7	76	12			
Josephine	45	2	5	2,000		
Total: 1948	153	534	1,433	2,300	3,000	
1947	1,557	733	23,777	28,000	21,100	2,000
BY CLASSES OF ORE						
Dry gold	153	534	1,433	2,300	3,000	
Total: 1948	153	534	1,433	2,300	3,000	

Gross metal content of Oregon crude ore shipped to smelters, by classes of ore, in 1948

Class of ore	Ore (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	153	534	1,433	2,564	3,143	4,061
Total: 1948	153	534	1,433	2,564	3,143	4,061
1947	1,557	733	23,777	30,588	33,253	3,055

REVIEW BY COUNTIES AND DISTRICTS

BAKER COUNTY

Baker District.—J. J. Davis worked his Washington Gulch and John Day placer claims intermittently during 10 months of 1948; 48 ounces of gold and 4 ounces of silver were recovered from 3,500 cubic yards of material hydraulicked.

Sumpter District.—Sumpter Valley placers on Powder River was worked by Sumpter Valley Dredging Co. in January 1948 and by its successor—Baker Dredging Co., largest producer of gold in Oregon in 1948—during the remainder of the year. A Yuba-type electric bucket-line dredge with seventy 9-cubic-foot buckets was operated.

Mine production of gold, silver, copper, and lead, in Oregon, by counties and districts,[1] in 1948, in terms of recovered metals

County and district [1]	Mines producing [2]		Ore and old tailings (short tons)	Gold (fine ounces)			Silver (lode and placer)[3] (fine ounces)	Lead (pounds)	Total value
	Lode	Placer		Lode	Placer	Total			
Baker County:									
Baker	3	1	107	82	81	163	468		$6,129
Cracker Creek	2		205	53		53	73		1,921
Eagle Creek	1		10	5		5	1		176
Upper Burnt River	1	3	665	93	432	525	75		18,443
Curry County: Sixes River		1			4	4			140
Grant County:									
Canyon		3			31	31	4		1,089
Quartzburg	1		6	6		6	2		212
Susanville		1			10	10	1		351
Jackson County:									
Gold Hill	3	4	78	20	75	95	16		3,339
Greenback [4]	1		13	66		66	12		2,321
Jacksonville	2	4	12	18	165	183	28		6,430
Upper Applegate	1	2	4	17	50	67	10		2,354
Josephine County:									
Galice	1	4	50	28	48	76	12		2,671
Grants Pass		1			38	38	6		1,335
Greenback [4]		4			173	173	23		6,076
Illinois River	1		30	4		4	2		142
Waldo	2	2	50	3	31	34	8		[5] 1,631
Malheur County: Mormon Basin		3			357	357	59		12,548
Other districts [6]	4	5	1,889	1,694	11,027	12,721	12,796	14,000	[7] 459,756
Total Oregon	23	38	3,119	2,089	12,522	14,611	13,596	14,000	[5 7] 527,064

[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 6 and their output included with "Other districts."
[2] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[3] Source of silver: 10,939 ounces from lode mines and 2,657 ounces from placers.
[4] Greenback district is in Jackson and Josephine Counties.
[5] Includes value of 2,000 pounds of copper from Waldo district, Josephine County.
[6] Includes Sparta and Sumpter districts in Baker County, Granite and Greenhorn districts in Grant County, and Spanish Gulch district in Wheeler County.
[7] Includes value of 2,000 pounds of copper from Granite district, Grant County.

Upper Burnt River District.—Progress Mining Co. operated its dragline dredge sporadically during 6 months of 1948; a small quantity of gold and some silver were recovered from the gravel handled. L. M. McCullough and B. Cole hydraulicked the Theresa K and Patsy D claims from January 1 to May 10, and L. M. McCullough worked the same properties from May 15 to November 22, 1948. A total of 500 cubic yards of material washed yielded 36 ounces of gold and 5 ounces of silver. Vinson and Leonhardy amalgamated 665 tons of ore from the Showdown and Lucky Boy mines from May 20 to September 30, 1948; 93 ounces of gold and 12 ounces of silver were recovered.

GRANT COUNTY

Granite District.—Porter & Co., second-largest producer of gold in Oregon in 1948, operated its Yuba-type electric bucket-line dredge with sixty 4½-cubic-foot buckets on Olive Creek during 9 months of the year. The Buffalo mine was operated throughout 1948 by R. G. Amidon under lease from Bruce Dennis. Gold ore was treated in a 35-ton flotation mill, and concentrate containing gold, silver, and some copper and lead was shipped to a smelter. In addition, smaller quantities of gold ore were shipped to smelters for treatment.

Greenhorn (North Fork) District.—Calhoun & Howell operated its Bucyrus-Monighan Diesel dragline excavator with 3-cubic-yard bucket and a Bodinson floating washing plant on the North Fork of John Day River for 7 months in 1948; a substantial quantity of gold and some silver were recovered.

JACKSON COUNTY

Gold Hill District.—R. E. McManus (Abbie mine), Homer Harrison (Black Channel mine), and R. E. Cook (Lance-Cook mine), hydraulicked intermittently during 1948. Oregon Dredging operated on Pleasant Creek from January 1 through February 1948 and recovered a small quantity of gold and some silver.

Jacksonville District.—The C & D Mining Co. operated its dragline dredge from December 1947 to May 26, 1948; a small quantity of gold and some silver were recovered.

Upper Applegate District.—Paul Pearce hydraulicked the Sterling mine (formerly a drift mine) from April 1 to July 1, 1948; 5,000 cubic yards of material washed yielded 39 ounces of gold and 6 ounces of silver.

JOSEPHINE COUNTY

Galice District.—C. W. Gray (Butte Creek mine), Cecil Conley (Conley mine) and Bert Pankey (Maloney mine) hydraulicked during January and February 1948.

Greenback District.—M. H. Davis hydraulicked the Blue Channel mine from January 1 to June 1, 1948, and recovered a small quantity of gold and some silver.

Waldo District.—Takilma Dredging Co. operated a high-line excavator with 2½-cubic-yard bucket and a portable Bodinson Diesel washing plant ¼ mile north of Takilma intermittently during 1948; 3,000 cubic yards of gravel treated yielded 25 ounces of gold and 2 ounces of silver.

MALHEUR COUNTY

Mormon Basin.—G. M. Whitney operated a gasoline-powered shovel with a ¾-cubic-yard bucket and a dry-land washing plant at the Boswell property on Basin Creek from March to May 1948; 218 ounces of gold and 39 ounces of silver were recovered from 10,000 cubic yards of material treated. Progress Mining Co. operated its dragline from May 9 to June 20, 1948. A small quantity of gold and some silver was recovered.

WHEELER COUNTY

Spanish Gulch District.—R. T. New treated ore from the Rosa D mine by amalgamation and recovered a substantial quantity of gold and some silver.

South Dakota

Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By A. J. MARTIN

GENERAL SUMMARY

ACTIVITY in gold mining—South Dakota's chief mineral industry—continued at a subnormal level throughout 1948. The State output of gold was 377,850 fine ounces compared with 407,194 ounces in 1947 and the peak of 618,536 ounces (valued at $21,648,760) in 1939. Shortage of underground labor and the high cost of labor and materials compared with the price of gold continued to be the principal factors in limiting output. The Homestake mine at Lead, Lawrence County, with current productive capacity for gold exceeding that of any other mine in the United States, operated at about two-thirds capacity. The Bald Mountain mine at Trojan, an important gold producer, also operated at less than capacity.

Nearly all the State silver output was incidental to the production of gold. The output of lead and zinc was contained in lead and zinc concentrates carrying gold and silver produced during mill test runs on ore removed in development at the Belle Eldridge mine near Deadwood. No production of copper was reported in South Dakota in 1948 or 1947.

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, 1944–48

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1944	$35.00	$0.711+	$0.135	$0.080	$0.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122
1947	35.00	.905	.210	.144	.121
1948	35.00	.905+	.217	.179	.133

[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. 1944 to June 30, 1946: $0.71111111; July 1, 1946, to Dec. 31, 1947: $0.905; 1948: $0.9050505.
[3] Yearly average weighted price of all grades of primary metal sold by producers; 1944–47: price included bonus payments by Office of Metals Reserve for overquota production.

The South Dakota output of gold, silver, copper, lead, and zinc has come largely from Lawrence County, in the mountain group known as the Black Hills. The adjoining Custer and Pennington Counties generally produce some gold and silver; but Custer County had no output from 1942 through 1948, and Pennington County had only a small production from 1945 through 1948 and none in 1943 and 1944.

Mine production of gold, silver, copper, lead, and zinc in South Dakota, 1944–48, and total, 1876–1948, 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
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
1947	4		939,384	407,194	14,251,790	111,684	101,074
1948	6		1,005,339	377,850	13,224,750	94,693	85,702
1876–1948			(2)	21,831,345	545,694,284	9,894,386	7,086,834

Year	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
1944	1	$270	34	$5,440	56	$12,768	$429,085
1945							1,977,070
1946							10,998,861
1947			8	2,304	19	4,598	14,359,766
1948			16	5,728	29	7,714	13,323,894
1876–1948	106	36,466	479	66,532	265	56,406	552,940,522

[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.

Mine production of gold, silver, lead, and zinc in South Dakota in 1948, by months, in terms of recovered metals

Month	Gold (fine ounces)	Silver (fine ounces)	Lead (short tons)	Zinc (short tons)
January	33,821	9,701		
February	28,318	8,355	4	5
March	33,650	8,818	1	2
April	33,808	8,136	4	7
May	31,235	7,546		
June	29,109	7,269	4	8
July	30,016	7,397	2	4
August	34,781	8,045	1	3
September	35,832	8,263		
October	31,221	7,661		
November	28,778	6,915		
December	27,281	6,587		
Total: 1948	377,850	94,693	16	29
1947	407,194	111,684	8	19

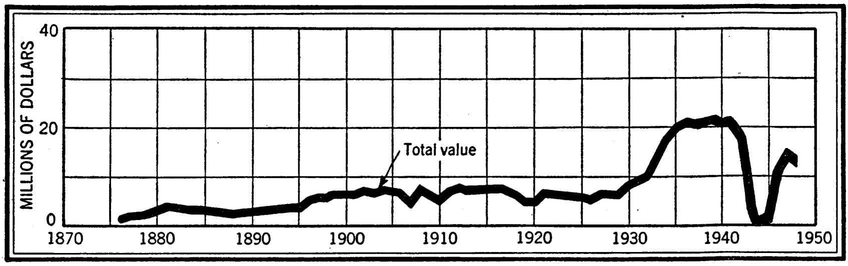

FIGURE 1.—Total value of mine production of gold and silver in South Dakota, 1876–1948.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, lead, and zinc in South Dakota in 1948, by counties, in terms of recovered metals

County	Mines producing		Ore sold or treated (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
Lawrence	4		1,005,269	377,836	$13,224,260	94,693	$85,702
Pennington	2		70	14	490		
Total: 1948	6		1,005,339	377,850	13,224,750	94,693	85,702
1947	4		939,384	407,194	14,251,790	111,684	101,074

County	Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	
Lawrence	16	$5,728	29	$7,714	$13,323,404
Pennington					490
Total: 1948	16	5,728	29	7,714	13,323,894
1947	8	2,304	19	4,598	14,359,766

MINING AND METALLURGIC INDUSTRY

Gold ore mined and treated in South Dakota in 1948 totaled 1,003,859 tons, yielding, in recovered metals, 377,780 ounces of gold and 93,769 ounces of silver. A break-down by methods of treatment shows that 896,862 tons of ore, yielding 360,716 ounces of gold and 72,100 ounces of silver, were treated by amalgamation followed by cyanidation of sands and slimes; 106,927 tons, yielding 17,050 ounces of gold and 21,669 ounces of silver, were treated by cyanidation only; and 70 tons, yielding 14 ounces of gold, were treated by amalgamation only. The zinc-lead ore (1,480 tons) that resulted from development work was treated by selective flotation in mill tests during the year. The ore yielded, in recovered metals, 70 ounces of gold, 924 ounces of silver, 16 tons of lead, and 29 tons of zinc, all contained in concentrates shipped to smelters.

No recovery of gold or silver has been reported from placer operations in the State since 1942.

Gold and silver bullion produced at mills in South Dakota by amalgamation, 1944–48

Year	Ore treated (short tons)	Gold in bullion (fine ounces)	Silver in bullion (fine ounces)	Quicksilver used (pounds)
1944				
1945	298,830	35,398	7,254	1,500
1946	793,034	197,425	35,498	(1)
1947	849,123	262,257	52,057	(1)
1948	896,932	250,782	72,100	(1)

[1] Figure not available.

Gold and silver bullion produced at mills in South Dakota by cyanidation, 1944–48

Year	Material treated (short tons)			Gold in bullion product (fine ounces)	Silver in bullion product (fine ounces)	Sodium cyanide used [1] (pounds)
	Crude ore	Sands and slimes	Total			
1944						
1945	13,782	237,503	251,285	20,550	19,310	109,900
1946	79,208	783,103	862,311	114,822	51,403	(2)
1947	86,511	848,875	935,386	144,888	59,092	(2)
1948	106,927	896,567	1,003,494	126,998	21,669	(2)

[1] In terms of 96- to 98-percent strength.
[2] Figure not available.

REVIEW BY COUNTIES

LAWRENCE COUNTY

Homestake Mine.—The Homestake mine and mills operated steadily throughout 1948. Ore treated averaged 2,450 tons daily, 7 days a week, compared with 2,326 tons in 1947 and 4,110 tons in 1941, the last year of full-scale operations before wartime restrictions on gold mining caused curtailment of production in 1942 and a complete shut-down from June 8, 1943, to July 2, 1945. Since the end of the war enough men have not been available for underground work to operate the mine at normal capacity. The mine has three vertical shafts, the deepest being 4,245 feet, and an inside winze to the 5,000-foot level. Development in 1948 included 22,935 feet of drifts, 10,712 feet of raises, and 27,592 feet of diamond drilling. The primary crushing plants are at the hoists. Other surface plants include the 180-stamp South mill (the main secondary crushing, grinding, and amalgamating plant), two cyanide plants, and the refinery 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. Regarding the gold-mining operations of the Homestake Mining Co., the annual report of the general manager for the year ended December 31, 1948, says—

Ore mined in 1948 was 896,862 tons which compares with 849,023 tons in 1947. Bullion with value of $12,658,138.55 was produced, which is $1,138,581.70 less than in 1947. Average realization was $14.11 per ton and metallurgical recovery was 96.85 percent, which is the highest recovery ever achieved by the company.

Output of ore was continuously limited by the number of men available for underground work. The average number of men employed in the mine department during 1948 was only about one percent greater than in 1947. There was, however, a substantial increase in the number of mine department employees in the last two months of the year. On December 31, the total was 104 more than at the end of 1947.

Operating expense per ton, exclusive of taxes, was 3.52 percent higher than in 1947 because of the continued increase in wages and cost of supplies. Such expense was 56.58 percent higher than in 1941.

The reserve of developed ore including 340,000 tons of broken ore in shrinkage stopes is 21,454,000 tons as compared to 21,524,000 tons at the end of 1947.

The mine and plant are in excellent condition and there were no interruptions of operations during the year.

An employee housing program begun in 1947 was continued. Ten houses, which are being sold to employees on an easy payment plan, were completed. Six apartment units with a total of fifty-five apartments were started and the first unit is nearly ready for occupancy. These will be rented to employees. It is expected that they will help to attract new employees for the mine.

Ore milled, receipts, and dividends, Homestake mine, 1944–48 [1]

Year	Ore milled (short tons)	Receipts for bullion product		Dividends
		Total	Per ton	
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
1947	849,023	13,796,720.25	16.2501	4,018,560
1948	896,862	12,658,138.55	14.1138	4,018,560

[1] From 1876 to 1948, inclusive, this mine yielded bullion and concentrates that brought a net return of $478,429,992 and paid $160,655,914 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 continuously its group of mines and 370-ton mill at Trojan. Ore treated in 1948 averaged 291 tons daily compared with 237 tons in 1947 and 370 tons in 1941, before operations were disrupted by war conditions. The producing claims in 1948, as in 1947 and 1946, were the Portland, Dakota, and Clinton. Mine development in 1948 comprised 5,652 feet of drifts and crosscuts and a 1,773-foot raise. The ore-treatment process includes crushing to ⅝-inch size, ball milling in cyanide solution, thickening and agitation, countercurrent washing in four stages, Merrill-Crowe zinc-dust precipitation, and reduction of precipitate in a gas-fired reverberatory-type tilting furnace. Sulfide ores, when available, are bypassed from the crushing circuit, dry rod-milled to 10-mesh, roasted, and returned to ball mills. Gold recovered in 1948 totaled 17,036 ounces and silver 21,636 ounces.

Operations of the Belle Eldridge Gold Mines, Inc., on the Belle Eldridge group near Deadwood centered on development in 1948. With a crew of only seven men, the company drove 1,866 feet of drifts, did 2,410 feet of diamond drilling, made additions to mill equipment, and operated the mill occasionally on a test basis while the flow sheet was being corrected. The company reported that a large and very consistent ore body was contacted by diamond core drilling at the

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250- to 285-foot level below present workings. The body contains zinc, gold, silver, and lead—zinc representing the greatest assay values to date. Drilling was being continued to estimate the extent of the ore body. Ore treated for test purposes in 1948 totaled 1,480 tons, yielding 50 tons of lead concentrate assaying 1.29 ounces of gold and 15.4 ounces of silver to the ton, 31.4 percent lead, 5.7 percent zinc, and 22.1 percent iron; and 80 tons of zinc concentrate assaying 0.105 ounce of gold and 1.55 ounces of silver to the ton, 1 percent lead, 43.73 percent zinc, and 14.15 percent iron.

The Frerichs Mining Co. developed its mine near Deadwood, remodeled its mill, and shipped a small quantity of gold-silver bullion to the Denver Mint.

PENNINGTON COUNTY

The Golden Arrow Mines, Inc., shipped a little gold bullion and a ton of gold concentrates from the Golden Arrow mine. R. E. Nelson recovered a small quantity of gold bullion from his mine. Both properties are in the Hill City area.

Texas

Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By A. J. MARTIN

GENERAL SUMMARY

ORES mined in Texas in 1948 yielded gold, silver, copper, and lead valued altogether at $75,611 compared with $50,478 (including zinc also) in 1947. Lead represented 80 percent of the total value in 1948 and 45 percent in 1947. Five small-scale operations in Culberson, Hudspeth, and Presidio Counties contributed to the output of two or more of the metals in 1948; in 1947 there were eight operations, including one that produced zinc also.

The new slag-fuming plant built by the American Smelting & Refining Co. at its El Paso Smelting Works began operating in August 1948. The plant is expected to produce about 25,000 tons of zinc annually after the trial-run period is completed. In the mine-production statistics the metals (principally zinc) recovered from domestic current hot slag are credited to the various shipping mines on the basis of the assay content of the ore and are thus apportioned to the States from which they came. Specific data on the quantity of metals recovered in 1948 from old slag accumulated in earlier years are not available, and this output is not included in the mine-production statistics.

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, 1944–48

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1944	$35.00	$0.711+	$0.135	$0.080	$0.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122
1947	35.00	.905	.210	.144	.121
1948	35.00	.905+	.217	.179	.133

[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. 1944 to June 30, 1946: $0.71111111; July 1, 1946, to Dec. 31, 1947: $0.905; 1948: $0.9050505.
[3] Yearly average weighted price of all grades of primary metal sold by producers; 1944–47: price included bonus payments by Office of Metals Reserve for overquota production.

MINE PRODUCTION

In total mine production from 1885 through 1948, silver was the principal metal produced in Texas, although the output has been small since large-scale operation of the Presidio mine at Shafter ceased in 1942. The following table shows the annual output of ore and the quantity and value of the metals recovered from Texas mines from 1944 to 1948, as well as the total metal production from 1885 to 1948.

Mine production of gold, silver, copper, lead, and zinc in Texas, 1944–48, and total, 1885–1948, in terms of recovered metals

Year	Ore (short tons)	Gold		Silver	
		Fine ounces	Value	Fine ounces	Value
1944	4,160			5,355	$3,808
1945	2,693			23,265	16,544
1946	6,705	9	$315	42,922	34,681
1947	4,552	45	1,575	20,547	18,595
1948	1,850	57	1,995	3,065	2,774
1885–1948	(1)	8,392	227,665	33,291,975	23,436,430

Year	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
1944	115	$31,050					$34,858
1945	55	14,850					31,394
1946	3	972	47	$10,246	44	$10,736	56,950
1947	6	2,520	78	22,464	22	5,324	50,478
1948 [2]	23	9,982	170	60,860			75,611
1885–1948	1,338	382,545	5,083	583,019	810	122,551	24,752,210

[1] Figure not available.
[2] Does not include zinc and lead that were recovered by the new slag-fuming plant at the El Paso smelter from old accumulated slag resulting from operations in previous years.

Mine production of gold, silver, copper, lead, and zinc in Texas in 1948, by counties, in terms of recovered metals

County	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Culberson	1	36		114	2	1	
Hudspeth	2	921		66	20		
Presidio	2	893	57	2,885	1	169	
Total: 1948	5	1,850	57	3,065	23	170	
1947	8	4,552	45	20,547	6	78	22

Mine production of gold, silver, copper, and lead in Texas in 1948, by months, in terms of recovered metals

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	1	80		6	
February	5	94		4	
March	9	310		21	
April	10	300		24	
May	5	269		14	
June	4	270		14	
July	5	228		13	
August					
September		93	4	1	
October	8	663	2	28	
November	7	440	4	25	
December	3	318	13	20	
Total: 1948	57	3,065	23	170	
1947	45	20,547	6	78	22

ORE CLASSIFICATION

Details of ore classification are given in the Gold and Silver chapter of this volume.

Ore sold or treated in Texas in 1948, with content in terms of recovered metals

Source	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Copper ore	3	957		180	22	1	
Lead ore	2	893	57	2,885	1	169	
Total: 1948	5	1,850	57	3,065	23	170	
1947	8	4,552	45	20,547	6	78	22

SMELTING AND REFINING PLANTS IN TEXAS

Smelters in Texas treat large tonnages of ore and concentrates from several Western States and foreign countries, as well as substantial tonnages of smelter residues and secondary material from plants in Texas and other States east of the Rocky Mountain region.

The copper and lead smelters of the American Smelting & Refining Co. at El Paso had an annual capacity of 600,000 and 250,000 tons, respectively, of furnace charge in 1948. During the year an additional lead blast furnace was being constructed to raise the plant capacity to the level required for steady operation of the new slag-fuming plant put in operation in August. Ores and concentrates received in 1948 came from mines in Arizona, Colorado, New Mexico, Texas, Central America, Mexico, the Netherlands, South-West Africa, Tasmania, and Argentina. Other material treated included zinc-smelter residues, matte, and clean-up material from plants in various States and foreign countries.

The Phelps Dodge Corp. Nichols electrolytic copper refinery at El Paso treats blister-copper anodes cast at corporation smelters in Arizona. The plant, which employs about 800 men, operated steadily throughout 1948. A copper sulfate (blue vitriol) section and a slime plant (for recovery of rare metals and gold, silver, and lead) are operated in connection with the electrolytic plant.

The three zinc-reduction plants in the State operated throughout 1948. The horizontal-retort smelter of the American Smelting & Refining Co. at Amarillo received concentrates from mines in Arizona, Colorado, New Mexico, and Utah and fume from the new slag-fuming plant at El Paso. The same company operates the electrolytic zinc plant at Corpus Christi (annual capacity, 30,000 tons of cathode zinc), which also treats both foreign and domestic concentrates. The horizontal-retort smelter of the American Zinc Co. of Illinois at Dumas purchased concentrates from mine operators in Arizona, Colorado, New Mexico, Oklahoma, South Dakota, and foreign countries and zinc fume from a slag-fuming plant in Utah.

REVIEW BY COUNTIES

Culberson County.—The Mary Ellen mine 25 miles north of Van Horn was worked on a small scale in 1948 by J. J. Trepanier, owner. Development totaled 40 feet of shaft and 160 feet of drifts. The output was a car of copper-lead-silver ore, shipped to the El Paso smelter.

Hudspeth County.—The Black Shaft and Sancho Panza mines, 9 and 7 miles, respectively, northeast of Allamoore, were operated during the last few months of 1948 by A. P. Williams. Several cars of copper-silver ore were shipped from each mine.

Presidio County.—R. I. Carr continued to ship lead ore from the Sullivan deposits, 7 miles west of Shafter, to the El Paso smelter. The ore is mined from shallow pits and contains, besides lead, some silver and gold and a little copper. The Marfa Mining Co. shipped a car of lead-silver ore from the Jones claims (Silver Dome group) 25 miles northwest of Presidio.

The Montezuma zinc-lead deposit in the Shafter district was investigated by the Bureau of Mines; the work included diamond drilling and exploratory development.

Utah
Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By C. E. NEEDHAM AND PAUL LUFF

GENERAL SUMMARY

LEAD held the spotlight in Utah metal mining in 1948 with a gain of 11 percent over 1947 output. Silver production rose 3 percent, but copper output declined 15 percent, gold 13, and zinc 5. Lead increased 40 percent in value, zinc 4, and silver 3, but the value of gold dropped 13 percent and that of copper 12. The 1948 total value of $149,763,677 was nearly 6 percent less than that of $158,624,849 in 1947. Of the total value in 1948, copper contributed 66 percent, lead 13, gold nearly 9, zinc 7, and silver almost 5 percent. Compared with 1947, the value of the five metals produced in the West Mountain (Bingham) district slumped 8 percent, but it rose 24 percent in the Park City region and 6 in the Tintic district.

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, 1944–48

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1944	$35	$0.711+	$0.135	$0.080	$0.114
1945	35	.711+	.135	.086	.115
1946	35	.808	.162	.109	.122
1947	35	.905	.210	.144	.121
1948	35	.905+	.217	.179	.133

[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. 1944 to June 30, 1946; $0.71111111; July 1, 1946, to Dec. 31, 1947; $0.905; 1948: $0.9050505.
[3] Yearly average weighted price of all grades of primary metal sold by producers; 1944–47; price includes bonus payments by Office of Metals Reserve for overquota production.

Mine production of gold, silver, copper, lead, and zinc in Utah, 1944–48, and total, 1864–1948, 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
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
1947	118	2	30,383,114	421,662	14,758,170	7,780,032	7,040,929
1948	118	2	25,741,911	368,422	12,894,770	8,045,329	7,281,429
1864–1948			[1] 625,727,713	11,433,062	300,382,210	734,997,880	538,408,120

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
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
1947	533,066,000	111,943,860	99,396,000	14,313,024	87,346,000	10,568,866	158,624,849
1948	454,014,000	98,521,038	111,900,000	20,030,100	82,980,000	11,036,340	149,763,677
1864–1948	[2] 5,393,981	1,582,855,387	[2] 4,524,688	523,600,698	[2] 1,068,174	159,577,147	3,104,823,562

[1] Figures estimated for certain years before 1901.
[2] Short tons.

Mine production of gold, silver, copper, lead, and zinc in Utah in 1948, by months, in terms of recovered metals

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	36,240	730,540	22,388	4,132	3,241
February	35,822	765,320	22,023	4,321	3,113
March	35,652	793,500	23,105	4,666	3,522
April	36,751	745,300	23,430	4,820	3,743
May	37,613	745,810	24,150	4,617	3,396
June	38,169	749,890	23,435	5,114	3,697
July	38,050	690,740	22,837	4,401	2,924
August	33,590	682,815	24,006	4,830	3,470
September	37,346	656,172	22,931	4,585	3,535
October	30,395	647,330	18,231	4,630	3,276
November	4,801	437,202	312	4,890	3,705
December	3,993	400,710	159	4,944	3,868
Total: 1948	368,422	8,045,329	227,007	55,950	41,490
1947	421,662	7,780,032	266,533	49,698	43,673

Gold.—The decline of over 53,000 ounces of gold in State output in 1948 resulted almost entirely from a work stoppage at the Utah Copper mine at Bingham. Copper ore remained the principal source of gold, contributing 85 percent of the State gold; zinc-lead supplied 10 percent and other base-metal ores about 1 percent; and gold and silver ores, 4 percent. Two placer operators reported production in 1948.

Of the State gold in 1948, 90 percent came from the West Mountain (Bingham) district, where gold output was 13 percent less than in 1947; the Park City region, second in position, gained 12 percent; and the Tintic district, in third place, dropped 28 percent.

The leading gold producers in Utah in 1948, each with an output of more than 1,000 ounces of recoverable metal, were as follows: Utah Copper mine and the United States & Lark group, both in the West Mountain (Bingham) district; New Park Mining Co. property in the Park City region; Tintic Bullion mine, Chief Consolidated Mining Co. property, and the Eureka Lilly mine, all three in the Tintic district; Calumet mine in the Rush Valley district; Oro Del Rey mine in the Willow Springs district; old pyritic tailings of the Combined Metals Reduction Co. at Bauer; Butterfield property in the West Mountain (Bingham) district; and the Park Utah Consolidated Mines Co. property in the Park City region. These 11 properties furnished over 98 percent of the State gold in 1948.

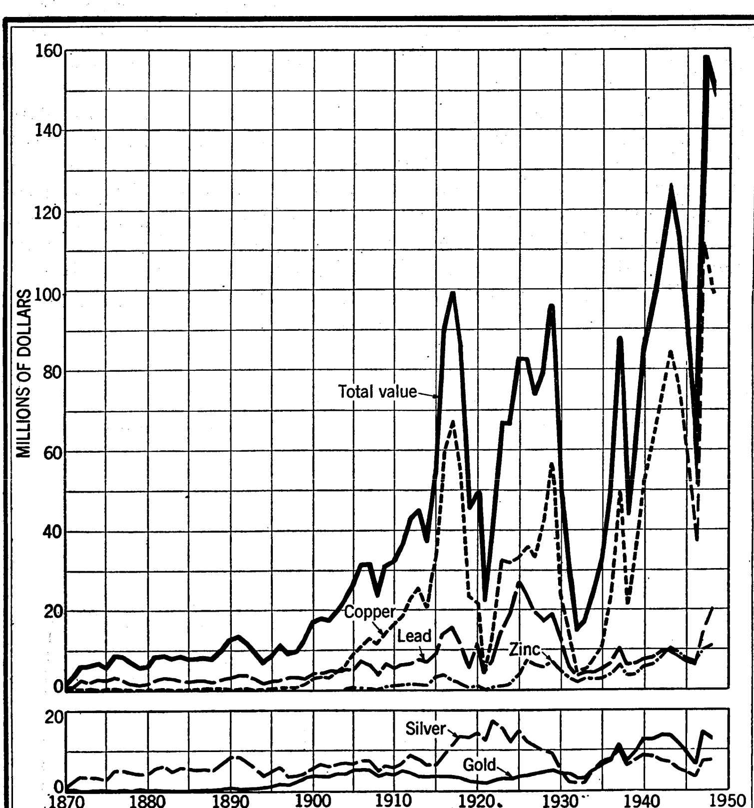

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc, and total value in Utah, 1870–1948

Silver.—With the exception of the Utah Copper mine and the old tailings operation of the Pacific Bridge Co. at Park City, all the larger producers of silver in Utah reported gains in 1948. Because of the work stoppage at the Utah Copper mine, output of silver in the West Mountain (Bingham) district in 1948 was 3 percent below that in 1947; increases were made in the Park City region and in the Tintic district.

Utah properties that produced more than 100,000 ounces of recoverable silver each in 1948 were as follows: Utah Copper mine, United States & Lark group, properties of the Chief Consolidated Mining Co., Silver King Coalition Mines Co., Park Utah Consolidated Mines Co., and New Park Mining Co., Calumet mine, Butterfield group, Pacific Bridge Co. property, Daly No. 1 dump, and Eureka Lilly mine. These 11 producers supplied 94 percent of the State's total silver in 1948.

Zinc-lead ore, zinc ore, lead ore, and zinc-lead-copper ore together furnished 57 percent of the State silver in 1948; copper ore 33 percent, and gold and silver ores nearly 10 percent; the remainder came principally from zinc slag fumed.

Copper.—The work stoppage at the Utah Copper mine was the sole factor in bringing about the 15-percent decline in State output of copper in 1948. Based on average production rates of copper at the mine until the strike began October 24, the loss in yield of the metal during that part of the strike in 1948 is estimated at 100,000,000 pounds. The United States & Lark group increased its copper output 10 percent and was the only other Utah property to produce more than a million pounds of recoverable copper in 1948. These two producers contributed 99 percent of the State copper.

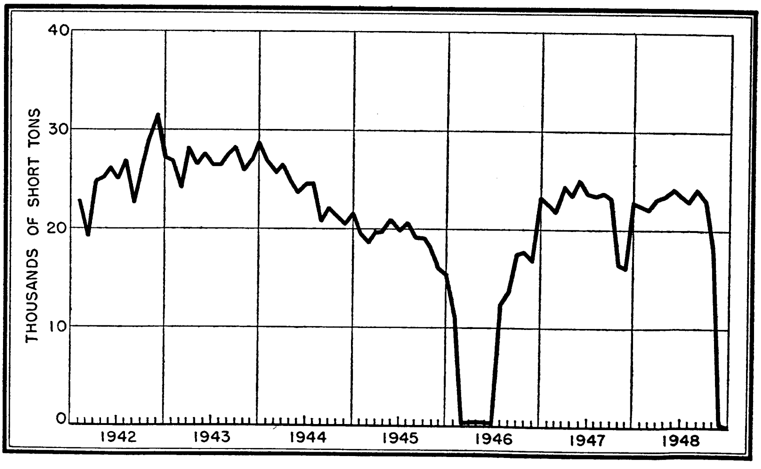

FIGURE 2.—Mine production of copper in Utah, by months, 1942–48, in terms of recovered metal

Lead.—Yield of lead in Utah in 1948 rose to the highest figure since 1943. Output of the metal from the Butterfield property at Lark was nearly double that in 1947, and gains of a third were made at the Calumet mine and the property of the Silver King Coalition Mines Co. Among the larger producers, only the Hidden Treasure mine and the New Park Mining Co. property reported declines in production of recoverable metal, and these were small.

The leading State lead producers in 1948, each with an output of more than a million pounds of recoverable metal, were the United States & Lark group, properties of Chief Consolidated Mining Co., Silver King Coalition Mines Co., and Park Utah Consolidated Mines Co., Calumet mine, New Park Mining Co. property, Butterfield group, Pacific Bridge Co. property, and Hidden Treasure mine. These nine producers supplied 93 percent of the State lead in 1948.

Of the total lead in 1948, 88 percent was recovered from zinc-lead ore, and most of the remainder from lead ore, gold and silver ores, and zinc slag.

Zinc.—Of the 10 leading zinc producers in Utah in 1948 only four succeeded in increasing their outputs of recoverable zinc beyond 1947 figures. Output at the Butterfield property doubled, and increases were made at the United States & Lark group and at the properties of the New Park Mining Co. and the Park Utah Consolidated Mines Co.

Leading producers of the metal in 1948 in order were the United States & Lark group, the properties of the New Park Mining Co., Chief Consolidated Mining Co., Park Utah Consolidated Mines Co., and Pacific Bridge Co., old slag pile at Tooele, Calumet mine, Silver King Coalition Mines Co. property, Butterfield property, and Hidden Treasure mine. The 10 producers, each with an output of more than a million pounds, supplied 96 percent of the total zinc.

Zinc-lead ore was the source of 94 percent of the total zinc in 1948; old zinc slag furnished most of the remainder.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Utah in 1948, by counties, in terms of recovered metals

County	Mines producing		Ore (short tons)	Gold		Silver	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
Beaver	13	--------	9,771	318	$11,130	28,816	$26,080
Box Elder	3	--------	622	3	105	843	763
Grand	1	1	11	1	35	31	28
Iron	1	--------	1	1	35	10	9
Juab	16	--------	143,841	3,341	116,935	911,580	825,026
Millard	2	1	81	13	455	94	85
Piute	4	--------	495	81	2,835	7,277	6,586
Salt Lake	13	--------	24,892,514	332,652	11,642,820	4,719,614	4,271,489
San Juan	1	--------	311	--------	--------	105	95
Summit	7	--------	433,774	2,964	103,740	1,339,480	1,212,297
Tooele	37	--------	151,328	5,217	182,595	429,870	389,054
Utah	14	--------	35,013	7,698	269,430	230,902	208,978
Wasatch	3	--------	72,897	16,123	564,305	364,384	329,786
Washington	2	--------	1,247	10	350	12,323	11,153
Wayne	1	--------	5	--------	--------	--------	--------
Total: 1948	118	2	25,741,911	368,422	12,894,770	8,045,329	7,281,429
1947	118	2	30,383,114	421,662	14,758,170	7,780,032	7,040,929

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaver	59,000	$12,803	700,400	$125,372	435,300	$57,895	$233,280
Box Elder	89,700	19,465	42,500	7,607	--------	--------	27,940
Grand	200	43	100	18	--------	--------	124
Iron	--------	--------	--------	--------	--------	--------	44
Juab	207,600	45,049	10,994,000	1,967,926	7,163,400	952,732	3,907,668
Millard	100	22	13,400	2,398	700	93	3,053
Piute	4,800	1,042	33,500	5,997	200	27	16,487
Salt Lake	450,523,400	97,763,578	62,198,900	11,133,603	44,731,400	5,949,276	130,760,766
San Juan	88,200	19,139	--------	--------	--------	--------	19,234
Summit	610,400	132,457	18,871,400	3,377,981	12,723,200	1,692,186	6,518,661
Tooele	981,800	213,051	10,866,000	1,945,014	8,893,800	1,182,875	3,912,589
Utah	802,100	174,056	1,422,600	254,645	1,115,500	148,362	1,055,471
Wasatch	582,900	126,489	6,468,000	1,157,772	7,916,500	1,052,894	3,231,246
Washington	63,500	13,779	289,200	51,767	--------	--------	77,049
Wayne	300	65	--------	--------	--------	--------	65
Total: 1948	454,014,000	98,521,038	111,900,000	20,030,100	82,980,000	11,036,340	149,763,677
1947	533,066,000	111,943,860	99,396,000	14,313,024	87,346,000	10,568,866	158,624,849

MINING INDUSTRY

The 15-percent decline in ore production in Utah in 1948, with accompanying heavy losses in outputs of copper and gold, was directly traceable to a work stoppage at the open-pit mine of the Kennecott Copper Corp. in Bingham Canyon. All work at the mine and mills was halted on October 24 by 311 locomotive operators inside the pit over the wage differential between them and the operators of the larger engines on the main ore-haulage line to the Arthur and Magna mills; settlement was not reached until February 1949. Most of the remaining large State producers reported increased tonnages for the year.

In spite of higher prices for base metals, active lode mines in the State in 1948 remained at 118, the same as in 1947.

ORE CLASSIFICATION

Details of ore classification are given in the Gold and Silver chapter of this volume.

Ore sold or treated in Utah in 1948, 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	8	4,949	5,686	12,362	53,783	27,785	
Dry and siliceous gold-silver ore	23	125,084	7,573	327,249	827,760	2,544,665	5,756
Dry and siliceous silver ore	32	85,679	1,964	432,575	227,599	2,678,312	
	63	215,712	15,223	772,186	1,109,142	5,250,762	5,756
Copper	13	24,458,362	312,536	2,649,771	[1] 449,117,454	94,372	840
Lead	62	27,416	3,003	273,487	132,529	6,562,950	198,452
Lead-copper	1	3		4	413	385	
Zinc	4	[2] 46,136	144	23,921	199,089	920,827	4,324,414
Zinc-lead	45	992,717	37,482	4,302,847	3,338,971	98,602,941	78,106,542
Zinc-lead-copper	1	1,565	20	23,113	116,402	467,763	343,996
Total lode mines	[3] 118	25,741,911	368,408	8,045,329	[1] 454,014,000	111,900,000	82,980,000
Placers	2		14				
Total: 1948	120	25,741,911	368,422	8,045,329	[1] 454,014,000	111,900,000	82,980,000
1947	120	30,383,114	421,662	7,780,032	[4] 533,066,000	99,396,000	87,346,000

[1] Includes 15,658,743 pounds recovered from mine-water precipitates.
[2] Includes 34,818 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] Includes 21,149,066 pounds recovered from mine-water precipitates.

METALLURGIC INDUSTRY

The 25,741,911 tons of ore produced in Utah in 1948 were treated as follows: 25,517,522 tons (over 99 percent) at mills (30,145,074 tons in 1947); 189,571 tons (0.74 percent) shipped crude to smelters (171,618 tons in 1947); and 34,818 tons (0.14 percent) of old slag fumed (66,422 tons in 1947).

The 11 mills active in Utah in 1948 treated Utah ore and tailings as follows: Three plants (Arthur, Magna, and Prosper), 24,454,125 tons of copper ore; six mills (Bauer, Midvale, Pacific Bridge, Silver King, Tooele, and Horn Silver), 989,492 tons of zinc-lead ore and old tailings, and lead ore; one plant (Bauer), 62,500 tons of old pyritic gold-silver tailings; one flotation mill in Summit County, 11,000 tons of current zinc tailings; one gravity mill in Utah County, 200 tons of lead ore; and one mill (Midvale), 205 tons of gold-silver ore.

The Midvale 1,700-ton concentrator of the United States Smelting, Refining & Mining Co. operated all year and continued to treat largely zinc-lead ore, most of which came from company-owned properties in the West Mountain (Bingham) district and from the property of the New Park Mining Co. in the Park City region. The 1,500-ton concentrator of the International Smelting & Refining Co. at Tooele operated mainly on zinc-lead ore supplied by the Chief Consolidated Mining Co. in the Tintic district and the Park Utah Consolidated Mines Co. in the Park City region; the copper unit at the concentrator remained idle. The 700-ton concentrator of the Combined Metals Reduction Co. at Bauer operated continuously largely on zinc-lead ore from company-owned or -operated mines in Utah and Idaho. The 800-ton concentrator of the Silver King Coalition Mines Co. at Park City was active throughout the year and treated only zinc-lead-silver ore from the company mine. The tailing plant of the Pacific Bridge Co. at Park City operated all year, but at a considerably lower rate than in 1947.

The Garfield copper smelter of the American Smelting & Refining Co. curtailed operations on October 24, when the work stoppage became effective at the Utah Copper mine, then closed on November 19; operations were not resumed until February 1949. The Murray lead smelter of the American Smelting & Refining Co. operated all year and treated lead concentrates, crude lead ores, and gold and silver ores chiefly from Utah and Idaho. The Midvale lead smelter of the United States Smelting, Refining & Mining Co. treated similar materials mainly from company properties in Utah. The Tooele lead plant of the International Smelting & Refining Co. operated in conjunction with the company zinc slag-fuming plant and treated zinc-lead ores and old slag, lead ores and concentrates, and zinc ores from both company and custom sources. The slag-fuming plant treated a total of 127,550 tons of current hot slag, old cold slag, and crude ore in 1948, compared with 160,482 tons in 1947; output was 19,560 tons of zinc fume, averaging 74.71 percent zinc, and 2,842 tons of lead fume, averaging 48.19 percent lead. The company copper smelter at Tooele remained idle throughout the year.

Grading was begun at Garfield late in the year for the construction of the $16,000,000 copper refinery of the Kennecott Copper Corp.; the first structural steel was erected early in 1949, and completion of the plant is expected in 1950.

Mine production of metals in Utah in 1948, 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	929,030	351,029	6,953,487	435,809,613	98,128,283	77,392,987
Ore smelted [1]	224,389	17,379	1,091,835	2,545,644	13,771,717	5,587,013
Mine-water precipitates smelted [2]	9,651		7	15,658,743		
Total lode		368,408	8,045,329	454,014,000	111,900,000	82,980,000
Placer		14				
Total: 1948		368,422	8,045,329	454,014,000	111,900,000	82,980,000
1947		421,662	7,780,032	533,066,000	99,396,000	87,346,000

[1] Includes 34,818 tons of old slag.
[2] All from Salt Lake County.

Gross metal content of Utah ore treated at mills in 1948, by classes of ore [1]

Class of ore	Ore (short tons)	Gross metal content of mill feed: Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold-silver ore	62,705	2,053	80,791	3,148	1,454,820	5,688
Copper	24,454,125	442,768	3,034,281	474,975,480		
Lead	437	21	2,368	791	48,397	3,429
Zinc	11,000	10	7,000	4,000	165,000	275,000
Zinc-lead	989,255	49,152	5,370,509	5,222,954	114,836,531	108,421,661
Total: 1948	25,517,522	494,004	8,494,949	480,206,373	116,504,748	108,705,778
1947	30,145,074	544,840	8,504,779	564,902,829	107,106,969	113,782,951

[1] Exclusive of copper ore treated by leaching.

Gross metal content of concentrates produced from ores mined in Utah in 1948, 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)
Silver	5		12		745	
Copper	670,087	312,197	2,622,273	441,342,241		
Lead	87,642	17,335	3,372,582	2,359,884	89,887,932	9,551,874
Zinc	73,147	7,461	543,149	1,156,325	6,713,509	77,520,623
Zinc-lead	921	25	8,131	3,238	290,932	222,790
Iron (from gold-silver, zinc, and zinc-lead ore)	97,228	14,045	426,139	594,617	5,658,160	4,708,210
Total: 1948	929,030	351,063	6,972,286	445,456,305	102,551,278	92,003,497
1947	1,019,624	399,079	6,669,841	520,429,805	89,918,139	90,770,421

Mine production of metals from mills [1] in Utah in 1948, in terms of recovered metals

	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)
BY COUNTIES							
Beaver	5,893	1,413	63	13,363	20,287	409,569	398,500
Juab	84,023	18,313	913	508,822	57,927	6,341,504	7,079,675
Millard	6	3		6	7	805	700
Piute	5	2		9	41	535	200
Salt Lake	24,839,865	815,680	328,416	4,516,115	434,542,448	57,892,053	44,032,841
Summit	399,003	31,688	2,242	1,161,730	525,981	17,762,754	12,722,398
Tooele	108,511	40,449	3,027	332,405	60,702	8,261,669	4,143,008
Utah	7,385	2,459	247	56,899	22,220	991,446	1,099,165
Wasatch	72,831	19,023	16,121	364,138	580,000	6,467,948	7,916,500
Total: 1948	25,517,522	929,030	351,029	6,953,487	435,809,613	98,128,283	77,392,987
1947	30,145,074	1,019,624	399,045	6,649,816	509,378,535	85,305,449	76,287,881
BY CLASSES OF CONCENTRATES SMELTED							
Silver		5		12		447	
Copper		670,087	312,197	2,622,273	432,515,056		
Lead		87,642	17,335	3,372,582	1,750,945	86,779,253	1,635,536
Zinc		73,147	7,427	524,350	1,091,319	6,286,368	75,296,480
Zinc-lead		921	25	8,131	2,444	258,199	189,082
Iron (from gold-silver, zinc, and zinc-lead ore)		97,228	14,045	426,139	449,849	4,804,016	271,889
Total 1948		929,030	351,029	6,953,487	435,809,613	98,128,283	77,392,987

[1] No bullion produced in 1948.

Gross metal content of Utah crude ore shipped to smelters in 1948, 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	4,949	5,686	12,362	55,000	46,308	-
Dry and siliceous gold-silver	62,379	6,130	277,826	842,619	3,585,747	2,722
Dry and siliceous silver	85,679	1,964	432,575	232,756	4,458,251	155
Copper	4,237	339	27,491	965,662	157,086	4,196
Lead	26,979	2,994	271,574	174,637	6,771,954	481,903
Lead-copper	3	-	4	590	401	-
Zinc[1]	35,136	157	24,663	266,230	960,561	5,811,398
Zinc-lead	3,462	104	23,726	56,175	932,703	1,099,222
Zinc-lead-copper	1,565	20	23,113	136,943	475,853	475,133
Total: 1948	224,389	17,394	1,093,334	2,730,612	17,388,864	7,874,729
1947	238,040	22,605	1,130,215	2,775,822	17,122,111	15,357,180

[1] Includes 34,818 tons of old slag.

Mine production of metals from Utah crude ore shipped to smelters in 1948, in terms of recovered metals

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES						
Beaver	3,878	255	15,453	38,713	290,831	36,800
Box Elder	622	3	843	89,700	42,500	-
Grand	11	-	31	200	100	-
Iron	1	1	10	-	-	-
Juab	59,818	2,428	402,758	149,673	4,652,496	83,725
Millard	75	-	88	93	12,595	-
Piute	490	81	7,268	4,759	32,965	-
Salt Lake	52,649	4,236	203,492	322,209	4,306,847	698,559
San Juan	311	-	105	88,200	-	-
Summit	34,771	722	177,750	84,419	1,108,646	802
Tooele	42,817	2,190	97,465	921,098	2,604,331	4,750,792
Utah	27,628	7,451	174,003	779,880	431,154	16,335
Wasatch	66	2	246	2,900	52	-
Washington	1,247	10	12,323	63,500	289,200	-
Wayne	5	-	-	300	-	-
Total: 1948	224,389	17,379	1,091,835	2,545,644	13,771,717	5,587,013
1947	238,040	22,605	1,130,208	2,538,399	14,090,551	11,058,119
BY CLASSES OF ORE						
Dry and siliceous gold	4,949	5,686	12,362	53,783	27,785	-
Dry and siliceous gold-silver	62,379	6,130	277,826	825,652	2,151,888	1,311
Dry and siliceous silver	85,679	1,964	432,575	227,599	2,678,312	-
Copper	4,237	339	27,491	943,655	94,372	840
Lead	26,979	2,994	271,574	132,100	6,522,136	197,042
Lead-copper	3	-	4	413	385	-
Zinc	[1] 35,136	142	23,164	198,331	912,160	4,248,007
Zinc-lead	3,462	104	23,726	47,709	916,916	795,817
Zinc-lead-copper	1,565	20	23,113	116,402	467,763	343,996
Total 1948	224,389	17,379	1,091,835	2,545,644	13,771,717	5,587,013

[1] Includes 34,818 tons of old slag.

REVIEW BY COUNTIES AND DISTRICTS

BEAVER COUNTY

Beaver Lake District.—A. M. Bealer operated the O. K. mine from June to December and produced about 165 tons of copper ore containing 7 ounces of gold, 192 ounces of silver, and 15,721 pounds of copper.

Granite District.—R. A. Glenny, lessee, operated the Beaver View group throughout the year and shipped to smelters 199 tons of zinc-lead ore containing 31 ounces of gold, 526 ounces of silver, 992 pounds of copper, 41,178 pounds of lead, and 50,870 pounds of zinc; and 52 tons of lead ore containing 9 ounces of gold, 190 ounces of silver, 382 pounds of copper, and 14,094 pounds of lead.

San Francisco District.—Lessees worked the Horn Silver mine and produced 5,016 tons of zinc-lead ore, 197 tons of lead ore, 78 tons of dump silver ore, and 27 tons of dump gold-silver ore. The 5,016 tons of zinc-lead ore, which was mined by Metal Producers, Inc., contained 65 ounces of gold, 13,659 ounces of silver, 11,881 pounds of copper, 477,907 pounds of lead, and 492,787 pounds of zinc. The bulk of this ore was treated in the company new 500-ton flotation mill. Remaining district output was 147 tons of copper smelting ore from the Cactus mine and 85 tons of zinc-lead milling ore and 40 tons of gold-silver smelting ore from the Frisco Lead-Silver mine.

Star and North Star District.—The Harrington-Hickory mine was operated throughout 1948 by James D. Williams, lessee. Production was 2,036 tons of silver smelting ore containing 29 ounces of gold, 8,704 ounces of silver, 8,286 pounds of copper, and 123,527 pounds of lead; 579 tons of gold smelting ore containing 151 ounces of gold, 1,465 ounces of silver, 1,424 pounds of copper, and 16,961 pounds of lead; 117 tons of gold-silver smelting ore containing 5 ounces of gold, 430 ounces of silver, 561 pounds of copper, and 9,404 pounds of lead; 640 tons of zinc-lead milling ore containing 6 ounces of gold, 1,804 ounces of silver, 15,707 pounds of lead, and 22,028 pounds of zinc; and 29 tons of lead smelting ore containing 273 ounces of silver, 249 pounds of copper, and 6,024 pounds of lead. Lead ore constituted the bulk of remaining district production—199 tons came from the Wild Bill mine, 27 tons from the St. Mary group, and 17 tons from the Florence claim; in addition, 45 tons of silver ore and 27 tons of lead ore were produced from the Rebel claim, and 12 tons of copper ore from the Gold Bar claim.

BOX ELDER COUNTY

Lucin District.—Principal production in 1948 was from the Copper Mountain (Salt Lake Copper) group which yielded 515 tons of copper smelting ore containing 1 ounce of gold, 130 ounces of silver, 90,596 pounds of copper, and 2,944 pounds of zinc; and 46 tons of lead smelting ore containing 1 ounce of gold, 685 ounces of silver, 695 pounds of copper, 14,703 pounds of lead, and 2,532 pounds of zinc. Lessees worked the United Metal Mine and shipped 52 tons of lead smelting ore containing 18 ounces of silver, 29,724 pounds of lead, and 7,571 pounds of zinc.

Mine production of gold, silver, copper, lead, and zinc in Utah in 1948, 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:									
Beaver Lake	1		165	5	148	13,700			$3,282
Bradshaw	1		10	1	95		6,200		1,231
Granite	1		251	40	716	1,100	54,000	36,800	16,847
San Francisco	3		5,590	73	14,271	31,300	481,500	377,800	158,699
Star and North Star	6		3,728	199	13,396	12,600	156,400	15,900	51,933
Washington	1		27		190	300	2,300	4,800	1,288
Box Elder County:									
Crater Island	1		9	1	10	300			109
Lucin	2		613	2	833	89,400	42,500		27,831
Grand County:									
Miners Basin		1		1					35
Salt Valley	1		11		31	200	100		89
Iron County: Stateline	1		1	1	10				44
Juab County:									
Fish Springs	3		41	1	2,107		16,000		4,806
Tintic [1]	12		143,773	3,340	909,441	207,600	10,965,400	7,163,400	3,900,578
West Tintic	1		27		32		12,600		2,284
Millard County:									
Cricket Mountain	1		19		10		2,300		421
Gordon (Dog Valley)	1		62		84	100	11,100	700	2,177
House Mountain		1		13					455
Piute County:									
Mount Baldy	1		378	57	6,582	4,300	22,100		12,841
Ohio	3		117	24	695	500	11,400	200	3,646
Salt Lake County:									
Big Cottonwood	3		1,706	17	12,733	22,300	525,300	416,700	166,408
Little Cottonwood	4		783	16	8,025	44,300	221,400	65,400	65,764
Smelter	(2)		891	31	4,182	6,000	108,300	96,000	38,326
West Mountain (Bingham)	6		24,889,134	332,588	4,694,674	450,450,800	61,343,900	44,153,300	130,490,268
San Juan County: La Sal	1		311		105	88,200			19,234
Summit County: Uintah	7		433,774	2,964	1,339,480	610,400	18,871,400	12,723,200	6,518,661
Tooele County:									
Blue Bell	2		200	3	1,622	200	63,600		13,001
Camp Floyd	2		782	282	210	400	3,600	1,500	10,990
Clifton	4		310	10	674	800	72,300	5,000	14,741
Dugway	5		680	10	1,864	2,200	207,000	62,900	47,933
Erickson	3		1,123	3	769	1,800	173,600	142,500	51,218
Free Coinage	1		15		21		1,800	1,400	527
Lakeside	1		164		106	200	27,300	2,400	5,345
Ophir	9		7,702	113	71,838	234,200	1,582,300	1,572,600	612,182
Rush Valley [3]	7		139,284	3,264	348,027	740,200	8,369,800	7,103,600	3,032,819
Third Term	2		224	9	389	600	29,000	1,700	6,214
Willow Springs	1		844	1,523	4,350	1,200	335,700	200	117,619

Utah County:									
American Fork	3	----------	2,849	31	16,852	6,900	437,600	918,700	218,351
North Tintic	1	----------	37	----------	21	----------	10,800	----------	1,952
Tintic [1]	9	----------	32,124	7,667	214,019	795,200	974,000	196,800	835,123
Utah Lake	1	----------	3	----------	10	----------	200	----------	45
Wasatch County:									
Blue Ledge	2	----------	72,839	16,121	364,341	580,000	6,468,000	7,916,500	3,230,508
Snake Creek	1	----------	58	2	43	2,900	----------	----------	738
Washington County: Tutsagubet	2	----------	1,247	10	12,323	63,500	289,200	----------	77,049
Wayne County: Miners Mountain	1	----------	5	----------	----------	300	----------	----------	65
Total Utah	118	2	25,741,911	368,422	8,045,329	454,014,000	111,900,000	82,980,000	149,763,677

[1] Tintic district is 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.

JUAB COUNTY

Fish Springs District.—Principal production in 1948 was from the Utah Mine group—26 tons of lead ore containing 1 ounce of gold, 1,754 ounces of silver, and 12,250 pounds of lead; and 3 tons of silver ore containing 16 ounces of silver, and 317 pounds of lead.

Tintic District.—The Tintic district, lying in both Juab and Utah Counties, is reviewed here. The following table gives metal production in each section of the district in 1948, a comparison with the total in 1947, and the grand total from 1869 to 1948.

Mine production of gold, silver, copper, lead, and zinc in Tintic district, Juab and Utah Counties, Utah, 1947–48, and total, 1869–1948, in terms of recovered metals

	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
1948								
Juab County	12	143, 773	3, 340	909, 441	207, 600	10, 965, 400	7, 163, 400	$3, 900, 578
Utah County	9	32, 124	7, 667	214, 019	795, 200	974, 000	196, 800	835, 123
Total: 1948	21	175, 897	11, 007	1, 123, 460	1, 002, 800	11, 939, 400	7, 360, 200	4, 735, 701
1947	27	167, 384	15, 385	1, 076, 726	1, 099, 600	12, 331, 000	7, 938, 400	4, 480, 038
Total 1869–1948		(1)	2, 614, 765	262, 015, 915	244, 847, 964	1, 888, 130, 479	84, 293, 138	402, 742, 651

1 Figure not available.

The Chief Consolidated Mining Co. operated its Chief No. 1, Gemini, and Eureka Hill mines throughout the year and exceeded its 1947 tonnage by 26 percent. Output from the mines comprised 83,740 tons of zinc-lead milling ore containing 1,574 ounces of gold, 615,420 ounces of silver, 80,535 pounds of copper, 7,399,410 pounds of lead, and 9,613,455 pounds of zinc; 24,814 tons of silver smelting ore containing 626 ounces of gold, 162,532 ounces of silver, 47,253 pounds of copper, and 1,950,443 pounds of lead; and 9,529 tons of lead smelting ore containing 201 ounces of gold, 119,574 ounces of silver, 11,645 pounds of copper, 2,210,971 pounds of lead, and 115,642 pounds of zinc.

At the Tintic Standard mine, most of the year was spent in moving surface equipment to the No. 1 shaft. During the period of its operation, the mine produced 1,549 tons of zinc-lead milling ore, 187 tons of gold-silver smelting ore, and 168 tons of silver smelting ore. The zinc-lead ore contained 51 ounces of gold, 15,870 ounces of silver, 5,247 pounds of copper, 304,910 pounds of lead, and 45,109 pounds of zinc. The company Iron Blossom mine produced 1,024 tons of gold-silver smelting ore, 1,451 tons of silver smelting ore, and 95 tons of lead milling ore.

The Eureka Lilly mine was operated until November 11; shipments totaled 14,023 tons of gold-silver smelting ore containing 1,674 ounces of gold, 112,283 ounces of silver, and 613,443 pounds of copper. From the Colorado mine of the Colorado Consolidated Mines Co. 802 tons of gold-silver ore, 39 tons of silver ore, 287 tons of lead ore, and 194 tons of zinc-lead ore were shipped to smelters.

Other operations in the district that produced more than 1,000 tons of ore each were the Yankee mine (gold-silver and zinc-lead ores), Tintic Bullion and Coyote group (gold, gold-silver, and zinc-lead ores), North Lily group (zinc-lead ore), Mountain View group (gold-silver, zinc-lead, and lead ores), Eureka Bullion mine (copper ore), Godiva mine and dump (gold-silver ore), Eagle and Blue Bell mine (gold-silver and lead ores), and Centennial-Beck-Victoria mine (gold, gold-silver, silver, and lead ores).

SALT LAKE COUNTY

Big Cottonwood District.—The Cardiff mine was the principal producer, shipping 1,144 tons of zinc-lead ore containing 13 ounces of gold, 8,519 ounces of silver, 16,989 pounds of copper, 386,788 pounds of lead, and 436,542 pounds of zinc; 368 tons of lead ore containing 4 ounces of gold, 4,081 ounces of silver, 11,147 pounds of copper, 148,323 pounds of lead, and 50,000 pounds of zinc; and 179 tons of zinc ore containing 34 ounces of silver, 179 pounds of copper, 2,572 pounds of lead, and 130,854 pounds of zinc.

Little Cottonwood District.—The Columbus-Rexall group led the district in ore production in 1948 with 208 tons of zinc-lead ore and 204 tons of lead ore. Lessees worked the properties of the Wasatch Mines Co. and shipped to smelters 199 tons of copper ore, 92 tons of lead ore, and 18 tons of silver ore.

Smelter District.—Output credited to the Smelter district comprised lead-plant dump slag and yard cleanings.

West Mountain (Bingham) District.—In 1948 the West Mountain (Bingham) district produced 90 percent of the State gold, 58 percent of the silver, 99 percent of the copper, 55 percent of the lead, and 53 percent of the zinc; total value of the five metals represented 87 percent of the State total value.

Output of copper at the Utah Copper mine of the Kennecott Copper Corp. was 14 percent less in 1948 than in 1947, owing to the previously mentioned work stoppage. In spite of this, the mine remained the largest copper mine in the United States and contributed about 27 percent of the Nation's mine production of copper in 1948. The Arthur and Magna mills operated 296 days and treated ore in 1948 at an average daily rate of 82,615 tons, compared with 81,775 tons in 1947. In addition, large quantities of copper were leached from waste dumps and precipitated in the company plant at the mouth of Bingham Canyon.

Mine production of gold, silver, copper, lead, and zinc in West Mountain (Bingham) district, Salt Lake County, Utah, 1947–48, and total, 1865–1948, 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
1947	5	29, 306, 718	384, 414	4, 816, 611	528, 630, 200	52, 325, 500	40, 892, 800	$141, 308, 766
1948	6	24, 889, 134	332, 588	4, 694, 674	450, 450, 800	61, 343, 900	44, 153, 300	130, 490, 268
Total 1865–1948		(1)	6, 561, 031	152, 635, 808	[2] 5, 159, 861	[2] 1, 618, 864	[2] 522, 220	2, 074, 225, 899

[1] Figure not available.
[2] Short tons.

Lead production increased 14 percent at the United States & Lark property of the United States Smelting, Refining & Mining Co., silver and copper each 10, zinc 7, and gold 3 percent, compared with 1947 figures. About 88 percent of the ore produced in 1948 was zinc-lead ore, nearly all of which was treated at the company Midvale concentrator; the remaining 12 percent was gold-silver, silver, and lead ores shipped direct to smelters.

Combined Metals Reduction Co. and lessees operated the Butterfield group throughout the year and increased the ore output nearly 76 percent above the 1947 level. Production comprised 31,117 tons of zinc-lead milling ore containing 1,926 ounces of gold, 277,866 ounces of silver, 111,500 pounds of copper, 6,575,260 pounds of lead, and 2,442,960 pounds of zinc; and 32 tons of gold-silver ore containing 1 ounce of gold, 88 ounces of silver, 1,248 pounds of lead, and 1,811 pounds of zinc.

Remaining district output was principally 1,287 tons of zinc-lead ore and 174 tons of lead ore produced by lessees from the Apex-Delaware group and 205 tons of gold-silver ore produced from exploration and development by the Ohio Copper Co. at its Columbia group.

SAN JUAN COUNTY

Output credited to San Juan County in 1948 consisted of mill cleanings from the Big Indian property operated by the Ohio Copper Co. until November 1947.

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 1948 compared with 1947 and the total from 1870 to 1948.

Mine production of gold, silver, copper, lead, and zinc in Park City region. Summit and Wasatch Counties, Utah, 1947–48, and total, 1870–1948, 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
1947	10	657,496	17,052	1,352,748	1,139,800	21,973,500	21,912,400	$7,875,999
1948	10	506,671	19,087	1,703,864	1,193,300	25,339,400	20,639,700	9,749,907
Total 1870–1948	--------	(1)	597,945	237,831,312	70,970,513	2,455,756,834	728,363,211	384,810,227

1 Figure not available.

Silver King Coalition Mines Co. produced 52,012 tons of ore in 1948, compared with 42,102 tons in 1947. The company 800-ton flotation mill treated 50,892 tons of zinc-lead ore containing 911 ounces of gold, 574,062 ounces of silver, 366,400 pounds of copper, 9,781,440 pounds of lead, and 4,091,720 pounds of zinc. The remaining ore, shipped to smelters, comprised 881 tons of lead ore and 239 tons of silver ore.

Park Utah Consolidated Mines Co. operated its property throughout the year and shipped 44,753 tons of zinc-lead ore, compared with 41,460 tons in 1947. The ore in 1948 contained 1,527 ounces of gold, 502,880 ounces of silver, 168,368 pounds of copper, 7,625,586 pounds of lead, and 7,055,731 pounds of zinc.

Pacific Bridge Co. operated its 1,000-ton flotation mill and treated 292,358 tons of old zinc-lead tailings from the Graselli dump, compared with 459,944 tons in 1947. Concentrates comprised 5,635 tons of lead concentrate containing 224 ounces of gold, 98,546 ounces of silver, 76,264 pounds of copper, 1,816,229 pounds of lead, and 569,849 pounds of zinc; and 4,611 tons of zinc concentrate containing 121 ounces of gold, 69,404 ounces of silver, 41,345 pounds of copper, 402,768 pounds of lead, and 4,818,599 pounds of zinc.

New Park Mining Co. produced 72,831 tons of ore in 1948—a new high—compared with 68,256 tons in 1947. Of the ore output in 1948, 62,951 tons came from the Mayflower fissure and 9,880 tons from the Pearl fissure. All was zinc-lead milling ore and contained 19,272 ounces of gold, 417,064 ounces of silver, 866,196 pounds of copper, 7,255,644 pounds of lead, and 10,084,961 pounds of zinc.

The Silver King Western mine came into production in September and shipped 342 tons of lead ore to smelters. McFarland & Hullinger, lessees, operated the Daly No. 1 waste dump until August and shipped 32,745 tons of siliceous silver ore to a smelter. Reuben Garbet produced zinc middling in a small flotation mill by re-treating current tailings from the Silver King Coalition mill. Remaining district production was principally 564 tons of dump silver ore from the Crescent property and 58 tons of copper ore from the West Park mine.

TOOELE COUNTY

Blue Bell District.—Output in 1948 was all lead ore—133 tons from the Blackhawk claim and 67 tons from the International group.

Camp Floyd District.—The New Mercur mine produced 748 tons of gold ore and the Rover group 34 tons of zinc-lead ore.

Clifton District.—Principal production was made by lessees working the Rube Lead group. Output was 289 tons of lead smelting ore containing 8 ounces of gold, 422 ounces of silver, 809 pounds of copper, 70,684 pounds of lead, and 6,115 pounds of zinc.

Dugway District.—The bulk of production was 234 tons of lead ore and 59 tons of zinc-lead ore from the Dugway claim, 90 tons of zinc-lead ore and 82 tons of lead ore from the Four Metals group, and 173 tons of zinc-lead ore from the Cannon property.

Erickson District.—Principal output came from the Esther group—984 tons of zinc-lead milling ore.

Ophir District.—Lessees at the Hidden Treasure mine produced 3,926 tons of zinc-lead ore, 1,565 tons of zinc-lead-copper ore, 414 tons of lead ore, and 42 tons of zinc ore. The Ophir Development Co. worked its Ophir Hill mine all year and shipped 203 tons of zinc-lead ore containing 2 ounces of gold, 1,173 ounces of silver, 2,926 pounds of copper, 29,732 pounds of lead, and 26,906 pounds of zinc. Lessees operated the Shoo Fly group of the Treasure Hill Mines Co. and shipped 423 tons of silver ore and 58 tons of zinc-lead ore. From the Ophir unit of the United States Smelting, Refining & Mining Co., lessees shipped 575 tons of zinc-lead milling ore.

Rush Valley District.—Ore production at the West Calumet (Calumet) mine of the Combined Metals Reduction Co. rose from 31,294 tons in 1947 to 38,396 tons in 1948. Of the ore produced in 1948, 38,342 tons were zinc-lead milling ore containing 2,716 ounces of gold, 308,186 ounces of silver, 7,890,711 pounds of lead, and 3,838,606 pounds of zinc; 54 tons of lead ore went direct to a smelter. From the company Honorine-Galena King group, 1,423 tons of zinc-lead ore and 333 tons of lead ore were produced. The company flotation mill at Bauer treated about 62,500 tons of pyritic gold-silver tailings, which yielded 20,886 tons of iron concentrate valuable chiefly for its gold and silver. Other district output was 708 tons of zinc-lead ore from the Silver Eagle group and 70 tons of lead ore from the Circle Amended claim.

Smelter District.—Output credited to producers in the Smelter district comprises the metals recovered from 1,036 tons of old copper slag shipped to a copper smelter by the International Smelting & Refining Co. at Tooele and 34,818 tons of old zinc slag treated at the company slag-fuming plant.

Willow Springs District.—Lessees operated the Oro Del Rey group and shipped to smelters 781 tons of lead ore containing 1,346 ounces of gold, 4,157 ounces of silver, 1,282 pounds of copper, 345,765 pounds of lead, and 253 pounds of zinc, and 63 tons of gold ore containing 177 ounces of gold, 193 ounces of silver, 109 pounds of copper, and 5,181 pounds of lead.

UTAH COUNTY

American Fork District.—Dutchman Mine Leasers operated the Dutchman group throughout 1948 and shipped 2,559 tons of zinc-lead milling ore containing 37 ounces of gold, 18,449 ounces of silver, 9,671 pounds of copper, 463,259 pounds of lead, and 1,147,095 pounds of zinc. Remaining district production was 200 tons of lead ore from the Blue Rock mine and 90 tons of zinc-lead ore from the Live Yankee claim.

Tintic District.—Mines in the Utah County section of the Tintic district are reviewed under Juab County.

WASHINGTON COUNTY

Tutsagubet District.—E. L. Cox worked the Dixie (Apex) mine and shipped to smelters 959 tons of lead ore containing 7 ounces of gold, 12,061 ounces of silver, 8,167 pounds of copper, and 269,995 pounds of lead; and 175 tons of copper ore containing 1 ounce of gold, 61 ounces of silver, and 57,599 pounds of copper. Wayne Snow shipped 113 tons of lead ore from the Black Warrior claim.

Washington
Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By C. E. NEEDHAM AND PAUL LUFF

GENERAL SUMMARY

COPPER, with an output 153 percent greater than in 1947, far surpassed the gains made by gold, silver, and lead in Washington in 1948. Gold yield rose 100 percent, lead 33, and silver 28; zinc reversed the trend and dropped 8 percent. Higher average prices for copper, lead, and zinc, coupled with increased yields of gold, silver, copper, and lead, pushed the value of the five metals in 1948 to an all-time high of $11,171,715, or nearly 53 percent greater than the value in 1947, and 37 percent greater than the previous high of $8,172,609 established in 1942. Of the total value in 1948, zinc contributed 30 percent, lead 23, copper 22, gold 22, and silver 3 percent.

Chelan County returned to first place among Washington counties in 1948 in both tonnage of ore treated and value of metals produced, owing to a full year of normal production at the Holden mine of the Howe Sound Co.

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, 1944–48

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1944	$35.00	$0.711+	$0.135	$0.080	$0.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122
1947	35.00	.905	.210	.144	.121
1948	35.00	.905+	.217	.179	.133

[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. 1944 to June 30, 1946: $0.71111111; July 1, 1946, to Dec. 31, 1947: $0.905: 1948: $0.9050505.
[3] Yearly average weighted price of all grades of primary metal sold by producers; 1944–47: price includes bonus payments by Office of Metals Reserve for overquota production.

Mine production of gold, silver, copper, lead, and zinc in Washington, 1944–48, and total, 1860–1948, 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
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
1947	25	6	676,176	34,965	1,223,775	293,736	265,831
1948	30	1	974,257	70,075	2,452,625	375,831	340,146
1860–1948			(1)	2,283,710	58,685,173	13,499,440	9,715,490

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
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
1947	4,480,000	940,800	10,718,000	1,543,392	27,600,000	3,339,600	7,313,398
1948	11,330,000	2,458,610	14,294,000	2,558,626	25,276,000	3,361,708	11,171,715
1860–1948	[2] 86,831	24,099,919	[2] 88,269	14,249,042	[2] 164,253	29,079,956	135,829,580

[1] 1860–1903: Figures not available; 1904–48, 14,175,855 tons produced.
[2] Short tons.

Mine production of gold, silver, copper, lead, and zinc in Washington in 1948, by months, in terms of recovered metals

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	4,806	34,190	490	649	1,326
February	4,176	29,263	428	844	1,277
March	5,488	30,869	488	945	1,512
April	5,860	31,783	490	688	1,256
May	5,136	26,293	386	625	1,226
June	4,669	24,903	344	601	1,063
July	6,221	32,030	464	417	792
August	7,048	31,578	540	433	925
September	7,273	32,664	584	415	802
October	6,959	35,924	522	514	823
November	6,426	33,554	487	417	769
December	6,013	32,780	442	599	867
Total: 1948	70,075	375,831	5,665	7,147	12,638
1947	34,965	293,736	2,240	5,359	13,800

Gold.—Gold output in Washington in 1948 was the highest since 1942, mainly as a result of a very large increase in production of the metal at the Holden mine. The Knob Hill mine in second place and the Aurum group in third place, both in Ferry County, also reported substantial gains. These three properties contributed all but a few ounces of the total State gold in 1948. Placer production was very small and came from one producer. Of the State total gold in 1948, 60 percent was recovered from zinc-copper ore and most of the remainder from gold ore.

Silver.—All four leading silver producers in the State gained appreciably in output of the metal in 1948, and yield was the highest since 1941; the Holden mine reported an especially large increase. The Knob Hill mine (gold ore) remained in the lead, followed by the Holden mine (zinc-copper ore), the Aurum group (gold ore), and the Bonanza mine (lead ore). These four producers furnished 90 percent of the State silver in 1948.

Gold ore was the leading source of State silver in 1948, supplying about 48 percent, followed by zinc-copper ore with 37 percent; most of the remainder came from lead and zinc-lead ores.

Copper.—After seven consecutive years of declines in copper output in Washington, the trend was reversed in 1948, and yield of the metal returned almost to the 1945 level. The large gain over 1947 output resulted from steady output throughout the year of zinc-copper ore from the Holden mine, the only important copper producer in the State.

Lead.—Lead output in Washington in 1948 was the highest in the history of the State, being 23 percent greater than the previous record of 11,650,000 pounds reached in 1944. Increases were large at the Deep Creek and Bonanza mines, both in Stevens County, and at the property of the Pend Oreille Mines & Metals Co. in Pend Oreille County. Owing to a 6-month labor strike at the Grandview mine of the American Zinc, Lead & Smelting Co. in Pend Oreille County, lead output from the property was only 85 percent of that in 1947. Leading State producers of lead in 1948 in order were the property of the Pend Oreille Mines & Metals Co., and the Grandview, Bonanza, and Deep Creek mines. From these four properties came 95 percent of the total lead in 1948. Of the total lead, 78 percent was derived from zinc-lead ore; nearly all the remainder came from lead ore.

Zinc.—But for the 6-month work stoppage at the Grandview mine, zinc, like lead, probably would have established an all-time production record for the State. The Holden mine produced over three times as much zinc in 1948 as in 1947, and the Deep Creek mine also made a substantial increase; output of the metal declined at the Grandview mine and at the property of the Pend Oreille Mines & Metals Co. The Holden mine was the leading State producer of zinc in 1948, followed in order by the Grandview and Deep Creek mines and the property of the Pend Oreille Mines & Metals Co., which together supplied 98 percent of the total zinc. Zinc-lead ore furnished 73 percent of the zinc in 1948, zinc-copper ore 26, and zinc ore nearly 1 percent.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Washington in 1948, 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
Chelan	3		41,833	$1,464,155	137,242	$124,211
Ferry	5		28,196	986,860	179,295	162,271
King	1				31	28
Okanogan	1	1	10	350	4,645	4,204
Pend Oreille	2				9,521	8,617
Snohomish	1		2	70	105	95
Stevens	16		28	980	44,992	40,720
Whatcom	1		6	210		
Total: 1948	30	1	70,075	2,452,625	375,831	340,146
1947	25	6	34,965	1,223,775	293,736	265,831

Mine production of gold, silver, copper, lead, and zinc in Washington in 1948, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Chelan	11,307,200	$2,453,662			6,577,200	$874,768	$4,916,796
Ferry	8,700	1,888	2,000	$358	32,000	4,256	1,155,633
King							28
Okanogan	2,000	434	33,800	6,050	1,800	239	11,277
Pend Oreille			8,593,000	1,538,147	11,969,000	1,591,877	3,138,641
Snohomish	4,800	1,042					1,207
Stevens	7,300	1,584	5,665,200	1,014,071	6,696,000	890,568	1,947,923
Whatcom							210
Total: 1948	11,330,000	2,458,610	14,294,000	2,558,626	25,276,000	3,361,708	11,171,715
1947	4,480,000	940,800	10,718,000	1,543,392	27,600,000	3,339,600	7,313,398

Gold produced at placer mines in Washington, 1944–48, 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:					
1944–45					
1946	1	10,000	85	$2,975	$0.298
1947	1	3,500	14	490	.140
1948					
Nonfloating washing plants: [1]					
1944	1	5,500	55	1,925	.350
1945					
1946	1	15,000	11	385	.026
1947	3	4,700	56	1,960	.417
1948	1	2,900	10	350	.121
Small-scale hand methods:					
1944	2	75	4	140	1.867
1945	3	275	14	490	1.782
1946	3	115	5	175	1.522
1947	2	400	7	245	.613
1948					
Grand total placers:					
1944	3	5,575	59	2,065	.370
1945	3	275	14	490	1.782
1946	5	25,115	101	3,535	.141
1947	6	8,600	77	2,695	.313
1948	1	2,900	10	350	.121

[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

The number of producing lode properties in Washington in 1948 increased 20 percent over the number in 1947; ore output for the year rose 44 percent, mainly as a result of uninterrupted production at the Holden mine. Owing to the work stoppage at the Grandview mine, ore production from that property was about 60 percent of that in 1947, but most other State producers reported increases for the year.

ORE CLASSIFICATION

Details of ore classification are given in the Gold and Silver chapter of this volume.

Ore sold or treated in Washington in 1948, 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	5	70,742	28,209	178,653			
Dry and siliceous silver ore	2	1,501		4,676	2,000	33,800	1,800
Copper ore	3	52	2	157	5,100		
Lead ore	5	15,350	8	23,358	4,200	3,074,735	12,851
Zinc ore	1	364		54	182	2,780	183,205
Zinc-copper ore	2	608,863	41,826	137,832	11,315,600	2,000	6,609,200
Zinc-lead ore	12	277,385	20	31,101	2,918	11,180,685	18,468,944
Total lode mines	30	974,257	70,065	375,831	11,330,000	14,294,000	25,276,000
Placers	1		10				
Total: 1948	31	974,257	70,075	375,831	11,330,000	14,294,000	25,276,000
1947	31	676,176	34,965	293,736	4,480,000	10,718,000	27,600,000

METALLURGIC INDUSTRY

Of the 974,257 tons of lode material sold or treated in Washington in 1948, 954,502 tons (98 percent) went to mills and 19,755 tons (2 percent) to smelters, compared with 98 and 2 percent, respectively, in 1947. The 954,502 tons treated at mills were distributed as follows: 2 plants, 608,863 tons of zinc-copper ore; 10 plants, 277,100 tons of zinc-lead ore; 3 plants, 51,174 tons of gold ore; 3 plants, 15,237 tons of lead ore; 1 plant, 1,500 tons of silver ore; and 1 plant, 364 tons of zinc ore. In addition, 264 tons of zinc-lead ore were shipped to a custom flotation mill in Utah.

Mine production of metals in Washington in 1948, 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	10				
Ore cyanided	51,091	3,879	25,376			
Concentrates smelted	59,480	60,551	314,327	11,324,900	14,155,787	25,266,194
Ore smelted	19,755	5,625	36,128	5,100	138,213	9,806
Placer		10				
Total: 1948		70,075	375,831	11,330,000	14,294,000	25,276,000
1947		34,965	293,736	4,480,000	10,718,000	27,600,000

Gross metal content of Washington ore treated at mills in 1948, by classes of ore

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	51,174	24,513	172,004			
Dry and siliceous silver	1,500		5,600	3,000	42,000	
Lead	15,237	15	26,175	7,500	3,275,000	88,000
Zinc	364		63	274	3,700	240,000
Zinc-copper	608,863	49,412	208,175	11,985,300	4,000	9,645,500
Zinc-lead	277,364	37	35,608	5,150	12,548,603	21,051,399
Total: 1948	954,502	73,977	447,625	12,001,224	15,873,303	31,024,899
1947	660,671	34,647	344,704	4,850,348	12,199,785	36,552.700

Mine production of metals from mills in Washington in 1948, by counties, in terms of recovered metals

	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)
BY COUNTIES									
Chelan	608,439	4		31,307	41,826	137,242	11,307,200		6,577,200
Ferry	51,523	3,879	25,376	1,587	18,697	118,590	8,400	2,000	32,000
Okanogan	1,500			34		4,645	2,000	33,800	1,800
Pend Oréille	223,586			16,457		9,487		8,575,500	11,967,239
Stevens	69,379			10,095	28	44,363	7,300	5,544,487	6,687,955
Whatcom	75	6							
Total: 1948	954,502	3,889	25,376	59,480	60,551	314,327	11,324,900	14,155,787	25,266,194
1947	660,671	2,717	16,938	46,661	28,279	256,009	4,447,912	10,586,527	27,596,752
BY CLASSES OF CONCENTRATES SMELTED									
Dry gold				1,541	21,051	123,085			
Copper				24,609	39,008	127,007	11,194,500	1,200	
Lead				10,257	21	51,947	8,668	13,733,907	308,373
Zinc				23,013	470	9,180	121,482	402,110	24,941,571
Zinc-lead				60	1	3,108	250	18,570	16,250
Total 1948				59,480	60,551	314,327	11,324,900	14,155,787	25,266,194

Gross metal content of concentrates produced from ores mined in Washington in 1948, 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	1,541	21,051	123,085			
Copper	24,609	39,008	127,007	11,540,787	1,964	1,628,500
Lead	10,257	21	51,947	10,265	13,991,364	466,852
Zinc	23,013	470	9,180	135,449	458,885	26,160,800
Zinc-lead	60	1	3,108	311	18,958	19,568
Total: 1948	59,480	60,551	314,327	11,686,812	14,471,171	28,275,720
1947	46,661	28,279	256,009	4,586,982	11,099,507	31,697,832

Gross metal content of Washington crude ore shipped to smelters in 1948, 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	19,568	5,623	35,277			
Dry and siliceous silver	1		31			
Copper	52	2	157	5,252		
Lead	113		123		133,282	4,266
Zinc-lead	21		540		7,590	8,177
Total: 1948	19,755	5,625	36,128	5,252	140,872	12,443
1947	15,505	3,892	20,779	33,297	134,070	7,677

Mine production of metals from Washington crude ore shipped to smelters in 1948, in terms of recovered metals

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
BY COUNTIES						
Chelan	11	3				
Ferry	19,560	5,620	35,329	300		
King	1		31			
Pend Oreille	16		34		17,500	1,761
Snohomish	49	2	105	4,800		
Stevens	118		629		120,713	8,045
Total: 1948	19,755	5,625	36,128	5,100	138,213	9,806
1947	15,505	3,892	20,779	32,088	131,473	3,248
BY CLASSES OF ORE						
Dry and siliceous gold	19,568	5,623	35,277			
Dry and siliceous silver	1		31			
Copper	52	2	157	5,100		
Lead	113		123		130,783	3,246
Zinc-lead	21		540		7,430	6,560
Total 1948	19,755	5,625	36,128	5,100	138,213	9,806

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Washington in 1948, 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
Chelan County:									
Chelan Lake	1		608,431	41,826	137,242	11,307,200		6,577,200	$4,916,551
Peshastin Creek	2		19	7					245
Ferry County:									
Keller (San Poil)	2		3		52	300			112
Orient	1		432		590	8,400	2,000	32,000	6,971
Republic (Eureka)	2		70,648	28,196	178,653				1,148,550
King County: Miller River	1		1		31				28
Okanogan County:									
Columbia River (Okanogan)		1		10					350
Loomis-Oroville	1		1,500		4,645	2,000	33,800	1,800	10,927
Pend Oreille County: Metaline	2		223,602		9,521		8,593,000	11,969,000	3,138,641
Snohomish County: Index	1		49	2	105	4,800			1,207
Stevens County:									
Bossburg (Clugston Creek)	3		14,401	17	36,462	4,800	2,787,800	140,500	552,339
Colville-Middleport	2		27		21		6,700	800	1,325
Deer Trail	2		335	1	3,718	500	19,000	12,600	8,585
Northport (Aladdin)	9		54,734	10	4,791	2,000	2,851,700	6,542,100	1,385,674
Whatcom County: Mount Baker	1		75	6					210
Total Washington	30	1	974,257	70,075	375,831	11,330,000	14,294,000	25,276,000	11,171,715

CHELAN COUNTY

Chelan Lake District.—The Howe Sound Co. operated its Holden mine and 2,000-ton concentration mill throughout 1948 and treated 608,431 tons of zinc-copper ore containing 49,412 ounces of gold, 207,475 ounces of silver, 11,975,000 pounds of copper, and 9,600,000 pounds of zinc. The mill yielded 24,590 tons of copper concentrate, 6,709 tons of zinc concentrate, and 8 tons of gold concentrate.

Peshastin Creek (Blewett) District.—District output was 19 tons of gold ore from the Polepick claim.

FERRY COUNTY

Orient District.—The Talisman Mining & Leasing Co. operated its Laurier mine and a mill part of the year. The mill produced 19 tons of copper concentrate and 35 tons of zinc concentrate.

Republic (Eureka) District.—Knob Hill Mines, Inc., operated its mine and 400-ton flotation-cyanidation mill on gold ore during all of 1948 and treated 5 percent more ore than in 1947. The ore was ground to 100-mesh with a rougher jig in the grinding circuit, followed by flotation; the flotation tailing was treated by cyanidation. The Aurum group of the Aurum Mining Co. was operated by the company and by lessees; production in 1948 was 19,557 tons of gold ore compared with 14,951 tons in 1947.

OKANOGAN COUNTY

Total county production in 1948 came from the Kaaba mine operated by the Kaaba Silver-Lead Mines, Inc., which produced ore only in January, then spent the remainder of the year in shaft sinking and development.

PEND OREILLE COUNTY

Metaline District.—The Grandview mine and 600-ton flotation mill of the American Zinc, Lead & Smelting Co. closed on July 1 because of labor difficulties and remained inoperative for the balance of the year. As a result, lead and zinc production at the property was much below the 1947 level.

The Pend Oreille Mines & Metals Co. operated its property and 700-ton mill throughout 1948 and treated 133,755 tons of zinc-lead ore compared with 116,695 tons in 1947. Gross metal content of the ore in 1948 was 8,025 ounces of silver, 6,200,000 pounds of lead, and 6,300,000 pounds of zinc.

The Metaline Mining & Leasing Co. conducted development during all of the year.

SNOHOMISH COUNTY

Total county production in 1948 was 49 tons of copper smelting ore shipped from the Wilbur-Index group by the Lake Serene Mining Co., Inc.

STEVENS COUNTY

Bossburg (Clugston Creek) District.—Bonanza Lead operated its Bonanza mine throughout the year and treated in the company 100-ton mill 12,386 tons (7,764 tons in 1947) of lead ore containing 15 ounces of gold, 26,000 ounces of silver, 7,500 pounds of copper, 2,950,000 pounds of lead, and 70,000 pounds of zinc. Remaining district output was zinc-lead ore from the Young America and High Cliff mines.

Deer Trail District.—The Cleveland mine of Basic Metals, Inc., closed on January 15, then passed into receivership. W. R. Borkey operated the Deer Trail mine from April to October and treated about 175 tons of zinc-lead ore in a 30-ton flotation mill on the property.

Northport (Aladdin) District.—The Deep Creek mine and 260-ton flotation mill of the Goldfield Consolidated Mines Co. operated throughout the year. The mill treated 50,421 tons of zinc-lead ore containing 20 ounces of gold, 5,000 ounces of silver, 3,000 pounds of copper, 3,002,593 pounds of lead, and 7,040,419 pounds of zinc. The Admiral mine of the Admiral Consolidated Mining Co. produced 364

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tons of zinc ore, part of which was treated in the 75-ton flotation mill on the property and part shipped to a concentrator in Utah. Gross metal content of the ore was 63 ounces of silver, 274 pounds of copper, 3,700 pounds of lead, and 240,000 pounds of zinc. Leadpoint Electric Mining Co. operated its Electric Point property, treated 2,155 tons of dump lead ore in a gravity mill, and shipped 52 tons of high-grade lead ore to a smelter. The Gladstone Mountain mine produced 696 tons of dump lead ore, which was treated at the mill of the Leadpoint Electric Mining Co., and 21 tons of high-grade lead smelting ore. Last Chance Consolidated Mines, Inc., operated the Last Chance group and treated about 800 tons of zinc-lead ore in the company 100-ton gravity-flotation mill. Remaining district production was principally zinc-lead ore—about 160 tons from the Lucille claim, 40 tons from the Farmer group, and 6 tons from the Morning mine.

Wyoming
Gold, Silver, Copper, and Lead

(MINE REPORT)

By A. J. MARTIN

GENERAL SUMMARY

GOLD mining in Wyoming in 1948, as in 1947, was active only in the South Pass district, Fremont County. Operations at the Carissa mine, which in 1947 produced 98 percent of the State total output of gold, were confined largely to development work in 1948, and the mill was not run until November. Output from the Carissa mine and that from two small-scale placer operations comprised the State total output of 115 fine ounces of gold and 11 fine ounces of silver during the year. The output in 1947 was 1,486 ounces of gold and 95 ounces of silver. No recoverable copper or lead was produced in the State in 1948 or 1947. Only a small output of lead and no output of zinc have been reported in Wyoming in the past.

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, 1944–48

Year	Gold [1] (per fine ounce)	Silver [2] (per fine ounce)	Copper [3] (per pound)	Lead [3] (per pound)	Zinc [3] (per pound)
1944	$35.00	$0.711+	$0.135	$0.080	$0.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122
1947	35.00	.905	.210	.144	.121
1948	35.00	.905+	.217	.179	.133

[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. 1944 to June 30, 1946: $0.71111111; July 1, 1946, to Dec. 31, 1947: $0.905; 1948: $0.9050505.
[3] Yearly average weighted price of all grades of primary metal sold by producers; 1944–47: price included 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 1944 to 1948; it also gives the total production of metals from 1867 to 1948.

Mine production of gold, silver, copper, and lead in Wyoming, 1944–48, and total, 1867–1948, 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	Short tons	Value	Short tons	Value	
1944	6	20	$700	3	$2					$702
1945	52	2	70	31	22			3	$516	608
1946	61	105	3,675	26	21	[1] 1	$324			4,020
1947	6,059	1,486	52,010	95	86					52,096
1948	867	115	4,025	11	10					4,035
1867–1948	[2]	79,642	1,895,798	74,798	51,893	16,326	5,684,372	14	1,486	7,633,549

[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.

Mine production of gold and silver in Wyoming in 1948, by months, in terms of recovered metals

Month	Gold (fine ounces)	Silver (fine ounces)
January-February		
March	3	
April-September		
October	2	
November	19	5
December	91	6
Total: 1948	115	11
1947	1,486	95

REVIEW BY COUNTIES

The entire output of gold and silver in Wyoming in 1948 came from Fremont County.

Milling operations at the Carissa mine at South Pass City, suspended October 1, 1947, were not resumed until November 1948. While the mill was idle a shaft was sunk to a lower level, and other mine development work was done. A shipment of crude ore was made to the Garfield (Utah) smelter in October. The mill had a capacity of 100 tons daily at the end of 1948 and uses the amalgamation and cyanidation processes; it operated at less than capacity during November and December. On September 27, 1948, a new company—Carissa Gold Mines, Inc.—was formed and took over operation of the Carissa property, succeeding Mica Mountain Mines, Inc.

A few ounces of placer gold were shipped to the Denver Mint from the Las Vegas and Gold Meadow claims in the South Pass district.

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By MABEL E. WINSLOW

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