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UNITED STATES DEPARTMENT OF THE INTERIOR

HAROLD L. ICKES, Secretary

BUREAU OF MINES

R. R. SAYERS, Director

MINERALS YEARBOOK

1940

Compiled under the supervision of

H. HERBERT HUGHES

Economics and Statistics Branch

UNITED STATES

GOVERNMENT PRINTING OFFICE

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FOREWORD

The record of developments and trends in the mineral industry of the United States in 1939 is set forth with statistical detail and analysis in the 1940 edition of Minerals Yearbook, presented by the Bureau of Mines herewith for the information and guidance of industry, Government, and the general public. The current volume is the latest product of a program of voluntary cooperation of industry with Government that was inaugurated more than 70 years ago and has been maintained upon an annual basis without interruption for 60 years. It includes the economic and statistical data essential for effective planning of future operations of the mineral industry and for the formation of Government policy with respect to the irreplaceable mineral resources of the country. The value to industry of maintaining comprehensive and cumulative economic data on production, consumption, sources, prices, and stocks of mineral commodities is a fact of common understanding and application. In pursuing its policy of supplying the mineral industries with useful and timely data, the Bureau of Mines during 1939 established a quarterly survey of consumption and dealer and consumer stocks of iron and steel scrap. Thus, for the first time industry has available reliable current information on inventories and rate of use of this important raw material.

The value of statistical and economic data for Government use was strikingly illustrated in 1939 when the Army and Navy Munitions Board called upon the Bureau to supplement its annual statistics with monthly reports on the strategic minerals required for industrial preparedness. Further expansion of its basic fact-finding activities is needed to provide necessary data for the national defense program.

The course of mineral production during the year under review represented an encouraging measure of recovery from the depressed levels of 1938. After the first quarter the rise in volume of production was steadily upward through September and was characterized by reaction thereafter as domestic production overtook demand and the impetus of the outbreak of war in Europe was not sustained. Although the effect upon domestic mineral markets of the existing military conflicts in Europe and the Far East is at present obscure, domestic demand contains encouraging elements sustained by prospective needs for a comprehensive program of national preparedness that promises to require some years for completion. In plans for the development of both foreign and domestic outlets for its products the mineral industry of the United States will find of major value the record of past performances preserved in the current Minerals Yearbook and its predecessors. The present emergency has emphasized the need for more detailed and, in some instances, more frequent statistical surveys. To meet this need the Bureau of Mines plans, should additional funds be provided, to expand and expedite its surveys of the more important commercial minerals, thereby providing producers and consumers of mineral products with the means for following short-time changes in conditions of supply and demand of the leading mineral commodities. Thus, the Bureau of Mines would materially enhance its service of providing the earliest and most complete official data covering the fundamental economic phases of the mineral industry.

R. R. SAYERS, *Director*.

JUNE 25, 1940.

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INTRODUCTION

Although the trend of business for the first 5 months of 1939 was downward, the year as a whole showed a marked improvement over 1938. The index of the volume of industrial production of the Federal Reserve Board, generally accepted as the most reliable business indicator, was 106 for 1939, an advance of 23 percent from 86 in 1938. This index, adjusted for seasonal variation, was 101 in January but dropped to 92 in April and May. Beginning in June it started a steady rise indicative of substantial improvement in virtually all lines of business. In the last quarter, under the impetus of actual and anticipated war orders, the index remained above 120 and actually reached an all-time peak of 128 in December. This spurt was short-lived, for the index slumped sharply for the first 4 months of 1940 before turning upward in May.

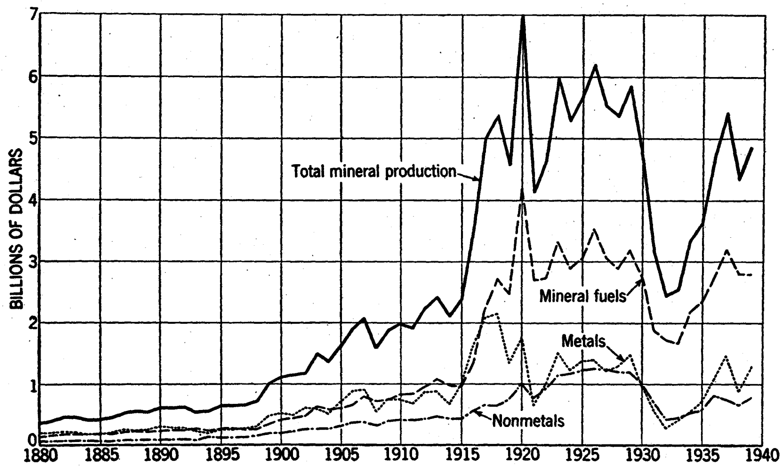

FIGURE 1.—Mineral production of the United States, 1880–1939.

Mineral production did not advance as rapidly in 1939 as business in general, although the index for the year was 108, 2 points higher than that for all industrial activity. In 1938 the spread was quite pronounced—99 for minerals and 86 for industrial activity. The preliminary total value of mineral production in the United States in 1939, as reported to the Bureau of Mines by producers, was $4,874,000,000, an increase of 12 percent from $4,362,900,000 in 1938. Metals, as a group, led with a rise of 45 percent in value, followed by nonmetals (other than fuels) with 18 percent; fuels decreased 0.06 percent.

The steel industry paced the industrial advance of the closing months of 1939, with production rising to a peak of 94.4 percent of capacity for the week ended December 2. Output of pig iron in 1939 was 84 percent above that in 1938. The greater activity in all phases of the iron and steel industry of course was reflected in sharply increased demand for iron ore, alloying metals, coke, fluorspar, fluxing stone, refractories, molding sand, and other lesser materials. The nonferrous metals—copper, lead, zinc, aluminum, and others—also were produced at a rate substantially above that for 1938. Gold output continued its steady advance of the past several years.

Production of the principal fuels—bituminous coal, anthracite, petroleum, and natural gas—was higher than in 1938, but the increases were relatively small compared to those of the metals. The building materials group—cement, sand and gravel, stone, clay products, gypsum, and lime—likewise achieved only moderate increases in 1939, quite in line with an 11-percent rise in construction contracts awarded. Production of virtually all other nonmetals was higher than in 1938.

Strategic minerals.—The Strategic Materials Act (Public, No. 117—76th Congress, chapter 190, 1st session) which was signed by the President on June 7, 1939, authorized the expenditure of $100,000,000 over a 4-year period for the purchase of strategic materials. Only $10,000,000 was appropriated in the Third Deficiency Bill, approved August 2, 1939 (Public, No. 361—76th Congress, chapter 633, 1st session), and purchases were restricted largely to the high-priority mineral commodities on the strategic list—manganese, chromium, tungsten, tin, and quartz crystals. The act also provided for the investigation of domestic sources of strategic minerals by the Bureau of Mines and the Geological Survey, and this work has been carried on actively since July 1, 1939. Information regarding progress in building stock piles, as well as the search for domestic sources, is supplied in the chapters on the various strategic minerals in this volume.

International production and trade statistics.—Anticipation of the conflict that began on September 1 influenced adoption earlier in 1939 of foreign trade control and domestic conservation measures by nearly all European countries and their colonies. However, soon after the outbreak of war, the belligerents and their overseas possessions as well as many European neutrals adopted more stringent systems of control over their foreign trade. In some instances these wartime measures comprised licensing regulations applicable to each prospective transaction. These controls of Great Britain and France have operated to curtail importations of many raw materials from sources outside their own dominions and to increase importations from elsewhere of commodities essential for the war economy. They also have hindered by delays in issuance of export licenses, reductions in export quotas, etc., the ability of neutrals as a group to purchase their requirements of certain minerals. Although Great Britain adopted the policy of purchasing raw materials from within the Empire whenever possible to conserve its foreign exchange, the United States as a neutral encountered relatively little difficulty, under trade regulations of the Emergency Powers (Defense) Act of August 1939 or later legislation, in acquiring essential materials, such as tin, chromite, and mica available in British Dominions. The French trade restrictions likewise failed to interfere seriously with purchases by American consumers. Despite unavoidable delays at first in obtaining licenses for export to the United States of graphite from Madagascar and mica from British India, owing to wartime restrictions, by the end of 1939 consumers in the United States were able to obtain from British, French, and nonbelligerent sources tonnages of strategic and critical materials adequate to satisfy domestic requirements.

As the war advanced numerous revisions and additions to the control measures were adopted by the belligerents and neutrals and were made known promptly throughout the trading world. However, suppression by a large majority of European countries of all details regarding the importation and exportation of mineral commodities as well as production data, effective in September or October 1939, has made impossible any analysis of world mineral production and trade during the year. Consequently no chapter on the subject appears in this volume of the Yearbook.

Minerals Yearbook series.—Minerals Yearbook, 1940, carries the progress made in Minerals Yearbook, 1939, in presenting final data for the year under review one step farther by including complete final statistics for coke. In this volume only the chapters on bituminous coal, petroleum, natural gas, and natural gasoline are based upon preliminary data for 1939.

The practice of issuing preprints of separate chapters in advance of the bound volume has met with widespread favor and is being continued this year; 46 chapters have been printed and distributed. This procedure was adopted with some misgiving because of its potential effect in lowering sales of the bound volume. This apprehension proved to be unfounded, for the sales edition of each of the past two volumes was exhausted long before the succeeding volume was available.

Acknowledgments.—By act of Congress the collection of production statistics of the bituminous-coal industry, previously conducted by the Bureau of Mines, was transferred to the National Bituminous Coal Commission July 1, 1937. Through the cooperation of this agency and its successor, the Bituminous Coal Division, United States Department of the Interior, the statistical record of the industry, maintained by the Geological Survey and the Bureau of Mines since 1880, remains unbroken. The cooperation of the Bituminous Coal Division in contributing the chapter on Bituminous Coal in this volume is gratefully acknowledged.

Presentation of data on imports and exports in Minerals Yearbook is made possible through the cooperation of the Bureau of Foreign and Domestic Commerce.

The statistical program of the Bureau of Mines depends entirely on the good will and voluntary cooperation of those interested in mining. It is a pleasure to acknowledge the generous support of thousands of individual mine operators, distributors, and consumers, as well as the many public officials and agencies that have returned questionnaires or otherwise supplied information. In addition, the Bureau is indebted to a large number of trade associations for liberal contributions of data and advice.

In several States the Bureau of Mines receives the formal cooperation of the State geologist or comparable State official in collecting mineral statistics. This arrangement eliminates duplication of canvasses by the State and Federal Governments and, through field contacts of the State officials, tends to improve the accuracy and coverage of the production data. State agents cooperating in the 1939 canvass were: Stewart J. Lloyd, acting State geologist, Univer-

sity, Ala.; Herman Gunter, State geologist, Tallahassee, Fla.; Garland Peyton, director, division of mines, mining, and geology, Department of Natural Resources, Atlanta, Ga.; M. M. Leighton, chief, and Walter H. Voskuil, mineral economist, State geological survey division, Urbana, Ill.; A. C. Trowbridge, director, Iowa Geological Survey, Iowa City, Iowa; Raymond C. Moore, State geologist, Lawrence, Kans.; Edward B. Mathews, State geologist, Baltimore, Md.; R. A. Smith, State geologist, Lansing, Mich.; H. A. Buehler, State geologist, Rolla, Mo.; Meredith E. Johnson, State geologist, Trenton, N. J.; H. J. Bryson, State geologist, Raleigh, N. C.; Robert H. Dott, director, Oklahoma Geological Survey, Norman, Okla.; E. P. Rothrock, State geologist, Vermillion, S. Dak.; E. H. Sellards, director, bureau of economic geology, Austin, Tex.; Arthur Bevan, State geologist, and Linwood H. Warwick, chief clerk, Virginia Geological Survey, Charlottesville, Va.; Harold E. Culver, supervisor, division of geology, department of conservation and development, Pullman, Wash.; and E. F. Bean, State geologist, Madison, Wis. In addition, Walter W. Bradley, State mineralogist, San Francisco, Calif., assisted in the compilation of statistics for California.

In addition to preparing the statistical summary of mineral production each year Martha B. Clark has been largely responsible for the maintenance of continuity of data and uniformity of statistical presentation throughout the Minerals Yearbook volumes.

Elva T. Shuey served as editorial associate in reviewing and checking chapters. Max Abel assisted in the administrative details of the Yearbook program, and Cecilia W. Justice helped in many phases of the work. The illustrations for the volume were prepared in the graphic section of the Bureau under the direction of Louis F. Perry. Mabel E. Winslow supplied helpful suggestions for improving individual contributions and, in collaboration with Eleanor C. Reid and Estelle R. Templeton, was responsible for the editing of the entire manuscript.

H. HERBERT HUGHES.

JUNE 25, 1940.

PART I. SURVEY OF THE MINERAL INDUSTRIES

STATISTICAL SUMMARY OF MINERAL PRODUCTION

(GENERAL UNITED STATES SUMMARY AND DETAILED PRODUCTION BY STATES)

By MARTHA B. CLARK

SUMMARY OUTLINE

INTRODUCTION

This report continues the series of annual statistical summaries published in previous years as chapters of Mineral Resources and Minerals Yearbook.

UNIT OF MEASUREMENT

The unit of measurement used by the Bureau of Mines for each mineral product in reports on the mineral resources is that common to the industry concerned, and the variation in these units makes it impracticable, if not impossible, directly to combine and compare the different minerals except as to value. Although most of the products are measured by weight, some are measured by volume and some by number of "pieces," etc.; for some no total quantity figures are available.

ELIMINATION OF DUPLICATION

In the totals for the United States, shown in the following "general" tables, duplication has been eliminated wherever practicable, and in the State totals given in the State tables virtually all duplication has been eliminated. For instance, in both general and State tables the output of coke is shown but its value is not included in the totals, as the value of the coal used in its manufacture enters into the value of the coal production which is included in the totals. For asphalt, both native and oil are shown in the general tables, but the value of the oil asphalt is excluded from the totals as it duplicates that of the petroleum from which it is manufactured. For the clay industries, no figures are available for total clay produced. For years before 1936, the total value of clay products is included in both general and

State totals as representing the first marketable form of the greater part of the clay produced; the quantity and value of the clay mined and sold in the raw state by miners to users of clay are shown separately also, but the value is not included in the totals as it is duplicated largely in that for clay products. For years beginning with 1936, as the Bureau of Mines believes that a closer approach to the value of domestic clay in its first marketable form results from the inclusion of the value of clay sold by producers and of clay products other than pottery and refractories, the United States and State totals include such values for the clay industries. This change in practice should be borne in mind when comparing the values beginning 1936 with those for earlier years.

United States totals.—In the general tables both iron ore and pig iron are shown, but the value of the pig iron rather than the iron ore is included in the United States totals, as that is considered the better means of presenting the statistics for iron in its first marketable form. For gold, silver, copper, lead, and zinc the value of "smelter output" is included in the general totals, and to account more fully for the value of the ores treated these smelter figures are supplemented by the value of the byproduct sulfuric acid. The value of pigments (white lead, red lead, lithopone, litharge, and orange mineral) manufactured from metals is not included in the general tables, as the base from which they are made is included in the output of lead or zinc, whereas the value of sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide is included, as these are made in large part direct from the ores and do not enter into the lead or zinc totals, which represent smelter output.

State totals.—In the State tables also iron ore and pig iron are both shown. As blast-furnace products cannot be traced to the States in which the ore is mined, the value of the ore is used in the State totals. For ores of gold, silver, copper, lead, and zinc no values are shown, and in fact none are recorded; instead, for each of these metals the recoverable content of the ores is used as the basis of valuation. The value of the zinc and lead pigments is not included in the State total, as the recoverable zinc and lead content of the ores from which the products were made is included under zinc or lead. The value of the sulfuric acid produced as a byproduct of copper and zinc smelting and zinc roasting is not included in the State total, as tracing this product back to the State producing the ore has not been possible.

GENERAL TABLES

Mineral products of the United States, 1937–39 [1]

Product	1937		1938		1939	
	Quantity	Value	Quantity	Value	Quantity	Value
METALLIC						
Aluminum ... pounds	292,681,000	$55,609,000	286,882,000	$56,659,000	327,090,000	$64,600,000
Antimonial lead ... short tons (2,000 pounds)	[2] 27,524	(2)	[2] 24,123	(2)	[2] 21,995	(2)
Antimony:						
Metal ... do	4,057	(3 4)	(3 4)	(3 4)	(3 4)	(3 4)
Ore and concentrates ... do	4,250	137,600	2,730	61,500	3,174	37,200
Bauxite ... long tons (2,240 pounds)	420,232	2,444,686	311,354	1,812,545	375,301	2,166,236
Cadmium ... pounds	3,995,739	4,555,000	3,753,323	2,815,000	4,141,242	2,236,000
Chromite ... long tons	2,321	14,888	812	10,730	3,614	46,892
Copper,[5] sales value ... pounds	1,669,322,278	201,988,000	1,124,656,539	110,216,000	1,425,349,488	148,236,000
Ferro-alloys ... long tons	970,651	86,140,492	464,112	42,459,513	841,162	76,156,588
Gold [6] ... troy ounces	4,804,540	168,158,900	5,089,811	178,143,400	5,611,171	196,391,000
Iron:						
Ore [4] ... long tons	72,347,785	[4] 207,828,213	26,430,910	[4] 74,322,405	54,820,589	[4] 158,511,338
Pig ... do	35,224,347	731,139,435	18,202,354	356,875,369	32,091,485	626,824,690
Lead (refined),[5] sales value ... short tons	443,142	52,291,000	331,964	30,541,000	420,967	39,571,000
Magnesium (new ingot) ... pounds	4,539,980	(7)	4,819,617	(7)	10,650,121	(7)
Manganese ore (35 percent or more Mn) ... long tons	40,241	1,062,399	25,321	681,679	29,307	794,746
Manganiferous ore (5 to 35 percent Mn) ... do	1,340,972	3,857,768	308,860	858,356	709,247	2,148,321
Mercury:						
Metal ... flasks (76 pounds net)	16,508	1,488,691	17,991	1,357,781	18,633	1,936,714
Ore ... short tons	(8)	(9)	(8)	(9)	(8)	(9)
Molybdenum ... pounds	30,122,000	20,571,000	25,727,000	17,977,000	32,415,000	22,157,000
Nickel ... short tons	219	(7)	416	(7)	394	(7)
Ores (crude), old tailings, etc.:						
Copper ... do	61,640,000	(9)	37,871,000	(9)	(10)	(9)
Dry and siliceous (gold and silver) ... do	17,355,000	(9)	18,038,000	(9)	(10)	(9)
Lead ... do	5,670,000	(9)	4,103,000	(9)	(10)	(9)
Lead-copper ... do	2,000	(9)	1,000	(9)	(10)	(9)
Zinc ... do	12,693,000	(9)	7,873,000	(9)	(10)	(9)
Zinc-copper ... do			33,000	(9)	(10)	(9)
Zinc-lead ... do	10,651,000	(9)	8,944,000	(9)	(10)	(9)
Zinc-lead-copper ... do					(10)	(9)
Platinum and allied metals (value at New York City) ... troy ounces	45,258	2,114,000	36,213	1,263,000	41,441	1,566,000
Selenium ... pounds	282,598	(7)	166,494	(7)	345,726	(7)
Silver [11] ... troy ounces	71,941,794	55,646,978	62,665,335	40,510,924	65,119,513	44,202,279
Tantalum ore ... pounds	16,307	13,317	36,189	35,127	340	200
Tellurium ... do	23,365	(7)	26,944	(7)	63,431	(7)
Tin (metallic equivalent) ... short tons	189	205,300	106	90,000	38	38,000

See footnotes at end of table.

Mineral products of the United States, 1937–39—Continued

Product	1937		1938		1939	
	Quantity	Value	Quantity	Value	Quantity	Value
METALLIC—continued						
Titanium ore:						
Ilmenite...short tons	[7]	[7]	[7]	[7]	[7]	[7]
Rutile...do	[7]	[7]	[7]	[7]	[7]	[7]
Tungsten ore (60-percent concentrates)...do	3,500	$4,094,000	3,044	$3,161,498	4,287	$4,402,182
Uranium and vanadium ores...do	131,080	[7]	251,687	898,779	279,354	1,053,660
Zinc,[5] sales value...do	551,165	71,651,000	436,007	41,857,000	491,058	51,070,000
Other metallic[12]		852,105		907,612		1,110,817
Total value of metallic products (approximate)		1,468,200,000		892,400,000		1,291,000,000
NONMETALLIC						
Arsenious oxide...short tons	17,636	541,555	13,160	393,022	22,439	495,500
Asbestos...do	12,079	344,644	10,440	247,264	15,459	512,788
Asphalt:						
Native...do	485,384	3,019,038	477,741	2,874,803	459,848	3,066,844
Oil (including road oil)[4]...do	3,844,326	[4] 36,670,827	4,249,226	[4] 34,572,918	4,860,540	[4] 36,038,696
Barite (crude)...do	355,888	2,240,970	309,663	2,004,521	383,609	2,344,103
Borates (naturally occurring sodium borates and colemanite (calcium borate))...short tons	358,898	7,232,897	219,513	4,570,316	249,976	5,882,302
Bromine...pounds	26,200,256	5,180,177	33,324,116	6,610,056	37,882,005	7,611,400
Calcium-magnesium chloride (75 percent $NaCl_2$)...short tons	97,142	1,295,403	96,470	1,218,938	108,441	1,307,717
Cement...barrels (376 pounds net)	115,678,182	171,414,093	108,192,076	156,703,002	125,056,594	184,254,932
Clay:						
Products (other than pottery and refractories)[13]		109,011,641		88,798,513		[13]
Raw (sold by producers)...short tons	4,237,386	15,708,064	2,730,861	11,775,572	3,760,694	15,354,918
Coal:						
Bituminous[14]...do	[15] 445,531,449	[16] 864,042,000	[15] 348,544,764	[16] 678,653,000	[15] 393,065,000	[16] 732,534,000
Pennsylvania anthracite...do	51,856,433	197,598,849	46,099,027	180,600,167	51,487,377	187,175,000
Coke[4]...do	52,375,469	[4] 261,003,903	32,495,815	[4] 167,181,834	44,326,641	[4] 212,884,050
Diatomite...do	[17]	[17]	[17]	[17]	[17]	[17]
Emery...do	320	2,780			765	6,828
Feldspar (crude)...long tons	268,532	1,383,249	196,119	895,081	253,466	1,112,857
Fluorspar...short tons	181,230	3,666,629	80,403	1,599,666	182,771	3,704,959
Fuller's earth...do	226,165	2,296,094	170,852	1,707,869	167,070	1,691,855
Garnet for abrasive purposes...do	4,863	382,535	2,669	191,658	4,056	278,534
Gems and precious stones		[18]		[18]		[18]
Graphite:						
Amorphous...short tons	[17]	[17]	[17]	[17]	[17]	[17]
Crystalline...pounds	[17]	[17]	[17]	[17]	[17]	[17]
Grindstones and pulpstones...short tons	14,541	572,708	6,206	240,006	10,434	426,375
Gypsum (crude)...do	3,058,166	4,782,503	2,684,205	4,271,674	3,226,737	4,431,005

Helium .... cubic feet	[19] 4, 809, 230	[19] 59, 315	[19] 6, 099, 960	[19] 64, 259	[19] 6, 281, 800	[19] 75, 262
Iodine .... pounds	299, 286	242, 422	(17)	(17)	(17)	(17)
Kyanite .... short tons	(8)	(8)	(8)	(8)	2, 950	69, 000
Lime .... do	4, 124, 165	30, 091, 168	3, 346, 954	24, 137, 638	4, 254, 348	30, 049, 394
Lithium minerals .... do	1, 357	36, 206	892	47, 088	1, 990	97, 000
Magnesite (crude) .... do	203, 437	1, 483, 492	97, 000	725, 000	198, 980	1, 465, 190
Magnesium oxide (hydrated) (brucite) .... do	(17)	(17)				
Magnesium salts (natural .... pounds	129, 553, 918	1, 578, 527	141, 465, 613	1, 588, 570	171, 508, 000	1, 907, 944
Marl:						
Calcareous .... short tons	46, 650	59, 775	23, 572	40, 270	22, 114	38, 492
Greensand .... do	9, 734	210, 974	6, 576	152, 000	6, 466	150, 500
Mica:						
Scrap .... do	25, 196	354, 737	20, 257	256, 382	24, 672	311, 895
Sheet .... pounds	1, 694, 538	285, 244	939, 507	139, 333	813, 708	138, 963
Millstones	....	8, 305	....	3, 743	....	11, 084
Mineral paints:						
Cadmium compounds [20] .... pounds	(8)	1, 441, 000	(8)	710, 000	(8)	1, 056, 000
Natural pigments [21] .... short tons	(21)	(21)	(21)	(21)	(21)	(21)
Zinc and lead pigments [22] .... do	163, 617	17, 088, 595	123, 146	13, 969, 840	162, 774	19, 029, 802
Mineral waters .... gallons sold	(18)	(18)	(18)	(18)	(18)	(18)
Natural gas .... M cubic feet	2, 407, 620, 000	528, 354, 000	2, 295, 562, 000	500, 698, 000	2, 435, 000, 000	539, 625, 000
Natural gasoline .... gallons	2, 065, 434, 000	97, 125, 000	2, 156, 574, 000	87, 266, 000	2, 095, 632, 000	94, 300, 000
Oilstones, etc .... short tons	810	112, 841	511	130, 277	620	115, 805
Olivine .... do	(8)	(8)	(8)	(8)	3, 000	15, 000
Peat .... do	51, 223	305, 156	45, 933	286, 127	55, 483	362, 066
Petroleum .... barrels (42 gallons)	1, 279, 160, 000	1, 513, 340, 000	1, 214, 355, 000	1, 373, 060, 000	1, 264, 256, 000	1, 265, 000, 000
Phosphate rock .... long tons	3, 956, 189	12, 975, 268	3, 739, 238	12, 952, 143	3, 757, 067	12, 294, 042
Potassium salts .... short tons	[23] 266, 938	9, 019, 534	[23] 286, 437	9, 748, 290	[23] 366, 287	12, 028, 195
Pumice .... do	71, 007	301, 936	65, 742	312, 886	89, 159	424, 780
Pyrites .... long tons	584, 166	1, 777, 787	555, 629	1, 685, 766	516, 408	1, 550, 449
Salt (sodium chloride) .... short tons	9, 241, 564	24, 131, 733	8, 025, 768	23, 242, 561	9, 277, 911	24, 509, 680
Sand and gravel:						
Glass sand .... do	2, 799, 230	4, 746, 629	2, 109, 462	3, 601, 734	2, 468, 290	4, 280, 936
Sand (molding, building, etc.) and gravel .... do	186, 861, 193	92, 726, 368	179, 210, 771	82, 321, 113	192, 350, 243	90, 943, 111
Sand-lime brick [13] .... thousands of brick	138, 335	1, 222, 273	94, 978	938, 912	(13)	(13)
Silica (quartz) .... short tons	13, 012	66, 041	18, 611	88, 197	34, 959	153, 038
Slate .... do	444, 560	5, 605, 322	492, 690	5, 655, 313	531, 380	6, 682, 214
Sodium salts (carbonates and sulfates) (natural) .... do	184, 764	1, 790, 751	180, 220	1, 832, 140	232, 222	2, 556, 686
Stone [24] .... do	133, 143, 240	146, 213, 128	124, 838, 940	139, 255, 046	147, 447, 130	158, 461, 515
Sulfur .... long tons	2, 466, 512	44, 300, 000	1, 628, 847	27, 300, 000	2, 233, 817	35, 500, 000
Sulfuric acid (60° Baumé) (byproduct) [25] .... short tons	833, 994	6, 735, 194	687, 176	5, 558, 926	(26)	(26)
Talc, pyrophyllite, and ground soapstone [24] .... do	229, 999	2, 561, 753	212, 775	2, 302, 560	253, 976	2, 700, 834
Tripoli .... do	34, 936	450, 570	22, 188	329, 081	33, 474	466, 380
Vermiculite .... do	26, 556	260, 664	20, 700	192, 000	21, 174	174, 587
Other nonmetallic [27]	....	2, 647, 381	....	1, 848, 890	....	2, 308, 068
Total value of nonmetallic products (approximate)	....	3, 945, 200, 000	....	3, 470, 500, 000	....	3, 583, 000, 000

See footnotes at end of table.

Mineral products of the United States, 1937–39—Continued

Product	1937		1938		1939	
	Quantity	Value	Quantity	Value	Quantity	Value
SUMMARY						
Total value:						
Metallic		$1,468,200,000		$892,400,000		$1,291,000,000
Nonmetallic:						
Fuels		3,200,500,000		2,820,300,000		2,818,600,000
Other		744,700,000		650,200,000		764,400,000
Grand total approximate value of mineral products		5,413,400,000		4,362,900,000		4,874,000,000

[1] In this general statement certain of the figures represent shipments rather than quantity mined, and some of the figures for 1939 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; Bureau of Mines not at liberty to publish figures.
[4] Value not included in total value. [5] Product from domestic ores only.
[6] According to Bureau of the Mint. Valued at $35 per ounce.
[7] Value included in total value of metallic products; Bureau of Mines not at liberty to publish figures.
[8] Figures not available. [9] Figures showing values not available.
[10] Figures for 1939 not yet available. [11] According to Bureau of the Mint.
[12] Includes value of following products. Figures are shown wherever Bureau of Mines is at liberty to publish them.
1937: Bismuth, iron ore sold for magnets (2 long tons), and iron ore sold for paint (8,375 long tons, $48,005).
1938: Bismuth, iron ore sold for magnets (2 long tons), and iron ore sold for paint (9,694 long tons, $44,249).
1939: Bismuth and iron ore sold for paint (12,235 long tons, $66,817).
[13] Figures obtained through cooperation with Bureau of the Census. Figures for 1939 not yet available; estimate of value included in total value of nonmetallic products.
[14] Includes brown coal and lignite, and anthracite mined elsewhere than in Pennsylvania.
[15] According to Bituminous Coal Division.
[16] Value is estimated from various sources and includes selling expenses.
[17] Value included in total value of nonmetallic products; Bureau of Mines not at liberty to publish figures.
[18] No canvass. Estimate of value included in total value of nonmetallic products.
[19] Figures cover fiscal year ended June 30 of year stated.
[20] Largely for use in manufacture of pigments. Figures for quantity of pigment not available.
[21] Canvass discontinued after 1915. Figures for iron ore sold for paint given in footnote 12.
[22] Sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide.
[23] Equivalent as K_2O.
[24] Figures for soapstone used as dimension stone included in figures for stone.
[25] From copper and zinc smelters and zinc roasters and from roasting of high-sulfide gold and silver concentrates.
[26] Figures not yet available; estimate of value included in total value of nonmetallic products.
[27] Includes value of following products. Figures are shown wherever Bureau of Mines is at liberty to publish them.
1937: Natural sulfonated bitumen, chats (5,976,040 short tons, $624,111), flint lining for tube mills, optical fluorspar (50 pounds, $120), pebbles for grinding, silica sand and sandstone (ground) (328,156 short tons, $1,996,528), and sulfur ore (221 long tons, $2,296).
1938: Natural sulfonated bitumen, chats (2,836,700 short tons, $414,300), flint lining for tube mills, optical fluorspar (5 ounces, $5), pebbles for grinding, and silica sand and sandstone (ground) (237,167 short tons, $1,425,445).
1939: Aplite, natural sulfonated bitumen, chats (2,237,000 short tons, $314,200), flint lining for tube mills, optical fluorspar (undetermined quantity, $25), pebbles for grinding, silica sand and sandstone (ground) (310,512 short tons, $1,930,301), and sulfur ore (79 long tons, $743).

Value of mineral products of the United States, 1880–1939 [1]

Year	Metallic	Nonmetallic			Grand total
		Fuels [2]	Other	Total	
1880 [1]	$190,881,000	$120,241,000	$56,341,000	$176,582,000	$367,463,000
1881	192,663,000	149,798,000	60,659,000	210,457,000	403,120,000
1882	219,070,000	170,479,000	63,557,000	234,036,000	453,106,000
1883	201,131,000	185,760,000	61,170,000	246,930,000	448,061,000
1884	182,784,000	165,825,000	58,431,000	224,256,000	407,040,000
1885	174,718,000	183,075,000	61,758,000	244,833,000	419,551,000
1886	204,795,000	184,608,000	66,782,000	251,390,000	456,185,000
1887	241,183,000	217,251,000	77,199,000	294,450,000	535,633,000
1888	242,460,000	231,459,000	79,880,000	311,339,000	553,799,000
1889	250,823,000	208,297,000	83,206,000	291,503,000	542,326,000
1890	303,937,000	230,962,000	80,530,000	311,492,000	615,429,000
1891	280,985,000	237,160,000	82,704,000	319,864,000	600,849,000
1892	284,215,000	248,344,000	89,673,000	338,017,000	622,232,000
1893	223,654,000	251,735,000	70,104,000	321,839,000	545,493,000
1894	187,335,000	235,618,000	127,292,000	362,910,000	550,245,000
1895	248,533,000	268,438,000	125,720,000	394,158,000	642,691,000
1896	252,575,000	268,161,000	120,305,000	388,466,000	641,041,000
1897	270,434,000	253,598,000	127,580,000	381,178,000	651,612,000
1898	308,747,000	267,513,000	150,782,000	418,295,000	727,042,000
1899	484,021,000	340,773,000	185,302,000	526,075,000	1,010,096,000
1900	514,232,000	406,376,000	188,328,000	594,704,000	1,108,936,000
1901	493,814,000	442,409,000	218,855,000	661,264,000	1,155,078,000
1902	605,017,000	469,079,000	253,855,000	722,934,000	1,327,951,000
1903	589,253,000	634,226,000	271,902,000	906,128,000	1,495,381,000
1904	501,314,000	584,043,000	273,824,000	857,867,000	1,359,181,000
1905	702,785,000	602,258,000	318,722,000	920,980,000	1,623,765,000
1906	886,280,000	652,398,000	362,202,000	1,014,600,000	1,900,880,000
1907	904,151,000	789,128,000	376,291,000	1,165,419,000	2,069,570,000
1908	550,890,000	716,034,000	324,849,000	1,040,883,000	1,591,773,000
1909	755,092,000	746,204,000	385,811,000	1,132,015,000	1,887,107,000
1910	750,027,000	828,213,000	409,604,000	1,237,817,000	1,987,844,000
1911	681,023,000	835,763,000	407,295,000	1,243,058,000	1,924,081,000
1912	862,191,000	945,541,000	430,062,000	1,375,603,000	2,237,794,000
1913	879,058,000	1,087,843,000	466,644,000	1,554,487,000	2,433,545,000
1914	687,101,000	992,837,000	431,234,000	1,424,071,000	2,111,172,000
1915	993,353,000	972,617,000	428,674,000	1,401,291,000	2,394,644,000
1916	1,622,129,000	1,332,584,000	553,726,000	1,886,310,000	3,508,439,000
1917	2,088,914,000	2,237,837,000	665,745,000	2,903,582,000	4,992,496,000
1918	2,156,588,000	2,736,151,000	647,969,000	3,384,120,000	5,540,708,000
1919	1,361,099,000	2,510,894,000	751,777,000	3,262,671,000	4,623,770,000
1920	1,763,675,000	4,192,910,000	1,024,755,000	5,217,665,000	6,981,340,000
1921	654,700,000	2,703,470,000	780,330,000	3,483,800,000	4,138,500,000
1922	988,100,000	2,737,880,000	921,310,000	3,659,190,000	4,647,290,000
1923	1,511,930,000	3,317,100,000	1,157,470,000	4,474,570,000	5,986,500,000
1924	1,233,370,000	2,898,630,000	1,173,800,000	4,072,430,000	5,305,800,000
1925	1,382,155,000	3,058,680,000	1,236,795,000	4,295,475,000	5,677,630,000
1926	1,405,345,000	3,541,916,000	1,266,339,000	4,808,255,000	6,213,600,000
1927	1,220,633,000	3,060,047,000	1,249,320,000	4,309,367,000	5,530,000,000
1928	1,288,290,000	2,884,962,000	1,211,948,000	4,096,910,000	5,385,200,000
1929	1,480,390,000	3,190,527,000	1,216,683,000	4,407,210,000	5,887,600,000
1930	985,790,000	2,764,500,000	1,014,510,000	3,779,010,000	4,764,800,000
1931	569,790,000	1,892,400,000	704,410,000	2,596,810,000	3,166,600,000
1932	285,875,000	1,743,400,000	432,425,000	2,175,825,000	2,461,700,000
1933	417,065,000	1,683,400,000	454,635,000	2,138,035,000	2,555,100,000
1934	548,934,000	2,233,300,000	543,166,000	2,776,466,000	3,325,400,000
1935	733,130,000	2,330,000,000	586,870,000	2,916,870,000	3,650,000,000
1936	1,081,600,000	2,759,200,000	716,000,000	3,475,200,000	4,556,800,000
1937	1,468,200,000	3,200,500,000	744,700,000	3,945,200,000	5,413,400,000
1938	892,400,000	2,820,300,000	650,200,000	3,470,500,000	4,362,900,000
1939 [3]	1,291,000,000	2,818,600,000	764,400,000	3,583,000,000	4,874,000,000
Grand total	44,731,627,000	80,773,252,000	27,846,410,000	108,619,662,000	153,351,289,000

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

The sum of the following State totals does not reach the total for the United States given in the preceding table partly because figures for certain of the products included in the United States total are not available by States of origin. This fact is brought out in the opening text of this chapter and in the second table following.

In addition, there are many factors (the more important discussed in the opening text) that account for the disagreement between the sum of the State totals and the grand total for the United States, by products. Chief among these are: (1) The use of iron ore values in State totals and pig iron values in United States total; (2) the use of mine figures for gold, silver, copper, lead, and zinc in the State totals and mint and smelter figures (supplemented by the value of byproduct sulfuric acid from copper and zinc smelting and zinc roasting and the value of zinc and lead pigments made in large part direct from ores) in the United States total; and (3) the inclusion of estimates in the United States total for a few products for which no canvass has been conducted for many years and for which no estimate by States is made.

Many other less important differences are involved, but both State and United States totals are as complete and definite as seems possible with the data available. The practice is consistent from year to year, and it is believed that the reader can determine readily just what minerals are covered by the total concerned.

In every table each mineral produced is listed, and all figures are shown except those that the Bureau of Mines is not at liberty to publish.

Value of mineral products of the United States, 1936–38, by States[1]

State	1936	1937	1938
Alabama	$44,752,688	$53,518,993	$46,296,293
Alaska	23,737,714	27,927,958	27,664,146
Arizona	60,532,996	94,564,494	60,756,253
Arkansas	21,296,783	25,578,393	29,395,086
California	437,565,809	476,880,603	489,948,802
Colorado	56,214,827	67,338,548	60,369,440
Connecticut	3,317,494	3,689,554	3,059,688
Delaware	444,093	397,362	320,621
District of Columbia	547,576	522,687	568,717
Florida	12,973,243	13,811,958	12,866,981
Georgia	11,756,592	12,584,060	11,598,421
Idaho	29,965,964	40,633,119	31,738,606
Illinois	117,916,128	133,437,554	130,155,083
Indiana	52,281,539	54,886,756	47,892,364
Iowa	28,359,140	26,941,350	24,794,058
Kansas	121,689,562	154,376,403	129,675,438
Kentucky	113,435,307	127,423,680	106,654,903
Louisiana	153,358,397	182,118,905	172,306,761
Maine	3,423,353	4,129,391	3,548,638
Maryland	11,157,550	10,634,854	9,407,723
Massachusetts	7,559,253	7,813,345	6,666,281
Michigan	100,646,492	119,167,573	81,380,602
Minnesota	94,568,991	152,107,070	51,425,289
Mississippi	3,846,104	4,821,950	5,209,547
Missouri	41,350,860	52,446,272	39,560,739
Montana	65,569,150	82,086,815	48,602,547
Nebraska	3,843,562	4,837,809	4,028,712
Nevada	32,693,129	38,871,816	27,031,281
New Hampshire	1,182,055	1,219,869	1,146,606
New Jersey	24,421,046	31,467,931	24,408,545
New Mexico	45,942,006	72,855,745	63,568,953
New York	71,647,775	77,665,874	73,217,430
North Carolina	9,955,519	11,160,444	14,959,228
North Dakota	2,902,453	2,873,011	2,653,473
Ohio	122,684,043	131,025,104	104,812,531
Oklahoma	305,191,649	367,444,222	272,860,078
Oregon	7,080,975	6,609,710	7,536,091
Pennsylvania	599,457,486	599,817,364	472,773,327
Rhode Island	929,103	862,710	911,599
South Carolina	3,432,662	4,022,325	4,364,034
South Dakota	23,221,620	23,472,873	23,583,359
Tennessee	31,121,865	34,893,847	32,428,512
Texas	638,643,488	813,290,605	740,147,465
Utah	61,209,302	105,652,422	59,236,355
Vermont	6,225,396	7,042,547	6,439,552
Virginia	37,295,168	46,019,085	42,370,169
Washington	22,921,456	26,658,257	21,167,004
West Virginia	271,501,941	306,590,947	254,995,309
Wisconsin	13,277,983	15,239,524	10,636,741
Wyoming	34,498,261	41,087,908	37,364,363

[1] In this table iron ore, not pig iron, is taken as the basis of iron valuation, and for other metals mine production (recoverable content of metals) is the basis. State totals for 1939 not yet available.

Mineral products of the United States and principal producing States in 1938

Rank in value	Product	Principal producing States [1]	
		In order of quantity	In order of value
14	Aluminum	New York, Tennessee, North Carolina	Rank same as for quantity.
(2)	Antimonial lead	Not separable by States	Not separable by States.
80	Antimony ore	Idaho, Alaska, California, Nevada	Alaska, Idaho, California, Nevada.
61	Arsenious oxide	Montana, Utah, Idaho	Rank same as for quantity.
69	Asbestos	Vermont, Arizona, Maryland	Do.
	Asphalt:		
35	Native	Kentucky, Texas, Alabama, Oklahoma	Kentucky, Utah, Texas, Oklahoma.
18	Oil	Not separable by States	Not separable by States.
38	Barite (crude)	Missouri, Georgia, California, Tennessee	Rank same as for quantity.
39	Bauxite	Arkansas, Alabama, Georgia	Do.
53	Bismuth	Not separable by States	Not separable by States.
90	Bitumen (natural sulfonated)	Utah	Rank same as for quantity.
32	Borates	California	Do.
28	Bromine	North Carolina, Michigan, California, West Virginia	Do.
36	Cadmium	Not separable by States	Not separable by States.
57	Cadmium compounds	do	Do.
48	Calcium-magnesium chloride	Michigan, West Virginia, Ohio	Rank same as for quantity.
7	Cement	Pennsylvania, California, Michigan, Texas	Pennsylvania, California, Texas, Michigan.
59	Chats	Oklahoma, Missouri, Kansas	Rank same as for quantity.
86	Chromite	California	Do.
	Clay:		
10	Products (other than pottery and refractories).		Ohio, Pennsylvania, California, Illinois.
26	Raw (sold by producers)	Georgia, Pennsylvania, California, Ohio	Georgia, Pennsylvania, California, Missouri.
2	Coal:		
	Bituminous	West Virginia, Pennsylvania, Illinois, Kentucky	Rank same as for quantity.
	Pennsylvania anthracite	Pennsylvania	Do.
6	Coke	Pennsylvania, New York, Ohio, Alabama	Pennsylvania, New York, Ohio, Indiana.
9	Copper	Arizona, Utah, Montana, Michigan	Rank same as for quantity.
47	Diatomite	California, Oregon, Washington, Nevada	California, Oregon, Washington, New York.
52	Feldspar (crude)	North Carolina, South Dakota, Colorado, New Hampshire	North Carolina, New Hampshire, South Dakota, Colorado.
15	Ferro-alloys	Pennsylvania, New York, Ohio, West Virginia	Pennsylvania, New York, West Virginia, Ohio.
88	Flint lining for tube mills	Minnesota	Rank same as for quantity.
42	Fluorspar	Illinois, Kentucky, New Mexico, Nevada	Do.
40	Fuller's earth	Georgia, Texas, Illinois, Florida	Georgia, Texas, Florida, Illinois.
72	Garnet (abrasive)	New York, North Carolina, New Hampshire	New York, New Hampshire, North Carolina.
(3)	Gems and precious stones	No canvass for 1938	No canvass for 1938.
5	Gold	California, Alaska, South Dakota, Colorado	Rank same as for quantity.
85	Graphite:		
	Amorphous	Nevada	Do.
	Crystalline	New York, Georgia	Do.
70	Grindstones and pulpstones	Ohio, West Virginia, Washington	Do.

33	Gypsum (crude)	New York, Michigan, Iowa, Texas	New York, Michigan, Iowa, Nevada.
77	Helium	Texas	Rank same as for quantity.
67	Iodine (natural)	California	Do.
	Iron:		
13	Ore	Minnesota, Alabama, Michigan, Pennsylvania	Minnesota, Michigan, Alabama, Pennsylvania.
4	Pig	Pennsylvania, Ohio, Alabama, Indiana	Pennsylvania, Ohio, Indiana, Illinois.
55	Sinter	Tennessee	Rank same as for quantity.
(4)	Kyanite	No figures available	No figures available.
19	Lead	Missouri, Idaho, Utah, Oklahoma	Rank same as for quantity.
21	Lime	Ohio, Pennsylvania, Missouri, West Virginia	Ohio, Pennsylvania, Missouri, Virginia.
81	Lithium minerals	South Dakota, California	California, South Dakota.
56	Magnesite (crude)	Washington, California	Rank same as for quantity.
49	Magnesium	Michigan	Do.
43	Magnesium salts (natural)	Michigan, Nevada, California, Washington	Michigan, California, Nevada, Washington.
58	Manganese ore	Montana, Tennessee, Georgia, Arkansas	Montana, Tennessee, Arkansas, Georgia.
54	Manganiferous ore	Minnesota, Michigan, New Mexico, Arkansas	Rank same as for quantity.
78	Manganiferous zinc residuum	New Jersey	Do.
	Marl:		
82	Calcareous	West Virginia, Virginia, Nevada, Wisconsin	Do.
73	Greensand	New Jersey	Do.
45	Mercury	California, Oregon, Texas, Nevada	Do.
60	Mica	North Carolina, Virginia, California, South Dakota	North Carolina, Connecticut, Virginia, New Hampshire.
	Scrap	do	North Carolina, Virginia, Connecticut, South Dakota.
	Sheet	North Carolina, Connecticut, New Hampshire, Georgia	Rank same as for quantity.
89	Millstones		Virginia, New York.
24	Mineral paints (zinc and lead pigments)	Pennsylvania, Kansas, Illinois, Indiana	Pennsylvania, Illinois, Kansas, Indiana.
(3)	Mineral waters	No canvass for 1938	No canvass for 1938.
23	Molybdenum	Colorado, Utah, Arizona, New Mexico	Rank same as for quantity.
3	Natural gas	Texas, California, Louisiana, Oklahoma	Texas, California, West Virginia, Louisiana.
11	Natural gasoline	Texas, California, Oklahoma, Louisiana	California, Texas, Oklahoma, Louisiana.
66	Nickel	Not separable by States	Not separable by States.
74	Oilstones, etc	Ohio, New Hampshire, Indiana, Arkansas	Ohio, Arkansas, New Hampshire, Indiana.
(4)	Olivine	No figures available	No figures available.
(5)	Ores (crude), etc.:		
	Copper	Arizona, Utah, Nevada, Michigan	Value not available.
	Dry and siliceous (gold and silver)	Alaska, California, Nevada, South Dakota	Do.
	Lead	Missouri, Idaho, Utah, Nevada	Do.
	Lead-copper	New Mexico, Arizona, Colorado	Do.
	Zinc	Oklahoma, Kansas, Tennessee, New Jersey	Do.
	Zinc-copper	Arizona	Do.
	Zinc-lead	Oklahoma, Kansas, Idaho, Virginia	Do.
65	Peat	New York, New Jersey, Michigan, California	Rank same as for quantity.
87	Pebbles for grinding	California, Minnesota	Minnesota, California.
1	Petroleum	Texas, California, Oklahoma, Louisiana	Rank same as for quantity.
25	Phosphate rock	Florida, Tennessee, Montana, Idaho	Florida, Tennessee, Idaho, Montana.
46	Platinum and allied metals	Alaska, California, Oregon	Rank same as for quantity.
27	Potassium salts	New Mexico, California, Maryland, Utah	Do.
63	Pumice	Kansas, California, Nebraska, Oklahoma	Kansas, California, New Mexico, Nebraska.
41	Pyrites	Tennessee, Virginia, New York, California	Tennessee, Virginia, California, New York.

[1] Rank of States in metal production (except aluminum, ferro-alloys, and pig iron) arranged according to mine reports, not smelter output.
[2] Separate figures for antimonial lead from primary sources not available. [3] No canvass for 1938. [4] No figures available. [5] Value not available.

Mineral products of the United States and principal producing States in 1938—Continued

Rank in value	Product	Principal producing States: In order of quantity	Principal producing States: In order of value
22	Salt	Michigan, New York, Ohio, Louisiana	Michigan, New York, Louisiana, Kansas.
12	Sand and gravel	New York, Illinois, California, Michigan	California, New York, Pennsylvania, Illinois.
50	Sand-lime brick	New York, Massachusetts, Minnesota, Michigan	New York, Massachusetts, Michigan, Minnesota.
68	Selenium	Not separable by States	Not separable by States.
77	Silica (quartz)	Wisconsin, Ohio, California, Tennessee	Wisconsin, California, Ohio, North Carolina.
44	Silica sand and sandstone (ground)	Illinois, New Jersey, Pennsylvania, Ohio	Illinois, New Jersey, West Virginia, Ohio.
17	Silver	Idaho, Utah, Colorado, Arizona	Rank same as for quantity.
30	Slate		Pennsylvania, Vermont, New York, Virginia.
29	Sodium salts (other than NaCl) (natural)	California, Texas, Wyoming, Utah	Rank same as for quantity.
8	Stone	Pennsylvania, New York, Ohio, Illinois	Do.
20	Sulfur	Texas, Louisiana, California, Utah	Do.
31	Sulfuric acid from copper and zinc smelters and roasters and from roasting of high-sulfide gold and silver concentrates.	Pennsylvania, Illinois, Tennessee, Arizona	Do.
37	Talc and ground soapstone [6]	New York, Vermont, California, North Carolina	New York, California, Vermont, North Carolina.
84	Tantalum ore	South Dakota, New Mexico, Wyoming	Rank same as for quantity.
83	Tellurium	Not separable by States	Not separable by States.
76	Tin	Alaska, South Dakota	Rank same as for quantity.
	Titanium ore:		
75	Ilmenite	Virginia	Do.
64	Rutile	Virginia, Arkansas	Do.
62	Tripoli	Illinois, Missouri, Oklahoma, Arkansas	Missouri, Illinois, Oklahoma, Arkansas.
34	Tungsten ore	Nevada, California, Washington, Colorado	Rank same as for quantity.
51	Uranium and vanadium ores	Arizona, Colorado, Utah, Nevada	Colorado, Utah, Arizona, Nevada.
71	Vermiculite	Montana, Colorado, Wyoming, North Carolina	Rank same as for quantity.
16	Zinc	Oklahoma, New Jersey, Kansas, Idaho	New Jersey, Oklahoma, Kansas, Idaho.

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

States and their principal mineral products in 1938 [1]

State	Rank	Principal mineral products in order of value
Alabama	20	Coal, iron ore, cement, stone.
Alaska	27	Gold, copper, coal, silver.
Arizona	14	Copper, gold, silver, lead.
Arkansas	26	Petroleum, coal, natural gas, bauxite.
California	2	Petroleum, natural gas, gold, natural gasoline.
Colorado	15	Coal, molybdenum, gold, silver.
Connecticut	45	Stone, clay products, sand and gravel, lime.
Delaware	50	Clay products, stone, sand and gravel, raw clay.
District of Columbia	49	Clay products, stone.
Florida	34	Phosphate rock, cement, stone, sand and gravel.
Georgia	35	Stone, raw clay, clay products, cement.
Idaho	25	Silver, lead, zinc, gold.
Illinois	7	Coal, petroleum, stone, cement.
Indiana	19	Coal, cement, stone, clay products.
Iowa	29	Do.
Kansas	8	Petroleum, natural gas, zinc, coal.
Kentucky	9	Coal, natural gas, petroleum, stone.
Louisiana	6	Petroleum, natural gas, sulfur, natural gasoline.
Maine	44	Stone, sand and gravel, cement, lime.
Maryland	37	Coal, sand and gravel, cement, clay products.
Massachusetts	39	Stone, sand and gravel, lime, clay products.
Michigan	11	Petroleum, iron ore, copper, cement.
Minnesota	17	Iron ore, stone, sand and gravel, cement.
Mississippi	41	Natural gas, sand and gravel, clay products, raw clay.
Missouri	22	Lead, cement, coal, stone.
Montana	18	Copper, gold, natural gas, petroleum.
Nebraska	43	Cement, sand and gravel, stone, clay products.
Nevada	28	Gold, copper, silver, tungsten ore.
New Hampshire	47	Stone, clay products, sand and gravel, feldspar.
New Jersey	30	Zinc, clay products, stone, sand and gravel.
New Mexico	13	Petroleum, natural gas, potassium salts, copper.
New York	12	Natural gas, stone, petroleum, cement.
North Carolina	33	Stone, bromine, clay products, sand and gravel.
North Dakota	46	Coal, sand and gravel, clay products, natural gas.
Ohio	10	Coal, clay products, natural gas, stone.
Oklahoma	4	Petroleum, natural gas, natural gasoline, zinc.
Oregon	38	Gold, stone, cement, sand and gravel.
Pennsylvania	3	Coal, petroleum, natural gas, cement.
Rhode Island	48	Stone, sand and gravel, clay products, lime.
South Carolina	42	Stone, clay products, raw clay, gold.
South Dakota	31	Gold, stone, cement, sand and gravel.
Tennessee	24	Coal, cement, stone, phosphate rock.
Texas	1	Petroleum, natural gas, sulfur, natural gasoline.
Utah	16	Copper, gold, coal, silver.
Vermont	40	Stone, slate, sand and gravel, lime.
Virginia	21	Coal, stone, cement, zinc.
Washington	32	Coal, cement, sand and gravel, gold.
West Virginia	5	Coal, natural gas, petroleum, stone.
Wisconsin	36	Stone, sand and gravel, iron ore, cement.
Wyoming	23	Petroleum, coal, natural gas, natural gasoline.

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

Prices of gold, silver, copper, lead, and zinc, 1932–39 [1]

Yaer	Gold [2]	Silver [3]	Copper [4]	Lead [4]	Zinc [4]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1932	[5] $20.67+	$0.282	$0.063	$0.030	$0.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[6] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[6] .646+	.098	.046	.048
1939	35.00	[7] .678+	.104	.047	.052

[1] Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+ per fine ounce. For table of prices for silver, copper, lead, and zinc from 1850 to 1931, by years, see Mineral Resources, 1931, pt. 1, p. A115.

[2] 1932: Legal coinage value; 1933–34: Yearly average weighted Government price; 1935–39: Price under authority of Gold Reserve Act of Jan. 31, 1934.

[3] 1932–33: Average New York price for bar silver; 1934 and 1938–39: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.

[4] Yearly average weighted price of all grades of primary metal sold by producers.

[5] $20.671835. [6] $0.64646464. [7] $0.67878787.

STATE TABLES

Mineral production of Alabama, 1937–38

Product	1937 Quantity	1937 Value	1938 Quantity	1938 Value
Asphalt (native)...short tons..	(1)	(1)	(1)	(1)
Bauxite...long tons..	(1)	(1)	(1)	(1)
Cement...barrels..	2 4,403,459	2 $6,165,974	2 4,548,079	2 $6,114,246
Clay:				
Products (other than pottery and refractories)...		3 2,077,606		3 1,487,067
Raw (sold by producers)...short tons..	76,584	99,730	25,871	41,885
Coal...do....	4 12,440,322	5 29,857,000	4 11,061,493	5 26,769,000
Coke...do....	4,259,771	6 13,275,098	3,378,044	6 9,888,292
Copper...pounds..	7,000	847		
Ferro-alloys...long tons..	20,470	6 1,455,967	19,446	6 1,707,736
Gold...troy ounces..	2,460	86,096	41	1,435
Iron:				
Ore...long tons..	6,350,316	10,747,967	4,281,332	7,341,620
Pig...do....	2,528,785	6 42,188,993	1,990,342	6 29,190,091
Lime...short tons..	176,085	964,400	151,937	911,033
Manganese ore...long tons..	289	8,448	202	3,030
Manganiferous ore...do....	428	2,884	356	2,797
Mineral waters...gallons sold..	(7)	(7)	(7)	(7)
Ore (dry and siliceous) (gold and silver)..short tons..	20,173	(8)	300	(8)
Sand and gravel...do....	1,489,131	695,858	3,110,183	782,131
Silver...troy ounces..	457	353	4	3
Stone...short tons..	9 1,500,860	9 1,573,890	1,326,160	1,809,379
Miscellaneous 10...		1,237,940		1,032,667
Total value, eliminating duplications...		53,518,993		46,296,293

1 Value included under "Miscellaneous."
2 Exclusive of puzzolan, value for which is included under "Miscellaneous."
3 Figures obtained through cooperation with Bureau of the Census.
4 According to Bituminous Coal Division.
5 Value is estimated from various sources and includes selling expenses.
6 Value not included in total value for State.
7 No canvass.
8 Not valued as ore; value of recoverable metal content included under the metals.
9 Exclusive of dimension limestone, value for which is included under "Miscellaneous."
10 Includes minerals indicated by "1", "2", and "9" above.

Mineral production of Alaska, 1937–38

Product	1937 Quantity	1937 Value	1938 Quantity	1938 Value
Antimony ore (concentrates)...short tons..	(1)	(1)	(1)	(1)
Arsenic...do....	(2)	(2)	(2)	(2)
Coal...do....	3 131,600	3 $552,700	3 159,230	3 $620,900
Copper...pounds..	34,672,000	4,195,312	29,098,000	2,851,604
Gold...troy ounces..	627,940	21,977,900	664,973	23,274,055
Lead...short tons..	823	97,114	994	91,448
Mercury...flasks (76 pounds)..			8	604
Ores (crude), etc.:				
Copper...short tons..	139,279	(4)	89,174	(4)
Dry and siliceous (gold and silver)...do....	4,580,923	(4)	4,767,545	(4)
Platinum and allied metals...troy ounces..	5,431	313,367	2,390	96,693
Sand and gravel...short tons..	(1)	(1)	(1)	(1)
Silver...troy ounces..	494,340	382,372	479,853	310,208
Stone...short tons..	5 38,450	5 59,845	189,090	204,232
Tin (metallic equivalent)...do....	186	202,300	105	89,100
Miscellaneous 6...		147,048		125,302
Total value, eliminating duplications...		27,927,958		27,664,146

1 Value included under "Miscellaneous."
2 Figures not available.
3 According to the Alaskan Branch of the Geological Survey.
4 Not valued as ore; value of recoverable metal content included under the metals.
5 Exclusive of dimension unclassified stone, value for which is included under "Miscellaneous."
6 Includes mineral indicated by "1" and "5" above.

Mineral production of Arizona, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Asbestos .... short tons	648	$76,059	942	$31,063
Barite .... do			(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] 209,631		[2] 180,305
Raw (sold by producers) .... short tons	(1)	(1)	(1)	(1)
Coal .... do	(1 3)	(1 4)	(1 3)	(1 4)
Copper .... pounds	576,956,000	69,811,676	421,594,000	41,316,212
Feldspar (crude) .... long tons	(1)	(1)	(1)	(1)
Fluorspar .... short tons	610	(1)	1,093	(1)
Gems and precious stones		(5)		(5)
Gold .... troy ounces	332,694	11,644,290	305,043	10,676,505
Gypsum (crude) .... short tons	(1)	(1)		
Lead .... do	12,354	1,457,772	10,571	972,532
Lime .... do	54,789	466,098	39,568	353,224
Mercury .... flasks (76 pounds)	37	3,337		
Mica, scrap .... short tons	(1)	(1)	(1)	(1)
Molybdenum .... pounds	1,173,942	(1)	1,061,995	(1)
Ores (crude), etc.:				
Copper .... short tons	19,928,824	(6)	13,047,356	(6)
Dry and siliceous (gold and silver) .... do	804,949	(6)	928,707	(6)
Lead .... do	29,969	(6)	6,072	(6)
Lead-copper .... do	59	(6)	201	(6)
Zinc .... do	91	(6)	160	(6)
Zinc-copper .... do			32,974	(6)
Zinc-lead .... do	212,467	(6)	187,694	(6)
Sand and gravel .... do	1,266,686	632,354	1,184,965	549,294
Sand-lime brick .... thousands of brick	(1 2)	(1 2)	(1 2)	(1 2)
Silica (quartz) .... short tons	(1)	(1)	(1)	(1)
Silver .... troy ounces	9,422,552	7,288,344	7,479,153	4,835,008
Stone .... short tons	754,170	983,073	431,310	337,078
Sulfuric acid [7] .... do	(1 8)	(1 8)	(1 8)	(1 8)
Tungsten ore (60-percent concentrates) .... do	349	(1)	37	30,863
Vanadium ores .... do	(1)	(1)	165,465	(1)
Zinc .... do	5,026	653,380	5,814	558,144
Miscellaneous [9]		1,878,418		1,406,991
Total value, eliminating duplications		94,564,494		60,756,253

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division.
[4] Value is estimated from various sources and includes selling expenses.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] From copper smelting.
[8] Value not included in total value for State.
[9] Includes minerals indicated by "1" above.

Mineral production of Arkansas, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Bauxite long tons	402,195	$2,322,861	293,280	$1,679,663
Cement barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] 729,920		[2] 656,637
Raw (sold by producers) short tons	(1)	(1)	(1)	(1)
Coal do	[3] 1,510,753	[4] 5,333,000	[3] 1,197,047	[4] 4,013,000
Gems and precious stones		(5)		(5)
Iron ore sold for magnets long tons	2	(1)	2	(1)
Lead short tons	40	4,720	7	644
Lime do	(1)	(1)	(1)	(1)
Manganese ore long tons	3,931	(1)	2,987	(1)
Manganiferous ore do	7,509	(1)	3,477	(1)
Mercury flasks (76 pounds)	(1)	(1)	(1)	(1)
Mineral waters gallons sold	(5)	(5)	(5)	(5)
Natural gas M cubic feet	9,690,000	1,984,000	11,301,000	2,168,000
Natural gasoline gallons	11,285,000	577,000	25,648,000	905,000
Oilstones short tons	47	44,465	41	43,777
Ores (crude), etc.:				
Lead do	(6)	(7)	(6)	(7)
Zinc do	(6)	(7)	(6)	(7)
Petroleum barrels	11,764,000	11,400,000	18,180,000	16,900,000
Sand and gravel short tons	3,370,634	757,162	1,697,600	779,219
Slate		(1)		(1)
Stone short tons	476,370	485,685	[8] 308,760	[8] 293,497
Titanium minerals: Rutile do	(1)	(1)	(1)	(1)
Tripoli do	(1)	(1)	(1)	(1)
Zinc do	241	31,330	152	14,592
Miscellaneous [9]		1,908,250		1,941,057
Total value, eliminating duplications		25,578,393		29,395,086

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division.
[4] Value is estimated from various sources and includes selling expenses.
[5] No canvass.
[6] Figures not available.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[9] Includes minerals indicated by "1" and "8" above.

Mineral production of California, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Antimony ore (concentrates)......short tons..	15	(1)	(1)	(1)
Asphalt (native)......do...	(1)	(1)	(1)	(1)
Barite......do...	(1)	(1)	(1)	(1)
Borates......do...	358,898	$7,232,897	219,513	$4,570,316
Bromine......pounds..	(1)	(1)	(1)	(1)
Cement......barrels..	11,877,642	17,900,739	10,539,010	15,689,210
Chromite......long tons..	2,033	14,008	812	10,730
Clay:				
Products (other than pottery and refractories)..	----------	[2] 7,925,875	----------	[2] 6,636,860
Raw (sold by producers)......short tons..	382,224	918,974	307,122	966,438
Coal......do...	(1 3)	(1 4)	----------	----------
Copper......pounds..	10,502,000	1,270,742	1,612,000	157,976
Diatomite......short tons..	(1)	(1)	(1)	(1)
Feldspar (crude)......long tons..	1,836	9,660	1,396	7,675
Fuller's earth......short tons..	(1)	(1)	(1)	(1)
Gems and precious stones......	----------	(5)	----------	(5)
Gold......troy ounces..	1,174,578	41,110,230	1,311,129	45,889,515
Gypsum (crude)......short tons..	186,158	355,834	162,056	334,208
Iodine......pounds..	299,286	242,422	(1)	(1)
Iron ore—				
Sold to furnaces......long tons..	97	808	28,378	(1)
Sold for paint......do...	(1)	(1)	(1)	(1)
Kyanite......short tons..	(6)	(6)	(6)	(6)
Lead......do...	1,186	139,948	495	45,540
Lime......do...	71,965	737,387	71,596	712,388
Lithium minerals......do...	----------	----------	(1)	(1)
Magnesite......do...	(1)	(1)	(1)	(1)
Magnesium salts (natural)......pounds..	(1)	(1)	(1)	(1)
Marl, calcareous......short tons..	(1)	(1)	(1)	(1)
Mercury......flasks (76 pounds)..	9,743	878,624	12,277	926,545
Mica, scrap......short tons..	(1)	(1)	(1)	(1)
Mineral paints (zinc and lead pigments)....do...	(1 7)	(1 7)	(1 7)	(1 7)
Mineral waters......gallons sold..	(5)	(5)	(5)	(5)
Natural gas......M cubic feet..	329,769,000	91,089,000	315,168,000	88,225,000
Natural gasoline......gallons..	623,894,000	37,719,000	660,890,000	41,085,000
Ores (crude), etc.:				
Copper......short tons..	447,248	(8)	66,943	(8)
Dry and siliceous (gold and silver)......do...	4,472,637	(8)	4,580,462	(8)
Lead......do...	5,009	(8)	844	(8)
Zinc-lead......do...	120	(8)	----------	----------
Peat......do...	4,057	23,131	4,385	25,192
Pebbles for grinding......do...	----------	----------	(1)	(1)
Petroleum......barrels..	238,521,000	242,100,000	249,749,000	257,250,000
Platinum and allied metals......troy ounces..	568	32,773	944	38,349
Potassium salts......short tons..	(1)	(1)	(1)	(1)
Pumice......do...	24,206	124,970	18,584	106,724
Pyrites......long tons..	(1)	(1)	(1)	(1)
Salt (sodium chloride)......short tons..	370,911	1,817,830	349,856	1,940,449
Sand and gravel......do...	12,575,937	6,749,768	11,895,272	7,577,587
Sand and sandstone (ground)......do...	(1)	(1)	(1)	(1)
Silica (quartz)......do...	746	6,072	1,494	20,809
Silver......troy ounces..	2,888,265	2,234,073	2,590,804	1,674,863
Slate......	----------	39,694	----------	27,877
Sodium salts (carbonates and sulfates) (natural) short tons..	182,609	1,777,266	149,060	1,514,400
Stone......do...	8,356,260	7,007,329	7,634,260	6,632,719
Sulfur......long tons..	(1)	(1)	(1)	(1)
Sulfuric acid [9]......short tons..	(1 7)	(1 7)	(1 7)	(1 7)
Talc and ground soapstone......do...	32,495	427,031	30,059	391,456
Tripoli......do...	313	3,756	(1)	(1)
Tungsten ore (60-percent concentrates)......do...	577	(1)	839	878,072
Zinc......do...	20	2,600	----------	----------
Miscellaneous [10]......	----------	7,026,348	----------	6,743,471
Total value, eliminating duplications......	----------	476,880,603	----------	489,948,802

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 According to Bituminous Coal Division.
4 Value is estimated from various sources and includes selling expenses.
5 No canvass.
6 Figures not available.
7 Value not included in total value for State.
8 Not valued as ore; value of recoverable metal content included under the metals.
9 From roasting of high-sulfide gold and silver concentrates.
10 Includes minerals indicated by "1" above.

Mineral production of Colorado, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Cement .... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)	----------	[2] $1,446,433	----------	[2] $1,170,874
Raw (sold by producers) .... short tons	125,018	152,503	102,817	114,927
Coal .... do	[3] 7,187,211	[4] 18,327,000	[3] 5,663,144	[4] 14,828,000
Coke .... do	551,167	(1 5)	241,526	(1 5)
Copper .... pounds	21,868,000	2,646,028	28,342,000	2,777,516
Feldspar (crude) .... long tons	42,221	178,148	27,452	104,673
Ferro-alloys .... do	(1 5)	(1 5)	(1 5)	(1 5)
Fluorspar .... short tons	7,883	98,493	1,704	(1)
Fuller's earth .... do	(1)	(1)	(1)	(1)
Gems and precious stones	----------	(6)	----------	(6)
Gold .... troy ounces	368,905	12,911,675	367,468	12,861,380
Gypsum (crude) .... short tons	28,586	50,034	21,591	41,080
Iron, pig .... long tons	(1 5)	(1 5)	(1 5)	(1 5)
Lead .... short tons	9,786	1,154,748	9,455	869,860
Lime .... do	7,163	72,831	9,564	95,207
Manganiferous ore .... long tons	11,577	59,385	655	(1)
Mica:				
Scrap .... short tons	(1)	(1)	870	9,842
Sheet .... pounds	(1)	(1)	----------	----------
Mineral waters .... gallons sold	(6)	(6)	(6)	(6)
Molybdenum .... pounds	23,566,481	(1)	20,763,884	(1)
Natural gas .... M cubic feet	3,186,000	673,000	1,904,000	464,000
Natural gasoline .... gallons	404,000	16,000	386,000	10,000
Ores (crude), etc.:				
Copper .... short tons	261,658	(7)	333,103	(7)
Dry and siliceous (gold and silver) .... do	1,681,183	(7)	1,528,658	(7)
Lead .... do	30,235	(7)	19,646	(7)
Lead-copper .... do	537	(7)	37	(7)
Zinc .... do	135	(7)	145	(7)
Zinc-lead .... do	94,871	(7)	114,506	(7)
Peat .... do	(1)	(1)	(1)	(1)
Petroleum .... barrels	1,605,000	1,800,000	1,412,000	1,540,000
Pyrites .... long tons	5,890	(1)	(1)	(1)
Salt .... short tons	----------	----------	(1)	(1)
Sand and gravel .... do	4,287,491	1,986,015	3,841,759	1,432,975
Silver .... troy ounces	6,260,693	4,842,646	7,932,095	5,127,819
Stone .... short tons	[8] 1,018,100	[8] 814,930	897,270	1,051,333
Sulfur ore .... long tons	11	(1)	----------	----------
Tantalum ore (columbo-tantalite) .... pounds	(1)	(1)	----------	----------
Tungsten ore (60-percent concentrates) .... short tons	219	(1)	240	(1)
Uranium and vanadium ores .... do	(1)	(1)	(1)	(1)
Vermiculite .... do	(1)	(1)	(1)	(1)
Zinc .... do	4,247	552,110	4,553	437,088
Miscellaneous [9]	----------	28,139,619	----------	21,266,795
Total value, eliminating duplications	----------	67,338,548	----------	60,369,440

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Exclusive of marble and dimension limestone, value for which is included under "Miscellaneous."
[9] Includes minerals indicated by "1" and "8" above.

Mineral production of Connecticut, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories)	------------	[1] $992,528	------------	([1] [2])
Raw (sold by producers)......short tons	3,156	3,944	3,381	$6,199
Coke......do	([2] [3])	([2] [3])	([2] [3])	([2] [3])
Feldspar (crude)......long tons	([2])	([2])	7,461	45,153
Lime......short tons	([2])	([2])	([2])	([2])
Mica:				
Scrap......do	561	8,616	([2])	([2])
Sheet......pounds	401,811	43,288	([2])	([2])
Mineral waters......gallons sold	([4])	([4])	([4])	([4])
Sand and gravel......short tons	1,293,617	573,643	1,376,963	522,777
Stone......do	[5] 1,661,630	[5] 1,859,648	1,529,730	1,731,707
Miscellaneous [6]	------------	3,438,300	------------	3,819,281
Total value, eliminating duplications	------------	3,689,554	------------	3,059,688

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] Value not included in total value for State.
[4] No canvass.
[5] Exclusive of sandstone, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "2" and "5" above.

Mineral production of Delaware, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories)	------------	([1] [2])	------------	[2] $128,295
Raw (sold by producers)......short tons	([1])	([1])	([1])	([1])
Sand and gravel......do	83,994	$47,468	108,875	63,366
Stone......do	([1])	([1])	([1])	([1])
Miscellaneous [3]	------------	349,894	------------	128,960
Total value, eliminating duplications	------------	397,362	------------	320,621

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Includes minerals indicated by "1" above.

Mineral production of the District of Columbia, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Clay products (other than pottery and refractories)	------------	([1] [2])	------------	([1] [2])
Stone......short tons	([1])	([1])	([1])	([1])
Miscellaneous [3]	------------	$522,687	------------	$568,717
Total value, eliminating duplications	------------	522,687	------------	568,717

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Includes minerals indicated by "1" above.

Mineral production of Florida, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)	------------	[2] $132,898	------------	(1 2)
Raw (sold by producers) ... short tons	(1)	(1)	(1)	(1)
Diatomite ... do	(1)	(1)	(1)	(1)
Fuller's earth ... do	(1)	(1)	(1)	(1)
Lime ... do	19,008	177,929	19,638	$185,286
Mineral waters ... gallons sold	(3)	(3)	(3)	(3)
Peat ... short tons	(1)	(1)	(1)	(1)
Phosphate rock ... long tons	2,996,820	9,142,985	2,707,335	8,773,680
Sand and gravel ... short tons	965,322	751,523	996,681	672,106
Sand-lime brick ... thousands of brick	(1 2)	(1 2)	------------	------------
Stone ... short tons	1,600,380	1,408,749	[4] 1,349,160	[4] 1,223,438
Miscellaneous [5]	------------	2,197,874	------------	2,012,471
Total value, eliminating duplications	------------	13,811,958	------------	12,866,981

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] No canvass.
[4] Exclusive of dimension unclassified stone, value for which is included under "Miscellaneous."
[5] Includes minerals indicated by "1" and "4" above.

Mineral production of Georgia, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Barite ... short tons	71,944	$400,687	64,304	$315,329
Bauxite ... long tons	(1)	(1)	(1)	(1)
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)	------------	[2] 2,118,952	------------	[2] 1,980,943
Raw (sold by producers) ... short tons	506,232	3,548,559	434,632	3,339,918
Coal ... do	(1 3)	(1 4)	(1 3)	(1 4)
Copper ... pounds	------------	------------	70	7
Fuller's earth ... short tons	(1)	(1)	(1)	(1)
Gems and precious stones	------------	(5)	------------	(5)
Gold ... troy ounces	743	25,995	872	30,520
Graphite, crystalline ... pounds	------------	------------	(1)	(1)
Iron ore ... long tons	14,593	19,130	9,221	11,375
Kyanite ... short tons	(6)	(6)	(6)	(6)
Lime ... do	7,964	62,196	7,046	54,150
Manganese ore ... long tons	689	11,423	3,058	46,443
Manganiferous ore ... do	9,537	28,459	2,807	12,057
Mica:				
Scrap ... short tons	(1)	(1)	(1)	(1)
Sheet ... pounds	(1)	(1)	(1)	(1)
Mineral waters ... gallons sold	(5)	(5)	(5)	(5)
Ore (dry and siliceous) (gold and silver) ... short tons	1,406	(7)	841	(7)
Sand and gravel ... do	429,122	211,026	395,758	207,048
Silver ... troy ounces	49	38	71	46
Slate	------------	(1)	------------	(1)
Stone ... short tons	1,737,760	3,597,039	1,465,680	3,581,319
Talc ... do	11,984	148,177	15,117	130,595
Miscellaneous [8]	------------	2,412,379	------------	1,888,671
Total value, eliminating duplications	------------	12,584,060	------------	11,598,421

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division.
[4] Value is estimated from various sources and includes selling expenses.
[5] No canvass.
[6] Figures not available.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Includes minerals indicated by "1" above.

Mineral production of Idaho, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Antimony ore (concentrates)......short tons..	3,295	(1)	(1)	(1)
Arsenious oxide......do....	(1)	(1)	(1)	(1)
Cement......barrels..	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)...		[2] $139,054		[2] $127,516
Raw (sold by producers)......short tons..	(1)	(1)	(1)	(1)
Coal......do....	(1 3)	(1 4)	(1 3)	(1 4)
Copper......pounds..	4,464,000	540,144	4,278,000	419,244
Diatomite......short tons..	50	500	(1)	(1)
Gems and precious stones......		(5)		(5)
Gold......troy ounces..	81,861	2,865,135	103,513	3,622,955
Gypsum (crude)......short tons..	(1)	(1)	(1)	(1)
Lead......do....	103,711	12,237,898	92,177	8,480,284
Lime......do....	(1)	(1)	(1)	(1)
Ores (crude), etc.:				
Copper......do....	850	(6)	165	(6)
Dry and siliceous (gold and silver)......do....	531,514	(6)	743,332	(6)
Lead......do....	412,378	(6)	272,904	(6)
Zinc-lead......do....	1,130,660	(6)	982,746	(6)
Phosphate rock......long tons..	83,436	356,037	66,014	296,595
Sand and gravel......short tons..	1,722,201	728,988	1,968,068	721,357
Silver......troy ounces..	19,587,766	15,151,137	18,993,676	12,278,740
Stone......short tons..	891,270	700,627	1,047,980	795,896
Tungsten ore (60-percent concentrates)......do....	99	(1)	154	(1)
Zinc......do....	54,199	7,045,870	44,030	4,226,880
Miscellaneous [7]......		867,729		769,139
Total value, eliminating duplications......		40,633,119		31,738,606

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division.
[4] Value is estimated from various sources and includes selling expenses.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Includes minerals indicated by "1" above.

Mineral production of Illinois, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Cement barrels	[1] 4,713,734	[1] $6,756,747	[1] 4,357,119	[1] $5,993,644
Clay:				
Products (other than pottery and refractories)		[2] 6,545,686		[2] 5,491,268
Raw (sold by producers) short tons	161,537	339,706	94,770	226,617
Coal do	[3] 51,601,638	[4] 89,271,000	[3] 41,912,085	[4] 71,837,000
Coke do	2,998,663	[5] 20,213,129	1,734,511	[5] 11,706,788
Fluorspar do	78,664	1,730,585	35,368	751,227
Fluorspar, optical ounces			5	5
Fuller's earth short tons	(6)	(6)	(6)	(6)
Iron, pig long tons	3,357,959	[5] 70,893,278	1,519,572	[5] 30,899,012
Lead short tons	186	21,948	175	16,100
Lime do	142,122	1,039,087	135,256	965,836
Mineral paints (zinc and lead pigments) do	22,171	[5] 2,406,423	(5 6)	(5 6)
Mineral waters gallons sold	(7)	(7)	(7)	(7)
Natural gas M cubic feet	1,040,000	533,000	1,169,000	616,000
Natural gasoline gallons	2,567,000	153,000	2,436,000	124,000
Ore (lead and zinc) short tons	(8)	(8)	(8)	(8)
Petroleum barrels	7,499,000	9,970,000	24,075,000	30,100,000
Pyrites long tons	10,220	(6)	(6)	(6)
Sand and gravel short tons	14,333,482	7,486,610	12,538,469	5,648,601
Sand and sandstone (ground) do	96,329	575,251	66,583	418,881
Silver troy ounces	887	686	576	372
Stone short tons	[9] 9,887,260	[9] 8,383,931	[9] 8,528,440	[9] 7,335,844
Sulfuric acid (60° Baumé) [10] do	142,206	[5] 1,326,782	143,343	[5] 1,305,855
Tripoli do	11,647	151,154	8,141	117,107
Miscellaneous [11]		479,163		2,754,664
Total value, eliminating duplications		133,437,554		130,155,083

[1] Exclusive of natural cement, value for which is included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] Value included under "Miscellaneous."
[7] No canvass.
[8] No ore milled in Northern Illinois; lead output of Southern Illinois is byproduct of fluorspar milling.
[9] Exclusive of sandstone, value for which is included under "Miscellaneous."
[10] From zinc smelting.
[11] Includes minerals indicated by "1", "6", and "9" above.

Mineral production of Indiana, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Cement barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $4,670,619		[2] $4,088,658
Raw (sold by producers) short tons	41,369	65,017	16,941	31,864
Coal do	[3] 17,764,774	[4] 28,601,000	[3] 14,758,484	[4] 23,968,000
Coke do	5,467,061	[5] 32,655,355	2,904,779	[5] 18,278,201
Iron, pig long tons	3,694,360	[5] 77,990,597	1,807,808	[5] 37,025,980
Lime short tons	94,053	552,243	102,054	581,922
Marl, calcareous do	(1)	(1)		
Mineral paints (zinc and lead pigments) do	(1 5)	(1 5)	(1 5)	(1 5)
Mineral waters gallons sold	(6)	(6)	(6)	(6)
Natural gas M cubic feet	1,551,000	996,000	1,299,000	734,000
Petroleum barrels	844,000	1,140,000	995,000	1,260,000
Rubbing stones and whetstones short tons	115	18,288	53	9,007
Sand and gravel do	6,598,723	3,227,514	5,479,548	2,958,473
Sand-lime brick thousands of brick	(1 2)	(1 2)	(1 2)	(1 2)
Stone short tons	[7] 3,504,530	[7] 6,397,891	[7] 3,782,410	[7] 6,486,996
Miscellaneous [8]		10,769,362		9,304,405
Total value, eliminating duplications		54,886,756		47,892,364

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 According to Bituminous Coal Division.
4 Value is estimated from various sources and includes selling expenses.
5 Value not included in total value for State.
6 No canvass.
7 Exclusive of dimension sandstone, value for which is included under "Miscellaneous."
8 Includes minerals indicated by "1" and "7" above.

Mineral production of Iowa, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Cement barrels	4,598,453	$7,046,021	4,759,390	$7,327,048
Clay:				
Products (other than pottery and refractories)		[1] 3,250,677		[1] 2,868,233
Raw (sold by producers) short tons	4,600	50,871	6,828	45,759
Coal do	[2] 3,637,054	[3] 9,529,000	[2] 3,103,187	[3] 7,963,000
Ferro-alloys long tons	(4 5)	(4 5)	(4 5)	(4 5)
Gypsum (crude) short tons	387,255	533,162	364,920	495,856
Iron, pig long tons	(4 5)	(4 5)	(4 5)	(4 5)
Mineral waters gallons sold	(6)	(6)	(6)	(6)
Peat short tons	(4)	(4)	(4)	(4)
Sand and gravel do	6,397,154	2,235,103	6,994,246	2,299,682
Stone do	4,294,310	4,276,891	3,369,750	3,782,480
Miscellaneous [7]		2,163,370		1,142,004
Total value, eliminating duplications		26,941,350		24,794,058

1 Figures obtained through cooperation with Bureau of the Census.
2 According to Bituminous Coal Division.
3 Value is estimated from various sources and includes selling expenses.
4 Value included under "Miscellaneous."
5 Value not included in total value for State.
6 No canvass.
7 Includes minerals indicated by "1" above.

Mineral production of Kansas, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Asphalt (native) short tons	(1)	(1)	(1)	(1)
Cement barrels	[2] 3,500,684	[2] $5,482,851	[2] 3,217,497	[2] $4,949,018
Chats short tons	(3)	(3)	25,000	1,930
Clay products (other than pottery and refractories)		[4] 1,408,376		[4] 879,595
Coal short tons	[5] 2,892,560	[6] 5,612,000	[5] 2,654,141	[6] 5,263,000
Gypsum (crude) do	(1)	(1)	(1)	(1)
Lead do	16,008	1,888,944	15,239	1,401,988
Mineral paints (zinc and lead pigments) do	(1 7)	(1 7)	(1 7)	(1 7)
Mineral waters gallons sold	(8)	(8)	(8)	(8)
Natural gas M cubic feet	83,890,000	30,376,000	75,203,000	27,485,000
Natural gasoline gallons	57,026,000	2,192,000	55,988,000	1,603,000
Ores (crude), etc.:				
Zinc short tons	3,526,600	(9)	1,706,800	(9)
Zinc-lead do	2,081,300	(9)	2,044,500	(9)
Petroleum barrels	70,761,000	88,100,000	60,064,000	72,100,000
Pumice short tons	38,438	111,655	38,136	112,823
Pyrites long tons	15,843	(1)	17,757	(1)
Salt short tons	654,089	2,759,062	597,909	2,565,447
Sand and gravel do	2,495,196	1,017,515	2,962,831	1,117,053
Stone do	[10] 3,540,860	[10] 4,763,080	[10] 3,676,230	[10] 4,958,723
Zinc do	80,300	10,439,000	73,024	7,010,304
Miscellaneous [11]		2,788,921		2,460,741
Total value, eliminating duplications		154,376,403		129,675,438

[1] Value included under "Miscellaneous."
[2] Exclusive of natural cement, value for which is included under "Miscellaneous."
[3] Figures not available. [4] Figures obtained through cooperation with Bureau of the Census.
[5] According to Bituminous Coal Division.
[6] Value is estimated from various sources and includes selling expenses.
[7] Value not included in total value for State. [8] No canvass.
[9] Not valued as ore; value of recoverable metal content included under the metals.
[10] Exclusive of unclassified stone in 1937 and of dimension sandstone in 1938, value for which is included under "Miscellaneous."
[11] Includes minerals indicated by "1", "2", and "10" above.

Mineral production of Kentucky, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Asphalt (native) short tons	(1)	(1)	(1)	(1)
Cement barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $1,220,962		[2] $1,266,284
Raw (sold by producers) short tons	340,325	1,193,410	148,330	666,560
Coal do	[3] 47,086,444	[4] 86,639,000	[3] 38,545,218	[4] 70,094,000
Coke do	(1 5)	(1 5)	(1 5)	(1 5)
Fluorspar do	87,296	1,710,122	34,803	678,094
Fluorspar, optical pounds	50	120		
Iron, pig long tons	243,010	(1 5)	126,102	(1 5)
Lead short tons	89	10,502	101	9,292
Lime do	(1)	(1)	(1)	(1)
Marl, calcareous do	(1)	(1)		
Mineral waters gallons sold	(6)	(6)	(6)	(6)
Natural gas M cubic feet	55,719,000	22,904,000	46,163,000	19,539,000
Natural gasoline gallons	7,344,000	382,000	7,040,000	364,000
Ores (lead and zinc) short tons	(7)	(7)	(7)	(7)
Petroleum barrels	5,484,000	7,680,000	5,821,000	7,570,000
Sand and gravel short tons	1,100,682	804,210	1,222,658	962,508
Stone do	[8] 3,433,190	[8] 3,040,322	[8] 3,361,600	[8] 2,987,494
Zinc do	270	35,100	322	30,912
Miscellaneous [9]		8,134,709		6,573,722
Total value, eliminating duplications		127,423,680		106,654,903

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State. [6] No canvass. [7] Figures not available.
[8] Exclusive of unclassified stone in 1937 and of sandstone in 1938, value for which is included under "Miscellaneous."
[9] Includes minerals indicated by "1" and "8" above.

Mineral production of Louisiana, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Cement...barrels..	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)...	....	[2] $489,255	....	[2] $547,478
Raw (sold by producers)...short tons..	....	....	(1)	(1)
Mineral waters...gallons sold..	(3)	(3)	(3)	(3)
Natural gas...M cubic feet..	315,301,000	53,908,000	283,899,000	47,991,000
Natural gasoline...gallons..	106,415,000	4,300,000	95,634,000	3,026,000
Petroleum...barrels..	90,924,000	110,300,000	95,208,000	110,100,000
Salt...short tons..	974,403	2,898,826	958,186	2,775,384
Sand and gravel...do....	2,065,447	1,250,439	2,248,657	1,241,455
Stone...do....	(1)	(1)	(1)	(1)
Sulfur...long tons..	429,602	7,705,448	294,235	(1)
Miscellaneous [4]...	....	1,266,937	....	6,625,444
Total value, eliminating duplications...	....	182,118,905	....	172,306,761

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] No canvass.
[4] Includes minerals indicated by "1" above.

Mineral production of Maine, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Cement...barrels..	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)...	....	[2] $358,589	....	[2] $210,814
Raw (sold by producers)...short tons..	(1)	(1)	....	....
Feldspar (crude)...long tons..	20,191	110,928	13,764	68,047
Gems and precious stones...	....	(3)	....	(3)
Lime...short tons..	(1)	(1)	(1)	(1)
Mica, scrap...do....	(1)	(1)	(1)	(1)
Mineral waters...gallons sold..	(3)	(3)	(3)	(3)
Peat...short tons..	(1)	(1)	(1)	(1)
Sand and gravel...do....	2,742,489	706,856	3,802,704	968,766
Silica (quartz)...do....	67	168	91	278
Slate...	....	388,521	....	(1)
Stone...short tons..	[4] 265,340	[4] 1,546,037	192,250	1,161,535
Miscellaneous [5]...	....	1,018,292	....	1,139,198
Total value, eliminating duplications...	....	4,129,391	....	3,548,638

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] No canvass.
[4] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[5] Includes minerals indicated by "1" and "4" above.

Mineral production of Maryland, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Asbestos .... short tons..	(1)	(1)	(1)	(1)
Cement .... barrels..	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)	....	[2] $1,313,811	....	[2] $1,210,947
Raw (sold by producers) .... short tons..	33,311	125,947	20,434	86,243
Coal .... do....	[3] 1,548,980	[4] 3,315,000	[3] 1,281,413	[4] 2,705,000
Coke .... do....	1,513,651	(1 5)	1,105,262	(1 5)
Feldspar (crude) .... long tons..	(1)	(1)	....	....
Gold .... troy ounces..	1,040	36,400	855	29,925
Iron, pig .... long tons..	1,514,372	(1 5)	1,219,611	(1 5)
Lime .... short tons..	59,575	404,562	62,479	446,013
Mineral waters .... gallons sold..	(6)	(6)	(6)	(6)
Ore (dry and siliceous) (gold and silver) .. short tons..	2,000	(7)	1,701	(7)
Potassium salts .... do....	(1)	(1)	(1)	(1)
Sand and gravel .... do....	2,441,612	2,236,132	2,177,162	1,848,211
Silica (quartz) .... do....	410	5,850	377	6,000
Silver .... troy ounces..	40	31	24	16
Slate	....	(1)	....	(1)
Stone .... short tons..	[8] 836,800	[8] 1,139,767	[8] 947,390	[8] 1,167,518
Talc and ground soapstone .... do....	(1)	(1)	(1)	(1)
Miscellaneous [9]	....	41,790,766	....	28,491,245
Total value, eliminating duplications	....	10,634,854	....	9,407,723

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Exclusive of marble in 1937 and of crushed sandstone in 1938, value for which is included under "Miscellaneous."
[9] Includes minerals indicated by "1" and "8" above.

Mineral production of Massachusetts, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories) ...	....	[1] $804,895	....	[1] $622,719
Raw (sold by producers) .... short tons..	2,125	17,868	864	12,150
Coke .... do....	1,130,620	(2 3)	1,019,302	(2 3)
Diatomite .... do....	(2)	(2)	....	....
Iron, pig .... long tons..	(2 3)	(2 3)	(2 3)	(2 3)
Lime .... short tons..	101,247	897,356	91,453	741,975
Manganiferous ore .... long tons..	....	....	230	(2)
Mineral waters .... gallons sold..	(4)	(4)	(4)	(4)
Peat .... short tons..	(2)	(2)	(2)	(2)
Sand and gravel .... do....	2,884,784	1,421,390	3,464,045	1,228,385
Sand and sandstone (ground) .... do....	2,613	12,448	1,234	4,102
Sand-lime brick .... thousands of brick..	[1] 18,741	[1] 168,672	[1] 15,047	[1] 143,764
Silica (quartz) .... short tons..	....	....	140	840
Stone .... do....	[5] 2,353,500	[5] 4,408,297	[5] 2,188,820	[5] 3,865,042
Miscellaneous [6]	....	9,083,198	....	7,056,024
Total value, eliminating duplications	....	7,813,345	....	6,666,281

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] Value not included in total value for State.
[4] No canvass.
[5] Exclusive of marble in 1937 and of sandstone in 1938, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "2" and "5" above.

Mineral production of Michigan, 1937–38

Product	1937 Quantity	1937 Value	1938 Quantity	1938 Value
Bromine pounds	13,494,677	$2,697,666	12,430,679	$2,490,607
Calcium chloride short tons	85,780	1,213,985	84,022	1,137,257
Cement barrels	7,831,880	9,836,999	7,192,511	8,767,859
Clay:				
Products (other than pottery and refractories)		[1] 1,838,709		[1] 1,444,472
Raw (sold by producers) short tons	(2)	(2)	(2)	(2)
Coal do	[3] 562,262	[4] 2,047,000	[3] 494,481	[4] 1,860,000
Coke do	2,283,518	[5] 13,816,401	1,742,787	[5] 10,135,722
Copper pounds	94,928,000	11,486,288	93,486,000	9,161,628
Gems and precious stones		(6)		(6)
Gold troy ounces	51	1,800		
Graphite, amorphous short tons	(2)	(2)		
Gypsum (crude) do	553,242	896,947	483,324	775,908
Iron:				
Ore—				
Sold to furnaces long tons	12,626,935	41,136,202	4,092,902	13,139,823
Sold for paint do	1,118	(2)	147	(2)
Pig do	886,602	[5] 15,064,083	558,782	[5] 9,806,994
Lime short tons	48,310	351,681	45,848	339,324
Magnesium pounds	4,539,980	(2)	4,819,617	(2)
Magnesium salts (natural):				
Carbonate do	(2)	(2)	(2)	(2)
Chloride do	(2)	(2)	(2)	(2)
Sulfate do	(2)	(2)	(2)	(2)
Manganiferous ore long tons	9,739	32,442	16,057	(2)
Marl, calcareous short tons	1,270	553	(2)	(2)
Mineral waters gallons sold	(6)	(6)	(6)	(6)
Natural gas M cubic feet	9,080,000	5,640,000	10,165,000	6,387,000
Natural gasoline gallons	2,408,000	103,000	3,581,000	107,000
Ores (crude), etc.:				
Copper short tons	4,197,881	(7)	3,757,705	(7)
Dry and siliceous (gold and silver) do	600	(7)		
Peat do	5,276	28,832	5,117	26,838
Petroleum barrels	16,628,000	21,950,000	18,745,000	19,300,000
Salt short tons	2,476,406	6,506,120	2,078,612	6,151,154
Sand and gravel do	10,987,148	4,430,584	9,821,298	3,734,012
Sand-lime brick thousands of brick	[1] 16,107	[1] 144,597	[1] 10,222	[1] 118,464
Silver troy ounces	25,454	19,689	93,634	60,531
Stone short tons	[8] 12,347,790	[8] 6,553,610	[8] 7,900,370	[8] 4,059,590
Miscellaneous [9]		2,250,869		2,319,135
Total value, eliminating duplications		119,167,573		81,380,602

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] According to Bituminous Coal Division.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Exclusive of sandstone in 1937 and of dimension limestone in 1938, value for which is included under "Miscellaneous."
[9] Includes minerals indicated by "2" and "8" above.

Mineral production of Minnesota, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Cement .... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)	------	2 $962,572	------	2 $1,003,631
Raw (sold by producers) .... short tons	3,116	6,250	(1)	(1)
Coke .... do	704,631	3 5,611,287	540,447	3 4,495,555
Flint lining for tube mills .... do	(1)	(1)	(1)	(1)
Gems and precious stones	------	(4)	------	(4)
Iron:				
Ore .... long tons	47,878,042	141,542,594	14,535,744	44,361,534
Pig .... do	248,363	(1 3)	135,931	(1 3)
Lime .... short tons	(1)	(1)	(1)	(1)
Manganiferous ore .... long tons	1,257,900	3,451,795	276,607	726,449
Marl, calcareous .... short tons	340	290	(1)	(1)
Mineral waters .... gallons sold	(4)	(4)	(4)	(4)
Peat .... short tons	(1)	(1)	(1)	(1)
Pebbles for grinding .... do	(1)	(1)	(1)	(1)
Sand and gravel .... do	7,781,830	1,905,441	8,486,147	1,586,836
Sand-lime brick .... thousands of brick	2 16,880	2 127,829	(1 2)	(1 2)
Stone .... short tons	5 822,680	5 1,991,199	941,050	1,914,056
Miscellaneous 6	------	7,503,912	------	4,601,225
Total value, eliminating duplications	------	152,107,070	------	51,425,289

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 Value not included in total value for State.
4 No canvass.
5 Exclusive of marble, value for which is included under "Miscellaneous."
6 Includes minerals indicated by "1" and "5" above.

Mineral production of Mississippi, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories)	------	1 $623,023	------	1 $605,311
Raw (sold by producers) .... short tons	(2)	(2)	(2)	(2)
Fuller's earth .... do	(2)	(2)	(2)	(2)
Iron ore .... long tons	97	(2)	------	------
Mineral waters .... gallons sold	(3)	(3)	(3)	(3)
Natural gas .... M cubic feet	13,348,000	3,041,000	13,656,000	3,210,000
Sand and gravel .... short tons	2,814,696	1,008,722	3,236,675	1,246,974
Stone .... do	(2)	(2)	------	------
Miscellaneous 4	------	149,205	------	147,262
Total value, eliminating duplications	------	4,821,950	------	5,209,547

1 Figures obtained through cooperation with Bureau of the Census.
2 Value included under "Miscellaneous."
3 No canvass.
4 Includes minerals indicated by "2" above.

Mineral production of Missouri, 1937–38

Product	1937 Quantity	1937 Value	1938 Quantity	1938 Value
Asphalt (native) short tons	(1)	(1)	(1)	(1)
Barite do	198, 101	$1, 430, 397	156, 539	$1, 150, 630
Cement barrels	4, 565, 448	7, 041, 016	4, 570, 389	6, 871, 120
Chats short tons	1, 984, 340	213, 436	1, 306, 800	196, 000
Clay:				
Products (other than pottery and refractories)		[2] 2, 542, 404		[2] 1, 910, 630
Raw (sold by producers) short tons	519, 561	1, 529, 239	258, 718	904, 766
Coal do	[3] 4, 091, 394	[4] 7, 978, 000	[3] 3, 436, 118	[4] 6, 814, 000
Coke do	(1 5)	(1 5)	(1 5)	(1 5)
Copper pounds	538, 000	65, 098		
Iron ore—				
Sold to furnaces long tons	19, 897	57, 687	20, 671	31, 514
Sold for paint do	1, 500	(1)	6, 500	(1)
Lead short tons	157, 631	18, 600, 458	122, 027	11, 226, 484
Lime do	426, 514	2, 326, 928	298, 151	1, 724, 140
Mineral paints (zinc and lead pigments) do	(1 5)	(1 5)	(1 5)	(1 5)
Mineral waters gallons sold	(6)	(6)	(6)	(6)
Natural gas M cubic feet	444, 000	226, 000	1, 369, 000	819, 000
Ores (crude), etc.:				
Lead short tons	5, 012, 631	(7)	3, 668, 400	(7)
Zinc do	438, 100	(7)	126, 600	(7)
Zinc-lead do	542, 000	(7)	353, 000	(7)
Petroleum barrels	40, 000	42, 000	(1)	(1)
Pyrites long tons	(1)	(1)	28, 828	71, 956
Sand and gravel short tons	4, 409, 708	2, 481, 464	3, 269, 856	1, 919, 146
Sand and sandstone (ground) do	(1)	(1)	(1)	(1)
Sand-lime brick thousands of brick	(1 2)	(1 2)	(1 2)	(1 2)
Silver troy ounces	179, 700	138, 999	292, 000	188, 768
Stone short tons	[8] 3, 635, 250	[8] 4, 742, 459	3, 332, 480	4, 458, 781
Tripoli do	(1)	(1)	(1)	(1)
Tungsten ore (60-percent concentrates) do	(1)	(1)	1	(1)
Zinc do	20, 600	2, 678, 000	10, 226	981, 696
Miscellaneous [9]		2, 243, 344		1, 816, 305
Total value, eliminating duplications		52, 446, 272		39, 560, 739

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Exclusive of sanstone, value for which is included under "Miscellaneous."
[9] Includes minerals indicated by "1" and "8" above.

Mineral production of Montana, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Arsenious oxide ... short tons	(1)	(1)	(1)	(1)
Asbestos ... do	(1)	(1)		
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $151,529		[2] $154,684
Raw (sold by producers) ... short tons	8,645	7,111	(1)	(1)
Coal ... do	[3] 2,965,193	[4] 4,423,000	[3] 2,732,050	[4] 4,106,000
Copper ... pounds	289,056,000	34,975,776	154,426,000	15,133,748
Gems and precious stones		(5)		(5)
Gold ... troy ounces	202,252	7,078,820	203,313	7,115,955
Graphite, crystalline ... pounds	(1)	(1)		
Gypsum (crude) ... short tons	(1)	(1)	(1)	(1)
Lead ... do	17,957	2,118,926	9,327	858,084
Lime ... do	13,295	79,201	(1)	(1)
Manganese ore ... long tons	26,744	785,129	11,936	451,396
Manganiferous ore ... do	19,660	114,692	452	1,971
Mineral waters ... gallons sold	(5)	(5)	(5)	(5)
Natural gas ... M cubic feet	24,765,000	6,667,000	21,216,000	6,132,000
Natural gasoline ... gallons	2,296,000	161,000	1,768,000	113,000
Ores (crude), etc.:				
Copper ... short tons	3,426,395	(6)	1,607 713	(6)
Dry and siliceous (gold and silver) ... do	904,489	(6)	914,601	(6)
Lead ... do	13,867	(6)	10,574	(6)
Zinc ... do	125,395	(6)	76,809	(6)
Zinc-lead ... do	427,863	(6)	114,769	(6)
Petroleum ... barrels	5,805,000	7,300,000	4,946,000	5,190,000
Phosphate rock ... long tons	50,834	133,138	66,491	155,917
Pyrites ... do	(1)	(1)	(1)	(1)
Sand and gravel ... short tons	4,601,999	1,590,403	2,946,572	1,064,274
Silver ... troy ounces	11,812,093	9,136,654	6,403,962	4,139,935
Stone ... short tons	[7] 340,450	[7] 439,785	1,364,680	1,717,417
Tungsten ore (60-percent concentrates) ... do	14	(1)		
Vermiculite ... do	(1)	(1)	(1)	(1)
Zinc ... do	39,168	5,091,840	8,844	849,024
Miscellaneous [8]		1,832,811		1,419,142
Total value, eliminating duplications		82,086,815		48,602,547

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division.
[4] Value is estimated from various sources and includes selling expenses.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of marble, value for which is included under "Miscellaneous."
[8] Includes minerals indicated by "1" and "7" above.

Mineral production of Nebraska, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $473,227		[2] $327,482
Raw (sold by producers) ... short tons	6,904	8,371	16,019	7,782
Mineral waters ... gallons sold	(3)	(3)	(3)	(3)
Pumice ... short tons	5,777	38,130	(1)	(1)
Sand and gravel ... do	2,850,963	1,061,589	2,928,904	1,020,806
Stone ... do	763,710	1,146,335	[4] 510,240	[4] 780,664
Miscellaneous		2,110,157		1,891,978
Total value, eliminating duplications		4,837,809		4,028,712

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] No canvass.
[4] Exclusive of dimension limestone. value for which is included under "Miscellaneous."

Mineral production of Nevada, 1937–38

Product	1937 Quantity	1937 Value	1938 Quantity	1938 Value
Antimony ore (concentrates)............short tons..	38	$300	31	$1,400
Barite........................do....	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)...	....	(1 2)	....	(1 2)
Raw (sold by producers)............short tons..	(1)	(1)	....	....
Copper........................pounds..	149,206,000	18,053,926	92,338,000	9,049,124
Diatomite........................short tons..	275	8,180	(1)	(1)
Fluorspar........................do....	2,544	(1)	2,909	(1)
Fuller's earth........................do....	4,485	51,718	5,984	57,499
Gems and precious stones........................	....	(3)	....	(3)
Gold........................troy ounces..	281,332	9,846,620	296,434	10,375,190
Graphite, amorphous........................short tons..	(1)	(1)	(1)	(1)
Gypsum (crude)........................do....	160,347	268,638	168,515	366,869
Iron ore........................long tons..	196	(1)	....	....
Kyanite........................short tons..	(4)	(4)	(4)	(4)
Lead........................do....	9,347	1,102,946	4,679	430,468
Lime........................do....	(1)	(1)	(1)	(1)
Magnesium oxide (hydrated) (brucite)........do....	(1)	(1)	(1)	(1)
Manganese ore........................long tons..	....	....	43	416
Manganiferous ore........................do....	533	3,167	....	....
Marl, calcareous........................short tons..	(1)	(1)	(1)	(1)
Mercury........................flasks (76 pounds)..	198	17,855	336	25,358
Mineral waters........................gallons sold..	(3)	(3)	(3)	(3)
Ores (crude), etc.:				
Copper........................short tons..	5,669,388	(5)	4,043,892	(5)
Dry and siliceous (gold and silver)........do....	1,729,048	(5)	1,745,060	(5)
Lead........................do....	11,218	(5)	28,325	(5)
Lead-copper........................do....	1,003	(5)	....	....
Zinc........................do....	103,305	(5)	....	....
Zinc-lead........................do....	51,504	(5)	62,744	(5)
Pumice........................do....	....	....	(1)	(1)
Sand and gravel........................do....	1,710,819	785,947	1,995,562	684,254
Silver........................troy ounces..	4,864,750	3,762,884	4,355,471	2,815,658
Stone........................short tons..	6 76,340	6 66,217	344,760	246,319
Sulfur ore........................long tons..	210	(1)	....	....
Tungsten ore (60-percent concentrates)..short tons..	2,153	(1)	1,461	(1)
Vanadium ores........................do....	....	....	7	(1)
Zinc........................do....	14,236	1,850,680	8,944	858,624
Miscellaneous 7........................	....	3,052,738	....	2,120,102
Total value, eliminating duplications........	....	38,871,816	....	27,031,281

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 No canvass.
4 Figures not available.
5 Not valued as ore; value of recoverable metal content included under the metals.
6 Exclusive of limestone, value for which is included under "Miscellaneous."
7 Includes minerals indicated by "1" and "6" above.

Mineral production of New Hampshire, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Clay products (other than pottery and refractories)		[1] $300, 219		[1] $278, 206
Diatomite ..... short tons	(2)	(2)		
Feldspar (crude) ..... long tons	28, 831	155, 925	25, 555	135, 760
Fluorspar ..... short tons	478	(2)	90	(2)
Garnet, abrasive ..... do	(2)	(2)	(2)	(2)
Gems and precious stones		(3)		(3)
Mica:				
Scrap ..... short tons	306	4, 397	(2)	(2)
Sheet ..... pounds	235, 055	20, 119	(2)	(2)
Mineral waters ..... gallons sold	(3)	(3)	(3)	(3)
Peat ..... short tons	(2)	(2)	(2)	(2)
Sand and gravel ..... do	2, 207, 922	252, 784	2, 495, 207	243, 040
Scythestones ..... do	(2)	(2)	(2)	(2)
Silica (quartz) ..... do	29	75	(2)	(2)
Stone ..... do	71, 090	442, 772	53, 790	444, 537
Miscellaneous [4]		43, 578		45, 063
Total value, eliminating duplications		1, 219, 869		1, 146, 606

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] No canvass.
[4] Includes minerals indicated by "2" above.

Mineral production of New Jersey, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Cement ..... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $6, 395, 790		[2] $5, 210, 105
Raw (sold by producers) ..... short tons	97, 978	514, 840	74, 018	383, 648
Coke ..... do	1, 015, 073	(1 3)	1, 007, 394	(1 3)
Diatomite ..... do	(1)	(1)		
Ferro-alloys ..... long tons	(1 3)	(1 3)	(1 3)	(1 3)
Iron ore ..... do	544, 635	2, 474, 087	139, 890	760, 929
Lime ..... short tons	20, 029	151, 350	19, 940	145, 076
Manganiferous residuum ..... long tons	115, 998	(1)	39, 079	(1)
Marl, greensand ..... short tons	9, 734	210, 974	6, 576	152, 000
Mineral waters ..... gallons sold	(4)	(4)	(4)	(4)
Ore (zinc) ..... short tons	590, 900	(5)	528, 595	(5)
Peat ..... do	13, 175	72, 768	12, 217	67, 550
Sand and gravel ..... do	4, 187, 492	3, 347, 390	3, 215, 406	2, 519, 575
Sand and sandstone (ground) ..... do	82, 398	430, 743	63, 968	338, 195
Sand-lime brick ..... thousands of brick	(1 2)	(1 2)	(1 2)	(1 2)
Stone ..... short tons	[6] 2, 379, 590	[6] 2, 621, 038	2, 583, 220	2, 678, 766
Zinc [7] ..... do	101, 408	13, 461, 309	85, 839	10, 891, 683
Miscellaneous [8]		8, 393, 235		7, 892, 232
Total value, elminating duplications		31, 467, 931		24, 408, 545

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metal.
[6] Exclusive of sandstone, value for which is included under "Miscellaneous."
[7] 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.
[8] Includes minerals indicated by "1" and "6" above.

Mineral production of New Mexico, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Asphalt (native) short tons	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		(1 2)		[2] $117,409
Raw (sold by producers) short tons	23,571	$114,914	13,908	37,786
Coal do	[3] 1,714,955	[4] 4,973,000	[3] 1,239,037	[4] 3,406,000
Copper pounds	64,106,000	7,756,826	40,878,000	4,006,044
Fluorspar short tons	3,324	(1)	4,066	(1)
Gems and precious stones		(5)		(5)
Gold troy ounces	41,171	1,440,985	43,050	1,506,750
Iron ore long tons	10,497	(1)	1,826	(1)
Lead short tons	6,512	768,416	4,949	455,308
Lime do	902	8,900	(1)	(1)
Manganese ore long tons	878	(1)	560	(1)
Manganiferous ore do	18,581	(1)	6,093	(1)
Mica:				
Scrap short tons	(1)	(1)	770	7,998
Sheet pounds	(1)	(1)	(1)	(1)
Mineral waters gallons sold	(5)	(5)	(5)	(5)
Molybdenum pounds	(1)	(1)	(1)	(1)
Natural gas M cubic feet	46,337,000	7,699,000	50,706,000	7,715,000
Natural gasoline gallons	38,253,000	1,493,000	49,596,000	1,415,000
Ores (crude), etc.:				
Copper short tons	3,631,454	(6)	1,904,374	(6)
Dry and siliceous (gold and silver) do	134,253	(6)	108,689	(6)
Lead do	1,853	(6)	962	(6)
Lead-copper do	396	(6)	303	(6)
Zinc do	170,510	(6)	182,822	(6)
Zinc-lead do	252,626	(6)	217,707	(6)
Petroleum barrels	38,854,000	36,600,000	35,759,000	33,250,000
Potassium salts short tons	(1)	(1)	(1)	(1)
Pumice do	(1)	(1)	(1)	(1)
Salt do	(1)	(1)	(1)	(1)
Sand and gravel do	1,686,727	974,763	(1)	(1)
Silver troy ounces	1,243,766	962,053	1,229,860	795,061
Stone short tons	713,500	302,723	[7] 698,350	[7] 438,284
Tantalum ore (columbo-tantalite) pounds	(1)	(1)	(1)	(1)
Tin (metallic equivalent) do	(1)	(1)		
Tungsten ore (60-percent concentrates) short tons	(1)	(1)	2	(1)
Zinc do	23,927	3,110,510	28,236	2,710,656
Miscellaneous [8]		6,650,655		7,707,657
Total value, eliminating duplications		72,855,745		63,568,953

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division.
[4] Value is estimated from various sources and includes selling expenses.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of sandstone, value for which is included under "Miscellaneous."
[8] Includes minerals indicated by "1" and "7" above.

Mineral production of New York, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Aluminum ... pounds	(1 2)	(1 2)	(1 2)	(1 2)
Cement ... barrels	[3] 6,106,083	[3] $8,825,785	[3] 5,720,922	[3] $7,893,270
Clay:				
Products (other than pottery and refractories)		[4] 5,435,096		[4] 4,434,918
Raw (sold by producers) ... short tons	6,465	41,020	(1)	(1)
Coke ... do	4,946,964	[2] 29,853,516	3,945,358	[2] 23,529,138
Diatomite ... do	(1)	(1)	(1)	(1)
Emery ... do	320	2,780		
Feldspar (crude) ... long tons	(1)	(1)	(1)	(1)
Ferro-alloys ... do	166,137	[2] 18,079,832	72,174	[2] 7,699,520
Garnet, abrasive ... short tons	(1)	(1)	(1)	(1)
Graphite:				
Artificial ... pounds	(1 2)	(1 2)	(1 2)	(1 2)
Crystalline ... do			(1)	(1)
Gypsum (crude) ... short tons	700,357	1,107,175	601,394	941,744
Iron:				
Ore—				
Sold to furnaces ... long tons	(1)	(1)	(1)	(1)
Sold for paint ... do	(1)	(1)	(1)	(1)
Pig ... do	2,702,072	[2] 55,789,609	1,222,832	[2] 25,450,764
Lead ... short tons	(1)	(1)	(1)	(1)
Lime ... do	55,947	438,151	39,439	302,360
Millstones		(1)		(1)
Mineral waters ... gallons sold	(5)	(5)	(5)	(5)
Natural gas ... M cubic feet	21,325,000	12,388,000	39,402,000	19,419,000
Natural gasoline ... gallons	33,000	2,000	27,000	2,000
Ores (crude), etc.:				
Zinc ... short tons	112,478	(6)	105,000	(6)
Zinc-lead ... do	352,392	(6)	280,600	(6)
Peat ... do	10,928	23,788	14,131	79,297
Petroleum ... barrels	5,478,000	14,140,000	5,045,000	9,550,000
Pyrites ... long tons	74,834	(1)	63,772	(1)
Salt ... short tons	2,084,867	5,795,551	1,717,064	5,467,077
Sand and gravel ... do	12,501,388	6,487,234	13,566,370	6,493,099
Sand-lime brick ... thousands of brick	(1 4)	(1 4)	(1 4)	(1 4)
Silica (quartz) ... short tons	(1)	(1)	(1)	(1)
Silver ... troy ounces	41,500	32,100	37,200	24,048
Slate		360,064		445,331
Stone ... short tons	10,882,980	11,244,495	10,061,250	10,527,452
Talc ... do	96,140	1,215,834	86,423	1,110,024
Zinc ... do	32,690	4,249,700	29,896	2,870,016
Miscellaneous [7]		33,773,381		30,239,794
Total value, eliminating duplications		77,665,874		73,217,430

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Exclusive of natural cement, value for which is included under "Miscellaneous."
[4] Figures obtained through cooperation with Bureau of the Census.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Includes minerals indicated by "1" and "3" above.

Mineral production of North Carolina, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Aluminum pounds	(1 2)	(1 2)	(1 2)	(1 2)
Asbestos short tons	(1)	(1)		
Bromine pounds	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[3] $3,263,898		[3] $3,324,461
Raw (sold by producers) short tons	9,832	144,639	(1)	(1)
Copper pounds	(1)	(1)	(1)	(1)
Feldspar (crude) long tons	94,595	538,567	56,795	295,800
Garnet, abrasive short tons	(1)	(1)	(1)	(1)
Gems and precious stones		(4)		(4)
Gold troy ounces	949	33,203	1,878	65,730
Kyanite short tons	(5)	(5)	(5)	(5)
Lead do			4	368
Lime do	(1)	(1)	(1)	(1)
Marl, calcareous do	(1)	(1)		
Mica:				
Scrap do	12,988	209,212	11,959	161,598
Sheet pounds	1,044,328	218,176	632,646	87,879
Mineral waters gallons sold	(4)	(4)	(4)	(4)
Olivine short tons	(5)	(5)	(5)	(5)
Ores (crude):				
Copper do	22,015	(6)	17,638	(6)
Dry and siliceous (gold and silver) do	5,209	(6)	8,219	(6)
Zinc-lead do			300	(6)
Sand and gravel do	1,824,082	539,501	2,505,180	762,827
Sand and sandstone (ground) do	(1)	(1)		
Silica (quartz) do	792	6,261	(1)	(1)
Silver troy ounces	5,538	4,284	5,500	3,556
Stone short tons	2,624,770	3,314,634	[7] 4,552,120	[7] 5,789,486
Talc and pyrophyllite do	28,250	271,013	27,460	241,337
Tantalum ore (columbo-tantalite) pounds	(1)	(1)		
Vermiculite short tons			(1)	(1)
Miscellaneous [8]		13,049,056		11,988,186
Total value, eliminating duplications		11,160,444		14,959,228

1 Value included under "Miscellaneous."
2 Value not included in total value for State.
3 Figures obtained through cooperation with Bureau of the Census.
4 No canvass.
5 Figures not available.
6 Not valued as ore; value of recoverable metal content included under the metals.
7 Exclusive of marble, value for which is included under "Miscellaneous."
8 Includes minerals indicated by "1" and "7" above.

Mineral production of North Dakota, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories)		(1 2)		(1 2)
Raw (sold by producers) short tons	(1)	(1)		
Coal do	2,250,837	$2,639,000	2,050,099	$2,380,000
Mineral waters gallons sold	(3)	(3)	(3)	(3)
Natural gas M cubic feet			71,000	27,000
Sand and gravel short tons	1,864,038	127,799	2,581,765	151,824
Stone do	44,570	15,012	20,090	5,395
Miscellaneous		91,200		89,254
Total value, eliminating duplications		2,873,011		2,653,473

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 No canvass.

Mineral production of Ohio, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Bromine .... pounds	....	....	(1)	(1)
Calcium chloride .... short tons	(1)	(1)	(1)	(1)
Cement .... barrels	[2] 5,501,769	[2] $7,771,268	[2] 5,258,603	[2] $7,094,745
Clay:				
Products (other than pottery and refractories)	....	[3] 23,327,740	....	[3] 17,679,691
Raw (sold by producers) .... short tons	452,258	1,001,343	301,945	595,190
Coal .... do	[4] 25,177,867	[5] 44,313,000	[4] 18,590,618	[5] 33,073,000
Coke .... do	6,737,881	[6] 32,185,945	3,699,995	[6] 18,413,808
Ferro-alloys .... long tons	156,653	[6] 6,229,723	65,605	[6] 2,793,907
Grindstones .... short tons	11,046	340,348	(1)	(1)
Gypsum (crude) .... do	(1)	(1)	(1)	(1)
Iron, pig .... long tons	7,724,882	[6] 167,076,855	4,186,217	[6] 85,186,824
Lime .... short tons	1,069,374	8,653,571	836,589	6,658,853
Marl, calcareous .... do	510	525	(1)	(1)
Mineral paints (zinc and lead pigments) .... do	(1 6)	(1 6)	(1 6)	(1 6)
Mineral waters .... gallons sold	(7)	(7)	(7)	(7)
Natural gas .... M cubic feet	42,783,000	19,967,000	35,257,000	17,550,000
Natural gasoline .... gallons	7,704,000	460,000	7,382,000	377,000
Peat .... short tons	3,160	26,900	2,026	18,756
Petroleum .... barrels	3,559,000	5,820,000	3,298,000	3,860,000
Rubbing stones, scythestones, and whetstones short tons	320	33,706	255	64,396
Salt .... do	1,733,875	2,625,644	1,489,270	2,562,620
Sand and gravel .... do	9,198,577	6,607,136	7,942,506	5,635,217
Sand and sandstone (ground) .... do	37,935	296,649	28,540	177,876
Silica (quartz) .... do	(1)	(1)	(1)	(1)
Stone .... do	10,306,140	9,426,808	[8] 9,888,730	[8] 8,970,552
Sulfuric acid [9] .... do	(1 6)	(1 6)	(1 6)	(1 6)
Miscellaneous [10]	....	2,618,287	....	2,098,599
Total value, eliminating duplications	....	131,025,104	....	104,812,531

[1] Value included under "Miscellaneous."
[2] Exclusive of natural cement, value for which is included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] According to Bituminous Coal Division.
[5] Value is estimated from various sources and includes selling expenses.
[6] Value not included in total value for State.
[7] No canvass.
[8] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[9] From zinc-roasting operation.
[10] Includes minerals indicated by "1", "2", and "8" above.

Mineral production of Oklahoma, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Asphalt (native)...short tons..	(1)	(1)	(1)	(1)
Cement...barrels..	(1)	(1)	(1)	(1)
Chats...short tons..	3,991,700	$410,675	1,504,900	$216,370
Clay:				
Products (other than pottery and refractories)...		[2] 583,334		[2] 572,289
Raw (sold by producers)...short tons..	(1)	(1)	(1)	(1)
Coal...do...	[3] 1,600,295	[4] 3,841,000	[3] 1,244,732	[4] 2,947,000
Gypsum (crude)...do...	159,639	266,091	141,341	231,910
Lead...do...	29,840	3,521,120	21,004	1,932,368
Lime...do...			(1)	(1)
Mineral waters...gallons sold..	(5)	(5)	(5)	(5)
Natural gas...M cubic feet..	296,260,000	32,039,000	263,164,000	27,391,000
Natural gasoline...gallons..	492,290,000	20,272,000	468,499,000	14,373,000
Ores (crude), etc.:				
Zinc...short tons..	6,644,400	(6)	4,249,000	(6)
Zinc-lead...do...	3,787,600	(6)	3,072,400	(6)
Petroleum...barrels..	228,839,000	283,500,000	174,994,000	209,500,000
Pumice...short tons..	(1)	(1)	(1)	(1)
Salt...do...	(1)	(1)	(1)	(1)
Sand and gravel...do...	934,499	414,495	823,814	354,486
Stone...do...	1,098,790	1,149,624	[7] 1,101,320	[7] 1,338,858
Sulfuric acid [8]...do...	(1 9)	(1 9)	(1 9)	(1 9)
Tripoli...do...	(1)	(1)	(1)	(1)
Zinc...do...	135,696	17,640,480	112,924	10,840,704
Miscellaneous [10]...		4,338,213		3,636,013
Total value, eliminating duplications...		367,444,222		272,860,078

[1] Value included under "Miscellaneous."
[2] Figures obtained through coöperation with Bureau of the Census.
[3] According to Bituminous Coal Division.
[4] Value is estimated from various sources and includes selling expenses. [5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of dimension limestone, value for which is included under "Miscellaneous."
[8] From zinc smelting. [9] Value not included in total value for State.
[10] Includes minerals indicated by "1" and "7" above.

Mineral production of Oregon, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Cement...barrels..	(1)	(1)	(1)	(1)
Chromite...long tons..	288	$880		
Clay:				
Products (other than pottery and refractories)...		[2] 430,884		[2] $226,312
Raw (sold by producers)...short tons..	(1)	(1)	(1)	(1)
Coal...do...	(1 3)	(1 4)	(1 3)	(1 4)
Copper...pounds..	820,000	99,220	76,000	7,448
Diatomite...short tons..	(1)	(1)	(1)	(1)
Gems and precious stones...		(5)		(5)
Gold...troy ounces..	52,662	1,843,170	81,729	2,860,515
Lead...short tons..	109	12,862	23	2,116
Lime...do...	(1)	(1)	(1)	(1)
Mercury...flasks (76 pounds)..	4,264	384,527	4,610	347,917
Mineral waters...gallons sold..	(5)	(5)	(5)	(5)
Ores (crude), etc.:				
Copper...short tons..	2,796	(6)	9	(6)
Dry and siliceous (gold and silver)...do...	74,401	(6)	74,925	(6)
Lead...do...	3	(6)	2	(6)
Lead-copper...do...	30	(6)		
Platinum and allied metals...troy ounces..	43	2,452	18	783
Pumice...short tons..	(1)	(1)	(1)	(1)
Sand and gravel...do...	2,490,872	1,074,907	2,079,026	926,661
Silica (quartz)...do...			(1)	(1)
Silver...troy ounces..	60,564	46,846	100,507	64,974
Stone...short tons..	[7] 2,010,490	[7] 1,442,916	[7] 2,355,970	[7] 2,025,335
Zinc...do...	24	3,120		
Miscellaneous [8]...		1,267,926		1,074,030
Total value, eliminating duplications...		6,609,710		7,536,091

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division.
[4] Value is estimated from various sources and includes selling expenses. [5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of granite, value for which is included under "Miscellaneous."
[8] Includes minerals indicated by "1" and "7" above.

Mineral production of Pennsylvania, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Cement ... barrels	[1] 22,952,603	[1] $31,917,831	[1] 21,082,966	[1] $28,242,913
Clay:				
Products (other than pottery and refractories)		[2] 11,713,891		[2] 8,844,284
Raw (sold by producers) ... short tons	875,869	2,245,001	422,372	1,096,795
Coal:				
Anthracite ... do	51,856,433	197,598,849	46,099,027	180,600,167
Bituminous ... do	[3] 111,002,289	[4] 228,665,000	[3] 77,704,537	[4] 160,965,000
Coke ... do	16,260,310	[5] 65,841,452	7,601,433	[5] 32,016,496
Copper [6] ... pounds	(7)	(7)	(7)	(7)
Feldspar (crude) ... long tons	(7)	(7)	(7)	(7)
Ferro-alloys ... do	428,582	[5] 42,548,365	188,697	[5] 19,624,173
Gems and precious stones		(8)		(8)
Gold [6] ... troy ounces	1,348	47,180	1,422	49,770
Iron:				
Ore—				
Sold to furnaces ... long tons	(7)	(7)	(7)	(7)
Sold for paint ... do	(7)	(7)	(7)	(7)
Pig ... do	11,036,467	[5] 239,838,942	4,684,017	[5] 101,266,844
Lime ... short tons	692,935	5,117,733	532,066	3,784,462
Mineral paints (zinc and lead pigments) ... do	(5 7)	(5 7)	(5 7)	(5 7)
Mineral waters ... gallons sold	(8)	(8)	(8)	(8)
Natural gas ... M cubic feet	115,928,000	41,842,000	76,547,000	29,544,000
Natural gasoline ... gallons	13,940,000	701,000	10,734,000	526,000
Peat ... short tons	(7)	(7)	(7)	(7)
Petroleum ... barrels	19,189,000	49,300,000	17,426,000	32,760,000
Sand and gravel ... short tons	7,715,962	7,587,013	5,721,011	5,759,996
Sand and sandstone (ground) ... do	(7)	(7)	(7)	(7)
Sand-lime brick ... thousands of brick	(2 7)	(2 7)	(2 7)	(2 7)
Silver [6] ... troy ounces	9,497	7,346	9,360	6,051
Slate		2,735,744		2,501,477
Soapstone ... short tons	(7)	(7)	(7)	(7)
Stone ... do	16,091,160	17,251,160	12,134,290	13,045,423
Sulfuric acid (60° Baumé) [9] ... do	263,341	[5] 2,456,972	221,563	[5] 2,018,439
Tripoli (rottenstone) ... do	200	4,800	164	3,608
Miscellaneous [10]		11,502,727		11,465,201
Total value, eliminating duplications		599,817,364		472,773,327

[1] Exclusive of natural cement, value for which is included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] Copper, gold, and silver were recovered from pyritiferous magnetite, which is included as iron ore produced. Bureau of Mines not at liberty to publish figures.
[7] Value included under "Miscellaneous."
[8] No canvass.
[9] From zinc smelting.
[10] Includes minerals indicated by "1" and "7" above.

Mineral production of Rhode Island, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Clay products (other than pottery and refractories)		(1 2)		(1 2)
Coke ... short tons	(1 3)	(1 3)	(1 3)	(1 3)
Lime ... do	(1)	(1)	(1)	(1)
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Sand and gravel ... short tons	370,614	$296,535	285,336	$193,172
Stone ... do	[5] 113,990	[5] 477,729	[5] 262,910	[5] 601,355
Miscellaneous [6]		1,492,693		1,343,598
Total value, eliminating duplications		862,710		911,599

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Exclusive of limestone, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "1" and "5" above.

Mineral production of South Carolina, 1937–38

Product	1937 Quantity	1937 Value	1938 Quantity	1938 Value
Barite ... short tons			(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $1,185,606		[2] $1,289,975
Raw (sold by producers) ... short tons	129,405	1,056,696	99,376	869,693
Copper ... pounds	1,500	182	(1)	(1)
Gold ... troy ounces	2,483	86,890	11,681	408,835
Kyanite ... short tons	(3)	(3)	(3)	(3)
Lime ... do	(1)	(1)		
Mica:				
Scrap ... do	(1)	(1)	(1)	(1)
Sheet ... pounds	(1)	(1)	(1)	(1)
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Ore (dry and siliceous) (gold and silver) ... short tons	21,585	(5)	59,930	(5)
Phosphate rock ... long tons			100	350
Sand and gravel ... short tons	381,185	213,488	464,312	305,299
Silver ... troy ounces	624	483	3,951	2,554
Stone ... short tons	936,880	1,462,738	[6] 987,280	[6] 1,315,999
Tin (metallic equivalent) ... pounds	90	(1)		
Miscellaneous [7]		16,242		171,329
Total value, eliminating duplications		4,022,325		4,364,034

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Figures not available.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of limestone, value for which is included under "Miscellaneous."
[7] Includes minerals indicated by "1" and "6" above.

Mineral production of South Dakota, 1937–38

Product	1937 Quantity	1937 Value	1938 Quantity	1938 Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		(1 2)		(1 2)
Raw (sold by producers) ... short tons	(1)	(1)	20,565	$155,821
Coal ... do	46,979	$63,000	48,058	65,000
Feldspar (crude) ... long tons	41,392	158,976	42,297	122,467
Gems and precious stones		(3)		(3)
Gold ... troy ounces	581,544	20,354,040	594,847	20,819,645
Gypsum (crude) ... short tons	(1)	(1)	(1)	(1)
Lime ... do	(1)	(1)	(1)	(1)
Lithium minerals ... do	1,357	36,206	(1)	(1)
Mica, scrap ... do	(1)	(1)	(1)	(1)
Mineral waters ... gallons sold	(3)	(3)	(3)	(3)
Natural gas ... M cubic feet	10,000	3,000	10,000	3,000
Ores (crude), etc.:				
Dry and siliceous (gold and silver) ... short tons	1,597,178	(4)	1,586,181	(4)
Sand and gravel ... do	3,845,432	612,552	4,677,593	627,344
Sand-lime brick ... thousands of brick	(1 2)	(1 2)	(1 2)	(1 2)
Silver ... troy ounces	139,638	108,010	162,295	104,918
Stone ... short tons	[5] 407,270	[5] 982,906	320,740	899,190
Tantalum ore (columbo-tantalite) ... pounds	13,376	11,307	33,922	33,406
Tin (metallic equivalent) ... short tons	1	1,000	1	900
Miscellaneous [6]		1,141,876		751,668
Total value, eliminating duplications		23,472,873		23,583,359

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] No canvass.
[4] Not valued as ore; value of recoverable metal content included under the metals.
[5] Exclusive of dimension sandstone, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "1" and "5" above.

Mineral production of Tennessee, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Aluminum ... pounds	([1,2])	([1,2])	([1,2])	([1,2])
Barite ... short tons	([1])	([1])	([1])	([1])
Cement ... barrels	3,013,817	$4,683,717	3,390,871	$5,063,628
Clay:				
Products (other than pottery and refractories)	------------	[3] 1,873,644	------------	[3] 1,499,108
Raw (sold by producers) ... short tons	68,499	437,345	52,356	347,035
Coal ... do	[4] 5,212,471	[5] 10,373,000	[4] 4,472,403	[5] 9,007,000
Coke ... do	104,433	[2] 519,077	81,623	[2] 508,771
Copper ... pounds	([1])	([1])	([1])	([1])
Ferro-alloys ... long tons	24,068	[2] 1,669,779	10,818	[2] 779,913
Fuller's earth ... short tons	([1])	([1])	([1])	([1])
Gold ... troy ounces	263	9,205	236	8,260
Iron:				
Ore ... long tons	28,359	89,761	([1])	([1])
Pig ... do	([1,2])	([1,2])	([1,2])	([1,2])
Sinter from copper sulfide ore ... do	([1])	([1])	([1])	([1])
Lead ... short tons	([1])	([1])	([1])	([1])
Lime ... do	157,440	909,839	162,661	901,460
Manganese ore ... long tons	3,575	99,055	4,130	77,806
Manganiferous ore ... do	902	6,475	456	3,228
Mineral waters ... gallons sold	([6])	([6])	([6])	([6])
Natural gas ... M cubic feet	17,000	6,000	6,000	2,000
Ores (crude), etc.:				
Copper ... short tons	705,000	([7])	597,620	([7])
Zinc ... do	975,956	([7])	896,700	([7])
Zinc-lead ... do	11,300	([7])	13,000	([7])
Petroleum ... barrels	35,000	35,000	([1])	([1])
Phosphate rock ... long tons	([1])	([1])	([1])	([1])
Pyrites ... do	([1])	([1])	([1])	([1])
Sand and gravel ... short tons	2,366,646	1,458,543	2,442,950	1,605,049
Silica (quartz) ... do	([1])	([1])	([1])	([1])
Silver ... troy ounces	49,057	37,946	38,333	24,781
Slate	------------	([1])	------------	([1])
Stone ... short tons	[8] 2,720,750	[8] 3,979,159	[8] 2,599,840	[8] 4,237,351
Sulfuric acid [9] ... do	([1,2])	([1,2])	([1,2])	([1,2])
Tripoli ... do	([1])	([1])	([1])	([1])
Zinc ... do	([1])	([1])	([1])	([1])
Miscellaneous [10]	------------	29,805,470	------------	32,864,794
Total value, eliminating duplications	------------	34,893,847	------------	32,428,512

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] According to Bituminous Coal Division.
[5] Value is estimated from various sources and includes selling expenses.
[6] No canvass
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Exclusive of crushed sandstone in 1937 and of dimension limestone in 1938, value for which is included under "Miscellaneous."
[9] From copper smelting.
[10] Includes minerals indicated by "1" and "8" above.

Mineral production of Texas, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Asphalt (native) short tons	96,671	$300,531	123,382	$366,030
Barite do	(1)	(1)	450	1,148
Cement barrels	6,687,719	11,488,866	7,116,545	11,885,494
Clay:				
Products (other than pottery and refractories)		[2] 3,242,832		[2] 2,549,979
Raw (sold by producers) short tons	51,486	347,244	43,857	410,498
Coal:				
Bituminous do	[3] 44,060	[4] 122,000	[3] 32,466	[4] 76,000
Lignite do	866,292	683,000	846,219	679,000
Copper pounds	320,000	38,720	32,000	3,136
Fuller's earth short tons	49,500	473,408	37,998	358,980
Gems and precious stones		(5)		(5)
Gold troy ounces	562	19,670	439	15,365
Graphite, crystalline pounds	(1)	(1)		
Gypsum (crude) short tons	280,807	313,563	246,990	260,094
Helium cubic feet	[6] 4,809,230	[6] 59,315	[6] 6,099,960	[6] 64,259
Lead short tons	395	46,610	342	31,464
Lime do	49,135	440,069	49,352	429,664
Manganese ore long tons	38	220		
Mercury flasks (76 pounds)	(1)	(1)	(1)	(1)
Mineral waters gallons sold	(5)	(5)	(5)	(5)
Natural gas M cubic feet	854,561,000	132,166,000	882,473,000	133,486,000
Natural gasoline gallons	615,281,000	24,329,000	685,920,000	19,781,000
Ores (crude), etc.:				
Copper short tons	3,949	(7)	70	(7)
Dry and siliceous (gold and silver) do	116,153	(7)	130,923	(7)
Lead do			9	(7)
Lead-copper do	43	(7)		
Petroleum barrels	510,318,000	594,500,000	475,850,000	539,150,000
Salt (sodium chloride) short tons	364,780	623,037	324,449	624,096
Sand and gravel do	7,186,717	4,058,566	7,647,981	3,966,148
Sand-lime brick thousands of brick	(1 2)	(1 2)	(1 2)	(1 2)
Silver troy ounces	1,325,660	1,025,398	1,433,008	926,389
Sodium sulfate (natural) short tons	(1)	(1)	(1)	(1)
Stone do	[8] 2,149,320	[8] 2,218,643	3,256,240	2,625,281
Sulfur long tons	2,030,315	36,545,670	1,331,014	(1)
Miscellaneous [9]		248,243		22,457,440
Total value, eliminating duplications		813,290,605		740,147,465

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division.
[4] Value is estimated from various sources and includes selling expenses.
[5] No canvass.
[6] Figures cover fiscal year ended June 30 of year stated.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Exclusive of marble, value for which is included under "Miscellaneous."
[9] Includes minerals indicated by "1" and "8" above.

Mineral production of Utah, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Arsenious oxide short tons	(1)	(1)	(1)	(1)
Asphalt (native) do	38,171	$983,628	28,650	$655,644
Bitumen, natural sulfonated do	(1)	(1)	(1)	(1)
Cement barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] 619,950		[2] 610,883
Raw (sold by producers) short tons	(1)	(1)	21,419	90,790
Coal do	[3] 3,809,476	[4] 8,648,000	[3] 2,946,951	[4] 6,875,000
Coke do	156,316	(1 5)	140,181	(1 5)
Copper pounds	411,988,000	49,850,548	216,252,000	21,192,696
Diatomite short tons	150	1,500		
Fluorspar do	431	(1)	370	(1)
Gems and precious stones		(6)		(6)
Gold troy ounces	322,759	11,296,565	200,630	7,022,050
Gypsum (crude) short tons	46,197	46,197	43,144	45,823
Iron:				
Ore long tons	188,794	(1)	169,947	(1)
Pig do	(1 5)	(1 5)	(1 5)	(1 5)
Lead short tons	89,458	10,556,044	65,657	6,040,444
Lime do	46,670	319,517	25,748	184,390
Manganese ore long tons	32	297		
Manganiferous ore do	3,436	25,771		
Mica, scrap short tons	(1)	(1)		
Molybdenum pounds	4,804,002	(1)	3,256,053	(1)
Natural gas M cubic feet	2,366,000	471,000	4,277,000	937,000
Natural gasoline gallons	367,000	19,000	623,000	28,000
Ores (crude), etc.:				
Copper short tons	23,197,017	(7)	12,032,385	(7)
Dry and siliceous (gold and silver) do	485,152	(7)	560,361	(7)
Lead do	152,691	(7)	94,883	(7)
Zinc do	173	(7)	83	(7)
Zinc-lead do	743,242	(7)	560,948	(7)
Petroleum barrels	2,000	3,000	(1)	(1)
Potassium salts short tons	(1)	(1)	(1)	(1)
Salt (sodium chloride) do	69,696	205,328	61,959	192,495
Sand and gravel do	2,345,451	1,158,387	2,775,005	1,263,722
Silver troy ounces	12,869,117	9,954,262	9,682,732	6,259,544
Sodium sulfate (natural) short tons			(1)	(1)
Stone do	453,540	315,985	[8] 709,430	[8] 390,249
Sulfur long tons	(1)	(1)	(1)	(1)
Sulfuric acid [9] short tons	(1 5)	(1 5)	(1 5)	(1 5)
Tungsten ore (60-percent concentrates) do	24	(1)	7	(1)
Uranium and vanadium ores do	(1)	(1)	1,300	88,764
Zinc do	48,001	6,240,130	33,658	3,231,168
Miscellaneous [10]		8,186,541		7,046,700
Total value, eliminating duplications		105,652,422		59,236,355

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State. [6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Exclusive of granite, value for which is included under "Miscellaneous." [9] From copper smelting.
[10] Includes minerals indicated by "1" and "8" above.

Mineral production of Vermont, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Asbestos short tons	(1)	(1)	9,348	$211,971
Clay products (other than pottery and refractories)		(1 2)		(1 2)
Lime short tons	56,585	$388,885	58,149	415,846
Mineral waters gallons sold	(3)	(3)	(3)	(3)
Sand and gravel short tons	636,710	306,892	1,103,395	530,686
Slate		1,431,798		1,729,655
Stone short tons	[4] 194,770	[4] 4,215,766	264,480	3,148,950
Talc do	41,118	384,474	35,126	329,084
Miscellaneous		314,732		73,360
Total value, eliminating duplications		7,042,547		6,439,552

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census. [3] No canvass.
[4] Exclusive of sandstone, value for which is included under "Miscellaneous."

Mineral production of Virginia, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Barite ---- short tons	(1)	(1)	----	----
Cement ---- barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)	----	[2] $2,544,596	----	[2] $1,885,876
Raw (sold by producers) ---- short tons	(1)	(1)	(1)	(1)
Coal ---- do	[3] 13,795,239	[4] 27,177,000	[3] 12,283,036	[4] 24,054,000
Coke ---- do	240,425	[5] 1,180,800	133,905	[5] 645,630
Copper ---- pounds	1,000	121	(1)	(1)
Feldspar (crude) ---- long tons	22,175	125,396	9,766	52,037
Ferro-alloys ---- do	(1 5)	(1 5)	(1 5)	(1 5)
Gold ---- troy ounces	1,396	48,863	2,943	103,005
Gypsum (crude) ---- short tons	(1)	(1)	(1)	(1)
Iron:				
Ore ---- long tons	518	(1)	(1)	(1)
Pig ---- do	(1 5)	(1 5)	(1 5)	(1 5)
Kyanite ---- short tons	(6)	(6)	(6)	(6)
Lead ---- do	(1)	(1)	(1)	(1)
Lime ---- do	192,493	1,248,479	161,687	1,014,607
Manganese ore ---- long tons	2,265	38,561	2,242	37,815
Manganiferous ore ---- do	1,170	9,663	1,670	15,502
Marl, calcareous ---- short tons	(1)	(1)	7,456	7,667
Mica:				
Scrap ---- do	(1)	(1)	2,174	22,758
Sheet ---- pounds	(1)	(1)	(1)	(1)
Millstones	----	(1)	----	(1)
Mineral waters ---- gallons sold	(7)	(7)	(7)	(7)
Ores (crude), etc.:				
Copper ---- short tons	----	----	145	(8)
Dry and siliceous (gold and silver) ---- do	10,169	(8)	17,680	(8)
Zinc-lead ---- do	577,300	(8)	631,611	(8)
Phosphate rock ---- long tons	(1)	(1)	(1)	(1)
Pyrites ---- do	(1)	(1)	(1)	(1)
Salt ---- short tons	(1)	(1)	(1)	(1)
Sand and gravel ---- do	2,398,462	1,753,865	2,796,569	2,186,111
Sand and sandstone (ground) ---- do	(1)	(1)	(1)	(1)
Silica (quartz) ---- do	369	1,063	(1)	(1)
Silver ---- troy ounces	111	86	502	325
Slate	----	355,467	----	369,060
Stone [9] ---- short tons	[10] 5,061,660	[10] 5,399,137	5,474,690	5,606,470
Talc and ground soapstone [9] ---- do	(1)	(1)	(1)	(1)
Titanium minerals:				
Ilmenite ---- do	(1)	(1)	(1)	(1)
Rutile ---- do	(1)	(1)	(1)	(1)
Zinc ---- do	(1)	(1)	(1)	(1)
Miscellaneous [11]	----	11,137,832	----	9,264,842
Total value, eliminating duplications	----	46,019,085	----	42,370,169

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] Figures not available.
[7] No canvass.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Soapstone used as dimension stone included in figures for stone.
[10] Exclusive of marble, value for which is included under "Miscellaneous."
[11] Includes minerals indicated by "1" and "10" above.

Mineral production of Washington, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Antimony ore ... short tons	(1)	(1)		
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		2 $1,028,804		2 $955,294
Raw (sold by producers) ... short tons	49,858	91,279	38,993	62,274
Coal ... do	3 2,001,449	4 6,325,000	3 1,566,973	4 4,939,000
Coke ... do	14,656	5 87,936		
Copper ... pounds	128,000	15,488	12,034,000	1,179,332
Diatomite ... short tons	1,932	32,803	1,072	16,684
Gems and precious stones		(6)		(6)
Gold ... troy ounces	36,310	1,270,850	74,175	2,596,125
Iron ore ... long tons	10,010	32,859	3,333	(1)
Lead ... short tons	2,830	333,940	4,284	394,128
Lime ... do	65,272	647,692	34,025	348,332
Magnesite ... do	(1)	(1)	(1)	(1)
Magnesium sulfate (natural) ... pounds	(1)	(1)	(1)	(1)
Mercury ... flasks (76 pounds)	(1)	(1)	(1)	(1)
Mineral waters ... gallons sold	(6)	(6)	(6)	(6)
Molybdenum ... pounds			4,380	(1)
Natural gas ... M cubic feet	143,000	100,000	117,000	91,000
Olivine ... short tons	(7)	(7)	(7)	(7)
Ores (crude), etc.:				
Copper ... do	6,631	(8)	373,120	(8)
Dry and siliceous (gold and silver) ... do	181,604	(8)	278,847	(8)
Lead ... do	445	(8)	538	(8)
Zinc-lead ... do	106,146	(8)	249,184	(8)
Peat ... do	(1)	(1)	543	7,630
Pulpstones ... do	(1)	(1)	(1)	(1)
Sand and gravel ... do	9,376,644	6,818,154	6,015,812	2,861,309
Sand-lime brick ... thousands of brick	(1 2)	(1 2)	(1 2)	(1 2)
Silver ... troy ounces	126,304	97,696	380,938	246,263
Stone ... short tons	2,027,420	1,909,604	9 2,321,210	9 1,849,051
Talc ... do	406	6,754	174	894
Tungsten ore (60-percent concentrates) ... do	64	(1)	303	(1)
Zinc ... do	4,116	535,080	11,402	1,094,592
Miscellaneous 10		7,412,254		4,525,096
Total value, eliminating duplications		26,658,257		21,167,004

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 According to Bituminous Coal Division.
4 Value is estimated from various sources and includes selling expenses.
5 Value not included in total value for State.
6 No canvass.
7 Figures not available.
8 Not valued as ore; value of recoverable metal content included under the metals.
9 Exclusive of marble, value for which is included under "Miscellaneous."
10 Includes minerals indicated by "1" and "9" above.

Mineral production of West Virginia, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Bromine pounds	816,375	$132,494	830,346	$134,021
Calcium chloride short tons	11,023	78,754	11,803	77,268
Cement barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] 2,675,183		[2] 2,114,974
Raw (sold by producers) short tons	48,619	94,413	31,658	68,687
Coal do	[3] 118,646,343	[4] 223,055,000	[3] 93,288,172	[4] 179,356,000
Coke do	2,097,380	[5] 7,054,186	1,500,247	[5] 4,820,199
Ferro-alloys long tons	(1 5)	(1 5)	(1 5)	(1 5)
Grindstones and pulpstones short tons	3,241	217,929	1,460	82,879
Iron, pig long tons	685,086	(1 5)	496,905	(1 5)
Lime short tons	250,205	1,617,040	163,064	1,003,559
Magnesium salts (natural) pounds	(1)	(1)		
Manganese ore long tons	1,800	36,461	163	2,470
Marl, calcareous short tons	(1)	(1)	(1)	(1)
Mineral waters gallons sold	(6)	(6)	(6)	(6)
Natural gas M cubic feet	149,084,000	58,639,000	134,342,000	55,910,000
Natural gasoline gallons	50,379,000	2,528,000	50,398,000	2,063,000
Petroleum barrels	3,845,000	8,800,000	3,684,000	5,600,000
Salt short tons	128,715	713,421	129,568	721,490
Sand and gravel do	2,407,911	2,349,356	1,654,546	1,803,474
Sand and sandstone (ground) do	(1)	(1)	(1)	(1)
Stone do	[7] 3,510,040	[7] 3,696,556	[7] 3,194,980	[7] 4,391,563
Sulfuric acid [8] do	(1 5)	(1 5)	(1 5)	(1 5)
Miscellaneous [9]		23,041,891		15,504,037
Total value, eliminating duplications		306,590,947		254,995,309

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State. [6] No canvass.
[7] Exclusive of dimension sandstone in 1937 and of unclassified stone in 1938, value for which is included under "Miscellaneous." [8] From zinc smelting.
[9] Includes minerals indicated by "1" and "7" above.

Mineral production of Wisconsin, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Cement barrels	(1)	(1)	(1)	(1)
Clay products (other than pottery and refractories)		[2] $557,152		[2] $406,811
Coke short tons	(1 3)	(1 3)	(1 3)	(1 3)
Iron ore—				
Sold to furnaces long tons	1,419,810	4,473,942	625,378	1,886,477
Sold for paint do	500	(1)		
Lead short tons	1,091	128,738	320	29,440
Lime do	59,536	508,536	55,993	483,111
Marl, calcareous do	9,460	2,914	(1)	(1)
Mineral waters gallons sold	(4)	(4)	(4)	(4)
Ores (crude), etc.:				
Zinc short tons	5,000	(5)		
Zinc-lead do	280,000	(5)	58,700	(5)
Pyrites long tons	(1)	(1)	(1)	(1)
Sand and gravel short tons	7,531,031	3,291,944	6,273,424	2,799,926
Sand and sandstone (ground) do	(1)	(1)	(1)	(1)
Sand-lime brick thousands of brick	(1 2)	(1 2)	(1 2)	(1 2)
Silica (quartz) short tons			(1)	(1)
Stone do	3,331,670	4,284,003	3,097,230	3,880,935
Sulfuric acid [6] do	(1 3)	(1 3)	(1 3)	(1 3)
Zinc do	6,938	901,940	2,073	199,008
Miscellaneous [7]		6,201,127		5,111,565
Total value, eliminating duplications		15,239,524		10,636,741

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State. [4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] From zinc-roasting operation.
[7] Includes minerals indicated by "1" above.

Mineral production of Wyoming, 1937–38

Product	1937		1938	
	Quantity	Value	Quantity	Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)	...	(1 2)	...	(1 2)
Raw (sold by producers) ... short tons	67,958	$659,111	58,911	$530,834
Coal ... do	[3] 5,918,359	[4] 11,600,000	[3] 5,203,877	[4] 9,851,000
Feldspar (crude) ... long tons	...	...	1,168	4,343
Gems and precious stones	...	(5)	...	(5)
Gold ... troy ounces	1,776	62,160	798	27,930
Gypsum (crude) ... short tons	(1)	(1)	(1)	(1)
Iron ore ... long tons	707,907	(1)	275,995	(1)
Mica, scrap ... short tons	...	...	(1)	(1)
Mineral waters ... gallons sold	(5)	(5)	(5)	(5)
Natural gas ... M cubic feet	31,023,000	4,997,000	26,678,000	4,853,000
Natural gasoline ... gallons	33,548,000	1,718,000	30,024,000	1,364,000
Ores (crude), etc.:				
Dry and siliceous (gold and silver) .. short tons	17	(6)	581	(6)
Petroleum ... barrels	19,166,000	18,860,000	19,022,000	18,000,000
Potassium salts ... short tons	(1)	(1)	(1)	(1)
Sand and gravel ... do	2,438,367	886,901	1,893,612	781,283
Silver ... troy ounces	203	157	328	212
Sodium sulfate (natural) ... short tons	(1)	(1)	(1)	(1)
Stone ... do	[7] 342,710	[7] 287,957	252,170	346,018
Tantalum ore (columbo-tantalite) ... pounds	...	...	(1)	(1)
Tin (metallic equivalent) ... short tons	2	2,000	...	...
Vermiculite ... do	(1)	(1)	(1)	(1)
Miscellaneous [8]	...	2,014,622	...	1,605,743
Total value, eliminating duplications	...	41,087,908	...	37,364,363

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to Bituminous Coal Division.
[4] Value is estimated from various sources and includes selling expenses.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of basalt, value for which is included under "Miscellaneous."
[8] Includes minerals indicated by "1" and "7" above.

PART II. METALS

GOLD AND SILVER

By Chas. W. Henderson

SUMMARY OUTLINE

The steadily increasing gold production of the world is of especial significance to the United States in view of the large accumulation of that metal in this country, amounting, according to the Federal Reserve Bulletin (May 1940) to 61 percent of the total known world monetary supply at the end of 1939 and to 64 percent by April 24, 1940. Countries at war in Europe continued to ship large quantities of gold to the United States in May 1940, and by June 1 stocks had risen to approximately 66 percent of the world total. On May 3, 1940, the Secretary of the Treasury in a public address told the National Institute of Government that the continued acceptance of gold by the United States Treasury is "the only sound course of action open to us."

The mine production of recoverable gold in the United States (Territories included) in 1939 totaled 5,672,485 fine ounces, a 10-percent increase over the previous record high annual output in 1938. Although final figures on the total output of gold in the world in 1939 are not yet available, preliminary data indicate that the world output increased 6 percent over 1938 to approximately 39,818,000 fine ounces, the highest in history. The principal gold-producing countries in 1939 were, in order, the Union of South Africa, United States (including Territories), U. S. S. R. and Canada; these four countries produced approximately 72 percent of the total world output of gold. Silver production in the United States in 1939 was 65,565,024 fine ounces, a 4-percent increase over 1938. Approximately 69 percent of the total world output of silver in 1939—estimated at 265,977,000 ounces—came from Mexico, United States, Canada, and Peru, listed in order of quantity produced.

DOMESTIC REFINERY PRODUCTION

The figures in the following table were obtained through cooperation between the United States Bureau of the Mint and the Bureau of Mines and were agreed upon after conference and adjustment between the two Bureaus.

The State totals are based upon bullion deposits in the United States mints and assay offices and upon returns to the Bureau of the Mint from smelting and refining companies. The State distribution is adjusted further by the Bureau of Mines from its geographical records of sources and production, both historical and current, from the producing mines and is tabulated for the mine reports discussed later. The data for the total production and in part for the distribution are obtained from records of (1) the unrefined domestic gold and silver deposited in the United States mints and assay offices; (2) the domestic gold and silver in fine bars reported by private refineries, supplemented by data of content of unrefined mattes, blister copper, copper anodes, and lead bullion; and (3) the unrefined domestic gold and silver contained in ore and matte exported for reduction. The last item is small.

Gold and silver produced in the United States, 1935–39, and approximate distribution of source, by States and Territories, in 1939

[Refinery figures supplied by U. S. Bureau of the Mint]

State or Territory	Gold [1]		Silver [2]	
	Fine ounces	Value	Fine ounces	Value
1935	3,609,283	$126,324,900	45,924,454	$33,008,201
1936	4,357,394	152,508,800	63,812,176	49,422,530
1937	4,804,540	168,158,900	71,941,794	55,646,978
1938	5,089,811	178,143,400	62,665,335	40,510,924
1939:				
Alabama	28	1,000	54	36
Alaska	671,157	23,490,500	298,146	202,377
Arizona	314,572	11,010,000	7,436,417	5,047,742
California	1,424,719	49,865,200	2,604,191	1,767,691
Colorado	370,934	12,982,700	8,205,703	5,569,932
Georgia	643	22,500	225	153
Idaho	115,183	4,031,400	17,239,334	11,701,835
Illinois			154	104
Indiana	3	100		
Maryland	72	2,500	2	1
Michigan			102,187	69,363
Missouri			244,074	165,674
Montana	256,437	8,975,300	8,927,157	6,059,638
Nevada	351,306	12,295,700	4,516,605	3,065,813
New Mexico	36,348	1,272,200	1,262,420	856,914
New York			44,232	30,024
North Carolina	520	18,200	3,639	2,470
Oregon	91,346	3,197,100	110,956	75,315
Pennsylvania	1,911	66,900	14,349	9,740
Philippine Islands	990,569	34,669,900	1,247,541	846,815
Puerto Rico	35	1,200	4	3
South Carolina	13,834	484,200	5,454	3,702
South Dakota	617,634	21,617,200	171,277	116,260
Tennessee	166	5,800	32,170	21,836
Texas	340	11,900	1,380,329	936,949
Utah	266,634	9,332,200	10,843,772	7,360,611
Virginia	363	12,700	1,460	991
Washington	85,820	3,003,700	427,519	290,194
Wyoming	597	20,900	142	96
	5,611,171	196,391,000	65,119,513	44,202,279

[1] Gold valued at $35 per fine ounce.
[2] Silver valued as follows: 1934, $0.646+ per fine ounce; 1935, $0.71875; 1936, $0.7745; 1937, $0.7735; 1938, $0.646+; 1939, $0.678787+.

The quantity of gold reclaimed in 1938 from old jewelry, dental waste, scrap, and other material received at private refineries and the United States mints and assay offices was 870,881 ounces and that sold for industrial use 861,622 ounces, the difference (9,259 ounces) representing the net return from the arts and industries during the year. From 1932 to 1936, inclusive, the quantity of gold returned from industrial to monetary use exceeded that issued for industrial use by 3,367,400 ounces; in 1937, however, the quantity absorbed by the industries was 91,840 ounces more than that returned to monetary use. Secondary silver recovered in 1938 from silverware, photographic film, and other sources totaled 18,438,847 ounces and that issued for the industrial arts 38,620,473 ounces, indicating that 20,181,626 fine ounces of new silver were required for industry.

Gold and silver produced in the United States, 1792–1939

[From Report of the Director of the Mint. The estimate for 1792-1873 is by R. W. Raymond, commissioner of mining statistics, and since then by the Director of the Mint]

Period	Gold		Silver	
	Fine ounces	Value [1]	Fine ounces	Value [2]
1792–1847	1, 187, 170	$24, 537, 000	309, 500	$404, 500
1848–72	58, 279, 778	1, 204, 750, 000	118, 568, 200	157, 749, 900
1873–1939	195, 978, 705	4, 431, 842, 000	3, 468, 509, 931	2, 614, 401, 705
	255, 445, 653	5, 661, 129, 000	3, 587, 387, 631	2, 772, 556, 105

[1] Gold valued in 1934 and thereafter at $35 per fine ounce; prior thereto at $20.67+ per fine ounce. Dollar figures are rounded.
[2] Silver valued in 1934 and thereafter at Government's average buying price for domestic product: In 1934 and 1938 at $0.64+ per fine ounce, in 1935 at $0.71875, in 1936 at $0.7745, in 1937 at $0.7735, and in 1939 at $0.678787+.

The average commercial value per fine ounce of silver for the total recorded domestic production is $0.773.

PRICES OF GOLD AND SILVER

Gold.—Under the Gold Reserve Act of 1934 the value of gold was fixed by Presidential proclamation on January 31, 1934, at $35 per fine troy ounce and has remained at that figure through 1939. From January 18, 1837,[1] through 1932, the price was $20.67+ per ounce, and in 1933 the legal coinage value was continued at $20.67+. The average weighted price per fine ounce in 1933, as computed by the Bureau of Mines, was $25.56 and in 1934, $34.95. A complete account of regulations pertaining to gold and silver in 1933–34 is given in the chapter on Gold and Silver in Minerals Yearbook, 1934 (pp. 25–46), issued by the Bureau of Mines.

Silver.—The Government price for newly mined domestic silver was maintained throughout 1938 and to June 30, 1939, at $0.64646464 per fine ounce. The act of Congress approved July 6, 1939, fixed the price of domestic silver mined after July 1, 1939, at $0.711+ per ounce. The annual average prices [2] used for domestic silver from

[1] For Congressional acts with reference to coinage from Apr. 2, 1792, to Jan. 31, 1934, see Minerals Yearbook, 1937, p. 113; for gold prices in London, 1931–36, p. 114.
[2] For highest, lowest, and average price of silver in New York, 1874-1935, see Minerals Yearbook, 1937, p. 115; for ratio of silver to gold, 1687–1935, p. 121.

1932 to 1939 are as follows: 1932, $0.282; 1933, $0.350; 1934, $0.64646464; 1935, $0.71875; 1936, $0.7745; 1937, $0.7735; 1938, $0.64646464; 1939, $0.67878787.

The following table, copied from the Annual Report of the Director of the Mint for the Fiscal Year Ended June 30, 1939, shows the price of silver in London and in New York in 1938 and the first half of 1939.

Price of silver in London and in New York, 1938–39

[From the Report of the Director of the Mint]

Month	London price per ounce, 0.925 fine			Average monthly exchange, New York on London	United States equivalent, per fine ounce, of London price, at current rate of exchange	Average monthly New York price of fine bar silver, per ounce (mean of bid and asked quotations)
	Highest	Lowest	Average			
1938	*Pence*	*Pence*	*Pence*	*Dollars*	*Dollar*	*Dollar*
January	20⅜	19¼	19.8950	4.9998	0.44807	0.45062
February	20⅜	19 15/16	20.1588	5.0180	.45567	.45062
March	20 9/16	18⅜	20.0879	4.9845	.45103	.44758
April	19⅛	18 9/16	18.8804	4.9812	.42338	.43062
May	18 15/16	18⅝	18.7307	4.9673	.41898	.43062
June	19 1/16	18 11/16	18.9450	4.9580	.42315	.43062
July	19 13/16	18 15/16	19.3557	4.9291	.42995	.43062
August	19 9/16	19⅛	19.3894	4.8808	.42617	.43062
September	19 11/16	18¾	19.3005	4.8038	.41779	.43062
October	19 13/16	19 5/16	19.6130	4.7685	.42115	.43062
November	20¼	19½	19.8341	4.7075	.42082	.43062
December	20¼	19 15/16	20.0825	4.6703	.42251	.43062
1939						
January	21⅛	19 15/16	20.3050	4.6694	.42706	.43062
February	20¾	19 15/16	20.3698	4.6857	.42963	.43062
March	20⅝	19⅞	20.2801	4.6854	.42802	.43062
April	20 3/16	19 15/16	20.0312	4.6805	.42233	.43062
May	20⅜	19 15/16	20.1226	4.6813	.42442	.43062
June	20	18	19.5048	4.6824	.41140	.42267
Average, calendar year 1938			19.5256	4.8894	.42989	.43537
Average, fiscal year 1938–39			19.8491	4.7371	.42344	.42996

UNITED STATES AND WORLD MONETARY STOCKS

The following tables show, respectively, the value of the gold and silver held by the United States Treasury as of June 1, 1940, and of the gold reserves of the central banks and governments as of March 31, 1940.

Daily statement of current assets and liabilities of the United States Treasury, June 1, 1940

GOLD

Assets		Liabilities		
Gold (oz. 548,825,961.7)	$19,208,908,661.06	Gold certificates:		
		Outstanding (outside of Treasury)		$2,882,523,469.00
		Gold certificate fund—Board of Governors, Federal Reserve System		14,168,032,390.77
		Redemption fund—Federal Reserve notes		11,019,001.14
		Gold reserve		156,039,430.93
		NOTE.—Reserve against $346,681,016 of United States notes and $1,163,022 of Treasury notes of 1890 outstanding. Treasury notes of 1890 are also secured by silver dollars in the Treasury.		
		Exchange stabilization fund		1,800,000,000.00
				19,017,614,291.84
		Gold in general fund:		
		Balance of increment resulting from reduction in the weight of the gold dollar	$142,756,207.64	
		In working balance	48,538,161.58	
				191,294,369.22
Total	19,208,908,661.06	Total		19,208,908,661.06

SILVER

Silver (oz. 1,041,985,993.2)	$1,347,214,213.51	Silver certificates outstanding	$1,819,657,393.00
Silver dollars (oz. 385,418,083.3)	498,318,330.00	Treasury notes of 1890 outstanding	1,163,022.00
		Silver in general fund	24,712,128.51
Total	1,845,532,543.51	Total	1,845,532,543.51

Gold reserves of central banks and governments as of March 31, 1940 [1]

Country	Millions of dollars	Country	Millions of dollars
United States [2]	18,433	Japan	164
United Kingdom [2]	[2] 1	Rumania	153
France [2]	2,000	Italy	144
Netherlands	690	Turkey	92
Belgium [2]	609	Java	90
Switzerland [3]	529	Norway	84
Spain	525	Portugal	69
Argentine	466	Uruguay	68
British India	274	Total (20 countries)	25,088
South Africa	268	Other countries (32)	645
Sweden	218		
Canada	211	Total 52 countries [4]	25,733

[1] Data from Federal Reserve Board. Figures for some countries are preliminary.
[2] Stabilization funds and central reserves in some countries not reported. The following are reported at infrequent intervals or on delayed basis: United Kingdom, Exchange Equilization Account (reported September 1939) held $2,690,000,000; France, Exchange Stabilization Fund and Rentes Fund (May 1939), $477,000,000; United States, Exchange Stabilization Fund (December 1939), $156,000,000; and Belgium, Treasury (December 1939), $17,000,000.
[3] National Bank $519,000,000; B. I. S. $10,000,000.
[4] Stabilization funds upon basis of last reports raise total reserves of the 52 countries to approximately $29,073,000,000.

IMPORTS AND EXPORTS[3]

Value of gold and silver imported into and exported from the United States, 1938–39, by classes

	Imports	Exports	Excess of imports over exports
1938			
Gold:			
Contained in ore and base bullion	$77,627,999	$882,874	$76,745,125
Bullion refined	1,885,628,425	5,006,017	1,880,622,408
United States coin	291		291
Foreign coin	16,200,804	13	16,200,791
	1,979,457,519	5,888,904	1,973,568,615
Silver:			
Contained in ore and base bullion	23,560,515	680,726	22,879,789
Bullion refined	82,711,006	790,293	81,920,713
United States coin	337,549	55	337,494
Foreign coin	123,922,067	5,611,079	118,310,988
	230,531,137	7,082,153	223,448,984
1939			
Gold:			
Contained in ore and base bullion	92,763,736	340,957	92,422,779
Bullion refined	3,476,102,792	167,106	3,475,935,686
United States coin	752		752
Foreign coin	5,791,560		5,791,560
	3,574,658,840	508,063	3,574,150,777
Silver:			
Contained in ore and base bullion	23,311,788	185,996	23,125,792
Bullion refined	54,598,730	8,312,856	46,285,874
United States coin	294,328	66,738	227,590
Foreign coin	7,102,249	6,064,202	1,038,047
	85,307,095	14,629,792	70,677,303

DOMESTIC SUPPLY

The domestic supply of new gold comes chiefly from dry and siliceous ore and from placer gravel. These two sources yielded 90 percent of the domestic gold (excluding Philippine Islands and Puerto Rico) in 1915, 80 percent in 1930, 87 percent in 1931, 93 percent in 1932, 1933, and 1934, 91 percent in 1935, 88 percent in 1936, 85 percent in 1937, 90 percent in 1938, and 88 percent in 1939. The proportionate output of gold from copper ore was 7 percent in 1915, 16 percent in 1930, 10 percent in 1931, 4 percent in 1932, 5 percent in 1933 and 1934, 7 percent in 1935, 10 percent in 1936, 12 percent in 1937, 8 percent in 1938, and 10 percent in 1939. These sources represented 96 to 98 percent of the gold supply in 1915 and 1930–39.

In 1915 dry and siliceous ore yielded 36 percent of the total silver; copper ore, 26 percent; lead ore, 27 percent; and zinc-lead ore, 9 percent. In 1938 dry and siliceous ores yielded 52 percent and in 1939, 47 percent; copper ore, 26 and 29 percent; lead ore, 5 and 5 percent; and zinc-lead ore, 17 and 19 percent. The rounded percentage figures for both 1938 and 1939 include some silver (less than 0.8 percent in each instance) from zinc ore, mixed base-metal ores, and placer gravel.

[3] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

WORLD PRODUCTION OF GOLD AND SILVER

According to the Bureau of the Mint the world output of gold and silver from 1493 to 1938 is 1,294,974,282 fine ounces of gold valued at $29,103,425,879 and 16,714,819,121 fine ounces of silver valued at $15,254,018,861.

The following tables show the world output of gold and silver from 1935 to 1939.

World production of gold, 1935–39, by countries, in fine ounces [1]

[Compiled by R. B. Miller]

Country	1935	1936	1937	1938	1939
North America:					
United States:					
Continental [2]	3,163,166	3,759,645	4,112,160	4,245,368	4,620,567
Puerto Rico	63	483	17	9	35
Canada	3,284,890	3,748,028	4,096,213	4,725,117	5,095,176
Central America and West Indies:					
Costa Rica	10,311	12,625	16,920	17,994	13,261
Cuba	(3)	[4] 2,140	3,707	3,889	3,851
Dominican Republic (exports)	7,553	8,901	7,102	5,275	6,304
Guatemala	4,221	1,824	4,180	5,466	3,821
Honduras	13,286	20,966	24,170	21,879	[4] 27,000
Nicaragua	16,193	23,077	24,242	44,301	100,182
Panama	5,705	12,651	5,098	4,867	2,736
Salvador [5]	11,837	15,071	15,310	12,065	16,424
Other countries [4]	48,700	42,700	39,300	48,300	41,400
Mexico	682,335	753,967	846,400	923,819	944,139
Newfoundland	12,728	16,114	22,470	24,246	20,000
	7,278,000	8,418,000	9,217,000	10,083,000	10,895,000
South America:					
Argentina	9,902	12,217	10,449	8,423	(3)
Bolivia [6]	18,158	13,833	14,251	9,255	7,884
Brazil [6]	262,414	223,351	203,643	216,630	290,096
Chile	265,944	248,799	272,704	294,001	302,667
Colombia	328,999	389,495	442,222	520,717	570,017
Ecuador	71,512	78,685	59,500	74,042	85,352
Guiana:					
British	30,488	32,234	35,993	38,482	38,473
Dutch (Surinam)	11,349	14,258	12,756	14,154	14,812
French	47,390	45,558	47,422	40,638	37,606
Peru	110,962	152,409	205,350	260,326	272,362
Uruguay	----------	----------	----------	657	1,608
Venezuela	112,390	109,996	116,519	114,985	146,608
	1,269,508	1,320,835	1,420,809	1,592,310	1,776,000
Europe:					
Bulgaria	17	----------	50	200	(3)
Czechoslovakia	16,575	16,248	9,930	10,000	(3)
Finland	4,630	4,919	4,822	3,858	(3)
France	91,598	85,682	66,423	87,354	(3)
Germany	5,958	7,584	8,028	8,650	(3)
Austria	----------	----------	140		
Hungary	1,479	836	5,159	5,655	(3)
Italy	2,894	3,697	3,103	5,016	(3)
Norway	231	42	96	55	(3)
Portugal	----------	3,282	4,366	6,186	(3)
Rumania	150,176	160,014	277,043	160,882	211,496
Spain	4,823	4,019	(3)	(3)	(3)
Sweden	180,559	158,342	193,226	234,122	(3)
Switzerland	804	965	964	1,125	1,447
U. S. S. R. [4]	4,547,000	5,327,000	5,359,000	5,236,000	(3)
United Kingdom	148	1	60	2,428	(3)
Yugoslavia	72,950	84,106	87,578	78,318	92,000
	5,080,000	5,857,000	6,024,000	5,844,000	5,922,000

See footnotes at end of table.

World production of gold, 1935–39, by countries, in fine ounces—Continued

Country	1935	1936	1937	1938	1939
Asia:					
Burma	1,483	1,439	1,004	1,209	(3)
China	(3)	(3)	(3)	(3)	(3)
Manchuria [6]	(3)	119,150	118,829	(3)	(3)
Chosen	472,948	562,316	734,585	948,447	(3)
Cyprus (exports)	6,872	20,991	23,650	29,245	(3)
India, British	326,170	331,946	330,744	321,138	318,000
Indochina	9,774	9,002	9,870	8,745	8,070
Japan	588,161	713,685	723,375	[4] 740,000	(3)
Malay States:					
Federated	29,771	37,779	33,828	40,209	40,283
Straits Settlements	----------	----------	----------	5	8
Unfederated	276	761	519	581	858
Netherland India	68,256	71,664	55,621	76,302	(3)
Philippine Islands	451,814	597,266	716,967	903,265	999,408
Sarawak	28,549	23,372	19,214	18,520	17,261
Siam	10,337	11,470	13,768	13,804	(3)
Taiwan	37,217	41,608	123,073	145,000	(3)
Turkey	----------	----------	----------	514	(3)
	2,187,000	2,697,000	3,006,000	3,347,000	3,545,000
Africa:					
Bechuanaland	11,419	16,746	17,577	19,111	17,219
Belgian Congo	370,409	389,281	419,664	455,264	494,642
Camerouns, French	2,829	11,027	14,211	15,542	(3)
Egypt	58	278	1,226	2,162	3,877
Eritrea	4,286	1,608	(3)	(3)	(3)
Ethiopia	13,736	25,700	(3)	(3)	(3)
French Equatorial Africa	27,971	22,088	21,490	40,028	(3)
French West Africa (exports)	125,677	114,424	128,346	127,220	(3)
Gold Coast	358,835	428,144	559,212	674,927	782,271
Kenya Colony	23,009	38,463	54,774	70,500	77,000
Liberia	965	[7] 1,567	2,457	1,902	6,536
Madagascar	15,465	15,111	13,471	13,770	(3)
Morocco, French	780	1,500	4,630	1,410	(3)
Nigeria	38,962	33,364	26,466	24,815	25,794
Nyasaland	127	30	2	5	(3)
Portuguese East Africa	6,379	8,223	11,129	9,609	11,064
Rhodesia:					
Northern	1,647	4,452	4,228	1,113	4,643
Southern	726,281	797,061	804,219	814,078	795,613
Sierra Leone	30,753	37,966	35,717	30,012	33,657
South-West Africa	3,206	4,065	2,804	1,796	1,619
Sudan	8,550	7,659	7,388	8,866	7,510
Swaziland	314	276	2,410	1,246	983
Tanganyika	52,182	69,675	75,281	81,857	[4] 150,000
Uganda	5,651	13,231	16,947	20,502	15,115
Union of South Africa	10,773,991	11,336,214	11,734,575	12,161,392	12,821,507
	12,603,000	13,378,000	13,972,000	14,609,000	15,483,000
Oceania:					
Australia:					
New South Wales	50,102	60,739	68,607	88,707	87,189
Northern Territory	9,272	7,705	11,563	12,378	16,586
Queensland	102,990	121,174	127,281	151,432	147,248
South Australia	7,333	7,681	6,962	5,292	3,930
Victoria	87,609	113,940	145,799	144,243	156,522
Western Australia	646,150	852,422	1,000,647	1,167,791	1,214,238
Fiji	6,728	16,955	24,917	92,362	110,000
New Guinea	184,009	220,974	217,152	236,133	241,296
New Zealand	165,277	164,575	168,487	152,050	172,062
Papua	17,012	20,719	22,153	33,249	28,164
Tasmania	8,343	17,600	20,276	22,200	19,984
	1,284,825	1,604,484	1,813,844	2,105,837	2,197,000
	29,702,000	33,275,000	35,454,000	37,581,000	39,818,000

1 Prepared with the cooperation of the Office of the Director of the Mint. All figures for 1939 preliminary and subject to revision. No official statistics are issued by the Government of U. S. S. R., consequently figures released by the various authorities vary widely and are irreconcilable. This table records only official production and export figures. In some countries accurate figures are not possible to obtain, due to clandestine trade in gold.
2 Refinery production.
3 Data not available. Estimate included in total.
4 Approximate production.
5 Imports into the United States.
6 Purchases by the State Central Bank.
7 Exports.

World production of silver, 1935–39, by countries, in fine ounces [1]

Country	1935	1936	1937	1938	1939
North America:					
United States [2]	45,612,926	63,350,774	71,298,930	61,688,834	63,871,972
Canada	16,618,558	18,334,487	22,977,751	22,219,195	23,116,861
Central America and West Indies:					
Honduras	2,641,346	3,104,507	3,210,337	3,335,070	4,118,864
Other countries [3]	859,000	495,000	390,000	965,000	681,000
Mexico	75,589,199	77,463,901	84,680,875	81,018,809	75,870,575
Newfoundland	1,123,997	1,249,472	1,447,637	1,645,590	1,421,060
	142,445,000	163,998,000	184,006,000	170,872,000	169,080,000
South America:					
Argentina	49,994	512,322	2,122,000	2,636,361	(4)
Bolivia	7,951,000	10,723,333	9,454,022	6,373,660	7,241,312
Brazil	20,833	23,887	25,238	25,585	27,075
Chile	1,298,755	1,431,383	1,854,649	1,414,086	1,327,422
Colombia	132,965	151,501	167,971	192,880	242,625
Ecuador	80,658	96,310	98,500	89,111	103,331
Guiana, British	4,010	4,240	4,740	5,060	(4)
Peru	17,104,300	19,915,101	17,453,331	20,552,816	18,802,075
	26,643,000	32,858,000	31,180,000	31,290,000	30,749,000
Europe:					
Bulgaria (estimated)	(4)	2,200	6,500	13,000	(4)
Czechoslovakia	1,329,734	1,088,718	1,103,444	1,190,326	(4)
Finland	(4)	(4)	57,900	57,900	(4)
France	569,615	476,860	563,860	[3] 565,000	(4)
Germany	6,257,788	6,541,551	6,774,161	7,010,000	(4)
Austria	11,863	29,061	9,774		
Greece [3]	217,906	310,000	375,000	335,000	(4)
Hungary	6,783	3,783	50,965	46,632	(4)
Italy	453,283	616,000	715,000	812,481	(4)
Norway	266,851	228,270	282,904	250,776	(4)
Poland	32,311	60,507	64,237	62,244	(4)
Portugal	----------	12,905	11,337	16,742	(4)
Rumania	471,876	594,757	615,944	819,876	(4)
Spain	861,640	[5] 900,000	[5] 600,000	(4)	(4)
Sweden	835,791	939,541	946,261	1,123,861	(4)
U. S. S. R.[3]	4,850,000	6,590,000	7,230,000	8,022,000	(4)
United Kingdom	92,851	76,872	71,439	108,985	(4)
Yugoslavia	1,753,534	1,948,174	2,242,546	2,524,123	2,570,000
	18,068,000	20,474,000	21,721,000	23,459,000	23,430,000
Asia:					
Burma	5,825,913	5,952,000	6,180,000	5,920,000	6,175,000
China [6]	150,000	150,000	201,000	(4)	(4)
Chosen	1,264,986	1,891,137	2,672,978	(4)	(4)
Cyprus (exports)	44,536	125,704	132,968	199,719	(4)
Federated Malay States	(4)	3,300	3,000	3,500	(4)
Hong Kong	----------	----------	----------	111,070	(4)
India, British	24,493	25,345	24,642	22,295	(4)
Indochina	3,633	5,594	3,537	2,411	(4)
Japan	8,230,751	9,765,572	9,902,000	10,100,000	(4)
Netherland India	701,722	662,654	500,095	579,144	(4)
Philippine Islands	322,022	491,701	719,771	1,167,612	1,247,541
Sarawak	----------	----------	----------	1,660	100
Taiwan	10,584	12,936	(4)	(4)	(4)
Turkey [5]	200,000	300,000	380,000	350,000	575,000
	16,782,000	19,386,000	20,735,000	21,322,000	21,843,000
Africa:					
Algeria	46,522	45,236	72,177	90,000	85,000
Bechuanaland	1,758	1,378	1,499	1,127	813
Belgian Congo	3,793,980	2,781,521	2,961,855	3,117,014	(4)
Gold Coast [6]	12,000	14,000	19,000	23,000	(4)
Kenya Colony	3,744	5,721	7,549	11,200	(4)
Morocco, French	2,733	88,254	241,549	280,000	(4)
Nigeria	139,200	153,000	102,120	(4)	(4)
Portuguese East Africa	725	1,337	1,474	1,808	2,319
Rhodesia:					
Northern	151	229,151	83,861	88,237	61,217
Southern	132,087	145,072	152,038	166,417	173,556
Sierra Leone	1,673	1,537	1,568	(4)	(4)
South-West Africa	----------	135,000	385,500	673,500	587,000
Tanganyika	6,134	9,254	11,696	16,473	(4)
Tunisia	17,008	44,979	58,354	61,149	(4)
Uganda	346	924	1,379	1,981	1,376
Union of South Africa	1,042,203	1,075,626	1,100,641	1,135,374	1,182,516
	5,200,000	4,732,000	5,202,000	5,719,000	5,409,000

See footnotes at end of table.

World production of silver, 1935–39, by countries, in fine ounces—Continued

Country	1935	1936	1937	1938	1939
Oceania:					
Australia:					
New South Wales	9,091,946	8,557,803	9,780,499	9,558,550	[3] 9,500,000
Queensland	2,409,165	3,084,008	3,264,994	3,533,490	3,885,963
South Australia		1,560	955	503	541
Victoria	3,948	7,964	5,443	5,898	6,285
Western Australia	50,516	76,798	180,562	271,346	287,439
Fiji	634	1,185	3,463	12,380	(4)
New Guinea [6]	83,000	97,000	96,000	104,000	(4)
New Zealand	437,967	432,973	443,981	357,709	389,492
Tasmania	323,901	906,458	1,060,785	1,219,550	1,278,116
	12,401,000	13,166,000	14,837,000	15,063,000	15,466,000
	221,539,000	254,614,000	277,681,000	267,725,000	265,977,000

[1] Preliminary world silver production table prepared with revisions and adjustments by R. B. Miller, Foreign Minerals Division, Bureau of Mines, in cooperation with the Office of the Director of the Mint. No official statistics are issued by the Government of U. S. S. R., consequently figures released by the various authorities vary widely and are irreconcilable.
[2] Philippine Islands excluded.
[3] Approximate production.
[4] Data not available. Estimate included in total.
[5] American Bureau of Metal Statistics (New York), Annual Issue.
[6] Imperial Institute (London), Statistical Summary.

MINE REPORT

METHOD OF COLLECTING STATISTICS

The first table in this report presents the official refinery figures for production of gold and silver in the United States from 1935 to 1939, as agreed upon by the Bureau of the Mint and the Bureau of Mines. These figures record the output of gold and silver bullion from domestic ore in marketable form as metals, either refined or unrefined.

To trace the gold and silver produced back to its source by States, counties, and mining districts, the Bureau of Mines systematically investigates the "mine production" of ores containing gold and silver and the output of the placer mines, the total being classified by methods of production and by kinds of ore, as well as by mining districts. The resulting figures form the basis of the mine reports.

Of the two systems for ascertaining the production of gold and silver, one is a measure of the metallurgic industry and the other of the mining industry; one reports the metal actually recovered in marketable form and the other the mine output and its recoverable content. The two methods will not produce identical results, but data for a period of years long enough to compensate for overlap or lag should agree within allowable limits of error.

Gold and silver produced in the United States, 1905–39, in fine ounces, according to mint and mine returns, in terms of recovered metals

Year	Mint		Mine	
	Gold	Silver	Gold	Silver
1905–34	101,453,517	1,716,350,359	101,096,635	1,705,292,736
1935	3,609,283	45,924,454	3,688,832	48,840,669
1936	4,357,394	63,812,176	4,405,118	61,647,455
1937	4,804,540	71,941,794	4,834,062	72,128,397
1938	5,089,811	62,665,335	5,170,743	62,873,450
1939	5,611,171	65,119,513	5,672,485	65,565,024
	124,925,716	2,025,813,631	124,867,875	2,016,347,731

Compared with the mine reports, the mint reports for the 35 years show a total excess of gold of 57,841 ounces (a difference of 0.05 percent) and a total excess of silver of 9,465,900 ounces (a difference of 0.47 percent).

UNITS OF MEASUREMENT

All tonnage figures are short tons of 2,000 pounds "dry weight"; that is, they do not include moisture. The weight unit for gold and silver is the troy ounce (480 grains). The totals are calculated upon the basis of recovered and recoverable fine gold and silver shown by assays to be contained in ore, bullion, and other material produced. Prices of gold and silver are discussed in a preceding section of this report.

MINES PRODUCING

LEADING GOLD PRODUCERS

The output of the 30 largest gold producers in the United States (Philippine Islands and Puerto Rico excluded) in 1939, none of which produced less than 19,900 ounces, was 2,346,407 fine ounces (50 percent of the total). Five of the companies, working placer mines with floating connected-bucket dredges, recovered 440,285 ounces of gold; the rest of the output of the largest producers came from lode mines. The total output of lode mines and placers producing less than 19,900 ounces each was 2,326,635 ounces.

Largest producers of gold in the United States in 1939, in order of output [1]

Rank	Operator	State	Mining district	Source of gold
1	Homestake Mining Co	South Dakota	Whitewood	Dry and siliceous ore.
2	United States Smelting, Refining & Mining Co.	Alaska	Fairbanks and Nome	Dredging gravel.
3	Utah Copper Co	Utah	West Mountain	Copper ore.
4	Golden Cycle Corporation [2]	Colorado	Cripple Creek, etc	Dry and siliceous ore.
5	Alaska Juneau Mining Co	Alaska	Juneau	Do.
6	Phelps Dodge Corporation	Arizona	Ajo, Copper Mountain, Verde, Warren.	Copper ore.
7	Empire Star Mines Co., Ltd	California	Grass Valley - Nevada City, Bear Valley, Browns Valley.	Dry and siliceous ore.
8	Idaho Maryland Mines Corporation.	do	Grass Valley - Nevada City.	Do.
9	Yuba Consolidated Gold Fields.	do	Callahan, Oroville, Snelling, Yuba River.	Dredging gravel.
10	Natomas Co	do	Folsom	Do.
11	Getchell Mine, Inc	Nevada	Potosi	Dry and siliceous ore.
12	Howe Sound Co	Washington	Chelan	Copper ore.
13	Consolidated Coppermines Corporation.	Nevada	Robinson	Do.
14	Central Eureka Mining Co	California	Mother Lode	Dry and siliceous ore.
15	Lava Cap Gold Mining Corporation.	do	Grass Valley-Nevada City.	Do.
16	Black Mammoth Consolidated Mining Co.	Nevada	Silver Peak	Gold ore.
17	Capital Dredging Co	California	Folsom	Dredging gravel.
18	Bald Mountain Mining Co	South Dakota	Trojan	Dry and siliceous ore.
19	Mammoth - St. Anthony, Ltd	Arizona	Old Hat	Do.
20	United States Smelting, Refining & Mining Co.	Utah	West Mountain and Tintic.	Zinc-lead ore, lead ore, dry and siliceous ore.
21	Carson Hill Gold Mining Corporation.	California	Mother Lode	Dry and siliceous ore.
22	Alaska-Pacific Consolidated Mining Co.	Alaska	Willow Creek	Do.
23	Nevada Consolidated Copper Corporation.	Nevada	Robinson	Copper ore.
24	United States Smelting, Refining & Mining Co. (Gold Road).	Arizona	San Francisco	Dry and siliceous ore.
25	London Mines & Milling Co	Colorado	Mosquito	Do.
26	New Jersey Zinc Co., Empire Zinc Division.	do	Battle Mountain	Copper ore.
27	Veta Mines, Inc	do	Upper San Miguel	Dry and siliceous ore.
28	Golden Queen Mining Co	California	Mojave	Do.
29	Argonaut Mining Co., Ltd	do	Mother Lode	Do.
30	Manhattan Gold Dredging Co	Nevada	Manhattan	Dredging gravel.

1 Philippine Islands excluded.
2 Custom mill. Includes mainly ore from Cresson, Portland, Ajax, Vindicator, and other mines in Cripple Creek district, Colo., but also from other districts in Colorado.

The Benguet Consolidated Mining Co. (including the Balatoc mine, controlled by Benguet stockholders) in the Philippine Islands ranked between the Homestake Mining Co. and the United States Smelting, Refining & Mining Co. Alaska operations.

LEADING SILVER PRODUCERS

The output of silver from the 43 leading silver-producing companies in 1939, none of which produced less than 200,000 ounces, was 50,552,212 ounces—79 percent of the total mine output of the United States (Philippine Islands and Puerto Rico excluded); the remaining 13,643,634 ounces (placer production excluded) came from 5,316 lode mines, many of which derive a substantial net income from the silver content.

Largest producers of silver in the United States in 1939, in order of output

Rank	Operator	State	Mining district	Source of silver
1	Sunshine Mining Co.	Idaho	Evolution	Dry and siliceous ore.
2	New Jersey Zinc Co., Empire Zinc Division.	Colorado	Battle Mountain	Copper ore.
3	Anaconda Copper Mining Co.	Montana	Summit Valley or Butte.	Copper ore, zinc-lead ore.
4	Phelps Dodge Corporation	Arizona	Ajo, Copper Mountain, Verde, Warren.	Copper ore.
5	United States Smelting, Refining & Mining Co.	Utah	West Mountain, Tintic.	Zinc-lead ore, lead ore, dry and siliceous ore.
6	Tintic Standard Mining Co.	do	Tintic	Dry and siliceous ore, lead ore.
7	Bunker Hill & Sullivan Mining & Concentrating Co.	Idaho	Yreka	Zinc-lead ore, dry and siliceous ore.
8	Utah Copper Co.	Utah	West Mountain	Copper ore.
9	Federal Mining & Smelting Co.	Idaho	Hunter, Lelande, Yreka.	Zinc-lead ore.
10	American Metal Co. (Presidio mine).	Texas	Shafter	Dry and siliceous ore.
11	Snyder Mines, Inc.	Idaho	Warm Springs	Zinc-lead ore, dry and siliceous ore.
12	Polaris Mining Co.	do	Evolution	Dry and siliceous ore.
13	Hecla Mining Co.	do	Lelande	Zinc-lead ore, lead ore.
14	Silver King Coalition Mines Co.	Utah	Uintah	Do.
15	Desert Silver, Inc.	Nevada	Silver Peak	Dry and siliceous ore.
16	Park City Consolidated Mines Co.	Utah	Blue Ledge	Zinc-lead ore.
17	Magma Copper Co.	Arizona	Pioneer	Copper ore, zinc-copper ore.
18	Cactus Mines Co.	California	Mojave	Dry and siliceous ore.
19	Eagle-Picher Mining & Smelting Co.	Arizona	Oro Blanco	Zinc-lead ore.
20	International Smelting & Refining Co.	Utah	Ophir	Dry and siliceous old tailings.
21	Anaconda Copper Mining Co. (Flathead mine).	Montana	Hog Heaven	Dry and siliceous ore, lead ore.
22	Emperius Mining Co.	Colorado	Creede	Dry and siliceous ore.
23	Lessees of the Tonopah Mining Co. of Nevada.	Nevada	Tonopah	Do.
24	Blackhawk Consolidated Mines Co.	New Mexico	Mogollon	Do.
25	Basin Montana Tunnel Co.	Montana	Cataract	Zinc-lead ore.
26	Chief Consolidated Mining Co.	Utah	Tintic	Dry and siliceous ore, lead ore, zinc-lead ore.
27	Philipsburg Mining Co.	Montana	Flint Creek	Dry and siliceous ore.
28	Ground Hog Unit, American Smelting & Refining Co.	New Mexico	Central	Zinc-lead ore.
29	Veta Mines, Inc.	Colorado	Upper San Miguel	Dry and siliceous ore.
30	Golden Queen Mining Co.	California	Mojave	Do.
31	Combined Metals Reduction Co. (Park-Bingham group).	Utah	West Mountain	Dry and siliceous ore, zinc-lead ore.
32	Graham Loftus Oil Corporation.	California	Calistoga	Dry and siliceous ore.
33	Veta Mines, Inc.	Arizona	Ash Peak	Do.
34	Montana Silver Queen Mining Co.	Montana	Montana (Neihart)	Do.
35	Lava Cap Gold Mining Corporation.	California	Grass Valley-Nevada City.	Do.
36	Shattuck Denn Mining Corporation.	Arizona	Warren	Copper ore.

Largest producers of silver in the United States in 1939, in order of output—Con.

Rank	Operator	State	Mining district	Source of silver
37	Combined Metals Reduction Co.	Nevada	Pioche	Zinc-lead ore.
38	Iron King Mining Co	Arizona	Big Bug	Dry and siliceous ore.
39	Coeur d'Alene Mines Corporation.	Idaho	Evolution	Do.
40	Shenandoah-Dives Mining Co.	Colorado	Animas	Do.
41	East Camp Exploration Syndicate.	New Mexico	Steeple Rock	Do.
42	Contact Mines Corporation	Montana	Flint Creek	Dry and siliceous ore, zinc-lead ore.
43	New Park Mining Co	Utah	Blue Ledge	Zinc-lead ore.

NUMBER OF MINES

The following table indicates the number of mines that produced gold and silver in 1938 and 1939. The placers are those in which gold and silver in natural alloy and, in a few placers, platinum are recovered from gravel and sand, whether by hand washing, sluicing, hydraulicking, drifting (in frozen ground or ancient buried river channels), or dredging. The lode mines are those yielding gold and silver from ore as distinguished from gravel, mainly from underground workings, and include those that yield ore mined chiefly for copper, lead, or zinc but that contribute the precious metals as by-products. In addition to the producing mines enumerated here many properties were being prospected and developed, and many other mining claims were being held by assessment work only.

The enumeration of placer mines is less satisfactory than that of lode mines, because some are operated only temporarily and are individually small. As far as possible the unit, as for lode mines, is not the operator but the mining claim or group of claims.

Number of mines in the United States producing gold and silver, 1938–39, by States[1]

State	Lode		Placer		Total	
	1938	1939	1938	1939	1938	1939
Alabama	1	1	2		3	1
Alaska[2]	70	73	1,164	1,114	1,234	1,187
Arizona	885	976	329	142	1,214	1,118
California	927	1,028	676	749	1,603	1,777
Colorado	669	758	592	583	1,261	1,341
Georgia	7	8	15	17	22	25
Idaho	305	362	463	465	768	827
Illinois[3]	2	2			2	2
Indiana				1		1
Maryland	2	3			2	3
Michigan[3]	2	2			2	2
Missouri	1	1			1	1
Montana	482	594	265	282	747	876
Nevada	795	891	130	104	925	995
New Mexico	166	214	164	168	330	382
New York[3]	1	2			1	2
North Carolina	14	13	6	4	20	17
Oregon	84	116	157	201	241	317
Pennsylvania	1	1			1	1
South Carolina	10	5	2	1	12	6
South Dakota	11	18	71	80	82	98
Tennessee	3	8			3	8
Texas	7	7			7	7
Utah	183	175	22	11	205	186
Virginia	3	4	1	2	4	6
Washington	77	88	80	84	157	172
Wyoming	8	9	26	28	34	37
	4,716	5,359	4,165	4,036	8,881	9,395

[1] Philippine Islands and Puerto Rico excluded.
[2] Number of mines contributing to production of gold or silver.
[3] Estimated.

MINE PRODUCTION

SUMMARY

The following table gives the mine production of gold and silver in 1938 and 1939, by States, in terms of recovered metals, as calculated by the Bureau of Mines from reports from the producing mines. The annual percentage gains in gold production in the years following the 69-percent increase in the price of gold are as follows: 1934 over 1933, 19 percent; 1935 over 1934, 18 percent; 1936 over 1935, 19 percent; 1937 over 1936, 9 percent; 1938 over 1937, 7 percent; and 1939 over 1938, 10 percent. The total gain in 1939 over 1933 was 116 percent. The output of silver increased 4 percent in 1939 over 1938 and was 181 percent above that in 1933.

Mine production of gold and silver in the United States, 1938–39, by regions and States, in terms of recovered metals

Region and State	Gold: Fine ounces 1938	Gold: Fine ounces 1939	Gold: Increase or decrease (percent)	Gold: Value (at $35 per ounce) 1938	Gold: Value (at $35 per ounce) 1939	Silver: Fine ounces 1938	Silver: Fine ounces 1939	Silver: Increase or decrease (percent)	Silver: Value 1938 (at $0.64646+ per ounce)	Silver: Value 1939 (at $0.67878+ per ounce)
Western States and Alaska:										
Alaska	664,973	676,737	+2	$23,274,055	$23,685,795	479,853	201,054	−58	$310,208	$136,473
Arizona	305,043	316,453	+4	10,676,505	11,075,855	7,479,153	7,824,004	+5	4,835,008	5,310,839
California	1,311,129	1,435,264	+9	45,889,515	50,234,240	2,590,804	2,599,139	(1)	1,674,863	1,764,264
Colorado	367,468	366,852	(1)	12,861,380	12,839,820	7,932,095	8,496,488	+7	5,127,819	5,767,313
Idaho	103,513	116,662	+13	3,622,955	4,083,170	18,993,676	17,222,370	−9	12,278,740	11,690,336
Montana	203,313	264,173	+30	7,115,955	9,246,055	6,403,962	9,087,571	+42	4,139,935	6,168,533
Nevada	296,434	361,518	+22	10,375,190	12,653,130	4,355,471	4,316,029	−1	2,815,658	2,929,668
New Mexico	43,050	36,979	−14	1,506,750	1,294,265	1,229,860	1,400,878	+14	795,061	950,899
Oregon	81,729	93,372	+14	2,860,515	3,268,020	100,507	105,388	+5	64,974	71,536
South Dakota	594,847	618,536	+4	20,819,645	21,648,760	162,295	167,584	+3	104,918	113,754
Texas	439	324	−26	15,365	11,340	1,433,008	1,341,945	−6	926,389	910,896
Utah	200,630	277,751	+38	7,022,050	9,721,285	9,682,732	10,758,657	+11	6,259,544	7,302,846
Washington	74,175	90,420	+22	2,596,125	3,164,700	380,938	442,063	+16	246,263	300,067
Wyoming	798	583	−27	27,930	20,405	328	75	−77	212	51
	4,247,541	4,655,624	+10	148,663,935	162,946,840	61,224,682	63,963,245	+4	39,579,592	43,417,475
Eastern States:										
Alabama	41	3	−93	1,435	105	4	------	−100	3	------
Georgia	872	670	−23	30,520	23,450	71	58	−18	46	39
Maryland	855	71	−92	29,925	2,485	24	2	−92	16	1
New York	------	------	------	------	------	37,200	37,250	(1)	24,048	25,285
North Carolina	1,878	495	−74	65,730	17,325	5,500	3,961	−28	3,556	2,689
Pennsylvania	1,422	1,815	+28	49,770	63,525	9,360	13,558	+45	6,051	9,203
South Carolina	11,681	13,833	+18	408,835	484,155	3,951	5,480	+39	2,554	3,720
Tennessee	236	163	−31	8,260	5,705	38,333	31,994	−17	24,781	21,717
Virginia	2,943	364	−88	103,005	12,740	502	1,780	+255	325	1,208
	19,928	17,414	−13	697,480	609,490	94,945	94,083	−1	61,380	63,862
Central States:										
Illinois	------	------	------	------	------	576	675	+17	372	458
Indiana	------	4	------	------	140	------	------	------	------	------
Michigan	------	------	------	------	------	93,634	101,878	+9	60,531	69,154
Missouri	------	------	------	------	------	292,000	213,400	−27	188,768	144,853
	------	4	------	------	140	386,210	315,953	−18	249,671	214,465
Philippine Islands	[2] 903,265	[3] 999,408	+11	31,614,275	34,979,280	1,167,612	[3] 1,191,739	+2	754,820	808,938
Puerto Rico	9	[3] 35	+289	315	1,225	1	[3] 4	+300	1	3
	903,274	999,443	+11	31,614,590	34,980,505	1,167,613	1,191,743	+2	754,821	808,941
	5,170,743	5,672,485	+10	180,976,005	198,536,975	62,873,450	65,565,024	+4	40,645,464	44,504,743

[1] Less than 0.5 percent.

[2] Division of Statistics, Department of Agriculture and Commerce, Manila.

[3] Refinery receipts.

Gold and silver produced in the Western States of the United States, 1848–1939, and in Alaska, 1880–1939, in terms of recovered metals

[Original research, 1848-1903, by Chas. W. Henderson; 1904-1939, by western offices]

State	Period	Gold		Silver (fine ounces)
		Fine ounces	Value [1]	
Arizona	1860–1939	9,564,090	$222,238,305	254,114,563
California	1848–1939	97,398,295	2,111,043,977	98,518,224
Colorado	1858–1939	37,549,390	808,105,614	700,938,158
Idaho	1863–1939	7,332,862	159,789,573	435,350,307
Montana	1862–1939	16,161,441	350,103,647	688,454,935
Nevada	1859–1939	24,025,110	519,440,526	569,700,164
New Mexico	1848–1939	2,084,992	46,308,913	62,540,420
Oregon	1852–1939	5,410,821	117,341,778	4,594,512
South Dakota	1876–1939	18,850,644	441,369,749	8,999,991
Texas	1885–1939	7,423	193,750	30,091,579
Utah	1864–1939	8,346,234	192,343,230	657,732,367
Washington	1860–1939	1,715,413	38,794,778	10,455,685
Wyoming	1867–1939	76,673	1,791,883	74,372
Total, Western States	1848–1939	228,523,388	5,008,865,723	3,521,565,277
Alaska	1880–1939	23,700,593	542,535,357	19,179,467
Total, Western States and Alaska	1848–1939	252,223,981	5,551,401,080	3,540,744,744

[1] Gold valued per fine ounce as follows: Prior to 1933, $20.67; 1933, $25.56; 1934, $34.95; 1935–39, $35.

ORE PRODUCTION, CLASSIFICATION, METAL YIELD, AND METHODS OF RECOVERY

The best index of lode mining is the quantity and metallic content of ore mined rather than the number of mines or operators. 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 produced gold and silver in the United States (excluding the Philippine Islands and Puerto Rico) in 1939. The individual State chapters from which these tables were compiled contain additional tables and text on the subject and may be found elsewhere in this volume.

The classification originally adopted in 1905 on the basis of smelter terminology, smelter settlement contracts, and smelter recovery has been used continuously in succeeding years, except for modifications necessitated by the improvement in recovery of metals and the lowering of grade of complex ores treated, accomplished by improved mill concentration processes. A "dry" ore is one that carries so little lead or copper that by itself in quantity it would not satisfy the requirements for the smelter charge in lead smelting or copper smelting, respectively. The copper ores include those smelting ores that contain 2.5 percent dry assay or more of copper (or less than this percentage if no other metal is present), or those ores concentrated chiefly for their copper content. The lead ores are those that contain 5 percent dry assay (minimum lead smelting charge requires 7.5 to 8.5 percent wet assay) or more of lead, irrespective of precious-metal content; an ore that carries any grade of lead exclusively is called a lead ore. Zinc smelting ores (chiefly oxides) range from 16 to 45 percent zinc; zinc concentrating ores include any grade of zinc ore that makes marketable zinc concentrate, irrespective of precious-metal content. The mixed ores are combinations of those enumerated. The smelter classification applies to concentrates.

Siliceous (silica [4] in excess of iron) gold, gold-silver, and silver ores containing too little copper, lead, or zinc to be classified as copper, lead, zinc, or mixed ores are called "dry" ores regardless of the ratio of concentration, except low-grade ore milled chiefly for its copper content and having very little or no precious-metal content (chiefly the "porphyry coppers") and ores from which separate products of lead concentrates and zinc concentrates are made. The crude ore into the mill in these two exceptional instances thus takes its name from its products—a name that is also justified by the mineralogical content and final recovery of metals. The "dry and siliceous ores" thus, by elimination, include both dry siliceous and irony, but chiefly siliceous, ores valuable for their gold and silver content, regardless of method of treatment, and dry fluxing ores carrying considerable quantities of iron and manganese oxides, or iron sulfide, and very small quantities of gold and silver. Dry and siliceous 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 arbitrarily on a basis of value, using the rule that the metal of lower value is not used in the bimetal classification unless its value is equal to or over one-quarter of the combined value of gold and silver.

The lead, zinc, and zinc-lead ores in most districts in the Eastern and Central States carry no appreciable quantity of gold or silver; such ores are excluded from this report.

Ore produced in the United States and average recovery in fine ounces of gold and silver per ton in 1939 [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:									
Arizona	803,816	0.169	0.32	153,289	0.135	5.85	84,899	0.020	9.30
California	5,048,051	.151	.24	157,171	.143	6.91	4,415	.005	9.54
Colorado	1,224,849	.245	.60	242,178	.079	2.13	75,208	.011	9.73
Idaho	245,001	.199	.65	88,044	.151	8.21	451,381	.001	24.90
Montana	815,949	.220	.55	55,620	.099	5.17	177,892	.031	9.03
Nevada	1,494,996	.147	.32	305,793	.114	5.66	106,262	.042	12.62
New Mexico	33,278	.171	.48	77,455	.157	8.31	469	.021	17.08
Oregon	68,938	.472	1.35	87	.862	17.54			
South Dakota	1,632,778	.378	.10						
Texas							141,132	.002	9.49
Utah	385,500	.165	1.09	133,029	.132	6.72	320,368	.014	6.50
Washington	261,651	.153	.64	68	.441	24.59	5,138	.013	12.74
Wyoming	57	.544	.23						
Total, Western States	12,014,864	.200	.35	1,212,734	.120	5.59	1,367,164	.013	14.08
Alaska	4,751,492	.044	.03						
Eastern States	120,274	.124	.05						
	16,886,630	.156	.25	1,212,734	.120	5.59	1,367,164	.013	14.08

See footnotes at end of table.

[4] Except where mineralization approaches a matte, ores in their natural state generally contain more silica than iron and usually are highly siliceous.

Ore produced in the United States and average recovery in fine ounces of gold and silver per ton in 1939—Continued

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:									
Arizona	17,468,926	0.008	0.28	9,778	0.127	8.61	30	0.200	54.47
California	367,477	.035	.53	706	.210	11.19	------	------	------
Colorado	342,499	.066	17.85	14,700	.253	21.81	1,464	.304	18.22
Idaho	1,416	.424	31.27	125,964	.005	6.55	------	------	------
Montana	2,253,270	.003	2.08	23,096	.099	9.28	------	------	------
Nevada	4,936,001	.014	.06	6,730	.188	33.58	219	.014	9.67
New Mexico	4,517,429	.002	.08	1,431	.223	5.21	1,102	.010	7.72
Oregon	------	------	------	------	------	------	------	------	------
South Dakota	------	------	------	------	------	------	------	------	------
Texas	657	------	3.36	6	------	21.17	------	------	------
Utah	19,602,472	.008	.08	77,072	.065	13.61	4,951	.008	16.46
Washington	597,957	.080	.32	400	.045	8.20	------	------	------
Wyoming	------	------	------	------	------	------	------	------	------
Total, Western States	50,088,104	.009	.36	259,883	.057	10.53	7,766	.065	15.51
Alaska	165	1.915	.44	------	------	------	------	------	------
Eastern States	[2] 3,246,344	.001	.02	------	------	------	------	------	------
	53,334,613	.009	.34	259,883	.057	10.53	7,766	.065	15.51

State	Zinc ore			Zinc-lead, zinc-copper, and zinc-lead-copper ores [5]			Total ore		
Western States:									
Arizona	670	0.221	6.01	271,852	0.039	3.58	18,793,260	0.016	0.42
California	------	------	------	33	.061	7.88	5,577,853	.143	.46
Colorado	344	.047	23.48	13,351	.021	2.81	1,914,593	.181	4.44
Idaho	144	.042	12.18	1,196,495	.004	3.52	2,108,445	.032	8.16
Montana	[3] 146,705	(4)	.26	320,248	.027	5.56	3,792,780	.055	2.39
Nevada	150	------	.08	44,848	.020	5.53	6,894,999	.048	.62
New Mexico	217,517	(4)	.13	128,694	.045	2.39	4,977,375	.007	.28
Oregon	------	------	------	------	------	------	69,025	.472	1.37
South Dakota	------	------	------	------	------	------	1,632,778	.378	.10
Texas	------	------	------	------	------	------	141,795	.002	9.46
Utah	------	------	------	570,705	.048	8.27	21,094,097	.013	.51
Washington	------	------	------	259,350	(4)	.05	1,124,564	.078	.39
Wyoming	------	------	------	------	------	------	57	.544	.23
Total, Western States	365,530	.001	.22	2,805,576	.021	4.38	68,121,621	.046	.93
Alaska	------	------	------	------	------	------	4,751,657	.044	.03
Eastern States	(6)	------	------	[7] 973,231	------	.04	4,339,849	.004	.02
	365,530	.001	.22	3,778,807	.015	3.26	77,213,127	.043	.83

[1] Illinois, Michigan, Missouri, Philippine Islands, and Puerto Rico excluded.
[2] Includes magnetite-pyrite-chalcopyrite ore from Pennsylvania yielding copper concentrates carrying gold and silver.
[3] Includes 145,638 tons of slag fumed.
[4] Less than 0.001 per ton.
[5] Includes zinc-lead-copper ore from 1 mine in Utah. Bureau of Mines not at liberty to publish figures. Zinc-copper ore from Arizona.
[6] Zinc ore yielded no gold or silver.
[7] Figures cover New York and Virginia.

Mine production of gold in the United States in 1939, by States and sources, in fine ounces, in terms of recovered metals [1]

State	Placers	Dry and siliceous ore	Copper ore	Lead ore	Lead-copper ore	Zinc ore	Zinc-lead, zinc-copper, and zinc-lead-copper ores [2]	Total
Alabama		3						3
Alaska	467,571	208,850	316					676,737
Arizona	6,409	158,398	139,527	1,240	6	148	[2] 10,725	316,453
California	636,045	786,107	12,962	148			2	1,435,264
Colorado	19,819	319,931	22,653	3,712	445	16	276	366,852
Georgia	393	277						670
Idaho	48,663	62,540	600	661		6	4,192	116,662
Indiana	4							4
Maryland		71						71
Montana	54,999	190,578	7,636	2,296		16	8,648	264,173
Nevada	32,558	258,753	68,028	1,266	3		910	361,518
New Mexico	3,474	17,885	9,426	319	11	55	5,809	36,979
North Carolina	7	412	76					495
Oregon	60,779	32,593						93,372
Pennsylvania			[3] 1,815					1,815
South Carolina	8	13,825						13,833
South Dakota	622	617,914						618,536
Tennessee		2	161					163
Texas		324						324
Utah	145	85,494	159,653	5,043	41		[2] 27,375	277,751
Virginia	5	359						364
Washington	2,261	40,076	48,064	18			1	90,420
Wyoming	552	31						583
	1,334,314	2,794,423	470,917	14,703	506	241	57,938	4,673,042

[1] Philippine Islands and Puerto Rico excluded.
[2] Includes zinc-lead-copper ore from 1 mine in Utah; zinc-copper ore from Arizona.
[3] From copper concentrates from magnetite-pyrite-chalcopyrite ore.

Mine production of silver in the United States in 1939, by States and sources, in fine ounces, in terms of recovered metals [1]

State	Placers	Dry and siliceous ore	Copper ore	Lead ore	Lead-copper ore	Zinc ore	Zinc-lead, zinc-copper, and zinc-lead-copper ores [2]	Total
Alaska	68,506	132,475	73					201,054
Arizona	691	1,939,317	4,820,469	84,208	1,634	4,030	[2] 973,655	7,824,004
California	56,131	2,338,874	195,972	7,902			260	2,599,139
Colorado	4,125	1,985,174	6,114,224	320,657	26,670	8,078	37,560	8,496,488
Georgia	35	23						58
Idaho	14,875	12,123,773	44,278	824,618		1,754	4,213,072	17,222,370
Illinois				[3] 675				675
Maryland		2						2
Michigan			101,878					101,878
Missouri				213,400				213,400
Montana	11,634	2,343,037	4,697,920	214,368		38,482	1,782,130	9,087,571
Nevada	10,143	3,549,110	280,654	225,992	2,118	12	248,000	4,316,029
New Mexico	209	667,579	381,875	7,461	8,503	27,298	307,953	1,400,878
New York							37,250	37,250
North Carolina		134	3,827					3,961
Oregon	10,594	94,794						105,388
Pennsylvania			[4] 13,558					13,558
South Carolina		5,480						5,480
South Dakota	47	167,537						167,584
Tennessee			31,994					31,994
Texas		1,339,609	2,209	127				1,341,945
Utah	25	3,395,656	1,514,899	1,048,887	81,490		[2] 4,717,700	10,758,657
Virginia		384					1,396	1,780
Washington	358	234,509	192,237	3,279			11,680	442,063
Wyoming	62	13						75
	177,435	30,317,480	18,396,067	2,951,574	120,415	79,654	12,330,656	64,373,281

[1] Philippine Island and Puerto Rico excluded.
[2] Includes zinc lead-copper ore from 1 mine in Utah; zinc-copper ore from Arizona.
[3] From galena concentrates containing silver, a byproduct of fluorspar ores.
[4] Magnetite-pyrite-chalcopyrite ore.

Gold and silver produced in the United States from ore, old tailings, etc., in 1939, by States and by methods of recovery, in terms of recovered metals [1]

State	Total ore, old tailings, etc., treated (short tons)	Ore, old tailings, etc., to amalgamation and cyanidation mills and bullion recovered				Ore and old tailings to concentrating mills (short tons)	Concentrates smelted (from amalgamation and cyanidation and concentrating mills combined)			Crude ore to smelters			Ore leached, old tailings and slag smelted, etc.		
		Ore (short tons)	Old tailings, etc. (short tons)	Gold (fine ounces)	Silver (fine ounces)		Short tons	Gold (fine ounces)	Silver (fine ounces)	Short tons	Gold (fine ounces)	Silver (fine ounces)	Short tons	Gold (fine ounces)	Silver (fine ounces)
Alaska	4,751,657	4,729,057	----------	172,035	29,877	22,407	4,658	36,661	102,562	193	470	109	----------	----------	----------
Arizona	18,793,260	738,943	----------	78,910	145,021	14,017,765	668,141	109,671	3,028,737	1,922,003	121,463	4,649,538	2,114,549	----------	17
California	5,577,853	4,435,311	637,771	600,500	998,619	493,693	56,012	190,732	1,338,426	11,078	7,987	205,963	----------	----------	----------
Colorado	1,914,593	1,054,840	----------	207,908	105,865	458,443	62,389	102,600	1,690,469	401,310	36,525	6,696,029	----------	----------	----------
Idaho	2,108,445	121,898	----------	19,567	12,892	1,919,136	246,821	33,159	15,895,169	67,411	15,273	1,299,434	----------	----------	----------
Montana	3,792,780	572,788	----------	77,632	128,057	2,836,478	500,204	44,614	7,177,059	237,876	86,928	1,747,220	145,638	----------	23,601
Nevada	6,894,999	1,121,956	615,708	196,036	1,670,507	4,964,600	256,708	81,388	730,332	187,087	51,103	1,865,584	5,648	433	39,463
New Mexico	4,977,375	88,453	----------	8,305	377,995	4,801,902	215,947	16,614	519,616	87,020	8,586	503,058	----------	----------	----------
Oregon	69,025	18,441	3,764	5,135	916	38,760	2,121	20,809	83,040	8,060	6,649	10,838	----------	----------	----------
South Dakota	1,632,778	1,632,696	----------	616,315	167,027	----------	101	348	67	82	1,251	443	----------	----------	----------
Texas	141,795	138,934	----------	298	1,099,261	----------	636	25	204,487	2,861	1	38,197	----------	----------	----------
Utah	21,094,097	230,224	----------	15,651	1,967	20,393,488	774,106	186,796	6,712,712	470,385	75,159	4,043,953	----------	----------	----------
Washington	1,124,564	167,972	----------	16,442	56,422	864,151	64,105	49,442	257,345	92,441	22,275	127,938	----------	----------	----------
Wyoming	57	3	----------	2	----------	----------	----------	----------	----------	54	29	13	----------	----------	----------
Eastern States	[2] 4,339,849	118,636	1,411	14,656	5,696	4,126,160	580,004	2,149	84,480	93,642	196	3,872	----------	----------	----------
	77,213,127	15,170,152	1,258,654	2,029,392	4,800,122	54,936,983	3,431,953	875,008	37,824,501	3,581,503	433,895	21,192,189	2,265,835	433	63,081

[1] Illinois, Michigan, Missouri, Philippine Islands, and Puerto Rico excluded.
[2] Includes magnetite-pyrite-chalcopyrite ore from Pennsylvania; excludes ore containing no gold or silver.

Gold and silver produced at amalgamation and cyanidation mills in the United States and percentage of gold and silver recovered from all sources, 1935–39 [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
1935	928, 949	433, 446	610, 144	1, 731, 622	28.7	0.9	18.8	3.6	28.7	95.3	23.7	0.2
1936	1, 025, 040	437, 091	711, 396	2, 518, 288	27.1	.7	18.8	4.1	30.2	95.0	23.9	.2
1937	1, 040, 593	368, 394	793, 204	3, 039, 172	25.3	.5	19.3	4.3	30.8	95.0	24.6	.2
1938	984, 620	223, 058	962, 788	4, 275, 154	23.1	.4	22.6	7.0	26.4	92.4	27.9	.2
1939	985, 717	243, 786	1, 043, 675	4, 556, 336	21.1	.4	22.3	7.1	28.0	92.2	28.6	.3

[1] Philippine Islands and Puerto Rico excluded.
[2] Both crude ores and concentrates.

Gold and silver produced at amalgamation and cyanidation mills in the United States in 1939, by States [1]

State	Amalgamation			Cyanidation			Percent of gold and silver from all sources in State			
	Ore, old tailings, concentrates, etc., treated (short tons)	Bullion recovered (fine ounces)		Ore, old tailings, concentrates, sands, slimes, etc., treated (short tons)	Bullion and precipitates recovered		Amalgamation		Cyanidation	
		Gold	Silver		Gold	Silver	Gold	Silver	Gold	Silver
Alaska	4, 725, 943	168, 788	29, 793	4, 825	3, 247	84	24.94	14.82	0.48	0.04
Arizona	5, 000	1, 087	308	733, 943	77, 823	144, 713	.34	(2)	24.59	1.85
California	2, 902, 583	342, 296	63, 720	2, 139, 243	258, 204	934, 899	23.85	2.45	17.99	35.97
Colorado	780, 064	72.095	27, 684	636, 969	135, 813	78, 181	19.65	.33	37.02	.92
Idaho	111, 480	18, 008	9, 821	10, 418	1, 559	3, 071	15.44	.06	1.34	.02
Montana	82, 359	9, 354	2, 042	490, 429	68, 278	126, 015	3.54	.02	25.85	1.39
Nevada	307, 959	33, 050	44, 458	1, 507, 366	162, 986	1, 626, 049	9.14	1.03	45.08	37.67
New Mexico	24, 703	658	179	63, 750	7, 647	377, 816	1.78	.01	20.68	26.97
Oregon	4, 747	2.048	516	17, 468	3.087	400	2.19	.49	3.31	.38
South Dakota	1, 461, 283	336, 425	64, 710	1, 613, 879	279.890	102.317	54.39	38.61	45.25	61.05
Texas	------	------	------	138, 298	298	1, 099.261	------	------	91.98	81.92
Utah	------	------	------	230.224	15, 651	1, 967	------	------	5.63	.02
Washington	6, 421	961	344	181, 551	15, 481	56, 078	1.06	.08	17.12	12.69
Wyoming	3	2	------	------	------	------	.34	------	------	------
Eastern States	5, 437	945	211	114, 610	13, 711	5.485	5.43	.22	78.74	5.83
	10, 417, 982	985, 717	243, 786	7, 862, 973	1, 043, 675	4, 556, 336	21.09	.38	22.33	7.11

[1] Philippine Islands and Puerto Rico excluded.
[2] Less than 0.005 percent.

PLACERS

Dredging.—Placer gold is obtained largely from gravels handled by connected-bucket floating dredges, which recovered approximately 59 percent of the total output from placers in the United States (Philippine Islands and Puerto Rico excluded) in 1939 and 62 percent in 1938. The quantity of gold recovered by dredges from the inception of the industry as a commercial factor in 1896 to the end of 1939 is recorded as 16,610,669 ounces, originating by States as follows: California, 10,419,552 ounces; Alaska 4,246,303 (including some gold by hydraulicking); Montana, 586,944; Idaho, 482,040; Colorado, 425,075; Oregon, 396,323; and other States, 54,432. The output in 1939 was 787,731 ounces from 114 dredges, of which California produced 370,264 ounces from 47 dredges; Alaska, 304,995 from 44 dredges; Idaho, 28,973 from 8 dredges; Montana, 33,815 from 7 dredges; Oregon, 25,028 from 5 dredges; and Colorado 4,688 from 2 dredges.

Connected-bucket floating gold dredges operated in the United States, 1938–39, by companies and districts

ALASKA

Company	Address	District	Number of dredges	
			1938	1939
Triple X Placers Co.[1]	Ferry	Bonnifield		1
Alluvial Golds, Inc	Fairbanks	Circle	1	1
C. J. Berry Dredging Co	Miller House	do	1	1
Deadwood Mining Co. (in 1939 dredge operated by Nome Creek Mining Co.).	Fairbanks	do	1	
Gold Placers, Inc	do	do	1	1
Nome Creek Mining Co. (formerly Deadwood Mining Co.).	do	do		1
Alaska Placer Co. (formerly North Star Dredging Co.).	Council	Council	1	1
Camp Creek Dredging Co	do	do		1
Council Dredging Co	do	do	1	1
Glass Dredging Co	do	do	1	
Inland Dredging Co	do	do	1	1
United States Smelting, Refining & Mining Co., Fairbanks Department.	Fairbanks	Fairbanks	6	6
Arctic Circle Exploration, Inc	Candle	Fairhaven	2	2
Forsgren Dredging Co	Deering	do	1	1
Boundary Dredging Co	Canyon Creek	Fortymile	1	1
North American Mines, Inc., Jack Wade Operations.	Fairbanks	do	1	1
Bristol Bay Mining Co	San Francisco	Goodnews Bay	1	1
American Creek Operating Co., Inc	Fairbanks	Hot Springs	1	1
North American Dredging Co	Flat	Iditarod	1	1
J. E. Riley Investment Co	do	do	1	1
Holky Dredging Co	Takotna	Innoko	1	1
Moss & Larson Mining Co. (formerly Savage & Matheson).	do	do	1	1
W. F. Puntila	do	do	1	1
Nels J. Vibe	do	do	1	1
Fox Bar Dredging Co	Nome	Kougarok	1	1
Kougarok Consolidated Placers, Inc	do	do	1	1
Dime Creek Dredging Co. (Wallace Porter)	Haycock	Koyuk	1	1
Shaw & Cook	Golovin	do	1	
Ungalik Syndicate	Nome	do	1	1
Alaska Sunset Mines, Inc	do	Nome	1	1
Casa de Paga Gold Co.[2]	do	do	1	1
Dry Creek Dredging Co	do	do	1	
Osborn Creek Dredging Co	do	do	1	1
Tolbert Scott (formerly Spruce Creek Dredging Co.).	do	do		1
United States Smelting, Refining & Mining Co., Nome Department.	do	do	3	3
Bartholomae Oil Corporation	do	Port Clarence	1	1
N. B. Tweet & Son	Teller	do	1	
Lee Brothers Dredging Co	Nome	Solomon	1	1
Slack & Mahan	do	do		1
New York Alaska Gold Dredging Co	Nyac	Tuluksak-Aniak	2	2
			44	44

[1] Single-dipper dredge. [2] Solomon district in 1938.

Connected-bucket floating gold dredges operated in the United States, 1938-39, by companies and districts—Continued

CALIFORNIA

Company	Address	District	Number of dredges 1938	Number of dredges 1939
Etna Gold Dredging Co	Callahan	Callahan	------	1
Yuba Consolidated Gold Fields	San Francisco	do	1	1
Camanche Placers, Ltd	Camanche	Camanche	1	------
Comanche Gold Dredging Co.[3]	San Francisco	do	1	1
Lancha Plana Gold Dredging Co	Camanche	do	1	1
Wallace Dredging Co	San Francisco	do	1	1
Cosumnes Gold Dredging Co	do	Cosumnes River	1	1
Capital Dredging Co	do	Folsom	3	2
Natomas Co	Sacramento	do	7	7
Cal Oro Gold Dredging Co	San Francisco	Greenhorn	1	1
Yreka Gold Dredging Co	Yreka	do	1	1
Callahan & Bates	Merced Falls	Hunter Valley	------	1
Roaring River Gold Dredging Co	San Francisco	Igo	1	1
Arroyo Seco Gold Dredging Co	do	Ione	2	1
Lancha Plana Gold Dredging Co	Camanche	do	1	1
California Gold Dredging Co	San Francisco	Jenny Lind	1	1
C. J. Thompson[4]	Linden	do	1	1
Junction City Mining Co	San Francisco	Junction City	1	1
La Grange Gold Dredging Co	do	La Grange	1	1
Tuolumne Gold Dredging Corporation	La Grange	do	1	1
Lewiston Gold Dredging Co	Lewiston	Lewiston	1	1
T. D. & C. R. Harris[5]	do	do	1	1
Antelope Creek Dredging Co	San Francisco	Ophir	1	------
Gold Hill Dredging Co	do	do	1	1
Oro Bell Dredging Co	Berkeley	do	1	1
Oroville Gold Dredging Co	Oroville	Oroville	1	------
Gold Hill Dredging Co	San Francisco	do	1	1
Yuba Consolidated Gold Fields	do	do	2	2
Williams Bar Dredging Co	do	Smartville	1	1
Merced Dredging Co	do	Snelling	1	1
San Joaquin Mining Co	do	do	1	1
Snelling Gold Dredging Co	Snelling	do	2	2
Yuba Consolidated Gold Fields	San Francisco	do	2	2
Carrville Gold Co	Duluth, Minn	Trinity Center	------	1
Yuba Consolidated Gold Fields	San Francisco	Yuba River	5	6
			48	47

COLORADO

Company	Address	District	1938	1939
Timberline Dredging Co	Denver	Beaver Creek	1	1
Continental Dredging Co	Breckenridge	Breckenridge	1	------
Blue River Co	do	do	------	1
			2	2

IDAHO

Company	Address	District	1938	1939
Fisher-Baumhoff Co	Centerville	Boise Basin	2	2
The Grimes Co	Pioneerville	do	1	1
Idaho-Canadian Dredging Co. (formerly Moores Creek Dredging Co.)	Idaho City	do	1	1
Jordan Creek Placers	De Lamar	Carson	1	------
Baumhoff-Fisher Co. (formerly Little Smoky Dredging Co.)	Centerville	Little Smoky	1	------
Mount Vernon Mining Co	Elk City	Orogrande	1	1
Quartz Creek Dredging Co	Pierce	Pierce	------	1
Baumhoff-Fisher Co	Warren	Warren	1	1
Warren Dredging Co	do	do	1	1
			9	8

[3] Comanche Gold Dredging Co. consolidated with Gold Hill Dredging Co. and continued operation under latter name from Oct. 13, 1939.
[4] C. J. Thompson changed to dragline dredge from connected-bucket dredge Nov. 1, 1939.
[5] Operated in 1938 by Trinity Gold Dredging Co.

Connected-bucket floating gold dredges operated in the United States, 1938–39, by companies and districts—Continued

MONTANA

Company	Address	Diistrict	Number of dredges	
			1938	1939
Winston Bros. Co	Helena	Clancey	1	1
Star Pointer Exploration Co	Bearmouth	First Chance		1
Porter Bros. Corporation	Helena	Helena	1	1
Perry-Schroeder Mining Co	do	Missouri River	1	1
Homer Wilson	Harrison	Norris	1	1
Pioneer Placer Dredging Co	Gold Creek	Pioneer	1	1
Gold Creek Mining Co	Deer Lodge	Washington	1	1
			6	7

NEVADA

Manhattan Gold Dredging Co	Manhattan	Manhattan	1	1

OREGON

Western Dredging Co	San Francisco	Canyon	1	1
Pleasant Creek Mining Corporation	Grants Pass	Gold Hill		1
Porter & Co	Helena	Granite	1	1
Rogue River Gold Co	Rogue River	Greenback	1	
The Sumpter Valley Dredging Co	Portland	Sumpter	1	1
Timms Gold Dredging Co	Galena	Susanville	1	1
			5	5

Gold produced in the United States by connected-bucket floating dredges, 1935–39, in fine ounces

Year	Dredges	California	Alaska	Other States [1]	Total
1935	91	236,404	216,560	53,324	506,288
1936	103	276,324	255,803	63,993	596,120
1937	105	322,961	255,568	65,614	644,143
1938	115	375,296	278,442	82,686	736,424
1939	114	370,264	304,995	112,472	787,731

[1] Colorado, Idaho, Montana, Oregon, and Nevada.

Other placer-mining methods.—From 1932 through 1939 dragline and power-shovel excavators operated in connection with dry-land and floating amalgamating and sluicing plants have been widely used in placer mining. In 1939 approximately 30 percent of the total output of placer gold, including that of Alaska and excluding that of the Philippine Islands, was recovered at these plants, and 11 percent was produced by old-established mining methods, such as hydraulicking, drift mining, sluicing, and rocking.

Additional information on placer-mining methods may be found in the State reviews in the Minerals Yearbook and Mineral Resources series.

PRODUCTION IN PHILIPPINE ISLANDS

The value of the gold produced in the Philippine Islands from 1907 to 1939, inclusive, is computed at $190,584,406. The gold production in 1939 was 999,408 ounces valued at $34,979,280 compared with 903,265 ounces valued at $31,614,275 in 1938, an increase of 11 percent. The annual value of the output from 1930 to 1939 was as follows:

Mine production of gold in the Philippine Islands, 1930–39

Year	Gold (fine ounces)	Value [1]	Year	Gold (fine ounces)	Value [1]
1930	179,220	$3,704,800	1935	451,818	$15,813,630
1931	182,008	3,762,433	1936 [2]	621,968	21,768,880
1932	244,298	5,050,084	1937 [2]	716,967	25,093,845
1933	325,039	8,308,009	1938 [2]	903,265	31,614,275
1934	340,314	11,893,975	1939 [3]	999,408	34,979,280

[1] Gold valued per fine ounce as follows: Prior to 1933, $20.67; 1933, $25.56; 1934, $34.95; 1935–39, $35.
[2] Division of Statistics, Department of Agriculture and Commerce, Manila.
[3] Refinery receipts.

The largest producers of gold, in approximate order of output in 1939, included: Benguet Consolidated Mining Co., Balatoc Mining Co., Itogon Mining Co., Philippine Smelting Co. (custom smelter), Masbate Consolidated Mining Co., Antamok Goldfields Mining Co., I. X. L. Mining Co., Coco Grove, Inc., Baguio Gold Mining Co., Suyoc Consolidated Mining Co., Atok Gold Mining Co., and Demonstration Gold Mines, Ltd., each of which produced over 20,000 ounces of gold; in all, they produced about 820,000 ounces; two floating connected-bucket dredges, each equipped with approximately 110 buckets of 8-cubic-foot capacity, were operated at Paracale, Camarines Norte, by Coco Grove, Inc.; and one 7-cubic-foot connected-bucket dredge by Tambis Gold Dredging Co., Inc., at Lianga, Surigao.

The output of silver from the Philippine Islands in 1939 was 1,191,739 ounces, all produced as a byproduct of gold mining.

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COPPER

By H. M. MEYER

SUMMARY OUTLINE

The world copper industry was geared to high speed in the latter part of 1939; and the threat of hostilities in Europe, which had been the principal spur to record-breaking consumption in foreign countries for a number of years, terminated in declaration of war on Germany by Great Britain and France in September.

The recent records for world consumption have been made in contradistinction to a depressed state of consumption in the United States. Indications point to a new record in 1939 resulting from a maintained high rate of consumption abroad in preparation for war and to improved consumption in the United States, owing to greater industrial requirements during the year and to exaggerated demands in the latter months because of fears of a shortage of supplies in consequence of the war. Domestic withdrawals were the largest since the period of industrial overexpansion in the late twenties and were surpassed only in 1916, 1918, 1926, 1928, and 1929. Consumption outside of the United States is believed to have been at approximately the record level of 1938.

World production in 1939, with the exception of that in 1937, was the highest on record. Outside of the United States output was slightly above that in 1938 and was exceeded only in 1937. Production in the United States, although 27 percent higher than in 1938, had been surpassed in 1937, in every year from 1923 to 1929, and in 1916, 1917, and 1918.

Monthly data released by the Copper Institute indicate that domestic deliveries of copper in the United States from January to July 1939 averaged 27 percent above the monthly average for 1938. This increase was due largely to improvement in industrial demand. The publication of monthly data was discontinued after July, but 5-month totals were released early in 1940. The average of monthly deliveries of copper for August to December was 79 percent over that for the first 7 months and substantially more than double the average for 1938. Undoubtedly, the main part of gains in the latter part of 1939 can be attributed to purchases because of the war, owing partly to actual increased needs, partly to fears that heavy world demands such as accompanied the World War would create a shortage of metal, and partly to speculative buying.

Monthly statistics covering world deliveries, production, and stocks were discontinued with the July statement, because it became impossible to obtain the necessary data. Statistics for the first 7 months reveal that only in June were deliveries as much or more than the average for 1938. It appears likely that deliveries in the last months more than made up for this deficiency.

Producers' stocks of refined copper in the United States fell 47 percent in 1939 and were the smallest since the end of 1928. The inroads into stocks took place in the last months of the year, for at the end of July they were 9 percent higher than at the beginning of the year. The foreign stock position at the end of 1939 is not known. At the end of July stocks were slightly higher than at the beginning of the year.

Self-sufficiency of European belligerents.—Not long after the declaration of war on Germany it became apparent that the experiences of the World War would be of little use as a guide to developments in the new war. As pointed out in Minerals Yearbook, 1939, page 93, one of the salient features of recent copper history has been the remarkable growth of the British Empire in production to a point where it now has an exportable surplus. Examination of the statistics reveals that possibly the surplus is large enough to supply a large part of the needs of its ally, France. In 1913 the British Empire produced 98,000 short tons and its consumption approximated 170,000 tons. In 1925 the Empire produced only 83,000 tons, but the rapid development of deposits in Northern Rhodesia and Canada was responsible for the jump in production to 587,000 tons in 1937 and 611,000 tons in 1938. Copper Cartel production restrictions kept output of copper in Rhodesia in 1938, while record breaking, far below actual production capacity. It is reported that all production restrictions were discontinued at the outset of the present war. The British Empire was reported to have consumed 422,000 short tons in 1937 and 366,000 in 1938, and this consumption rate obviously includes large tonnages for war preparation. Adequate copper for all emergencies seems available to the British Empire, and the problems in connection with supplies appear to revolve principally around ocean transportation and electrolytic refining capacity. The British Government made far-reaching agreements with the Dominions at the beginning of the war for its wartime supplies.

France, on the other hand, must depend for its copper requirements on supplies from outside its political confines. In 1913 it required 113,000 short tons of copper, in 1937 took 132,000 tons, and in 1938 about 120,000 tons. The recent statistical record of France appears to allow less leeway for the building of a war reserve than do those of other important contestants. Developments in 1939 and 1940, when

France entered the market on more than one occasion for substantial quantities of metal, add weight to the belief that it may not have been adequately supplied with metal at the outbreak of the war.

The available statistical record of Germany gives evidence that an apparent reserve, probably of large proportions, was being built during the several years preceding the present war. Germany, too, must obtain the principal part of its copper needs from beyond its political boundaries. In 1913 Germany and Austria-Hungary produced 34,000 short tons of copper and consumed 329,000 tons between them. In 1937 and 1938 Germany produced 30,000 and 33,000 tons and with Austria and Czechoslovakia consumed 306,000 and 439,000 tons.

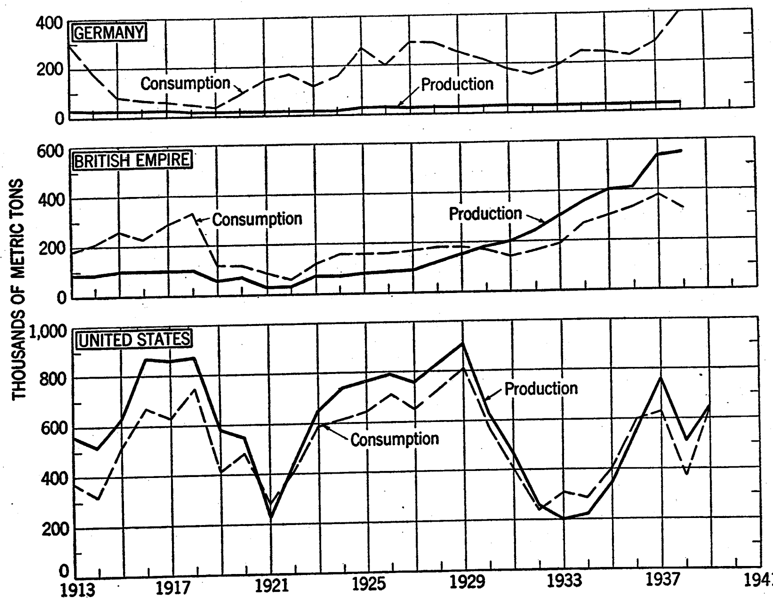

FIGURE 1.—Production and consumption of copper in Germany, the British Empire, and the United States for 1913–38 and in the United States for 1939. Germany includes Austria-Hungary for 1913–14 and Austria for 1919–38; no output was reported for Austria for 1915–18. Consumption and available production data for Czechoslovakia also are included under Germany. The British Empire, as shown here, includes Canada, Great Britain, India, Northern Rhodesia, Union of South Africa, and Australia.

The average consumption for this group for the 5-year period 1934–38 amounted to 308,000 short tons compared with 219,000 in 1929–33 and 266,000 in 1924–28.

Figure 1 shows the relationship of production to consumption in Germany, the British Empire, and the United States.

Market dislocations.—British and French attempts to blockade Germany have extended to rationing of the quantities of copper permitted through the blockade to such countries as Belgium and Netherlands, to prevent the excess over domestic requirements in those nations from reaching Germany. The blockade measures have caused considerable hindrance to the ordinary flow of copper to consuming nations, noncontestants as well as contestants. Chile normally disposes of most of its output in Europe. Because of the blockade and of the contracts between the British Government and Empire producers for its war requirements for copper, Chile was cut off from most of its principal markets when war developed. Thus, production from the largest, lowest-cost mines in the world was temporarily without adequate outlet. This situation was eased by large orders placed by the French Government in November 1939 for copper, principally from Chile and Belgian Congo, with the Cerro de Pasco Copper Corporation and the International Nickel Co. participating. These orders were purported to be on the basis of an annual total of 300,000 tons, and the copper was to be shipped from United States ports. The failure of France to draw on the British Empire for needed metal doubtless was a precautionary measure to safeguard Allied supplies and probably was due also to the deficient Empire production of electrolytic copper.

Large exports of copper from the United States to U. S. S. R., beginning November 1939, drew attention of the Allies because of the possibility that this copper might find its way to Germany. As indicated in Minerals Yearbook, 1939, page 114, U. S. S. R. has been unsuccessful thus far in its attempts to increase output to the point where it can supply its own needs; at present, therefore, the alliance with that country fails to help Germany solve its problems with regard to future supplies. Other available copper output in Europe, could Germany seize it all, would be inadequate to fill the Reich's war demands.

Transactions on the London Metal Exchange were discontinued at the outbreak of war, and this move naturally diverted business formerly handled there to New York. This business is exclusive of Empire needs, however; as already stated, wartime needs of the Empire were cared for by contracts between the Government and Dominion producers.

Domestic changes since World War.—From a domestic standpoint, as well as from that of the British Empire, conditions have changed greatly since the World War of 1914–18, although in a different direction. In 1913 the United States produced 57 percent of total world output compared with 25 percent in 1938 and 30 percent in 1939. Production from domestic ores totaled 612,000 short tons in 1913, rose to an average of 954,000 tons for 1916–18, then declined to 562,000 in 1938 and 713,000 in 1939. Domestic consumption was 33 percent of the world total in 1913, 54 percent in 1929, and 24 percent in 1938. About 406,000 short tons were consumed in 1913, an average of 756,000 tons for 1916–18, 407,000 in 1938, and 715,000 in 1939. With domestic mines producing more than half of the world supply at the beginning of the World War, huge demands for copper resulted in record domestic production tonnages. The records achieved in 1916–18 were surpassed only once since then—in 1929—when industrial activity was at an abnormally high level.

Mines in Northern Rhodesia and Canada were developed chiefly at the expense of production in the United States. The threat of invasion of domestic markets by this new copper led to demands for protection, and in 1932 a tariff of 4 cents a pound was placed on imports. Exportation of larger quantities of domestic copper in 1938 and 1939 is believed to have been due partly to conditions brought about by the cartel group, which restricted production outside the United States, and in periods of sharp buying pressure, common to the copper industry and accentuated by war fears and the war itself, foreign producers were unable to increase output quickly enough to accommodate demands. The principal increase in use of United States copper abroad as a result of the war probably will be in products manufactured in the United States from domestic copper.

Salient statistics of the copper industry in the United States, 1925–29 (average) and 1936–39, in short tons

	Average (1925-29)	1936	1937	1938	1939
New copper produced—					
From domestic ores, as reported by—					
Mines	885,826	614,516	841,998	557,763	728,320
Ore produced:					
Copper ore	59,505,871	[1] 38,514,245	[1 2] 61,513,148	[1 2] 37,794,938	(3)
Average yield of copper, percent	1.44	1.54	1.29	1.34	(3)
Smelters	892,730	611,410	834,661	562,328	712,675
Percent of world total	51	32	32	25	30
Refineries	890,767	645,462	822,253	552,574	704,873
From foreign ores, matte, etc., refinery reports	317,287	177,027	244,561	239,842	304,642
Total new refined, domestic and foreign	1,208,054	822,489	1,066,814	792,416	1,009,515
Secondary copper recovered from old scrap only	347,512	382,700	408,900	267,300	(3)
Copper content of copper sulfate produced by refiners	4,601	4,642	5,855	4,978	4,868
Total production, new and old and domestic and foreign	1,560,167	1,209,831	1,481,569	1,064,694	(3)
Imports (unmanufactured) [4]	391,212	190,339	279,875	252,164	336,297
Refined [4]	59,236	4,782	7,487	1,802	16,264
Exports of metallic copper [5]	522,616	259,032	346,229	421,012	427,517
Refined (ingots, bars, rods, etc.)	482,868	236,091	310,396	385,223	396,406
Stocks at end of year	307,200	305,500	393,000	414,000	355,500
Refined copper	86,100	110,000	179,000	181,000	95,500
Blister and materials in solution	221,100	195,500	214,000	233,000	260,000
Withdrawals from total supply on domestic account:					
Total new copper	778,123	656,179	694,906	406,994	714,873
Total new and old copper	1,288,700	1,141,000	1,227,000	767,000	(3)
Price, average.......cents per pound	14.7	9.2	12.1	9.8	10.4
World smelter production, new copper	1,761,000	1,895,000	2,585,000	2,247,000	[6] 2,414,000

[1] Includes old tailings.
[2] Exclusive of Alaska, figures for which the Bureau of Mines is not at liberty to publish.
[3] Figures not yet available.
[4] Data include copper imported for immediate consumption plus material entering the country under bond.
[5] 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.
[6] Approximate.

Domestic demand in 1939 was sporadic, and sales were concentrated in short periods of heavy buying. Domestic sales were only 15,500 tons in January; rose almost continuously to 66,400 tons in June and jumped to new high record monthly sales of 183,200 tons in July; declined to 38,300 tons in August; and, spurred by the advent of war in September, reached another new record of 183,700 tons in that month. Realization of the effect of changes in world sources of supply since the World War of 1914–18 evidently contributed to the drastic drop in sales to 29,600 tons in December.

In June the 4-cent excise tax on copper imported into the United States was extended to July 1941. The domestic producers have received little benefit from the duty in respect to price advantage over world markets. Undoubtedly, however, the tariff has been responsible for preventing large quantities of foreign copper from entering consumption channels in the United States.

Proposed trade agreement with Chile.—Reduction in the copper tax to Chile was one of the principal factors considered when the possibilities of a trade agreement with that country were being examined late in the year. Companies that have domestic mines only and one whose foreign holdings are proportionately slight filed vigorous briefs against the reduction, and Michigan and western Congressmen strongly opposed the move, some claiming that the Reciprocal Trade Act gave the President authority to cut tariffs only, whereas the tax on copper was an excise tax imposed originally under a provision of the Revenue Act of 1932. Although claiming full authority to decrease the tax to 2 cents a pound, if found desirable, the Government decided against the cut, and negotiations for a trade agreement with Chile were discontinued later.

T. N. E. C. investigation.—During the latter part of January 1940 the copper industry was questioned by the Temporary National Economic Committee (T. N. E. C.), under the chairmanship of Senator O'Mahoney, in its study of monopolies. The investigation was principally concerned with cooperative group action and called only upon those domestic mine producers that have large foreign interests and were members of the Copper Cartel.

First, Dr. Theodore J. Kreps, economic consultant of the committee, testified at length on cartels, tracing the development of these organizations abroad.

Charts prepared by T. N. E. C. showed that the Anaconda Copper Mining Co., Phelps Dodge Corporation, and Kennecott Copper Corporation produced about 26 percent of domestic mine output in 1915 and that the proportion supplied by them had grown to nearly 80 percent by 1937. The most phenomenal gain among these companies was made by Kennecott, whose share rose from less than 1 to 36 percent of the total during that period.

Cornelius F. Kelly, president of Anaconda Copper Mining Co., stated that both the Copper Export Association, Inc., 1919–23, and Copper Exporters, Inc., 1927–32—the latter including foreign as well as domestic members—were formed under the Webb-Pomerene Act permitting combinations of domestic producers to fix prices, for export trade only, to meet concentration of foreign buying power abroad effectively. Copper Export Association aided in the orderly liquidation after the World War of a copper pool of 200,000 tons against which a loan of $40,000,000 was obtained, secured by debentures that were retired as the copper was sold. The purpose of Copper Exporters, Inc., was to try to eliminate speculation in copper abroad. Kelly estimated that 70 percent of primary fabrication is controlled by producing companies.

E. T. Stannard, president of Kennecott Copper Corporation, testified that the copper industry had been unable to agree on a code under N. R. A. and that it was dissatisfied with the one imposed upon it. His testimony indicated that the International Cartel Agreement of 1935 was between subsidiaries of Anaconda and Kennecott in South America and Mexico; Mufulira, Roan Antelope, and Rhokana in Rhodesia; Rio Tinto in Spain; Katanga in Belgian Congo; and Bor in Yugoslavia. All told, these companies controlled about 50 percent of foreign copper production. The purpose of the agreement was to help stabilize production, distribution, and marketing of copper outside of the United States. A quota system allotted production curtailment based upon standard tonnages for each producer which did not represent production capacity. There was no price fixing, he stated, and no allocation of markets. In pointing out the harm done by speculators, Stannard stated that his company had sold almost no copper on the London Metal Exchange in a number of years, except about 5,000 tons on the rising market in 1937 in an attempt to discourage the exaggerated movement. He understood that during the boom of 1937 speculators on the exchange bought 100,000 to 150,000 tons of copper.

Both Kelly and Stannard suggested that the Government afford the copper industry some sort of cooperation, under Government supervision, such as that accorded agriculture under the Capper-Volstead law.

Francis H. Brownell, chairman of the board of the American Smelting & Refining Co., represented custom smelters. He stated that the problems of his organization differed greatly from those of the mining companies, particularly those that operated fabricating subsidiaries. In general, a custom smelter must sell each day an amount equivalent to its intake of metal. Differences between the lead and copper industries which, he thought, caused wider fluctuations in prices of copper were that it is sold 4 months ahead compared with 1 month for lead and that mining-company ownership of fabricating subsidiaries, prevalent in the copper industry, is not common in the lead industry.

Arthur Notman, consulting mining engineer, testified on economic phases of the copper industry. He pointed out that differentials between prices for electrolytic copper and certain fabricated products had increased considerably from 1909–12 to 1935–38. His figures showed that the difference between electrolytic copper, f. o. b. refinery, and copper wire was 1.38 cents a pound in 1909–12 and 3.5 cents in 1935–38; between electrolytic copper and sheet copper it was 4.73 and 7.85 cents; and between electrolytic copper and high brass sheets it was 0.4 cent and 5.95 cents. The later higher-differential period coincided with the ownership of fabricating subsidiaries by copper producers. Notman expressed the view that integration of production and fabricating facilities was unwise for all concerned and that cooperative undertakings to stabilize the industry had always resulted in higher prices for copper.

A résumé of the hearings is published in the Engineering and Mining Journal of February 1940.[1]

DOMESTIC PRODUCTION

Statistics on copper production may be compiled on a mine, smelter, or refinery basis. Mine data are most accurate for showing the geographic distribution of production; smelter figures are better for showing the actual recovery of metal and are fairly accurate for showing the source of production; and refinery statistics give precise information regarding metal recovery but indicate only in a general way the source of crude materials treated. The chapter on Copper in Mineral Resources of the United States, 1930, contains a discussion of the differences among the three sets of figures.

[1] Engineering and Mining Journal, vol. 141, No. 2, February 1940, pp. 110 and 118.

Copper produced from domestic ores, as reported by mines, smelters, and refineries, 1935–39, in pounds

Year	Mine	Smelter	Refinery
1935	760,979,802	762,587,340	676,642,866
1936	1,229,030,719	1,222,819,396	1,290,924,195
1937	1,683,996,000	1,669,322,278	1,644,505,129
1938	1,115,525,160	1,124,656,539	1,105,148,323
1939	1,456,639,000	1,425,349,488	1,409,745,816

PRIMARY COPPER

Smelter production.—The recovery of copper by United States smelters from ores of domestic origin totaled 1,425,349,488 pounds in 1939, a 27-percent increase over 1938. Smelter domestic output constituted 51 percent of world production from 1925–29. The proportion dropped sharply in the succeeding years until 1934, when it represented only 17 percent. From then it increased until it reached 32 percent in 1936 and 1937, declined to 25 percent in 1938, and rose again to 30 percent in 1939.

The figures for smelter production in 1939 are based upon confidential 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 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 precise 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.

Copper produced in the United States from domestic ores, 1935–39

[Smelter output, in pounds fine]

State	1935	1936	1937	1938	1939
Alabama	10,061	14,293	18,820	----------	----------
Alaska	14,601,603	30,421,557	42,215,119	33,492,746	304,000
Arizona	278,519,397	414,144,129	580,493,036	420,351,310	469,712,905
California	1,629,735	10,327,582	10,615,215	1,680,754	8,490,872
Colorado	14,340,744	19,181,339	21,826,209	30,563,654	25,548,762
Idaho	2,124,725	2,924,763	4,804,162	5,611,392	4,632,415
Michigan	73,811,562	91,105,431	84,751,478	75,281,469	89,402,464
Missouri	85,166	464,418	695,569	625,844	1,020,000
Montana	157,760,435	215,433,377	280,662,270	156,249,794	203,512,107
Nevada	72,818,792	146,154,075	149,963,847	93,655,642	184,542,525
New Mexico	4,559,874	6,974,705	63,573,985	43,913,133	74,083,586
North Carolina	(1)	(1)	(1)	(1)	(1)
Oregon	372,093	566,388	870,102	88,670	95,557
Pennsylvania	(1)	(1)	(1)	(1)	(1)
South Carolina	7,796	----------	136	7,893	66
Tennessee	(1)	(1)	(1)	(1)	(1)
Texas	17,995	55,336	316,102	35,740	66,000
Utah	120,972,668	261,202,190	404,168,742	229,876,860	326,117,467
Virginia	683	----------	953	43,279	741
Washington	81,482	201,944	124,422	12,494,297	16,756,007
Wyoming	1,749	42	75	155	----------
Undistributed	20,870,780	23,647,827	24,222,036	20,683,907	21,064,014
	762,587,340	1,222,819,396	1,669,322,278	1,124,656,539	1,425,349,488

(1) Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.

Copper produced (smelter output) in the United States, 1935–39, and total, 1845–1939

[Values rounded]

Year	Short tons	Value
1935	381,294	$63,295,000
1936	611,410	112,499,000
1937	834,661	201,988,000
1938	562,328	110,216,000
1939	712,675	148,236,000
Total, 1845–1939	26,589,394	8,046,567,000

Mine production.—The figures for mine production are based upon reports supplied to the Bureau of Mines by all domestic mines that produce copper. Details of the method of collecting the statistics and reasons for the discrepancy between mine-, smelter-, and refinery-production figures are given in the Copper chapter of Mineral Resources of the United States, 1930.

Mine production is more accurate than either refinery or smelter production for showing the distribution of domestic production by States and districts. It also indicates the production by calendar years more exactly, because additional time is required for smelting and refining. Mine production in 1939 was 1,456,639,000 pounds, an increase of 31 percent over that in 1938 but 18 percent below the average for 1925–29.

Production by States and districts.—The following tables show mine and smelter production by States for 1938 and 1939 and by districts for 1935–39. In 1939 Arizona, Utah, and Montana led in production, with 70 percent of the smelter total compared with 72 percent in 1938. If the output of Nevada and Michigan is added to the above, 89 percent of the output of the country is represented compared with 87 percent in 1938. Arizona's proportion of the total dropped from 37 percent in 1938 to 33 in 1939. Utah's rose from 20 to 23 percent, and Montana's remained unchanged at 14 percent. Nevada's proportion of the total increased from 8 to 13 percent while Michigan's share dropped nearly 1 point to 6 percent. Of the most important copper-producing States, Arizona supplied the same percentage for 1939 as for 1845–1939. Utah and Nevada made excellent showings with 23 and 13 percent in 1939 compared with 12 and 5 percent, respectively, in 1845–1939. On the other hand, Montana and Michigan supplied only 14 and 6 percent of the total for 1939 compared with 22 and 17 percent, respectively, for 1845–1939.

Copper produced in the United States, according to smelter and mine returns, by States, 1938–39, and 1845–1939, in short tons

	1938		1939			1845–1939, Smelter output	
	Smelter returns	Mine returns	Smelter returns		Mine returns		
			Percent of total	Quantity		Total quantity	Percent of total
Alaska	16,746	14,549	0.02	152	128	676,624	2.54
Arizona	210,176	210,797	32.95	234,857	262,112	8,770,822	32.99
California	840	806	.60	4,246	4,180	563,907	2.12
Colorado	15,282	14,171	1.79	12,774	13,215	251,846	.95
Idaho	2,806	2,139	.32	2,316	2,516	84,250	.32
Michigan	37,641	46,743	6.27	44,701	43,985	4,544,890	17.09
Missouri	313		.07	510		(1)	(1)
Montana	78,125	77,213	14.28	101,756	97,827	5,824,974	21.91
Nevada	46,828	46,169	12.95	92,271	66,597	1,322,187	4.97
New Mexico	21,956	20,439	5.20	37,042	46,142	865,971	3.26
North Carolina	(2)	(2)	(2)	(2)	(2)	(1)	(1)
Oregon	44	38	.01	48	48	11,350	.04
Pennsylvania	(2)	(2)	(2)	(2)	(2)	(1)	(1)
South Carolina	4	(2)		(3)		(1)	(1)
Tennessee	(2)	(2)	(2)	(2)	(2)	[4] 259,508	[4] .97
Texas	18	16	(5)	33	34	(1)	(1)
Utah	114,938	108,126	22.88	163,059	171,890	3,148,359	11.84
Virginia	22	(2)		(3)		(1)	(1)
Washington	6,247	6,017	1.18	8,378	8,998	29,098	.11
Wyoming						15,863	.06
Undistributed	10,342	10,540	1.48	10,532	10,648	[6] 219,745	.83
	562,328	557,763	100.00	712,675	728,320	26,589,394	100.00

[1] Included under "Undistributed"; figures not separately recorded.
[2] Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.
[3] Less than 1 ton.
[4] Approximate production through 1928. Figures for 1929–39 are confidential and are included under "Undistributed."
[5] Less than 0.01 percent.
[6] Includes Tennessee for 1929–39.

The Bingham (Utah) district again produced more copper than any other in 1939, followed, as in 1938, by Butte, Mont. The Globe-Miami (Ariz.) district stood third in 1939, having replaced Bisbee, Ariz., which held that position in 1938.

Details of mine production, by districts and companies, in 1939 are available in other chapters of this volume dealing with the production of gold, silver, copper, lead, and zinc in the various States.

Mine production of copper in the principal districts,[1] 1935–39, in terms of recovered copper, in short tons

District or region	State	1935	1936	1937	1938	1939
Bingham	Utah	63,060	124,453	203,421	106,049	167,856
Butte	Montana	76,964	109,004	143,879	76,855	97,266
Globe-Miami	Arizona	18,680	55,668	88,509	44,528	62,400
Bisbee (Warren)	do	32,281	39,842	55,991	47,518	54,617
Ely (Robinson)	Nevada	32,815	57,580	56,706	38,501	51,590
Ajo	Arizona	33,560	48,020	55,375	43,180	49,871
Lake Superior	Michigan	32,054	47,984	47,464	46,743	43,985
Central (including Santa Rita)	New Mexico	1,547	2,213	29,464	16,557	42,344
Yavapai County (mostly Jerome district).	Arizona	38,086	50,327	43,403	29,437	38,203
Ray (Mineral Creek)	do	1	7	17,308	15,029	21,583
Pioneer	do	15,874	16,224	17,104	17,167	17,952
Copper Mountain (Morenci-Metcalf).	do	1	6	6,822	11,148	15,878
Cope	Nevada	3,973	12,557	16,588	6,563	14,065
Red Cliff (Battle Mountain)	Colorado	6,592	7,966	9,458	12,013	11,921
Chelan Lake	Washington				5,931	8,786
Plumas County	California	827	4,239	4,939	602	4,029
Lordsburg	New Mexico	39	408	1,904	3,173	3,184
Ophir	Utah	268	407	391	437	2,070
Coeur d'Alene region	Idaho	987	1,315	1,944	1,883	2,068
Tintic	Utah	882	856	1,331	1,177	1,413
San Juan Mountains	Colorado	536	721	1,142	1,819	981
Bunker Hill	Arizona	16	623	1,396	1,626	246
Copper River [2]	Alaska	[3] 7,750	[3] 18,850	[3] 17,336	[3] 14,549	[4]
Swain County [2]	North Carolina	[5]	[5]	[5]	[5]	[5]
Lebanon (Cornwall mine)[2]	Pennsylvania	[5]	[5]	[5]	[5]	[5]
Ducktown [2]	Tennessee	[5]	[5]	[5]	[5]	[5]

[1] Districts producing 1,000 short tons or more in any year of the period, 1935–39.
[2] Not listed in order of output.
[3] Includes a small quantity produced elsewhere in Alaska.
[4] Negligible.
[5] Bureau of Mines not at liberty to publish figures.

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 United States mines in 1938; figures for 1939 are not yet available. Of the total copper produced from copper ores in the United States in 1938, 79 percent was obtained from ores concentrated before smelting and 18 percent from direct-smelting ore. Included in ore concentrated in 1938 were 3,443,247 tons treated by combined leaching and flotation. In addition to the above, 1,380,212 tons of copper ore were treated by straight leaching. The percentages for 1938 are to be compared with 85 percent obtained from concentrated ore and 15 percent from direct-smelting ores in 1937.

Close agreement between the output as reported by smelters and the recoverable quantity as reported by mines indicates that the estimated recoverable tenor is close to the actual recovery. Classification of some of the complex western ores is difficult and more or less arbitrary. "Copper ores" include not only those that contain 2.5 percent or more copper but also those that contain less than this percentage if they are valuable chiefly for copper. Mines report considerable copper from ores mined primarily for other metals. These include siliceous gold and silver ores, lead and zinc ores, and pyritic sulfur ores.

Copper ore, old tailings, etc., sold or treated in the United States [1] in 1938, 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	13,047,356	[2] 388,594,482	1.49	133,409	4,525,435	$0.58
California	66,943	1,209,600	.90	2,295	47,016	1.65
Colorado	333,103	24,750,110	3.72	17,131	5,421,143	12.32
Idaho	165	34,361	10.41	58	1,339	17.55
Michigan	3,757,705	93,486,000	1.24		93,634	[3] .46
Montana	1,607,713	[2] 148,141,493	4.61	4,965	3,859,576	1.66
Nevada	4,043,892	90,940,400	1.12	47,024	437,970	.48
New Mexico	1,904,374	39,434,566	1.04	5,388	150,094	.15
Oregon	9	660	3.67	10	4	39.22
Texas	70	6,326	4.52		1,235	11.40
Utah	12,032,385	[2] 196,793,479	.82	98,100	919,224	.33
Washington	373,120	11,983,694	1.61	30,650	124,307	3.09
Eastern States	[4] 628,103	21,062,590	1.68	1,797	51,830	.15
	[1] [4] 37,794,938	[1] 1,016,437,761	[1] 1.34	[1] 340,777	[1] 15,632,807	[1] .58

[1] Exclusive of Alaska, figures for which the Bureau of Mines is not at liberty to publish.
[2] Excludes copper recovered from mine-water precipitates as follows: Arizona, 30,142,472 pounds; Montana, 5,563,800 pounds; and Utah, 10,220,878 pounds.
[3] Calculated only on ore that yielded silver.
[4] Includes copper concentrates from pyritiferous magnetite ore from Pennsylvania.

Copper ore, old tailings, etc., concentrated [1] in the United States [2] in 1938, with content in terms of recovered copper [3]

State	Ore, old tailings, etc., concentrated (short tons)	Concentrates produced (short tons)	Copper produced (pounds)	Percent of copper from ore, etc.
Arizona	[1] 10,118,757	485,771	[3] 211,103,892	1.04
California	66,822	2,463	1,195,200	.89
Michigan	3,757,705	72,482	93,486,000	1.24
Montana	1,561,804	314,167	144,949,179	4.64
Nevada	4,029,302	182,469	86,861,500	1.08
New Mexico	1,902,991	72,264	39,277,000	1.03
Utah	12,031,615	303,952	196,641,452	.82
Washington	373,000	25,778	11,948,337	1.60
Eastern States	[4] 532,030	42,274	17,239,970	[5] 1.58
	[2] 34,374,026	[2] 1,501,620	[2] 802,702,530	[2] 1.17

[1] Includes 3,443,247 tons of copper ore treated by combined leaching and flotation but excludes 1,380,212 tons of copper ore treated by straight leaching.
[2] Exclusive of Alaska, figures for which the Bureau of Mines is not at liberty to publish.
[3] Includes copper from copper ore treated by combined leaching and flotation but excludes 31,597,202 pounds of electrolytic copper from copper ore treated by straight leaching.
[4] Pyritiferous magnetite yielding copper concentrates not included with copper ore.
[5] Obtained by including copper concentrates for Pennsylvania and copper ore for other Eastern States.

Copper ore, old tailings, etc., smelted in the United States [1] in 1938, with content in terms of recovered copper and copper produced from all sources, in terms of recovered copper

State	Ore, old tailings, etc, smelted: Short tons	Copper produced (pounds)	Percent of copper	Copper from all sources, including old slags, smelter cleanings, and precipitates (pounds)
Alaska	(2)	(2)	(2)	29,098,000
Arizona	1,548,387	145,893,388	4.71	[3] 421,594,000
California	121	20,400	8.43	1,612,000
Colorado	333,103	24,750,110	3.72	28,342,000
Idaho	165	34,361	10.41	[4] 4,278,000
Michigan				93,486,000
Montana	45,909	3,192,314	3.48	[3] 154,426,000
Nevada	14,590	4,078,900	13.98	92,338,000
New Mexico	1,383	157,566	5.70	40,878,000
Oregon	9	660	3.67	76,000
Texas	70	6,326	4.52	32,000
Utah	770	152,027	9.87	[5] 216,252,000
Washington	120	35,357	14.73	12,034,000
Eastern States	83,373	3,822,620	2.29	21,079,160
	[1] 2,028,000	[1] 182,144,029	[1] 4.49	1,115,525,160

[1] Exclusive of Alaska, figures for which the Bureau of Mines is not at liberty to publish.
[2] Bureau of Mines not at liberty to publish figures.
[3] Considerable copper was recovered from mine-water precipitates.
[4] Mostly recovered from ores classed as dry and siliceous silver ores.
[5] Considerable copper was recovered from mine-water precipitates and from ores classed as zinc-lead and dry and siliceous ores.

Copper ores produced in the United States, 1934–38, and average yield in copper, gold, and silver

Year	Smelting ores: Short tons	Smelting ores: Yield in copper (percent)	Concentrating ores [1]: Short tons	Concentrating ores [1]: Yield in copper (percent)	Total: Short tons [1]	Total: Yield in copper (percent)	Total: Yield per ton in gold (ounce)	Total: Yield per ton in silver (ounce)	Total: Value per ton in gold and silver
1934	977,096	6.21	10,681,967	1.53	11,723,638	1.92	0.0124	0.661	$0.86
1935	[1] 1,612,200	5.42	[2] 17,065,419	1.57	19,112,054	1.89	.0119	.664	.93
1936	[1] 2,388,635	5.05	36,116,692	1.31	38,514,245	1.54	.0099	.453	.70
1937	[1 3] 2,763,184	4.30	[3] 58,737,922	1.15	[3] 61,513,148	1.29	.0081	.327	.53
1938	[1 3] 2,028,000	4.49	[3] 34,374,026	1.17	[3] 37,794,938	1.34	.0090	.414	.58

[1] Includes old tailings, etc.
[2] Exclusive of a small quantity from California, which the Bureau of Mines is not at liberty to publish.
[3] Exclusive of Alaska, figures for which the Bureau of Mines is not at liberty to publish.

REFINERY PRODUCTION

The refinery output of copper in the United States in 1939 was made by 10 plants; 8 of these employed the electrolytic method and 2 the furnace process on Lake Superior copper.

There are five large electrolytic refineries on the Atlantic seaboard, three lake refineries on the Great Lakes, and three refineries west of the Great Lakes—one at Great Falls, Mont.; one at Tacoma, Wash.; and one at El Paso, Tex. Of the above plants, the lake refinery of the Quincy Mining Co. has been idle since 1933.

In addition to the plants mentioned above that at Inspiration, Ariz., is equipped to make electrolytically refined copper direct from the liquors obtained from leaching operations; this copper is shipped as cathodes to other refineries, where it is melted and cast into merchant shapes. The Inspiration plant was idle during 1933 and 1934, but operations were resumed during the latter part of 1935.

The above 12 plants constitute what commonly are termed "regular refineries." Of these plants, 9 employ the electrolytic process and 3 the furnace process. The electrolytic plants have a rated capacity of 1,572,000 tons of refined copper per annum. As they produced but 1,084,000 tons in 1939, only 69 percent of the electrolytic refining capacity was utilized.

The following tables show the production of refined copper at regular refining plants, classified according to source, grade, and form in which it is cast.

Primary and secondary copper produced by regular refining plants in the United States and imported, 1935–39, in pounds

	1935	1936	1937	1938	1939
Primary: [1]					
Domestic: [1]					
Electrolytic	[2] 602,826,051	1,198,132,177	[2] 1,548,857,307	[2] 1,032,976,656	[2] 1,324,817,430
Lake	[2] 73,605,212	91,105,431	[2] 84,007,120	[2] 72,021,341	[2] 84,928,386
Casting	211,603	1,686,587	11,640,702	150,326	
	676,642,866	1,290,924,195	1,644,505,129	1,105,148,323	1,409,745,816
Foreign: [1]					
Electrolytic	500,878,984	353,817,802	486,285,376	479,635,732	609,284,939
Casting and best select	88,947	235,413	2,837,298	47,674	
Refinery production, new copper	1,177,610,797	1,644,977,410	2,133,627,803	1,584,831,729	2,019,030,755
Imports, refined copper [3]	36,142,671	9,563,232	14,974,815	3,603,025	32,527,473
Total new refined copper made available	1,213,753,468	1,654,540,642	2,148,602,618	1,588,434,754	2,051,558,228
Secondary:					
Electrolytic	296,028,315	265,437,556	[4] 312,831,103	[4] 185,084,601	[4] 233,225,695
Casting	927,450	392,167	380,000		
	296,955,765	265,829,723	313,211,103	185,084,601	233,225,695
Grand total	1,510,709,233	1,920,370,365	2,461,813,721	1,773,519,355	2,284,783,923

[1] The separation of refined copper into metal of domestic and foreign origin is only approximate, as an accurate separation at this stage of manufacture is not possible.
[2] Some copper from Michigan was electrolytically refined at an eastern refinery and is included as electrolytic copper.
[3] Data include copper imported for immediate consumption plus material entering the country under bond.
[4] Includes some secondary lake copper.

Copper cast in forms in the United States, 1938–39

Form	1938		1939	
	Pounds	Percent	Pounds	Percent
Wire bars	825,000,000	46.61	1,077,000,000	47.83
Cathodes	522,000,000	29.49	532,000,000	23.62
Cakes	215,000,000	12.15	330,000,000	14.65
Ingots	88,000,000	4.97	137,000,000	6.08
Other forms	120,000,000	6.78	176,000,000	7.82
	1,770,000,000	100.00	2,252,000,000	100.00

In addition to the regular refineries, numerous plants throughout the country operate on scrap exclusively, producing metallic copper and a great 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 of secondary-copper production.

Copper sulfate.—The production of hydrous copper sulfate or bluestone by copper refineries in the United States was 38,219,447 pounds having a copper content of 9,735,000 pounds in 1939 compared with 39,081,407 pounds having a copper content of 9,955,000 pounds in 1938.

The output of copper sulfate by plants other than the regular primary refineries was 48,312,400 pounds with a reported copper content of 12,290,000 pounds in 1939 compared with 49,819,375 pounds containing 12,565,000 pounds in 1938.

SECONDARY COPPER

Secondary copper includes material recovered from remelting old copper and copper scrap and from the treatment of copper alloys or alloys treated without separation of the copper. The following table summarizes the production of secondary copper during 1934–38. The scope of Bureau of Mines work on secondary nonferrous metals was broadened considerably in 1939, and completion of data for that year was necessarily delayed. Statistics for 1939 were not available when this report was written. Further details appear in the chapter on Secondary Metals—Nonferrous.

Secondary copper produced in the United States, 1934–38, in short tons

	1934	1935	1936	1937	1938
Copper as metal	220,400	270,000	260,000	285,600	192,400
Copper in alloys	157,000	178,900	224,600	246,500	167,400
Total secondary copper	377,400	448,900	484,600	532,100	359,800
From new scrap	66,500	87,200	101,900	123,200	92,500
From old scrap	310,900	361,700	382,700	408,900	267,300
Percent of domestic mine output	159	118	79	63	65

CONSUMPTION AND USES

New supply.—The total available supply of new copper consists of the total output of primary copper by refineries plus the imports of refined copper; in 1939 it was 2,051,558,000 pounds, a 29-percent increase from 1938. If this figure is reduced by the quantity of refined copper exported and adjusted for changes in stocks at refineries the quantity of new copper made available for domestic consumption may be estimated. This computation is made in the table that follows. It should be noted, however, that exports and stocks include some refined secondary copper that cannot be determined separately and that actual consumption of new copper would differ from the figures shown in the table by the changes in consumers' stocks, on which data are not available.

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New refined copper withdrawn from total year's supply on domestic account, 1935–39, in pounds

	1935	1936	1937	1938	1939
Total supply of new copper	1,213,753,468	1,654,540,642	2,148,602,618	1,588,434,754	2,051,558,228
Stock at beginning of year	569,000,000	350,000,000	220,000,000	358,000,000	362,000,000
Total available supply	1,782,753,468	2,004,540,642	2,368,602,618	1,946,434,754	2,413,558,228
Copper exported [1]	550,012,320	472,182,922	620,791,029	770,446,945	792,812,995
Stock at end of year	350,000,000	220,000,000	358,000,000	362,000,000	191,000,000
	900,012,320	692,182,922	978,791,029	1,132,446,945	983,812,995
Withdrawn on domestic account	882,741,148	1,312,357,720	1,389,811,589	813,987,809	1,429,745,233

[1] Includes refined copper in ingots, bars, rods, or other forms.

As shown in the foregoing table, the quantity of new copper withdrawn on domestic account in 1939 was 76 percent larger than in 1938 but 20 percent less than in the record year 1929.

Industrial use of copper.—The American Bureau of Metal Statistics estimates the actual consumption of new and old copper in the United States by uses. Data for the past 5 years are shown in the accompanying table.

Estimated use of copper in the United States, 1935–39, in short tons

Use	1935	1936	1937	1938	1939
Electrical manufactures [1]	128,000	164,000	212,000	150,000	185,000
Telephones and telegraphs	18,000	26,000	40,000	30,000	39,000
Light and power lines [2]	55,500	72,000	83,000	62,000	67,000
Wire cloth	5,600	6,500	6,800	6,000	8,000
Other rod and wire [3]	48,000	90,000	102,000	60,000	95,000
Ammunition	13,700	11,900	14,100	12,500	14,500
Automobiles [4]	95,000	108,000	112,000	55,000	85,000
Buildings [5]	49,000	71,000	70,500	67,500	89,000
Castings, n. e. s.[6]	36,000	39,000	40,000	31,000	33,000
Clocks and watches	2,400	3,400	4,000	3,000	3,600
Copper-bearing steel	2,300	3,900	4,600	2,600	4,200
Radiators, heating	1,100	2,000	2,100	2,000	3,600
Radio receiving sets	16,000	24,000	23,100	21,000	27,000
Railway equipment [7]	1,800	4,000	7,100	1,700	2,700
Refrigerators [8]	15,400	15,000	13,500	6,700	10,000
Shipbuilding [8]	1,100	5,000	6,400	6,000	8,500
Air conditioning [8 9]	4,800	6,400	7,200	6,000	6,000
Other uses [10]	51,500	65,300	66,600	46,200	68,000
Manufactures for export	29,500	31,600	45,000	38,800	51,000
	574,700	749,000	860,000	608,000	801,000

[1] Generators, motors, electric locomotives, switchboards, light bulbs, etc.
[2] Transmission and distribution wire and busbars, accounting only for the public-utility companies.
[3] Includes industrial wire and cable, wire in buildings, railway cars and ships, radio broadcasting, railway and municipal signaling, railway electrification, trolley wire, rod and wire for Government projects, blasting wire, flexible cord, and sundries.
[4] Does not include starter, generator, and ignition equipment.
[5] Excludes electrical work.
[6] Bearings, bushings, lubricators, valves, and fittings.
[7] Includes air conditioning.
[8] Excludes electrical equipment.
[9] Other than railway.
[10] Includes condenser tubes, oil-burner tubing, welding rod, screw-machine products, nickel-silver and phosphor bronze products, rivets and burrs, toilet pins, eyelets and grommets, electrotyping and engraving sheet, spark plugs, inner-tube valve stems, jar tops and rouge boxes, flashlight tubes, kerosene lamps, kitchen utensils, kitchen-range boilers, linotype matrices, safety razors, blasting caps, asbestos textiles, water meters, thermostats, soldering coppers, yacht fittings, coinage, washing machines, household water heaters, fire extinguishers, pumps, engines, and sundry machinery, etc., all reckoned in terms of copper content.

The foregoing table shows that the estimated quantity of copper going into use in 1939 was 32 percent larger than in 1938, but in comparison with consumption in 1929 a decline of 31 percent was indicated. Of the more important uses, light and power lines gained only 8 percent in 1939, while other rod and wire rose 58 percent, the largest percentage increase; other rod and wire made one of the best showings compared with 1929, having decreased only 11 percent from that year. Automobiles took 55 percent more copper in 1939 than in 1938, but dropped 38 percent from 1929; refrigerators rose 49 percent in 1939 but were 42 percent below 1929; telephones and telegraphs gained 30 percent over 1938 but made the poorest showing in relation to 1929, having fallen 76 percent from that year. The most important use of copper is for electrical manufactures, which took 23 percent more than in 1938 and 29 percent less than in 1929. Castings gained only 6 percent over 1938 and were 58 percent below 1929. The only important uses that improved over both 1938 and 1929 were buildings, with increases of 32 and 51 percent, respectively; radio, with 29 and 74 percent; and ammunition, with 16 and 110 percent. The consumption of copper in manufactures for export rose 34 percent over 1938 but was 31 percent lower than 1929. The use of copper as measured in pounds per person was 12.21 in 1939, 9.34 in 1938, and 19.08 in 1929.

STOCKS

The following table gives domestic stocks of copper as reported by primary smelting and refining plants. Stocks of blister copper in transit from smelters to refineries are included under blister copper.

Stocks of copper in the United States, Jan. 1, 1936–40, in pounds

Year	Refined copper	Blister and materials in process of refining	Year	Refined copper	Blister and materials in process of refining
1936	350,000,000	472,000,000	1939	362,000,000	466,000,000
1937	220,000,000	391,000,000	1940	191,000,000	520,000,000
1938	358,000,000	428,000,000			

At the end of 1939 inventories of refined copper were 47 percent lower than at the close of 1938. The drop, as will be shown in the subsequent paragraph, was due to acceleration of demand in the latter part of the year, particularly in the final quarter. On the other hand, stocks of blister and anode copper at smelters, in transit to refineries, and blister and unfinished materials in process of refining at refineries increased 12 percent so that total stocks at smelters and refineries were only 14 percent less than at the end of 1938.

Figures compiled by the Copper Institute and published in the press show that domestic stocks of refined, duty-free copper were 289,755 tons at the end of 1938 and rose monthly until the end of May, when they reached the highest level of 1939—337,155 tons. There was a sharp gain in deliveries beginning in July, and notable inroads were made in inventories. Statistics for August to December were published as totals for the period only, so that the month-to-month movements are not clear. Year-end refined-copper stocks stood at only 159,485 tons, so the trend during those months was steeply downward, although, with rapidly advancing domestic production, it probably was arrested in December. During the latter part of the year expanded exports contributed to the downtrend of metal on hand. The Copper Institute reported that blister stocks gained 18,082 tons in 1939. The trend of refined stocks abroad was similar to that in the United States. They were 167,413 tons at the end of 1938 and advanced to reach the highest level of 1939—190,209 tons—in April. They then declined monthly until they were 173,876 tons at the end of July. Foreign data were discontinued after July owing to inability of the Copper Institute to obtain the necessary information.

Copper Institute figures for the United States presumably include some metal held by consumers or at some secondary plants, as reports to the Bureau of Mines from primary refineries indicate that stocks of refined copper at refineries, shown in the foregoing table, were 95,500 tons at the end of 1939 and 181,000 at the end of 1938 (compared with 159,485 and 289,755 tons).

Data for consumers' stocks are not available.

PRICES

Reports to the Bureau of Mines from copper-selling agencies indicate that 910,000 short tons of copper were delivered to domestic and foreign purchasers in 1939 at an average price (f. o. b. refinery) of 10.4 cents a pound compared with 9.8 cents in 1938 and 12.1 in 1937.

Fluctuations in copper prices were relatively narrow in 1939, particularly in view of the startling world events. The small changes were noteworthy also because sales of copper were highly concentrated into short periods during the year. The tendency to concentrate purchases, however, is rather characteristic of the copper-consuming industry.

In the first 2 months of the year sales continued at the abnormally low rate of November and December 1938, and the domestic price stood at 11.025 cents a pound for electrolytic copper, f. o. b. refinery. This price, incidentally, was the highest level attained in 1938, and was due to the momentum from activity early in the final quarter of that year. A high rate of production continued into the first months of 1939 and with lowered demand resulted in a period of rising inventories. Nevertheless, the price held at 11.025 cents until early April, when the pressure of increasing stocks caused a break of ½-cent a pound. Stocks gained until they reached the highest point of the year at the end of May; the price trended downward until late in April and held at that level, with virtually no change, until it reached 9.775 cents early in July. Meanwhile, consumption in the United

States began to improve, export demand picked up, and stocks turned downward in June. As conditions improved it soon became evident that consumers had again refrained from purchasing their needs at declining prices, and they rushed into the market in midyear. Monthly domestic sales in the first half of 1939 ranged from 15,507 tons in January to 60,004 in April and 66,381 in June. Sales aggregated 182,576 tons in July, fell to 38,276 tons in August and reached a new all-time high record of 183,626 tons in September. War rumors contributed to the rush of buying in July, when purchases by France were reported to have touched off the buying movement. The declaration of war by Great Britain early in September, accompanied by the memory of the World War of 1914–18, was responsible for the enormous sales in that month. Realization of changes in conditions of supply since the previous war, however, was followed by a drop in sales to 51,591 tons in November and to 29,592 tons in December. The major price changes of the year were the jump of 1 cent a pound on September 6, following the spectacular purchases made just after the outbreak of the war, and the further increase of ½ cent on October 5. These gains brought the price to 12.275 cents, the highest level of the year, where it continued throughout the remainder of the year.

Transactions on the London Metal Exchange were suspended at the outbreak of the war, and this action had the effect of increasing activity on the New York market. From January through April the domestic price, f. o. b. refinery, was higher than the London price, and for the next 4 months the London price exceeded the domestic one. Coincident with the price advantage on the London market, exports of copper rose. For the first 8 months of the year the domestic price averaged 10.398 cents and the London price 10.066 cents. This price differential is to be compared with the tariff of 4 cents a pound on copper imported into the United States.

When war was declared the British Government made contracts with Dominion producers for its copper requirements for the war period. Maximum prices fixed by the British authorities in September on the various forms of copper were:

Refined copper unwrought, £46, ex warehouse.
Refined copper, unwrought, in ingots, bars, etc., £49 10s., c. i. f.
Electrolytic copper, unwrought, wire bars, ingot bars, or in any other form, £51, c. i. f.
Copper billets, £55, c. i. f.
Copper cakes, £51 12s. 6d., c. i. f., English ports.
Copper cathodes, £50 10s., c. i. f., Engish ports.
Copper-wire rods, £55, delivered.

During December the British Ministry of Supply increased the maximum buyers' prices on copper—mainly, it is understood, to offset increased freight and insurance charges—and at the end of the year the price for electrolytic copper delivered was £62 and for fire-refined copper was £61 10s.

Average monthly quoted prices of electrolytic copper for domestic and export shipments, f. o. b. refineries, United States, and for spot copper at London, 1938–39, in cents per pound

Month	1938				1939			
	Domestic f. o. b. refinery [1]	Domestic f. o. b. refinery [2]	Export f. o. b. refinery [2]	London spot [2 3]	Domestic f. o. b. refinery [1]	Domestic f. o. b. refinery [2]	Export f. o. b. refinery [2]	London spot [2 3]
January	10.30	10.198	9.908	10.131	11.12	11.025	9.912	10.098
February	9.87	9.775	9.525	9.759	11.12	11.025	9.735	9.910
March	9.87	9.775	9.496	9.698	11.12	11.025	9.888	10.065
April	9.87	9.775	9.443	9.653	10.34	10.265	9.820	9.995
May	9.47	9.375	8.801	9.059	9.93	9.833	9.738	9.933
June	8.87	8.775	8.500	8.725	9.87	9.775	9.738	9.935
July	9.68	9.585	9.573	9.771	10.09	9.976	9.944	10.212
August	10.00	9.900	9.844	10.003	10.37	10.261	10.211	10.376
September	10.13	10.028	9.943	10.111	11.80	11.635	11.685	(4)
October	10.86	10.760	10.713	10.897	12.32	12.215	12.491	(4)
November	11.12	11.025	10.569	10.735	12.37	12.275	12.929	(4)
December	11.12	11.025	10.023	10.214	12.37	12.275	12.631	(4)
Average for year	10.10	10.000	9.695	9.912	11.07	10.965	10.727	[5] 10.066

[1] As reported by the American Metal Market Co. [2] As reported by the Engineering and Mining Journal.
[3] Conversion of English quotations into American money based on average rates of exchange recorded by the Federal Reserve Board of the Treasury.
[4] London Metal Exchange dealings suspended for duration of the war.
[5] Average for 8 months; comparable average for "Domestic, f. o. b. refinery," was 10.398 cents.

Average yearly quoted prices of electrolytic copper for domestic and export shipment, f. o. b. refineries, United States, and for spot copper at London, 1930–39, in cents per pound

	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939
Domestic f. o. b. refinery [1]	13.11	8.24	5.67	7.15	8.53	8.76	9.58	13.27	10.10	11.07
Domestic f. o. b. refinery [2]	12.982	8.116	5.555	7.025	8.428	8.649	9.474	13.167	10.000	10.965
Export f. o. b. refinery [2]	(3)	(3)	(3)	6.713	7.271	7.538	9.230	13.018	9.695	10.727
London spot [2 4]	13.355	8.522	5.629	6.877	7.496	7.753	9.465	13.097	9.912	[5] 10.066

[1] As reported by the American Metal Market Co. [2] As reported by Engineering and Mining Journal.
[3] Not available. Export quotation was established after imposition of tariff in 1932.
[4] Conversion of English quotations into American money based on average rates of exchange recorded by the Federal Reserve Board of the Treasury. [5] Average for 8 months.

FOREIGN TRADE [2]

United States imports and exports of copper constitute a well-balanced trade through which the smelting, refining, and manufacturing facilities of this country are utilized to treat foreign raw materials and to return refined copper and manufactures of copper abroad. Ninety-four percent by weight of the copper imported in 1939 was contained in ore, concentrates, and unrefined furnace products, 5 percent was refined copper, and the remainder consisted of ingots to be remelted and recast in the United States. Increased receipts of refined metal in 1939 were due to disruption of ocean transportation caused by the European war in September. By contrast, 96 percent of the exports comprised refined copper and primary manufactures therefrom.

[2] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

The United States has long had an exportable surplus of copper and for many years exported more copper than it imported. In 1930–32 imports exceeded exports, and a tariff of 4 cents a pound was placed on copper in 1932. Exports have exceeded imports since that time, and the principal part of imports has been for smelting, refining, and export.

Separation of total exports to show the quantity of domestic copper shipped from the United States is not possible. Data at hand, however, indicate that exports of domestic copper declined from the quantities shipped in 1938. Excess of total exports over imports of unmanufactured copper fell from 340,000,000 pounds in 1938 to 183,000,000 in 1939. In addition to the copper shown in the accompanying tables, an unrecorded quantity of metal is exported in manufactures, such as electrical machinery, automobiles, and similar equipment.

Imports.—The principal changes were increases in refined imports from 3,603,025 pounds in 1938 to 32,527,473 in 1939, and in imports of unrefined blister and converter copper from 353,596,562 pounds to 490,260,671. Imports of ore were mainly from Chile and Cyprus, those from the former declining while those from the latter rose. Canada, Newfoundland and Labrador, Cuba, and Mexico were the sources of the principal part of receipts of concentrates. Of this group a large decrease was indicated in receipts from Cuba; Mexico also was lower, while there were increases for the other two countries. Large increases were noted in imports of unrefined copper from Chile, British Africa, Mexico, and Turkey. Imports from Peru, Canada, and Yugoslavia, other large sources of unrefined copper, slumped somewhat in 1939. Virtually all refined copper entered is from Chile, and this class increased sharply in 1939.

Copper (unmanufactured) imported into the United States in 1939, in pounds [1]

Country	Ore (copper content)	Concentrates (copper content)	Regulus, black or coarse copper, and cement copper (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
Africa:						
British:						
Union of South		382,941	8,129	33,609,821		120,749
Other South		873,853		29,031,657		
Australia	828,200	4,614,665	579,000			37,839
Bolivia	23,833	4,202,327	53,806	563		
Canada	203,844	53,645,268	2,538,950	32,337,051	840,198	5,117,163
Chile	5,967,129	4,491,438	5,101	197,686,306	31,686,924	
Cuba	356,144	19,369,860				68,316
Malta, Gozo, and Cyprus Islands	3,250,240					
Mexico	702,603	10,972,865	22,787	93,341,911		37,996
Newfoundland and Labrador		20,283,735				31,256
Peru	987,259	465,641	403,365	75,128,805		118,835
Philippine Islands		3,035,336				
Turkey		642,145		10,069,885		
Yugoslavia				19,054,672		
Other countries	17,478	1,341,326	2,044,782		351	1,959,774
	12,336,730	124,321,400	5,655,920	490,260,671	32,527,473	7,491,928

[1] Data include copper imported for immediate consumption plus material entering the country under bond.

Copper (unmanufactured) imported[1] into the United States, 1935–39

Year	Pounds	Year	Pounds
1935	514,364,526	1938	504,327,779
1936	380,677,700	1939	672,594,122
1937	559,749,133		

[1] Data include copper imported for immediate consumption plus material entering the country under bond.

Exports.—Exports of all classes of copper totaled 855,157,653 pounds in 1939—a 1-percent increase over 1938—and were the largest since 1929. The principal class—refined, bars, ingots, or other forms—was virtually unchanged from 1938, while rods, the second-ranking class in 1939, made a substantial gain. Exports of scrap copper declined in 1939. It is noteworthy that France increased its share of exports of refined ingots, etc., by 137 percent, while Sweden gained 34 percent, Italy 28 percent, and Japan 14 percent; U. S. S. R., which took only 110,359 pounds of this class in 1938, received 45,496,194 pounds in 1939. Exports of ingots, bars, etc., to Germany were 71 percent lower than in 1938. Actually, the decrease was more severe, for data covering parts of Czechoslovakia were included under Germany after March 18 or 19, 1939.

Copper exported from the United States in 1939,[1] in pounds

Country	Ore, concentrates, composition metal, and unrefined copper (copper content)	Refined: Bars, ingots, or other forms	Refined: Rods	Old and scrap	Pipes and tubes	Plates and sheets	Wire (except insulated)	Insulated wire and cable	Other copper manufactures
Argentina	13,489	3,191,895			100,063	25,364	117,007	235,742	
Belgium		11,607,307	2,018,698	151,129	2,648		149	32,946	
Brazil	838	7,538,813	263,225	6,702	125,858	27,505	131,610	220,950	
China		2,079,573	711	44,607	125,270	17,708	326,528	331,747	
Czechoslovakia [2]		2,096,989		27,498				1,426	
Denmark		3,469,723	4,041,128		152		310	23,663	
Finland		40,691	6,877,764		376			31,461	
France		152,048,789	561,428	414,046	123	58,829	395	16,062	
Germany [2]	52,675	42,568,111		11,049,580	333		32,881	1,052	
Hong Kong		90,470			3,603	1,478	33,397	61,162	
Hungary [2]		7,357,416		2,648,645			196,055	20,230	
India, British		3,179,372	6,511,215	11,608	252,111	466,511	57,227	159,552	
Indochina, French		10,527,998	7,121		1,931	341	224,000	1,505	(3)
Italy		56,028,758		3,986,127		25,068	88,868	185	
Japan		249,276,881		9,882,258	2,956	32,504	33,246	34,719	
Kwantung		3,356,686	12,945,834	622,903	13,897		24,957	2,795	
Mexico	3,520	2,657,401	11,075	10,962	238,449	170,155	105,270	789,176	
Netherlands		10,844,493	3,827,516	856,028	131,153	7,305	15,873	39,991	
Norway	6,720	3,381,178	8,574,642	13,440	14,621	16,126	70,829	5,399	
Poland and Danzig [2]		25,519,771						130	
Sweden	901	49,968,297	330,000	100,777	48,543	58,123	33,537	50,221	
Switzerland		6,505,861	112,000	224,449	39	24,000		372	
U. S. S. R.[2]		45,496,194		2,745,082	218,280		149,931	2,051	
United Kingdom	38,552	44,456,696	144,318	729,770	13,801	45,843	30,685	115,605	
Other countries	7,144	2,265,288	1,031,669	1,760,045	1,845,681	708,358	5,587,015	12,672,145	
	123,839	745,554,651	47,258,344	35,285,656	3,139,888	1,685,218	7,259,770	14,850,287	(3)
Total value	$24,644	$82,232,831	$5,489,481	$3,375,608	$746,833	$353,280	$997,698	$3,100,990	$863,561

[1] Changes in table in Minerals Yearbook, 1939, p. 111, are as follows: Old and scrap exported to British India should read, 210,088 pounds; Other countries, 140,465 pounds. Insulated wire and cable exported to Brazil should read 522,297 pounds; Sweden, 18,492 pounds; U. S. S. R., 188 pounds; Other countries, 7,123,960 pounds.

[2] For statistical purposes trade with the Sudeten area, as far as ascertainable, is included with Germany, while trade with the other Czechoslovak provinces occupied by Germany, Hungary, and Poland has been included with these countries since March 18 or 19, 1939. After November 16, 1939, trade with Danzig and that part of Poland occupied by Germany has been included with Germany, and trade with that part of Poland occupied by U. S. S. R. has been included with U. S. S. R.

[3] Figures for quantity not recorded.

Copper [1] exported from the United States, 1935–39

Year	Pounds		Total value	Year	Pounds		Total value
	Metallic [2]	Total			Metallic [2]	Total	
1935	590,396,106	605,746,050	$48,363,303	1938	842,023,197	844,027,426	$86,119,848
1936	518,064,333	524,833,536	50,077,631	1939	855,033,814	855,157,653	96,321,365
1937	692,458,087	700,633,261	92,774,770				

[1] Exclusive of "other copper manufactures" valued at $570,061 in 1935, $585,568 in 1936, $851,697 in 1937, $689,008 in 1938, and $863,561 in 1939; quantity not recorded.
[2] Exclusive of ore, concentrates, and composition metal. Exclusive also of unrefined copper, figures for which are not separable from those for ore and concentrates.

Copper sulfate (blue vitriol) exported from the United States, 1935–39

Year	Pounds	Value	Year	Pounds	Value
1935	4,508,271	$142,467	1938	31,249,735	$1,229,317
1936	10,734,408	342,847	1939	29,239,575	1,157,498
1937	23,528,240	1,212,430			

Brass and bronze exported from the United States, 1938–39

	1938		1939	
	Pounds	Value	Pounds	Value
Ingots	236,061	$24,186	1,626,469	$229,753
Scrap and old	31,976,834	2,295,074	10,676,747	743,428
Bars and rods	2,311,072	411,417	9,091,621	1,182,535
Plates and sheets	1,098,504	242,206	2,233,802	534,290
Pipes and tubes	1,385,065	310,903	2,237,718	500,492
Pipe fittings and valves	1,971,222	1,256,571	2,540,930	1,572,466
Plumbers' brass goods	997,044	575,691	1,444,486	801,631
Wire of brass or bronze	367,305	103,831	1,355,583	335,820
Brass wood screws	(1)	23,742	(1)	43,584
Hinges and butts of brass or bronze	(1)	57,883	(1)	74,903
Other hardware of brass or bronze	(1)	248,932	(1)	276,729
Other brass and bronze manufactures	(1)	2,394,411	(1)	2,622,271
	-------------	7,944,847	-------------	8,917,902

[1] Weight not recorded.

Unmanufactured brass exported from the United States, 1935–39

[Ingots, bars and rods, and plates and sheets]

Year	Pounds	Value	Year	Pounds	Value
1935	2,329,353	$382,681	1938	3,645,637	$677,809
1936	2,712,758	462,535	1939	12,951,892	1,946,578
1937	17,373,035	2,573,245			

WORLD ASPECTS OF COPPER INDUSTRY

International cooperation.—At the beginning of 1939 foreign producers who are members of the Copper Cartel were operating at 100 percent of their agreed production capacities—far below actual capacities. The rate was cut to 95 percent effective March 1, but owing to increased demands in anticipation of war it was raised to 105 percent effective August 16. It is stated that all restrictions were removed at the outbreak of the war.

World production.—Mining and smelting of copper in the world are concentrated in the United States, Chile, Canada, Northern Rhodesia, Belgian Congo, U. S. S. R., and Japan. The United States predominates in copper refining by a much wider margin than in mining or smelting and is followed in importance by Chile, Germany, Canada, Belgium, and Great Britain. World smelter production increased 7 percent in 1939 and except for 1937 was the highest ever recorded. Outside United States production was at its highest levels except for 1937, while output in the United States for 1939 (although 27 percent above 1938), had been exceeded in 1937, in every year from 1923 to 1929, and in the World War years, 1916–18. Of the important copper-producing nations in 1939, Canada again surpassed previous mine and smelter records. Northern Rhodesia may also have made a new mine record in 1939, although totals for the year are not yet available. Its smelter output lagged slightly behind the previous record established in 1938. Chile's mine and smelter totals declined 3 and 4 percent, respectively, from production in 1938, while smelter output in Belgian Congo dropped by 2 percent. Production data strongly favor the Allies from the point of view of available supplies. The British Empire is considerably more than self-sufficient in regard to copper and can help to supply France from its surplus. Germany, on the other hand, must import the principal part of its requirements. The countries recently annexed by Germany—that is, Austria, Czechoslovakia, and Poland—add to Germany's problems in regard to copper supplies. U. S. S. R. and Italy, which cooperate with Germany, at present must import copper to meet their requirements, U. S. S. R. to supplement output from its own mines and reduction plants. U. S. S. R. has been making strenuous efforts to raise production to the point where it will not only fill home needs but supply a substantial exportable surplus, and the prospects are that this plan will be accomplished some time in the future. Italy's efforts have been directed toward reducing its consumption of copper.

World mine and smelter production of copper, 1937–39, in metric tons

[Compiled by M. T. Latus]

Country	Mine 1937	Mine 1938	Mine 1939	Smelter 1937	Smelter 1938	Smelter 1939
North America:						
Canada	240,416	259,113	275,829	[1] 210,024	[1] 215,732	[1] 229,370
Cuba	13,191	14,431	9,964			
Mexico	46,077	41,851	44,380	45,755	37,100	44,300
Newfoundland	8,463	8,056	10,341			
Panama	3					
United States	763,844	505,991	660,717	[2] 820,333	[2] 570,773	[2] 698,323
	1,071,994	829,442	1,001,231	1,076,112	823,605	971,993
South America:						
Bolivia	[3] 3,699	[3] 2,885	[3] 4,056			
Brazil		15	14			
Chile	413,282	351,443	339,170	396,444	337,508	324,591
Peru	35,702	37,750	36,087	35,439	35,969	35,001
	452,683	392,093	379,327	431,883	373,477	359,592
Europe:						
Belgium				[4] 90,260	[4] 81,460	(5)
Bulgaria	16	64	(5)			
Czechoslovakia	(5)	(5)	(5)	2,013	(5)	(5)
Finland	12,227	12,232	(5)	10,545	11,824	13,246
France	591	[6] 600	(5)	1,043	(5)	(5)
Germany	27,129	30,000	(5)	[7] 68,000	[7] 70,000	[7] 66,000
Austria	12					
Greece	300		(5)			
Hungary	309	336	(5)			
Italy	1,143	[6] 1,000	(5)	1,465	2,963	(5)
Norway	20,075	21,619	(5)	8,302	10,547	10,515
Portugal	5,607	4,884	(5)			
Rumania	[8] 1,361	[8] 580	(5)	1,361	580	(5)
Spain	[6] 28,000	[6] 30,000	(5)	[6] 10,200	[6] 11,000	[6] 10,000
Sweden	7,174	9,289	(5)	9,093	10,668	11,337
U. S. S. R.[9]	[10] 94,250	[10] 114,552	[10] 108,000	94,250	114,552	108,000
United Kingdom	37	37	(5)	7,519	7,200	(5)
Yugoslavia	42,300	49,500	63,000	39,410	41,993	41,658
	241,000	275,000	(5)	344,000	363,000	(5)
Asia:						
Burma	[6] 3,800	[6] 3,600	(5)			
China[11]	(12)	240	1	(12)	240	1
Cyprus	27,461	29,780	(5)			
India, British	[6] 7,200	[6] 5,600	(5)	6,940	5,416	6,800
Japan:						
Japan Proper	[10] 87,600	[10] 102,000	[10] 104,000	87,600	102,000	104,000
Chosen	[10] 5,122	(5)	(5)	5,122	(5)	(5)
Taiwan	[6] 4,000	[6] 4,000	[6] 4,000			
Netherland India	49	89	(5)			
Philippine Islands	2,038	3,528	5,486			
Turkey	[10] 400	[10] 2,488	[10] 5,917	400	2,488	5,917
U. S. S. R.	(9)	(9)	(9)	(9)	(9)	(9)
	[9] 138,000	[9] 151,000	(5)	[9] 100,062	[9] 110,000	(5)
Africa:						
Algeria		22	(5)			
Belgian Congo	[10] 150,588	[10] 123,943	[10] 121,498	150,588	123,943	121,498
Rhodesia:						
Northern	249,835	254,904	(5)	211,513	216,450	215,065
Southern		5	(5)			
South-West Africa	1,575	4,828	3,530			
Union of South Africa	11,389	11,305	11,077	13,302	10,570	14,287
	413,387	395,007	(5)	375,403	350,963	350,850
Oceania: Australia	19,434	19,758	19,800	17,679	17,372	20,219
	2,336,000	2,062,000	(5)	2,345,000	2,038,000	[13] 2,190,000

[1] Copper content of blister produced.
[2] Smelter output from domestic and foreign ores, exclusive of scrap. The production from domestic ores only, exclusive of scrap, was as follows: 1937, 757,188 tons; 1938, 510,133 tons; 1939, 646,524 tons.
[3] Copper content of exports.
[4] Figures represent blister copper only. In addition to blister copper, Belgium reports a large output of refined copper which is not included above as it is believed produced principally from crude copper from the Belgian Congo and would therefore duplicate output reported under the latter country.
[5] Data not yet available. [6] Approximate production. [7] Exclusive of material from scrap.
[8] Smelter output from ores. [9] Output from U.S.S.R. in Asia included under U. S. S. R. in Europe.
[10] Smelter product. [11] Exports of ingots and slabs. [12] Less than 1 ton.
[13] Approximate production based on the output of the countries shown, which in 1938 contributed about 95 percent of the total world output.

World consumption.—Inability to obtain statistics for many countries covering imports and exports in the latter part of 1939 has made it impossible to calculate world consumption, so that the usual discussion of American Bureau of Metal Statistics data cannot be presented. Indications are that a new high record was attained in 1939, in consequence of a maintained high rate of use abroad in preparation for war and of improved consumption in the United States, owing to greater industrial requirements and to exaggerated demands in the latter part of the year because of fears of a shortage of supplies as a result of the war.

Data for the first 6 months of 1939 indicate that apparent consumption of copper in Great Britian and Italy was at rates approximately 5 and 30 percent, respectively, over the annual rate for 1938, while that in France and Germany was about 5–10 and 30 percent, respectively, below.

REVIEW BY COUNTRIES

Belgian Congo.—Production of copper in Belgian Congo amounted to 121,498 metric tons compared with 123,943 in 1938 and 150,588 in 1937. During the first 8 months of 1939 production was regulated by the Copper Cartel and ranged from 95 to 105 percent of nominal capacity (considerably below actual capacity), but after the opening of hositilities between the Allies and Germany in September, apportionment of production was abandoned temporarily. After war started the Allies began to ration quantities of copper permitted through their blockade to neutrals, to prevent Germany from receiving the excess over consumption in such countries. This practice interfered with the free movement of copper from Belgian Congo to Belgium. In November it was announced in the press that copper for Belgian consumption would continue to be refined at the Hoboken plants at Oolen near Antwerp and that the remainder of Belgian Congo copper would be treated on the spot at the Panda works or shipped to North America for refining. A Belgian news letter, quoted in the Metal Bulletin, London, of January 16, 1940, stated that the Allies had liberalized embargo restrictions on copper for Belgium, that Union Minière du Haut Katanga probably would produce 80,000 tons in the first half of 1940, and that raising the output to a basis of 250,000 tons a year was prevented only by a hesitancy to make the necessary capital expenditure in the face of uncertain conditions. This company has opened offices in New York, Johannesburg, Cape Town, and Lisbon. It shared in large purchases of the French Government late in 1939 and early in 1940, which eased the situation caused by the Allied blockade.

Development work at the new Ruwe and Kolwezi copper deposits is reported to have been promising, and Union Minière is building a 1,500-ton concentrator at Kolwezi. The concentrates will be transported by rail to other works of the company for further treatment.

Canada.—The breaking of copper-production records is beginning to be an annual accomplishment in Canada, and 1939 marked another forward step. Mine output totaled 304,051 short tons compared with 285,625 in 1938, the previous record year, and smelter production amounted to 252,838 tons compared with 237,806 in 1938, the previous record year.

An outstanding feature of the year was the agreement between the Imperial Government and large base-metal producers by which the producers were to supply the Imperial Government with copper, lead, and zinc at prices that prevailed shortly before the outbreak of the war. As in past years, more than half of the copper produced—54 percent in 1939—came from the nickel-copper mines of the Sudbury district, Ontario. The principal producer is the International Nickel Co. of Canada, Ltd., which refines the major part of the copper it produces in the company refinery at Copper Cliff and exports the remainder as matte. At the Copper Cliff smelter 185,578 tons of bessemer matte and 165,129 tons of converter copper were produced. Some plant expansion is planned to provide smelter capacity for increased output at the concentrator. The refinery received 165,129 tons of molten converter copper from the Copper Cliff smelter and produced 150,541 tons of refined copper. A second electric furnace was brought into operation in January 1939, and the year's operation was featured by increased electric furnace activity and decreased use of reverberatory furnaces for producing refined shapes. The Falconbridge Nickel Mines, Ltd., exports its matte to Norway for refining. The Noranda Mines, Ltd., with a smelter at Noranda, Quebec, is the largest producer in Quebec; this Province supplied 19 percent of the country's total. Noranda blister is shipped to the Canadian Copper Refiners, Ltd., at Montreal East, in which it owns the principal interest. An article [3] on smelting practice at Noranda was published in 1939. Late in the year it was reported that the Waite-Amulet mill was handling more than 600 tons of ore daily and planned further plant increases to an eventual total of 1,000 tons by the spring of 1940. Noranda has a controlling interest in this company and smelts its concentrates. The Normetal Mining Corporation, Ltd., operated throughout the year and shipped its concentrates to Noranda. Concentrates produced by the Aldermac Mines, Ltd., were exported to the United States for smelting. The Eustis mine of the Consolidated Copper & Sulphur Co. in Quebec, reported to have produced for 74 years, was closed in midyear owing to exhaustion of ore reserves. The output of Manitoba and Saskatchewan Provinces was from the Flin Flon mine of Hudson Bay Mining & Smelting Co., Ltd., and the Sherritt Gordon mine of the Sherritt Gordon Mines Co., Ltd. The Hudson Bay smelter treats ore from both properties. The two principal copper-producing mines in British Columbia are the Britannia mine at Howe Sound and the Copper Mountain mine of Granby Consolidated Mining, Smelting & Power Co. Concentrates from these two properties are exported. Early in 1940 it was reported that Granby had extended for 3 years the contract for the shipment of all its concentrates to Japan. The new contract can be canceled by either party as of June 30, 1941.

Copper produced (mine output) in Canada, 1938–39, by Provinces, in pounds

Province	1938	1939
British Columbia	65,759,265	72,530,552
Manitoba	65,582,772	70,458,890
Northwest Territories	75,567	42,382
Nova Scotia	----------	1,269,179
Ontario	309,030,106	328,428,665
Quebec	112,645,797	117,238,897
Saskatchewan	18,156,157	18,133,149
	571,249,664	608,101,714

[3] The Mining Journal, London, Recent Smelting Practice at Noranda: August 26, 1939, vol. 206, No. 5427, pp. 793–4.

Canada exports most of its copper and in 1939 shipped 60,750 tons of copper in ore, matte, regulus, etc.; 15,556 tons of blister; 165,819 tons of ingots, bars, etc.; 29,370 tons of rods, strips, etc.; and 3,465 tons of old and scrap copper to foreign countries. Of the ore exported 31,973 tons went to the United States and 17,022 tons to Japan. The United Kingdom was the destination of 125,917 tons of the refined ingots and bars exported.

Chile.—In 1939 smelter production of copper in Chile amounted to 324,591 metric tons compared with 337,508 in 1938 and 396,444 in the record year 1937. Mine production totaled 339,170 tons compared with 351,443 in 1938 and 413,282 in 1937. Chile normally disposes of most of her copper in Europe. When war was declared between Great Britain and France and Germany considerable disruption to Chilean export copper trade was caused owing to contracts entered into between Great Britain and its dominions for its copper requirements for the war period and to attempts of the Allies to throw an economic blockade around Germany, which included rationing of quantities permitted through the blockade to neutrals in order that there would be no excess commodities for reshipment to Germany. Large orders from France late in 1939 and early in 1940 for Chilean and Belgian Congo metal eased the situation.

The Chilean Government raised the income-tax rate from 18 to 33 percent as of January 1, 1939.

Exports of electrolytic copper totaled 156,852 metric tons in 1939 compared with 184,200 in 1938. Of the 1939 total, 47,586 tons were shipped to the United States, 26,417 to Belgium, 23,148 to Sweden, 21,148 to Great Britain, 18,870 to France, and 15,740 to Italy. Blister exports totaled 155,393 tons in 1939 compared with 165,120 tons in 1938. The United States was the principal destination of the exports of blister in 1939; 85,218 tons went to that country while 39,367 went to Great Britain, 7,682 to France, and 7,011 to Italy. Exports of ore and concentrates rose from 6,088 tons in 1938 to 12,867 in 1939.

The Chile Copper Co. produced 139,300 metric tons of copper in 1939 compared with 148,100 in 1938, and Andes Copper 55,100 tons compared with 55,200. These two companies are subsidiaries of Anaconda Copper Mining Co. Braden Copper Co. (subsidiary of Kennecott Copper Corporation) produced 118,400 tons of copper in 1939 compared with 119,800 in 1938. During 1939, 6,962,687 short (6,316,410 metric) tons, assaying 2.15 percent copper, were mined and treated.

An extensive report on the mining industries of Chile, by Charles Will Wright,[4] was recently published by the Bureau of Mines. This report describes the principal copper-mining and reduction operations in Chile and contains general information regarding labor organizations, marketing of ores and concentrates, and other matters. According to this report, the erection of a smelter for copper and gold ores and concentrates, which would be financed by the Government, is being considered. The purpose of this action would be not only to encourage increased output from the small mines but to obtain additional foreign exchange, estimated at $1,000,000. The annual output of the proposed plant probably would be only about 10,000 tons of

[4] Wright, Charles Will, The Mining Industries of Chile, Their Production and Future Possibilities: Bureau of Mines Foreign Minerals Quart., vol. 3, No. 2, April 1940, 80 pp.

copper, which is small in comparison with Chile's total. The problems connected with carrying out such a project, principally concerned with an adequate supply of ores and fluxes to assure continuous operation, are being studied by Government engineers. The technical difficulties include the high silica and aluminum content and the deficiency in iron and sulfur in Chilean ores; the latter characteristics contribute to their salability in the United States, where they are mixed with ores high in iron and sulfur.

Wright states that copper companies operating in Chile and controlled by United States capital supply 57.4 percent of the mineral exports and furnish 45.7 percent of the total exports from Chile, and that these companies have invested about $350,000,000 in mine plants and in the development of low-grade copper deposits. Besides paying a profits tax of 33 percent, the companies are obliged to convert their dollars for pay rolls and purchases in Chile at 19.37 pesos to the dollar instead of at the export rate of 25 pesos. They also pay the workmen the highest wages and supply them with better living conditions than any of the other industries.

Germany.—For many years the output of copper from domestic ores has averaged less than 30,000 metric tons. During these years Germany has taken turns with the United Kingdom as the second-largest consuming nation in the world, with an average annual apparent consumption of 162,000 tons for 1913–38; for 1934–38 the average was 237,000 tons. These figures exclude consumption in Austria and Czechoslovakia, which increase Germany's dependence on outside sources for copper. The difference between mine output and consumption has been filled by imports of ore, metal, and scrap material. During the past few years apparent consumption is believed to have been considerably above real consumption, and large stocks of copper probably were accumulated in preparation for war. Strenuous efforts to increase mine output and to decrease consumption in order to become more nearly self-sufficient as regards this commodity have failed to make Germany independent, except for a period during which available stocks could be used.

The following tables indicate the principal sources of crude and refined imports of copper during the past 5 years. It is notable that the largest quantities of ore are credited to France, British possessions in the Mediterranean, Netherlands, Belgium, Denmark, and the United Kingdom; and of ingots, bars, etc., to Rhodesia, Chile, the United States, and Belgian Congo. Obviously, the outbreak of hostilities between Germany and the United Kingdom and France in September, and the attempted placing of a blockade around Germany, had the effect of cutting off most of the copper from these sources. Prospects for Germany obtaining her requirements from European sources appear to be entirely out of the question, for it would take almost the combined continental output; even U. S. S. R., the largest producer, at present must import metal to meet its own requirements. Other smaller producers dispose of the principal part of their production but sell to various countries. Increased receipts of copper from European producers, such as Yugoslavia, Spain, Norway, and Finland, however, would tend to increase the life of Germany's stock pile. The fact that the Bor mine in Yugoslavia and the Rio Tinto mine in Spain, principal producers in those countries, are owned by French and British capital complicates the task of obtaining larger supplies from those sources, but does not present an insuperable problem.

Imports of copper into Germany in ingots, bars, etc., 1935–39, by countries, in metric tons

Country	1935	1936	1937	1938	1939 (7 months)
Rhodesia		39,124	52,001	76,500	28,668
Chile	35,173	18,994	19,920	40,007	19,728
United States	16,588	6,568	23,395	62,330	18,580
Belgian Congo	24,991	27,807	29,608	39,931	17,376
Finland	4	5,787	11,224	13,030	7,587
Sweden	3,292	5,564	4,534	6,244	4,201
Yugoslavia	11,671	13,000	11,527	7,011	3,538
Canada	2,067	1,524	6,414	18,995	1,638
Belgium-Luxemburg	4,576	3,395	5,314	5,932	819
British South Africa	47,624				
Other countries	7,379	5,786	5,983	2,420	1,297
	153,365	127,549	169,920	272,400	103,432

Imports of copper ore (including burnt cupreous pyrite), into Germany, 1935–39, by countries, in metric tons

Country	1935	1936	1937	1938	1939 (7 months)
France	34,154	65,404	86,228	155,869	109,676
British possessions in the Mediterranean	3,048	28,204	79,710	141,481	82,804
Netherlands	76,067	115,865	131,236	114,287	54,531
Belgium	68,085	62,903	66,752	53,711	38,083
Denmark	59,150	63,269	48,805	50,289	34,824
United Kingdom	50,985	57,876	60,082	32,055	30,649
Eire (Irish Free State)	4,361	19,303	11,711	11,403	20,363
Norway	15,485	14,861	31,324	36,077	18,398
Finland	56,448	26,412	4,642		(1)
Lithuania	10,085	9,354	10,975	9,688	(1)
Other countries	22,670	19,020	24,113	49,071	23,886
	400,538	482,471	555,578	653,931	413,214

1 Not separately reported so some ore from these countries may be included under "Other countries."

Imports of copper scrap for the first 7 months of 1939 were 12,107 tons compared with 27,308 tons in all of 1938 and 32,703 tons in 1937. Exports of ore totaled 4,773 tons in the first 7 months of 1939 compared with 5,625 in all of 1938 and 4,559 in 1937, while exports of bars were 182, 355, and 7,157 tons, respectively; those of rods, sheets, etc., were 9,884, 11,795, and 16,555 tons; of wire were 3,487, 4,572, and 4,961 tons; and of tubes were 3,409, 4,976, and 4,928 tons, respectively.

According to a report from Consul Sydney B. Redecker, Frankfort on the Main, June 7, 1939, exploratory work was in progress at what were purported to be extensive copper deposits in Lower Silesia. When fully developed, it was reported, these deposits will yield 2,500 to 3,000 metric tons of copper annually. They are reported to resemble the copper ore deposits of the Mansfeld district in many respects but to be more extensive and of considerably lower grade. As in the case of the Mansfeld deposits, production is expected to be possible only as a result of substantial Government subsidies.

Mexico.—Smelter and mine outputs of copper were virtually the same in 1939—44,300 and 44,380 metric tons—compared with 37,100 and 41,851 metric tons, respectively, in 1938.

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Difficulties in connection with operations in Mexico are shown by the following items. In midyear the Mazapil Copper Co. petitioned the Mexican Government for permission to suspend operations temporarily, owing to the fact that the company was operating at a heavy loss. It is reported that the petition was refused. Later in the year, however, the property was turned over to approximately 600 employees to conduct on a cooperative basis under a 10-year lease; during the first year the company was to recover 5-percent royalty and during the remaining years 8 percent. Early in 1940 it was reported that Asarco had started a court presentation in Mexico City to prove that it cannot comply with the orders of the Federal Board of Conciliation and Arbitration that it must continue to operate its copper smelter at Matehuala, San Luis Potosi. The company presented proofs of its contention that this plant cannot continue operation owing to a lack of crude material. In its annual report the American Smelting & Refining Co. states that on account of existing conditions in Mexico the company is pursuing the policy of making no new investments there and is avoiding expenditure upon its plants for more than the amount necessary to keep them in efficient operating condition. In the year ended June 30, 1939, the smelter of Compagnie du Boleo produced 7,695 metric tons of copper compared with 8,285 tons in the previous year.

Northern Rhodesia.—Smelter output totaled 215,065 metric tons and was slightly below the record production of 216,450 tons in 1938. A new record may have been established for mine production in 1939, but statistics thereon are not yet available.

In the fiscal year ended June 30, 1939, Roan Antelope Copper Mines, Ltd., extracted and milled 2,816,000 short (2,514,000 long) tons of ore, averaging 3.25 percent copper compared with 3,126,100 short (2,791,000 long) tons in the year immediately preceding. Blister production was 68,262 long tons in the year ended June 30, 1939, and 75,253 long tons in the earlier year; and the average cost, not including reserve for depreciation, was £21.322 per long ton of blister compared with £22.151. Total costs, including all but taxation, amounted to £24.252 in the year ended June 30, 1939, and £24.809 in the year immediately preceding. Revenue from copper sales amounted to £44.129 and £45.469, respectively, in the 2 years. Ore reserves were reported as 110,426,774 short (98,595,000 long) tons, containing 3.428 percent copper, at the end of June 1939, an increase of 26,988,102 short (24,097,000 long) tons over the reserve previously reported. The increase was due to the finding by drilling and underground exploration of additional ore in the eastern section of the Roan Antelope Extension area and by the addition of the pillar of ore under the Luansbya River for which a method of mining has been devised. Progress was reported in construction and in other work necessary to permit a monthly output of over 11,000 short tons when required.

The Rhokana Corporation, Ltd., produced 50,810 long tons of blister copper and 31,691 tons of electrolytic copper, a total of 82,501 tons, in the fiscal year ended June 30, 1939, compared with 76,275 tons in the year immediately preceding. The average cost of blister production was £22 17s. 3d. and of electrolytic copper was £25 16s. 8d. In the previous year costs were £22 7s. 5d. and £24 4s. 3d., respectively. A total of 2,817,500 short (2,516,000 long) tons of ore was mined from the Nkana and Mindola sections and 2,830,000 short (2,527,000 long) tons containing 3.625 percent copper were concentrated. Corresponding figures for the previous year were 2,801,500 short (2,501,000 long) tons and 2,796,500 short (2,497,000 long) tons, respectively. The differential flotation of copper and cobalt was practiced until the end of May 1939, when it was stopped to conduct a new segregation experiment in the smelter. Ore reserves at the end of June 1939 were reported as follows: Nkana North Ore Body, 22,755,250 short tons containing 3.55 percent copper; Mindola Ore Body, 76,070,542 tons containing 3.52 percent; and Nkana South Ore Body, 15,181,000 tons containing 2.79 percent—a total of 114,006,792 tons averaging 3.43 percent copper. The company owns a 32.303-percent interest in Mufulira Copper Mines, Ltd.

Considerable work was reported done toward equipping and opening the Nchanga Consolidated Copper mine and draining the syncline. As a result of development work it has been estimated provisionally that the ore available for mining above the 470-foot level amounts to approximately 3,000,000 short tons averaging 6.86 percent copper, of which 2.29 percent is sulfide and 4.57 percent oxide. The pilot plant for experimental treatment of the ore was reported to have given encouraging results. In April 1940 it was reported that the plant at the Nchanga mine was to be extended to produce concentrates equivalent to 5,000 tons of copper a month.

The Mufulira Copper Mines, Ltd., produced 59,616 long tons of blister copper in the fiscal year ended June 30, 1939, compared with 52,436 tons in the previous year. The production cost, including reserve for replacements but excluding taxation, was £25.707 per long ton compared with £28.608 per ton in the year ended June 30, 1938.

Peru.—In 1939 the Cerro de Pasco Copper Corporation produced 74,878,473 pounds (33,965 metric tons) of copper, 12,168,901 ounces of silver, 79,557 ounces of gold, 52,896,176 pounds of lead, and 21,087 short tons of zinc concentrates. Production of this company in 1938 totaled 78,458,979 pounds (35,588 metric tons) of copper, 12,396,991 ounces of silver, 74,063 ounces of gold, 57,329,999 pounds of lead, and 21,379 short tons of zinc concentrates. Descriptions of the Cerro de Pasco district, its history, and ore reserves and of the Northern Peru Mining & Smelting Co. and other copper mines are given in a report by Wright.[5]

U. S. S. R.—Brief notes on the copper deposits and plants in U. S. S. R. are included in the chapter on copper in Minerals Yearbook, 1939.

The Mining Journal (London) of August 19, 1939, in a report from an occasional correspondent, states that a powerful nonferrous-metal industry has been built in U. S. S. R.; that during the Second 5-year Plan (1933–37) the Soviet Union doubled its output of copper and that by 1942 output of copper would be three times that for 1937. Mine data are not available for 1937, but smelters produced 94,250 metric tons, which was increased to 114,552 tons in 1938 but fell to 108,000 tons in 1939.

As previously stated in Minerals Yearbook reports, efforts of the Government not only to become self-sufficient in regard to copper but to produce a large exportable surplus have thus far fallen far short of

[5] Wright, Charles Will, Mineral Resources, Production, and Trade of Peru: Bureau of Mines Foreign Minerals Quart., vol. 3, No. 1, January 1940, pp. 24–33.

plans. Numerous reports are to the effect that mine development and plant construction lack the desired efficiency. In any event, the U. S. S. R. still must import large quantities of copper to supply home requirements. A development of possible significance was the sudden shipment of large quantities of refined copper from the United States to the U. S. S. R. In the first 10 months of 1939 no such exports were reported, but in November 5,200 metric tons of refined copper were shipped there, December 15,500 tons, January (1940) 24,100 tons, February 5,800 tons, March 5,100 tons, and April none. Rumor stated that much of this copper was ultimately for German consumption, and in the early months of 1940 the Allies are reported to have interrupted shipments destined for Vladivostok. Further rumors claimed that the U. S. S. R. later had copper up for resale in the United States market.

A recent report [6] states that the Moscow "Pravda" of November 17, 1939, contains an article describing the construction of the Sreduralmedzavod (Central Ural copper-refining plant), near Sverdlovsk. The following quotation is of possible interest:

> The ore, ground first coarse then fine in crushers and ball mills, passes into the flotation baths, from which it comes in a moist mass, where the copper is mixed only with pyrites tailings. Here the drier takes up the task of eliminating the 10 to 12 percent of moisture, which at present increases the weight of concentrates shipped to the refineries. The drier conveyors and drums are now installed and ready to operate; a start is scheduled for January next.
>
> The complete working of the recovery process is still, it is felt, hampered by the lack of facilities to recover the sulfur gases released in roasting. At the present a chimney 150 meters high is supposed to release these gases so high up as to prevent injury to vegetation in the vicinity. But it would be much more profitable if the authorities erected a chemical factory to recover and utilize the sulfur, estimated at 100 metric tons daily under full operation of the refinery, instead of wasting them.
>
> The output of concentrate has been steadily rising, and for 10 months of this year was 61 percent higher than for all of 1938; the proportion of metal recovered from the ore has also risen, from about 75 percent to 82 to 84 percent.
>
> The present management of this plant is weak, and much engaged in futile paper work. In 10 months of 1939 a total of 729 orders were issued by the chief engineer's office, ranging from the purchase of a pair of pliers to some important production process. The engineers attempt to limit their efforts to actual production, but are constantly assigned to other work. There must be a change of system here, to secure greater efficiency when the plant is in full operation.

Yugoslavia.—This country has been successful in sharply increasing its mine output in recent years. For 1939 a record production of 63,000 metric tons was reported compared with 49,500 in 1938, 42,300 in 1937, and an annual average of 35,000 metric tons for 1932–36. Smelter production totaled 41,658 tons in 1939, 41,993 in 1938, and 39,410 in 1937; the average annual smelter output for 1932–36 was 38,700 tons. The Mines de Bor, operated under French control, is responsible for virtually the entire production. In January 1940 it was reported [7] that this company had arranged with the Government to sell part of its output to the State and to have the remainder available for its free disposal. Naturally, efforts were being made to prevent shipments of any Bor copper to Germany. An electrolytic refinery was completed and opened on July 2, 1938. Exports of crude copper began to fall when the new refinery was assured. Imports into the United States of unrefined copper from Yugoslavia fell from 17,300 tons in 1936 to 14,600 in 1937, 9,600 in 1938, and 8,600 in 1939.

[6] Russian Economic Notes, vol. 2, No. 3, February 15, 1940, pp. 6–7.
[7] The Metal Bulletin (London), No. 2454, January 9, 1940, p. 4.

LEAD [1]

By E. W. Pehrson and H. M. Meyer

SUMMARY OUTLINE

Conditions that affected the lead industry were considerably improved in 1939; production and consumption increased, prices were higher, and stocks were reduced. Production of refined primary lead from domestic ores increased 27 percent in 1939 and was, except for that in 1937, the highest on record since 1930. Production from foreign ores and base bullion increased 22 percent in 1939. Imports of lead ore decreased, but there was a marked increase in imports of base bullion. Exports of refined pig lead were the highest since 1928. Production exceeded demand during the first half of 1939 and stocks increased slightly, but domestic shipments increased rapidly after July and by the end of the year stocks had declined to the lowest year-end inventory since 1929. Prices remained fairly constant near 4.80 cents per pound at New York from January to July, but increases during the third quarter of the year raised the price to 5.50 cents a pound, which held for the remainder of the year. The average for the year was 5.05 cents a pound compared with 4.74 cents in 1938. Quotations on the London Metal Exchange were discontinued in September; for the first 8 months of 1939 the average differential between New York and London prices was 1.74 cents a pound.

[1] This report deals primarily with the smelting, refining, and consuming phases of the industry. For full details of mining operations see separate reports issued for the various States.

Salient statistics of the lead industry in the United States, 1925–29 (average) and 1935–39, in short tons

	1925–29 (average)	1935	1936	1937	1938	1939
Production of refined primary lead:						
From domestic ores	660,525	310,505	387,698	443,142	331,964	420,967
From foreign ores and base bullion	123,104	14,055	11,458	24,175	51,705	63,068
	783,629	324,560	399,156	467,317	383,669	484,035
Recovery of secondary lead:						
As pig lead	126,600	156,800	137,500	154,500	119,400	(1)
In alloys	153,400	113,600	125,400	120,600	105,500	(1)
	280,000	270,400	262,900	275,100	224,900	(1)
Total production of pig lead (primary and secondary)	910,229	481,360	536,656	621,817	503,069	(1)
Imports: [2]						
Lead in base bullion	95,747	2,692	312	1,800	15,296	48,902
Lead in ore	40,096	20,025	20,713	34,103	45,370	30,842
Exports of refined pig lead	98,048	6,982	18,313	20,091	45,866	74,392
Refined primary lead available for consumption	690,916	318,900	383,433	449,464	339,708	415,031
Estimated consumption of primary and secondary lead	900,250	538,900	633,550	678,700	546,000	667,000
Prices:						
New York:						
Average for year cents per pound	7.47	4.06	4.71	6.01	4.74	5.05
Quotation at end of year do	6.25	4.50	6.03	4.75	4.85	5.50
London average do	5.87	3.12	3.91	5.15	3.33	[3] 3.09
Mine production of recoverable lead	664,230	331,103	372,919	464,892	369,726	413,979
World smelter production of lead	1,850,000	1,524,000	1,629,000	1,851,000	1,874,000	1,874,000

[1] Data not yet available.
[2] Data include lead imported for immediate consumption plus material entering the country under bond.
[3] Average for 8 months; London Metal Exchange dealings suspended in September.

Figure 1 shows trends in the domestic lead industry since 1900.

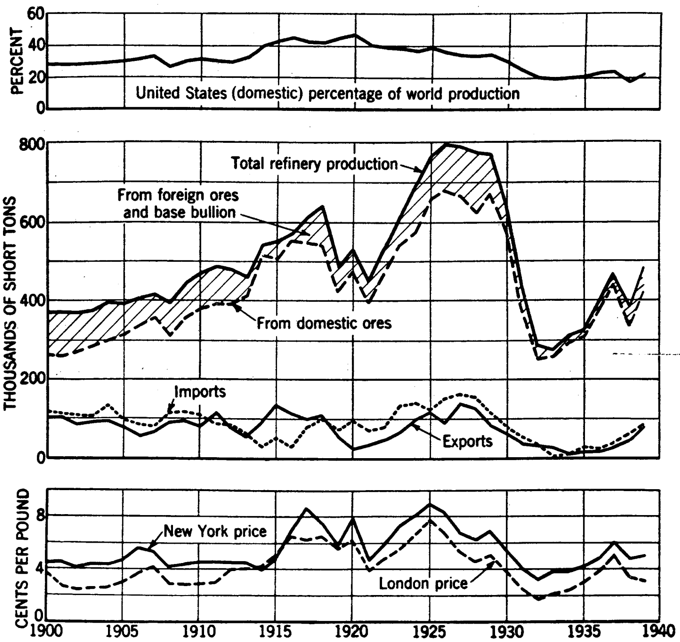

FIGURE 1.—Trends in the lead industry in the United States, 1900–1939. Imports include lead in ore, base bullion, pig lead, and scrap; exports include pigs, bars, and scrap lead exported in manufactures with benefit of draw-back.

World smelter production of lead was approximately the same in 1939 as in 1938. Production outside the United States declined 5 percent in contrast to the 22-percent increase in the United States. Output decreased in Mexico, Canada, Belgium, Burma, Italy, and Spain. Australia increased its output, and German production was virtually unchanged. Data on world consumption in 1939 are not available. Some foreign producers operated part of the year under the 10-percent reduction program agreed upon in 1938. After the outbreak of war in September lead prices in the United Kingdom were fixed by the British Ministry of Supply, and the British Government contracted for Empire supplies.

DOMESTIC PRODUCTION

Refined pig lead produced in the United States is derived from three main sources—domestic ore, foreign ore and base bullion, and secondary materials. The following table lists the production from each of these sources from 1935 to 1939:

Total pig lead produced in the United States, 1935–39, in short tons

Year	From domestic ores and base bullion	From foreign ores and base bullion	From secondary materials	Total
1935	310,505	14,055	156,800	481,360
1936	387,698	11,458	137,500	536,656
1937	443,142	24,175	154,500	621,817
1938	331,964	51,705	119,400	503,069
1939	420,967	63,068	(1)	(1)

1 Data not yet available.

PRIMARY LEAD

Refinery production.—Production of refined primary lead in 1939 increased 26 percent but was only 62 percent of the 1925–29 average. Production from domestic ores increased 27 percent in 1939, whereas that from foreign ores and base bullion increased 22 percent. Production from foreign materials was the largest since 1930 but represented only 51 percent of the 1925–29 average; it comprised only 13 percent of the total output of refined primary lead.

Refined primary lead produced in the United States, 1935–39

Year	Production by—							Value	
	Classes (short tons)				Sources (short tons)				
	Desilverized lead [1] [2]	Soft lead [3]		Total production [1]	From domestic ores and base bullion	From foreign ores	From foreign base bullion	Average per pound	Total
		Desilverized	Undesilverized						
1935	192,544	35,233	96,783	324,560	310,505	13,659	396	$0.040	$25,965,000
1936	239,944	47,462	111,750	399,156	387,698	11,401	57	.046	36,722,000
1937	272,051	55,317	139,949	467,317	443,142	23,393	782	.059	55,143,000
1938	243,891	31,986	107,792	383,669	331,964	32,862	18,843	.046	35,298,000
1939	280,356	65,349	138,330	484,035	420,967	24,652	38,416	.047	45,499,000

1 The lead content of antimonial lead is excluded. 2 Desilverized soft lead is excluded.
3 Includes lead derived from Missouri ores and other nonargentiferous ores.

Source of primary lead.—Of the total refined lead produced in 1939, 87 percent was derived from domestic ores and 13 percent from foreign ores and base bullion, the same proportion as in 1938. Production from foreign ores decreased 25 percent in 1939. Refining of foreign bullion was resumed on a large scale in 1938, chiefly because of the closing of one Mexican refinery during the latter part of the year, which diverted bullion to domestic plants. Output of lead from this source more than doubled in 1939, amounting to 38,416 tons, or the largest quantity since 1929. Details of the sources of lead from domestic ores are given in the section on Mine Production.

Refined primary lead produced in the United States, 1935–39, by sources, in short tons

Source	1935	1936	1937	1938	1939
Domestic ore	310,505	387,698	443,142	331,964	420,967
Foreign ore:					
Australia		172	3,088	7,320	7,580
Canada	1,039	2,277	5,343	3,562	4,763
Europe	1,086	1,133	388	14	188
Mexico	5,809	1,486	3,836	9,745	227
South America	2,872	3,883	8,497	9,887	8,869
Other foreign	2,853	2,450	2,241	2,334	3,025
	13,659	11,401	23,393	32,862	24,652
Foreign base bullion:					
Mexico	396	57	782	18,268	37,463
South America					9
Other foreign				575	944
	396	57	782	18,843	38,416
Total foreign	14,055	11,458	24,175	51,705	63,068
Grand total	324,560	399,156	467,317	383,669	484,035

Antimonial lead.—Antimonial or hard lead is an important by-product of the refining of base bullion, but the quantity derived from this source is only a small part of the country's yearly production. The major part is obtained from the smelting of antimonial-lead scrap, and some is produced by mixing metallic antimony with refined soft lead.

Several lead-smelting plants handle scrap materials exclusively. A large quantity of hard-lead scrap also is treated at primary smelters and refineries, and the production of antimonial lead at these plants is shown in the table that follows. Further information in secondary antimonial lead in 1939 is given in the chapter in this volume on Secondary Metals—Nonferrous.

Antimonial lead produced at primary lead refineries, 1935–39

Year	Production (short tons)	Antimony content		Lead content by difference (short tons)			
		Short tons	Percent	From domestic ore	From foreign ore	From scrap	Total
1935	16,384	1,729	10.6	4,685	491	9,479	14,655
1936	23,230	2,162	9.3	7,442	696	12,930	21,068
1937	27,524	2,579	9.4	7,833	1,721	15,391	24,945
1938	24,123	2,809	11.6	6,759	3,385	11,170	21,314
1939	21,995	2,031	9.2	4,117	3,189	12,658	19,964

SECONDARY LEAD

A large number of plants operate exclusively on scrap and other secondary materials. The following table summarizes production of secondary lead at such plants during the years 1934–38. The scope of Bureau of Mines work on secondary metals was broadened considerably in 1939; as a result, completion of data for that year was necessarily delayed. Statistics for 1939 were not available at the time this report was written. Further details on secondary lead appear in the chapter on Secondary Metals—Nonferrous.

Secondary lead recovered in the United States, 1934–38

[Compiled by J. P. Dunlop]

Year	Pig lead (short tons)			Lead in alloys (short tons)	Total recovered lead		
	At primary plants	At secondary plants	Total		Short tons	Value	Ratio to domestic refined primary lead (percent)
1934	33,557	90,943	124,500	83,900	208,400	$15,421,600	70
1935	44,748	112,052	156,800	113,600	270,400	21,632,000	87
1936	34,556	102,944	137,500	125,400	262,900	24,186,800	68
1937	29,986	124,514	154,500	120,600	275,100	32,461,800	62
1938	24,800	94,600	119,400	105,500	224,900	20,690,800	68

LEAD PIGMENTS

Lead pigments manufactured in 1939 contained 215,561 tons of lead, a 23-percent increase from 1938. Of this total, 200,390 tons were derived from refined pig lead; litharge comprised 42 percent, white lead 39 percent, red lead 18 percent, and sublimed lead and orange mineral 1 percent. Leaded zinc oxide and sublimed lead are the principal pigments in which the lead content is derived from ores. Details of production and consumption of lead pigments are given in the chapter in this volume on Lead and Zinc Pigments and Zinc Salts.

Lead in pigments, 1935–39, by sources, in short tons [1]

Year	Lead in pigments from—				Year	Lead in pigments from—			
	Domestic ore [2]	Metal	Scrap	Total		Domestic ore [2]	Metal	Scrap	Total
1935	12,109	185,151	144	197,404	1938	12,025	[3] 163,815		[3] 175,840
1936	15,062	204,997	37	220,096	1939	15,171	200,390		215,561
1937	17,363	204,961	127	222,451					

[1] Includes also lead recovered in zinc oxide and leaded zinc oxide.
[2] No pigments from foreign ore.
[3] Revised figures.

MINE PRODUCTION

The output of recoverable lead from domestic mines in 1939 increased 12 percent over that in 1938 but was 11 percent less than in 1937. Lead from the Central States increased nearly 40,000 tons in 1939 and that from the Western States 6,261 tons, but lead from the Eastern States decreased 1,616 tons. Lead from Southeastern Missouri rose 34,652 tons (29 percent) in 1939, as output was increased during the last quarter of the year. Lead from Oklahoma also was greater than in 1938, but that from Kansas declined. Idaho was again the leading lead producer in the Western States group, followed in 1939 by Utah and Montana. Lead from Idaho decreased slightly in 1939, as there were decreases in output in both the Coeur d'Alene region in Shoshone County and in the Warm Springs district in Blaine County. Lead from Utah increased about 2,000 tons as gains in the Park City region (owing to reopening in May of the Silver King Coalition and Park Utah Consolidated mines) and in the Ophir district more than offset losses in the Bingham and Tintic districts. Lead from Montana increased 7,228 tons in 1939. Most of the gain was in the Butte district and was due to reopening of the zinc-lead properties of the Anaconda Copper Mining Co., but gains also were reported at the slag-burning plant at East Helena, at the Flathead mine in the Hog Heaven district, and at the Comet mine in Jefferson County. Lead in Arizona was about the same as in 1938, but that from Colorado decreased, as the Sunnyside property in San Juan County was idle throughout 1939. Lead from New Mexico increased slightly, as gains in Grant County more than offset the loss in San Miguel County owing to the closing of the Pecos mine in May 1939. Decreases in lead were also noted in the Pioche district, Nevada, and in the Metaline district, Washington. Additional details of production by mines, districts, and States can be found in the State chapters in this volume.

Mine production of recoverable lead in the United States, 1925–29 (average) and 1935–39, in short tons

State	1925-29 (average)	1935	1936	1937	1938	1939
Western States and Alaska:						
Alaska	982	670	941	823	994	937
Arizona	9,743	7,783	10,688	12,354	10,571	10,771
California	2,070	567	482	1,186	495	526
Colorado	30,112	5,673	7,267	9,786	9,455	8,222
Idaho	141,610	79,020	91,339	103,711	92,177	90,981
Montana	18,871	15,589	19,059	17,957	9,327	16,555
Nevada	9,807	12,676	10,712	9,347	4,679	4,236
New Mexico	6,730	7,289	6,626	6,512	4,949	5,392
Oregon	6	30	79	109	23	15
South Dakota	21	4				
Texas	213	522	468	395	342	227
Utah	149,509	63,510	69,886	89,458	65,657	67,634
Washington	1,323	103	840	2,830	4,284	3,718
Wyoming		3				
	370,997	193,439	218,387	254,468	202,953	209,214
Central States:						
Arkansas	38	38	24	40	7	
Illinois	552	436	294	186	175	308
Kansas	26,121	10,892	11,409	16,008	15,239	13,697
Kentucky	135	132	50	89	101	87
Missouri	202,240	97,493	110,428	157,631	122,027	156,281
Oklahoma	58,306	23,405	25,427	29,840	21,004	27,720
Wisconsin	1,745	286	904	1,091	320	388
	289,137	132,682	148,536	204,885	158,873	198,481
Eastern States:						
New York		4,982	5,996	5,539		
Tennessee	4,096				7,896	6,284
Virginia						
North Carolina					4	
	4,096	4,982	5,996	5,539	7,900	6,284
	664,230	331,103	372,919	464,892	369,726	413,979

Mine production of recoverable lead in the principal lead-producing districts of the United States, 1935–39, in short tons

District	State	1935	1936	1937	1938	1939
Southeastern Missouri region	Missouri	96,941	108,422	153,205	118,870	153,522
Coeur d'Alene region	Idaho	78,290	86,634	96,505	82,274	81,699
Joplin region	Kansas, Missouri, Oklahoma.	34,849	38,842	50,274	39,400	44,176
Bingham	Utah	36,293	32,451	45,233	41,334	36,842
Park City region	do	13,180	17,421	22,417	7,258	11,631
Tintic	do	5,833	7,063	10,198	9,605	8,618
Ophir	do	2,392	3,862	3,307	2,013	6,050
Warm Springs	Idaho	32	2,757	4,004	7,370	5,565
Butte	Montana	10,302	10,527	5,780	204	4,708
San Juan Mountains	Colorado	2,428	3,279	4,998	5,885	4,402
Oro Blanco	Arizona	4,717	4,426	3,864	4,150	3,568
Metaline	Washington		770	2,644	4,009	3,509
Rush Valley	Utah	4,907	8,191	6,410	4,619	3,422
Eagle	Montana	1,121	3,113	4,812	4,301	3,252
Pioche	Nevada	4,955	4,706	4,759	3,214	2,964
Central	New Mexico	1,891	2,689	2,281	340	2,941
Hog Heaven	Montana			808	1,214	2,767
Harshaw	Arizona	7	1,049	984	149	2,287
Old Hat	do	292	463	794	1,919	1,861
Willow Creek	New Mexico	5,162	3,746	3,852	4,277	1,800
Cataract	Montana	1,227	1,704	1,946	1,326	1,672
Smelter	do	1,239	945	1,178	710	1,256
Red Cliff	Colorado	155	491	580	933	1,137
Port Hill	Idaho	8	72	519	291	1,111
Leadville	Colorado	1,288	1,550	2,100	1,222	1,088
Wallapai	Arizona	70	841	2,489	4,004	703
Upper Mississippi Valley	Iowa, northern Illinois, Wisconsin.	286	904	1,091	320	388
Tombstone	Arizona	1,081	417	315	315	290
Flint Creek	Montana	988	1,496	1,511	113	218
Bisbee (Warren)	Arizona	200	1,154	1,018	14	120
Tybo	Nevada	5,519	3,818	2,439		14
Banner	Arizona	857	1,541	1,205	302	3
Austinville [1]	Virginia	(2)	(2)	(2)	(2)	(2)
St. Lawrence County [1]	New York	(2)	(2)	(2)	(2)	(2)

[1] Not listed according to rank. [2] Bureau of Mines not at liberty to publish figures.

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 most refiners of secondary material who produce common lead. Foreign lead refined in the United States and entered for domestic consumption is included.

Lead stocks at end of year at smelters and refineries in the United States, 1935–39, in short tons

	1935	1936	1937	1938	1939
Refined pig lead	215,595	165,159	119,837	102,489	52,783
Antimonial lead	6,711	6,697	9,294	13,413	5,994
	222,306	171,856	129,131	115,902	58,777
Lead in base bullion:					
At smelters and refineries	15,072	9,187	10,959	18,693	10,337
In transit to refineries	1,860	1,070	2,219	2,339	3,521
In process at refineries	16,233	14,100	14,413	16,690	15,958
	33,165	24,357	27,591	37,722	29,816
Lead in ore and matte and in process at smelters	58,562	50,098	52,081	56,332	59,486
	314,033	246,311	208,803	209,956	148,079

In the first half of 1939 the excess of output over shipments for virtually every month resulted in increasing inventories. Stocks of refined and antimonial lead at refineries totaled 115,900 tons at the end of 1938 and had reached 129,600 tons by the end of June. Accelerated demand as a result of industrial improvement, in anticipation of war, and more largely because of actual opening of hostilities in September, caused a reversal of early conditions in the latter half of the year, and stocks declined monthly from June until they reached the lowest level of the year at the end of November, when they stood at 58,100 tons. A slight excess of production in December carried stocks to 58,800 tons at the end of the year. These were the smallest year-end inventories on hand since the end of 1929 and only a little more than half the amount on hand as the year began. Stocks of lead in ore and matte and in process at smelters, and base bullion at smelters and refineries, in transit to refineries, and in process at refineries, were 5 percent lower at the end than at the beginning of the year.

DOMESTIC CONSUMPTION

New supply.—The following table shows the refined primary lead available for consumption from 1935 to 1939. The figures do not consider variations in producers' stocks, and as these have changed considerably during the past 5 years the quantities stated do not indicate the true trend in actual consumption of new lead. The supply available for consumption in 1939 was 22 percent higher than in 1938 but was equivalent to only 60 percent of the 1925–29 average. The total consumption of lead, as indicated by the second table following, also rose 22 percent in 1939.

Refined primary pig lead available for consumption in the United States, 1935–39, in short tons

	1935	1936	1937	1938	1939
Supply:					
Imports	[1] 1,322	[1] 2,590	2,238	1,905	5,388
Production	324,560	399,156	467,317	383,669	484,035
	325,882	401,746	469,555	385,574	489,423
Withdrawn: Exports	[2] 6,982	18,313	20,091	[3] 45,866	74,392
Supply available for consumption	318,900	383,433	449,464	339,708	415,031

[1] Includes small quantities of old, reclaimed, and scrap lead.
[2] Includes small quantities of foreign lead reexported.
[3] Includes a small quantity, not separable, of "sheets."

Consumption by uses.—Owing to the return of large quantities of secondary lead in discarded and obsolete articles and from the lead-consuming industries, the total consumption of pig lead greatly exceeds the supply of new lead available. The following table gives the American Bureau of Metal Statistics estimate of the total consumption of lead by industries, 1935–39.

Lead consumed in the United States, 1935–39, in short tons [1]

Purpose	1935	1936	1937	1938	1939
White lead	80,000	85,500	86,000	71,000	75,000
Red lead and litharge	47,500	54,000	57,000	43,000	57,200
Storage batteries	175,000	191,000	192,000	167,000	198,000
Cable covering	38,900	61,400	90,000	60,000	74,400
Building	32,000	40,000	45,000	36,000	50,000
Automobiles	10,000	11,100	12,000	6,000	8,900
Ammunition	29,200	32,500	39,500	31,200	42,300
Terneplate	4,700	6,200	6,400	4,300	5,400
Foil	15,900	28,500	21,700	22,000	21,800
Bearing metal	13,000	16,500	15,000	9,000	12,800
Solder	20,000	22,000	22,000	15,000	20,000
Type metal	15,000	17,000	17,000	12,000	14,000
Calking	12,000	13,500	15,000	12,000	16,000
Castings	5,000	5,750	6,000	6,000	7,500
Other uses	40,700	48,600	54,100	51,500	63,700
	538,900	633,550	678,700	546,000	667,000

[1] American Bureau of Metal Statistics. These estimates are for the total consumption of lead irrespective of whether its origin is primary or secondary. Antimonial lead is included.

The principal use of lead is in the manufacture of storage batteries, and in most recent years 30 percent or more of the total lead requirements have been for that purpose. Consumption in storage batteries during 1939 was 19 percent higher than in 1938 and made a good showing in relation to the record year, having declined only 6 percent from 1929. As pointed out in Minerals Yearbook, 1939, lead used in storage batteries returns quickly to the trade in the form of scrap and therefore noticeably curtails the need for newly mined metal. White lead is regularly the second-largest use for lead. Consumption for this purpose is welcomed by producers because it is dissipative. The amount of lead consumed in the manufacture of white lead increased 6 percent over 1938 but lagged 37 percent behind 1929. In 1929, the year of record consumption, and again in 1930 cable covering ranked as the largest use for lead. Since 1929 the tonnage sold for that purpose has dropped 66 percent, although in 1939 it was 24 percent above 1938. It required 23 percent of the total lead used in 1929 and 27 percent in 1930 but fell to 11 percent in 1938 and 1939. The failure of the utility industry to purchase its proportionate share of total lead requirements of the country has been a depressing influence on the lead industry. The building industry has also lagged behind most others in respect to lead consumption. This industry has been on the upgrade in recent years and used 39 percent more lead in 1939 than in 1938, but it was 48 percent below 1929. Red lead and litharge—exclusive of quantities used in storage batteries—took nearly 9 percent of the total lead used in 1939, which is nearly three times the proportion for that purpose in 1929. This use consumed 33 percent more lead than in 1938 and 91 percent more than in 1929. Among the smaller uses for lead, ammunition took 36 percent more in 1939 than in 1938. It was one of the three uses indicated by the foregoing table to have been higher than in 1929, having been 3 percent larger than in that year.

PRICES

The two major markets for lead in the United States are New York and St. Louis; much of the lead produced in the United States is sold at prices based upon quotations in these markets. The New York quotations are influenced to some extent by the lower prices usually prevailing on the London market, so that the New York price seldom exceeds the St. Louis price by as much as the freight differential, which normally is 0.35 cent a pound.

In view of the startling world events in 1939, prices for lead were remarkably steady, fluctuating less than those for other common nonferrous metals. The average monthly quoted price for pig lead at New York, outside market, was 4.83 cents a pound in January. In the first half of the year the monthly average varied only 0.1 cent a pound. The average for July was 4.85 cents. In the first half of the year monthly refined production exceeded shipments, except in March, when a virtual balance was temporarily established. After June, however, the situation was reversed and, as a result of improving demand, shipments began to rise while output held at former levels. The declaration of war between Germany and France and Great Britain in September was the signal for sharply increased demands. Shipments, which averaged 40,000 tons for the first 8 months of the year, rose to 60,000 tons in September and 66,000 in October, then declined slightly to 64,000 in November and 45,000 in December. Weekly domestic sales of lead reached a new high record in the week ended September 9, when they amounted to more than 42,000 tons. In all of September transactions aggregated 104,000 tons, the largest monthly total on record. In an endeavor to discourage excessive purchases, producers assured consumers that no shortage was likely, but with little apparent success. They maintained a conservative price policy in the face of spectacular sales during the latter part of the year, and price advances were proportionately far less than requirement gains. Production trended upward in the final quarter but failed to equal shipments until an approximate balance was attained in December. The average price at New York for August was 5.04 cents; it rose to 5.45 cents in September and was at the highest levels of the year—5.50 cents a pound—throughout the final quarter.

Average monthly and yearly quoted prices of lead at St. Louis, New York, and London, 1937–39, in cents per pound [1]

Month	1937			1938			1939		
	St. Louis	New York	London	St. Louis	New York	London	St. Louis	New York	London
January	5.85	6.03	5.97	4.72	4.89	3.60	4.68	4.83	3.03
February	6.09	6.26	6.19	4.48	4.63	3.45	4.65	4.80	3.20
March	7.05	7.20	7.20	4.35	4.50	3.56	4.67	4.82	3.07
April	6.03	6.18	5.71	4.35	4.50	3.46	4.63	4.78	3.00
May	5.85	6.00	5.28	4.25	4.40	3.15	4.60	4.75	3.03
June	5.85	6.00	5.03	4.00	4.15	3.09	4.65	4.80	3.04
July	5.85	6.00	5.30	4.73	4.88	3.28	4.70	4.85	3.08
August	6.30	6.46	5.02	4.75	4.90	3.13	4.89	5.04	3.30
September	6.23	6.39	4.63	4.85	5.01	3.27	5.30	5.45	(2)
October	5.56	5.71	4.03	4.95	5.10	3.44	5.35	5.50	(2)
November	4.88	5.03	3.72	4.94	5.09	3.38	5.35	5.50	(3)
December	4.72	4.86	3.54	4.69	4.84	3.15	5.35	5.50	(2)
Average	5.86	6.01	[3] 5.15	4.59	4.74	[3] 3.33	4.90	5.05	[3, 4] 3.09

[1] St. Louis: Metal Statistics, 1940, p. 455. Average daily quotations of soft Missouri lead, f. o. b. St. Louis (open market), as reported daily in the American Metal Market.
New York: American Metal Market, daily issues. Pig lead, New York (outside market), prompt shipment from West.
London: Metal Statistics, 1940, p. 459. Average price of foreign lead. Price per long ton, as published in Metal Statistics, converted to cents per pound at average exchange rate reported by the Federal Reserve Board.
[2] London Metal Exchange dealings suspended for duration of the war.
[3] London quotations in pounds sterling per long ton, as follows: 1937, £23.3250; 1938, £15.2667; 1939 (8 months), £14.7083.
[4] Average for 8 months: Comparable average for New York was 4.83 cents.

There were narrow movements in the London market also in 1939. In January the average price (United States exchange basis) was 3.03 cents; it rose to 3.20 cents in February and then declined in April to the low point for the year—3.00 cents. A slow rise carried the price to 3.30 cents in August. Quotations on the London Metal Exchange were discontinued at the outbreak of war in September. The differential between selling prices in New York and London was notably higher in 1939 than in 1938, continuing the gains indicated for that year. The differential in 1939 ranged from 1.60 to 1.80 cents, the low point occurring in February and the high in January; the average for 8 months was 1.74 cents. In 1938 New York monthly prices ranged from 0.94 cent to 1.77 cents higher than those for London, and the average for the year was 1.41 cents higher. In 1937 the average difference was 0.86 cent, and in 1936 was 0.80 cent.

In September 1939 it was announced that the British Ministry of Supply had established the maximum price of Empire lead at £17 per long ton ex ship and of foreign lead at £16 12s. 6d. ex ship. In December control prices for Empire and foreign lead were raised to £25 per long ton, duty paid, delivered.

FOREIGN TRADE[2]

Although imports of lead in ore, matte, and bullion increased 31 percent in 1939 compared with 1938 and exports of pig lead showed a 62-percent increase for the same period, the total of pig lead exported in 1939 approximated the lead in ore, matte, and bullion imported; domestic exports of pig lead for some years have comprised principally crude material imported for smelting and refining in bond and earmarked for export.

Imports.—Aside from the significant increase in total imports of unrefined lead in 1939, a noticeable feature was the 84-percent decrease in imports from Mexico of lead in ore and matte and a compensating 232-percent increase in imports of lead bullion from the same country. Although Mexico, for years the principal source of unrefined lead imports, contributed 65 percent of the total tonnage imported in 1939, Canada's imports of ore and matte increased 77 percent in 1939 compared with 1938; however, Chile and Peru supplied less unrefined lead in 1939 than in 1938, the total decrease for both countries being 22 percent.

Total lead imported into the United States, 1935–39, by classes, in short tons [1]

Year	Lead in ore and matte	Lead in base bullion	Pigs, bars, and old	Total lead content
1935	20,025	2,692	1,322	24,039
1936	20,713	312	2,590	23,615
1937	34,103	1,800	4,903	40,806
1938	45,370	15,296	3,235	63,901
1939	30,842	48,902	7,139	86,883

[1] Data include lead imported for immediate consumption plus material entering the country under bond.

Total lead imported into the United States, in ore, base bullion, and refined, 1935–39, by countries, in short tons [1]

Year	Canada	Mexico	Newfoundland	South America	Europe	Other countries	Total
1935	236	9,786	6,837	6,643	512	25	24,039
1936	1,692	10,501	3,955	6,861	341	265	23,615
1937	5,749	17,068		13,229	535	4,225	40,806
1938	3,174	38,467		13,426	680	8,154	63,901
1939	5,641	52,059	1	16,527	1,971	10,684	86,883

[1] Data include lead imported for immediate consumption plus material entering the country under bond.

Total lead imported into the United States in ore, matte, and base bullion, 1935–39, by countries, in short tons [1]

Country	1935	1936	1937	1938	1939
In ore and matte:					
Canada	58	1,419	5,211	3,173	5,624
Chile	1,102	574	474	2,107	1,844
Mexico	7,986	10,462	15,970	24,023	3,846
Newfoundland	6,818	3,955			
Peru	3,716	4,007	10,132	9,317	7,174
Other countries	345	296	2,316	6,750	12,354
	20,025	20,713	34,103	45,370	30,842
In base bullion:					
Mexico	1,746	39	1,067	14,444	47,915
Peru	784	52	239	198	84
Other countries	162	221	494	654	903
	2,692	312	1,800	15,296	48,902

[1] Data include lead imported for immediate consumption plus material entering the country under bond.

[2] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Lead remaining in warehouses in the United States, Dec. 31, 1935–39, in short tons

[Stated in the form in which the material was entered for warehouse]

Year	Lead in ore and matte	Lead in base bullion [1]	Year	Lead in ore and matte	Lead in base bullion [1]
1935	22,598	2,173	1938	76,287	11,524
1936	33,401	1,930	1939	72,737	6,478
1937	57,509	2,622			

[1] Pigs, bars, sheets, and old lead included with base bullion.

Lead [1] imported for consumption in the United States, 1935–39, by classes

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	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value		
1935	8,273	$258,954	1,154	$66,559	1,368	$83,841	404	$51,979	$12,484	$489,775
1936	5,836	225,568	763	45,340	1,979	97,614	304	38,546	12,729	443,331
1937	5,613	507,945	188	12,788	2,355	174,077	376	54,649	13,527	793,796
1938	6,722	543,164	304	31,147	2,001	84,109	166	30,906	23,381	733,081
1939	12,317	1,063,512	1,764	166,298	4,772	176,437	170	28,296	11,611	1,449,541

[1] In addition 285 tons valued at $10,678 of "reclaimed, scrap, etc." were imported in 1934; 223 tons, $15,958 in 1935; 342 tons, $23,534 in 1936; 349 tons, $30,810 in 1937; 189 tons, $20,374 in 1938, and 36 tons, $3,387 in 1939; value included in total values.

Miscellaneous products containing lead imported for consumption in the United States, 1935–39

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
1935	128	24	$44,269	534	445	$36,453
1936	334	67	112,205	456	400	34,694
1937	618	178	213,734	132	115	13,572
1938	390	77	126,660	433	374	38,708
1939	136	45	96,492	380	321	38,491

Exports.—Most significant during 1939 was the 1600-percent increase in pig-lead exports to Europe, which rose from 1,950 short tons in 1938 to 33,152 in 1939. There was a sharp 663-percent increase in purchases by Germany, but of note also is the fact that the combined exportations to Belgium, Denmark, Hungary, Netherlands, Norway, and Sweden jumped from 51 tons in 1938 to 13,249 in 1939. Although there was a fourfold increase in exports to Japan in 1938 compared with 1937, purchases by that country in 1939 increased only 15 percent over those in the preceding year. Exports to the United Kingdom increased noticeably from 78 short tons to 9,411. The only decrease of importance during the year was in exports to Mexico, due possibly to refining of bullion in that country rather than shipment of the material to the United States for refining and reexport.

Lead exported from the United States, 1935–39

Year	Pigs, bars, and old		Foreign lead exported in manufactures with benefit of draw-back (short tons)	Year	Pigs, bars, and old		Foreign lead exported in manufactures with benefit of draw-back (short tons)
	Short tons	Value			Short tons	Value	
1935	[1] 6,982	[1] $472,017	8,995	1938	[2] 45,866	[2] $3,354,616	9,061
1936	18,313	1,390,454	8,312	1939	74,392	4,547,219	10,359
1937	20,091	1,838,262	8,679				

[1] Includes small quantities of foreign lead reexported.
[2] Contains sheets and pipes; figures not separable.

Pig lead exported from the United States, 1935–39, by destinations, in short tons

Destination	1935 [1]	1936	1937	1938 [2]	1939
Countries:					
Belgium	----------	----------	43	28	588
Brazil	338	795	652	111	647
Canada	45	45	7	101	5
Denmark	----------	----------	----------	----------	1,569
Finland	----------	----------	----------	560	616
France	----------	----------	----------	(3)	540
Germany	11	2	568	1,092	8,333
Hungary	----------	----------	----------	----------	560
Japan	5,324	8,629	7,320	30,203	34,790
Kwangtung	----------	----------	56	314	99
Mexico	38	8,049	8,122	11,403	2,922
Netherlands	188	----------	----------	----------	2,101
Norway	----------	----------	112	----------	1,091
Philippine Islands	217	223	569	1,037	974
Sweden	----------	5	----------	23	7,340
United Kingdom	8	123	2,226	78	9,411
Other countries	813	442	416	916	2,806
	6,982	18,313	20,091	45,866	74,392
Continents:					
North America	157	8,282	8,337	12,002	3,345
South America	668	1,021	784	303	1,317
Europe	212	133	2,949	1,950	33,152
Asia	5,945	8,865	7,989	31,606	36,122
Africa and Oceania	(3)	12	32	5	456

[1] Includes small quantities of foreign lead reexported.
[2] Includes sheets and pipes; figures not separable.
[3] Less than 1 ton.

WORLD ASPECTS OF LEAD INDUSTRY

International cooperation.—The Lead Producers Association, representing 60 to 75 percent of the lead produced outside the United States, agreed on November 1, 1938, to a 10-percent reduction in output; this action represents the first positive step toward control of the lead market since 1932. The output of lead during the first 6 months of 1939, however, was higher than for the same period of 1938.

Early in September, after the outbreak of hostilities in Europe, dealings on the London Metal Exchange were suspended, and metal supplies and prices were placed under supervision of the Nonferrous Metals Control created under the Defense Act.

World production.—Lack of adequate production data precludes any reliable estimate of world lead output during 1939. According to the American Bureau of Metal Statistics, lead in ore production in 1938 was 1,772,012 metric tons. Of this total North America produced 836,702 tons (47 percent); in 1939 the American Bureau of

Metal Statistics reported North American production at 792,368 metric tons. In 1938 South American output was 95,569 metric tons —5 percent of the total; in 1939 it was reported as 88,019 metric tons. The mine production of lead in the Western Hemisphere, which in 1938 was slightly over half of the total world output, decreased in 1939 and may indicate a lower world production in 1939.

Smelter production of lead in 1939 is estimated at 1,700,000 metric tons. Output of the United States increased from 330,963 tons in 1938 to 404,257 tons in 1939, representing 24 percent of the world production for the latter year. Australian production increased considerably, whereas Mexican output showed a marked decline.

World production of lead, 1935–39, in metric tons [1]

[Compiled by R. B. Miller]

Country	1935	1936	1937	1938	1939
Argentina	4,112	10,700	9,900	10,200	(2)
Australia	221,431	196,051	232,198	226,155	252,383
Belgium	68,980	67,000	93,310	94,170	82,000
Burma	73,217	74,329	77,728	80,166	77,220
Canada	148,558	164,857	181,162	181,783	172,880
China	[3] 1,600	[3] 1,600	[3] 1,500	(2)	(2)
Chosen	1,728	2,738	5,850	(2)	(2)
Czechoslovakia	3,986	4,126	4,300	(2)	(2)
France	14,575	15,127	37,168	41,753	(2)
Germany [4]	122,300	139,000	162,400	171,700	181,440
Austria	8,048	8,732	10,836	9,280	
Greece	4,679	4,172	5,890	6,050	(2)
Hungary	14	26	147	(2)	(2)
Indochina	18	12	8	10	(2)
Italy	35,803	36,307	38,938	43,287	38,102
Japan	7,442	8,883	10,200	(2)	(2)
Mexico	178,923	214,376	214,653	273,529	219,300
Northern Rhodesia	185	305	568	277	2,778
Norway	577	227	236	323	(2)
Peru	6,452	8,899	19,053	28,478	24,310
Poland	18,819	15,021	17,587	19,973	(2)
Rumania	4,557	4,783	6,725	5,655	5,100
South-West Africa	—	—	1,355	3,214	4,283
Spain	62,742	46,600	30,000	36,000	27,000
Tunisia	25,390	21,497	24,758	23,916	23,421
Union of South Africa	—	—	—	19	11
U. S. S. R.	44,853	50,800	[2] 55,000	(2)	(2)
United Kingdom	22,350	13,800	10,313	10,000	(2)
United States (refined) [5]	294,075	362,055	423,232	330,963	404,257
Yugoslavia	7,554	5,804	4,038	8,646	10,624
	1,383,000	1,478,000	1,679,000	1,700,000	[3] 1,700,000

[1] By countries where smelted but not necessarily refined.
[2] Data not yet available. Estimate included in total.   [3] Approximate production.
[4] Exclusive of secondary material (Metallgesellschaft, Frankfort on the Main).
[5] Figures cover lead refined from domestic and foreign ore; refined lead produced from foreign base bullion not included.

World consumption.—Owing to disturbed world conditions the total consumption of lead in 1939 cannot be estimated. The American Bureau of Metal Statistics reported world consumption of lead in 1938 as 1,638,100 metric tons.

REVIEW BY COUNTRIES

Argentina.—The Compania Minera Aguilar S. A., a subsidiary of the St. Joseph Lead Co., supplied 94 percent of the Argentine output of lead in 1938. During 1938 the flotation plant at Tres Cruces treated 174,445 metric tons of ore containing an average of 14.07 percent lead, 11.94 percent zinc, and 325 grams of silver per ton. In 1938, 29,836 tons of concentrates were produced, and in 1939 the output of concentrates amounted to 36,728 tons.

The Pumahuasi mines, operated by a subsidiary of the National Lead Co., produced 1,418 tons of concentrates in 1938. The National Lead Co. operates a smelter at Puerto Vilelas with a capacity of 15,000 tons of refined lead a year. In 1938 this smelter produced 9,051 tons of lead, of which 7,025 tons was derived from domestic concentrates and 2,026 tons from imported Bolivian concentrates.

Australia.—Smelter production in Australia increased from 226,155 metric tons in 1938 to 252,383 in 1939. Output of the Mount Isa Mines, Ltd., during 1939 amounted to 44,659 metric tons, representing a slight increase compared with 1938. Production at the Port Pirie smelter was not reported for 1939. During the year mining and milling problems were overcome by the Lake George Mining Corporation, and by the end of 1939 production was at the rate of 500 tons of ore per day. The equipment at this plant is reported to have cost about £1,000,000 and the company employs approximately 300 miners.

Effective February 11, 1939, an agreement with affiliated unions that will continue in force until June 30, 1942, was entered into at Broken Hill. Wages were advanced slightly, and provisions were made for further advances if living costs in the Broken Hill area increase. The 40-hour-week aboveground and 35-hour-week underground provisions were continued. In the 1939 agreement the bonus provision of the previous agreement was altered somewhat but does not advance the limitation of combined basic wage and lead bonus.

To assist in prosecution of the war Broken Hill mining companies entered into contracts with the British Government, and prices were fixed approximately at those prevailing on the London Metal Exchange at the outbreak of the war. These prices were made subject to adjustment in accordance with rises or declines in the costs of production. On December 19, 1939, the maximum price for Australian lead was advanced to £A20 17s. 3d. On February 8, 1940, the maximum price was established at £22, which was £9 5s. less than the London rates expressed in Australian currency.

Belgium.—Production of electrolytic lead in Belgium at the rate of about 100 to 200 tons per month began at the Dumont plant, Sclaigneaux, early in 1939. The process enables impure ores not otherwise usable to be employed.

Imports by Belgium of 109,302 metric tons of lead ore represent only a slight increase over the preceding year. The Belgian Congo supplied only 605 metric tons in 1939 compared with 6,364 in 1938. Pig-lead imports of 13,131 metric tons in 1939 represent a decrease of over 50 percent compared with 1938. The decline in imports of pig lead from Mexico was notable, amounting to 11,061 metric tons in 1939 compared with 22,849 in 1938. Exports of crude or pig lead in 1939 increased to 70,270 metric tons as compared with 67,097 in 1938.

Bolivia.—Present production of lead in Bolivia gives no indication of potentialities, as there are large known deposits that, under favorable conditions, unquestionably will be developed. At present most of Bolivia's output is derived from small mines in the La Quiaca region. The concentrates are exported to smelters in Argentina.

Brazil.—Lead deposits are distributed throughout Brazil, but the principal deposits are in the States of São Paulo and Paraná. Present production is negligible.

Bulgaria.—Active development of Bulgarian resources by foreign capital was reported in 1939. Early in the year an agreement was reached whereby the Bulgarian concern Granitoid and a German group comprised of the Cologne concerns Felten & Guilleaume Carlswerk A. G. and Otto Wolff were to take over 50 percent of the shares of the Bergwerks A. G. Pirin in Sofia from the Bulgarian firm. Lead and zinc deposits of the Rhodope Mountains are to be exploited. Another group comprising the "Metallochemia" Hutten—Chemische Industrie & Metallhandels A. G. of Budapest organized the Rodopsky Metall A. G. in Sofia for the purpose of operating mines in southern Bulgaria and shipping ore to Hungary for smelting. It is reported that lead-zinc deposits near the city of Kirdschalü, southern Bulgaria, will be in production by the close of 1940.

Burma.—The Burma Corporation, Ltd., produced 76,000 long tons of refined lead and 1,180 of antimonial lead in 1939 compared with 78,900 and 1,200 tons, respectively, in 1938. In 1939, 6,175,000 ounces of refined silver were recovered compared with 5,920,000 in 1938. Monthly data covering the quantities of lead concentrates produced were not released after July.

Canada.—Mine production in Canada in 1939 totaled 176,165 metric tons compared with 190,021 in 1938. The Sullivan silver-lead-zinc mine in British Columbia furnished 97 percent of the total Canadian output. The Mayo district, Yukon Territory, produced 3,422 metric tons, the Stirling mine in Nova Scotia 1,154 metric tons, and the Algoma district of Ontario 18 metric tons. Considerable development work on Calumet Island in the Ottawa River, Ontario, by Calumet Mines, Ltd., is reported to indicate reserves of 1 million tons of ore averaging 2.15 percent lead, 8.6 percent zinc, and 5.76 ounces of silver per ton.

Refined lead output during 1939 at Trail, B. C., was less than the 1938 production figure owing to the 10-percent reduction agreement of the Lead Producers Association.

After the outbreak of war in Europe in September 1939 Canadian producers negotiated contracts with the British Government for the delivery of lead at fixed prices. At the beginning of 1939 unsold stocks of lead were larger than average, but by the end of the year no stocks were unsold.

In 1939 exports of lead in ore totaling 3,721 metric tons represent a slight increase over the preceding year. Pig-lead exports in 1939 likewise advanced to 163,960 metric tons from 140,551 in 1938. Shipments to Japan increased greatly, amounting to 43,018 metric tons in 1939 compared with 15,768 in 1938. However, shipments to Great Britain decreased somewhat, amounting in 1939 to 100,286 metric tons compared with 108,481 in 1938.

China.—The National Resources Commission, the Yunnan Provincial Government, and the Fu Tseng Bank are reported to have organized the Southwest Lead Export Corporation to increase the lead output of China. It is reported that a lead refinery will be built at Kunming, the provincial capital of Yunnan.

France.—France depends almost entirely on imports for its large consumption of lead. A total of 86,100 metric tons was reported used in 1938 compared with an annual average of 129,000 tons for 1929–33 and of 99,000 tons for 1934–38. Data for 6 months of 1939 indicate that 36,200 tons were used during that period.

Lead ore imported into France during the first 7 months of 1939 totaled 43,756 tons, of which 50 percent was from Morocco, 24 percent from Yugoslavia, and 8 percent from Peru. Imports of pig lead in the same period totaled 24,800 tons, of which Tunis supplied 52 and Belgium 32 percent. Exports of ore totaled 4,400 tons and of pig lead 8,100 tons in the first 7 months of 1939.

Germany.—Germany ranks as the third largest lead-consuming nation in the world, following the United States and the United Kingdom. Production of lead from mines in Germany is inadequate for home needs, as the total for 1932–38 amounted to 449,600 metric tons or only a little more than one-third of apparent total requirements for that period—1,281,600 tons. Doubtless, however, part of apparent consumption in recent years has gone toward the building of a stockpile. In this connection it is noteworthy that the average annual apparent consumption was 175,000 metric tons in 1924–28, 155,000 in 1929–33, and 204,000 in 1934–38; the total for 1938 was 246,500 tons. Figures for all of 1939 are not available, but totals for 6 months amounted to about half of the quantity for all of 1938.

Smelter output of lead in Germany, including Austria, was 181,440 metric tons in 1939, about the same as in the preceding year. Imports of pig lead amounted to 42,511 tons in the first 7 months of 1939 compared with 75,327 tons in all of 1938. Mexico supplied 23 percent of the amount shown for 1939, Belgium 21 percent, and the United States 20 percent Lead ore imported in the first 7 months of 1939 totaled 78,424 tons compared with 141,288 in all of 1938. Yugoslavia supplied 31 percent of the quantity shown for 1939, and Newfoundland furnished 22 percent. Germany exported 730 tons of pig lead and 556 tons of lead sheets during the first 7 months of 1939.

The drive for expansion of domestic production and restriction of home use continued in 1939.

Hong Kong.—The Lin Ma Hang mine, situated about 30 miles north of Hong Kong and managed by the Hong Kong Mines, Ltd., produced 3,765 metric tons of lead in ore during 1939, silver content unknown, compared with 4,336 tons in 1938 having a silver content of 111,070 ounces. It was expected that a smelter would be in operation by February 1940.

Italy.—Under Government stimulus mine output of lead in Italy has been increasing; it amounted to 39,500 metric tons in 1938 compared with 35,200 tons in 1937 and 30,200 in 1936. Although consumption totaled 51,900 tons in 1938, 50,400 in 1937, and 45,200 in 1936, indicating that the country must rely on imports to supplement domestic output, Italy is more nearly self-sufficient with regard to lead than most other metals. Available statistics for 1939 indicate that Italian consumption during the first 6 months was 9 percent below the monthly rate for all of 1938. Imports of 4,638 tons of pig lead in the first 7 months of 1939 were largely from Canada and Germany.

Mexico.—Mine production in Mexico during 1939 amounted to 219,506 metric tons of lead in ore, representing a notable decrease from the 282,369 tons produced in 1938. Exports of lead in all forms in 1939 totaled 207,199 metric tons compared with 250,868 tons in 1938. The destination of approximately 50 percent of the exports in 1939 was the United States; most of the European countries purchased the remainder in tonnages not exceeding 13,000 tons in any instance.

On August 31, 1939, the export duty was raised. In November 1939 it was reported that the then-existing export tax on lead ore was abolished, and the arbitrary value placed for tax purposes on concentrates, bullion, and refined lead was reduced about 29 percent because of export difficulties traceable to the European war and consequent accumulation of stocks.

In October 1939 the major mining organizations and most of the important independent miners whose ores were treated at the smelter in Chihuahua pooled their sales through the New York office of the American Smelting & Refining Co. This arrangement provided for payments to pool members at regular intervals, and the plan appears to be encouraging operation of small mines.

Newfoundland.—In Newfoundland about 425,167 metric tons of ore were milled during 1939, providing 37,332 metric tons of lead concentrates containing 21,223 metric tons of lead. In 1938, 416,396 metric tons of ore were milled furnishing 42,745 tons of concentrates with a lead content of 24,817 tons.

Peru.—The principal lead and zinc deposits are situated in central Peru. During the last few years large reserves have been developed in the Cerro de Pasco district. About half the total lead ore produced is refined at the Oroya smelter and the remainder exported as ores and concentrates to foreign smelters. The Cerro de Pasco Copper Corporation operates the only lead smelter in Peru. In 1939, the lead mines produced 26,098 metric tons of lead concentrates containing 60 percent lead and 8,997 tons of ore carrying 45.60 percent lead. Antimonial lead production during the year was 18 metric tons containing 86 percent lead; bismuth-lead bullion amounted to about 41 metric tons containing approximately 8 tons of lead.

Spain.—Little information is available regarding reconstruction of the Spanish lead industry following conclusion of the Spanish civil war in April 1939. Spanish lead production, which reached a total of 175,000 tons in 1914, declined to 66,000 tons in 1935 and is estimated at 27,000 tons in 1939.

After civil strife ended in 1939 the Government established an agency (Rama del Plomo) in the Ministry of Industry in which lead producers, consumers, and dealers are represented. The purpose of this agency is to rehabilitate and develop the lead industry within Spain. The damage to the mines during the civil war was severe, but mines and plants gradually have been repaired and output increased. It is reported that no stocks of lead were on hand at the end of 1939.

U. S. S. R.—Official statistical information concerning the lead industry, as of all metallic industries, in the U. S. S. R. is meager. It is estimated that about 25 percent of the country's requirements of pig lead is imported. The estimated production of pig lead in 1938 totaled 80,000 metric tons, and the planned annual output by 1942, as established by the third Five-year Plan, was set at 134,000 metric tons.

Yugoslavia.—Mine production in Yugoslavia in 1939 was reported to be 775,000 metric tons of ore containing 69,000 metric tons of lead compared with a total of 878,000 tons in 1938 with a lead content of 77,700 tons. However, smelter production in 1939 is reported as 10,624 metric tons compared with 8,646 in 1938.

ZINC [1]

By E. W. PEHRSON

SUMMARY OUTLINE

The zinc industry experienced a more favorable year in 1939 than in 1938. Domestic production and consumption increased, prices were higher, and stocks were reduced. However, producers did not reap the full benefit of the larger domestic market, owing to a sharp increase in receipts of foreign zinc. Net imports were the highest on record, exceeding the previous peak established in 1937. Imports of zinc ore and slab zinc rose sharply in 1939 as a consequence of the 20-percent reduction in the tariff on zinc, which became effective at the beginning of the year, and the dislocation of shipping and foreign markets caused by the outbreak of war in Europe. Ore and metal, chiefly from the Western Hemisphere, that ordinarily would have gone elsewhere, were diverted to the United States, particularly during the latter part of the year. Exports of slab and rolled zinc also were higher in 1939 than in 1938 but gained in smaller proportion than imports. Increased receipts of ore came largely from Mexico, although there were sharp gains in receipts from Argentina and Canada. Mexico also was responsible for the greater part of the tonnage increase in imports of slab zinc, but shipments from Canada nearly trebled.

During the first quarter of the year, production and shipments were at virtually the same level; but shipments dropped in the second quarter, and the decline was not offset by a reduction in output. Hence, producers' stocks rose and at the end of June were at the highest level of the year—about 7 percent above inventories on January 1. Shipments increased sharply in the latter part of the year while production advanced more slowly, with the result that stocks were little more than half as large at the end as at the beginning of the year.

[1] This report deals primarily with the smelting branch of the industry. Full details of zinc mining are given in the various State reports. Some zinc ore is used directly in the manufacture of zinc pigments. (See chapter on Lead and Zinc Pigments and Zinc Salts.)

The apparent consumption of primary slab zinc in 1939 was 62 percent above that of 1938 and the highest ever recorded. This rise is considerably above that in general industrial activity and that in output of many zinc products. The use of zinc in galvanizing, for instance, advanced 39 percent, and rolled-zinc production increased only 35 percent. Although brass-making used 72 percent more zinc in 1939 than in 1938, this industry normally consumes less than 30 percent of the total. The disparity between the rates of increase in actual use and apparent consumption in 1939 indicates that consumers' stocks increased substantially during the year.

Salient statistics of the zinc industry in the United States, 1925–29 (average) and 1935–39

	1925–29 (average)	1935	1936	1937	1938	1939
Production of primary slab zinc:						
By sources:						
From domestic ores...short tons..	589,648	412,184	491,803	551,165	436,007	491,058
From foreign ores.........do....	12,734	8,450	329	5,739	10,334	16,178
	602,382	420,634	492,132	556,904	446,341	507,236
By methods:						
Electrolytic.....percent of total...	21	28	26	21	21	25
Distilled..................do....	79	72	74	79	79	75
Production of redistilled secondary slab zinc..................short tons..	43,756	28,650	42,209	51,554	31,613	50,428
Stocks on hand at primary smelters Dec. 31..................short tons..	45,575	90,539	55,500	79,144	157,511	83,728
Primary zinc available for consumption short tons..	548,472	457,705	538,794	570,219	375,004	607,464
Price—Prime Western at St. Louis:						
Average for year....cents per pound..	6.76	4.33	4.90	6.52	4.61	5.12
Highest quotation.............do....	8.90	4.95	5.45	7.50	5.05	6.50
Lowest quotation..............do....	5.40	3.70	4.75	5.00	4.00	4.50
Price—yearly average at London...do....	6.46	3.08	3.31	4.91	3.05	[1] 2.89
Mine production of recoverable zinc short tons..	724,720	517,903	575,574	626,362	516,699	583,807
Tri-State district (Joplin) percent of total..	49	37	39	38	38	38
Western States..............do....	30	31	31	31	28	29
Other.......................do....	21	32	30	31	34	33
World smelter production of zinc short tons..	1,435,000	1,468,000	1,614,000	1,792,000	1,728,000	1,813,000

[1] Average for 8 months; London Metal Exchange dealings suspended in September.

The quoted price for Prime Western zinc at St. Louis remained at 4.50 cents a pound from January 1 until July 27, 1939, when it advanced to 4.60. As industrial activity advanced and the European crisis approached the price continued upward and late in September reached 6.50 cents, where it held through December 1. In December the quotation fell, reaching 5.75 cents as the year ended. The average quoted price for 1939 was 5.12 cents compared with 4.61 cents in 1938 and 6.52 in 1937. London quotations for the first 8 months of 1939 ranged from a low monthly average of 2.8 cents a pound in April to a high of 3.0 cents in August. After war was declared London Metal Exchange quotations were suspended on September 3, and subsequently the British Metal Control established fixed prices. The maximum price for foreign zinc was fixed at £15 a long ton, ex-ship, duty for buyers' account, in September, but in December was increased to £25 15s., delivered, duty paid.

Figure 1 shows trends in the domestic zinc industry since 1900.

Statistical data on the zinc industry abroad during 1939 are incomplete because publication of official figures ceased in many countries. World smelter production outside the United States is estimated to have increased only 2 percent. The Allied blockade diverted shipments of ore from Belgium, the Netherlands, and Norway, which rely almost entirely on imported ores, and these countries reported reduced smelter activity. Acquisition of Polish smelters and mines placed Germany far in the lead among European countries and made it more than self-sufficient in zinc. As mine production exceeded smelter output there were large accumulations of zinc ore stocks during 1939. World consumption of zinc probably advanced, but the extent of the increase cannot be estimated owing to lack of data. An attempt was made to revive the International Zinc Cartel during

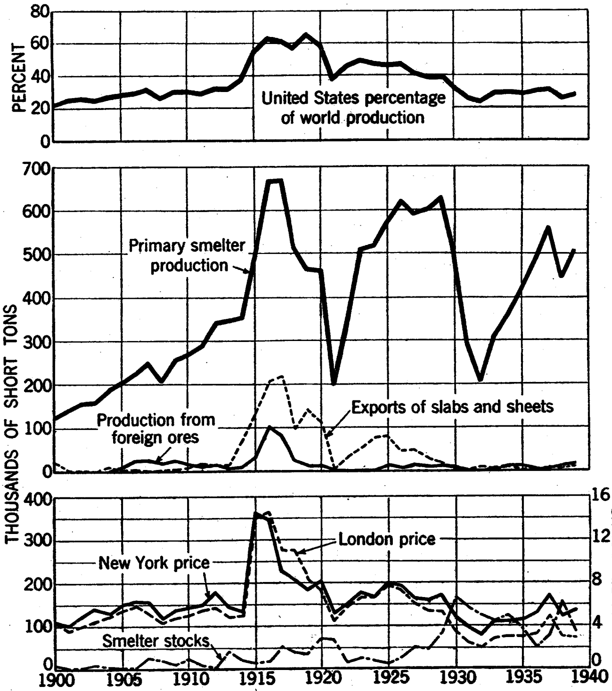

FIGURE 1.—Trends in the zinc industry in the United States, 1900–1939. Imports of slab and sheet zinc are not shown. Before 1936 they seldom exceeded 500 tons annually, but in recent years they have increased, amounting to 37,439 tons in 1937, 7,456 tons in 1938, and 31,138 tons in 1939.

the year, but owing to the tense political situation in Europe no success was achieved.

Reduction in tariff.—On January 1, 1939, the 20-percent reduction in import duties on zinc, established by the Canadian Trade Agreement signed November 17, 1938, became effective. Under the revised schedules the tariff on slab zinc was reduced from 1.75 to 1.40 cents a pound and that on zinc contained in ore from 1.50 to 1.20 cents a pound.

As stated in Minerals Yearbook, 1939, this reduction aggravated the already unfavorable competitive position of the domestic zinc industry that has resulted from overproduction of zinc in foreign countries during recent years. The depressed state of the foreign market is illustrated by the decline in London prices from 5.40 cents in 1929 to 3.05 cents in 1938 and 2.89 cents during the first 8 months of 1939, despite large increases in consumption abroad. Because of this decline, the domestic tariff on zinc has been virtually 100 percent effective since 1935 so that any reduction in the import duty under normal conditions would affect domestic prices adversely. After announcement of the terms of the Canadian Trade Agreement the latter part of November 1938, the St. Louis quotation for prime western zinc dropped from 5.05 to 4.50 cents and was maintained at this level until late July 1939, when markets moved upward owing to improved industrial activity in the United States and accelerated buying in anticipation of the outbreak of war in Europe.

Complications arising from the war make it difficult to appraise the net result of the tariff reduction on the domestic zinc industry during 1939. In the first half of the year the trade was in a depressed state because of the low price and low rate of consumption. Some plants were closed, and there were rumors of wage cuts or shut-downs at others. The condition was reversed, however, the latter part of the year, as the price rose to 6.50 cents from September to November. The high rate of demand coupled with the higher price brought a measure of prosperity to the industry, although from the long-range view this situation could be considered only temporary. While the war was playing an important role in stimulating demand and forcing prices upward it was also creating other conditions that ultimately may have unfavorable effects on markets. The Allied blockade of Germany greatly reduced the flow of zinc and zinc ores to Europe; consequently, producers sought other outlets. Because of its enormous demand for zinc the United States was the logical market for these products, and their sale to domestic consumers has been facilitated to a considerable extent by the lower import duties now prevalent. This situation is reflected in the figures for net imports of zinc into the United States in 1939, which were the highest on record. Significant also was the announcement by an official of a large producer in Mexico in March 1940, that, owing to scarcity and high cost of freight to Belgium, zinc ores were being diverted to the United States, "where there is surplus smelting capacity and a deficiency between domestic production and consumption of zinc." [2]

The war has brought about large increases in world stocks of zinc not only in various forms of metal stored for military purposes but also as ore accumulated in producing countries. For the past few years zinc concentrate inventories abroad have increased rapidly, notwithstanding successive new records in foreign zinc consumption. Mine output persistently has exceeded demand. According to the American Bureau of Metal Statistics stocks of concentrates held by the Electrolytic Zinc Co. of Australasia were 236,000 short tons on June 30, 1939, and at the end of the year there were 220,000 tons on hand in North and South America, making a total of 456,000 tons. With inventories of this magnitude hanging over the market it is evident that the present price level under which the domestic industry is operating profitably involves considerable hazard and that eventually the excessive stocks will be liquidated, possibly at distress prices.

During 1939 the zinc-producing industry requested the United States Government to take action toward restoring the former import duties under procedures provided in the Canadian Trade Agreement. The State Department was studying the problem carefully, but nc decision had been announced by the end of the year.

[2] Pott, C. T., Report of Ordinary General Meeting of Shareholders, 1940: San Francisco Mines of Mexico, Ltd., March 15, 1940.

DOMESTIC PRODUCTION

Production of primary and secondary slab zinc.—Production of primary slab zinc from both domestic and foreign ores in 1939 was 14 percent greater than in 1938 and was equivalent to 84 percent of the average yearly output in the 5 years 1925–29. Both domestic and foreign ores contributed to the increase, as production from the former advanced by 13 percent and that from the latter by 57 percent.

A substantial increase in the production of secondary slab zinc is indicated by the 60-percent gain in the output of redistilled metal. Figures for the output of remelted secondary zinc are not yet available.

Primary and secondary slab zinc produced in the United States, 1935–39, in short tons

Year	Primary			Secondary			Grand total
	Domestic	Foreign [1]	Total	Redistilled	Remelted	Total	
1935	412,184	8,450	420,634	28,650	(2)	(2)	(2)
1936	491,803	329	492,132	42,209	(2)	(2)	(2)
1937	551,165	5,739	556,904	51,554	12,986	64,540	621,444
1938	436,007	10,334	446,341	31,613	10,657	42,270	488,611
1939	491,058	16,178	507,236	50,428	(3)	(3)	(3)

[1] All foreign zinc smelted in the United States in 1935–36 was derived from Mexican ores; in 1937–38, most of it originated in Peru; in 1939, it came from Mexico, Peru, and Argentina.

[2] Figures in process of revision. [3] Data not yet available.

Distilled and electrolytic zinc.—Of the primary zinc produced in 1939, 75 percent was distilled and 25 percent electrolytic. For 1938 the corresponding figures were 79 percent and 21 percent, respectively. The substantial gain in production of redistilled secondary zinc virtually recouped the loss in 1938 and restored the 1937 level of output.

Distilled and electrolytic zinc, primary and secondary, produced in the United States, 1935–39, in short tons

APPORTIONED ACCORDING TO METHOD OF REDUCTION

Year	Electrolytic primary	Distilled primary	Redistilled secondary [1]		Total
			At primary smelters	At secondary smelters	
1935	118,476	302,158	13,439	15,211	449,284
1936	127,175	364,957	22,142	20,067	534,341
1937	117,511	439,393	24,131	27,423	608,458
1938	93,272	353,069	14,003	17,610	477,954
1939	127,056	380,180	23,471	26,957	557,664

APPORTIONED ACCORDING TO GRADE

Year	Grade A (High Grade)	Grade B (Intermediate)	Grades C and D (Brass Special and Selected)	Grade E (Prime Western)	Total
1935	155,516	49,118	49,909	194,741	449,284
1936	183,841	59,879	65,728	224,893	534,341
1937	196,052	67,132	72,993	272,281	608,458
1938	140,256	58,128	73,724	205,846	477,954
1939	162,345	66,591	86,274	242,454	557,664

[1] For total production of secondary zinc see chapter on Secondary Metals—Nonferrous.

Production of primary slab zinc by States.—Pennsylvania continued to be the leading zinc producer in the United States, a distinction held without interruption since1934. Next in order of importance as producers were Montana, Oklahoma, and Illinois, retaining respectively their relative positions of 1938. All producing States made substantial gains, except Arkansas and the West Virginia-Texas group. As in the preceding year, Montana and Idaho produced electrolytic zinc only in 1939, and the other States shown produced distilled zinc only.

Primary slab zinc produced in the United States, by States, 1935–39, in short tons

Year	Arkansas	Idaho	Illinois	Montana	Oklahoma	Pennsylvania	Other States [1]	Total	
								Short tons	Value
1935	10,147	12,448	67,348	106,028	58,612	119,452	46,599	420,634	$37,016,000
1936	18,005	21,223	81,174	105,952	62,963	150,425	52,390	492,132	49,213,000
1937	25,799	22,831	73,151	94,680	96,153	175,275	69,015	556,904	72,398,000
1938	20,476	15,634	68,167	77,638	68,224	139,897	56,305	446,341	42,849,000
1939	19,892	18,427	79,480	108,629	84,551	155,598	40,659	507,236	52,753,000

[1] Texas and West Virginia.

Secondary zinc.—In addition to the redistilled and remelted secondary slab zinc (unalloyed) already reported herein, 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 chapter of this volume on Secondary Metals—Nonferrous.

Byproduct sulfuric acid.—Sulfuric acid made from the sulfur dioxide gases produced in the roasting of zinc blende is an important byproduct of zinc smelting. To utilize a larger proportion of their acid-producing capacity, some plants also consume large quantities of sulfur in addition. The production of sulfuric acid at zinc blende roasting plants from 1934 to 1938, inclusive, is shown in the following table. Data for 1939 are not yet available.

Sulfuric acid (60° B. basis) made at zinc blende roasting plants in the United States, 1934–38 [1]

Year	Made from zinc blende		Made from sulfur		Total		
	Short tons	Value [2]	Short tons	Value [2]	Short tons	Value [2]	
						Total	Average per ton
1934	[3] 406,984	$3,215,173	89,162	$704,380	496,146	$3,919,553	$7.90
1935	[3] 443,476	3,756,242	90,884	769,787	534,360	4,526,029	8.47
1936	505,882	4,497,291	161,169	1,432,792	667,051	5,930,083	8.89
1937	[3] 542,356	5,060,181	151,090	1,409,670	693,446	6,469,851	9.33
1938	[3] 466,879	4,253,268	30,996	282,373	497,875	4,535,641	9.11

[1] Figures for 1939 not yet available.
[2] At average of sales of 60° acid.
[3] Includes acid from small quantity of foreign blende.

Rolled zinc.—The output of rolled zinc in 1939 was 35 percent greater than in 1938. The average value remained the same, at $0.086 a pound. Some mills that manufacture their rolled zinc into various products, other than those shown in the accompanying table, remelt and reroll the resulting scrap. The scrap thus treated in 1939 was 12,916 tons, a 38-percent increase over the 1938 figure. The zinc lost in such waste products as skimmings, drosses, and pot losses totaled 1,644 tons in 1939—equivalent to about 3 percent of the net production of rolled zinc. Zinc purchased for rolling in 1939 consisted of 39 percent Brass Special, 24 percent Prime Western, 19 percent Selected, 14 percent High Grade, and 4 percent Electrolytic and Intermediate grades. Stocks of slab zinc on hand at zinc rolling-mills were about 6,600 tons (revised figure) at the beginning and 7,800 tons at the end of the year.

Rolled zinc produced and quantity available for consumption in the United States, 1938–39

	1938			1939		
	Short tons	Value: Total	Value: Average per pound	Short tons	Value: Total	Value: Average per pound
Production:						
Sheet zinc not over 0.1 inch thick	12,219	$2,503,000	$0.102	15,599	$3,282,000	$0.105
Boiler plate and sheets over 0.1 inch thick	829	145,000	.087	1,098	184,000	.084
Strip and ribbon zinc [1]	32,827	5,278,000	.080	45,185	7,148,000	.079
Total zinc rolled [1]	45,875	7,926,000	.086	61,882	10,614,000	.086
Imports	226	26,000		178	21,000	
Exports	[2] 5,736	[2] 908,000	.079	6,449	1,052,000	.082
Available for consumption	40,365			55,611		
Value of slab zinc (all grades)			.048			.052
Value added by rolling			.038			.034

[1] Figures represent net production. In addition, 9,392 tons of strip and ribbon zinc in 1938 and 12,916 tons of strip and ribbon zinc in 1939 were rerolled from scrap originating in fabricating plants operated in connection with zinc rolling-mills.
[2] Includes some slab zinc; not separately recorded.

Zinc dust.—Production of zinc dust in 1939 increased 45 percent over 1938 and was the largest on record. The zinc content of dust produced ranged from 94.0 to 98.5 percent and averaged 97.0 percent. Almost all of the zinc dust produced since 1931 has been from redistillation of zinc drosses and slab zinc.

Zinc dust [1] produced in the United States, 1935–39

Year	Short tons	Value: Total	Value: Average per pound	Year	Short tons	Value: Total	Value: Average per pound
1935	12,453	$1,574,259	$0.063	1938	11,609	$1,542,511	$0.066
1936	14,425	1,957,300	.068	1939	16,835	2,367,861	.070
1937	15,242	2,587,577	.085				

[1] All produced by distillation.

Zinc pigments and salts.—The principal zinc pigments are zinc oxide, leaded zinc oxide, and lithopone, and the principal salts are the chloride and sulfate. These products are manufactured from various zinciferous materials—ores, metal, and secondary substances. Details of the production of zinc pigments and salts are given in the chapter on Lead and Zinc Pigments and Zinc Salts.

Mine production.—Mine production increased 13 percent in 1939 owing to gains in output of 18 percent in the Western States, 17 percent in the Central States, and 5 percent in the Eastern States. Tonnage advances were largest in the Central States, followed by the western and eastern groups. New Jersey leads in production in the Eastern States and ranks second in importance in the country. Output in New Jersey gained 3 percent and in New York 20 percent in 1939. Tennessee's output also rose, but that in Virginia declined.

In the Western States the most spectacular gain was that for Montana, where output rose from 8,844 tons in 1938 to 34,799 in 1939. Reopening early in the year of the Orphan Girl mine and other zinc-lead properties owned by the Anaconda Copper Mining Co. resulted in large gains in output from Butte, and production from the slag fuming plant at East Helena was expanded. Idaho, the largest zinc-producing State in the western group, increased 8 percent in production in 1939, while Utah, third in importance, gained 3 percent. The output from the Bingham and Tintic districts was less in 1939 than in 1938, but production from the Park City area increased following reopening of the Silver King Coalition and Park Utah Consolidated properties. New Mexico's total increased 4 percent in 1939, although the State's largest producer—the Pecos mine—was closed permanently May 31, 1939, because ore was exhausted. Output in Nevada fell 30 percent and in Colorado 60 percent. Colorado's drop was due largely to the idleness throughout 1939 of the Sunnyside mine, San Juan County.

Zinc produced in the Central States represented 40 percent of the country's total in 1939. Production was stimulated late in the year by increased prices for zinc, and many of the mines and mills of the area were running at capacity at that time. Oklahoma is the principal zinc-producing State in the region and in the country, with an output that represented 24 percent of the country's total in 1939. Production in Oklahoma rose 24 percent in 1939 and that in Missouri 48 percent, while output in Kansas dropped 6 percent.

Further details of zinc mining will be found in the various State reports in this volume.

Mine production of recoverable zinc in the United States, 1925–29 (average) and 1935–39, in short tons

State	1925-29 (average)	1935	1936	1937	1938	1939
Western States:						
Arizona	2,628	3,337	3,589	5,026	5,814	6,711
California	3,999	161	8	20		6
Colorado	32,868	1,202	1,172	4,247	4,553	1,830
Idaho	29,128	31,053	49,100	54,199	44,030	47,549
Montana	72,519	54,781	49,717	39,168	8,844	34,799
Nevada	5,570	15,536	13,477	14,236	8,944	6,228
New Mexico	23,351	22,126	20,668	23,927	28,236	29,356
Oregon			61	24		
Utah	44,385	31,107	36,192	48,001	33,658	34,526
Washington	575	1	4,403	4,116	11,402	10,131
	215,023	159,304	178,387	192,964	145,481	171,136
Central States:						
Arkansas	71	153	182	241	152	123
Illinois	1,174					334
Kansas	114,323	54,110	79,017	80,300	73,024	68,971
Kentucky	644	127	238	270	322	909
Missouri	16,708	7,263	18,709	20,600	10,226	15,096
Oklahoma	226,969	129,763	129,175	135,696	112,924	140,379
Wisconsin	23,055	8,923	8,126	6,938	2,073	5,904
	382,944	200,339	235,447	244,045	198,721	231,716
Eastern States:						
New Jersey	93,839	85,708	89,883	101,408	85,839	88,716
New York	7,091	23,720	26,941	32,690	29,896	36,014
Tennessee and Virginia [1]	25,823	48,832	44,916	55,255	56,766	56,225
	126,753	158,260	161,740	189,353	172,501	180,955
	724,720	517,903	575,574	626,362	516,703	583,807

[1] Bureau of Mines not at liberty to publish figures for Tennessee and Virginia separately.

Mine production of recoverable zinc in the principal zinc-producing districts of the United States, 1935–39, in short tons

District	State	1935	1936	1937	1938	1939
Joplin region	Kansas, Missouri, Oklahoma	191,136	226,857	236,585	196,174	224,446
New Jersey	New Jersey	85,708	89,883	101,408	85,839	88,716
Eastern Tennessee Austinville	Tennessee Virginia	48,832	44,916	55,255	56,766	56,225
Coeur d'Alene region	Idaho	31,009	44,310	47,070	31,937	40,065
St. Lawrence County	New York	23,720	26,941	32,690	29,896	36,014
Central	New Mexico	8,404	10,706	11,887	16,695	23,677
Bingham	Utah	17,996	17,422	20,570	23,096	20,861
Summit Valley (Butte)	Montana	37,646	34,940	22,033	942	20,016
Smelter	do	11,078	7,986	10,330	6,063	12,639
Metaline	Washington		4,389	4,095	11,402	10,130
Park City region	Utah	9,659	13,579	19,342	5,678	9,054
Warm Springs	Idaho	39	4,771	6,959	12,070	7,463
Upper Mississippi Valley	Iowa, northern Illinois, Wisconsin.	8,923	8,126	6,938	2,073	5,904
Pioche	Nevada	12,183	12,047	12,472	8,414	5,737
Willow Creek	New Mexico	13,372	9,667	10,882	11,291	4,925
Oro Blanco	Arizona	3,270	3,065	2,700	3,265	2,377
Rush Valley	Utah	981	1,366	2,205	1,955	2,370
Pioneer	Arizona				825	2,000
San Juan Mountains	Colorado	153	140	2,092	4,308	1,465
Ophir	Utah	2,167	3,563	4,023	1,893	1,268
Kentucky-Southern Illinois	Kentucky-Southern Illinois	127	238	270	322	1,243
Harshaw	Arizona					1,075
Cataract	Montana	1,029	1,354	1,043	605	1,070
Tintic	Utah	15	177	1,259	921	851
Wallapai	Arizona	67	524	1,714	1,660	770
Flint Creek	Montana	4,746	4,307	4,641	426	663
Leadville	Colorado	924	871	1,676	97	172
Tybo	Nevada	[1]	[1]	1,417		

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

STOCKS

Stocks of zinc at primary reduction plants fell 47 percent during 1939 from the unusually high stocks carried over from the preceding year. Stocks at secondary distilling plants increased 33 percent. Total stocks declined 46 percent. Of the total stocks on hand at the end of the year, 34,334 tons were of the higher grades of zinc (A and B) and 51,949 tons of the lower grades (C, D, and E) compared with 75,864 and 83,562 tons, respectively, at the end of 1938.

According to the American Zinc Institute, stocks of slab zinc declined moderately in the first quarter, increased materially in the second quarter, and reached the peak for the year at the end of June, declining steadily thereafter to the end of November as shipments to consumers increased. During December zinc stocks increased slightly, but the year-end figure was little more than half that at the beginning of the year.

Stocks of zinc on hand at zinc-reduction plants in the United States at end of year, 1935–39, in short tons

	1935	1936	1937	1938	1939
At primary reduction plants	90,539	55,500	79,144	157,511	83,728
At secondary distilling plants	1,151	626	1,969	1,915	2,555
	91,690	56,126	81,113	159,426	86,283

Stocks of zinc ore (60 percent concentrates) in the Tri-State district at the beginning of 1939 totaled 8,400 tons. In January 1940 production exceeded shipments, and early in February stocks increased to 12,100 tons. A reduction to 5,500 tons on July 1 was followed by an advance to over 10,000 tons early in September. Sharp increases in shipments from September 16 through October reduced stocks to 5,100 tons on November 4, but a subsequent increase in output and a decline in demand reversed the trend, and by December 23 stocks had risen to 13,200 tons—the peak for the year. At the close of the year 12,000 tons of ore were on hand.

Data on stocks of zinc outside the United States are not available, but some authorities estimate that there was little change in the stock situation during 1939. Estimates of world stocks of slab zinc at the end of 1938 ranged from 425,000 to 470,000 tons. The disruption of international trade in zinc ore caused by the war has increased inventories of ore at producing centers. The Electrolytic Zinc Co. of Australasia reports that its stock of ore as of June 30 has increased from 117,000 short tons in 1936 to 203,000 in 1938 and 236,000 in 1939. The American Bureau of Metal Statistics states that stocks in North and South America at the end of the year rose from 118,000 tons in 1936 to 190,000 in 1938 and 220,000 in 1939.

DOMESTIC CONSUMPTION

New supply.—The supply of new slab zinc available for consumption in 1939 increased 62 percent over 1938 and established a record, exceeding the previous one of 1928 (578,060 tons) by 5 percent and the 1925–29 average (548,472 tons) by 11 percent. By comparison supplies of copper, lead, and pig iron increased 76, 22, and 70 percent over 1938, respectively. Larger production from both domestic and foreign ores and a substantial reduction in producers' stocks during the year explained the record supply of zinc available in 1939. However, it is believed that consumers' stocks increased appreciably, particularly during the latter part of the year. The American Bureau of Metal Statistics estimates the industrial consumption of primary and redistilled secondary zinc at 626,000 tons, which is nearly 32,000 tons below the supply of new zinc available plus the production of redistilled secondary zinc as reported by the Bureau of Mines. Domestic shipments during the last third of 1939 averaged 65,157 tons a month compared with 42,293 tons during the first 8 months, according to the American Zinc Institute. This 54-percent increase in deliveries to consumers probably is far above the rise in actual consumption, supporting the assumption that consumers were accumulating stocks during the latter part of the year. Sheet galvanizing operations, for instance, were only about 30 percent higher in the last 4 months of 1939 than in the preceding 8 months; and automobile production, where large quantities of zinc die castings are used, increased only 15 percent.

Primary slab zinc available for consumption in the United States, 1935–39, in short tons

	1935	1936	1937	1938	1939
Supply:					
Stock at smelters Jan. 1	124,783	90,539	55,500	79,144	157,511
Production	420,634	492,132	556,904	446,341	507,236
Imports	4,444	11,660	37,208	7,230	30,960
Total available	549,861	594,331	649,612	532,715	695,707
Withdrawn:					
Exports	1,617	37	249	[1] 200	4,515
Stock at smelters Dec. 31	90,539	55,500	79,144	157,511	83,728
Total withdrawn	92,156	55,537	79,393	157,711	88,243
Available for consumption	457,705	538,794	570,219	375,004	607,464

[1] Not separately recorded; estimated.

Industrial use of slab zinc.—In addition to the new supply of zinc shown in the preceding table, a large supply of secondary zinc is available for consumption each year. The estimated industrial use of both primary and secondary zinc, as calculated by the American Bureau of Metal Statistics, is shown in the following table:

Estimated industrial use of zinc in the United States, 1935–39, in short tons [1]

Purpose	1935	1936	1937	1938	1939
Galvanizing:					
Sheets	110,000	132,000	139,000	108,500	147,500
Tubes	25,000	36,000	37,000	29,300	43,000
Wire	25,000	30,000	33,000	23,600	30,900
Wire cloth	5,000	6,000	7,000	5,600	7,000
Shapes [2]	30,000	38,000	40,000	31,000	46,600
	195,000	242,000	256,000	198,000	275,000
Brass making	124,000	165,000	169,000	102,000	175,000
Rolled zinc	56,500	55,000	58,000	46,000	62,000
Die castings	55,500	72,000	88,000	48,000	84,000
Other uses [3]	42,000	48,000	39,000	27,000	30,000
	473,000	582,000	610,000	421,000	626,000

[1] Year Book, American Bureau of Metal Statistics, 1939.
[2] Includes pole-line hardware, hollow ware, chains, and all articles not elsewhere mentioned.
[3] Includes slab zinc used for manufacture of French oxide, zinc for wet batteries, slush castings, the desilverization of lead, wire for metalizing, etc., and sundries.

The quantity of zinc used by industry in 1939 was 49 percent higher than in 1938 and totaled 99 percent of the record amount consumed in 1929. All four of the principal uses increased in 1939—galvanizing 39 percent, brass making 72 percent, rolled zinc 35 percent, and die castings 75 percent. The largest use—galvanizing—took 44 percent of the total tonnage in 1939 compared with 47 percent in 1938. This item includes zinc used in electrogalvanizing and that used in sheradizing. The former increased from 3,978 tons in 1938 to 5,740 in 1939 and the latter from 264 tons to 511.

Zinc used in rolled products in 1939 (1938 figures in parentheses) included 21,670 tons (15,300) in battery cans, 20,000 (15,000) in glass jar tops, 1,000 (2,000) in automobile manufacture, 5,000 (4,000) in photoengraving sheet, 1,100 (830) in boiler plate, 340 (270) in brake lining, and 250 (300) in electric refrigerators. The remaining tonnage was used in miscellaneous other uses or exported. The chief item in "Other uses" is the slab zinc employed in making French-process zinc oxide, which totaled about 17,000 tons in 1939 compared with 16,000 in 1938.

PRICES

The spot price of zinc did not change during the first half of 1939 but advanced consistently throughout the greater part of the latter half. At the beginning of the year the St. Louis price of Prime Western zinc stood at the 4.50-cent level in effect since November 29, 1938. This quotation held throughout the first half of the year and until July 26, when it reached 4.55 cents. As demand improved, production of slab zinc was accelerated but failed to meet the rapidly expanding market. As a result, stocks trended downward, and prices responded with a consistent rise to 4.60 cents on July 27 and 4.75 cents on August 7, and a rapid advance from then through September. The outbreak of war in Europe added a stimulus to normal demand. After reaching the year's peak of 6.50 cents on September 27—apparently this figure reflected an overestimate of demand for the near future—the price fell to 6.00 cents on December 4 and was 5.75 cents at the end of the year, with an average of 5.12 cents for the year compared with 4.61 cents in 1938, an 11-percent increase.

London Metal Exchange dealings were suspended at the outbreak of the war, and zinc market quotations in London are available only for the first 8 months of 1939. The monthly average price fluctuated from 2.85 cents in January to a low of 2.81 cents in April, from which it advanced steadily to 3.01 cents in August—about 3 percent above the average price for August 1938. For the 8-month period the 1939 average price was 2.89 cents—about 6 percent below the January-August average of 1938. For the first 8 months of the year the New York price averaged 2.03 cents higher than the London price, the monthly differential ranging from 2.04 cents in January to a low of 1.94 cents in July and a high of 2.10 cents in August.

On September 8 the Nonferrous Metal Control for the United Kingdom fixed the price of zinc at £15 ex-ship and £15 12s. 6d. ex-warehouse, duty for buyers' account for foreign metal, and £17 5s. ex-ship and £17 17s. 6d. ex-warehouse for domestic and Empire metal. On December 18 prices were raised sharply to £25 15s., delivered consumers, duty paid for foreign zinc and £26 10s. for domestic metal.

Price of zinc and zinc concentrates, 1935–39

	1935	1936	1937	1938	1939
Average price of common zinc at—					
St. Louis (spot) cents per pound	4.33	4.90	6.52	4.61	5.12
New York do	4.70	5.28	6.87	4.99	5.51
London do	3.08	3.31	4.91	3.05	[1] 2.89
Excess New York over London do	1.62	1.97	1.96	1.94	[2] 2.03
Joplin 60-percent zinc concentrates:					
Price per short ton dollars	28.81	31.95	39.87	27.83	34.15
Price of zinc content cents per pound	2.40	2.66	3.32	2.32	2.85
Smelter margin do	1.93	2.24	3.20	2.29	2.27
Price indexes (1925–29 average=100):					
Zinc (New York)	66	74	97	70	77
Lead (New York)	54	63	80	63	68
Copper (New York)	59	65	90	68	75
Nonferrous metals [3]	69	72	91	74	79
All commodities [3]	81	82	88	80	79

[1] Average for 8 months; London Metal Exchange dealings suspended in September.
[2] Difference based upon 8-month averages.
[3] Based upon price indexes of the U. S. Department of Labor.

Average monthly quoted prices of common zinc (prompt delivery or spot) at St. Louis and London, and of 60-percent zinc concentrates at Joplin, 1938–39 [1]

Month	1938			1939		
	60-percent zinc concentrates in the Joplin region (dollars per ton)	Metallic zinc (cents per pound) St. Louis	Metallic zinc (cents per pound) London	60-percent zinc concentrates in the Joplin region (dollars per ton)	Metallic zinc (cents per pound) St. Louis	Metallic zinc (cents per pound) London
January	29.13	5.00	3.34	29.00	4.50	2.85
February	28.17	4.82	3.23	29.00	4.50	2.83
March	27.28	4.41	3.20	29.00	4.50	2.87
April	26.04	4.15	3.05	30.00	4.50	2.81
May	25.43	4.04	2.81	30.00	4.50	2.87
June	25.43	4.14	2.85	30.00	4.50	2.93
July	27.75	4.75	3.11	30.00	4.52	2.97
August	27.75	4.75	2.93	31.27	4.72	3.01
September	27.75	4.85	3.01	37.96	6.15	(2)
October	29.47	5.01	3.21	44.00	6.50	(2)
November	30.56	4.91	3.02	44.00	6.50	(2)
December	27.16	4.50	2.86	41.42	6.01	(2)
Average for year	27.83	4.61	3.05	34.15	5.12	[3] 2.89

[1] All quotations from Metal Statistics, 1940. Conversion of English quotations into American money based upon average rates of exchange recorded by the Federal Reserve Board of the Treasury.
[2] London Metal Exchange dealings suspended for duration of war.
[3] Average for 8 months; comparable average for St. Louis was 4.53 cents.

Average price of zinc received by producers, 1935–39, by grades, in cents per pound

	1935	1936	1937	1938	1939
Grade A (High Grade) [1] } Grade B (Intermediate) }	4.55	5.15	6.65	5.03	5.34
Grades C and D (Select and Brass Special) [1]	4.31	4.91	6.47	4.73	5.00
Grade E (Prime Western)	4.32	4.89	6.44	4.71	5.08
All grades	4.4	5.0	6.5	4.8	5.2
Prime Western; spot quotation at St. Louis	4.3	4.9	6.5	4.6	5.1

[1] American Metal Market quotes average prices of High Grade and Brass Special as follows: High Grade (f. o. b. New York), 1935, 5.33 cents; 1936, 5.90 cents; 1937, 7.76 cents; 1938, 5.74 cents; 1939, 6.16 cents; Brass Special (f. o. b. East St. Louis), 1935, 4.41 cents; 1936, 4.98 cents; 1937, 6.62 cents; 1938, 4.71 cents; 1939, 5.22 cents.

ZINC-REDUCTION PLANTS

Zinc smelters.—There were no changes during 1939 in the number of active and idle zinc smelters; as in the previous year, there were 17 active and 2 idle plants. Of the active plants, 13 operated exclusively with horizontal retorts, 1 with both horizontal and vertical retorts, 2 with large vertical retorts exclusively, and 1 with electrothermic furnaces. At the active plants, 69,180 horizontal retorts were available, the same as in 1938, but the number in use at the end of the year increased from 33,949 in 1938 to 49,151 in 1939. In addition, 50 of the 52 installed vertical retorts were in operation at the close of 1939.

Many primary smelters treat scrap as well as ore. Horizontal-retort plants at Beckemeyer and Sandoval, Ill., and large graphite-retort plants at Trenton, N. J., Philadelphia, and Bristol, Pa., Wheeling, W. Va., Tottenville, N. Y., and Fairfield, Ala., handle scrap exclusively. The Torrance (Calif.) plant of the Pacific Smelting Co., Ltd., contains small clay retorts as well as large graphite retorts for treating secondary materials.

Electrolytic plants.—Three electrolytic zinc plants were in operation during 1939. The enlarged Kellogg (Idaho) plant of the Sullivan Mining Co. was operating at capacity at the end of 1939, as was the Great Falls (Mont.) plant of the Anaconda Copper Mining Co., but the plant of the latter company at Anaconda was operating only at half capacity at the end of the year. The plant of the Evans-Wallower Zinc Co. at East St. Louis remained idle during 1939. At the 3 active plants, 1,904 cells out of a total of 2,192 were in use at the end of 1939, compared with 1,460 at the end of 1938.

FOREIGN TRADE[3]

Imports.—The following tables give zinc imports into the United States, 1935–39, inclusive, and a record of bonded-warehouse inventories.

Zinc ores (zinc content) imported into the United States, 1935–39, in short tons[1]

Year	Canada	Mexico	Other countries	Total	Year	Canada	Mexico	Other countries	Total
1935		10,520		10,520	1938		7,253	[2] 11,330	18,583
1936		172		172	1939	1,613	23,221	[2] 11,266	36,100
1937	84	338	[2] 8,390	8,812					

[1] Data include ore imported for immediate consumption plus material entering the country under bond.
[2] Includes 8,373 tons imported from Peru in 1937, all from Peru in 1938, and 9,722 tons from Peru in 1939.

Zinc[1] *remaining in warehouse in the United States, December 31, 1935–39*

Year	Pounds	Year	Pounds
1935	13,840,586	1938	51,058,373
1936	10,690,832	1939	20,295,817
1937	24,904,405		

[1] Includes zinc ore (zinc content), zinc blocks, pigs, old, and sheets.

[3] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Imports of zinc ore in 1939 advanced 94 percent over 1938 owing to continued large increases in shipments from Mexico. More than 64 percent of the ore imported in 1939 came from Mexico and 27 percent from Peru; most of the remainder came from Canada and Argentina. Imports of slab zinc increased from 7,230 tons in 1938 to 30,960 in 1939. Imports of slab zinc in 1939 (1938 figures in parentheses) included 16,506 tons (3,346) from Mexico, 6,402 tons (2,332) from Canada, 4,790 tons (286) from Belgium, 1,456 tons (none) from Norway, and 806 tons (1,210) from Poland and Danzig.

Zinc imported for consumption in the United States, 1935–39

Year	Blocks, pigs, or slabs		Sheets		Old, dross, and skimmings [1]		Zinc dust		Value of manufactures	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value		
1935	4,444	$270,350	112	$9,423	29	$979	40	$2,486	$1,149	$284,387
1936	11,660	770,496	242	23,077	16	769	57	3,647	540	798,529
1937	37,208	3,852,884	231	30,398	678	70,460	69	6,169	828	3,960,739
1938	7,230	480,169	226	25,989	96	8,944	64	5,074	463	520,639
1939	30,960	1,890,236	178	21,166	203	14,067	41	3,388	1,545	1,930,402

[1] Includes dross and skimmings: 29 tons valued at $974 in 1935; 15 tons valued at $721 in 1936; 560 tons valued at $59,635 in 1937; and 30 tons valued at $1,918 in 1939. None reported in 1938.

Exports.—The total value of the 1939 exports of zinc ore and manufactured articles containing zinc of foreign and domestic origin (excluding galvanized products, alloys, and pigments) was $2,075,000, an increase from $1,271,000 in 1938. Most of the increase in exports was in plates, sheets, pigs, and slabs; there were slight increases in zinc dust and zinc ore. 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. The American Bureau of Metal Statistics estimates that 14,900 tons of zinc were exported in galvanized products in 1939. Export data on zinc pigments and chemicals are given in the chapter in this volume on Lead and Zinc Pigments and Zinc Salts. Much of the zinc used in the manufacture of these products is of foreign origin, and when it is exported a draw-back of 99 percent of the import duty is paid. In 1939 draw-back was paid on 16,213 tons of zinc, of which 10,625 tons had been imported as slabs and 5,588 tons as ore. The totals for previous years were: 1938, 11,550 tons; 1937, 9,253 tons; 1936, 8,909 tons; 1935, 7,297 tons; and 1934, 4,139 tons.

Zinc ore and manufactures of zinc exported from the United States, 1935–39

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
1935	461	$10,818	1,617	$83,925	4,813	$755,033	1,613	$238,158
1936	245	5,902	37	4,962	4,483	723,142	1,793	273,813
1937	314	10,145	249	25,706	5,813	1,103,533	2,145	418,376
1938	135	6,404	(1)	(1)	[1] 5,736	[1] 908,381	2,253	355,856
1939	303	11,253	4,515	479,338	[2] 6,708	[2] 1,116,485	2,834	468,516

[1] Pigs and slabs not shown separately; included with sheets, strips, or other forms, n. e. s.
[2] Includes 259 tons valued at $64,434 of "Other forms, n. e. s. (including scrap)" not separately classified before 1939.

Slab and sheet zinc exported from the United States, 1936–39, by destinations, in short tons

Destination	Slabs, plates, and blocks				Sheets, strips, or other forms, n. e. s			
	1936	1937	1938	1939	1936	1937	1938	1939
Country:								
Argentina			(1)	56	183	344	471	404
Australia			(1)		245	977	841	1,052
Brazil		2	(1)	526	7	(2)	9	50
Canada	5	1	(1)	5	1,999	2,251	2,317	2,902
Chile	7	65	(1)	298	6	1	9	20
China		6	(1)	201	223	331	11	148
India, British			(1)		3	90	110	122
Japan	1		(1)	3,025	199	194	232	5
United Kingdom		23	(1)		1,048	849	775	841
Other countries	24	152	(1)	404	570	776	961	1,164
Total	37	249	(1)	4,515	4,483	5,813	5,736	6,708
Continent:								
North America	19	10	(1)	31	2,164	2,413	2,527	3,167
South America	10	72	(1)	996	244	409	643	555
Europe		148	(1)		1,151	922	914	952
Asia	8	19	(1)	3,488	678	1,010	673	741
Africa			(1)		1	82	107	159
Oceania			(1)		245	977	872	1,134

[1] Slabs, blocks, or pigs not shown separately; included with sheets, strips, or other forms, n. e. s.
[2] Less than 1 ton.

WORLD ASPECTS OF ZINC INDUSTRY

Cartel activities.—Political conditions in Europe in 1939 were not conducive to international cooperation in economic matters. Consequently no progress was made toward reconstituting the International Zinc Cartel, which collapsed in 1934. A meeting of British, Belgian, and French interests was reported to have been held in Paris in June to discuss the possibilities of an agreement but achieved no success.

World smelter production.—There were no material changes in output of zinc in the principal producing countries of the world during 1939. Exclusive of the United States, where production of slab zinc during the year increased 14 percent, total world production increased only 2 percent above the figure for 1938. Such countries as Belgium, Norway, and the Netherlands, in which the customs smelters depend on imported concentrates, reported reductions in output for 1939. This condition may be attributed in part to the depreciated franc and pound sterling.

Dislocation of the zinc industry throughout Europe followed the outbreak of war in September. Acquisition of the Polish smelters, which were in operating condition when confiscated, placed Germany far in the lead among European producers and renders the nation self-sufficient in this nonferrous metal.

World smelter production of zinc, 1935–39, by countries where smelted, in metric tons [1]

[Compiled by R. B. Miller]

Country	1935	1936	1937	1938	1939
Australia	68,752	71,641	70,869	70,941	72,363
Belgium [2]	183,540	201,686	225,580	210,400	185,700
Canada	135,645	137,078	143,826	156,008	159,372
Czechoslovakia	9,648	7,670	7,336	8,876	(3)
France	47,443	51,694	60,427	60,560	60,262
Germany [4]	123,198	133,427	163,814	194,370	212,285
Indochina	3,837	4,112	4,204	4,470	5,439
Italy	27,579	27,025	37,982	33,637	33,566
Japan	34,191	39,066	45,500	(3)	(3)
Mexico	32,327	31,913	36,587	35,881	38,167
Netherlands	13,747	15,428	24,645	25,300	20,534
Northern Rhodesia	21,012	21,063	14,256	10,379	12,899
Norway	45,019	45,028	41,276	46,523	45,000
Poland	84,606	92,580	107,174	108,071	117,936
Spain	7,648	7,803	5,279	7,652	11,340
U. S. S. R	47,910	[5] 65,000	[5] 65,000	(3)	(3)
United Kingdom [4]	61,433	61,768	63,138	56,190	50,440
United States	381,591	446,452	505,212	404,912	460,154
Yugoslavia	3,356	3,599	4,259	3,956	4,182
	1,332,000	1,464,000	1,626,000	1,568,000	1,645,000

[1] Statistical data derived in part from the Yearbook of the American Bureau of Metal Statistics.
[2] Includes the following tonnages of electrolytic zinc: 1935, 1,800 tons; 1936, 6,366 tons; 1937, 7,830 tons; and 1938, 8,670 tons. Data not available for 1939. Production of electrolytic zinc began in August 1935.
[3] Estimate included in total. [4] Some secondary material included. [5] Approximate production.

World consumption.—World consumption of slab zinc during 1939 cannot be estimated accurately, as all belligerent countries suspended publication of certain essential data immediately after outbreak of the European war. It is reasonable to assume that there was some increase in consumption above the 1,489,800 metric tons reported for 1938 by the American Bureau of Metal Statistics. According to this authority, consumption in the United States increased 59 percent. Larger consumption also was indicated in Canada and other American countries and India, but data for other foreign countries are not complete enough for comparisons.

REVIEW BY COUNTRIES

Argentina.—Argentina produced 41,300 metric tons of zinc concentrates in 1939. The St. Joseph Lead Co. shipped lead and zinc concentrates to Europe from the Aguilar mine, Province of Jujuy.

Australia.—The Electrolytic Zinc Co. of Australasia, Ltd., received zinc concentrates at its Risdon electrolytic plant from mines at Broken Hill and Roseberry in excess of its requirements and during the first part of 1939 shipped 55,000 long tons of concentrates to the United Kingdom for emergency use. Subsequently, the concentrates were sold to the Imperial Smelting Corporation, Ltd.

The Zinc Corporation, Ltd., completed the new main shaft which is to serve its mine and that of the adjoining New Broken Hill Consolidated, Ltd. The flotation mill, which has a capacity of 10,000 tons of ore weekly, also was completed. The two companies will equip and operate their adjoining properties together in order to reduce the cost and time required in bringing the New Broken Hill mine into production. Estimated ore reserves in the North Broken Hill mine were increased to 5,084,000 tons as of June 30, 1939. Cessation of operations at the Central mine, Broken Hill, belonging to the Sulfide Corporation, Ltd., again was postponed during the year.

For the year ended June 30, 1939, Mt. Isa made a profit of £18,798 compared with £19,742 in the previous year. Ore treated during the last fiscal year totaled 575,884 tons containing 9.0 percent zinc, 9.2 percent lead, and 7.4 ounces silver per ton. The zinc concentrate output (44,700 tons) was 10,500 tons less than that in the preceding year and was caused by a 2-month stoppage of production following a coal strike. Milling equipment added in February 1940 increased capacity 20 percent and permitted 15,000 tons of ore to be treated weekly. Estimated ore reserves totaled 10,167,100 tons.

Australia produced about 410,000 tons of zinc concentrates in 1939 (392,000 in 1938). On February 8, 1940, the National Security (Prices) Regulations increased the maximum lead and zinc prices to £22 a long ton, which was considerably less than the London rates expressed in Australian currency.

Belgium.—Zinc ore imports into Belgium totaled 402,700 metric tons in 1939, 25 percent less than that in 1938. Mexico supplied 26 percent of the total. Receipts decreased from all the principal sources, including Australia, Canada, and Newfoundland, Sweden, Burma, Yugoslavia, and Italy. Slab zinc exports continued to decline—from 129,850 to 117,100 tons. Zinc sheet and wire exports dropped from 37,600 to 36,200 tons. The depreciation of sterling and the franc and the suspension of zinc quotations on the London market in September made it difficult for the Belgian, as well as the Dutch and Norwegian custom smelters, to compete in the world market, thus reducing exports. Slab zinc imports remained the same as in 1938, at 14,000 tons. Vieille Montagne zinc production was 110,500 tons in 1939, or about the same as in 1938. The company also produced 35,048 tons of rolled zinc and 15,496 tons of zinc white. The war affected its regular supply of ore during the last 4 months of 1939 as limited shipping facilities caused freight rates to advance five times over pre-war levels and war-insurance premium rates often were prohibitive. At the end of 1939 a number of furnaces were shut down. The Société Anonyme de Rothem produced 18,000 tons of zinc ingots in 1939.

Burma.—The production of zinc concentrates in Burma totaled 59,500 long tons in 1939 compared with 60,700 tons in 1938. Exports of zinc, chiefly concentrates, totaled 44,831 long tons (64,651 in 1938). Of these exports, 13,900 tons went to Belgium. The Burma Corporation, Ltd., produced 59,300 long tons of zinc concentrates averaging less than 58 percent zinc in 1939. The British Government officially requested the corporation to discontinue publication of production figures early in 1940. On June 30, 1939, ore reserves totaled 3,608,000 tons. During the fiscal year 1938–39 the company mined 485,115 tons of ore, the second largest output in the history of Bawdwin mines, but the grade was the lowest produced in any year and contained approximately 5 percent less lead and zinc and 8 percent less silver than in the previous year. In 1939 British India imported 23,000 tons of slab zinc (21,200 in 1938).

Brazil.—Zinc ores are found at the Morro do Bule mine, Ouro Preto, and at Januaria, State of Minas Geraes, and at Iporanga, State of São Paulo.

Bulgaria.—German and Bulgarian interests plan to complete development by the end of 1940 of an ore deposit in the Rhodope Mountains containing 15 to 23 percent Pb, 6 to 9 percent Zn, and 0.4 to 0.7 percent Cu, and 100 to 230 grams of silver per ton.

Canada.—In 1939 Trail and Flin Flon supplied three-fourths and one-fourth, respectively, of Canada's production of metallic zinc. The latter milled 1,721,783 short tons of ore (a new record), which averaged 4 percent zinc, 2 percent copper, 1.6 ounces silver, and 0.1 ounce gold per ton. The creation of an electrolytic zinc custom plant in Canada is still under consideration. In 1939 zinc concentrates were exported from Canada by the Normetal, Waite Amulet, Stirling (mine idle), and Consolidated mining companies. The Waite Amulet mines shipped 19,258 tons of zinc concentrates averaging 54 percent zinc produced in 1937 and 1938 but made no recovery of zinc concentrates in 1939. The company placed a new mine surface plant and mill in operation, and at the end of 1939 its total zinc ore reserves were estimated at 3,727,100 tons. In Ontario a large, low-grade zinc deposit was discovered 4 miles from Renfrew, and over 1,000,000 tons of ore averaging 8 percent zinc, 2 percent lead, and some gold and silver were indicated by diamond drilling on Calumet Island. Canadian zinc ore exports decreased from 22,900 to 20,600 short tons, most of which continued to go to Belgium. Slab zinc exports in 1939 aggregated 156,000 tons (132,000 in 1938), of which the United Kingdom took 121,700 and British India 22,600 tons, 1.2 and almost 4 times as much, respectively, as in 1938.

France.—During the first 7 months of 1939 France imported 90,800 metric tons of zinc ore compared with 116,200 tons during the same period in 1938; the 1939 imports included 27,700 tons from Mexico, 15,800 from Turkey, 12,200 from Australia, 11,200 from Sweden, 9,000 from Yugoslavia, and 7,500 from Italy. Zinc ore exports during the period, chiefly to Norway, totaled only 10,300 tons (25,700 in previous period). Slab-zinc imports, chiefly from Belgium and Norway, totaled 16,800 tons (15,500 in the previous period).

Germany.—The capture of the Polish zinc mines and smelters in good working order early in the fall of 1939 made Germany largely self-sufficient in zinc. Germany now should be able to produce more than 300,000 tons of zinc annually without importing foreign ore, which is adequate to cover all reasonable demands unless the substitution of zinc for copper and other imported metals should be increased further. The use of zinc has been promoted for all purposes where other more abundant material could not suitably be employed, but at the same time there have been certain restrictions upon its use. Many new zinc alloys have been placed on the market, chiefly with additions of copper and aluminum. German consumption of zinc totaled almost 270,000 metric tons in 1938, in which year it produced 192,000 tons and Poland 108,000 tons. Zinc output in Germany has been greatly expanded by extension of the Magdeburg electrolytic zinc plant which serves the Upper Silesia zinc-mining district and by rehabilitation of the Oker and other works. Lead-zinc production probably increased in 1939 from the Bleiberger Bergwerks Union properties in Kärnten, Austria, and those recently acquired in the Inn Valley of the Northern Tyrol. During the first 7 months of 1939 German zinc ore imports totaled 91,341 metric tons (123,966 in 7 months of 1938), exports 34,045 tons (32,155). Spelter imports totaled 41,684 tons (43,853) and exports 6,844 tons (4,263).

Indochina.—The Compagnie Minière et Métallurgique de l'Indo-Chine produced 12,500 metric tons of zinc concentrates averaging 45 percent zinc in 1939 (11,300 in 1938) which were shipped to the smelter at Quang Yen, Tonkin.

Italy.—Lead and zinc ores usually are found together in Italy, and to increase the lead output and compensate the producer for the overproduction of zinc (exported at a loss with the low prices prevailing earlier in 1939) the Government granted a bonus of 350 lire per ton on excess quantities produced in 1939. The three largest zinc plants—at Porto Marghera, Vado Ligure, and Crotone—have an annual capacity of nearly 50,000 metric tons. Italy expects to use zinc alloys in place of copper, as is done in Germany. The plant at Porto Marghera is now producing zinc alloys.

Japan.—The Nippon K. K. expected to complete the construction of an electrolytic zinc plant of 1,000 metric tons monthly capacity by the end of 1939.

Mexico.—Mine production of zinc in Mexico totaled 134,000 metric tons in 1939 compared with 172,000 in 1938. Smelter output aggregated only 38,000 tons in 1939, leaving about 93,000 tons (186,000 tons of 50-percent concentrates) available for export after allowance for smelter losses on ores treated in Mexico. Mexican export figures do not report shipments of zinc ore or concentrates separately. However, reported receipts of Mexican ore in 1939 were: Belgium, 105,800 tons, the United States approximately 46,000, France (7 months) 27,700, the Netherlands 13,300, and Germany (7 months) 2,700. The European war and the Government-controlled metal market and legislation seriously affected mining, and until the spring of 1940 substantial quantities of zinc concentrates formerly refined in Europe were stored by the larger companies. The San Francisco Mines of Mexico temporarily terminated its contract for shipping zinc concentrates to the Belgian Société Genérale des Minerais and diverted them to smelters in the United States.

Netherlands.—Zinc ore imports into the Netherlands totaled 45,200 metric tons in 1939 (45,400 in 1938) of which 13,300 tons were from Mexico, 9,300 from Canada, and 8,500 from Belgium. Zinc ingots and sheets imported totaled 11,600 tons. Exports included 15,400 tons of ingots.

Newfoundland.—Zinc concentrates produced in Newfoundland totaled 105,600 short tons in 1939 (122,000 in 1938). The 1939 product contained 54,600 tons of zinc and 397,700 ounces of silver. Lead and copper concentrates contained an additional 11,000 tons of zinc. Exports of zinc concentrates dropped from 121,000 to 61,000 tons, indicating a substantial increase in producers' stocks during 1939.

Peru.—The Cerro de Pasco Copper Corporation produced 19,000 metric tons of zinc concentrates in Peru in 1939. Zinc concentrates exported in 1939 totaled 29,000 tons (25,000 in 1938).

Poland.—The Polish zinc mines and smelters fell into German hands early in the fall of 1939. Further details are given in the discussion under Germany.

Turkey.—Zinc ore and concentrates exported from Turkey in 1939 totaled 20,500 metric tons. The producers of lead and zinc concentrates include the Balya-Karaaydin mine, the operation of which apparently is subsidized by the Government.

United Kingdom.—On May 26, 1939, the Import Duties Advisory Committee of the United Kingdom approved the increased tariff protection proposed by the Imperial Smelting Corporation, Ltd., whereby the import duty paid by Empire zinc producers (chiefly in Australia and Canada) was raised from 12s. 6d. to 30s. per long ton. The producers also agreed to pay the corporation on behalf of the National Smelting Co., Ltd., a subvention of 10s. for every ton of zinc they import and sell. The corporation agreed to restrict its zinc output to 60,000 long tons, although its annual capacity is 85,000 tons. Another part of the arrangement grants a rebate to British manufacturers on the increased duty paid on zinc imported for export. The United Kingdom agreed to purchase all the export surplus of refined zinc in Australia. According to the British Metal Corporation, Ltd., the United Kingdom imported 96,500 tons and produced 23,000 tons of slab zinc during the first half of 1939. Exports, including reexports, totaled 3,400 tons. Stocks of zinc in official warehouses at the end of June 1939 totaled 21,500 tons. Of the 109,000 tons consumed during the half-year period, 46,500 were used for galvanizing (24,500 for sheet and 22,000 for other galvanizing), 27,500 for brass, 15,000 for oxide, 10,000 for rolled products, 6,000 for die casting, and 4,000 for miscellaneous uses. Of the total consumption of slab zinc, 89 percent was imported. The "Anderson" air-raid shelter program caused a heavy demand for heavy-gage galvanized steel until August, when other uses probably found more urgent requirements for steel.

Yugoslavia.—For the year ended September 30, 1939, Trepca Mines, Ltd., treated 616,073 metric tons of ores from the Stantrg mine (655,892 tons the year before), which resulted in the production and sale of 65,561 tons of lead concentrates, 53,182 tons of zinc concentrates, and 77,117 tons of pyrite. A strike of workmen at the mine suspended operations from July 19 to September 3. Development work, but no production, was carried on at the company Kopaonik or Vojetin mine during the year. At the Zletovo or Dobrevo mine underground work was suspended July 15, and the mill treated experimentally 5,082 tons of lead-silver ore. Revaluation of ore reserves at the Stantrg mine was delayed by the strike, but the estimated reserves of Kopaonik totaled 750,000 tons averaging 9 percent lead, 6.5 percent zinc, and 3.7 ounces silver, and those of Zletovo totaled 948,000 tons, averaging 11.5 percent lead, 1.7 percent zinc, and 3.5 ounces silver per ton. Preparations of Topionica Cinka A. D., a subsidiary, for construction of an electrolytic zinc plant at Sabac were delayed by the European war. The war also caused difficulties in connection with the exportation of concentrates from Yugoslavia and the remittance of funds to that country. The final settlement resulted in Trepca's suspension of its former arrangement with the Government until June 30, 1940, during which time a proportion of production will be sold on the basis of whatever may be considered the world price of metals to the Yugoslav State or on its behalf for payment in dinars. The geology, development, and history of the Mezica lead-zinc mines in the Karawanken Alps of northern Yugoslavia, now operated by the Central European Mines, Ltd. (British), are well-described by Loch.[4] The run-of-mine ore averages about 13.5 percent lead and 5 percent zinc, and the zinc content appears to be increasing in depth at the Moreing shaft. The flotation plant produces about 16 tons of zinc concentrates averaging 50 percent zinc in 8 hours.

[4] Loch, Charles W., A Lead-zinc Enterprise in Yugoslavia: Mining Mag. (London), vol. 61, No. 4, October 1939, pp. 201–215.

LEAD AND ZINC PIGMENTS AND ZINC SALTS

By H. M. Meyer and A. W. Mitchell

SUMMARY OUTLINE

Lead and zinc pigment manufacturers reported some improvement in 1939 over 1938, owing to gains by industries that are the principal consumers of pigments, namely the paint, automobile, rubber, floor covering, paper, and other trades.

In general, activity in pigments, as measured by monthly sales, increased until it reached the highest levels of the year in the third quarter, then receded somewhat in the final months of the year. Quoted prices for white lead were higher than in 1938 but remained unchanged from the levels established in November 1938. Producers reported that they received 12 and 25 percent higher average values for the two grades of white lead than in 1938. In general, quotations for the other lead pigments rose with those for pig metal, but producers apparently did not receive the full benefits of the increases indicated. Prices for various grades of zinc oxide and zinc sulfate were stationary throughout the year, but those for lithopone and zinc sulfide showed a declining tendency. These prices reflected producers' values but seemed to be influenced little by the movements of the metal.

Although sales of lead pigments increased only 14 percent in total quantity whereas those of zinc pigments increased 23 percent, lead pigments fared better inasmuch as they gained 25 percent in total value compared with 24 percent for zinc pigments. In relation to 1925–29 averages, however, zinc pigments made the best showing, as their total value in 1939 represented 70 percent of the average for 1925–29, while that for lead pigments was only 59 percent. The popularity of leaded grades of zinc oxide continued to grow in 1939, and sales for the year established a new high record. Sales of leaded zinc oxide in 1939 were 60 percent above the 1925–29 average, whereas those of the lead-free grades were 26 percent below the average for that period. It is noteworthy that owing to recently improved technique white lead paints are now available in colors.

The total value of imports of lead and zinc pigments and zinc salts changed little from 1938 to 1939, but the value of exports virtually doubled in 1939.

Salient statistics of the lead and zinc pigments industry of the United States, 1925–29 (average) and 1935–39

	1925–29 (average)	1935	1936	1937	1938	1939
Production (sales) of principal pigments:						
White lead (dry and in oil) short tons	154,483	96,831	118,407	98,213	[1] 100,213	98,429
Litharge do	84,845	79,930	86,246	83,902	68,711	89,518
Red lead do	41,362	28,776	34,896	33,931	30,183	39,976
Zinc oxide do	154,208	99,697	126,800	114,652	79,129	114,552
Leaded zinc oxide do	26,609	29,976	40,512	40,343	38,216	42,684
Lithopone do	177,745	159,486	158,319	154,771	125,746	142,759
Value of products:						
All lead pigments	$60,092,000	$28,064,000	$34,206,000	$35,676,000	[1] $28,351,000	$35,485,000
All zinc pigments	41,314,000	26,500,000	27,862,000	28,038,000	23,301,000	28,794,000
Total	101,406,000	54,564,000	62,068,000	63,714,000	[1] 51,652,000	64,279,000
Value per ton received by producers:						
White lead (dry)	178	124	126	140	[1] 123	138
Litharge	176	104	116	143	122	123
Red lead	193	121	133	160	137	140
Zinc oxide	133	103	90	103	117	117
Leaded zinc oxide	124	93	87	104	107	114
Lithopone	98	84	82	78	79	73
Foreign trade:						
Lead pigments:						
Value of exports	1,346,000	512,000	546,000	586,000	510,000	715,000
Value of imports	30,000	2,000	12,000	17,000	10,000	10,000
Zinc pigments:						
Value of exports	2,150,000	392,000	420,000	610,000	339,000	925,000
Value of imports	931,000	468,000	375,000	414,000	285,000	280,000
Export balance	2,535,000	434,000	579,000	765,000	554,000	1,350,000

[1] Revised figures.

Titanium pigments again absorbed a larger share of the market for white pigments than in previous years. It was estimated [1] that production of titanium pigments approached 165,000 tons in 1939. According to this report, one of the largest paint manufacturers completed and put into successful operation a pilot plant using a recently developed process.

PRODUCTION

In this chapter sales are used as being more significant than production, for no account is taken of stocks on hand at the beginning and end of the year. The quantities consumed by the producers in manufacturing products at their own plants are included under sales. Production figures are used only in calculating the metal content of pigments and salts in the section of this report on Raw Materials Used in the Manufacture of Lead and Zinc Pigments and Zinc Salts.

The total value of sales of lead and zinc pigments rose from $51,652,000 in 1938 to $64,279,000 in 1939, which was 63 percent of the average for 1925–29. The increase in 1939 was caused by greater sales of lead oxide pigments and all zinc pigments and by higher average values received by producers for several items.

Lead pigments.—Increased quantities of red lead, orange mineral, and litharge were sold in 1939. Sales of white lead (dry) were slightly higher, and sales of white lead in oil and basic lead sulfate declined. Changes in sales from 1938 to 1939 ranged from a decline of 5 percent for basic lead sulfate to increases of 30–32 percent for litharge and red lead. The average values received by producers for all lead pigments

[1] Chemical and Metallurgical Engineering, vol. 47, No. 2, February 1940, p. 76.

except orange mineral were higher in 1939 than in 1938. Quotations for red lead, litharge, and orange mineral advanced during the year, but those for white lead were stationary at the level established in November 1938. The figures given in this report for basic lead sulfate are exclusive of the amounts used in the manufacture of leaded zinc oxide. For statistical purposes and to avoid duplication of tonnages, basic sulfate so used is reported under leaded zinc oxide only. This use of basic lead sulfate has expanded rapidly in recent years and totaled about 7,700 tons in 1939. Litharge was the only lead pigment of which a higher tonnage was sold in 1939 than the average for 1925–29, the advance being 6 percent.

Lead pigments sold by domestic manufacturers in the United States, 1938–39

Pigment	1938			1939		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Basic lead sulfate or sublimed lead:						
White	5,030	$555,203	$110	4,688	$585,616	$125
Blue	771	88,873	115	850	111,272	131
Red lead	30,183	4,121,428	137	39,976	5,615,838	140
Orange mineral	127	27,547	217	131	28,010	214
Litharge	68,711	8,359,629	122	89,518	11,050,843	123
White lead:						
Dry	[1] 29,813	[1] 3,681,052	[1] 123	30,509	4,196,462	138
In oil [2]	70,400	11,517,656	164	67,920	13,896,464	205

[1] Revised figures. [2] Weight of white lead only but value of paste.

Lead pigments sold by domestic manufacturers in the United States, 1935–39, in short tons

Year	White lead		Basic lead sulfate or sublimed lead		Red lead	Orange mineral	Litharge
	Dry	In oil	White	Blue			
1935	27,972	68,859	7,572	727	28,776	252	79,930
1936	34,775	83,632	7,531	891	34,896	248	86,246
1937	32,661	65,552	7,514	1,108	33,931	206	83,902
1938	[1] 29,813	70,400	5,030	771	30,183	127	68,711
1939	30,509	67,920	4,688	850	39,976	131	89,518

[1] Revised figures.

Zinc pigments and salts.—Sales of leaded zinc oxide established a new high record in 1939, being 6 percent above the previous record tonnages of 1936 and 1937 and 60 percent above the annual average for 1925–29. Sales of zinc oxide and lithopone were 45 and 14 percent higher than in 1938, but amounted to only 74 and 80 percent of the 1925–29 averages. Average quoted prices for the various grades of lead-free zinc oxide were unchanged throughout 1938 and 1939, and the average values reported by producers were identical for the 2 years. Prices of leaded zinc oxide were somewhat higher in 1939 than in 1938, and producers reported an advance of 7 percent in the average value they received. On the other hand, lithopone quotations were lower in 1939, the top of the price range for 1939 coinciding with the bottom of the range for 1938.

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Large quantities of basic lead sulfate now used in making leaded zinc oxide are included as part of the leaded zinc oxide total and, to avoid duplication, are not shown as basic lead sulfate.

Complete data covering the production of zinc chloride in recent years are not available owing to the refusal of one large producer to supply an accurate report.

Sales of zinc sulfate in 1939 almost equaled the high record established in 1937.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1938–39

Pigment or salt	1938			1939		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Zinc oxide [1]	79,129	$9,253,342	$117	114,552	$13,446,443	$117
Leaded zinc oxide [1]	38,216	4,072,422	107	42,684	4,886,471	114
Lithopone	125,746	9,975,012	79	142,759	10,461,102	73
Zinc chloride, 50° B	(2)	(2)	(2)	(2)	(2)	(2)
Zinc sulfate	7,757	439,479	57	10,157	582,831	57

[1] Zinc oxide containing 5 percent or more lead is classed as leaded zinc oxide. [2] Data not available.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1935–39, in short tons

Year	Zinc oxide	Leaded zinc oxide	Lithopone	Zinc chloride (50° B.)	Zinc sulfate
1935	99,697	29,976	159,486	(1)	7,892
1936	126,800	40,512	158,319	(1)	9,721
1937	114,652	40,343	154,771	(1)	10,521
1938	79,129	38,216	125,746	(1)	7,757
1939	114,552	42,684	142,759	(1)	10,157

[1] Data not available.

CONSUMPTION BY INDUSTRIES

White lead.—Prices received by producers for white lead were higher in 1939 than in 1938, and the increased values per ton were responsible for the improvement in this industry for the year. Tonnage data showed relatively little change in sales of dry white lead and a drop of 4 percent in sales of white lead in oil. Normally 95 percent of the white lead made is used in the manufacture of paint. As stated in Minerals Yearbook, 1939, the Lead Industries Association began a 3-year promotion campaign in 1939 designed to increase the use of white-lead paint. Early in 1940 it was announced that white-lead paints were now available in colors. Previously white lead was generally available only in paste form, and it was mixed with linseed oil on the job and tinted to taste or specification.

Late in 1939 a Canadian article called attention of the lead industry to the thousands of gallons of white paint being used on the roads and curbs of England in preparation for "black-outs." A market summary on page 7 of the Metal Bulletin, London, January 16, 1940, pointed out that paint makers—at any rate, those of the lead-paint section—had suffered a sharp decline in business. The summary stated that it might have been expected that Government construction work and camouflaging would have offset the slack in building but that most camouflage and road paints contain no lead.

In March it was stated that the Federal specification on white lead would be revised, and a preliminary draft was issued. Later in the year, however, the Technical Committee on Paint decided that no change should be made. The specification for white lead, TT-W-251A-White Lead, Basic Carbonate, Dry, Paste-in-Oil and Semi-paste containing Turpentine, was dated November 6, 1934, and the latest amendment (Amendment 2) was made June 25, 1938.

Distribution of white-lead (dry and in oil) sales, 1935-39, by industries, in short tons

Industry	1935	1936	1937	1938	1939
Paint	91,297	113,363	93,580	[1] 95,018	92,380
Ceramics	1,834	2,653	2,506	1,918	1,767
Other	3,700	2,391	2,127	3,277	4,282
	96,831	118,407	98,213	[1] 100,213	98,429

[1] Revised figures.

Basic lead sulfate.—The outstanding use of basic lead sulfate is in the manufacture of paint, 93 percent of the sales reported for 1939 being for that purpose. Increasing quantities of this pigment are being used annually in making leaded zinc oxide. The amounts so used are included in the totals for leaded zinc oxide and excluded from the totals for basic lead sulfate to avoid duplication in reporting lead tonnages. In 1939, 7,700 tons of basic lead sulfate were used in making leaded zinc oxide compared with 7,000 tons in 1938 and 5,500 in 1937.

Distribution of basic lead sulfate sales, 1935-39, by industries, in short tons

Industry	1935	1936	1937	1938	1939
Paints	7,770	8,124	8,255	5,024	5,170
Rubber	155	126	213	91	140
Storage batteries		28	6	3	4
Other	374	144	148	683	224
	8,299	8,422	8,622	5,801	5,538

Red lead.—Total sales of red lead gained 32 percent over 1938, faring better in relation to that year than sales of other lead pigments. The principal use of red lead is in the manufacture of storage batteries, and 62 percent of the 1939 total was sold for that purpose. Paints consume the second largest quantity of red lead, and sales for this outlet gained in the same proportion as those for storage batteries.

Distribution of red lead sales, 1935-39, by industries, in short tons

Industry	1935	1936	1937	1938	1939
Storage batteries	17,657	20,323	20,275	19,057	24,709
Paints	8,721	11,786	10,440	8,698	11,421
Ceramics	867	807	854	655	1,123
Other	1,531	1,980	2,362	1,773	2,723
	28,776	34,896	33,931	30,183	39,976

Orange mineral.—Ink manufacture and color pigments have alternated as leading consumers of orange mineral. Ink manufacture led in 1939 and used 49 percent of the total sales reported.

Distribution of orange mineral sales, 1935–39, by industries, in short tons

Industry	1935	1936	1937	1938	1939
Ink manufacture	85	71	76	20	64
Color pigments	125	77	51	94	40
Other	42	100	79	13	27
	252	248	206	127	131

Litharge.—Sales of litharge made a good showing in 1939; they were 30 percent higher than in 1938 and 6 percent higher than the annual average for 1925–29. Leaded zinc oxide was the only other pigment covered in this report that exceeded its 1925–29 average in 1939. All uses of litharge showed noteworthy increases in 1939 except varnish and linoleum, which remained virtually stationary. Storage batteries, the principal use, took 44 percent of the total in 1939. Black oxide or suboxide of lead used by battery manufacturers reached a new peak of 45,000 tons compared with the previous record of 42,000 tons in 1937. Sales of black oxide are not included in Bureau of Mines totals for litharge. The preparation of lead oxide for use in storage batteries was the subject of a new patent issued in December (U. S. Patent 2,182,479). Since 1931 insecticides have been the second most important use of litharge. Sales for this purpose rose 40 percent in 1939 but were 10 percent below the record tonnage in 1937. The ceramics industry attained third place as a consumer of litharge in 1939, having displaced the oil-refining industry.

Distribution of litharge sales, 1935–39, by industries, in short tons

Industry	1935	1936	1937	1938	1939
Storage batteries	36,067	38,700	32,228	32,514	39,754
Insecticides	14,665	14,662	18,242	11,736	16,435
Ceramics	6,751	7,762	7,577	5,889	8,679
Chrome pigments	6,617	6,662	7,330	4,590	7,815
Oil refining	7,869	7,259	8,311	6,411	7,619
Varnish	1,610	4,247	3,366	2,449	2,428
Rubber	3,171	2,147	1,659	880	1,404
Linoleum	220	254	264	231	226
Other	2,960	4,553	4,925	4,011	5,158
	79,930	86,246	83,902	68,711	89,518

Zinc oxide.—Sales of zinc oxide advanced 45 percent in 1939—the greatest percentage gain of any of the lead and zinc pigments. Sales of this product, however, were only 74 percent of the annual average for 1925–29. The rubber industry takes most of the zinc oxide sold, and this use comprised 61 percent of the total in 1939. Consumption of zinc oxide in rubber rose 52 percent compared with increases of 21 and 34 percent, respectively, in paints and ceramics. Floor coverings and textiles regained part of the ground lost in 1938, when sales fell 66 percent, as consumption advanced 86 percent in 1939. Of the zinc oxide produced in 1939, 59 percent was made by the American process and 41 percent by the French process compared with 62 and 38 percent, respectively, in 1938. The proportion of French-process oxide made from scrap zinc rose sharply in 1939 to 49 percent of the total compared with 32 percent in 1938 and 25 percent in 1937. A large quantity of zinc oxide is used in the manufacture of leaded zinc oxide. This tonnage is included in the totals for leaded zinc oxide and is excluded from zinc oxide totals to avoid duplication in reporting zinc tonnages. The rubber and ceramic industries were introduced to a new pelleted type of zinc oxide during the year.[2]

Distribution of zinc oxide sales, 1935–39, by industries, in short tons

Industry	1935	1936	1937	1938	1939
Rubber	57,734	72,885	67,061	46,266	70,187
Paints	25,289	33,149	27,987	20,884	25,334
Ceramics	4,028	6,102	5,216	4,908	6,572
Floor coverings and textiles	7,179	7,178	9,019	3,030	5,641
Other	5,467	7,486	5,369	4,041	6,818
	99,697	126,800	114,652	79,129	114,552

Leaded zinc oxide.—The manufacture of paint uses virtually all (97 or more percent) of the leaded zinc oxide made. This pigment has become increasingly popular in recent years, and sales were at a record high level in 1939, exceeding the previous records established in 1936 and 1937 by 6 percent. The total for 1939 includes about 7,700 tons of basic lead sulfate used to increase the lead content of this product; this tonnage is excluded from basic lead sulfate totals to avoid duplication in reporting metal tonnages.

Distribution of leaded zinc oxide sales, 1935–39, by industries, in short tons

Industry	1935	1936	1937	1938	1939
Paints	29,632	40,156	39,584	37,348	41,519
Rubber	36	32	97		1
Other	308	324	662	868	1,164
	29,976	40,512	40,343	38,216	42,684

Lithopone.—Lithopone statistics are reported on the basis of the regular lithopone content of high-strength lithopone plus normal lithopone sold as such. Before 1936 the figures were on the basis of standard-strength plus high-strength product. The manufacture of paint, varnish, and lacquer has consumed about 80 percent of the total lithopone sold in recent years. Sales of lithopone gained 14 percent in 1939, but the quantities employed for paint and for floor coverings and textiles, the two largest uses, advanced proportionally less than the total. On the basis of somewhat incomplete information, separation of the quantities shown in the following table for floor coverings and textiles indicates that 14,000 tons were for linoleum and felt-base floor coverings and the rest for coated fabrics and textiles (oilcloth, shade cloth, artificial leather, and similar products). Other uses in 1939 included 2,407 tons for paper and 712 tons for printing ink. It was reported in midyear that a new lithopone plant of 12,000 tons capacity had been completed recently at Kutais, U. S. S. R., the second plant of the type in the country.

[2] Chemical and Metallurgical Engineering, vol. 47, No. 2, February 1940, p. 76.

Distribution of lithopone sales, 1935–39, by industries, in short tons

Industry	1935	1936	1937	1938	1939
Paints, etc	124,615	122,461	122,915	101,924	113,995
Floor coverings and textiles	19,440	23,085	20,194	15,400	17,429
Rubber	4,435	4,908	4,383	3,148	3,189
Other	10,996	7,865	7,279	5,274	8,146
	159,486	158,319	154,771	125,746	142,759

The use of ordinary-strength lithopone in the manufacture of titanated lithopone, which usually contains 15 percent TiO_2, has increased rapidly since the output of this product was begun. It declined, however, in 1938 and fell rather sharply in 1939, when 13,700 tons were used for this purpose compared with 17,000 tons in 1938 and 19,400 in 1937. These figures are included in Bureau of Mines totals for lithopone.

Zinc sulfide.—Production of zinc sulfide was reported by four plants in 1939, as in 1938, but since one producer dominates the industry, the Bureau of Mines cannot publish representative statistics. Most of the zinc sulfide is mixed with regular lithopone to make high-strength lithopone. Two patents on zinc sulfide were issued recently: United States Patent 2,175,273, purported to be an improved process for production of zinc sulfide, and United States Patent 2,187,130, which claims that zinc sulfide-containing pigments are rendered stain resistant by incorporating in them a minor quantity of relatively insoluble metallic thiosalt, such as thiocyanate, thiosulfate, and xanthate.

Zinc chloride.—Complete data on sales of zinc chloride are not reported to the Bureau of Mines, but returns from producers responsible for more than two-thirds of the output indicate the following distribution of sales by uses in 1939:

	Percent		*Percent*
Soldering flux	33	Oil refining	4
Dry-cell batteries	22	Others	9
Wood preserving	19		
Vulcanized fiber	13		100

Zinc sulfate.—The trend in sales of zinc sulfate was upward from 1932 to 1937, and a new high record was established in 1937. Sales fell in 1938 but in 1939 virtually equaled the record of 1937. Of the total sales in 1939 (10,157 tons), 3,897 tons were reported as sold to the rayon industry, 2,168 tons for agricultural purposes, 1,309 tons for chemical manufacture (including the medicinal trade), 583 tons to paint and varnish manufacturers, 556 tons to electrogalvanizers, and 172 tons for glue manufacture; 1,472 tons were undistributed. A break-down of the 1,472 tons under "undistributed" undoubtedly would increase the tonnages under some or all of the uses itemized.

RAW MATERIALS USED IN MANUFACTURE OF LEAD AND ZINC PIGMENTS AND SALTS

Lead pigments and zinc pigments and salts are manufactured from a variety of materials, including ore, refined metal, and such miscellaneous secondary materials as scrap and waste from various industrial processes. In 1939, 93 percent of the lead in lead pigments was derived from pig lead and 7 percent from ore. The proportions for zinc pigments in 1939 were 64 percent from ore, 13 percent from slab zinc, and 23 percent from secondary materials.

Metal content of lead and zinc pigments produced by domestic manufacturers, 1938–39, by sources, in short tons

Source	1938		1939	
	Lead in pigments [1]	Zinc in pigments	Lead in pigments [1]	Zinc in pigments
Domestic ore	12,025	68,168	15,171	83,829
Metal	[2] 163,815	15,760	200,390	17,169
Secondary material [3]		18,718		30,138
	[2] 175,840	102,646	215,561	131,136

[1] Includes also lead recovered in zinc oxide and leaded zinc oxide.
[2] Revised figures.
[3] Zinc ashes, skimmings, drosses, and old metal.

The following tables give the source of the metal used in the manufacture of each pigment and salt. Pig lead is employed exclusively, either directly or indirectly, in the manufacture of white lead, litharge, red lead, and orange mineral and is used also in the manufacture of basic lead sulfate. 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 sulfate, and basic lead sulfate. A substantial proportion of the zinc in lithopone and zinc chloride made in the United States is derived from secondary material. There has been a decided increase in the quantity of secondary zinc consumed in the manufacture of zinc oxide since 1933. This material has displaced slab zinc in the manufacture of French process oxide.

Lead content of lead and zinc pigments produced by domestic manufacturers, 1938–39, by sources, in short tons

Pigment	1938				1939			
	Lead in pigments produced from—			Total lead in pigments	Lead in pigments produced from—			Total lead in pigments
	Domestic ore	Pig lead	Secondary material		Domestic ore	Pig lead	Secondary material	
White lead		[1] 75,115		[1] 75,115		78,593		78,593
Red lead		26,608		26,608		35,977		35,977
Litharge		60,509		60,509		83,935		83,935
Orange mineral		91		91		120		120
Basic lead sulfate	2,830	739		3,569	2,868	979		3,847
Leaded zinc oxide	9,195	753		9,948	12,303	786		13,089
	12,025	[1] 163,815		[1] 175,840	15,171	200,390		215,561

[1] Revised figures.

Zinc content of zinc pigments and salts produced by domestic manufacturers, 1938–39, by sources, in short tons

Pigment or salt	1938				1939			
	Zinc in pigments and salts produced from—			Total zinc in pigments and salts	Zinc in pigments and salts produced from—			Total zinc in pigments and salts
	Domestic ore	Slab zinc	Secondary material		Domestic ore	Slab zinc	Secondary material	
Zinc oxide	37,069	15,713	7,456	60,238	49,125	17,117	16,429	82,671
Leaded zinc oxide	18,502			18,502	21,050	5		21,055
Lithopone	12,597	47	11,262	23,906	13,654	47	13,709	27,410
Zinc sulfide	(1)		(1)	(1)	(1)		(1)	(1)
Zinc chloride	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Zinc sulfate	931		1,395	2,326	1,157		1,674	2,831

1 Data not available.

PRICES

The total values reported by producers for lead and zinc pigments and zinc salts are given in the tables in the first part of this report. The average values received for all important lead pigments increased from 1 percent for litharge to 25 percent for white lead in oil. On the other hand, while the average value for leaded zinc oxide rose 7 percent, that for zinc oxide remained unchanged and that for lithopone dropped 8 percent. The range of market quotations, as reported by the Oil, Paint and Drug Reporter, appears in the following table. Quoted prices for white lead were unchanged from November 1938 throughout 1939. Quotations for other lead pigments in general followed price changes in pig lead, moving upward after the middle of the year and standing at their highest levels at the end of the year. Prices for zinc pigments apparently were not influenced by price changes for the metal. Quotations for lead-free zinc oxide were stationary throughout 1938 and 1939; those for the 5–35 percent leaded grade ranged from 6.25 to 6.38 cents in 1939 compared with 5.90 to 6.38 cents in 1938. Quotations for lithopone and zinc sulfide showed a downward trend in the latter part of the year against the trend for most commodities. The average value reported by producers for zinc sulfate in 1939 was unchanged from 1938, but quotations for this product had a narrower range in 1939, both the low and high quotations coming between the extremes reported for 1938.

Range of quotations on lead pigments and zinc pigments and salts at New York (or delivered in the East), 1936–39, in cents per pound

Product	1936	1937	1938	1939
Basic lead sulfate, or sublimed lead, less than carlots, barrels	6.25- 6.75	6.50- 8.75	5.50- 6.50	6.25- 6.50
White lead, or basic lead carbonate, dry, carlots, barrels	6.50- 7.25	6.75- 9.00	6.00- 7.00	7.00
Litharge, commercial, powdered, barrels	6.00- 8.50	6.25-10.00	5.50- 7.50	6.25- 7.75
Red lead, dry, 95 percent or less, less than carlots, barrels	7.50- 9.50	7.75-11.00	7.00- 8.50	7.75- 9.00
Orange mineral, American, small lots, barrels:				
Ex-white lead; Ex-red lead	10.50-11.25	10.25-13.50	9.50-11.00	10.25-11.25
Zinc oxide:				
American process, lead-free, bags, carlots	5.00- 5.25	5.25- 7.50	6.25- 7.50	6.25- 7.50
American process, 5 to 35 percent lead, barrels, carlots	5.13- 5.38	5.38- 6.88	5.90- 6.38	6.25- 6.38
French process, red seal, bags, carlots	5.50- 5.75	5.75- 7.50	7.50	7.50
French process, green seal, bags, carlots	6.00- 6.25	6.25- 8.00	8.00	8.00
French process, white seal, barrels, carlots	6.50- 6.75	7.00- 8.75	8.75	8.75
Lithopone, domestic, 5-ton lots, bags	4.25- 4.50	4.25- 4.63	4.38- 4.63	4.00- 4.38
Zinc sulfide, less than carlots, bags, barrels	9.25-11.75	9.25- 9.50	8.63- 9.50	7.75- 8.88
Zinc chloride, works:				
Solution, tanks	2.00	2.00- 2.25	2.25	2.25
Fused, drums	4.25- 5.75	4.25- 5.75	4.25- 5.75	4.25- 5.75
Zinc sulfate, crystals, barrels	2.65- 3.95	2.80- 4.05	2.65- 4.05	2.90- 3.65

FOREIGN TRADE [3]

Imports of lead and zinc pigments remained virtually stationary, and exports almost doubled in value in 1939. The excess value of exports over imports amounted to $1,351,508 and was a little more than half the annual average for 1925–29. The value of imports of lead and zinc salts gained 16 percent in 1939, while the value of exports of lead arsenate, the only salt reported separately, increased 68 percent.

The following table shows the value of various pigments and salts imported and exported in 1938 and 1939.

Value of foreign trade of the United States in lead and zinc pigments and salts, 1938–39

	1938		1939	
	Imports	Exports	Imports	Exports
Lead pigments:				
White lead	$3,979	$190,795	$2,108	$275,311
Red lead	79	115,474	300	186,396
Litharge	123	203,610		253,731
Orange mineral	271	(1)	143	(1)
Other lead pigments	5,533	(1)	7,310	(1)
	9,985	509,879	9,861	715,438
Zinc pigments:				
Zinc oxide	73,487	185,848	145,916	532,670
Lithopone	207,121	153,567	130,893	392,798
Zinc sulfide	4,798	(1)	2,728	(1)
	285,406	339,415	279,537	925,468
Lead and zinc salts:				
Lead arsenate		95,196	3,316	159,797
Other lead compounds	12,659	(1)	15,071	(1)
Zinc chloride	19,718	(1)	25,661	(1)
Zinc sulfate	16,321	(1)	12,521	(1)
	48,698	95,196	56,569	159,797
Grand total	344,089	944,490	345,967	1,800,703

[1] Data not available.

[3] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Lead pigments and salts.—Imports of these commodities are insignificant. The most important item is the group of lead compounds, which include lead acetate, lead nitrate, and others, and imports of these compounds rose from 85 short tons in 1938 to 104 in 1939. Imports of suboxide of lead increased from 16 tons in 1938 to 20 in 1939.

Lead pigments and salts imported for consumption in the United States, 1935–39

Year	Short tons					Total value
	Basic carbonate white lead	Red lead	Litharge	Orange mineral	Lead compounds	
1935	6	1		2	302	[1] $38,228
1936	32	2	1	5	185	[1] 37,878
1937	34	1	(2)	5	213	[1] 53,984
1938	20	1	1	2	85	[1] 22,644
1939	11	2		1	104	[1] 28,248

[1] Includes also—1935: Lead pigments, n. s. p. f., $478 (4,405 pounds); 1936: Lead pigments, n. s. p. f., $19 (33 pounds), sublimed lead (basic sulfate) $9 (15 pounds), and suboxide of lead, n. s. p. f., $5,264 (39,010 pounds); 1937: Lead pigments, n. s. p. f., $8 (100 pounds), sublimed lead (basic sulfate), $2 (10 pounds), and suboxide of lead, n. s. p. f., $9,396 (55,453 pounds); 1938: Lead pigments, n. s. p. f., $198 (2,330 pounds), and suboxide of lead, n. s. p. f., $5,335 (31, 834 pounds); 1939: Lead pigments, n. s. p. f., $690 (5,270 pounds), and suboxide of lead, n. s. p. f., $6,620 (40,445 pounds).
[2] Less than 1 ton.

The principal exports are white lead and litharge, and these two items made proportionately large gains in 1939. Exports of red lead and lead arsenate also rose in 1939. The total value for exports of the items listed was $875,235 in 1939 compared with $605,075 in 1938. Exports of white lead, red lead, and litharge comprised 3 percent or less of domestic sales of these pigments.

White lead was exported principally to the Netherlands, Philippine Islands, and Canada, whereas the principal recipients of red lead and litharge were Canada, the Philippine Islands, and Argentina.

Lead pigments and salts exported from the United States, 1935–39

Year	Short tons				Total value
	White lead	Red lead	Litharge	Lead arsenate	
1935	2,337	750	1,280	578	$606,734
1936	1,862	810	1,386	414	609,890
1937	1,236	934	1,452	521	677,815
1938	1,411	806	1,694	511	605,075
1939	2,024	1,324	2,077	856	875,235

White lead, red lead, and litharge exported from the United States, 1936–39, by destinations, in short tons

Destination	White lead				Red lead and litharge			
	1936	1937	1938	1939	1936	1937	1938	1939
Countries:								
Argentina	126	89	97	87	139	204	359	282
Brazil	12	28	72	166	96	44	47	48
Canada	74	126	220	256	544	703	542	688
Mexico	151	44	71	117	108	112	103	186
Netherlands	387	83	222	491	43			103
Netherlands West Indies	3	5	5	5	273	287	400	144
Panama	453	206	108	113	53	76	78	26
Philippine Islands	170	272	385	428	342	353	406	515
Others	486	383	231	361	598	607	565	1,409
	1,862	1,236	1,411	2,024	2,196	2,386	2,500	3,401
Continents:								
North America	754	479	448	541	1,140	1,379	1,275	1,216
South America	218	170	221	360	344	374	494	514
Europe	707	232	279	622	220	157	105	460
Asia	174	336	450	478	407	413	494	948
Africa	9	18	13	23	61	63	131	261
Oceania	(1)	1	(1)	(1)	24	(1)	1	2

[1] Less than 1 ton.

Zinc pigments and salts.—Imports of zinc oxide and zinc chloride increased in 1939, while those of lithopone and zinc sulfate fell. Lithopone ranks as the most important zinc pigment imported, although imports of this commodity represented only 2 percent of domestic sales in 1939. Imports of zinc oxide (dry and in oil) totaled 1,551 tons, a gain over the 645 tons received in 1938.

Zinc pigments and salts imported for consumption in the United States, 1935–39

Year	Short tons						Total value
	Zinc oxide		Lithopone	Zinc sulfide	Zinc chloride	Zinc sulfate	
	Dry	In oil					
1935	1,932	59	4,603	16	564	135	$508,476
1936	694	96	4,781	30	520	385	425,493
1937	680	95	5,601	113	667	593	488,116
1938	579	66	3,932	12	272	392	321,445
1939	1,485	66	2,641	7	399	325	317,719

Exports of zinc oxide trebled in 1939 and were 3 percent of sales of lead-free zinc oxide by domestic producers. Shipments went principally to Canada, Brazil, and the Philippine Islands. Exports of lithopone jumped from 1,734 tons in 1938 to 4,845 tons in 1939 and amounted to 3 percent of sales of domestic manufacturers. More than half the total was shipped to Canada and smaller amounts to Mexico, Cuba, Chile, and other scattered nations.

Zinc pigments and salts [1] exported from the United States, 1935–39

Year	Short tons		Total value	Year	Short tons		Total value
	Zinc oxide	Litho-pone			Zinc oxide	Litho-pone	
1935	1,140	2,372	$392,368	1938	1,163	1,734	$339,415
1936	1,330	2,538	419,987	1939	3,485	4,845	925,468
1937	2,953	2,671	609,954				

[1] Zinc salts not separately recorded.

Zinc oxide and lithopone exported from the United States, 1936–39, by destinations, in short tons

Destination	Zinc oxide				Lithopone			
	1936	1937	1938	1939	1936	1937	1938	1939
Countries:								
Argentina	55	48	86	104	35	63	28	89
Brazil	39	32	6	285		(1)		55
Canada	704	1,583	514	898	1,812	1,740	1,219	2,775
Chile	20	12	13	69	(1)	(1)	(1)	189
Cuba	80	207	48	84	186	258	115	244
Mexico	14	57	9	105	103	185	146	361
Philippine Islands	15	415	141	281	16	5	11	20
Others	403	599	346	1,659	386	420	215	1,112
	1,330	2,953	1,163	3,485	2,538	2,671	1,734	4,845
Continents:								
North America	882	1,972	659	1,168	2,104	2,184	1,483	3,405
South America	130	149	117	514	57	90	41	359
Europe	99	148	85	593	218	217	132	153
Asia	52	467	159	844	25	24	13	287
Africa	6	57	3	175	4	1	1	25
Oceania	161	160	140	191	130	155	64	616

[1] Less than 1 ton.

GOLD, SILVER, COPPER, AND LEAD IN ALASKA

(MINE REPORT)

By Chas. W. Henderson

SUMMARY OUTLINE

Gold recovered from Alaska ores and gravels in 1939 totaled 676,737 fine ounces valued at $23,685,795, an increase of 2 percent over the 664,973 ounces valued at $23,274,055 in 1938, due to increased output from placer mines. The value of the gold in 1939 was 99 percent of the total gross value of the gold, silver, copper, and lead produced. Copper was produced in 1939 only as a byproduct of gold mining, and the output of recovered metal fell to 256,000 pounds from 29,098,000 pounds in 1938, when it came mostly from copper mines.

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, 1935–39

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1935	$35.00	$0.71875	$0.083	$0.040	$0.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4].646+	.098	.046	.048
1939	35.00	[5].678+	.104	.047	.052

[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] 1935–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–39: Treasury buying price for newly mined silver.

[3] Yearly average weighted price of all grades of primary metal sold by producers.

[4] $0.64646464.

[5] $0.67878787.

The following tables show the mine production of gold, silver, copper, and lead in Alaska in 1935–39 and 1880–1939 in terms of recovered metals; the output of gold and silver in 1939, by types of operation; and the output of gold, silver, copper, and lead from amalgamation and cyanidation mills (with or without concentration equipment) in 1939, by regions.

Mine production of gold, silver, copper, and lead in Alaska, 1935–39, and total, 1880–1939, in terms of recovered metals

Year	Gold (lode and placer)		Silver (lode and placer)	
	Fine ounces	Value	Fine ounces	Value
1935	469,495	$16,432,325	286,848	$206,172
1936	540,580	18,920,300	484,306	375,095
1937	627,940	21,977,900	494,340	382,372
1938	664,973	23,274,055	479,853	310,208
1939	676,737	23,685,795	201,054	136,473
1880–1939	23,700,593	542,535,357	19,179,467	13,643,173

Year	Copper		Lead		Total value
	Pounds	Value	Pounds	Value	
1935	15,500,000	$1,286,500	1,340,000	$53,600	$17,978,597
1936	37,700,000	3,468,400	1,882,000	86,572	22,850,367
1937	34,672,000	4,195,312	1,646,000	97,114	26,652,698
1938	29,098,000	2,851,604	1,988,000	91,448	26,527,315
1939	256,000	26,624	1,874,000	88,078	23,936,970
1880–1939	[1] 685,681	226,519,560	[1] 22,700	2,501,653	785,199,743

[1] Short tons.

Mine production of gold and silver in Alaska in 1939, by types of operation, in terms of recovered metals

Type of operation	Mines producing	Material treated	Gold			Silver			Total value
			Fine ounces	Percent of total		Fine ounces	Percent of total		
				1939	1938		1939	1938	
Lode mines	73	[1] 4,751,657	209,166	31	35	132,548	66	87	$7,410,782
Floating connected-bucket dredges	[2] 44	[3] 19,799,526	304,995	45	42	42,371	21	8	10,703,586
Placers (dragline and dry-land dredges, hydraulic, drift mining, and sluicing)	[4] 1,070	([5])	162,576	24	23	26,135	13	5	5,707,900
	1,187	------------	676,737	100	------	201,054	100	------	23,822,268
Total, 1938	1,234	------------	664,973	------	100	479,853	------	100	23,584,263

[1] Short tons of ore.
[2] Number of dredges, including 1 single-dipper dredge. In addition, there was a floating dredge that produced platinum only.
[3] Cubic yards of gravel (average recovered per yard, $0.54).
[4] Includes all types and sizes of placer operations excluding floating connected-bucket dredges.
[5] Cubic yards of gravel; figures not available.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Alaska in 1939, by regions, in terms of recovered metals

Region	Ore treated	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Cook Inlet-Susitna	45,666	33,682	1,761	1,076	5,645	473	3,800	200
Copper River	927	140	40	-------	-------	-------	-------	-------
Kenai Peninsula	830	787	247	5	22	8	-------	-------
Kuskokwim	1,500	759	159	-------	-------	-------	-------	-------
Seward Peninsula	50	36	3	-------	-------	-------	-------	-------
Southeastern Alaska	4,663,056	117,750	23,864	2,859	26,025	91,862	58,862	1,836,150
Yukon River Basin	17,028	18,881	3,803	106	565	1,686	300	3,100
	4,729,057	172,035	29,877	4,046	32,257	94,029	62,962	1,839,450
Total, 1938	4,733,174	185,208	33,126	3,583	32,567	104,922	([1])	1,935,174

[1] Bureau of Mines not at liberty to publish details of copper production.

Gold.—The value of the gold output of Alaska in 1939 was 99 percent of the total gross value of the gold, silver, copper, and lead produced. The source of gold has been divided in this report into only three types of operations—placers using floating connected-bucket dredges; other placer operations, large and small; and lode mines. The output from dredges was by far the largest, followed in order by lode mines and by other placer mines. The increased output from floating connected-bucket dredges was due directly to the higher tenor of the gravel washed in 1939; gold recovered per cubic yard increased from 49 cents in 1938 to 54 cents in 1939. The yardage handled was virtually the same in both years. The output of gold from lode mines was 24,852 ounces less than in 1938; although three more mines were producing, the decline in output from three of the largest producers was great enough to effect a decrease in total production of lode gold. The steady increase in use of mechanical equipment—such as draglines, slackline scrapers, bulldozers, portable washing plants, pumps, and hydraulic machinery—caused the output from placer mines other than bucket dredges to increase 10,063 ounces over 1938. The wider use of mechanical moving equipment has lengthened the operating season for hydraulic miners by allowing them to prepare ground in advance by removing overburden formerly hydraulicked, by transferring some of the gold-bearing gravel into position for hydraulicking, and by removing tailings. Thus they can make more efficient use of available water, whether seasonal rain or run-off.

Silver.—All the silver produced in Alaska in 1939 was a byproduct of gold mining.

Copper.—The output of recoverable copper in Alaska in 1939 was negligible compared with that in 1938; the decline is attributable to abandonment in 1938 of the copper mines at Kennecott by the Kennecott Copper Corporation, owing to exhaustion of the ore bodies. The copper produced in 1939 was a byproduct of production at the gold lode mines.

Lead.—The bulk of the recovered lead output of Alaska in 1939 came from lead concentrates produced at the flotation mill of the Alaska Juneau Gold Mining Co. at Juneau.

MARKETS AND METALLURGY

More than 94 percent of the gold and nearly 50 percent of the silver produced from Alaska ores and gravels in 1939 were obtained in the form of gold-silver bullion, which was sold finally to the Seattle Assay Office and the San Francisco Mint. As there are no smelters or refineries in Alaska, all the remaining gold and silver produced and all the lead and copper were obtained from high-grade ore and concentrates shipped to smelters and refineries in the States, largely to the Tacoma (Wash.) and Selby (Calif.) smelters.

More than 175,000 ounces of fine gold were handled in 1939 by banks and bullion buyers throughout the Territory. The gold-silver bullion was either sent direct to the mints or cast into bars for shipping; in many instances the banks acted merely as agents for the lode and placer operators. The six largest purchasers (or agents) of bullion (handling over 165,000 fine ounces of gold) were: The First National Bank of Fairbanks, Fairbanks; the Miners and Merchants Bank of

Alaska, Nome; the Miners and Merchants Bank of Iditarod, Flat; the First National Bank, Anchorage; and the Northern Commercial Co. and the Seattle First National Bank, Seattle, Wash.

Sixty-three mines in Alaska in 1939 were equipped with amalgamation or cyanidation plants, ranging in daily capacity from 1 ton to 12,000 tons; of these, 22 were equipped also with flotation, table, or jig concentrators. Seven properties were equipped with straight concentration mills, chiefly flotation. Virtually all the lead concentrates produced in 1939 were obtained from concentration by flotation of the dry gold ore of the Alaska Juneau Gold Mining Co. property at Juneau. Most of the copper came from copper concentrates produced by the Alaska Gold and Metals Co. in Southeastern Alaska. Concentrates obtained from the amalgamation-concentration and cyanidation-concentration mills averaged 8 ounces of gold and 23 ounces of silver to the ton and were shipped chiefly to the Tacoma (Wash.) plant; concentrates from the straight concentration mills averaged 7 ounces of gold and 14 ounces of silver to the ton. Dry gold ore shipped direct to smelters averaged 6 ounces of gold and 1 ounce of silver to the ton. Mill heads averaging more than 1 ounce of gold to the ton were not uncommon.

The United States Assay Office at Seattle, Wash., reports the following receipts from Alaska in 1939.

Bullion of Alaskan origin deposited at United States Assay Office, Seattle, Wash., during year ended December 31, 1939, in fine ounces

District	Gold	Silver	District	Gold	Silver
Circle	17,652.677	1,764.97	Kuskokwim	26,139.579	3,110.06
Cook Inlet	50,255.140	5,273.77	Nome	96,702.422	10,741.95
Copper River	5,140.968	684.69	Southeastern Alaska	119,597.820	24,180.40
Eagle	6,243.471	1,177.67	Tanana [1]	228,437.485	36,658.44
Iditarod	53,504.835	7,879.63			
Koyukuk	1,600.159	179.02		605,274.556	91,650.60

[1] Includes mainly Bonnifield, Fairbanks, Hot Springs, Kantishna, and Tolovana districts in the Yukon Basin region.

REVIEW BY REGIONS

Cook Inlet-Susitna region.—The Cook Inlet-Susitna region—comprising the Prince William Sound, Valdez Creek, Willow Creek, and Yentna-Cache Creek districts—produced 19 percent of the total gold output from Alaska lode mines in 1939.

Again, in 1939, the Alaska-Pacific Consolidated Mining Co. at Wasilla, operating the Independence and Martin mines, was the largest producer of lode gold in the Cook Inlet region and second-largest in Alaska. The company 100-ton amalgamation-flotation mill has been operated continuously since its completion in 1937. The mill and 110-hp. Diesel power plant are on the west branch of Fish-Hook Creek 26 miles west of Wasilla. The ore is brought to the mill from the mine by a ¼-mile aerial tram; 23,808 tons of crude ore averaging 1.12 ounces of gold to the ton were milled in 1939. Of the total gold produced during the year, 86 percent was obtained in the form of gold amalgam, which was retorted and sent to the Seattle Assay Office; the remainder was contained in 485 tons of gold concentrates averaging 7.05 ounces of gold to the ton. The over-all recovery in the mill was 95.44 percent. Development work consisted of 7,500 feet of drifts, 2,000 feet of tunnel, 400 feet of shaft, and 1,961 feet of diamond drilling. A 1,000-cubic foot compressor, a 100-kw. generator and motor, a 40-ton ball mill, and two Diesel power units were installed in 1939, bringing the total power available at the operation to 335 hp.

The Conwest Exploration Co., operating the Willow Creek mines in the Willow Creek district, was the second-largest producer of lode gold in the Cook Inlet-Susitna region in 1939. A ½-mile aerial tram brings the crude ore (carrying free gold, pyrite, and arsenopyrite) from the mine to the 40-ton amalgamation-flotation-cyanidation mill. During the year 10,526 tons of ore averaging 0.71 ounce of gold to the ton were separated into jig and flotation concentrates; the jig concentrates were amalgamated, and the flotation concentrates were cyanided. The tailings (averaging 1.25 ounces of gold to the ton) from the cyanide operation were shipped to the Tacoma (Wash.) smelter. Much development work was done. A new level, called the 725th, was opened up; several new shoots of ore were opened on the strike of the vein.

Rapp & Till continued in 1939 to re-treat impounded tails from the old Gold Bullion mine of the Willow Creek Mines Co. in the 35-ton cyanide plant erected on the property in 1938. The precipitates were refined at the mill, and bullion was shipped to the Seattle Assay Office.

Among the other leading lode producers in the Cook Inlet-Susitna region making notable output in 1939 were: The Fern Gold Leasing Co., the Gold Cord Development Co., Mabelle Mines, Inc., and Donan Mines, Inc., all operating in the Willow Creek district.

There were no floating connected-bucket dredges operating in the Cook Inlet-Susitna region during 1939. Several operators using hydraulic giants, dragline excavators, and portable washing plants made sizable production. Gravels from streams and benches in the Yentna-Cache Creek district yielded most of the placer gold output. One of the leading operators using mechanical equipment in the mining of placer gravels was the Spokane Peters Creek Co., placering on Peters Creek in the Yentna-Cache Creek district. A Bucyrus dragline equipped with a 1½-cubic yard bucket was used as the prime mover of the prethawed gold-bearing gravel. About 100,000 cubic yards of gravel were washed during the 60 days of active operation, and the gold was concentrated in a portable washing plant. Other placer operators using mechanical equipment and making production worthy of note were: The Dutch Creek Mining Co., hydraulicking stream gravels on Dutch Creek in the Yentna-Cache Creek district; and C. A. Devault, placering on Pass Creek in the Fairview district.

Copper River region.—The value of the gold, silver, copper, and lead produced in the Copper River region—including the Chistochina, Nabesna, Nelchina, and Nizina districts—showed the largest decrease in any region of Alaska in 1939. The value of copper production was negligible compared with 1938, owing to abandonment of the copper properties of the Kennecott Copper Corporation at Kennecott and the greatly curtailed output of the Nabesna Mining Corporation properties at Nabesna. In 1938 the tonnage of copper concentrates shipped from the Nabesna mine to Tacoma for treatment contained nearly half of the gold production of the region, but in 1939 such output was less than half of that in 1938. The Yellow Band Gold Mines, operating the Yellow Band group of lode claims in the Nizina district, carried on development and test milling work during the year; roads, a transmission line, and a cable tramline from the mine to the mill were among the improvements.

There were no floating connected-bucket dredges operating in the Copper River region in 1939. Gold recovered from placer gravels came from hydraulic, sluicing, and dragline operations throughout the region. One of the leading producers of gold from gravels was Joshua Green Associates, operating a hydraulic plant on Dan Creek about 20 miles south of McCarthy in the Nizina district; between May 19 and September 20 six hydraulic giants sluiced 172,000 cubic yards of gravel and recovered 1,365 ounces of gold about 0.903 fine. Among other principal producers were: The Slate Creek Placers, Inc., working on Slate Creek in the Chistochina district; Chititu Mines, hydraulicking on Chititu Creek in the Nizina district; and A. C. Baldwin, lessee of claims on Rex Creek in the Nizina district.

Kenai Peninsula region.—In the Kenai Peninsula region—including the Girdwood, Moose Pass-Hope, and Nuka Bay districts—lode mines contributed the bulk of the gold and silver output in 1939. Gold recovered from lode operations was chiefly in the form of gold-silver bullion shipped to the Seattle Assay Office; some high-grade dry gold concentrates were shipped to the Tacoma smelter from the amalgamation-concentration mills. The leading producers from lode mines were: The Crown Point Mining Co., operating the Crown Point mine; United Mining & Development Co., operating the Gilpatrick lode; and R. B. McEachern, operating the Alaska Oracle—all in the Moose Pass-Hope district; and the Crow Creek Gold Corporation, operating the Monarch mine in the Girdwood district.

There were no floating connected-bucket dredges in the region in 1939. The placer output came from small placers throughout the region; production was slightly less than the lode output.

Kodiak Island region.—The output of metals from Kodiak Island during 1939 came almost entirely from small placer operations on beaches and streams.

Kuskokwim region.—Placer gravels handled by three floating connected-bucket dredges yielded most of the gold and silver produced in 1939 in the Kuskokwim region, which includes the Goodnews Bay, Nixon Fork, and Tuluksak-Aniak districts. Operations began about June 1 and ended about November 15.

The dredge operated by the Bristol Bay Mining Co. on Watamuse Creek in the Goodnews Bay district made the largest output of gold in the region in 1939; the W. W. Johnson Co. manufactured the dredge, which is fuel oil-powered and equipped with sixty-four 2½-cubic foot buckets. Dredging operations began June 2 and ended November 11; during this period 331,000 cubic yards of gravel averaging $1.23 per cubic yard in recovered gold were washed.

In the Tuluksak-Aniak district the New York Alaska Gold Dredging Co., second-largest producer of gold in the region in 1939, operated its two floating connected-bucket dredges (one 2-cubic foot and one 4-cubic foot), handling approximately 882,000 cubic yards of gravel.

Nearly 1,000,000 cubic yards of platinum-bearing gravel were dredged by the Goodnews Bay Mining Co. in 1939. The dredge, with ninety-two 8-cubic foot buckets and powered by a Diesel electric plant, has been in operation two full seasons. The platinum output from the dredge and from a 1¼-cubic yard Bucyrus dragline owned and operated by the same company was slightly less than in 1938.

The recovery of gold from placer operations using mechanical equipment other than floating connected-bucket dredges was maintained in 1939 at virtually the same level as in 1938. Three of the largest operations in the region recovered approximately 6,860 fine ounces of gold from about 400,000 cubic yards of gravel. The season began May 15 and terminated about October 15.

Among other large placer operators making notable output in 1939 were: The Marvel Creek Mining Co., on Marvel Creek and Solomon River in the Tuluksak-Aniak district, which used a Bucyrus 1¼-cubic yard dragline, a D–8 caterpillar bulldozer, and six hydraulic giants as excavators and washed 150,000 cubic yards of gravel; the Goodnews Bay Mining Co., on a stream and bench deposit in Snow Gulch, tributary of the Arolic River, which was equipped with a portable washing plant and excavated with a 1¼-yard Bucyrus Diesel-powered dragline and bulldozer; and the Kow Kow Mining Co., which recovered gold from a stream deposit on Kow Kow Creek 35 miles north of Goodnews Bay with a washing plant, supplied with gold-bearing gravel by a 1¼-yard P & H dragline.

Gold production from lodes was less in 1939 than in 1938 and was small compared with that from placers. The leading producer from lode deposits was Mespelt & Co., operating the Nixon Fork mine in the Nixon Fork district.

Northwestern Alaska region.—Mining in the Northwestern Alaska region—comprising the Kiana and Shungnak districts and covering the area of the Kobuk River Valley—was confined almost entirely to small placer operations in 1939.

Seward Peninsula region.—In the Seward Peninsula region, comprising all the area of the Seward Peninsula, floating connected-bucket dredges were the leading producers of gold and silver in 1939; of the total output of gold from dredges in Alaska during the year, the 21 dredges in the Seward Peninsula produced 26 percent and increased their output by 2,617 fine ounces over 1938. The average tenor of the gold-bearing gravel handled in 1939 increased 5 cents per cubic yard to an average of 47 cents in value of recovered gold. One less dredge was active than in 1938, but the higher tenor of the gravel resulted in a slightly increased output of gold. The active dredging season started during the latter part of May and, in rare instances, lasted until November 15. Preparation of the ground for active dredging was carried on by most of the operators well in advance of the dredges; in some instances this preparatory work was continuous throughout the year.

The United States Smelting, Refining & Mining Co. in the Nome district, operating three electrically powered Yuba dredges (one with 112, one with 103, and one with 78 9-cubic foot buckets) was the largest producer in 1939 in the Seward Peninsula region. The open dredging season began May 28 and lasted through November 16, during which time more than 3,100,000 cubic yards of gravel were washed. The gold output from these three dredges was slightly greater than in 1938, owing to the higher grade of the gravel handled, as the total quantity of gravel was about 400,000 yards less than in 1938. Preparatory work on additional tracts of land was carried on in advance of actual dredging. The Thirty-fourth Annual Report of the United States Smelting, Refining & Mining Co. for the year ended December 31, 1939 (dated March 14, 1940), says—

> At Nome, Alaska, dredge No. 2 started on May 28, 1939, and all three dredges were in operation by June 17, continuing until about the middle of November, an aggregate of 483 dredging days compared with 468 in 1938. Yardage dredged was a little less than in 1938 but value per yard slightly more, the net result being a small increase in the amount of gold recovered. Plans for the installation of a fourth deep-digging dredge are completed, and this dredge will be ordered in 1940 for operation in 1941.

On Candle Creek in the Fairhaven district the Arctic Circle Exploration, Inc., operated two dredges, each with seventy 4-cubic foot buckets (one dredge electrically powered and one Diesel-powered) and was the second most important producer of placer gold in 1939. Active dredging began June 19 and continued through October 6, during which time 733,030 cubic yards of gravel were washed and 13,509 crude ounces of gold about 0.856 fine were recovered. The total output of gold was 1,648 fine ounces more than in 1938. Preparatory work on the 5,000 acres of placer ground owned or controlled by the company was kept well in advance of actual dredging operations.

In the Kougarok district of the Seward Peninsula two dredges were active during the 1939 season. The more productive was the Diesel-powered Yuba dredge equipped with fifty-four 3-cubic foot buckets, owned by the Fox Bar Dredging Co., which dredged 302,540 cubic yards of gravel averaging 40 cents per cubic yard in recovered gold between June 28 and October 11. The Kougarok Consolidated Placers, Inc., operated a Washington Iron Works Diesel-powered dredge equipped with eighty 2¼-cubic foot buckets from June 20 to September 1.

In the Koyuk (Saint Michael) district the Ungalik Syndicate, using a Diesel-powered dredge equipped with seventy-five 3½-cubic foot buckets, handled 200,000 cubic yards of gravel in 1939 during the open dredging season of approximately 100 days; this dredge was the most productive in the district. The Dime Creek Dredging Co., operating a gasoline-powered flume dredge equipped with twenty-nine 1½-cubic foot buckets, washed about 10,000 cubic yards of gravel averaging $1.26 in recovered gold per cubic yard; the dredge was active only 45 days.

Among the other operators of floating connected-bucket dredges in 1939, the following made production worthy of note: The Alaska Placer Dredging Co. (formerly the North Star Dredging Co.), operating in the Council district; Alaska Sunset Mines, Inc., in the Nome district; Casa de Paga Gold Co., operating a fuel oil-powered dredge equipped with fifty-two 1¼-cubic foot buckets, in the Nome district; Bartholomae Oil Corporation, operating with thirty-one 2¾-cubic foot buckets, in the Port Clarence district; and Lee Brothers Dredging Co., operating on Solomon River in the Solomon district.

General increases in 1939 in gold output by placer operators using equipment other than floating connected-bucket dredges were noted throughout most of the districts in the Seward Peninsula region. Rainfall was about normal, thus permitting regularity in hydraulic operations; owing to the steadily increasing use of draglines and bulldozers the seasonal rainfalls are losing their importance as a major factor in determining the length of the mining season. In most operations using draglines, bulldozers, and slackline scrapers the season is from break-up to freeze-up. The average length of the season for operators not using floating connected-bucket dredges was about 120 days for all mines mechanically equipped, except for hydraulic miners, whose average was from 10 to, in some instances, 30 days less.

The Arctic Circle Exploration, Inc., operating in the Fairhaven district, hydraulicked 178,000 cubic yards of gravel between June 1 and October 1 and recovered 43 cents in gold per yard; 100,000 yards of tailings were removed during the same period by a 1½-yard Diesel-powered Northwest dragline.

In the Kougarok district three hydraulic plants sluiced 351,496 cubic yards of gravel in 1939, recovering 84 cents per yard in gold; draglines were used to remove the tailings from the sluicing operation.

In the Nome district operators of two drift mines received $27,428 in 1939 for gold obtained from sluicing approximately 8,250 cubic yards of gravel.

Lode mining in the Seward Peninsula region in 1939 yielded less than 1,500 ounces of fine gold.

Southeastern Alaska region.—Southeastern Alaska—covering the Admiralty Island, Chichagof Island, Hyder, Juneau, Ketchikan, and Windham Bay districts—produced 70 percent of the total output of lode gold from Alaska in 1939 and most of the silver, copper, and lead. During the year there were 21 active or developing mines in operation; by far the largest producer of gold, silver, and lead was the Alaska Juneau Gold Mining Co. at Juneau. The Twenty-fifth Annual Report of this company for the year ended December 31, 1939 (dated February 29, 1940), says—

The gold assay value of the ore mined in the year 1939 was less by 16 cents per ton than the corresponding figure for the preceding year. This falling off in gold content reduced the operating profit before deduction for depreciation and depletion to $1,565,169.22. The first 6 months of the year made the poorest showing, for during this time operations in the Perseverance section were being tied in and coordinated with the operations as a whole. While the temporary dislocation in the smoothness of operation was being overcome, and passed, each succeeding quarter of the year showed improvement over the preceding quarter. The Perseverance section is now producing about 50 percent of the total tonnage output, and the expectations are for an improvement in the gold content of the total ore mined and milled during the coming year.

During the past 4 years, the exploratory, development, and preparatory mining work in the Perseverance section has brought the production from that section up from 1.37 percent in 1936 to 43.67 percent of the total mine output in 1939. At present six stopes in the Perseverance are producing, and preparatory work for six additional stopes is under way or programmed. Exploratory work is also planned for the easterly portion of the area of which there is little knowledge at this time.

Work done in the deep levels was routine, no change of importance occurring there. Work for bringing in three additional stopes is well under way and exploratory work continues for delimiting the ore laterally and in depth; however, there is now little evidence that further work below the present bottom level is justified.

In the annual report for the year 1932 there appeared a statement showing developed ore reserves sufficient for about 13 years' operations at the present rate of production. After 7 years have elapsed there are still about 10 years of developed reserves in those portions of the mine where development and exploration work is more or less complete.

Development work and stope preparation were carried on during the year at the same rate as in the previous year; 4,648,060 tons were trammed from mine to mill in the year 1939, of which 2,029,920 tons or 44 percent came from the Perseverance section.

Four days regular operating time were lost on account of a rock and mud slide, caused by continued wet weather and heavy rains. This slide took out some track and snowshed between the mine and the mill and necessitated stopping tramming and milling until the slide was cleared away and the track was repaired. The amount of damage done, other than lost time, was not large.

Development and preparatory work in the Perseverance section was continued at about the same rate as in the previous year. A compressor of 1,500-cubic-foot capacity was installed at the bottom of the Perseverance Shaft to supplement the compressed-air supply in this part of the mine.

Owing to the fact that the ore zone is not as wide in the Perseverance section as in the Alaska Juneau South Orebody, the cost of development and preparatory work per ton mined will be more; and the production per unit of development and preparatory work will be somewhat less.

The first half of the year was spent in further outlining the ore on the Nos. 11, 12, and 13 levels in the vicinity of 53 winze. In the last half of the year a pilot drift was driven on No. 13 level to a point under the Main Shaft, and raising to connect with the Main Shaft was begun. When this raise is connected to the Main Shaft, the shaft will be enlarged to its full size to a point below the No. 13 level, which is 1,500 feet vertically below the Gold Creek Tunnel level. While the Main Shaft is being constructed, preparatory work in the orebody between No. 12 level and No. 10 level in the vicinity of 53 winze will be carried on from 53 winze so that when the shaft and haulageway on No. 13 are completed a stope will be ready for production.

During the year 440,450 pounds of powder were used in blasting powder drifts, 28,300 pounds were used in blasting long hole drill stations, making a total of 468,750 pounds of powder for primary breaking, or 0.10 pound per ton trammed. Total powder consumption for mining was 0.32 pound per ton trammed as against 0.36 pound in 1938 and 0.40 pound in 1937.

Mill.—Experimental work on flotation of rougher table tailings, mentioned in last year's report, was carried to a point where it was demonstrated that it was not practicable to treat the coarser portion of the tailings without regrinding. Additional tube mills have been installed so that the rougher middlings may be reground. At the present time the mill is so equipped that approximately one-half of the ore milled will be treated by flotation, either as slimes or reground middlings.

During the year 634,419 tons of slimes and 275,975 tons of reground middlings were treated by flotation, while 286,590 tons of slimes were discarded as thickener overflow. The installation of the regrinding mills was not completed until shortly after the end of the year.

The fine tailings pumping plant installed in 1937 continues to work satisfactorily. During the current year some money was spent in relocating the public road so that the full use of this plant and its accompanying flume may be had.

As during the past few years, there was an abundance of unskilled labor available. The number of skilled miners applying for work was, however, limited.

Last year's adjustment of wages to conform with the Wage-Hour law continued in effect until October of this year, when an adjustment was again made. The average wage per day was $6.63 in 1939 as against $6.55 in 1938.

Except in a few cases of isolated power-plant operators and hoistmen, where it is not practical to continually change, the men worked 6 days per week, overtime being paid in accordance with the Wage-Hour law. The men who work 7 days per week are also paid overtime for all time in excess of 42 hours per week.

The over-all cost per man per day was $11.22, which is the same figure as for the previous year.

Power plants.—Maintenance of plants and transmission lines together with some minor improvements continued as usual. Owing to the lateness of the summer season, progress on moving the Annex Creek line was not as great as had been expected. Material progress was made on this item, however. The work will be continued in the summer of 1940.

While no large items of improvement are contemplated at this time, the six hydroelectric plants and the connecting power lines have been installed for 25 years or more, and the cost of repairs and renewals from now on will be greater than in the years following their installation.

Gold content of ore from Alaska Juneau mine, 1935–39, and total, 1893–1939

Year	Rock to mill from mine (tons)		Gold (ounce)				
			Recovery per ton fine-milled		Losses per ton of tailings		Content of rock from mine to mill
	Ore fine-milled	Coarse tailings rejected	In bullion	In galena concentrates	Fine	Coarse	
1935	2,091,475	1,638,185	0.0533	0.0035	0.0108	0.0078	0.0413
1936	2,462,046	1,904,754	.0544	.0061	.0089	.0069	.0422
1937	2,251,079	2,191,681	.0594	.0080	.0116	.0082	.0441
1938	2,478,928	2,184,952	.0515	.0081	.0090	.0071	.0398
1939	2,377,718	2,270,342	.0454	.0088	.0083	.0066	.0352
Total and average, 1893–1939	39,908,636	34,857,062	.0514	.0116	.0124	.0087	.0443

Gold, silver, and lead recoveries from Alaska Juneau mine, 1893–1939

Year	Gold		Silver		Lead		Total value recovered
	Fine ounces	Value	Fine ounces	Value	Pounds	Value	
1893–1913	34,239.49	$707,730.15	(1)	(1)	(1)	(1)	$707,730.15
1914–34	1,784,591.74	39,415,350.08	1,112,319.44	$619,434.94	25,910,982	$1,466,066.83	41,500,851.85
1935	118,997.83	4,165,784.05	77,787.17	56,265.16	1,455,167	59,061.05	4,281,110.26
1936	149,235.23	5,223,231.16	101,590.59	78,794.94	2,102,594	98,594.68	5,400,620.78
1937	151,670.64	5,308,471.55	120,691.21	91,528.49	1,980,405	116,414.16	5,516,414.20
1938	148,103.14	5,183,542.98	121,473.25	78,999.04	2,152,714	101,945.80	5,364,487.82
1939	129,011.74	4,515,410.28	111,494.24	75,165.90	2,040,280	104,961.22	4,695,537.40
Total	2,515,849.81	64,519,520.25	1,645,355.90	1,000,188.47	35,642,142	1,947,043.74	67,466,752.46

[1] Lost in tailings.

The Hirst-Chichagof Mining Co., operating the Hirst-Chichagof mine in the Chichagof Island district, was the second-largest producer of gold and silver in the region in 1939. About two-thirds of its output was in the form of gold-silver bars shipped to the Seattle Assay Office; the remainder came from dry gold concentrates (of which it was the largest producer in the region) shipped to Tacoma.

Copper concentrates from gold-palladium ore mined by the Alaska Gold and Metals Co. yielded most of the copper output of Alaska in 1939; the concentrates were shipped to the Tacoma smelter.

Other important producers from lode mines in the region in 1939 were: The Chichagof Mining Co., shipping dry gold concentrates from ores of the Chichagof mine in the Chichagof Island district; Nelson & Tift, working the N & T mine in the Ketchikan district; the Flagstaff Mining Co., operating the Treasurer group in the Ketchikan district; and the Alaska Empire Gold Mining Co., working the Williams mine in the Admiralty Island district.

Yukon River Basin region.—The Yukon River Basin—comprising the Bonnifield, Chandalar, Chisana, Circle, Eagle, Fairbanks, Fort Gibbon, Fortymile, Hot Springs, Iditarod, Innoko, Kantishna, Koyukuk, Marshall, Rampart, Richardson, Ruby, and Tolovana districts—yielded 66 percent of the total output from connected-bucket dredges in Alaska during 1939. It ranked second in gold recovered from other placers and third in that from lode mines.

Nineteen floating connected-bucket dredges were active in the region in 1939. During the open season, which began about March 15 and terminated December 1, approximately 12,851,000 cubic yards of gold-bearing gravels were washed, with an average recovery in gold of 55 cents per cubic yard, an increase of 3 cents over 1938. Preparatory work was done in some instances throughout the entire year.

The United States Smelting, Refining & Mining Co., operating six floating connected-bucket dredges in 1939 in the Fairbanks district—two 10-cubic foot electrically driven Bethlehem dredges (with 111 and 93 buckets, respectively), three 6-cubic foot electrically driven Bethlehem dredges (with 78, 78, and 68 buckets, respectively), and one shallow-digging 3-cubic foot Yuba dredge (with 68 buckets)—was by far the largest producer of gold and silver in the Yukon Basin region. These six dredges handled a slightly greater yardage of gravel than in 1938 and of approximately the same grade, resulting in a slight increase in recovered gold in 1939. Especially worthy of note are the new installations brought into use during the 1939 season for clearing large tracts of land for future dredging. The principal items of this installation include an enormous walking dragline of the Bucyrus type; a belt-conveyor system 1 mile or more long; and a large movable and self-propelling loading plant that receives material from the 8- and 12-cubic yard buckets of the dragline and delivers it in a steady stream to the belt-conveyor system. This installation is being used at the company open pit on Cripple Creek. The Thirty-fourth Annual Report of the United States Smelting, Refining & Mining Co. for the year ended December 31, 1939 (dated March 14, 1940), says—

At Fairbanks, Alaska, dredging operations started for the season on March 15, 1939, and continued until about the first of December. The six dredges aggregated 1,462 dredging days, compared with 1,453 in 1938, and handled a slightly greater yardage of gravel of approximately the same grade. On the new area mentioned in previous reports the installation of the dragline and conveyor was completed and the removal of the upper barren gravels commenced during the latter part of the season. A new dredge is being erected and should be ready to start work on the underlying pay gravels in this area about the middle of the 1940 season. Another newly acquired small dredge will start work on an outlying area during 1940.

At both the Fairbanks and Nome fields preparation of ground has been actively carried on with the result that at the present there is a greater yardage of thawed ground ahead of the dredges than has been the case in any previous year. Acquisition and development of additional dredging ground has been going on steadily, and the known gold reserves at the end of 1939 are greater than at any time in the past.

In the Circle district more than 1,000,000 cubic yards of gravel were washed by three floating connected-bucket dredges, making this district second in importance in the region in recovery of placer gold in 1939. Gold Placers, Inc., recovered the largest quantity of gold in the district, using a W. W. Johnson Co. type of Diesel-powered dredge equipped with sixty 4-cubic foot buckets; 393,700 cubic yards of gravel were handled between May 30 and October 15. The second-largest quantity of recovered gold came from operations of the steam-driven flume-type dredge equipped with sixty 3-cubic foot buckets and operated by the C. J. Berry Dredging Co. on its Mammoth Creek properties; during the open season (May 15 to October 18) 271,000 cubic yards of gravel were dredged. Dredging was carried on at Woodchopper Creek by Alluvial Golds, Inc., which used a W. W. Johnson

Co. type of Diesel-powered dredge equipped with seventy-two 4-cubic foot buckets.

The American Creek Operating Co., Inc., mining on American Creek, operated the only dredge active in the Hot Springs district in 1939. Dredging began June 10 and ended October 1; during this period the Diesel-powered Yuba dredge, equipped with 2½-cubic foot buckets, handled 187,038 cubic yards of gravel from which 4,002 ounces of fine gold were recovered.

In the Iditarod district the North American Dredging Co., operating a fuel oil-powered dredge equipped with sixty-one 3½-cubic foot buckets, and the J. E. Riley Investment Co., using a Diesel-powered dredge of Union type, equipped with fifty-eight 3½-cubic foot buckets, washed more than 550,000 cubic yards of gravel during the 5 months of open season beginning about June 1.

A new type of floating dredge was installed by the Triple X Placers Co. and was engaged actively during the 1939 season in recovery of gold in the Bonnifield district near Ferry. Instead of the conventional bucket line, a single dipper similar in type to that of a power shovel is employed for excavating. The dipper is mounted on a steel framework at the digging end of the dredge in such a manner as to permit it to be elevated to an angle that allows the gold-bearing gravel to be discharged into a trommel screen on the floating washing plant. The washing plant and stacker unit are similar to those used on light-weight dredges. The output of recovered gold during 1939 compared favorably with recoveries by floating connected-bucket dredges using up to 3½-cubic foot buckets.

Among other floating connected-bucket dredges in the region recovering quantities of gold in 1939 worthy of note were: The Holky Dredging Co. and Nels J. Vibe, both in the Innoko district; the Nome Creek Mining Co., in the Circle district; the Boundary Dredging Co., operating on Canyon Creek, in the Fortymile district; and North American Mines, Inc., dredging on Jack Wade Creek, also in the Fortymile district.

The second most productive source of gold in the Yukon Basin region in 1939 was the many placer mines—other than floating connected-bucket dredges—throughout the area. In most of the region water supplies in the early part of the open season were inadequate to insure continuous work for all operators; later, seasonal rains relieved this situation. Additional draglines, hydraulic giants, bulldozers, slack-line scrapers, and water pumps were installed in most of the districts of the region, especially in the Fortymile, Fairbanks, Innoko, Koyukuk, Ruby, and Tolovana districts. The open season, beginning about May 1 to 15 and lasting in some rare instances to December 1, was about normal. Most of the gold recovered from small placer operations in the region was shipped by bullion buyers, principally the First National Bank of Fairbanks, either as agents or purchasers.

In the Bonnifield district three hydraulic operators washed about 60,000 cubic yards of gravel in 1939 with an average recovery of 34 cents in gold per cubic yard; hydraulicking began about May 2 and continued intermittently until about September 15.

In the Chisana district two hydraulic plants, beginning work about May 15 and ending about September 1, washed about 26,000 cubic yards of gravel, with an average in recovered gold of 55 cents per cubic yard.

Among the principal producers in the Circle district in 1939 was the Mastodon Mining Co., which operated a hydraulic plant, with a Bucyrus Diesel-powered 1½-cubic yard dragline and two RD-8 tractors as auxiliary equipment; 259,960 cubic yards of gravel were hydraulicked during the open season, May 29 to September 29. Johnston, Blondo & Co., using a Diesel-powered dragline and an overhead sluice, washed approximately 84,000 cubic yards of gravel which netted $76,284 in gold-silver bullion during 84 days of operation; two hydraulic giants also were employed in this operation.

In the Fairbanks district three operators, using hydraulic, dragline, and bulldozing equipment in 1939, washed approximately 100,000 cubic yards of gold-bearing gravel which netted $88,656 in recovered gold. The Deadwood Mining Co., sluicing gravels on Deadwood Creek near Circle Springs, employed two N. W. fuel oil-powered draglines with 1½- and 2¼-yard buckets.

L. McGee, owner of 1,600 acres of placer ground 21 miles east of Hughes on Utopia Creek in the Fort Gibbon district, used a 1¼-cubic yard dragline and three caterpillar bulldozers, all Diesel-powered, in recovering 1,383 fine ounces of gold from about 142,000 cubic yards of gravel in 1939.

The Central Development Syndicate, working in 1939 on Jack Wade Creek in the Fortymile district, removed 97,000 cubic yards of muck, sluiced 73,200 cubic yards of gold-bearing gravel during the open season, and recovered gold which netted $65,777. Prime movers of the gold-bearing gravel and the muck were two Diesel-powered caterpillar bulldozers; the gravel was treated in a washing plant.

In the Hot Springs district three operators sluiced 45,333 cubic yards of material in 1939, recovering gold for which $29,026 was received; hydraulic giants, bulldozers, and draglines were used in moving the gravel.

In the Innoko district 3 draglines (two 1¼-cubic yard and one 1-cubic yard), a slackline scraper (one 1-cubic yard bucket), 6 bulldozers (Diesel-powered caterpillar tractors), and 17 hydraulic giants, owned and operated by four different partnerships, removed overburden and allowed sluicing in 1939 of 342,730 cubic yards of gold-bearing gravel averaging 57 cents per cubic yard in recovered gold. Three Miners, Inc., controlling 440 acres of placer ground on the Innoko River, recovered 1,361 ounces of fine gold from 112,730 yards of gravel from May 21 to October 23; equipment comprised a Bucyrus-Erie Diesel-powered dragline, a fuel oil-powered caterpillar tractor bulldozer, a fabricated hydraulic giant, and a washing plant.

The operation of N. R. Hudson on Olive Creek in the Tolovana district is typical of the wide use to which bulldozing tractors and draglines are put in the recovery of gold from placer gravels. During the 1939 season (May 1 to the latter part of September) approximately 76,000 cubic yards of gravel averaging about $1 per cubic yard in recovered gold were handled by two bulldozers (International–40), a ½-yard gasoline-powered dragline, and four 3-inch hydraulic giants; the bulldozers were used for general utility work, and the dragline was used to dispose of the tailings from the sluice boxes. An International pumping unit run by a 100-hp. motor supplied or added to the necessary head or water pressure on the giants.

Other placer operators in the region recovering quantities of gold in 1939 worthy of note were: The Berry Holding Co., hydraulicking on

Eagle Creek in the Circle district; Alder Creek Mining Co., operating on Alder Creek in the Fairbanks district; Cleary Hill Mines Co., operating on Tofty Creek in the Hot Springs district; Northland Development Co., working on Willow Creek in the Iditarod district; Olson & Co., operating on Happy Creek in the Iditarod district; Eric Hard and partners, on Ophir Creek in the Innoko district; Awe Mining Co., Peter Miscovich, and the Moore Creek Mining Co., all with headquarters at Flat; Long Creek Mining Co., working on Long Creek in the Ruby district; and Wilbur Mines, operating on Wilbur Creek in the Tolovana district.

The Yukon Basin region ranked third in importance in Alaska in 1939 in output of lode gold; it produced 19,572 fine ounces of gold and 5,514 fine ounces of silver, principally in the form of gold-silver bullion shipped finally to the Seattle Assay Office; some high-grade dry gold concentrates were shipped to the Tacoma smelter. The leading producers from lode mines in the region were: The Cleary Hill Mines Co., operating the Cleary Hill mine; the Hi Yu Mining Co., with a 50-ton amalgamation-flotation mill at the Hi Yu mine; and the United States Smelting, Refining & Mining Co., operating the old McCarty property—all in the Fairbanks district; and the Red Top Mining Co., operating the Red Top mine in the Kantishna district.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN ARIZONA

(MINE REPORT)

By T. H. Miller and Paul Luff

SUMMARY OUTLINE

The total value of the recoverable metal output from mines in Arizona was $72,616,408 in 1939 compared with $58,358,401 in 1938, an increase of more than 24 percent. The value for 1939 has been exceeded in only two years during the past decade — in 1930 ($81,042,416) and in 1937 ($90,855,462). Both quantity and total value of each metal in 1939 increased; the total value of the gold was $399,350 greater than in 1938, silver $475,831, copper $13,203,084, lead $39,942, and zinc $139,800. The several metals recovered from copper ore were valued at $62,227,585 in 1939, or 86 percent of the State total. Copper has long been the most important metal resource and mineral product of Arizona, hence the increase in 1939 in the average sales price of the metal to 10.4 cents a pound caused increased output of copper ore in all the copper-producing districts. The rise in the average sales price of silver, lead, and zinc resulted likewise in stimulating activity in the silver-lead-zinc districts.

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, 1935–39

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1935	$35.00	$0.71875	$0.083	$0.040	$0.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052

[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] 1935–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–39: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787.

Mine production of gold, silver, copper, lead, and zinc in Arizona, 1935–39, and total, 1860–1939, 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
1935	904	1,197	6,770,050	241,754.60	$8,461,411	6,601,280	$4,744,670
1936	847	787	13,819,838	322,408.20	11,284,287	8,386,043	6,494,990
1937	888	376	20,976,359	332,694.00	11,644,290	9,422,552	7,288,344
1938	885	329	14,203,164	305,043.00	10,676,505	7,479,153	4,835,008
1939	976	142	18,793,260	316,453.00	11,075,855	7,824,004	5,310,839
1860–1939			(1)	9,564,090.00	222,238,305	254,114,563	189,518,409

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1935	278,029,289	$23,076,431	15,566,100	$622,644	6,673,932	$293,653	$37,198,809
1936	422,550,000	38,874,600	21,376,000	983,296	7,178,000	358,900	57,996,073
1937	576,956,000	69,811,676	24,708,000	1,457,772	10,052,000	653,380	90,855,462
1938	421,594,000	41,316,212	21,142,000	972,532	11,628,000	558,144	58,358,401
1939	524,224,000	54,519,296	21,542,000	1,012,474	13,422,000	697,944	72,616,408
1860–1939	[2] 8,839,310	2,700,700,210	[2] 253,150	29,390,318	[2] 94,354	14,721,395	3,156,568,637

[1] Figures not available. [2] Short tons.

Gold and silver produced at placer mines in Arizona, 1935–39, in fine ounces, in terms of recovered metals

Year	Sluicing [1]		Drift mining		Dry-land and floating dragline dredges [2]		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1935	[3] 2,561.47	[3] 494	(3)	(3)	2,595.53	338	5,157.00	832
1936	[3] 2,083.69	[3] 286	(3)	(3)	4,403.91	604	6,487.60	890
1937	1,275.00	212	258.00	34	2,866.00	403	4,399.00	649
1938	1,624.00	213	328.00	35	3,033.00	380	4,985.00	628
1939	1,919.00	227	1,850.00	125	2,640.00	339	6,409.00	691

[1] Includes placer sands treated by dry concentration plants.
[2] A floating washing plant supplied with gravel by a dragline excavator is called a "dragline dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."
[3] Figures for sluicing include those for drift mining.

Gold.—The output of recoverable gold in Arizona in 1939 was 316,453 fine ounces, a gain of 4 percent over 1938. Gold from siliceous ores (chiefly dry and siliceous gold ore) increased 8,027 ounces owing to marked increases in gold ore treated by concentration followed by cyanidation in the Old Hat district and in gold ore treated by direct cyanidation in the Weaver district and the Katherine section of the San Francisco district. Gold from copper ore increased 6,118 ounces, but gold from zinc-lead ore declined 4,741 ounces owing to the large decrease in output of zinc-lead ore from the Tennessee mine at Chloride. Gold from placers increased 1,424 ounces; 64 percent of the total placer gold was recovered by dragline dredging at a property on Lynx Creek in Yavapai County and by drift mining at a property near Quartzsite in Yuma County. The Copper Queen (Bisbee) branch of the Phelps Dodge Corporation was, as usual, the leading gold producer in Arizona, and the United Verde (Jerome) and New Cornelia (Ajo) branches of the company ranked second and third, respectively; there was a marked increase in gold output from the New Cornelia, but a decrease from the United Verde; and the total output of gold from these three properties represented 38 percent of the State total. Other large gold producers in 1939 were the Mammoth-St.

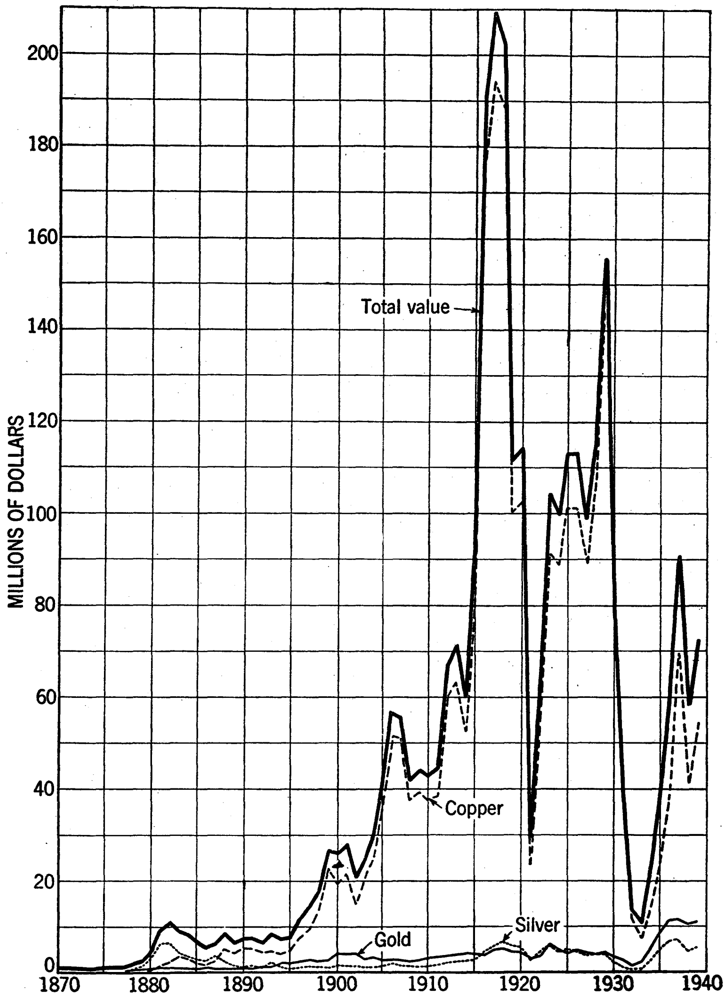

FIGURE 1.—Value of mine production of gold, silver, and copper and total value of gold, silver, copper, lead, and zinc in Arizona, 1870–1939. The value of lead and zinc has been less than $2,000,000 annually, except in a few years.

Anthony Limited property in Pinal County, the Goldroad mine (United States Smelting, Refining & Mining Co.) in Mohave County, the Octave mine (American Smelting & Refining Co.) in Yavapai County, the Iron King mine in Yavapai County, the Gold Standard Mines Corporation in Mohave County, and the Montana mine (Eagle-Picher Mining & Smelting Co.) in Santa Cruz County. Siliceous ore yielded 50 percent of the State total gold, copper ore 44 percent, and zinc-lead ore 3 percent. The chief gold-producing districts in Arizona were the Warren (mostly copper ore), San Francisco (mostly gold ore), Verde (mostly copper ore), Ajo (copper ore), Old Hat (gold ore), and Weaver (Yavapai County) (gold ore).

Silver.—The output of recoverable silver in Arizona in 1939 was 7,824,004 fine ounces, a gain of 5 percent over 1938. Silver from copper ore increased 295,034 ounces, that from zinc-lead ore 139,891 ounces, and that from zinc-copper ore 118,955 ounces, but silver from siliceous ores declined 207,816 ounces and that from lead ore decreased slightly. Copper ore yielded nearly 62 percent of the State total silver, siliceous ores 25 percent, zinc-lead ore 10 percent, zinc-copper ore 2 percent, and lead ore 1 percent. The Phelps Dodge Corporation continued as the chief silver producer in Arizona, although its output was 2 percent less than in 1938; the company's three properties (Copper Queen, United Verde, and New Cornelia) produced 51 percent of the State total. Other large silver producers in 1939 were the Magma, Montana, Ash Peak, Shattuck Denn, and Iron King mines. Silver output decreased substantially in the Ash Peak (Duncan), Wallapai (Chloride), and Eureka (Hillside) districts but increased sharply in the Verde (Jerome), Harshaw (Patagonia), Big Bug (Humboldt), Pioneer (Superior), Black Canyon (Cleator), and Ajo districts.

Copper.—The output of recoverable copper in Arizona in 1939 was 524,224,000 pounds, a gain of 24 percent over 1938; there was a general increase in each of the seven chief copper-producing districts, as follows: Globe-Miami district increased 35,745,031 pounds; Warren (Bisbee) district, 14,197,289 pounds; Verde (Jerome) district, 17,566,496 pounds; Ajo (New Cornelia) district, 13,382,587 pounds; Mineral Creek (Ray) district, 13,107,102 pounds; Copper Mountain (Morenci) district, 9,459,464 pounds; and Pioneer (Superior) district, 1,572,510 pounds. These seven districts contributed 99 percent of the State total copper, and the Globe-Miami district was the leading producer. Copper ore and its products yielded 519,923,639 pounds of copper, as follows: 13,542,200 tons of copper ore treated by concentration yielded 51 percent, 1,812,177 tons of copper ore shipped crude to smelters 32 percent, and 2,114,407 tons of copper ore leached and 21,330 tons of cement copper (from mine-water precipitates and underground leaching operations) 17 percent. The New Cornelia property continued to be the largest copper producer in Arizona; its output was 15 percent greater than in 1938, and it was followed in order by the Copper Queen, United Verde, Miami, Inspiration, Ray (Nevada Consolidated Copper Corporation), Magma, and Morenci (Phelps Dodge Corporation).

Lead and zinc.—The output of recoverable lead in Arizona in 1939 was 21,542,000 pounds, an increase of 2 percent over 1938; the output of recoverable zinc was 13,422,000 pounds, an increase of 15 percent. About 55 percent of the State total lead and 51 percent of the zinc came from Santa Cruz County, 19 percent of the lead and 30 percent of the zinc from Pinal County, and 12 percent of the lead and 7 percent of the zinc from Yavapai County; the remainder of the lead came chiefly from Mohave and Cochise Counties, and nearly all the rest of the zinc from Mohave County. More than 60 percent of the total lead and nearly 68 percent of the total zinc came from zinc-lead ore; nearly all the rest of the lead came from siliceous ores and lead ore, and nearly all the rest of the zinc from zinc-copper ore. The Montana mine of the Eagle-Picher Mining & Smelting Co. at Ruby in Santa Cruz County continued to be the chief producer of both lead and zinc in the State; the Magma mine at Superior ranked second in zinc and was followed by the Trench, Tennessee, and Hillside mines. Other large producers of lead were the Trench, Mammoth-St. Anthony, Iron King, Hillside, Tennessee, and Golden Turkey properties. The marked increase in output of lead and zinc from the Trench mine more than offset decreases from the Montana and Tennessee mines.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1939, 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	44	7	59, 321	$2, 076, 235	2, 695, 001	$1, 829, 334
Coconino	4		4	140	828	562
Gila	74	8	6, 117	214, 095	141, 866	96, 297
Graham	6		8	280	2, 696	1, 830
Greenlee	11	4	1, 592	55, 720	313, 892	213, 066
Maricopa	51	9	3, 076	107, 660	42, 906	29, 124
Mohave	190	15	69, 988	2, 449, 580	542, 171	368, 019
Pima	70	7	32, 692	1, 144, 220	385, 543	261, 702
Pinal	83	3	41, 465	1, 451, 275	958, 756	650, 792
Santa Cruz	65	1	5, 708	199, 780	755, 205	512, 624
Yavapai	320	61	92, 225	3, 227, 875	1, 977, 270	1, 342, 147
Yuma	58	27	4, 257	148, 995	7, 870	5, 342
	976	142	316, 453	11, 075, 855	7, 824, 004	5, 310, 839
Total, 1938	885	329	305, 043	10, 676, 505	7, 479, 153	4, 835, 008

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Cochise	109, 282, 596	$11, 365, 390	1, 124, 659	$52, 859	37, 712	$1, 961	$15, 325, 779
Coconino	112, 894	11, 741					12, 443
Gila	125, 916, 721	13, 095, 339	51, 341	2, 413			13, 408, 144
Graham	6, 539	680	151, 723	7, 131			9, 921
Greenlee	31, 763, 500	3, 303, 404	33, 042	1, 553	46, 039	2, 394	3. 576, 137
Maricopa	408, 115	42, 444	617	29			179, 257
Mohave	185, 529	19, 295	1, 459, 107	68, 578	1, 539, 692	80, 064	2, 985, 536
Pima	99, 867, 616	10, 386, 232	83, 724	3, 935			11, 796, 089
Pinal	79, 664, 884	8, 285, 148	4, 134, 170	194, 306	4, 000, 000	208, 000	10, 789, 521
Santa Cruz	545, 269	56, 708	11, 772, 085	553, 288	6. 904, 211	359, 019	1, 681, 419
Yavapai	76, 406, 260	7, 946, 251	2, 685, 638	126, 225	894, 346	46, 506	12, 689, 004
Yuma	64, 077	6, 664	45, 894	2, 157			163, 158
	524, 224, 000	54, 519, 296	21, 542, 000	1, 012, 474	13, 422, 000	697, 944	72, 616, 408
Total, 1938	421, 594, 000	41, 316, 212	21, 142, 000	972, 532	11, 628, 000	558, 144	58, 358, 401

Gold and silver produced at lode mines in Arizona in 1939, by counties, in terms of recovered metals

County	Ore sold or treated	Gold	Silver
	Short tons	*Fine ounces*	*Fine ounces*
Cochise	1,033,813	59,277	2,694,998
Coconino	573	4	828
Gila	7,172,500	6,090	141,866
Graham	1,282	8	2,696
Greenlee	489,239	1,571	313,892
Maricopa	27,594	2,966	42,897
Mohave	427,998	69,891	542,162
Pima	6,111,215	32,626	385,524
Pinal	2,023,555	41,456	958,756
Santa Cruz	175,701	5,706	755,205
Yavapai	1,320,482	88,443	1,976,784
Yuma	9,308	2,006	7,705
	18,793,260	310,044	7,823,313
Total, 1938	14,203,164	300,058	7,478,525

Gold and silver produced at placer mines in Arizona in 1939, by counties, in fine ounces, in terms of recovered metals

County	Sluicing [1]		Drift mining		Dry-land and floating dragline dredges [2]		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Cochise	26	1	--------	--------	18	2	44	3
Gila	27	--------	--------	--------	--------	--------	27	--------
Greenlee	21	--------	--------	--------	--------	--------	21	--------
Maricopa	110	9	--------	--------	--------	--------	110	9
Mohave	97	9	--------	--------	--------	--------	97	9
Pima	66	19	--------	--------	--------	--------	66	19
Pinal	9	--------	--------	--------	--------	--------	9	--------
Santa Cruz	2	--------	--------	--------	--------	--------	2	--------
Yavapai	1,156	149	4	--------	2,622	337	3,782	486
Yuma	405	40	1,846	125	--------	--------	2,251	165
	1,919	227	1,850	125	2,640	339	6,409	691
Total, 1938	1,624	213	328	35	3,033	380	4,985	628

[1] Includes placer sands treated by dry concentration plants.
[2] A floating washing plant supplied with gravel by a dragline excavator is called a "dragline dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a 'dry-land dredge."

MINING INDUSTRY

The increase in sales price of copper, silver, lead, and zinc in 1939 resulted in substantial improvement in the mining industry of Arizona, especially in the mining of copper ore. Arizona has seven large copper-producing districts—Ajo, Globe-Miami, Verde (Jerome), Warren (Bisbee), Mineral Creek (Ray), Pioneer (Superior), and Copper Mountain (Morenci)—and the output of copper ore from each was much greater than in 1938. The 20,000-ton concentrator at Ajo, the 9,000-ton ferric sulfate leaching plant at Inspiration, the 18,000-ton concentrator and 3,000-ton leaching plant at Miami, the 1,600-ton concentrator at Clarkdale, the 12,000-ton concentrator at Hayden, the 850-ton concentrator at Superior, and the 1,500-ton test concentrator at Morenci were operated continuously on copper ore in 1939 at an increased rate over 1938. Copper-smelting plants at Douglas (5,000-ton), Clarkdale (5,000-ton), Hayden (1,000-ton), Miami (1,500-ton), and Superior (500-ton) were operated throughout the year. Nearly half of the total gold and more than half of the total silver produced in Arizona are recovered usually from copper ore;

consequently, when the price of copper rises or falls it affects the State production of gold and silver. Maintaining the price of gold at $35 an ounce continued to stimulate operations at gold properties, as evidenced by the large increase in number of gold producers in 1939 and the marked increase in output of gold ore. The output of zinc-lead-silver ore also increased owing to the gain from mines in the Harshaw district, Santa Cruz County.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Arizona in 1939, with content in terms of recovered metals

Source	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold ore	619	803, 816	135, 943	253, 778	555, 401	4, 151, 510	
Dry and siliceous gold-silver ore	63	153, 289	20, 766	896, 106	731, 385	2, 127, 224	220, 500
Dry and siliceous silver ore	86	84, 899	1, 689	789, 433	158, 105	172, 186	
	[1] 756	1, 042, 004	158, 398	1, 939, 317	1, 444, 891	6, 450, 920	220, 500
Copper ore	136	17, 468, 926	139, 527	4, 820, 469	[2] 519, 923, 639	116	
Lead ore	109	9, 778	1, 240	84, 208	61, 616	2, 073, 050	
Lead-copper ore	5	30	6	1, 634	2, 329	8, 601	
Zinc ore	4	670	148	4, 030	2, 553	10, 354	103, 173
Zinc-copper ore	1	67, 074	661	182, 800	2, 252, 500		4, 000, 000
Zinc-lead ore	8	204, 778	10, 064	790, 855	536, 472	12, 998, 959	9, 098, 327
Total, lode mines	[1] 976	18, 793, 260	310, 044	7, 823, 313	[2] 524,224.000	21, 542, 000	13, 422, 000
Total, placers	142		6, 409	691			
	1, 118	18, 793, 260	316, 453	7, 824, 004	[2] 524,224,000	21, 542, 000	13, 422, 000
Total, 1938	1, 214	14, 203, 164	305, 043	7, 479, 153	[3] 421,594,000	21, 142, 000	11, 628, 000

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[2] Includes 86,058,553 pounds recovered from ore leached and mine-water precipitates.
[3] Includes 61,739,674 pounds recovered from ore leached and mine-water precipitates.

METALLURGIC INDUSTRY

The output of ore of all classes treated in Arizona increased from 14,203,164 tons in 1938 to 18,793,260 tons in 1939, and that of copper ore from 13,047,356 to 17,468,926 tons. Nearly 93 percent of the total in 1939 was copper ore, 4 percent gold ore, and the rest principally zinc-lead ore, gold-silver ore, silver ore, and zinc-copper ore.

Gold ore treated at amalgamation mills decreased from 11,177 tons in 1938 to 5,000 tons in 1939, but siliceous material treated at cyanidation plants increased from 605,367 to 733,943 tons. Cyanidation plants were operated continuously in 1939 at the Goldroad, Tom Reed, Gold Standard, Producers Mines, Inc., Vivian, Congress, Octave, Mammoth-St. Anthony, and Alvarado properties. Cyanidation plants used 207,920 pounds of sodium cyanide, 590,998 pounds of "Aero Brand" calcium cyanide, 100,000 pounds of zinc dust, 3,050,000 pounds of lime, 331 pounds of ferric sulfate, and 200 pounds of lead acetate.

Ore treated at concentration plants increased from 10,546,807 tons in 1938 to 14,017,765 tons in 1939; the ore concentrated in 1939 comprised 24,271 tons of gold ore, 119,058 tons of gold-silver ore, 58,593 tons of silver ore, 13,542,200 tons of copper ore (compared with 10,118,757 tons in 1938), 1,351 tons of lead ore, 628 tons of zinc ore, 67,074 tons of zinc-copper ore, and 204,590 tons of zinc-lead ore.

Copper ore from the Miami property (4,870,684 tons) was treated by a combination of leaching and concentration, and this tonnage is included in figures for ore treated at straight concentration plants. Ore from the Inspiration mine in 1939 was treated by straight leaching, but 147,693 tons of slimes discarded from the leaching-plant feed were concentrated.

The following tables give details of the treatment of all ores produced in Arizona in 1939.

Mine production of metals in Arizona in 1939, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore and old tailings amalgamated	5,000	1,087	308			
Ore and old tailings cyanided	733,943	77,823	144,713			
Concentrates smelted	668,141	109,671	3,028,737	269,134,268	19,282,374	13,338,249
Ore smelted	1,922,003	121,463	4,649,538	169,031,179	2,259,626	83,751
Copper precipitates smelted	21,330		17	[1] 35,357,650		
Copper ore leached	[2] 2,114,407			50,700,903		
Placer		6,409	691			
		316,453	7,824,004	524,224,000	21,542,000	13,422,000
Total, 1938		305,043	7,479,153	421,594,000	21,142,000	11,628,000

[1] Distributed as follows: Cochise County, 1,758,050 pounds; Gila County, 116,800 pounds; Greenlee County, 23,000,000 pounds; Pinal County, 9,713,400 pounds; and Yavapai County, 769,400 pounds.
[2] Treated by straight leaching at 1 plant in Gila County.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Arizona in 1939, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Material treated	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Gila	75	34	9					
Maricopa	1,883	110	28	42	129	89	193	30
Mohave	22	17	3					
Pima	716	181	96	13	40	80	177	2,426
Pinal	25	77	16					
Santa Cruz	18	7	5					
Yavapai	653	213	102	28	30	90		
Yuma	1,608	448	49	6	7	175	85	
	5,000	1,087	308	89	206	434	455	2,456
Total, 1938	11,177	1,796	575	243	672	497	1,510	2,000

CYANIDATION MILLS

County	Material treated	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
Cochise	70	8	19					
Gila	100	16	2					
Maricopa	10,888	456	403					
Mohave	360,207	59,876	101,011					
Pinal	192,392	3,791	8,628	4,471	24,413	27,767	8,000	3,700,000
Yavapai	165,260	13,266	34,550	619	8,637	8,551	10,320	57,000
Yuma	5,026	410	100					
	733,943	77,823	144,713	5,090	33,050	36,318	18,320	3,757,000
Total, 1938	605,367	73,856	134,682	4,775	27,311	35,510	7,013	3,861,391
Grand total: 1939	738,943	78,910	145,021	5,179	33,256	36,752	18,775	3,759,456
1938	616,544	75,652	135,257	5,018	27,983	36,007	8,523	3,863,391

Mine production of metals from concentrating mills in Arizona in 1939, by counties, in terms of recovered metals

County	Material treated	Concentrates smelted and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Cochise	163	31	25	798		10, 215	
Gila	5, 018, 385	96, 264	1, 463	61, 251	73, 769, 923	659	
Graham	1, 200	119	2	2, 386	6, 000	104, 728	
Greenlee	488, 562	22, 465	1, 354	311, 200	8, 758, 456	4, 200	
Maricopa	1, 200	203	4	19, 273	62, 143		
Mohave	61, 727	9, 078	6, 528	316, 568	145, 959	1, 277, 957	1, 539, 692
Pima	6, 109, 236	164, 610	32, 069	366, 982	99, 835, 064	2, 406	
Pinal	1, 734, 153	181, 800	6, 438	473, 698	59, 254, 380	2, 548	4, 000, 000
Santa Cruz	171, 288	18, 945	5, 252	674, 608	473, 151	11, 546, 890	6, 904, 211
Yavapai	431, 806	169, 438	23, 275	765, 188	26, 810, 217	2, 569, 591	894, 346
Yuma	45	9	5	33	200	3, 724	
	14, 017, 765	662, 962	76, 415	2, 991, 985	269, 115, 493	15, 522, 918	13, 338, 249
Total, 1938	10, 546, 807	542, 501	78, 522	2, 781, 817	213, 188, 561	14, 026, 089	11, 628, 000

Gross metal content of concentrates produced from ores mined in Arizona in 1939, by classes of concentrates smelted

Class of concentrates	Concentrates produced	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	1, 194	10, 149	23, 450	14, 546	80, 245	
Dry gold-silver	26, 939	10, 320	376, 216	265, 620	1, 421, 053	
Dry silver	2, 464	1, 307	391, 125	66, 600	140, 730	
Copper	597, 428	46, 768	1, 178, 181	276, 491, 738	3, 000	2, 682, 000
Lead	25, 604	40, 236	943, 217	675, 614	18, 266, 743	2, 755, 758
Zinc	14, 512	891	116, 548	298, 343	738, 529	14, 835, 306
	668, 141	109, 671	3, 028, 737	277, 812, 461	20, 650, 300	20, 273. 064
Total, 1938	547, 519	106, 505	2, 817, 824	220, 304, 713	18, 873, 836	17, 604, 947

Mine production of metals from Arizona concentrates shipped to smelters in 1939, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Cochise	31	25	798		10, 215	
Gila	96, 264	1, 463	61, 251	73, 769, 923	659	
Graham	119	2	2, 386	6, 000	104, 728	
Greenlee	22, 465	1, 354	311, 200	8, 758, 456	4, 200	
Maricopa	245	133	19, 362	62, 336	30	
Mohave	9, 078	6, 528	316, 568	145, 959	1, 277, 957	1, 539, 692
Pima	164, 623	32, 109	367, 062	99, 835, 241	4, 832	
Pinal	186, 271	30, 851	501, 465	59, 262, 380	3, 702, 548	4, 000, 000
Santa Cruz	18, 945	5, 252	674, 608	473, 151	11, 546. 890	6, 904, 211
Yavapai	170, 085	31, 942	773, 829	26, 820, 537	2, 626, 591	894, 346
Yuma	15	12	208	285	3, 724	
	668, 141	109, 671	3, 028, 737	269, 134, 268	19, 282, 374	13, 338, 249
Total, 1938	547, 519	106, 505	2, 817, 824	213, 197, 084	17, 889, 480	11, 628, 000

BY CLASSES OF CONCENTRATES

Dry gold	1, 194	10, 149	23, 450	12, 646	67, 842	
Dry gold-silver	26, 939	10, 320	376, 216	243, 351	1, 118, 895	
Dry silver	2, 464	1, 307	391, 125	63, 956	119, 400	
Copper	597, 428	46, 768	1, 178, 181	268, 069, 515	2, 200	
Lead	25, 604	40, 236	943, 217	536, 322	17, 389, 281	
Zinc	14, 512	891	116, 548	208, 478	584, 756	13, 338, 249
	668, 141	109, 671	3, 028, 737	269, 134, 268	19, 282, 374	13, 338, 249

Gross metal content of Arizona crude ore shipped to smelters in 1939, by classes of ore

Class of ore	Ore	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold	44,768	19,357	69,144	534,502	24,220	
Dry and siliceous gold-silver	30,568	7,071	304,266	412,317	262,403	
Dry and siliceous silver	25,803	361	379,397	98,716	69,522	
Copper	1,812,177	93,440	3,813,733	178,441,982	166	
Lead	8,427	1,228	81,364	73,584	2,045,921	
Lead-copper	30	6	1,634	2,982	9,045	
Zinc	42				2,540	27,000
Zinc-lead	188				31,646	69,269
	1,922,003	121,463	4,649,538	179,564,083	2,445,463	96,269
Total, 1938	1,659,601	117,901	4,525,444	156,575,773	3,603,044	

Mine production of metals from Arizona crude ore shipped to smelters in 1939, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Cochise	1,033,580	59,244	2,694,181	107,524,546	1,114,444	37,712
Coconino	573	4	828	112,894		
Gila	39,391	4,577	80,587	1,329,095	50,682	
Graham	82	6	310	539	46,995	
Greenlee	677	217	2,692	5,044	28,842	46,039
Maricopa	13,623	2,267	23,104	345,779	587	
Mohave	6,042	3,470	124,580	39,570	181,150	
Pima	1,263	336	18,366	32,375	78,892	
Pinal	96,985	6,737	448,647	10,689,104	431,622	
Santa Cruz	4,395	447	80,592	72,118	225,195	
Yavapai	722,763	43,022	1,168,303	48,816,323	59,047	
Yuma	2,629	1,136	7,348	63,792	42,170	
	1,922,003	121,463	4,649,538	169,031,179	2,259,626	83,751
Total, 1938	1,659,601	117,901	4,525,444	146,657,242	3,252,520	

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous gold	44,768	19,357	69,144	515,440	18,911	
Dry and siliceous gold-silver	30,568	7,071	304,266	396,249	204,829	
Dry and siliceous silver	25,803	361	379,397	94,149	52,786	
Copper	1,812,177	93,440	3,813,733	167,967,623	116	
Lead	8,427	1,228	81,364	55,389	1,948,955	
Lead-copper	30	6	1,634	2,329	8,601	
Zinc	42				1,778	23,481
Zinc-lead	188				23,650	60,270
	1,922,003	121,463	4,649,538	169,031,179	2,259,626	83,751

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1939, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Cochise County:													
California	4		231	7		7	1, 560		1, 560	731	70, 978		$4, 716
Cochise (Dragoon)	1		18				3		3	3, 077			322
Dos Cabezas and Tevis	8	4	100	66	33	99	106	3	109	202	4, 276		3, 761
Hartford (Huachuca Mountains)	3	2	5	16	7	23	31		31	106	362		854
Swisshelm	4		54	3		3	196		196		11, 383		773
Tombstone	11		8, 007	1, 501		1, 501	92, 509		92, 509	30, 586	579, 085		145, 727
Turquoise	10		1, 614	94		94	10, 258		10, 258	13, 942	218, 447	23, 481	23, 191
Warren	3	1	1, 023, 784	57, 590	4	57, 594	2, 590, 335		2, 590, 335	109, 233, 952	240, 128	14, 231	15, 146, 435
Coconino County:													
Francis	1		2				3		3	528			57
Jacob Canyon	1		462	3		3	243		243	93, 202			9, 963
Ryan (Warm Springs)	1		9				9		9	2, 606			277
White Mesa	1		100	1		1	573		573	16, 558			2, 146
Gila County:													
Banner and Dripping Springs	12		28, 202	2, 624		2, 624	9, 514		9, 514	1, 077, 462	5, 575		210, 616
Globe-Miami	35	5	7, 142, 998	3, 093	13	3, 106	127, 190		127, 190	124, 800, 154	45, 107		13, 176, 381
Green Valley	13	3	354	163	14	177	84		84	1, 452	659		6, 434
Pioneer (Pinal Mountains)	8		157	19		19	3, 627		3, 627	12, 240			4, 400
Roosevelt	1		491	189		189	137		137	125			6, 721
Rye Creek	1		38	2		2	931		931	1, 019			808
Summit	4		260				383		383	24, 269			2, 784
Graham County: Aravaipa	6		1, 282	8		8	2, 696		2, 696	6, 539	151, 723		9, 921
Greenlee County:													
Ash Peak	2		50, 465	793		793	279, 653		279, 653	3, 808	4, 383		218, 182
Copper Mountain	4	1	438, 477	713	2	715	33, 638		33, 638	31, 755, 933	4, 085		3, 350, 667
Granville	2		53	32		32	56		56	125	6, 404		1, 472
Mayflower	1		16				78		78	3, 067			372
Metcalf (Greenlee)	2		228	33		33	467		467	567	18, 170	46, 039	4, 779
San Francisco		3			19	19							665
Maricopa County:													
Beardsley	1		11	1		1	3		3	77			45
Big Horn	4	4	416	32	32	64	9	3	12				2, 248
Cave Creek and Camp Creek	10	1	5, 545	703	2	705	31, 294		31, 294	215, 644	64		68, 347
Ellsworth (Harqua Hala) [1]	5		37	26		26	9		9	3, 567			1, 287
Hassayampa River		1			2	2							70

[1] Ellsworth district lies in both Maricopa and Yuma Counties.

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1939, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Maricopa County—Continued.													
New River	2		507	10		10	168		168	44,288			$5,070
Osborn	3		6,661	630		630	10,305		10,305	141,164			43,726
Pikes Peak (Morgan City)	1	1	3	2	2	4							140
Salt River Mountains	3		1,909	713		713	489		489	202			25,308
San Domingo		1			63	63		6	6				2,209
Sunflower	1		700	76		76	47		47				2,692
Vulture	12	1	9,392	531	9	540	411		411	2,904	553		19,507
Webb (Gila Bend Mountains)	2		7	5		5	3		3				177
White Tanks	1		3	1		1							35
Winifred	6		2,403	236		236	159		159	269			8,396
Mohave County:													
Cedar Valley	5		633	100		100	573		573	13,538	531		5,322
Chemehuevis	10	5	72	42	28	70	19	3	22	202	127		2,492
Cottonwood	1		21	7		7	34		34	58			274
Gold Basin	11	5	3,658	953	44	997	361	3	364	366	6,724		35,496
Greenwood	3		10	8		8							280
Hacks Canyon	1		1	1		1	3		3	96			47
Indian Secret (White Hills)	5		1,188	91		91	22,001		22,001				18,119
Lost Basin		5			25	25		3	3				877
Maynard and McConnico	7		1,105	287		287	3,362		3,362	1,404			12,473
Minnesota	7		3,560	1,663		1,663	3,801		3,801	452			60,832
Music Mountain	10		724	643		643	3,045		3,045	1,221	7,299		25,042
Owens	19		612	323		323	2,173		2,173	22,115	37,213		16,829
San Francisco (Oatman, Goldroad, Katherine, Vivian)	48		284,370	44,757		44,757	42,486		42,486				1,595,334
Wallapai	47		68,716	9,301		9,301	451,325		451,325	146,077	1,406,553	1,539,692	793,253
Weaver	16		63,328	11,715		11,715	12,979		12,979		660		418,866
Pima County:													
Agua Dulce	1		1	1		1	9		9	221			64
Ajo	1		6,107,206	32,063		32,063	365,500		365,500	99,742,587			11,743,531
Arivaca	26	2	623	274	12	286	5,137		5,137	4,029	17,320		14,730
Baboquivari	4		303	100		100	2,005		2,005	1,260	553		5,018
Cababi (Comobabi)	4		430	115		115	2,864		2,864	6,289	5,595		6,886
Cerro Colorado	4		6				215		215	86	618		184
Cimarron Mountains	1		9	7		7	3		3				247
Empire	2		2				271		271		1,467		253
Greaterville	2	1	79	21	20	41	794		794	538	28,320		3,361
Growler	1		18				174		174		7,233		458
Helvetia (Rosemont)	5		69	3		3	439		439	8,875	213		1,336

Meyer	2		9	8		8	6		6		42		286
Old Hat [1]	3		2,035	6		6	1,494		1,494	95,683			11,175
Pima (Sierritas, Papago, Twin Buttes)	6		228	18		18	2,631		2,631	4,029	21,086		3,826
Quijotoa	2	4	4	2	34	36	78	19	97	106	1,277		1,397
Roskruge and Waterman	2		152	1		1	3,493		3,493	3,048			2,723
Santa Rosa	3		40	6		6	411		411	865			579
Silver Bell	1		1	1		1							35
Pinal County:													
Astraya	1		39	13		13	90		90	5,000			1,036
Bunker Hill	1		3,977	85		85	2,796		2,796	492,510			56,094
Casa Grande	14		794	260		260	2,715		2,715	4,558	3,319		11,573
Cottonwood and Black Mountain	5		250	110		110	221		221	740			4,077
Goldfields	1		500	22		22	168		168				884
Hackberry	1		18	7		7	174		174	567			422
Martinez Canyon	1		107				1,815		1,815	673	37,851		3,081
Mineral Creek	7		1,428,639	1,685		1,685	28,153		28,153	43,165,663	371,362		4,584,768
Mineral Hill	4		406	160		160	380		380	5,461			6,426
Old Hat [1]	17	2	192,724	28,467	6	28,473	37,299		37,299	47,779	3,721,255		1,201,741
Owl Head	1		6							404			42
Picacho	2		147	26		26	78		78	2,885			1,263
Pioneer	13	1	393,096	10,168	3	10,171	868,513		868,513	35,904,673		4,000,000	4,887,607
Ripsey	2		2,394	369		369	15,669		15,669	32,596			26,941
Riverside	3		20	4		4	19		19	202			174
Sacaton Mountains and Blackwater	2		13	2		2	47		47	77	383		128
Saddle Mountain	7		410	78		78	557		557	529			3,163
Steamboat	1		15				62		62	567			101
Santa Cruz County:													
Harshaw	13		37,740	61		61	233,232		233,232	50,567	4,574,320	2,149,769	492,490
Nogales (Gold Hill)	11		129	49		49	940		940	529	7,935		2,781
Oro Blanco	23		137,303	5,584		5,584	515,566		515,566	444,942	7,136,617	4,754,442	1,174,326
Palmetto	3		294	6		6	333		333	28,163	3,341		3,522
Patagonia	4	1	37	3	2	5	112		112	231	8,361		668
Redrock	4		36	1		1	2,914		2,914	19,548	894		4,088
Tyndall	4		9	1		1	741		741	866	2,532		747
Wrightson	3		153	1		1	1,367		1,367	423	38,085		2,797
Yavapai County:													
Ash Creek	2		38	18		18	75		75	269			709
Big Bug	21	9	71,043	9,142	448	9,590	250,059	47	250,106	266,548	1,083,489	220,500	595,530
Black Canyon	15	1	27,778	4,237	35	4,272	179,156	3	179,159	18,183	704,745		306,145
Black Hills	1		5	3		3	3		3	29			110
Black Rock	11	3	289	290	17	307	420		420	7,798			11,841
Blue Tank	2		104	10		10	6		6				354
Bullard (Pierce)	6		3,730	834		834	1,161		1,161	125,452			43,025
Castle Creek	8	1	139	58	12	70	19		19	5,760			3,062
Cherry Creek	24		980	732		732	1,594		1,594	7,807			27,514
Copper Basin	5	6	73	62	64	126	193	19	212	2,904			4,856
Eureka	21	1	36,439	4,154	8	4,162	93,714		93,714	327,173	800,702	673,846	315,981
Granite Creek		1			11	11							385
Hassayampa	76	2	1,983	1,670	102	1,772	13,010	19	13,029	18,635	7,403		73,150
Humbug	6	3	457	437	63	500	1,379	9	1,388	1,087	2,448		18,670
Kirkland	4	1	13	22	3	25	6		6				879

[1] Old Hat district lies in both Pima and Pinal Counties.

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1939, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Yavapai County—Continued.													
Lynx Creek		8			2,631	2,631		352	352				$92,324
Martinez	13		105,023	5,415		5,415	23,903		23,903	2,558	724		206,050
Mineral Point	3		225	74		74	165		165	490			2,753
Oak Creek		2			6	6							210
Peck	3		5	3		3	81		81				160
Pine Grove	9		6,458	2,127		2,127	31,048		31,048	91,481	4,914		105,265
Seal Mountain	1		8	3		3							105
Silver Mountain	2	2	85	13	11	24	6,152		6,152		6,192		5,307
Squaw Creek	1		2	1		1							35
Thumb Butte	3	1	52	17	1	18	6		6	240			659
Tiger	5		148	96		96	280		280	125			3,563
Tip Top	5	3	50	3	17	20	7,699		7,699	356	638		5,993
Turkey Creek	8	1	232	132	4	136	1,239		1,239	692			5,673
Verde	4		999,023	40,312		40,312	1,327,472		1,327,472	75,430,241			10,156,737
Wagoner (Hassayampa River)		1			7	7							245
Walker	24	4	2,316	741	38	779	14,542	6	14,548	82,904	6,915		46,087
Walnut Grove	9	4	97	93	55	148	81	6	87	365	808		5,315
Weaver	24	7	63,394	17,598	249	17,847	20,485	25	20,510	11,615	57,149		642,461
White Picacho	4		293	146		146	2,836		2,836	3,548	9,511		7,851
Yuma County:													
Castle Dome	6		221	124		124	2,195		2,195	702	42,170		7,885
Cienega	3		34	30		30	3		3	365			1,090
Dome (Gila City)		2			42	42		3	3				1,472
Ellsworth (Harqua Hala)[1]	28		1,116	466		466	1,345		1,345	19,481			19,249
Fortuna	2	2	2,227	528	4	532	62		62				18,662
Kofa	2	2	513	257	5	262	3,487		3,487	250			11,563
Laguna	1	1	27	11	45	56		6	6				1,964
La Paz and Middle Camp	3	10	3,861	216	166	382	137	19	156	1,654			13,648
La Posa (Copper Mountains)	2		73	14		14	78		78	1,692			719
Muggins		1			15	15							525
Plomosa and La Cholla	8	8	737	256	1,968	2,224	333	137	470	38,471			82,160
San Pablo		1			6	6							210
Santa Maria (Planet, Bill Williams)	1		72	9		9	50		50	1,462	3,724		676
Welton Hills	1		60	15		15	6		6				529
Yuma	1		367	80		80	9		9				2,806
Total Arizona	976	142	18,793,260	310,044	6,409	316,453	7,823,313	691	7,824,004	524,224,000	21,542,000	13,422,000	72,616,408

[1] Ellsworth district lies in both Maricopa and Yuma Counties.

COCHISE COUNTY

California district (Hilltop).—Nearly all the output of the California district in 1939 was first-class lead ore from the Hilltop, Blackwell, and Columbia mines; the Hilltop was the chief producer.

Cochise (Dragoon) district.—In 1939 a little copper ore from the Centurion mine at Dragoon was shipped to a smelter.

Dos Cabezas and Tevis district.—Production of gold from the Dos Cabezas and Tevis district declined in 1939 owing to suspension late in 1938 of operations at the Dives mine and to decrease in output of placer gold from Inspiration Placers. Most of the output was gold ore shipped to smelters from the Golden Eagle, Good Luck, and Busenbach properties and lead-gold ore from the Cowboy mine. The most important placer operation in the district was the dry-land four-bowl washing dredge of Gould & Cross at Inspiration Placers.

Hartford (Huachuca Mountains) district.—A little ore was marketed in 1939 from the Comet, Dewey, and Western claims, and placer gold was recovered chiefly from the Gold Nugget property.

Swisshelm district (Webb, Elfrida).—Nearly all the output of the Swisshelm district in 1939 was lead ore (concentrated) from the Scribner mine.

Tombstone district.—The Tombstone (Bunker Hill) property was in 1939, as usual, the most important producer in the Tombstone district, but its output of gold-silver-lead ore was 27 percent less than in 1938. Lessees operated the property throughout the year and shipped 6,530 tons of ore to the smelter at El Paso, Tex. Lessees also operated the Tombstone Extension mine and shipped about 850 tons of lead ore. The remainder of the district output was principally silver ore from the Bonanza (Mellgren) and San Pedro mines.

Turquoise district (Courtland, Pearce, Gleeson).—Lessees operated the Silver Bill-Mona-Dragoon group in 1939 and shipped about 1,500 tons of silver-lead ore to a smelter. The rest of the Turquoise district output was chiefly zinc ore from the McLendon property and silver ore from the Elsicor mine.

Warren district (Bisbee, Warren).—The value of the metal output of the Warren district was $15,146,435 in 1939, a gain of 18 percent over 1938. The chief producer was, as usual, the Copper Queen branch of the Phelps Dodge Corporation; more than 900,000 tons of copper ore were shipped to a smelter, or 7 percent more than in 1938. The property also yielded several hundred tons of lead ore and a little zinc-lead ore, continued as the largest producer of gold and silver in the State, and again ranked second in copper. The Shattuck Denn Mining Corporation worked its property continuously and shipped 117,547 tons of copper ore to the smelter at El Paso, Tex., an increase of 45,517 tons over 1938. The McKenna Lease operated the Czar property of the Phelps Dodge Corporation in 1939 and shipped 6,995 tons of copper ore.

COCONINO COUNTY

Jacob Canyon district.—The Mackin property owned by the Los Angeles Exploration & Metals Corporation was operated by lessees in 1939, and 462 tons of carbonate copper ore were shipped to a smelter in Utah.

Ryan (Warm Springs) district.—In 1939 a small lot of rich copper ore was marketed from the Black Beauty claim.

White Mesa district.—The Coconino Copper & Chemical Co. operated its property in 1939, shipped several lots of carbonate copper ore to a smelter, and manufactured and sold copper sulfate to various consumers.

GILA COUNTY

Banner and Dripping Springs district.—The large gain (about 1,700 ounces) in output of gold in the Banner and Dripping Springs district in 1939 resulted from increased shipments of gold ore from the Columbia and Gold Queen-Gold Nugget properties, and the increase (736,646 pounds) in copper was due to resumption of operations at the Christmas copper property. Lessees reopened the Christmas mine in January and during the year shipped 24,790 tons of copper ore to the smelter at Hayden. The rest of the district output was principally gold ore from the Arizona-Apex, Standard, Gold Slope, and Gold Stone properties; the output of lead was small in 1939, as the "79" mine was idle.

Globe-Miami district.—In 1939 the Globe-Miami district was the chief copper-producing area in Arizona owing to increased output of copper ore from the Miami and Inspiration properties. The Miami Copper Co. treated 4,870,684 tons of copper ore—a gain of 46 percent over 1938—by leaching and concentration and recovered 72,894,493 net pounds of copper. The Inspiration Consolidated Copper Co. treated 2,262,100 tons of copper ore—a gain of 52 percent—chiefly by straight leaching and recovered 51,576,333 net pounds of copper. According to the printed annual report of the Miami Copper Co. for the year ended December 31, 1939, 431,652 pounds of molybdenite were recovered from the copper sulfide concentrates. Mine development comprised 31,139 feet of drifting, 22,770 feet of raising, and 473 feet of shaft sinking; in addition, 34,941 feet of drifts and raises were driven. Ore reserves as of January 1, 1940, were estimated to be 2,306,877 tons of mixed ore containing an average of 1.614 percent copper and 67,520,231 tons of sulfide ore containing an average of 0.887 percent copper. Lessees operated the Old Dominion mine in 1939 and shipped 8,934 tons of gold-silver ore. The rest of the district output was principally gold ore from the Gibbons, Golden Eagle, Camp Bird, and Ralston mines; silver ore from the Silver Plume, Rescue, and New Dominion mines; copper ore from the Porphyry Reserve, September Morn, and Schulze mines; and lead ore from the Albert Lee and Ireland mines.

Green Valley district (Payson).—The output of the Green Valley district in 1939 was chiefly gold ore from the Gowan (Verde Falls), Rodeo, Squatter, Blue Goose, Tornado, and Packard properties.

Pioneer (Pinal Mountains) district.—Copper ore was produced from the Marland (Stigall) and Bolder mines in 1939, silver ore chiefly from the Pioneer mine, and gold ore from the Little Four mine.

Roosevelt district.—In 1939, as in 1938, all the output of the Roosevelt district was gold ore from the Christmas Gift & Good Luck property.

Rye Creek district.—A little silver-copper ore from the Silver Crown mine was sold in 1939.

Summit district.—The entire output of the Summit district in 1939 was copper ore from the Arizona-Globe, Chatryn, Gibson, and Ritchard properties.

GRAHAM COUNTY

Virtually all the output of Graham County in 1939 was lead ore from mines near Klondyke in the Aravaipa district. Of the total ore, 94 percent was lead ore (concentrated) from the Grand Reef property; the remainder was chiefly lead ore shipped to a smelter from the Head Center mine.

GREENLEE COUNTY

Ash Peak district (*Duncan*).—Production of gold and silver in the Ash Peak district in 1939 was much less than in 1938 owing to the decline in output of silver ore from the Ash Peak property of Veta Mines, Inc.; about 50,400 tons of silver ore were concentrated in 1939 compared with a total output of 70,269 tons in 1938. The property was closed November 15 and the lease surrendered.

Copper Mountain district (*Morenci*).—The chief output of the Copper Mountain district in 1939 was copper concentrates and copper precipitates from the Morenci branch of the Phelps Dodge Corporation; the production of copper increased 42 percent in 1939 owing chiefly to treatment of 438,169 tons of copper ore in the test mill (no ore was treated by concentration in 1938). However, most of the copper produced in 1939 was recovered from leaching old caved stopes in place. The principal work at the Morenci branch was stripping overburden material in developing a large open pit. The stripping proceeds at the rate of 25,000 tons a day, and the minimum required to uncover the ore body and develop the pit will be 43,000,000 tons. The estimated ore reserve is 230,000,000 tons, averaging 1.06 percent copper. The company plans to construct in 1940 a new 25,000-ton concentration plant and smelter at the mouth of Morenci Canyon 2 miles from the open pit. The rest of the district output was chiefly gold ore shipped to a smelter from the Keating and Gold Belt properties.

Granville district.—Gold-lead ore from the Lady Mary and Rozell mines was sold in 1939.

Mayflower district.—A little copper ore from the Providencia claim was shipped in 1939 to the smelter at Miami.

Metcalf (*Greenlee*) *district.*—The output of the Metcalf district in 1939 comprised 80 tons of gold ore from the Gray Mare mine and 148 tons of zinc-lead ore from the Lime Cap group.

San Francisco district.—A little placer gold was recovered in 1939 by sluicing at various claims along the San Francisco River near Clifton.

MARICOPA COUNTY

Big Horn district.—The chief output of the Big Horn district in 1939 was old tailings (gold) cyanided from the Tiger property, gold ore from the Alice (Pump) mine, and placer gold principally from the Sweeney and Tiger claims.

Cave Creek and Camp Creek district.—Lessees operated the Blue Bird mine on Camp Creek in 1939 and shipped 3,412 tons of gold ore to the smelter at Miami. About 1,200 tons of copper-silver ore from the Red Rover mine, also on Camp Creek, were concentrated, and 353 tons of similar ore were shipped to a smelter. The rest of the district output was largely gold ore from the Maricopa, Portmanteau, and King-Virginia property on Cave Creek.

Ellsworth (Harqua Hala) district.—A little copper ore was produced in 1939 from the Copper Belt, Copper Prince, and Crystal claims and gold ore from the Golden and Golden Relief properties.

New River district.—All the output from the New River district in 1939 was copper ore, chiefly from the Orizaba mine on Moors Gulch; the Allied Mining & Smelting Corporation operated the mine and constructed a small copper smelter, which ran a short time.

Osborn district.—The output from the Osborn district in 1939 comprised 5,970 tons of old tailings (gold) and 641 tons of gold ore from the Belmont-McNeil property and 50 tons of copper ore from the Morning Star mine.

Salt River Mountains district.—The Delta mine continued to be the chief producer in the Salt River Mountains district, and about 1,800 tons of gold ore were shipped from the mine in 1939. Other producers of gold ore were the North Delta and Josephine properties.

San Domingo district.—In 1939, as in 1938, the entire output of the San Domingo district was placer gold and silver recovered by several small-scale operators along San Domingo Wash.

Sunflower district.—The Golden Rule Mining Co. operated the Little Daisy mine in 1939 and treated about 700 tons of gold ore by amalgamation and concentration.

Vulture district.—The Vulture mine was in 1939, as usual, the most important producer in the Vulture district. In January about 700 tons of gold ore from the property were treated by amalgamation and concentration; it was nonproductive from February to October 16, when construction of a new 150-ton cyanide plant was completed; and during the remainder of the year 5,068 tons of gold ore and 3,020 tons of old tailings were treated in the new plant. The rest of the district output was mostly old tailings (treated by cyanidation) from the Last Chance property and gold ore from the Sunrise mine.

Webb (Gila Bend Mountains) district.—A little gold ore was produced in 1939 at two prospects near Arlington.

Winifred district.—About 2,000 tons of old tailings (gold) from the Hartman (Jack White) mill dump were treated by cyanidation in 1939, and gold ore from the Oro Fino, Union, and Red Dog properties was shipped to a smelter.

MOHAVE COUNTY

Cedar Valley district.—The chief output from the Cedar Valley district in 1939 was tungsten ore from the Boriana mine and gold ore from the San Francisco mine, all treated by concentration. A few tons of copper concentrates were recovered at the Boriana mill and shipped to the smelter at Superior.

Chemehuevis district.—Small lots of gold ore were produced in 1939 from various claims in the Chemehuevis district; placer gold was recovered chiefly from the "49," Chief, and Prentice Gulch properties.

Cottonwood district.—The only production in the Cottonwood district in 1939 was a little gold ore from the North Star claim.

Gold Basin district.—Approximately 2,930 tons of gold ore from the O. K.-Excelsior group were treated by concentration in 1939; the property and 25-ton flotation plant were operated by the Malco Gold Mining Co. Other fairly important gold producers were the Gold Hill, M. O., Narrow Gauge (Fry), Bear Cat, and Golden Link properties.

Greenwood district.—Small lots of gold ore were produced in 1939 from the Burro, Lucky Strike, and Waldey claims.

Indian Secret (White Hills) district.—All the ore (1,188 tons) produced in the Indian Secret district in 1939 was treated in the custom cyanide mill of Producers Mines, Inc. The output comprised 703 tons of gold-silver ore from the Accident, G. A. R., Silver Hills, and White Hills properties and 485 tons of silver ore from the Hulda mine.

Maynard and McConnico district.—Lessees continued to operate the Bimetal (McGuire) mine and in 1939 shipped 791 tons of gold ore to various custom mills. The remainder of the district output was principally gold-silver ore from the Democrat mine.

Minnesota district.—In 1939, as in 1938, the chief output of the Minnesota district was gold ore from the Pope mine 40 miles north of Chloride; 3,219 tons of ore were treated in the custom cyanide mill of Producers Mines, Inc. Other producers included the Blue Rock, Horn Silver, Van Diemon, and Yellow Aster properties.

Music Mountain district.—Production of gold in the Music Mountain district was greater in 1939 than in 1938 owing to increased output of gold ore from the Roosevelt and North Star mines. Gold ore was produced also from the Newell, Neilson, and Butler properties and from various small prospects.

Owens (McCracken and Potts Mountain) district.—Most of the output in the Owens district in 1939 was gold-copper ore from the New England, North Star, and Cleopatra mines; gold ore from the Gold Leaf mine; and lead ore from the Lead Pill claim.

San Francisco (Oatman, Goldroad, Katherine, Vivian) district.—Production of gold in the San Francisco district in 1939 was 44,757 fine ounces, or 6 percent less than in 1938. The largest decrease was in output of gold ore from the Tom Reed mine at Oatman. The Goldroad mine of the United States Smelting, Refining & Mining Co. again was the largest producer of gold in Mohave County; the company operated its 300-ton cyanide plant continuously and treated 121,574 tons of gold ore and 20,044 tons of old tailings.

The output of gold ore and old tailings from 36 properties at Oatman and Goldroad was 224,499 tons in 1939, which yielded 37,403 ounces of gold and 26,525 ounces of silver, compared with 203,706 tons in 1938, which yielded 42,457 ounces of gold and 32,438 ounces of silver. The Tom Reed Gold Mines Co. operated its 300-ton cyanide plant at Oatman on company and custom ores until November 8, when the mill was closed. The output of gold ore from the Tom Reed mine declined from 25,171 tons in 1938 to 3,900 tons in 1939, but 29,563 tons of old tailings were treated. The Tom Reed Gold Mines Co. and Johnston & Witcher Mines continued leasing operations at the Big Jim mine, and a total of 17,946 tons of gold ore was treated in the Tom Reed mill. Lessees also continued to operate the Pioneer group and trucked 4,768 tons of gold ore to various custom mills. About 19,350 tons of gold ore from the United Western mine were treated by concentration and cyanidation; the mine was operated throughout the year by the Vivian Mining Co. Various lessees worked in the Vivian-Lelande group in 1939, and 1,630 tons of gold ore were treated in the Vivian custom mill. Other large producers of gold ore at Oatman were the Gold Dust, Telluride, Carter, and Crown City properties.

The output of gold ore from 12 properties in the Katherine section of the San Francisco district was 59,871 tons in 1939, which yielded 7,354 ounces of gold and 15,961 ounces of silver, compared with 36,715 tons in 1938, which yielded 4,975 ounces of gold and 45,888 ounces of silver. The gain in output of ore and gold was due chiefly to the large increase in output of gold ore from the Tyro mine, and the decline in silver resulted from the decrease in output of gold-silver ore from the Arabian mine. The Gold Standard Mines Corporation operated the Tyro and Katherine mines continuously and treated 48,959 tons of ore from the Tyro and 9,555 tons from the Katherine in the 300-ton cyanidation plant at Katherine. Other important producers of gold ore were the Frisco, Philadelphia, Burt, Minnie, and Escondido properties.

Wallapai district (Cerbat, Chloride, Mineral Park, Stockton Hill).—The output of ore and each of the five metals in the Wallapai district decreased from 1938, owing chiefly to the closing of the Tennessee mine at Chloride in January 1939; however, the mine was reopened in October and 11,588 tons of zinc-lead ore were treated by concentration during the year, compared with 54,092 tons in 1938. Production of gold-silver ore was maintained at the Diana group by the Arizona Magma Mining Co.; about 21,000 tons of ore were treated by concentration. The Alpha-Keystone Mines, Inc., operated the Keystone and Summit groups most of the year and treated 8,190 tons of silver ore from the Keystone and 2,679 tons of gold-silver ore from the Summit. Various lessees worked in the White Eagle mine and shipped a total of 3,539 tons of rich gold-silver ore to the smelter at El Paso, Tex. From the Oro Plata group about 2,800 tons of gold ore were concentrated, 1,055 tons of similar ore were cyanided, and 400 tons of zinc ore were concentrated. The Grand View Mining Co. operated the Rainbow property the first 5 months of the year and treated 3,600 tons of gold ore by concentration. Old tailings (5,058 tons), containing chiefly gold and lead, from the Elkhart dump were treated by concentration. Other fairly important producers in the district in 1939 were the Golden Eagle-Bobtail, Golden Gem, O'Brien-Blunket, Juno, Ark-San Antonio, Golconda, Congress & Home, Mohawk, Rico, Minnesota-Connor, Nighthawk, and Tintic mines.

Weaver (Mocking Bird, Pilgrim, Portland) district.—Production of both gold and silver from the Weaver district in 1939 was less than in 1938, owing chiefly to the large decline in output of gold ore from the Portland mine; 8,636 tons were treated by cyanidation in 1939 compared with 25,419 tons in 1938. The mine was operated by the Gold Standard Mines Corporation until August 15, when it was closed. There was substantial increase in output of gold ore from the Pilgrim and Klondyke mines, both operated by Producers Mines, Inc.; 25,221 tons of gold ore and 4,634 tons of old tailings from the Pilgrim property and 20,822 tons of gold ore from the Klondyke mine were treated by cyanidation. Other large producers of gold ore were the Dixie Gold, Dixie Queen, Pershing, and Scout properties. Most of the ore in the district was treated in the 300-ton cyanide plant of Producers Mines, Inc., near Chloride.

PIMA COUNTY

Ajo district.—Production of gold, silver, and copper from the Ajo district in 1939 was considerably greater than in 1938 owing to the large increase in output of copper ore from the New Cornelia mine. The mine and 20,000-ton concentrator were operated continuously by the Phelps Dodge Corporation; about 6,107,200 tons of copper ore were treated, a gain of 23 percent over 1938.

Arivaca district.—The chief output of the Arivaca district in 1939 was gold ore from the Cotton Tail mine and gold-silver ore and silver-lead ore from the Tunquepata mine. Numerous small lots of gold ore and silver ore from prospects in the district were sold to an ore buyer in Nogales.

Baboquivari district.—Lessees operated the Allison mine in 1939 and treated about 150 tons of gold ore by amalgamation and shipped 136 tons of gold-silver ore to a smelter. The rest of the district output was chiefly silver-copper ore and lead-copper ore from the Papago Chief claim.

Cababi (*Comobabi*) *district.*—Nearly all the output of the Cababi district in 1939 was gold ore from the Jaeger group and silver-copper ore from the Picacho mine.

Cimarron Mountains district.—A little gold ore was produced in 1939 from the Monte Cristo claim.

Empire district.—Small lots of silver-lead ore were sold in 1939 from the Total Wreck and State of Maine properties.

Greaterville district.—The output of the Greaterville district in 1939 was principally lead ore from the Arizona Comstock group and placer gold recovered by various small-scale operators.

Helvetia (*Rosemont*) *district.*—Copper ore was produced in 1939 from the Narragansett Bay, Old Dick, Half Moon, and Silver Dollar properties and silver ore from the Blue Jay mine.

Meyer district.—Small lots of gold ore were marketed in 1939 from the Hadsell & O'Brien and Sunset properties.

Old Hat district (*Oracle*).—All the output from the Old Hat district in Pima County in 1939 was copper ore, chiefly from the Leatherwood (Geesaman) mine operated by Control Mines, Inc.

Pima (*Sierritas, Papago, Twin Buttes*) *district.*—Gold-copper ore was produced in 1939 from the Cat's Paw mine, gold-silver ore from the High Hill group, and silver-lead ore from the Paymaster, Schell, and Vivienne properties.

Quijotoa district.—The output of the Quijotoa district in 1939 was chiefly placer gold from the Mariposa, Right Spot, New Deal. and Sunshine claims.

Roskruge and Waterman district.—Virtually all the output from the Roskruge and Waterman district in 1939 was silver ore from the St. Jude mine.

Santa Rosa district.—Gold ore was produced in 1939 from the Ludlam claim, silver ore from the Grubstake mine, and silver-copper ore from the Little Horn claim.

PINAL COUNTY

Astraya district.—Lessees operated the Astraya mine a short time in 1939 and shipped copper ore to a smelter.

Bunker Hill district (Copper Creek).—The output of gold, silver, and copper in the Bunker Hill district was much less in 1939 than in 1938 owing to suspension of operations at the Childs mine late in 1938 by the Arizona Molybdenum Corporation. Lessees operated the mine in 1939, treated 3,900 tons of copper ore by concentration, and shipped 77 tons of similar ore to a smelter; the output in 1938 was 44,203 tons of ore and 35,130 tons of old tailings.

Casa Grande district.—Most of the output from the Casa Grande district in 1939 was gold ore shipped to smelters from the Greenback, Turning Point, Hillside, and Mammon properties and silver ore from the Orizaba and Reward mines.

Cottonwood and Black Mountain district.—Nearly all the output from the Cottonwood and Black Mountain district in 1939 was first-class gold ore from the Betty Jane, Hot Boy, and Bulldog mines.

Goldfields district.—The entire output of the Goldfields district in 1939 was old tailings (cyanided) from the Bulldog property.

Hackberry district.—A little copper ore and gold ore were produced in 1939 from the Last Chance claim.

Martinez Canyon district.—Lessees operated the Silver Bell mine in 1939 and shipped 2 cars of silver-lead ore to a smelter.

Mineral Creek district (Ray).—The value of the metal output of the Mineral Creek district was $4,584,768 in 1939, a gain of 53 percent over 1938; the chief output was copper ore from the Ray mine. The Nevada Consolidated Copper Corporation operated the mine and 12,000-ton concentrator throughout the year and treated 1,425,228 tons of copper ore yielding 77,174 tons of copper concentrates; it also shipped 5,555 tons of copper precipitates to a smelter; and the output of copper increased 43 percent over 1938. Lessees operated the Broken Hill mine in 1939 and shipped 2,364 tons of gold ore to a smelter. The remainder of the district output was mostly lead ore from the Ray Silver-Lead property.

Mineral Hill district.—Gold ore was produced in 1939 from the Sunset, Little May, Troxel, and Hornet mines.

Old Hat district (Oracle, Mammoth).—Mammoth-St. Anthony, Ltd., continued in 1939 to be a large producer of gold-molybdenum-lead ore; its output was 38 percent greater than in 1938, and it was the largest producer of gold and lead in Pinal County. During the year the company treated 191,892 tons of ore, including 13,697 tons from the adjoining New Year-Mohawk group, which was purchased by Mammoth-St. Anthony, Ltd., in May. Lead concentrates (4,471 tons) containing considerable gold were smelted in the company 20-ton lead furnace; lead bullion, gold bullion, molybdenum, and vanadium were shipped to eastern markets. The rest of the district output was principally gold ore shipped from the Old Gold Camp and Golden Slipper properties.

Picacho district.—Low-grade gold ore was shipped in 1939 from the Better Pay property and a prospect near Wymola.

Pioneer district (Superior).—The value of the metal output of the Pioneer district was $4,887,607 in 1939, a gain of 12 percent over 1938. The Magma Copper Co. was, as usual, the most important producer in Pinal County; the company treated 236,991 tons of copper ore and 67,074 tons of zinc-copper ore in the concentrator and in addition produced 60,829 tons of copper ore sent direct to the smelter. According to the company printed annual report the metal output of the Magma mine, after deduction of all losses including refining, was 11,610 ounces of gold, 599,588 ounces of silver, 34,065,869 pounds of copper, and 4,261,616 pounds of zinc. The average net cost of producing copper after deduction of gold, silver, and zinc values was 7.5 cents a pound. Mine development in 1939 comprised 10,017 feet of drifting, 4,349 feet of raising, 2,826 feet of crosscutting, and 816 feet of sinking. The 850-ton copper concentrator and 450-ton copper smelter were operated continuously, except for the usual summer shut-down (July 1 to August 16). Lessees continued to work the Superior & Arizona group of the Magma Copper Co. and shipped 6,112 tons of gold ore to the Magma smelter. Wm. J. Forbach continued operations at the Reymert mine and shipped 19,766 tons of silver ore to smelters. The rest of the district output was principally gold-silver ore from the Belmont mine and silver ore from the Magma Chief and Magma Apex mines.

Ripsey district.—The output of the Ripsey district in 1939 comprised 2,000 tons of gold-silver ore from the Norman group (Old Ripsey) and 394 tons of silver ore from waste dumps of the Florence Lead & Silver property.

Riverside district.—A little gold ore was sold in 1939 from the Arizona Gold and Lucky Strike claims and copper ore from the Buckeye claim.

Sacaton Mountains and Blackwater district.—Gold ore was produced in 1939 from the Lucky Strike claim and lead-silver ore from the Santa Rosa claim.

Saddle Mountain district.—Most of the output from the Saddle Mountain district in 1939 was gold ore from the Hoosier and Columbia mines and gold-silver ore from the Adjust property.

SANTA CRUZ COUNTY

Harshaw district.—The value of the metal output of the Harshaw district was $492,490 in 1939 compared with $49,977 in 1938. This large gain resulted chiefly from the increase in output of zinc-lead-silver ore from the Trench mine. The American Smelting & Refining Co. completed construction of a new 200-ton flotation plant at the mine in May 1939 and treated a total of 33,660 tons of zinc-lead-silver ore during the last 7 months of the year; the property ranked second in production of lead in Arizona in 1939 and third in zinc. Lessees operated the American mine and shipped 1,880 tons of silver ore to a smelter. The rest of the district output was mostly zinc-lead ore and silver-lead ore from the Flux mine and silver ore from the World's Fair, Salvador, and Black Eagle mines.

Nogales (Gold Hill) district.—The chief output of the Nogales district in 1939 was gold ore and gold-lead ore from the Uncle Sam mine and gold ore from the Clyne claim.

Oro Blanco district (Ruby).—Production of zinc-lead-silver-gold-copper ore from the Montana mine at Ruby was maintained throughout 1939, but the yield of gold, silver, copper, lead, and zinc was less than in 1938; about 136,600 dry tons of ore were concentrated, or 3 percent more than in 1938. The mine again was the largest producer of lead and zinc in the State. The rest of the district output was chiefly gold ore from the Old Glory & Sargent, Margarita, Austerlitz, Grubstake, Oro Fino, and Golden Pen mines; silver ore from the Brick mine; and gold-silver ore from the Pitchburg mine.

Palmetto district.—Nearly all the output from the Palmetto district in 1939 was copper ore from the Three R property shipped to a smelter.

Patagonia (Washington, Duquesne) district.—One car of lead ore was shipped by a lessee from the Mowry mine in 1939, and small lots of ore from prospects were sold to an ore buyer in Nogales.

Redrock district.—The chief output of the Redrock district in 1939 was silver-copper ore from the Copper and Silver Ridge-Silver Queen groups.

Wrightson district.—Nearly all the output from the Wrightson district in 1939 was silver-lead ore from the Blabon property.

YAVAPAI COUNTY

Ash Creek district.—The Gold Coin mine was operated a short time in 1939, and 1 car of gold ore was shipped to a smelter. A small lot of gold ore was marketed from the Golden Crown claim.

Big Bug district.—The output of each of the five metals in the Big Bug district increased decidedly in 1939, owing chiefly to the gain in output of gold-silver-lead ore from the Iron King mine at Humboldt. The Iron King Mining Co. operated the mine continuously, treated 69,620 tons of gold-silver-lead ore by concentration, and shipped 603 tons of gold-silver ore to a smelter; in addition to gold-silver-lead concentrates, the mill produced a few cars of zinc concentrates. Gold-copper ore and gold-lead ore were produced from the Hackberry mine. The chief producers of gold ore were the Union-Jessie, Boggs, Belcher, and Four Boys properties. The output of placer gold in the district dropped to 448 ounces in 1939, owing to suspension late in 1938 of dry-land dredge operations at the Lawson group by the Hassayampa River Mining Co.; most of the placer gold was recovered by dry-land dredging at the Savoy & Shanks property and by sluicing operations at the Hill, Johnson, and Caywood properties.

Black Canyon district.—The value of the metal output of the Black Canyon district increased to $306,145 in 1939, owing chiefly to resumption of operations at the Golden Belt mine near Cleator. The mine and 50-ton flotation plant were taken over in June 1939 by the Golden Turkey Mining Co., and during the rest of the year about 5,500 tons of gold ore were treated by concentration. The Golden Turkey mine, adjoining the Golden Belt, continued to be the most important producer in the district; it was operated throughout the year, and about 21,500 tons of gold-silver-lead ore were treated in the Golden Turkey flotation mill. The rest of the district output was chiefly gold ore concentrated from the Richinbar property.

Black Rock district.—Nearly all the output from the Black Rock district in 1939 was crude gold ore shipped to a smelter from the Unida and Turtle mines.

Blue Tank district.—Lessees operated the Orogrande mine a short time in 1939 and treated 100 tons of gold ore by amalgamation. A little gold ore was produced from the Quartz mine.

Bullard (Pierce) district.—There was a substantial increase in output of gold and copper in the Bullard district in 1939, resulting chiefly from the shipments of gold-copper ore from the Bullard mine near Aguila. The Bullard Gold Mines, Inc., was organized late in 1938 to operate the mine, and during 1939 the company shipped 2,758 tons of gold-copper ore to various smelters. The rest of the district output was mostly old tailings (gold) from the Gold Leaf (Rush) property treated by cyanidation.

Castle Creek district.—The output of the Castle Creek district in 1939 comprised gold ore from the Jack Pot, Bennet, and Swallow properties; small lots of copper ore from various claims; and placer gold from a claim on Buckhorn Creek.

Cherry Creek district.—Virtually all the output in the Cherry Creek district in 1939 was crude gold ore shipped to smelters; the chief producers were the Sitting Bull, Gold Pick, Gold Eagle, Gold Bullion, Dove, Etta, Little Dora, and Sugar Bowl properties.

Copper Basin district.—Small lots of rich gold ore were marketed in 1939 from the McNary and Flower Gold claims, and a little gold-copper ore was produced from the Plymouth mine. Most of the placer gold recovered came from the Smith & Roby, Queen of Sheba, and Stupe properties.

Eureka district.—There was a sharp decline in output of gold, silver, and lead in the Eureka district in 1939, owing chiefly to the drop in output of ore from the Hillside mine, the most important producer in the district; the decline in output of copper resulted from decreased production of copper ore from the Bagdad mine. There was, however, a substantial increase in production of zinc, as the mill at the Hillside mine produced more zinc concentrate than in 1938. Hillside Mines, Inc., operated its mine and concentrator until October 13, when both were closed temporarily; it concentrated 21,744 tons of gold-silver-zinc-lead ore compared with 38,850 tons in 1938. The Bagdad Copper Corporation resumed operations November 1 and during the last 2 months of the year treated 14,196 tons of copper ore in its 275-ton flotation plant. The rest of the district output was principally crude gold ore shipped to smelters from the Belle, Mammoth, Crosby, and Dunlap mines. Comstock-Dexter Mines, Inc., and the Santa Maria Mining Corporation, both fairly large producers of gold ore in 1938, were idle in 1939.

Hassayampa (Groom Creek, Hassayampa River, Senator, Prescott) district.—Production of gold from the Hassayampa district totaled 1,772 ounces in 1939, or 34 percent more than in 1938; however, there was no individual large producer. Most of the output was gold ore from the Oro Flame, Alma, Home Run, Forest & Forlorn Hope, Nevada, Infanta, Sacramento, Empire, Big Chief, Great Divide, Railroad, Jim Crow, and Evergreen properties; gold-silver ore from the White Spar and Davis-Dunkirk mines; and gold-copper ore from the Porphyry mine. Numerous small lots of ore and placer gold from various prospects in the district were sold to buyers of ore and placer gold in Prescott.

Humbug district.—The chief output from the Humbug district in 1939 was gold ore from the Little Joseph and Humbug Gold Mines properties and placer gold recovered by various small-scale operators working on Cow, French, and Humbug Creeks.

Lynx Creek district.—The output of the Lynx Creek district in 1939 was, as usual, placer gold and silver recovered chiefly from property operated by the Lynx Creek Placer Mine Co. The company worked its two draglines and its floating washing plant continuously from February 15 to December 31 and treated 542,815 cubic yards of gravel; it remained the largest producer of placer gold in Arizona, and its output was 20 percent greater than in 1938. The Rock Castle Placer Mines was organized in September 1939 to work bench gravel above the ground being dredged by the Lynx Creek Placer Mine Co.; during the last quarter of the year about 12,000 cubic yards of gravel were handled by a dry-land dredge equipped with four bowl-amalgamators. Other placer producers included the Federal, Flynn, and Granite Fraction claims.

Martinez (Congress) district.—Production of gold in the Martinez district increased to 5,415 ounces in 1939, owing chiefly to the increase in treatment of old tailings and waste-dump ore from the Congress property; 99,645 tons of old tailings and 3,337 tons of waste-dump ore were treated by cyanidation by The Congress Mining Corporation. The rest of the district output was principally crude gold ore of smelting grade from the Golden Key and Blue Bird mines.

Mineral Point district.—Gold ore was produced in 1939 from the Buster, Golden Daisy, and Golden Chance properties.

Oak Creek district.—A little placer gold was marketed in 1939 from the Gotcher and Trimplex claims.

Peck district.—The output of the Peck district was small in 1939, as the Swastika mine, a producer of rich silver ore in 1937 and 1938, was idle.

Pine Grove district (Crown King).—Production of gold ore from the Gladiator-War Eagle group was maintained throughout 1939, and the property again was by far the most important producer in the Pine Grove district; about 4,200 tons of gold ore containing some silver and copper were shipped to a smelter. The Golden Crown Mining Co. operated its 75-ton flotation plant a few months and treated 1,680 tons of gold-silver-copper ore. The rest of the district output was mostly gold-silver ore from the Union & Eagle group and gold ore and gold-lead ore from the Del Pasco mine.

Silver Mountain district (Wagoner).—The output of the Silver Mountain district in 1939 comprised silver-lead ore and silver ore from the Little Joker mine, gold ore from the Silver Dollar mine, and placer gold from the C. B. C. and Silver Mountain claims.

Thumb Butte district.—Nearly all the output from the Thumb Butte district in 1939 was crude gold ore shipped to a smelter from the Last Chance Extension mine.

Tiger district.—Gold ore was produced in 1939 from the Fortuna, Oro Belle, Southern Belle, Violet & Snowdrift, and Wink properties.

Tip Top district.—Lessees operated the "76" mine in 1939 and shipped 19 tons of rich silver ore to a smelter; other producers of rich silver ore were the La Fortuna and Humming Bird properties. Placer gold was recovered chiefly from the Badger Springs and Rock Springs claims.

Turkey Creek district.—Most of the output from the Turkey Creek district in 1939 was old tailings (gold-silver) and gold ore of smelting grade from the Parker property near Cordes.

Verde district (Jerome).—The value of the metal output of the Verde district was $10,156,737 in 1939, a gain of 27 percent over 1938. The United Verde mine was, as usual, the chief producer in the district, and its output of copper ore was 26 percent greater than in 1938. The property ranked second in the State in production of gold and silver and third in copper. The open-pit and underground sections of the mine and the 1,600-ton concentrator were operated continuously by the Phelps Dodge Corporation; 694,716 tons of copper ore and 491 tons of copper precipitates were smelted, and 294,933 tons of copper ore were concentrated. A. B. Peach continued to operate the Iron King-Equator group and shipped 6,729 tons of gold-silver ore to the smelter at Clarkdale. The remainder of the district output comprised 1,126 tons of copper ore from the Daisy (United Verde Extension) mine dump and 1,519 tons of copper cleanings from the United Verde Extension smelter dump.

Walker district.—There was a substantial increase in output of gold, silver, and copper in the Walker district in 1939 owing to the larger output of gold-silver-copper ore from the Sheldon mine and to the gain in output of gold ore from several properties; about 2,000 tons of crude ore from the Sheldon mine were shipped to a smelter. The chief producers of gold ore were the Alturas Extension, Virgin Mary, Mohawk, Last Chance, Chance, and Alturas properties. Placer gold and silver were recovered by various small-scale operators working on Lynx Creek near Walker.

Walnut Grove district.—Nearly all the output of the Walnut Grove district in 1939 was gold ore from the Big Rebel, Portland, and Moyer mines and placer gold, chiefly from the Maggie Moyer property. The Gallup Gold Mining Co., a fairly large producer of gold ore in 1938, was idle.

Weaver district (Octave).—Production of gold in the Weaver district was 17,847 ounces in 1939, a gain of 3,369 ounces over 1938; more than 95 percent of the total was produced from two properties—the Octave and the Alvarado. The Octave mine, operated throughout the year by the American Smelting & Refining Co., continued to be the most important producer in the district; 29,334 tons of gold ore were treated by concentration and cyanidation. The Alvarado mine was operated continuously by Liberty Hill Gold Mines, Ltd., and 31,652 tons of gold ore were cyanided, or more than double the tonnage in 1938. The Yarnell mine was operated a short time in 1939, and 1,200 tons of gold ore were treated by concentration; the 50-ton flotation plant was removed during the year, and a new cyanidation plant was built in its place. Other producers of gold ore included the Hosford, Dora, Laurella, May Queen, Leviathan, Hayden, and Sunny Slope properties. Production of placer gold in the district was less than in 1938 owing to suspension late in 1938 of operations at the Thunder Bird claim; the chief producers were the Longerot, Johns, Lucero, McIntosh, and Merrill properties.

White Picacho district.—In 1939, 204 tons of crude gold ore were shipped from the Young mine; the rest of the district output was mostly silver-lead ore from the Independence claim.

YUMA COUNTY

Castle Dome district.—Nearly all the output from the Castle Dome district in 1939 was gold ore of smelting grade from the Big Eye and Southern Extension mines and silver-lead ore from the Haack property.

Cienega district.—A little gold ore was produced in 1939 from the Baker and Sue claims and copper ore from the Black Hill mine.

Ellsworth district (*Salome*).—The chief output of the Ellsworth district in 1939 was gold ore from the Hercules, Desert, Blue Eagle, Alaskan, Why Not, Fieldness, Red Bird, and Red Rose properties and gold-copper ore from the Critic and Centroid mines. Numerous small lots of gold ore from prospects were sold to an ore buyer in Wickenburg.

Fortuna district.—Production of gold in the Fortuna district was much greater in 1939 than in 1938, owing to operation of the Fortuna mine, which had been idle for several years. H. C. & C. F. Burton operated the mine throughout 1939 and treated 1,427 tons of gold ore by amalgamation and 450 tons of old tailings by cyanidation. A few hundred tons of old tailings (gold) from the Graham property were treated by cyanidation.

Kofa district.—Virtually all the output of the Kofa district in 1939 was gold ore from the Sheep Tanks mine shipped to various smelters.

Laguna district.—A little gold ore from the Las Flores mine was cyanided in 1939, and placer gold and silver were recovered by various small-scale operators working in the Laguna Dam and Las Flores areas.

La Paz and Middle Camp district.—The output of the La Paz and Middle Camp district in 1939 comprised 3,800 tons of old tailings (gold) from the Goodman property, which were cyanided; 44 tons of low-grade gold-copper ore from the Copper Bottom mine; 17 tons of rich gold ore from the Ah-Ve-Aha claim; and placer gold and silver recovered chiefly by drift mining at the Golden Anchor (Jones), Middle Camp & Oro Fino, Gold Buckle, Cave Creek, and Ferrar Gulch properties.

La Posa (*Copper Mountains*) *district.*—A little gold-copper ore was produced in 1939 from the Betty Lee and Frisco mines.

Muggins district.—The output of the Muggins district in 1939 was placer gold recovered by various small-scale operators.

Plomosa and La Cholla district.—Production of gold in the Plomosa and La Cholla district was much greater in 1939 than in 1938, owing to the large increase in output of placer gold from the La Cholla Placers (Arizona Drift). The property was operated continuously by drift mining by the La Posa Development Co.; 15,033 cubic yards of gravel were handled, and the company became a large producer of gold. Other producers of placer gold included the Can Do & Crown, N. R. A., Sore Thumb, and Virginia properties. Most of the lode output of the district was gold-copper ore from the Little Butte mine and gold ore from the Julius mine.

Santa Maria (*Planet, Bill Williams*) *district.*—The Townsend mine was the only producer in the Santa Maria district in 1939; 1 car of copper ore was shipped to a smelter, and about 45 tons of lead ore were concentrated.

Welton Hills district.—The Poorman mine was operated a short time in 1939, and 2 cars of gold ore were shipped to a smelter.

Yuma district.—In 1939, 367 tons of gold ore from the Jude-Silverfields group were cyanided in the Burton custom mill near Yuma.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN CALIFORNIA

(MINE REPORT)

By Charles White Merrill and H. M. Gaylord

SUMMARY OUTLINE

The total value of the gold, silver, copper, lead, and zinc recovered from ores, old tailings, and gravels in California in 1939—$52,918,012—was greater than in any year since 1856; it exceeded that in 1938 by more than 5 million dollars, or nearly 11 percent. Although most of the increase may be ascribed to the advance in gold production, the output of each of the other four metals was larger in both quantity and value than in 1938.

Gold increased 9 percent in both quantity and value, silver increased slightly in quantity and 5 percent in value, copper 419 percent in quantity and 450 percent in value, and lead 6 percent in quantity and 9 percent in value; 12,000 pounds of zinc were produced in 1939, but none was reported recovered in 1938. Of the total value of the five metals in 1939, gold represented 95 percent, silver 3 percent, copper almost 2 percent, and lead and zinc combined less than 0.1 percent.

Nevada County, despite a 2-percent decline in total value of production in 1939, continued to be the largest contributor to the metal-mining output of California; it supplied 22 percent of the State total value of the five metals, 22 percent of the total gold, and 37 percent of the lode gold. Sacramento County (largely from gold dredging) contributed 10 percent of the total value of the five metals; Amador County (about 70 percent from gold ore and 30 percent from placer gravels), 8 percent; Kern County (largely from gold and gold-silver ores), 7 percent; Calaveras County (about equally from gold ore and placer gravels), 7 percent; Yuba County (largely from gold dredging), 6 percent; Eldorado County (about 80 percent from gold ore and 20 percent from placer gravels), 5 percent; Plumas County (largely from gold and copper ores), 4 percent; Butte County (largely from placer gravels), 4 percent; and Merced County (all from placer gravels), 3 percent. Thus, the foregoing 10 of the 43 counties producing the metals in California in 1939 supplied over 75 percent of the State total value.

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, 1935–39

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1935	$35.00	$0.71875	$0.083	$0.040	$0.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052

[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] 1935–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–39: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464.
[5] $0.67878787.

Mine production of gold, silver, copper, lead, and zinc in California, 1935–39, and total, 1848–1939, 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
1935	1,112	1,487	3,337,773	890,430	$31,165,050	1,191,112	$856,112
1936	903	639	4,635,691	1,077,442	37,710,470	2,103,799	1,629,392
1937	913	838	4,925,014	1,174,578	41,110,230	2,888,265	2,234,073
1938	927	676	4,648,249	1,311,129	45,889,515	2,590,804	1,674,863
1939	1,028	749	5,577,853	1,435,264	50,234,240	2,599,139	1,764,264
1848–1939	--------	--------	(2)	97,398,295	2,111,043,977	98,518,224	80,125,973

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1935	1,954,000	$162,182	1,134,000	$45,360	322,000	$14,168	$32,242,872
1936	8,762,000	806,104	964,000	44,344	16,000	800	40,191,110
1937	10,502,000	1,270,742	2,372,000	139,948	40,000	2,600	44,757,593
1938	1,612,000	157,976	990,000	45,540	----------	----------	47,767,894
1939	8,360,000	869,440	1,052,000	49,444	12,000	624	52,918,012
1848–1939	[3] 582,189	189,818,032	[3] 120,616	14,192,825	[3] 51,964	9,379,510	2,404,560,317

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Figures not available. [3] Short tons.

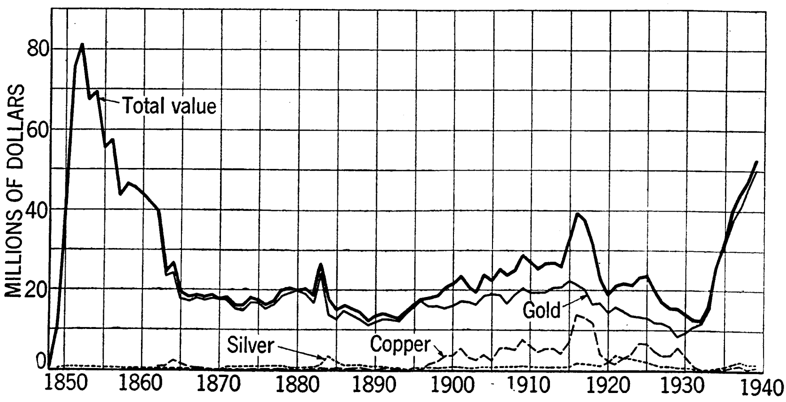

FIGURE 1.—Value of mine production of gold, silver, and copper and total value of gold, silver, copper, lead, and zinc in California, 1848–1939. The value of lead and zinc has exceeded $1,000,000 in only a few years.

Gold.—Since 1929, when the value of the California gold output reached a low of $8,526,703, the value of production has expanded almost sixfold; the gain in 1939 over 1938 was equivalent to more than half the total value of the output in 1929. In quantity the 1939 gold output was greater than in any year since 1862, and in value it was greater than in any year since 1856. During the last 3 years there have been the following gains over the immediately preceding years: 1939, 9 percent; 1938, 12 percent; and 1937, 9 percent. Thus, the yearly increase has averaged 10 percent over the period.

Although data for gold production in California before 1901 do not segregate placer and lode gold, it appears certain that the output of lode gold was larger in 1939 in both quantity and value than in any year in the history of the State. The quantity and value of placer gold produced are known to have been higher in 1939 than in any year since 1900. Moreover, the value of the output of placer gold in 1939 exceeded that of lode and placer gold combined in any year from 1865 to 1882 and from 1884 to 1900.

The 25 leading gold-producing mines in California in 1939, listed in the following table, yielded 54 percent of the total gold output of

Twenty-five leading gold-producing mines in California in 1939, in order of output

Rank	Mine	District	County	Rank in 1938	Operator	Source of gold
1	Idaho Maryland	Grass Valley-Nevada City.	Nevada	2	Idaho Maryland Mines Corporation.	Gold ore.
2	Empire Star mines	do	do	1	Empire Star Mines Co., Ltd.	Do.
3	Natomas Co.	Folsom	Sacramento	3	Natomas Co.	Dredge.
4	Yuba Unit	Yuba River	Yuba	4	Yuba Consolidated Gold Fields.	Do.
5	Central Eureka and Old Eureka.	Mother Lode	Amador	7	Central Eureka Mining Co.	Gold ore.
6	Lava Cap	Grass Valley-Nevada City.	Nevada	6	Lava Cap Gold Mining Corporation.	Do.
7	Capital dredges	Folsom	Sacramento	5	Capital Dredging Co.	Dredge.
8	Carson Hill	Mother Lode	Calaveras	8	Carson Hill Gold Mining Corporation.	Gold ore.
9	Golden Queen	Mojave	Kern	9	Golden Queen Mining Co.	Do.
10	Argonaut	Mother Lode	Amador	17	Argonaut Mining Co., Ltd.	Do.
11	Butte Unit	Oroville	Butte	22	Yuba Consolidated Gold Fields.	Dredge.
12	Alhambra-Shumway.	Mother Lode	Eldorado	(1)	Alhambra-Shumway Mines, Inc.	Gold ore.
13	Yellow Aster	Randsburg	Kern	15	Anglo American Mining Corporation, Ltd.	Do.
14	Snelling	Snelling	Merced	12	Snelling Gold Dredging Co.	Dredge.
15	Iron Mountain	Iron Mountain	Shasta	13	The Mountain Copper Co., Ltd.	Gold ore.
16	Merced Unit	Snelling	Merced	10	Yuba Consolidated Gold Fields.	Dredge.
17	Ohio Point	Rich Bar	Plumas	32	Virgilia Mining Corporation.	Gold ore.
18	Sheepranch	East Belt	Calaveras	16	St. Joseph Lead Co.	Do.
19	Sliger	Mother Lode	Eldorado	66	Middle Fork Gold Mining Co.	Do.
20	Alabama	Ophir	Placer	30	Alabama California Gold Mines Co.	Do.
21	Cactus Queen	Mojave	Kern	11	Cactus Mines Co.	Gold-silver ore.
22	Walker	Genesee	Plumas	100	Walker Mining Co.	Copper ore.
23	Starlight	Mojave	Kern	21	Lodestar Mining Co.	Gold ore.
24	Cargo Muchacho	Cargo Muchacho	Imperial	134	Holmes & Nicholson Mining & Milling Co.	Do.
25	San Joaquin dredge.	Snelling	Merced	23	San Joaquin Mining Co.	Dredge.

1 Production began Mar. 14, 1939.

the State in that year. Newcomers to the list in 1939 were six lode mines, which displaced four connected-bucket dredges and two lode mines; all of them had substantial output in 1938 except the Alhambra-Shumway, which began production March 14, 1939, after a long exploration campaign. Of the leading mines, 16 yielded gold from gold ore, 7 from dredging gravel, and 1 each from gold-silver ore and copper ore. The mines ranking first, second, and sixth are in the Grass Valley-Nevada City district of Nevada County.

Silver.—Most of the silver output of California in 1939 was more centralized than that of the gold; the 10 leading silver-producing mines, listed in the following table, yielded 83 percent of the State total recoverable silver in that year. Newcomers to the list in 1939 were the Walker mine in the Genesee district, Plumas County, and the Alabama mine in the Ophir district, Placer County, which displaced the Silverado-Kentuck in the Mount Patterson district, Mono County, and the Idaho Maryland mine in the Grass Valley-Nevada City district, Nevada County. The two newcomers were substantial producers in 1938; the Idaho Maryland ranked eleventh in 1939, but the Silverado-Kentuck, leading silver producer for several years before 1938, was idle in 1939. Of the 10 leading mines in 1939, 5 yielded silver from gold ore, 4 from gold-silver ore, and 1 from copper ore. Only 42,132 ounces of silver came from straight silver ores in 1939. In addition to the mines listed, some silver was reported recovered from almost every lode and placer mine operating in the State in 1939.

Ten leading silver-producing mines in California in 1939, in order of output

Rank	Mine	District	County	Rank in 1938	Operator	Source of silver
1	Cactus Queen	Mojave	Kern	1	Cactus Mines Co	Gold-silver ore.
2	Golden Queen	do	do	5	Golden Queen Mining Co.	Gold ore.
3	Grigsby (Palisade)	Calistoga	Napa	6	Graham Loftus Oil Corporation.	Gold-silver ore.
4	Lava Cap	Grass Valley-Nevada City.	Nevada	2	Lava Cap Gold Mining Corporation.	Gold ore.
5	Starlight	Mojave	Kern	3	Lodestar Mining Co	Do.
6	Walker	Genesee	Plumas	11	Walker Mining Co	Copper ore.
7	Kelly	Randsburg	San Bernardino.	4	F. Royer and lessees	Gold-silver ore.
8	Empire Star mines	Grass Valley-Nevada City.	Nevada	8	Empire Star Mines Co., Ltd.	Gold ore.
9	Standard	Bodie	Mono	9	Roseklip Mines Co	Gold-silver ore.
10	Alabama	Ophir	Placer	13	Alabama California Gold Mines Co.	Gold ore.

Copper.—The discontinuance of a production-curtailment program at the Walker mine in the Genesee district, Plumas County, was the outstanding feature of the California copper-mining industry in 1939; this mine produced over 96 percent of the copper output of the State.

Lead.—Almost two-thirds of the small production of lead in California in 1939 came from Riverside County; Inyo County was the second-largest producer.

Zinc.—Production of zinc in California in 1939 was valued at only $624.

Gold produced at placer mines in California, 1935–39, by classes of mines and by methods of recovery

Class and method	Mines producing [1]	Material treated (cubic yards)	Gold recovered		
			Fine ounces	Value	Average per cubic yard
Surface placers:					
Gravel mechanically handled:					
Connected-bucket dredges: [2]					
1935	20	75,014,000	236,403.70	$8,274,130	$0.110
1936	26	78,855,000	276,324.21	9,671,347	.123
1937	33	94,809,000	322,961.00	11,303,635	.119
1938	33	117,080,000	375,296.00	13,135,360	.112
1939	34	121,655,000	370,264.00	12,959,240	.107
Dragline dredges: [3]					
1935	24	3,906,000	22,191.47	776,701	.199
1936	30	10,016,000	49,967.54	1,748,864	.175
1937	51	19,364,000	94,142.00	3,294,970	.170
1938	77	24,560,000	118,108.00	4,133,780	.168
1939	142	31,618,000	172,519.00	6,038,165	.191
Nonfloating washing plants: [4]					
1935	54	1,466,000	11,892.57	416,240	.284
1936	50	1,433,000	12,059.39	422,079	.295
1937	58	2,338,000	17,079.00	597,765	.256
1938	74	3,538,000	23,046.00	806,610	.228
1939	114	5,512,000	41,694.00	1,459,290	.265
Gravel hydraulically handled:					
Hydraulic:					
1935	93	3,013,000	13,623.10	476,809	.158
1936	84	1,878,000	7,670.01	268,450	.142
1937	82	1,324,000	4,628.00	161,980	.122
1938	86	1,719,000	7,061.00	247,135	.144
1939	74	921,000	6,059.00	212,065	.230
Small-scale hand methods: [5]					
Wet:					
1935	1,132	2,895,500	44,147.24	1,545,153	.534
1936	326	2,523,600	39,132.00	1,369,620	.543
1937	463	2,209,000	25,612.00	896,420	.406
1938	292	2,863,500	41,686.00	1,459,010	.510
1939	267	2,534,100	38,815.00	1,358,525	.536
Dry:					
1935	21	6,500	128.40	4,494	.691
1936	10	4,400	337.90	11,827	2.688
1937	30	14,000	486.00	17,010	1.215
1938	15	6,500	172.00	6,020	.926
1939	25	11,900	169.00	5,915	.497
Underground placers:					
Drift:					
1935	143	141,000	17,139.52	599,883	4.254
1936	113	129,000	23,931.95	837,618	6.493
1937	121	98,000	7,398.00	258,930	2.642
1938	99	97,000	7,144.00	250,040	2.578
1939	94	83,000	6,525.00	228,375	2.752
Grand total placer:					
1935	1,487	86,442,000	345,526.00	12,093,410	.140
1936	639	94,839,000	409,423.00	14,329,805	.151
1937	838	120,156,000	472,306.00	16,530,710	.138
1938	676	149,864,000	572,513.00	20,037,955	.134
1939	[6] 749	162,335,000	636,045.00	22,261,575	.137

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] In 1935 there were 36 connected-bucket dredges in operation; in 1936, 40; in 1937, 46; in 1938, 48; and in 1939, 47.
[3] Includes all placer operations using dragline excavator for delivering gravel to floating washing plant. In 1939, as a result of the moving of dragline dredges, 142 mines were worked by 109 dredges; corresponding data for earlier years are incomplete.
[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." In 1939, as a result of the moving of nonfloating washing plants, 114 mines were worked by 101 plants; corresponding data for earlier years are incomplete.
[5] Includes all operations in which hand labor is principal factor in delivering gravel to sluices, long toms, dip boxes, pans, rockers, dry washers, etc.
[6] A mine using more than 1 method of recovery is counted but once in arriving at total for all methods.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in California in 1939, 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	4	—	49	$1,715	—	—	49	$1,715
Amador	22	34	84,434	2,955,190	34,624	$1,211,840	119,058	4,167,030
Butte	18	41	7,601	266,035	51,810	1,813,350	59,411	2,079,385
Calaveras	37	68	56,079	1,962,765	49,918	1,747,130	105,997	3,709,895
Colusa	1	—	1	35	—	—	1	35
Del Norte	—	4	—	—	126	4,410	126	4,410
Eldorado	62	31	58,874	2,060,590	13,129	459,515	72,003	2,520,105
Fresno	3	3	13	455	447	15,645	460	16,100
Humboldt	1	9	3	105	1,310	45,850	1,313	45,955
Imperial	16	3	19,380	678,300	277	9,695	19,657	687,995
Inyo	85	10	12,585	440,475	80	2,800	12,665	443,275
Kern	141	9	89,672	3,138,520	357	12,495	90,029	3,151,015
Lassen	7	—	95	3,325	—	—	95	3,325
Los Angeles	11	8	4,423	154,805	161	5,635	4,584	160,440
Madera	14	19	477	16,695	384	13,440	861	30,135
Mariposa	85	21	31,364	1,097,740	5,669	198,415	37,033	1,296,155
Merced	—	6	—	—	50,895	1,781,325	50,895	1,781,325
Modoc	1	—	7	245	—	—	7	245
Mono	24	2	6,335	221,725	2	70	6,337	221,795
Monterey, Orange, and Ventura [2]	3	2	122	4,270	5	175	127	4,445
Napa	1	—	3,306	115,710	—	—	3,306	115,710
Nevada	42	35	293,326	10,266,410	25,407	889,245	318,733	11,155,655
Placer	28	75	22,230	778,050	21,597	755,895	43,827	1,533,945
Plumas	25	44	33,016	1,155,560	3,165	110,775	36,181	1,266,335
Riverside	44	5	2,653	92,855	44	1,540	2,697	94,395
Sacramento	2	15	41	1,435	154,100	5,393,500	154,141	5,394,935
San Bernardino	135	18	10,077	352,695	575	20,125	10,652	372,820
San Diego	8	—	418	14,630	—	—	418	14,630
San Francisco	—	[3]	—	—	224	7,840	224	7,840
San Joaquin	—	4	—	—	1,891	66,185	1,891	66,185
San Luis Obispo	—	2	—	—	14	490	14	490
Santa Cruz	—	1	—	—	2	70	2	70
Shasta	26	42	22,025	770,875	22,741	795,935	44,766	1,566,810
Sierra	21	42	21,889	766,115	2,809	98,315	24,698	864,430
Siskiyou	63	76	5,309	185,815	43,515	1,523,025	48,824	1,708,840
Stanislaus	—	9	—	—	21,791	762,685	21,791	762,685
Tehama	—	2	—	—	905	31,675	905	31,675
Trinity	27	70	1,257	43,995	41,273	1,444,555	42,530	1,488,550
Tulare	3	2	79	2,765	14	490	93	3,255
Tuolumne	57	15	5,820	203,700	6,244	218,540	12,064	422,240
Yuba	11	22	6,259	219,065	80,540	2,818,900	86,799	3,037,965
	1,028	749	799,219	27,972,665	636,045	22,261,575	1,435,264	50,234,240
Total, 1938	927	676	738,616	25,851,560	572,513	20,037,955	1,311,129	45,889,515

[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] Output from property not classed as a "mine."

Mine production of gold, silver, copper, lead, and zinc in California in 1939, by counties, in terms of recovered metals—Continued

County	Silver					
	Lode		Placer		Total	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Alpine	4,489	$3,047	----------	----------	4,489	$3,047
Amador	18,412	12,498	4,291	$2,913	22,703	15,411
Butte	12,981	8,811	4,125	2,800	17,106	11,611
Calaveras	19,518	13,249	4,146	2,814	23,664	16,063
Colusa	----------	----------	----------	----------	----------	----------
Del Norte	----------	----------	22	15	22	15
Eldorado	10,880	7,385	1,830	1,242	12,710	8,627
Fresno	4	3	81	55	85	58
Humboldt	1	1	165	112	166	113
Imperial	8,916	6,052	35	24	8,951	6,076
Inyo	30,098	20,430	6	4	30,104	20,434
Kern	1,130,812	767,581	76	52	1,130,888	767,633
Lassen	355	241	----------	----------	355	241
Los Angeles	945	641	22	15	967	656
Madera	155	105	112	76	267	181
Mariposa	18,527	12,576	891	605	19,418	13,181
Merced	----------	----------	4,743	3,219	4,743	3,219
Modoc	4	3	----------	----------	4	3
Mono	87,279	59,243	----------	----------	87,279	59,243
Monterey, Orange, and Ventura [2]	4,253	2,887	1	1	4,254	2,888
Napa	291,248	197,696	----------	----------	291,248	197,696
Nevada	407,102	276,336	3,724	2,528	410,826	278,864
Placer	50,957	34,589	3,278	2,225	54,235	36,814
Plumas	194,274	131,871	304	206	194,578	132,077
Riverside	17,088	11,599	7	5	17,095	11,604
Sacramento	7	5	7,512	5,099	7,519	5,104
San Bernardino	189,331	128,516	46	31	189,377	128,547
San Diego	245	166	----------	----------	245	166
San Francisco	----------	----------	18	12	18	12
San Joaquin	----------	----------	212	144	212	144
San Luis Obispo	----------	----------	----------	----------	----------	----------
Santa Cruz	----------	----------	----------	----------	----------	----------
Shasta	32,477	22,045	2,096	1,423	34,573	23,468
Sierra	4,388	2,979	292	198	4,680	3,177
Siskiyou	1,660	1,127	5,955	4,042	7,615	5,169
Stanislaus	----------	----------	1,748	1,187	1,748	1,187
Tehama	----------	----------	68	46	68	46
Trinity	384	261	4,295	2,915	4,679	3,176
Tulare	40	27	4	3	44	30
Tuolumne	2,067	1,403	967	656	3,034	2,059
Yuba	4,111	2,790	5,059	3,434	9,170	6,224
	2,543,008	1,726,163	56,131	38,101	2,599,139	1,764,264
Total, 1938	2,541,016	1,642,677	49,788	32,186	2,590,804	1,674,863

[2] Combined to avoid disclosure of individual output.

Mine production of gold, silver, copper, lead, and zinc in California in 1939, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Alpine			6,000	$282			$5,044
Amador	2,000	$208					4,182,649
Butte	4,000	416	2,000	94			2,091,506
Calaveras							3,725,958
Colusa							35
Del Norte							4,425
Eldorado	6,000	624	4,000	188			2,529,544
Fresno							16,158
Humboldt							46,068
Imperial	68,000	7,072	2,000	94			701,237
Inyo	76,000	7,904	180,000	8,460	6,000	$312	480,385
Kern	2,000	208	16,000	752			3,919,608
Lassen							3,566
Los Angeles							161,096
Madera							30,316
Mariposa	4,000	416	50,000	2,350			1,312,102
Merced							1,784,544
Modoc							248
Mono	2,000	208	12,000	564			281,810
Monterey, Orange, and Ventura [2]			10,000	470	6,000	312	8,115
Napa	10,000	1,040					314,446
Nevada	26,000	2,704	40,000	1,880			11,439,103
Placer	4,000	416	26,000	1,222			1,572,397
Plumas	8,058,000	838,032	10,000	470			2,236,914
Riverside	60,000	6,240	650,000	30,550			142,789
Sacramento							5,400,039
San Bernardino	38,000	3,952	38,000	1,786			507,105
San Diego							14,796
San Francisco							7,852
San Joaquin							66,329
San Luis Obispo							490
Santa Cruz							70
Shasta			4,000	188			1,590,466
Sierra			2,000	94			867,701
Siskiyou							1,714,009
Stanislaus							763,872
Tehama							31,721
Trinity							1,491,726
Tulare							3,285
Tuolumne							424,299
Yuba							3,044,189
	8,360,000	869,440	1,052,000	49,444	12,000	624	52,918,012
Total, 1938	1,612,000	157,976	990,000	45,540			47,767,894

[2] Combined to avoid disclosure of individual output.

MINING INDUSTRY

The tonnage of material treated from lode mines in California in 1939, compared with 1938, increased 20 percent and the yardage at placer mines 8 percent; the output of lode gold rose 8 percent and that of placer gold 11 percent. Thus, the average grade of lode material declined, whereas the average gold content of gravels rose. Of the State total gold in 1939, 56 percent was from lode mines and 44 percent from placers.

Dredges of the connected-bucket type handled 75 percent of the gravel mined, and they recovered 58 percent of the State total placer gold in 1939; the quantity of gravel handled by such dredges increased, but the total value of the gold recovered decreased compared with the preceding year for the first time since 1930.

The second most important method of placer mining—dragline dredging—continued in 1939 its spectacular rise as a means of recovering gold. The first dragline dredge production in the United States was reported in California in 1933, when two outfits began work late in the year and recovered less than 100 ounces of gold. In 1939, 142 properties were worked by 109 dragline dredges. It will be noted that the average gold recovery by dragline dredges reversed a downward trend and rose to 19.1 cents a cubic yard in 1939. Many dragline operators appear to find that moving to smaller and smaller bodies of gravel is profitable, provided the recoverable gold content is substantially higher than the material available in larger bodies. During 1939 dragline dredges treated 19 percent of the State total placer gravels and recovered 27 percent of the total placer gold.

Nonfloating washing plants to which gravel was delivered by mechanical means showed a very large gain over 1938 in yardage handled and gold recovered, and the average gold recovery per cubic yard of gravel treated rose from 22.8 to 26.5 cents. Equipment was moved from one property to another, as was the practice with dragline dredges, and 114 mines were worked by 101 plants. Some of these nonfloating washing plants are stationary; others are built to move on skids, wheels, or tracks, or by other means. Dragline excavators, power shovels, slackline excavators, trucks, bulldozers, and other machines were used to deliver gravel to these washing plants.

Gold production by hydraulicking, small-scale hand methods, and drift mining was lower in 1939 than in 1938.

Consumption of quicksilver at California placer mines was 19,617 pounds in 1939. The following quantities of gold were recovered per pound of quicksilver used: Connected-bucket dredging, 41 ounces; dragline dredging, 29 ounces; nonfloating washing plants with mechanical gravel handling, 31 ounces; hydraulicking, 21 ounces; small-scale hand operation, 13 ounces; and drift mining, 26 ounces.

ORE CLASSIFICATION

Of the 5,577,853 tons of ore (including 637,891 tons of old tailings) sold or treated in 1939, 91 percent was dry gold ore and old tailings, 7 percent copper ore, and most of the remainder dry gold-silver ore.

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore and old tailings sold or treated in California in 1939, with content in terms of recovered metals

Source	Ore and old tailings treated: Ore	Ore and old tailings treated: Old tailings	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold ore	4,414,435	633,616	763,666	1,209,975	185,400	830,600	6,000
Dry and siliceous gold-silver ore	156,841	330	22,421	1,086,767	21,700	1,600	
Dry and siliceous silver ore	470	3,945	20	42,132	4,500	14,400	
	4,571,746	637,891	786,107	2,338,874	211,600	846,600	6,000
Copper ore	367,477		12,962	195,972	8,145,000	200	
Lead ore	706		148	7,902	3,400	199,200	
Zinc-lead ore	33		2	260		6,000	6,000
Total, lode mines	4,939,962	637,891	799,219	2,543,008	8,360,000	1,052,000	12,000
Total, placers			636,045	56,131			
	4,939,962	637,891	1,435,264	2,599,139	8,360,000	1,052,000	12,000
Total, 1938	3,659,919	988,330	1,311,129	2,590,804	1,612,000	990,000	

METALLURGIC INDUSTRY

During 1939, as in former years, most of the ore and virtually all the old tailings were treated at amalgamation and cyanidation mills (with or without concentrating equipment); 91 percent of the total ore and old tailings was treated at such mills in 1939. Almost all the remaining ore and all the rest of the old tailings were treated at concentrating mills. Only 11,078 tons of crude ore were shipped for direct smelting. Smelters received 53,340 tons of flotation concentrates and 2,672 tons of gravity concentrates from California mine operators in 1939. Comparing 1939 with 1938, there was an increase of 36 percent in ore and a decrease of 35 percent in old tailings treated at amalgamation and cyanidation mills; ore and old tailings combined increased 20 percent. The quantity of material treated at concentrating mills rose 29 percent, and the quantity of crude ore smelted declined 13 percent. The increase in quantity of concentrates shipped in 1939 for smelting was due largely to expanded production at the Walker mine in Plumas County, which made very large shipments of copper concentrates.

Quicksilver consumption at California amalgamation mills was 13,125 pounds in the treatment of 2,902,583 tons of material to recover 342,296 ounces of gold and 63,720 ounces of silver in 1939. In the treatment of 1,409,777 tons of ore, 262,445 tons of old tailings, and 10,648 tons of concentrates to recover 175,086 ounces of gold and 838,056 ounces of silver, cyanide consumption was 778,579 pounds of 91-percent sodium cyanide and 775,426 pounds of commercial calcium cyanide (50-percent NaCN equivalent); in terms of 98-percent NaCN the consumption was 1,118,592 pounds, or 0.66 pound per ton. A substantial part of the cyanide was consumed at custom mills.

Companies producing most of California's lode gold in 1939 owned and operated their own metallurgical plants, but a number of custom mills were active and served small-scale miners principally. The leading operators of metallurgical plants receiving custom material were: Burton Bros., Inc., Rosamond, Kern County; Golden Queen Mining Co., Mojave, Kern County; Mineral Reduction Co., Benton, Mono County; Gold Crown Mining Co., Ltd., east of Twentynine Palms, San Bernardino County; and Keeler Gold Mines, Inc., Keeler, Inyo County. All these mills were cyanidation plants and accepted ore and old tailings. The Idaho Maryland Mines Corporation, Grass Valley, Nevada County, discontinued custom work on ore and concentrates during 1939, except for a few lots. The largest metallurgical custom plant in California continued to be the State's only smelter—the Selby lead plant of the American Smelting & Refining Co., at Selby, Contra Costa County.

Mine production of metals in California in 1939, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore, old tailings, and concentrates amalgamated	2,902,583	342,296	63,720	-----	-----	-----
Ore, old tailings, sands, slimes, and concentrates cyanided	2,139,243	258,204	934,899	-----	-----	-----
Concentrates smelted:						
Flotation	53,340	181,861	1,311,989	8,204,100	348,200	12,000
Gravity	2,672	8,871	26,437	37,900	486,400	-----
Ore smelted	11,078	7,987	205,963	118,000	217,400	-----
Total, lode mines	-----	799,219	2,543,008	8,360,000	1,052,000	12,000
Total, placers	-----	636,045	56,131	-----	-----	-----
	-----	1,435,264	2,599,139	8,360,000	1,052,000	12,000
Total, 1938	-----	1,311,129	2,590,804	1,612,000	990,000	-----

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in California in 1939, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Material treated		Recovered in bullion		Concentrates smelted and recovered metal				
	Ore [1]	Old tailings	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Amador	273,332	-----	49,024	9,742	5,274	20,894	3,515	2,000	-----
Butte	1,483	-----	176	46	60	121	141	100	200
Calaveras	545,938	-----	24,753	3,246	4,126	17,495	9,309	-----	-----
Colusa	6	-----	1		-----	-----	-----	-----	-----
Eldorado	82,104	200	27,939	3,593	7,750	21,127	4,437	5,800	4,000
Fresno	25	-----	10	3	-----	-----	-----	-----	-----
Humboldt	15	-----	3	1	-----	-----	-----	-----	-----
Imperial	172	-----	379	231	-----	-----	-----	-----	-----
Inyo	1,137	220	436	476	3	67	164	-----	200
Kern	323,358	1,350	11,391	3,651	589	6,327	7,849	2,000	16,000
Lassen	423	-----	52	40	-----	-----	-----	-----	-----
Los Angeles, Monterey, and Ventura [2]	29,023	-----	4,284	873	-----	-----	-----	-----	-----
Madera	1,362	-----	304	99	2	14	13	-----	-----
Mariposa	86,365	470	15,731	4,253	2,257	15,129	13,775	3,700	50,000
Mono	19,260	-----	2,210	694	-----	-----	-----	-----	-----
Nevada	1,139,508	782	151,341	23,915	7,663	39,294	273,308	21,900	28,900
Placer	120,405	-----	16,809	5,010	861	3,895	42,027	3,900	26,000
Plumas	34,852	-----	3,320	739	174	2,863	1,061	1,900	9,100
Riverside	1,425	-----	647	169	889	1,102	16,460	57,700	649,800
Sacramento	2	-----	41	7	-----	-----	-----	-----	-----
San Bernardino	33,735	-----	2,391	852	96	550	3,588	1,800	13,800
San Diego	681	-----	237	57	-----	-----	-----	-----	-----
Shasta	12,074	26	3,605	750	430	2,530	842	-----	3,800
Sierra	64,604	550	18,113	3,582	477	1,633	556	-----	-----
Siskiyou	75,681	-----	4,934	944	60	331	673	-----	-----
Trinity	3,778	-----	1,111	208	18	91	74	-----	-----
Tulare	12	-----	3	2	-----	-----	-----	-----	-----
Tuolumne	43,886	-----	2,508	431	1,214	2,921	1,440	-----	-----
Yuba	4,339	-----	543	106	8	10	3	-----	-----
	2,898,985	3,598	342,296	63,720	31,951	136,394	379,235	100,800	801,800
Total, 1938	2,533,649	14,510	337,514	63,930	17,969	84,111	362,639	68,600	96,200

[1] Figures under "Ore" include both raw ore and concentrates amalgamated or cyanided, but not raw ore concentrated before amalgamation or cyanidation of concentrates.
[2] Combined to avoid disclosure of individual output.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in California in 1939, by types of mills and by counties, in terms of recovered metals—Continued

CYANIDATION MILLS

County	Material treated		Recovered in bullion		Concentrates smelted and recovered metal				
	Ore [1]	Old tailings	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Amador	25,588	448,882	13,198	4,812	214	1,271	321	--------	--------
Butte	22,170	--------	1,365	1,266	297	5,801	11,481	3,900	1,800
Calaveras	396,116	--------	13,751	6,611	--------	--------	--------	--------	--------
Eldorado	45,476	982	9,624	2,656	10	139	184	200	--------
Imperial	32,134	470	13,849	6,288	--------	--------	--------	--------	--------
Inyo	34,894	758	11,309	13,642	2	9	7	--------	--------
Kern	493,980	166,522	61,823	668,381	184	10,110	450,923	--------	--------
Lassen	12		7	35	--------	--------	--------	--------	--------
Los Angeles	325	--------	186	80	--------	--------	--------	--------	--------
Madera	--------	4,102	159	43	--------	--------	--------	--------	--------
Mariposa	16	3,350	185	159	--------	--------	--------	--------	--------
Mono	72,135	1,500	4,122	71,270	--------	--------	--------	--------	--------
Nevada	90,647	--------	100,315	105,400	123	53	877	4,000	10,000
Placer	3,761	--------	878	2,874	--------	--------	--------	--------	--------
Plumas	10	--------	49	8	--------	--------	--------	--------	--------
Riverside	1,093	--------	780	91	8	87	292	--------	200
San Bernardino	17,656	5,841	5,006	16,416	4	123	191	--------	--------
San Diego	170	--------	142	183	--------	--------	--------	--------	--------
Shasta	265,953	--------	15,352	30,554	--------	--------	--------	--------	--------
Sierra	--------	1,311	95	28	20	146	46	--------	--------
Siskiyou	141	--------	30	24	--------	--------	--------	--------	--------
Tulare	49	450	76	38	--------	--------	--------	--------	--------
Tuolumne	1,744	5	203	40	--------	--------	--------	--------	--------
Yuba	1,000	--------	5,700	4,000	--------	--------	--------	--------	--------
	1,505,070	634,173	258,204	934,899	862	17,739	464,322	8,100	12,000
Total, 1938	1,412,810	969,445	232,113	891,087	2,775	18,734	574,890	81,300	222,700
Grand total: 1939	4,404,055	637,771	600,500	998,619	32,813	154,133	843,557	108,900	813,800
1938	3,946,459	983,955	569,627	955,017	20,744	102,845	937,529	149,900	318,900

[1] Figures under "Ore" include both raw ore and concentrates amalgamated or cyanided, but not raw ore concentrated before amalgamation or cyanidation of concentrates.

Mine production of metals from concentrating mills in California in 1939, by counties, in terms of recovered metals

County	Material treated		Concentrates smelted and recovered metal					
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Alpine	510	--------	17	37	4,141	--------	1,000	--------
Butte	30	--------	2	23	4	--------	--------	--------
Imperial	33,345	--------	888	4,815	1,863	66,300	--------	--------
Inyo	233	120	48	270	531	800	6,900	6,000
Mariposa	4,134	--------	45	270	205	--------	--------	--------
Napa	31,948	--------	636	3,306	291,248	10,000	--------	--------
Nevada	580	--------	48	269	121	--------	900	--------
Orange and Sierra [1]	6,477	--------	186	826	4,267	--------	12,000	6,000
Plumas	415,516	--------	21,281	26,664	192,367	8,056,000	--------	--------
Shasta	800	--------	48	119	122	--------	--------	--------
	493,573	120	23,199	36,599	494,869	8,133,100	20,800	12,000
Total, 1938	379,635	4,375	17,158	55,817	376,926	1,391,500	321,700	--------

[1] Combined to avoid disclosure of individual output.

Gross metal content of concentrates produced from ores mined in California in 1939, by classes of concentrates

Class of concentrates	Concentrates	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	35,721	156,598	374,308	71,814	123,994	8,965
Dry gold-silver	862	13,440	746,354	13,973	1,102	
Copper	18,313	17,752	191,485	8,382,440		
Lead	222	1,864	9,472	903	82,693	3,289
Lead-copper	881	1,077	16,451	88,220	676,180	
Zinc	13	1	356	34	1,191	13,529
	56,012	190,732	1,338,426	8,557,384	885,160	25,783
Total, 1938	37,902	158,662	1,314,455	1,677,975	704,466	

Mine production of metals from California concentrates shipped to smelters in 1939, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Alpine	17	37	4,141		1,000	
Amador	5,488	22,165	3,836	2,000		
Butte	359	5,945	11,626	4,000	2,000	
Calaveras	4,126	17,495	9,309			
Eldorado	7,760	21,266	4,621	6,000	4,000	
Imperial and Orange [1]	931	4,824	5,958	66,300	10,000	6,000
Inyo	53	346	702	800	7,100	6,000
Kern	773	16,437	458,772	2,000	16,000	
Madera	2	14	13			
Mariposa	2,302	15,399	13,980	3,700	50,000	
Napa	636	3,306	291,248	10,000		
Nevada	7,834	39,616	274,306	25,900	39,800	
Placer	861	3,895	42,027	3,900	26,000	
Plumas	21,455	29,527	193,428	8,057,900	9,100	
Riverside	897	1,189	16,752	57,700	650,000	
San Bernardino	100	673	3,779	1,800	13,800	
Shasta	478	2,649	964		3,800	
Sierra	640	2,596	774		2,000	
Siskiyou	60	331	673			
Trinity	18	91	74			
Tuolumne	1,214	2,921	1,440			
Yuba	8	10	3			
	56,012	190,732	1,338,426	8,242,000	834,600	12,000
Total, 1938	37,902	158,662	1,314,455	1,541,400	640,600	

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
Dry gold	35,721	156,598	374,308	48,000	105,500	
Dry gold-silver	862	13,440	746,354	10,000	1,000	
Copper	18,313	17,752	191,485	8,125,600		
Lead	222	1,864	9,472	700	77,300	
Lead-copper	881	1,077	16,451	57,700	649,800	
Zinc	13	1	356		1,000	12,000
	56,012	190,732	1,338,426	8,242,000	834,600	12,000

[1] Combined to avoid disclosure of individual output.

Gross metal content of California crude ore shipped to smelters in 1939, by classes of ore

Class of ore	Ore	Gross metal content			
		Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry and siliceous gold	5,540	6,677	7,728	9,603	4,453
Dry and siliceous gold-silver	3,990	1,062	154,640	13,275	760
Dry and siliceous silver	406	7	29,291	5,946	20,085
Copper	436	93	6,402	94,179	238
Lead	706	148	7,902	5,345	208,482
	11,078	7,987	205,963	128,348	234,018
Total, 1938	12,750	10,327	271,544	79,339	368,446

Mine production of metals from California crude ore shipped to smelters in 1939, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Alpine	18	12	348		5,000
Amador	21	47	22		
Butte	100	115	43		
Calaveras	96	80	352		
Eldorado	11	45	10		
Fresno	11	3	1		
Imperial	426	337	534	1,700	2,000
Inyo	926	494	15,278	75,200	172,900
Kern	8	21	8		
Lassen	75	36	280		
Los Angeles and Monterey [1]	114	66	150		
Mariposa	53	49	135	300	
Modoc	1	7	4		
Mono	178	3	15,315	2,000	12,000
Nevada	48	2,054	3,481	100	200
Placer	753	648	1,046	100	
Plumas	144	120	99	100	900
Riverside	83	37	76	2,300	
San Bernardino	6,575	2,007	168,284	36,200	24,200
San Diego	17	39	5		
Shasta	233	419	209		200
Sierra	968	1,085	4		
Siskiyou	21	14	19		
Trinity	42	55	102		
Tuolumne	145	188	156		
Yuba	11	6	2		
	11,078	7,987	205,963	118,000	217,400
Total, 1938	12,750	10,327	271,544	70,600	349,400

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead
Dry and siliceous gold	5,540	6,677	7,728	7,700	3,000
Dry and siliceous gold-silver	3,990	1,062	154,640	11,600	600
Dry and siliceous silver	406	7	29,291	4,500	14,400
Copper	436	93	6,402	90,800	200
Lead	706	148	7,902	3,400	199,200
	11,078	7,987	205,963	118,000	217,400

[1] Combined to avoid disclosure of individual output.

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in California in 1939, by counties and districts, in terms of recovered metals [1]

County and district [1]	Mines producing[2]		Ore and old tailings	Gold			Silver (lode and placer)[3]	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Alpine County:											
Monitor	1		510	37		37	4,141		1,000		$4,153
Silver Mountain	1		4	3		3	265				285
Summit City	2		14	9		9	83		5,000		606
Amador County:											
East Belt [4]	9	6	1,640	253	2,090	2,343	881				82,603
Ione		15			20,659	20,659	2,417				724,706
Mother Lode [5]	13	11	720,595	84,181	6,658	90,839	18,833	2,000			3,192,357
Butte County:											
Butte Creek	2	6	1,086	194	8,380	8,574	893				300,696
Centerville		1			83	83	8				2,910
Forbestown	2	(6)	81	106	30	136	130				4,848
Inskip	1	1	150	9	17	26	3				912
Magalia	2	10	2	17	1,109	1,126	126				39,496
Merrimac	2	2	34	24	1,552	1,576	239				55,322
Oroville	5	17	200	72	38,324	38,396	2,771	100	200		1,345,761
Yankee Hill	4	2	22,230	7,179	1,135	8,314	12,896	3,900	1,800		300,234
Calaveras County:											
Camanche [7]		7			7,600	7,600	687				266,466
Campo Seco		3			2,313	2,313	65				80,999
Copperopolis	4		86,151	8,723		8,723	7,854				310,637
East Belt [4]	11	3	45,901	14,086	198	14,284	2,030				501,318
Jenny Lind	2	15	721	72	12,272	12,344	1,136				432,811
Mother Lode [5]	20	39	456,863	33,198	18,161	51,359	10,896				1,804,961
West Belt [8]		1			9,374	9,374	996				328,766
Colusa County: Sulphur Creek	1		6	1		1					35
Del Norte County:											
French Hill		3			103	103	20				3,619
Smith River		1			23	23	2				806
Eldorado County:											
East Belt [4]	7	5	12,381	2,290	1,479	3,769	1,529		1,300		133,014
Mother Lode [5]	44	21	79,293	38,262	5,414	43,676	5,512	5,500			1,532,973
West Belt [8]	11	5	105,856	18,322	6,236	24,558	5,669	500	2,700		863,557
Fresno County:											
Auberry	1		15	6		6	3				212
Copper King	1		10	4		4					140
Friant	1	2	11	3	439	442	80				15,524

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1939, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore and old tailings	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Humboldt County:											
China Flat		1			724	724	81				$25,395
Gold Bluff		2			32	32	1				1,121
Orleans	1	5	15	3	540	543	82				19,061
Trinity River		1			14	14	2				491
Imperial County:											
Cargo Muchacho	13	(9)	66,444	19,025	(9)	[10] 19,025	[10] 8,373	68,000			[10] 678,630
Mesquite	2	(6)	83	348	15	363	542		2,000		13,167
Pot Holes	1	1	20	7	6	13	2				456
Inyo County:											
Beveridge	1		150	22		22	48		200		812
Bishop Creek	1		178	12		12	6,095	70,900			11,931
Carbonate	6		236	144		144	1,415	300	44,200		8,109
Cerro Gordo	8		1,191	244		244	5,982	2,500	99,700		17,546
Chidago [11]	1		120	83		83	12				2,913
Chloride Cliff	7		137	110		110	171	600			4,028
Coso	17	(9)	1,826	287	(9)	[10] 287	[10] 566				[10] 10,429
Echo	2		321	350		350	205				12,389
Fish Springs	4		195	36		36	1,366	100	21,000	6,000	3,497
Furnace Creek	1		4				134	300	200		132
Laws	1		61	80		80	58				2,839
Marble Canyon		5			63	63	5				2,208
Resting Springs	1		200	42		42	96				1,535
Sherman	3		24,433	4,313		4,313	663				151,405
Sherwin	2		41	19		19	107				738
Slate Range [12]	5		188	122		122	579	500	13,200		5,335
South Park	11		1,287	1,059		1,059	802	800	900		37,735
Sudian	1		11	13		13	45				486
Ubehebe	1		37	44		44	7				1,545
Union	4	3	1,799	1,766	14	1,780	6,044				66,403
Wildrose	7		5,599	3,799		3,799	4,613				136,096
Kern County:											
Agua Caliente	8		2,646	265		265	125				9,360
Black Mountain		1			22	22	3				772
China Grade		1			89	89	16				3,126
Cove	3	(6)	34,289	7,916	1	7,917	6,506	1,300	7,200		281,985
Frazier Mountain	2		26	32		32	13				1,129
Goler	2	(6)	42	6	46	52	9				1,826
Greenhorn	2	(6)	24	13	16	29	7				1,020
Green Mountain	11		1,570	519		519	545				18,535

Havilah	11	1	319	128	8	136	69				4,807
Long Tom	2		89	7		7	3				245
Mojave	35	1	230,101	58,358	1	58,359	1,116,349	700	8,800		2,800,816
Pioneer	10	2	2,961	250	62	312	471				11,240
Rademacher	5		143	99		99	78				3,518
Randsburg [13]	38	(9)	1,030,881	21,937	(9)	[10] 21,937	[10] 6,593				[10] 772,270
Red Rock	3		15	7		7	12				253
Sageland	7		126	64		64	38				2,266
Summit		1			27	27	3				947
White River	2	1	610	71	4	75	38				2,651
Lassen County:											
Diamond Mountain	4		238	55		55	320				2,142
Hayden Hill	3		272	40		40	35				1,424
Los Angeles County:											
Cedar	7		28,628	4,287		4,287	899				150,655
Iron Mountain	1		500	54		54	14				1,900
Neenach	2		68	16		16	22				575
Palomas	1	4	19	66	23	89	11				3,122
San Gabriel		4			138	138	21				4,844
Madera County:											
Hildreth	6	(6)	80	78	55	133	49				4,688
Potter Ridge	8	19	5,384	399	329	728	218				25,628
Mariposa County:											
East Belt [4]	22	3	12,810	3,738	210	3,948	1,186	200			139,006
Hunter Valley	14	1	30,534	8,881	175	9,056	3,481	2,000	1,500		319,601
Mother Lode [5]	49	17	102,812	18,745	5,284	24,029	14,751	1,800	48,500		853,495
Merced County: Snelling		6			50,895	50,895	4,743				1,784,544
Modoc County: High Grade	1		1	7		7	4				248
Mono County:											
Blind Springs	5		652	171		171	3,203				8,159
Bodie	6		71,467	3,410		3,410	63,032				162,135
Chidago [11]	6		1,275	327		327	2,014				12,812
Dunderburg	1		40	9		9	5				318
Mammoth Lakes	2		331	191		191	3,013				8,730
Masonic	1		59	39		39	11				1,372
May Lundy	1		19,069	2,182		2,182	686				76,836
Mono Diggings	1	2	2	3	2	5	1				176
White Mountain	1		178	3		3	15,314	2,000	12,000		11,272
Napa County: Calistoga	1		31,948	3,306		3,306	291,248	10,000			314,446
Nevada County:											
French Gulch	1	6	49	22	1,250	1,272	178				44,641
Grass Valley-Nevada City	33	15	1,139,559	292,059	18,740	310,799	403,126	16,800	28,900		11,154,708
Washington	7	5	6,665	1,235	3,149	4,384	7,301	9,200	11,100		159,874
You Bet	1	9	200	10	2,268	2,278	221				79,880
Placer County:											
Auburn	3	4	716	140	1,056	1,196	760	100	300		42,400
Butcher Ranch	(9)	1	(9)	(9)	5	[14] 5	[14] 1				[14] 176
Dutch Flat	3	4	19,349	3,191	653	3,844	528				134,898

See footnotes at end of table

Mine production of gold, silver, copper, lead, and zinc in California in 1939, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore and old tailings	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Placer County—Continued.											
Foresthill	7	9	379	146	1,014	1,160	135	----	----	----	$ 40,692
Iowa Hill	1	10	130	19	1,093	1,112	127	----	----	----	39,006
Last Chance	2	6	120	58	466	524	57	----	----	----	18,379
Lincoln	----	16	----	----	9,228	9,228	1,520	----	----	----	324,012
Michigan Bluff	----	3	----	----	244	244	57	----	----	----	8,579
Ophir	10	21	100,014	18,457	7,651	26,108	50,967	3,900	25,700	----	949,989
Plumas County:											
Bucks Lake	1	----	50	29	----	29	6	----	----	----	1,020
Butte Valley	----	1	----	----	68	68	8	----	----	----	2,385
Crescent Mills	10	9	49,070	4,915	441	5,356	1,167	600	----	----	188,315
Genesee	3	(9)	367,572	12,911	(9)	[10] 12,911	[10] 189,591	8,054,200	----	----	[10] 1,418,214
Granite Basin	3	1	4,327	590	1	591	616	1,400	10,000	----	21,719
Johnsville	3	(6)	406	148	76	224	68	----	----	----	7,886
La Porte	----	7	----	----	934	934	73	----	----	----	32,740
Lights Canyon	----	4	----	----	115	115	8	----	----	----	4,030
Quincy	3	13	4,620	627	552	1,179	142	----	----	----	41,361
Rich Bar	1	5	48,475	13,795	923	14,718	2,893	1,800	----	----	517,281
Seneca	----	2	----	----	41	41	3	----	----	----	1,437
Riverside County:											
Arica	1	----	30	19	----	19	18	200	----	----	698
Bendigo	1	----	5	2	----	2	1	----	----	----	71
Chuckawalla	5	(6)	207	87	1	88	17	----	----	----	3,092
Cottonwood Springs	1	----	14	3	----	3	3	----	----	----	107
Dale [15]	19	----	1,054	845	----	845	406	500	200	----	29,912
Eagle Mountain	3	3	7,910	1,201	10	1,211	16,451	57,700	649,800	----	90,093
Gold Park	1	----	60	14	----	14	----	----	----	----	490
Ironwood	1	----	40	16	----	16	----	----	----	----	560
Pinacate	5	2	1,045	420	33	453	148	----	----	----	15,955
Pinon	5	----	110	45	----	45	7	----	----	----	1,580
Santa Rosa [16]	2	----	24	1	----	1	44	1,600	----	----	231
Sacramento County:											
Cosumnes River	----	6	----	----	14,436	14,436	806	----	----	----	505,807
Folsom	1	9	1	4	139,664	139,668	6,706	----	----	----	4,892,932
Walltown	1	----	1	37	----	37	7	----	----	----	1,300
San Bernardino County:											
Alamo	2	----	8	5	----	5	3	----	----	----	177
Baxter	1	----	50	13	----	13	8	----	----	----	460
Buckeye	4	----	1,007	136	----	136	689	4,100	----	----	5,654
Calico	4	----	4,090	8	----	8	13,788	2,600	----	----	9,910

Clark Mountain	1		1				1		1,400		66
Coolgardie		4			11	11					385
Dale [15]	13		20,641	4,508		4,508	6,519	700	2,300		162,386
Dry Lake	1	1	2	4	2	6	2				211
Fremont Peak	3		398	21		21	6				739
Gold Park	1		40	11		11	4				388
Goldstone	6		108	66		66	85				2,368
Grapevine	2		2	2		2	2				71
Holcomb Valley	5	4	24,533	1,022	369	1,391	344				48,919
Ibex	2		45	12		12	1				421
Ivanpah	8		330	110		110	9,384	1,400	800		10,403
Kelso	7		85	39		39	392		100		1,636
Kingston Mountain	2		59	3		3	571	600	12,300		1,133
Lead Mountain	1		23	7		7					245
Lytle Creek	1	3	80	7	15	22	1				771
Mid Hills	1		30	5		5	3				177
Morongo		2			6	6					210
Old Woman Mountain	5		271	154		154	17				5,402
Ord Mountain	3		2,559	933		933	410	200			32,954
Panamint	2		6	6		6	3		100		217
Providence	1		42	11		11	8				390
Randsburg [13]	5	2	4,585	1,223	167	1,390	153,185	11,600			153,837
Shadow Mountain	2		43	36		36	34				1,283
Signal	2		24	47		47	26	300			1,693
Silver Mountain	19		1,237	563		563	1,753	7,300	12,100		22,223
Slate Range [12]	7		145	68		68	83				2,436
Solo	7		874	714		714	883	800	8,900		26,091
Spangler	3		137	25		25	31				896
Summit Valley		2			5	5					175
Vanderbilt	3		1,846	151		151	1,093	800			6,110
Whipple Mountain	9		251	161		161	43	7,600			6,455
San Diego County:											
El Cajon	1		40	8		8	2				281
Julian	5		541	227		227	55				7,982
Pine Valley	2		287	183		183	188				6,533
San Francisco County: San Francisco		(6)			224	224	18				7,852
San Joaquin County:											
Camanche [7]		3			860	860	143				30,197
Linden		1			1,031	1,031	69				36,132
San Luis Obispo County: Pozo		2			14	14					490
Santa Cruz County: Santa Cruz		1			2	2					70
Shasta County:											
Centerville		2			8	8	1				281
French Gulch	11	5	15,477	6,047	1,453	7,500	2,034		3,800		264,059
Igo	3	29	53	62	20,777	20,839	1,906				730,659
Old Diggings	4	2	10,737	1,385	219	1,604	776				56,667
Redding	(9)	2	(9)	(9)	206	[14] 206	[14] 23		(9)		[14] 7,226
Shasta	5	(9)	584	264	(9)	[10] 264	[10] 41				[10] 9,268

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1939, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore and old tailings	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Sierra County:											
Alleghany	13	14	68,717	18,201	726	18,927	3,687				$664,948
Depot Hill		2			74	74	6				2,594
Downieville	3	21	1,025	217	1,916	2,133	278		2,000		74,938
Poker Flat		2			51	51	4				1,788
Port Wine		1			29	29	3				1,017
Sierra City	4	2	2,804	1,507	13	1,520	127				53,286
Siskiyou County:											
Callahan	6	9	218	215	9,815	10,030	1,314				351,942
Greenhorn	15	8	319	217	13,432	13,649	2,002				479,074
Humbug	5	4	129	131	4,328	4,459	650				156,506
Klamath River	13	26	1,392	804	12,607	13,411	2,632				471,172
Liberty	12	17	72,319	3,179	1,153	4,332	509				151,966
Quartz Valley	8	2	524	276	71	347	89				12,205
Salmon River	1	5	277	131	1,789	1,920	317				67,415
Scott Bar	3	5	545	356	320	676	102				23,729
Stanislaus County:											
Knights Ferry		4			3,783	3,783	328				132,628
La Grange		3			11,579	11,579	1,161				406,053
Waterford		1			7	7	1				246
Tehama County: Bend		2			905	905	68				31,721
Trinity County:											
Big Bar		6			98	98	9				3,436
Coffee Creek	7	4	157	73	141	214	102				7,559
Hayfork	3	7	132	219	2,062	2,281	137				79,928
Helena	2	4	585	319	228	547	113				19,222
Junction City	1	7	39	5	13,422	13,427	1,323				470,843
Lewiston	9	11	2,267	206	9,830	10,036	1,375				352,193
New River	(9)	7	(9)	(9)	195	[14] 195	[14] 28				[14] 6,844
Salyer		7			520	520	44				18,230
Trinity Center		3			1,347	1,347	181				47,268
Weaverville	3	14	82	99	13,430	13,529	1,341				474,425
Tulare County: White River	3	2	511	79	14	93	44				3,285
Tuolumne County:											
East Belt [4]	47	10	9,208	2,297	3,723	6,020	1,222				211,529
Mother Lode [5]	10	5	36,572	3,523	2,521	6,044	1,812				212,770

Yuba County:											
Camptonville	2	6	9	50	393	443	74				15,555
Challenge	[9]	2	[9]	[9]	175	[14] 175	[14] 15				[14] 6,135
Dobbins	1	2	20	8	167	175	20				6,139
Indian Ranch	1	2	49	9	217	226	22				7,925
Smartville	1	2	10	3	9,989	9,992	768				350,241
Strawberry Valley	3	6	1,165	304	1,614	1,918	176				67,249
Other counties and districts [17]	18	20	286,766	22,840	81,436	104,276	44,840		10,800	6,000	3,680,916
Total, California	1,028	749	5,577,853	799,219	636,045	1,435,264	2,599,139	8,360,000	1,052,000	12,000	52,918,012

[1] Only those counties and districts shown separately for which Bureau of Mines is at liberty to publish figures; others producing listed in footnote 17 and their output included under "Other counties and 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: 2,543,008 ounces from lode mines and 56,131 ounces from placers.

[4] East Belt district lies in Amador, Calaveras, Eldorado, Mariposa, and Tuolumne Counties.

[5] Mother Lode district lies in Amador, Calaveras, Eldorado, Mariposa, and Tuolumne Counties.

[6] Output from property not classed as a "mine."

[7] Camanche district lies in Amador, Calaveras, and San Joaquin Counties.

[8] West Belt district lies in Calaveras and Eldorado Counties.

[9] Included under "Other counties and districts."

[10] Exclusive of placer output, which is included under "Other counties and districts."

[11] Chidago district lies in Inyo and Mono Counties.

[12] Slate Range district lies in Inyo and San Bernardino Counties.

[13] Randsburg district lies in Kern and San Bernardino Counties.

[14] Exclusive of lode output, which is included under "Other counties and districts."

[15] Dale district lies in Riverside and San Bernardino Counties.

[16] Santa Rosa district lies in Orange and Riverside Counties.

[17] Includes following: Camanche district in Amador County; Golden Summit in Butte County; Sycamore in Fresno County; Cargo Muchacho (placer) in Imperial County; Coso (placer) and Modoc in Inyo County; Randsburg (placer) in Kern County; Monterey County (Los Burros district); Orange County (Lucas and Santa Rosa districts); Butcher Ranch (lode) and Damascus in Placer County; Genesee (placer) and Gold Lake in Plumas County; Paradise in San Bernardino County; Iron Mountain, North Cow Creek, Redding (lode), and Shasta (placer) in Shasta County; Pike in Sierra County; Jenny Lind in Stanislaus County; New River (lode) in Trinity County; Ventura County (Snowey district); and Bear Valley, Browns Valley, Challenge (lode), and Yuba River in Yuba County.

ALPINE COUNTY

Monitor district.—The Zaca Mining Corporation, which operated the Zaca mine, was the principal producer in Alpine County in 1939.

AMADOR COUNTY

Camanche district.—The Comanche Gold Dredging Co. was consolidated with the Gold Hill Dredging Co. during 1939, and dredging by the Comanche boat was continued under the Gold Hill name. The dredge had sixty-two 7-cubic foot buckets.

East Belt district.—Garibaldi Bros. operated a nonfloating washing plant about one-half mile east of Volcano intermittently during 1939. E. A. Kent operated a dragline dredge on the South Branch of Sutter Creek one-half mile south of Volcano from January 1 until June 6; the dragline excavator had a 2½-cubic yard bucket. Lessees carried on hydraulic operations at the Union Flat mine from February 1 to July 1. The Fort Ann Mining Co. worked the Fort Ann mine from March 1 to June 1 and treated its ore by amalgamation and concentration.

Ione district.—The Arroyo Seco Gold Dredging Co. worked a property 3 miles west of Ione throughout 1939; the company's connected-bucket dredge had eighty-six 6-cubic foot buckets and was powered by electricity. The Lancha Plana Gold Dredging Co. operated a connected-bucket dredge on Jackson Creek almost continuously during the year; the electric-powered dredge was of Yuba type, with sixty-five 4½-cubic foot buckets. H. G. and H. H. Kreth hydraulicked gravel on the Horton claim at Buena Vista on Jackson Creek from the first of the year until May 12. E. L. Lilly operated a dragline dredge with a 2¼-cubic yard bucket on the Lorentz property from January 1 to August 21. The San Andreas Gold Dredging Co. moved one of its dragline dredges from Calaveras County to a property near Ione and began operations on September 21; the dragline excavator was Diesel-powered and used a 1½-cubic yard bucket. E. A. Kent operated a dragline dredge on Sutter Creek 5 miles west of the town of Sutter Creek; the dragline excavator had a 2½-cubic yard bucket. The Universal Dredging Corporation and the Humphreys Gold Corporation carried on dragline dredging.

Mother Lode district.—The Placeritas Mining Co. operated a dragline dredge on Indian Creek throughout 1939 except for a 6-week shut-down during August and September; the dragline excavator had a 1¼-cubic yard bucket. The River Pine Mining Co. worked a dragline dredge. Two dragline dredges operated on the Hingston ranch part of the year. The dredge formerly operated by Wolin, Hall, & Wackman was worked during the early months of the year by Wolin-Hall; the plant was sold May 6 to T. M. Hingston, who optioned the dredge to Searcy and Poole on November 6. E. L. Lilly began work on the same property with a larger dragline dredge August 27 and continued until the end of the year; his dragline excavator was equipped with a 2¼-cubic yard bucket. A large number of other placer operators, including many snipers, were reported in the Mother Lode district. The Argonaut Mining Co., Ltd., operated the Argonaut mine throughout 1939; the company gold ore was treated by amalgamation and flotation, and the concentrates were shipped to a smelter. In addition to operations at the Argonaut mine, the company started work June 1 on the tailings pile at the Plymouth mine and continued production until the end of the year; for this operation the company built a flotation and cyanidation plant with a daily capacity of 500 tons. The tailings pile contained approximately 750,000 tons when operations began. The Central Eureka Mining Co. operated the Central Eureka and Old Eureka mines throughout the year. According to the company printed annual report for the year ended December 31, 1939, 50,242 tons of ore were treated, from which the mill recovered $25.13 per ton; except for a small quantity of silver, the product was gold and totaled $1,262,395.86; 86 percent was recovered by amalgamation and 14 percent by cyanidation of flotation concentrates. During the year $270,000 was paid in dividends. The Delta Tailings Co. continued to cyanide material derived from a deposit of old tailings collected as a delta on one of the streams draining a section of the Mother Lode district. The Fremont Gover Co. continued operations at the Fremont Gover group of claims; part of the work at the property was reopening of old workings. The Kennedy Mining & Milling Co. operated the Kennedy mine throughout 1939; gold ore was treated by amalgamation and flotation, and old tailings were treated in the company 1,000-ton cyanide plant. The Keystone Mine Syndicate worked the Keystone mines throughout the year; 65,291 tons of ore were treated in the company 225-ton amalgamation-flotation mill; and gold recovery was 3,610 ounces in bullion and 3,752 ounces in concentrates sent to a smelter.

BUTTE COUNTY

Forbestown district.—Clean-up of the Midas mill site by a lessee, after the Idaho Maryland Corporation had dismantled its mill at the property, resulted in a small production of gold and silver in 1939.

Golden Summit district.—The Table Mountain Dredging Co. worked a dragline dredge at Thompson's Flat during the early months of 1939.

Magalia district.—Wilder and Cornell worked the Evers mine with gasoline shovel and Ainlay bowls from January 1 to June 1, 1939.

Merrimac district.—Piombo Bros. & Co. moved its dragline dredge to French Creek and on June 15, 1939, started operations that continued until the end of the year.

Oroville district.—The Amo drift placer mine treated 987 cubic yards of gravel in 1939, from which 167 ounces of gold and 14 ounces of silver were recovered; the company developed a special gravity-concentration method for saving very fine gold. Baker and McCowan operated a dragline dredge on the Farnan ranch near Palermo, using a 1½-cubic yard dragline excavator from August 1 until the end of the year. The Golden Feather Dredging Co. operated a dragline dredge on the Feather River near Oroville from October 14 to 28; gravel was dredged with a 6-cubic yard dragline excavator. Lord & Bishop worked a dragline dredge on the Gianella ranch from January to March. The Gibson Mining Co. operated a dragline dredge on the Miller property. William Richter & Sons operated a dragline dredge using a dragline excavator with a 1½-cubic yard bucket throughout the year. The Gold Hill Dredging Co. operated a dredge of the connected-bucket type on the east side of the Feather River 7 miles south of Oroville the entire year; the dredge used electric power and had seventy-four 9-cubic foot buckets. Yuba Consolidated Gold Fields operated two electrically powered dredges of the connected-bucket type on land adjoining the Feather River throughout the year; one had eighty-four and the other eighty-nine 9-cubic foot buckets. A very large quantity of gold was reported by gold buyers as having originated from small-scale hand-operated mines in the Oroville district.

Yankee Hill district.—The Morris Ravine Mining Co. treated 1,100 cubic yards of gravel from its drift mine on Table Mountain and recovered 119 ounces of gold and 11 ounces of silver in 1939. Hoefling Bros. worked the Surcease mine throughout the year and treated the ore in a 70-ton flotation and cyanidation plant; the flotation tailings were classified and cyanided, and the concentrates were shipped to a smelter.

CALAVERAS COUNTY

Camanche district.—The Wallace Dredging Co. operated its electrically powered connected-bucket dredge with sixty 3-cubic foot buckets from January 1 to October 11, 1939, on land bordering Bear Creek southeast of Wallace; the dredge was idle the rest of the year. The Lancha Plana Gold Dredging Co. operated the Lancha Plana Dredge No. 2 on gravel along the Mokelumne River throughout the year; the dredge used electric power and had eighty-four 6-cubic foot buckets. At the Merhten Bros. property along the Mokelumne River gravel was delivered to sluice boxes by a carry-all drawn by a tractor.

Campo Seco district.—The Pacific Placers Engineering Co. operated its nonfloating washing plant in 1939 on several properties near Valley Springs.

Copperopolis district.—The Jumbo Consolidated Mining Co. worked the Mt. King mine in the Madam Felix section of the Copperopolis district during 1939; ore was treated in a 250-ton flotation-amalgamation mill, and the concentrates were shipped to a smelter. Ore from the Royal mine, reported as in production throughout the year, was treated in a stamp mill with plate-amalgamation and flotation; concentrates were smelted.

East Belt district.—A lessee operated the Continental mine throughout 1939; 413 tons of gold ore were treated in a stamp mill using amalgamation plates followed by flotation, and 126 ounces of gold were shipped as bullion and 87 ounces were contained in concentrates shipped to a smelter. The St. Joseph Lead Co. worked the Sheepranch mine throughout the year and treated the ore in the company 150-ton amalgamation-flotation mill.

Jenny Lind district.—The California Gold Dredging Co. operated its connected-bucket dredge in the Jenny Lind district (Calaveras County) in 1939 from the first of the year until March 6, when the county line was crossed; the remainder of the year was spent dredging gravels in Stanislaus County. A small connected-bucket dredge was operated on the Dickhart ranch. The Pacific Placers Engineering Co. operated its nonfloating mechanical placer equipment on several properties in the district. The Milton Gold Dredging Enterprise operated its dragline dredge from the first of the year until August 29. The General Dredging Corporation used a dragline dredge on San Antonio Creek from January 1 to August 23; the dragline excavator had a 1½-cubic yard bucket. The General Dredging Corporation took over the dragline dredge operated by the General Gold Corporation (formerly South Gulch Placers) September 1; the dragline excavator had a 2-cubic yard bucket. The former company had operated on South Gulch since May 5, 1939. The Thompson dredge operating east of Linden was converted November 1 from a connected-bucket dredge with twenty-seven 1-cubic foot buckets to a dragline dredge.

Mother Lode district.—The San Andreas Gold Dredging Co. operated a dragline dredge on the Airola and Costa properties from January 2 to February 25, 1939, the dragline excavator using a 1½-cubic yard bucket; this dredge worked the Carrie Rivara property from February 26 to March 5, the Cademartori property from April 6 to 17, the Costa de Martini property from April 18 to May 16, the Drury property from May 7 to July 6, and the Calaveras Cement Co. property from July 7 to August 26; it was then moved to the Ione district of Amador County. On September 9, 1939, the San Andreas Gold Dredging Co. purchased a dragline dredge with a Diesel-powered dragline excavator and a 1-cubic yard bucket from Houston, Houston & Bever; this dredge worked the Bonnie, Bowling Green, and Batten properties the rest of the year. C. E. Gruwell operated a dragline dredge on the Calaveras Central and Vallecito Western properties and worked gravel on Coyote and French Creeks. E. A. Kent worked a dragline dredge on San Antonio Creek 7 miles northeast of Angels Camp from February 21 until March 26, the dragline excavator having a 1¾-cubic yard bucket; this dredge was moved to Coyote Creek 6 miles east of Angels Camp and operated from June 3 to the end of the year. The R. & M. Mining Co. operated a dragline dredge with a dragline excavator equipped with a 1-cubic yard bucket on Coyote Creek throughout the year. Houston Bros. (Houston, Houston, & Bever) treated 500,000 cubic yards of gravel on Coyote Creek between January 1 and September 7 and recovered 4,022 ounces of gold; this dredge was sold to the San Andreas Gold Dredging Co. The Calaveras Land Co. worked the Lloyd drift mine on the Central Hill Channel throughout 1939. In addition to the gold recovered by dragline dredging on the Vallecito Western property, a lessee recovered 274 ounces of gold and 31 ounces of silver from 687 cubic yards of gravel obtained by drift mining. C. E. Gruwell operated the Big Springs quartz mine at Angels Camp throughout the year. The Carson Hill Gold Mining Corporation operated the Carson Hill mine throughout 1939, and 396,114 tons of ore were treated in the company 1,100-ton amalgamation-concentration-cyanidation plant; after amalgamation and concentration the concentrates were reground and returned to the circuit for cyanidation. Amalgamation accounted for the recovery of 12,419 ounces of gold and 1,207 ounces of silver, and cyanidation for 13,751 ounces of gold and 6,611 ounces of silver; 7 tons of concentrates smelted contained 155 ounces of gold and 37 ounces of silver. This company mined a larger tonnage than any other lode property on the Mother Lode. Gold ore was treated by amalgamation and gravity concentration at the Comet mine throughout 1939. The LeRoi Mines, Inc., operated the Easyz Bird mine throughout the year and treated a large tonnage of ore by flotation; most of the recovered gold came from the concentrates shipped to a smelter.

ELDORADO COUNTY[1]

East Belt district.—In 1939 a lessee on the C. G. Woodburn drift mine 2 miles east of Fairplay mined 301 cubic yards of gravel from which 92 ounces of gold and 22 ounces silver were recovered. Work at the Cooley drift mine yielded 87 ounces of gold and 11 ounces of silver from 2,500 cubic yards of gravel. The Rocky Bar mine on the Middle Fork of Cosumnes River 5 miles east of Fairplay yielded 1,042 ounces of gold and 308 ounces of silver from the treatment of 40,000 cubic yards of gravel; in addition, 15,000 cubic yards of overburden were removed. The mine was worked with a 1¼-cubic yard gasoline shovel loading 5-ton dump trucks, which hauled the material to a stationary washing plant. The Cosumnes Mines, Inc., operated the Middle End mine near Grizzly Flat.

Mother Lode district.—The General Dredging Corporation worked the bed of the American River in 1939 near the point where James W. Marshall made his historic gold discovery in 1848; the company operated a dragline dredge which had a dragline excavator with a 1½-cubic yard bucket. Sills Bros. worked the Coolridge and Marr property on Greenwood Creek with a dry-land washing plant from April 1 to July 31. Hoosier Gulch Placers operated a dragline dredge, using an electric dragline excavator with a 3-cubic yard bucket, on Logtown Ravine from June 1 until December 27. The Stuchara Mining Co. worked the Skinner property 1½ miles south of Pilot Knob from May 15 to August 1; gravel was excavated with a ⅜-cubic yard gasoline shovel and the gold recovered in a stationary washing plant. Alhambra-Shumway Mines, Inc., which had been exploring the Alhambra-Shumway mine near Kelsey since 1937, uncovered a high-grade ore shoot during the early months of 1939; production began March 14, and before the end of the year 4,043 tons of ore had been mined, from which 17,572 ounces of gold and 2,401 ounces of silver were recovered by amalgamation and in gravity concentrates. During the year the company paid $268,826.20 in dividends. The Beebe Gold Mining Co. treated 9,482 tons of ore and 982 tons of old tailings in 1939 from the Beebe-Eureka mine, from which 1,752 ounces of gold and 474 ounces of silver were recovered before the mine and mill were closed June 22. Ore from the Black Oak mine was treated by amalgamation and flotation. H. H. Smith treated 500 tons of ore mined at the Funny Bug mine and recovered bullion containing 33 ounces of gold and 11 ounces of silver and concentrates (27 tons) containing 22 ounces of gold, 30 ounces of silver, and 6,713 pounds of copper. The Lode Development Co. worked the Rozecrans mine from January 1 until mine operations were suspended July 31; the mill treated ores from other mines later in the year. The Middle Fork Gold Mining Co., one of the leading producers in Eldorado County, worked the Sliger mine in the Spanish Dry Diggings section of the Lode throughout 1939; the company reported good headway in sinking its new shaft. A pocket at the Stuckslager mine 10 miles west of Placerville yielded 50 tons of ore containing 267 ounces of gold and 46 ounces of silver. The Lode Development Co. operated the Taylor mine from April 1 to October 1; the ore was treated at the Rozecrans mill.

[1] *See also* Logan, C. A., Mineral Resources of Eldorado County, Calif.: Jour. Mines and Geol., State Min. Rept., vol. 34, No. 3, 1938, pp. 206–280.

West Belt district.—The Big Canyon Dredging Co. operated a dragline dredge using a Diesel-powered dragline excavator with a 3½-cubic yard bucket on Big Canyon Creek throughout 1939; 3,735 ounces of gold and 451 ounces of silver were recovered from 710,000 cubic yards of gravel. A dragline dredge using a dragline excavator with a 1½-cubic yard bucket was operated from April 1 until the end of the year by the Horseshoe Dredging Co. on Weber Creek; 225,350 yards of gravel were treated and 1,298 ounces of gold recovered. The Lemroh Mining Co. treated 100,762 cubic yards of gravel on Weber Creek 10 miles west of Placerville by dragline dredging and recovered 663 ounces of gold; operation was begun October 21 and continued until the end of the year. The dragline excavator was electrically powered and had a 1-cubic yard bucket. A dry-land dredge mounted on four wheels and fed by a dragline excavator with a 1½-cubic yard bucket was used at the Muir mine on Sweetwater Creek 7 miles west of Rescue; 34,680 cubic yards of gravel were treated and 289 ounces of gold recovered. The Mountain Copper Co., Ltd., worked the Big Canyon mine throughout 1939; the ore was treated in the company 300-ton flotation mill, and the concentrates were shipped to a smelter. The El Dorado Crystal mine was operated throughout the year, and the ore was treated by cyanidation.

FRESNO COUNTY

Friant district.—The Grant-Service Rock Co. recovered more than $5,000 in gold in 1939 as a byproduct at its Rockfield sand and gravel plant on the San Joaquin River.

HUMBOLDT COUNTY

China Flat district.—The Frederick Gold Mining Corporation operated a nonfloating washing plant and an electrically powered excavator at its mine on Willow Creek in 1939.

Orleans district.—Hydraulicking of 4,000 cubic yards of gravel at the Nichols mine on Red Cap Creek yielded 84 ounces of gold and 9 ounces of silver in 1939. Cleaning bedrock at the Pearch hydraulic mine on the Klamath River northwest of Orleans yielded 154 ounces of gold and 23 ounces of silver.

IMPERIAL COUNTY

Cargo Muchacho district.—In 1939 the Desert Gold & Aluminum Corporation used a power shovel for delivering gravel to stationary sluice boxes. The American Girl mine was operated by O'Brien Mines, Inc., from the first of the year until April 30, when the company was consolidated with Gold Diggers, Inc. The new organization, Allied Mines, Inc., worked the property until August 7, when operations were suspended owing to lack of profitable ore; 33,345 tons of ore were treated in the company 160-ton flotation mill, and 888 tons of copper concentrates shipped to smelters contained 4,815 ounces of gold, 1,863 ounces of silver, and 71,605 pounds of copper. This operation was in process of liquidation at the end of the year. The Holmes & Nicholson Mining & Milling Co. worked the Cargo Muchacho Group comprising the Madre, Padre, Madre No. 2, Cargo Muchacho, and Cargo Muchacho No. 3 claims; the gold ore was hauled to the company 80-ton cyanide mill 12 miles from the mine and 4 miles west of Winterhaven. This mill also accepted custom ore. The Sovereign Development Co. worked the Sovereign mine in the same district; all the ore, except a small quantity shipped for direct smelting, was treated by cyanidation. The principal product was gold. A small quantity of Tumco old tailings was treated by cyanidation.

INYO COUNTY [2]

Carbonate district.—Gold ore from the Ashford and Golden Treasure mines was shipped to a custom cyanide plant and to a smelter in 1939.

Cerro Gordo district.—Ore and old tailings from the Monte Carlo mine were treated early in 1939 in the 75-ton countercurrent decantation-cyanidation plant of Keeler Gold Mines, Inc.; this plant also treated custom ore, principally from the Skidoo section of the Wildrose mining district.

Coso (Darwin) district.[3]—A number of old mines in the Coso district were explored during 1939, and several small shipments of gold and gold ore were reported.

Echo Canyon district.—A number of shipments of gold ore were made from the Inyo mine to a custom cyanidation mill in 1939.

Fish Springs district.—Several kinds of ore were shipped from the Montezuma mine in 1939—25 tons of gold-silver ore shipped to a custom cyanide plant yielded 3 ounces of gold and 193 ounces of silver; from 33 tons of zinc-lead ore shipped to a selective-flotation custom mill concentrates were made, containing 2 ounces of gold, 260 ounces of silver, 6,435 pounds of lead, and 7,914 pounds of zinc; and 70 tons of lead ore shipped to a smelter contained 6 ounces of gold, 629 ounces of silver, 164 pounds of copper, and 15,075 pounds of lead.

Sherman district.—The Argus Mining Co. operated the Orondo mine throughout 1939; the ore was crushed, and gold and silver were extracted by cyanide leaching. Burton Bros., Inc., cyanided 18,117 tons of ore from its Ruth mine and recovered 2,930 ounces of gold and 651 ounces of silver; the ore was very porous and after crushing was treated by cyanide leaching in a 5-day cycle.

South Park district.—Banta Mines produced 239 tons of gold ore at the American Eagle and Suitcase mines during 1939; the ore was treated by amalgamation and cyanidation and yielded 168 ounces of gold and 147 ounces of silver. The Gem Mines, Inc., operated a flotation mill at the Gem mine in the Jail Canyon section of the South Park district. Lessees worked the Gold Bug mine.

Union district.—Ore was shipped to custom cyanidation plants from the Reward (Brown Monster) mine during 1939.

Wildrose district.—Lessees operated the Del Norte mine in the Skidoo section of the Wildrose district during 1939; the ore was shipped to custom cyanidation mills for treatment. P. H. Greer Co., Inc., worked the Gold King mine for 8 months and shipped 1,273 tons of ore to a custom cyanidation mill; 726 ounces of gold and 3 ounces of silver were recovered.

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[2] *See also* Tucker, W. B., and Sampson, R. J., Mineral Resources of Inyo County, Calif.: Jour. Mines and Geol., State Min. Rept., vol. 34, No. 4, 1938, pp. 368–500.

[3] *See also* Kelley, Vincent C., Geology and Ore Deposits of the Darwin Silver-lead Mining District, Inyo County, Calif.: Jour. Mines and Geol., State Min. Rept., vol. 34, No. 4, 1938, pp. 503–562.

KERN COUNTY

Agua Caliente district.—Gold ore was treated by amalgamation and gravity concentration at the Aunt Rosa mine in 1939.

Cove district.—The Kern Mines, Inc., worked the Big Blue and Lady Belle groups throughout 1939 and treated 34,259 tons of ore by amalgamation and flotation in its 150-ton mill; the product was 2,178 ounces of gold and 887 ounces of silver, recovered as bullion, and 481 tons of concentrates which contained 5,724 ounces of gold, 5,611 ounces of silver, 1,314 pounds of copper, and 11,900 pounds of lead.

Mojave district.—Lindgren and Ryder shipped 240 tons of ore from the New Bob-Tail mine to a custom cyanidation mill in 1939; 139 ounces of gold were recovered. The Cactus Mines Co. operated the Cactus Queen mine in the Middle Butte section of the Mojave district throughout the year; gold-silver ore was treated in the company 125-ton cyanidation and flotation mill, and the resulting concentrates were shipped to a smelter. This mine was the State's leading silver producer in 1939, as in 1938. Gold ore was shipped to a custom cyanidation plant from the Eureka mine in 1939. Lessees shipped 6,722 tons of ore to a custom cyanide plant from the Fairview mine in the Rosamond section of the Mojave district; 1,334 ounces of gold and 5,270 ounces of silver were recovered. Four sets of lessees at the Four Jacks mine mined 2,481 tons of ore, which was shipped to custom cyanide mills and yielded 765 ounces of gold and 13,995 ounces of silver. The Pride of Mojave Mining Co. worked the Four Star mine. The Golden Queen Mining Co. operated the Golden Queen mine the entire year; in addition to treating a large tonnage of company ore in its 425-ton cyanidation mill, it did a substantial custom-mill business. The Lodestar Mining Co. worked the Lodestar mine throughout the year and shipped gold ore to the Golden Queen mill for treatment. Lessees worked the Middle Butte mine. Burton Bros., Inc., operated the Tropico mine both on company account and through lessees; 15,226 tons of ore cyanided yielded 4,877 ounces of gold and 15,674 ounces of silver. In addition to treating company and lessee ore, the organization handled custom ore for more than 350 shippers. As a pioneer in California custom milling east of the Sierra Nevada Mountains, Burton Bros., Inc., has been an important factor in the development of mineral resources within a radius of many miles. Owing to good roads and cheap truck transportation, ore has been sent to this mill from mines more than 100 miles away. Whitmore Mines, Inc., and lessees shipped 1,573 tons of gold-silver ore to custom cyanide mills; 444 ounces of gold and 12,690 ounces of silver were recovered. Lessees shipped gold ore to custom cyanide mills from the Yellow Dog mine throughout 1939.

Pioneer district.—A lessee on the Mammoth property in the Keysville section of the Pioneer district cyanided old tailings in 1939.

Randsburg district.—The Big Dyke mine was operated intermittentlyd uring 1939. Ore and old tailings were treated by amalgamation at the Black Hawk mine. The Butte Lode Mining Co. worked the Big Butte property. Ore and old tailings were treated by amalgamation at the King Solomon mine. Ore was shipped to custom mills from the Lucky Boy mine; 302 tons of ore yielded 336 ounces of gold and 93 ounces of silver. At the Operator mine ore was amalgamated and old tailings were cyanided. The Anglo American Mining Corporation, Ltd., operated the Yellow Aster mine [4] and old tailing pile from the first of the year until December, when a labor strike caused suspension of operations. According to the company printed annual report for the year ended December 31, 1939, 852,438 tons of ore were mined from the open pit and dumps, of which 845,654 tons were crushed and screened; the undersize—271,413 tons—was milled and the oversize discarded as waste; 266,907 tons were cyanided. The average content of the ore in place was valued at 72 cents per ton, the average of cyanide-plant tailings at 28 cents per ton, and the average of oversize discarded at 26 cents per ton. Ore was mined with power shovels and delivered to the crushing plant in trucks. In addition to the ore sent to the cyanide plant, 156,243 tons of old tailings were cyanided. When the labor strike was settled March 26, 1940, the pit was not reopened, but cyanidation of old tailings was resumed. This company handled more than a million tons of ore and old tailings and ranked higher in tonnage worked than any lode mine in the State during 1939.

LOS ANGELES COUNTY

Cedar district.—The Governor mine operated by the Governor Mine Co. was the leading producer of gold in Los Angeles County in 1939.

MADERA COUNTY

Potter Ridge district.—A lessee worked the Enterprise mine throughout 1939. A 35-ton cyanide leaching plant treated old tailings at the Nogi Extension mine from January 1 to September 20; 4,102 tons of old tailings yielded 159 ounces of gold and 43 ounces of silver.

MARIPOSA COUNTY

East Belt district.—The Bandarita Mining Co. worked the Bandarita mine in the Red Cloud section of the East Belt district throughout 1939 and treated 1,228 tons of ore by amalgamation and flotation; 179 ounces of gold and 22 ounces of silver were recovered in bullion, and 125 ounces of gold, 150 ounces of silver, and 254 pounds of copper were contained in 73 tons of concentrates. A lessee operated the Marble Springs mine during 1939 and treated 466 tons of ore by amalgamation to recover 124 ounces of gold and 32 ounces of silver. Operation of the Nutmeg mine in the Whitlock section of the district from January 1 to November 1 resulted in the production of 425 tons of ore yielding 394 ounces of gold and 92 ounces of silver by amalgamation; the property was sold November 1 to an organization that prepared for expanded production by building a powerline to the property, installing a 25-ton mill, and deepening the shaft 130 feet. The San Juan Ramsey Co. worked the Original and Ferguson mine throughout the year; 7,573 tons of ore treated by amalgamation and flotation yielded bullion, containing 1,911 ounces of gold and 510 ounces of silver, and 81 tons of concentrates, containing 256 ounces of gold and 141 ounces of silver. Amalgamation of 665 tons of ore at the Our Chance mine yielded 344 ounces of gold and 58 ounces of silver.

[4] *See also* Frolli, A. W., Open-pit Mining and Milling Methods and Costs at the Yellow Aster Mine, Randsburg, Calif.: Bureau of Mines Inf. Circ. 7096, 1940, 46 pp.

Hunter Valley district.—The Cotton Creek Mining Co. worked the Cotton Creek mine during 1939. The Mount Gaines Mining Co. operated the Mount Gaines mine in the Quartzburg section of the Hunter Valley district throughout the year; 19,341 tons of ore treated by amalgamation and flotation yielded bullion, containing 3,793 ounces of gold and 1,189 ounces of silver, and 445 tons of concentrates, containing 3,527 ounces of gold, 1,332 ounces of silver, 1,758 pounds of copper, and 324 pounds of lead. The Mariposa-Washington Mining Co. worked the Washington mine, also in the Quartzburg section of the district, from August 1 to the end of the year and built a 75-ton concentrating mill. A lessee on the Ruth Pierce property in the Hornitos section of the district cyanided 3,181 tons of old tailings and recovered 176 ounces of gold and 149 ounces of silver; the tailings were given a 72-hour leach.

Mother Lode district.—A bulldozer was used to move 10,000 cubic yards of gravel to sluices at the Five Aces mine on the North Fork of Merced River; 105 ounces of gold and 11 ounces of silver were recovered in 1939. The Trebor Corporation operated a dragline dredge on Agua Fria Creek for 9 months; the dragline excavator had a 2-cubic yard bucket. The Bondurant Mining & Milling Co. worked the Bondurant mine. Madden and Goulter worked the Goldbug, Miocene No. 2, and Miocene No. 3 claims from May until the end of the year; 138 tons of ore amalgamated yielded 595 ounces of gold and 122 ounces of silver. The Buckeye Mining Co. worked the Granite King mine throughout the year and produced 396 tons of ore from which 285 ounces of gold and 91 ounces of silver were recovered by amalgamation. Operation of the Hasloe mine yielded 211 tons of ore, from which 199 ounces of gold and 76 ounces of silver were recovered by plate-amalgamation and barrel-amalgamation of gravity concentrates. The Boston California Mining Co. operated the Malvina mine. The Pacific Mining Co. worked the Pine Tree and Josephine mines throughout the year and treated ore in the company 150-ton flotation mill; jig concentrates were amalgamated and flotation concentrates shipped to a smelter. This company was the largest gold producer in Mariposa County in 1939. A partnership worked the Red Banks mine from March 15 to October 15 and treated 12,796 tons of ore by amalgamation and flotation; 206 ounces of gold and 70 ounces of silver were recovered as bullion; and 1,340 ounces of gold, 6,822 ounces of silver, and 481 pounds of copper were contained in concentrates.

MERCED COUNTY

Snelling district.—The B & W Mining Co. operated a dragline dredge 1 mile west of the town of Merced Falls from August 15, 1939, until the end of the year, and 120,000 cubic yards of gravel yielded 879 ounces of gold and 102 ounces of silver; the washing plant used electric power, and the dragline excavator (2-cubic yard bucket) burned stove oil. The Merced Dredging Co. operated an electrically powered dredge, with sixty 9½-cubic foot buckets, 1 mile west of Snelling throughout the year. The San Joaquin Mining Co. operated an electrically powered dredge, with sixty-four 9½-cubicfo ot buckets, 3 miles west of Snelling. The Snelling Gold Dredging Co. operated two electrically powered dredges—one with sixty-six and the other with seventy-seven 7-cubic foot buckets; both dredges operated the full year. Four miles east of Snelling the Yuba Consolidated Gold Fields operated throughout the year two electrically powered dredges—one with seventy-two 9-cubic foot buckets and the other with seventy-one 5¾-cubic foot buckets.

MONO COUNTY

Blind Springs district.—Several small mines were active in the Blind Springs district during 1939. The most important development, however, was the building of a cyanidation and flotation custom mill by the Mineral Reduction Co. By the end of the year more than 75 shippers had taken advantage of the mill and nearly 4,000 tons of ore had been treated; treatment of a much larger tonnage in 1940 was expected. Ore was shipped from many points in the Owens Valley and from Nevada, and a substantial revival of mining, particularly at small gold and silver properties, seemed probable.

Bodie district.—The Roseklip Mines Co. operated its 300-ton cyanidation mill on dump ore from the Standard mine throughout 1939. A small cyanide leaching plant treated 1,500 tons of old tailings at the Syndicate mine between July 12 and November 8 and recovered 164 ounces of gold and 379 ounces of silver.

Chidago district.—Lessees operated the Casa Diablo mine and shipped gold-silver ore to a cyanidation custom mill in 1939. The Gold Crown mine also was active.

Mammoth Lakes district.—The Monte Christo Co. worked the Monte Christo mine from October 10 to December 23, 1939; 257 tons of ore shipped to a custom cyanidation plant yielded 168 ounces of gold and 2,981 ounces of silver.

May Lundy district.—The Simpson (Log Cabin) mine was operated during 1939.

White Mountain district.—Molini Bros. operated the Green Monster mine and shipped silver ore to a smelter in 1939.

MONTEREY COUNTY

Los Burros district.—An exploration and development campaign was carried on at the Last Chance property in 1939; new ore was developed in the old mine, and a 25-ton flotation plant was built during the year.

NAPA COUNTY

Calistoga district.—The Graham Loftus Oil Corporation operated the Grigsby (Palisade) mine throughout 1939; the ore was treated by flotation, and the concentrates were shipped for smelting.

NEVADA COUNTY

French Corral district.—The Climax Dredging Co. operated a dragline dredge on the H. C. Black property on Deer Creek from November 10, 1939, until the end of the year. The dragline excavator had a Diesel engine and a 1-cubic yard bucket.

Grass Valley-Nevada City district.—The Atlas Gold Dredging Corporation operated a dragline dredge on several properties, including the Dawson City and the Larsen-Klein, during the first half of 1939. The Innis Dredging Co. treated 750,000 cubic yards of gravel and recovered 5,557 ounces of gold with a dragline dredge during 1939; the dragline excavator had a 2-cubic yard bucket. The Calneva Mining Co. worked gravel on the Martell ranch with a dragline dredge. J. C. Pantle operated a dry-land dredge equipped with Ainlay centrifugal bowls on the Gleason and Robinson ranches on Clear Creek 4 miles south of Rough and Ready; 107,138 cubic yards of gravel treated at the Robinson ranch yielded 563 ounces of gold, and 95,000 yards of gravel treated at the Gleason ranch yielded 303 ounces of gold. William Richter operated a dragline dredge on Scotts Flat Creek from October 25 until the end of the year; the dragline excavator had a 1½-cubic yard bucket. The Grass Valley Bullion Mines, Inc., operated throughout 1939; the ore was trucked to the Idaho Maryland Mines, Inc., mill at Grass Valley for treatment by amalgamation, flotation, and concentrate-cyanidation. Empire Star Mines, Ltd., operated the Empire, North Star, and Pennsylvania mines at Grass Valley; the Murchie mine at Nevada City; the Zeibright mine in Bear Valley; and the Pennsylvania mine at Browns Valley, Yuba County. During the year known bodies of ore at the Murchie mine were exhausted, but exploration work was continued. Early in 1940 a flood on the Bear River washed out the Zeibright tailings pond and caused a cessation of operations until a new tailings-disposal method could be worked out. Cooley Butler operated the Golden Center mine throughout 1939. The Great Northern Mines, Inc., worked the Hoge mine throughout the year; gold ore and old tailings were treated by amalgamation and flotation. A lessee worked the Green Mountain mine at Nevada City. The Idaho Maryland Mines Corporation operated the Idaho Maryland-Brunswick Group throughout 1939. According to the company printed annual report for the year ended December 31, 1939, 115,001 ounces of gold were recovered from 410,411 tons of ore compared with 117,267 ounces of gold recovered from 331,406 tons in 1938. In 1939, 30 percent of the production came from development headings. In addition to company ore, 23,815 tons of custom ore from Grass Valley Bullion Mines, Inc., and 218 tons of custom concentrates were treated in the company metallurgical plant. Dividends declared and paid in 1939 totaled $1,066,285.80. This mine had the largest gold output of any mine in California in 1939. The Lava Cap Gold Mining Corporation operated the Lava Cap mine throughout the year; 116,380 tons of ore were treated by amalgamation and flotation, and the resulting concentrates were shipped for smelting. Recovery was as follows: By amalgamation, 2,285 ounces of gold and 596 ounces of silver; in flotation concentrates, 32,580 ounces of gold, 265,319 ounces of silver, 10,486 pounds of copper, and 17,712 pounds of lead. Development work was continued by the Spring Hill Gold Mines Corporation throughout the year.

Washington district.—The Bradley Mining Co., operator of the Spanish mine, ended in 1939 its long record as the largest producer in the Washington district; the mine was on a production basis until March, on a development basis from April to August, and on a small-production basis by lessees the rest of the year.

You Bet district.—The Pilot Dredging Co. operated a dragline dredge on the Alpha Stores property during 1939. Minnis & Moody worked the Little York placer 3 miles west of Dutch Flat from May 1 to December 1; a ¾-cubic yard gasoline shovel and trucks were used for delivering 18,000 cubic yards of gravel to a stationary washing plant; and 525 ounces of gold were recovered. F. R. Croft operated a dry-bank plant on the Shorty Jefferies mine from January 1 to June 15; a bulldozer and ⅜-cubic yard gasoline shovel were used in delivering gravel to a stationary washing plant; and 351 ounces of gold were recovered.

ORANGE COUNTY

Santa Rosa district.—The Blue Light Silver Mines Co. operated the Silverado or Blue Light mine in Silverado Canyon from May 15, 1939, until the end of the year; 800 tons of ore were treated by flotation, and a bulk concentrate containing 9 ounces of gold, 4,095 ounces of silver, 10,476 pounds of lead, and 9,549 pounds of zinc was shipped to another mill for selective flotation.

PLACER COUNTY

Auburn district.—The Gaylord La Valle drift mine was operated in 1939 (in succession) by Swinburn & Associates, Jose Oro Mining Co., J. A. Conner, and Conner and Swinburn; 1,975 cubic yards of gravel yielded 326 ounces of gold.

Butcher Ranch district.—The Monarch Syndicate cyanided ore from the Monarch mine during the early months of 1939.

Damascus district.—The Lost Camp Mining Co. worked the Lost Camp hydraulic mine in Blue Canyon for 45 days in 1939.

Dutch Flat district.—The Canyon Mines Corporation treated ore from the Rawhide mine throughout 1939 in the company 100-ton amalgamation and concentration mill.

Foresthill district.—The Volcano Mining Co., Ltd., worked the Volcano drift mine throughout 1939; 1,400 cubic yards of gravel yielded 271 ounces of gold and 35 ounces of silver.

Lincoln district.—Pantle Bros. operated a dry-land dredge on the Stevens, Clark, and Ahart ranches and in Auburn Ravine in 1939; in all, 329,000 cubic yards of gravel were excavated with a 1-cubic yard gasoline dragline excavator and delivered to a dry-land washing plant carrying four Ainlay bowls. Fay Placer mine operated a dragline dredge on the Guilford ranch throughout the year; the dragline excavator had a ½-cubic yard bucket. W. K. Jansen treated 245,162 cubic yards of gravel on the Jones and Finney ranches; a dragline excavator with a 1½-cubic yard bucket was used to deliver gravel to a dry-land washing plant. The Midland Co. operated a dragline dredge intermittently during 1939 and treated 250,000 yards of gravel yielding 715 ounces of gold and 104 ounces of silver; the dragline excavator had a 1¼-cubic yard bucket. Four miles east of Lincoln the Jasper-Stacy Co. operated throughout the year an electrically powered dragline dredge using a dragline excavator with a 2-cubic yard bucket. The gravels of this district carry zircon, which was produced as a byproduct at plants using jigs; no market has yet been developed for this product.

Ophir district.—The Panob Gold Dredging Co. operated a nonfloating washing plant, using a dragline excavator with a 1¼-cubic yard bucket, on the F. E. Kayo and the G. E. Stoll properties near Loomis in 1939. The Gold Hill Dredging Co. operated an electrically powered connected-bucket dredge with eighty-seven 8½-cubic foot buckets on the Chabot property 2 miles east of Loomis from January

1 to May 14. F. O. Bohnett operated a dry-land plant on several properties during the year. The Alabama California Gold Mines Co. worked the Alabama mine throughout 1939 and treated 74,539 tons of ore in the company 300-ton amalgamation and flotation mill to yield bullion, containing 10,157 ounces of gold and 3,266 ounces of silver, and 652 tons of concentrates, containing 3,231 ounces of gold, 39,530 ounces of silver, 5,771 pounds of copper, and 26,826 pounds of lead. The Oro Fino Consolidated Mines operated the Oro Fino mine. The Burm Ball Mining Co. operated the Sisley mine throughout the year.

PLUMAS COUNTY

Crescent Mills district.—A. A. Merritt and F. Humphrey, under the name of "Cherokee Mine", produced 8,635 tons of ore from the Cherokee mine between January 16, 1939, and the end of the year; the ore was treated in a 100-ton amalgamation and flotation mill (built during the year) and yielded 165 ounces of gold and 40 ounces of silver in bullion and 1,046 ounces of gold, 277 ounces of silver, and 904 pounds of copper in 35 tons of flotation concentrates. The North Canyon Mines, Inc., worked the Droege and New York mines in 1939. The Indian Valley Mining Co., Inc., worked the Standart mine from January 1 until February 27, when a fire destroyed the 150-ton mill built in 1938; a new 250-ton amalgamation and flotation mill was built and placed in operation August 16, and 24,000 tons of ore treated yielded 1,410 ounces of gold and 347 ounces of silver.

Genesee district.—The Walker mine of the Walker Mining Co. (affiliate of the Anaconda Copper Mining Co.) has been the outstanding mine in Plumas County for many years and was the State's principal copper producer in 1939. According to the company printed annual report for the year ended December 31, 1939, 367,041 tons of ore were milled and 17,342 tons of concentrates produced. Shipments consisted of 17,056 tons of concentrates, lime scale, and precipitates, with a net recovery of 8,010,226 pounds of copper, 180,039 ounces of silver, and 11,777 ounces of gold.

Granite Basin district.—The Robinson mine was operated in 1939 from May until November 10; ore was treated in the 50-ton amalgamation and flotation mill on the property.

Quincy district.—The Imperial mine was active during 1939.

Rich Bar district.—Lord & Bishop operated a dragline dredge at Grays Flat during the early months of 1939. The Virgilia Mining Corporation continued operations at the Ohio Point Group during 1939.

RIVERSIDE COUNTY

Dale district.—A large number of small operations in 1939 were reported in the Riverside County part of the Dale district.

Eagle Mountain district.—The Imperial Smelting & Refining Co. treated 7,903 tons of ore in the 100-ton flotation mill at the Black Eagle mine in 1939; 1,195 ounces of gold, 16,451 ounces of silver, 88,220 pounds of copper, and 676,180 pounds of lead were contained in the concentrates produced. The company contributed 62 percent of the total lead produced in the State in 1939.

Pinacate district.—The Ida Leona Mine & Milling Co. worked the Ida Leona mine throughout 1939.

SACRAMENTO COUNTY

Cosumnes River district.—The Cosumnes Gold Dredging Co. operated a connected-bucket dredge with sixty-three 12-cubic foot buckets 7 miles southwest of Sloughhouse during 1939. The Hoosier Gulch Placers worked bodies of gravel throughout the year on Hoosier Gulch, Katesville Gulch, Lagoon Gulch, and Ohio Gulch with an electrically powered dragline dredge; the dragline excavator used a 2-cubic yard bucket.

Folsom district.—The Capital Dredging Co. operated two connected-bucket dredges in 1939 at its property 5 miles south of Folsom; both dredges were electrically powered—one having 88 and the other 100 18-cubic foot buckets. Cutter & Mueller treated 17,492 cubic yards of gravel on a property 2 miles east of Fair Oaks on the American River from May until December, using a gasoline shovel with a ¾-cubic yard dipper in connection with a dry-bank washing plant; 150 ounces of gold and 8 ounces of silver were recovered. The General Dredging Corporation operated a dragline dredge on two properties on the American River; one dragline excavator had a 1¼-cubic yard bucket and the other a 3-cubic yard bucket. The Natomas Co. operated a fleet of seven dredges, all electrically powered, on its property near Natoma. The number and size of buckets per dredge were: No. 1 dredge, 62 16-cubic foot buckets; No. 4, 67 15-cubic foot buckets; No. 5, 105 12-cubic foot buckets; No. 6, 106 11-cubic foot buckets; No. 7, 98 9-cubic foot buckets; No. 8, 105 12-cubic foot buckets; and No. 10, 83 15-cubic foot buckets.

SAN BERNARDINO COUNTY

Calico district.—A lessee on the Zenda mine in 1939 recovered 8,329 ounces of silver and 2 ounces of gold by treating old tailings in a 12-ton leaching plant; in addition, 107 tons of ore shipped for smelting contained 3,291 ounces of recoverable silver.

Dale district.—The Camco Mining Co. operated the Carlyle mine during 1939. The Gold Crown Mining Co., Ltd., worked the Gold Crown mine throughout the year; in addition to treating company ore, the mill handled a large quantity of custom material. This new outlet for ore helped to reopen many small mines nearby in both San Bernardino and Riverside Counties.

Holcomb Valley district.—The Holcomb Valley Placer Co. operated a dry-bank plant in 1939 from February 5 to November 27. The Santa Fe Gold Mining Corporation worked the Santa Fe mine the latter part of the year.

Ord Mountain district.—The Ramsey Mining Co. worked the Ramsey or Wheeler mine throughout 1939.

Randsburg district.—In 1939 a lessee on the property of Atolia Rand Placers, Inc., 1 mile west of Atolia in the part of the Randsburg district extending from Kern into San Bernardino County, treated 1,309 cubic yards of gravel obtained by trenching and drifting, which yielded 148 ounces of gold and 27 ounces of silver. Lessees working the Kelly mine shipped gold-silver ore to a smelter. The mill at the property was rehabilitated during the year as a cyanidation and flotation plant; treatment of ore began January 1, 1940. In addition to ore from the Kelly mine, custom material is solicited.

Silver Mountain district.—A number of operations in 1939 reported small outputs in the Silver Mountain district; much of the ore produced was shipped to a custom cyanide plant.

Solo district.—The Korfist Mining Co. worked the Aero Trust mine during 1939; most of the ore was shipped to a smelter.

SAN FRANCISCO COUNTY

Small-scale placer miners worked the Pacific Ocean beach sands near the San Francisco-San Mateo County line in 1939 and recovered 224 ounces of gold and 18 ounces of silver.

SAN DIEGO COUNTY [5]

Julian district.—Development work and some production during 1939 were reported at the Ranchito mine.

Pine Valley district.—Ore was shipped to a custom cyanide plant and a smelter from the Eagles Nest Group in Long Valley; the property was discovered in April 1939.

SAN JOAQUIN COUNTY

Linden district.—A. G. Watkins & Sons operated a dragline dredge throughout 1939.

SHASTA COUNTY [6]

French Gulch district.—The Lincoln Gold Dredging Co. treated 198,163 cubic yards of gravel in 1939 and recovered 544 ounces of gold and 61 ounces of silver by dragline dredging on Clear Creek near French Gulch; the dragline excavator had a 1¼-cubic yard bucket. Operations at the Mad Ox mine produced 1,327 tons of ore which yielded 211 ounces of gold and 5 ounces of silver. The J. H. Scott Co. worked the Washington mine throughout the year; 8,174 tons of ore were treated by amalgamation and flotation to yield 2,561 ounces of gold and 574 ounces of silver in bullion and 2,200 ounces of gold, 742 ounces of silver, and 4,000 pounds of lead in 330 tons of concentrates.

Igo district.—R. S. Olson operated a dragline dredge on China Gulch, using a dragline excavator with a ¾-cubic yard bucket, throughout 1939. The Clear Creek Dredging Co. operated a dragline dredge from May 1 to the end of the year; the dragline excavator, with a 1½-cubic yard bucket, used Diesel power. Lord & Bishop operated a dragline dredge during 1939. Baker & McCowan operated a dragline dredge with a dragline excavator and a 1½-cubic yard bucket on Dry Creek from January 1 to June 17. Cinco Mineros Co. operated a dragline dredge near Gas Point from January 1 until May 15; the dragline excavator had a 1½-cubic yard bucket. Piombo Bros. & Co. operated a dragline dredge on Dry Creek from January 1 to June 15; the dragline excavator used gasoline-engine power and had a 1½-cubic yard bucket. The Pioneer Dredging Co. operated an electrically powered dragline dredge with a 3-cubic yard bucket in the Happy Valley section of the Igo district. The El Oro Dredging Co.

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[5] *See also* Tucker, W. B., and Sampson, R. J., Mineral Resources of San Diego County, Calif.: Jour. Mines and Geol., State Min. Rept., vol. 35, No. 1, 1939, pp. 8–55.

[6] *See also* Averill, Chas. Volney, Mineral Resources of Shasta County, Calif.: Jour. Mines and Geol., State Min. Rept., vol. 35, No. 2, 1939, pp. 108–191.

worked a dragline dredge on the Rice property. The Roaring River Gold Dredging Co. operated a connected-bucket dredge with seventy-two 3-cubic foot buckets on Roaring River near Gas Point.

Iron Mountain district.—The Mountain Copper Co. Ltd.,[7] largest mineral producer in Shasta County, worked the Iron Mountain mine throughout 1939; the ore was mined by the open-cut method and cyanided in a 500-ton sand-leaching plant and a 200-ton counter-current slime plant.

Old Diggings district.—Walker Mines, Consolidated, worked the Walker mine in 1939 from April until the end of the year; 9,770 tons of ore were cyanided and yielded 984 ounces of gold and 495 ounces of silver.

Redding district.—A sand and gravel plant on the Sacramento River north of Redding recovered 152 ounces of gold and 14 ounces of silver in 1939 as a byproduct in the preparation of 75,000 tons of sand and gravel.

Shasta district.—Treatment of 430 tons of ore in a 600-ton ball mill in the Hopeso mine yielded 159 ounces of gold and 23 ounces of silver by amalgamation in 1939.

SIERRA COUNTY

Alleghany district.—Gamble & Wilson operated the Kenton mine from the beginning of 1939 until December 1. The Dickey Exploration Co. worked the Oriental mine from September 1 until the end of the year; the old stamp mill on the property was rebuilt as a flotation plant so that sulfide ores could be treated. Original Sixteen to One Mine, Inc., largest gold producer in Sierra County, was active throughout the year. After consolidation of O'Brien Mines, Inc., former operator of the Plumbago mine, with Gold Diggers Syndicate, control of the property passed to Allied Mines, Inc., on April 30; 9,854 tons of ore treated by amalgamation and gravity concentration yielded bullion, containing 1,329 ounces of gold and 215 ounces of silver, and 162 tons of concentrates, containing 521 ounces of gold.

Downieville district.—The Ruby mine on Rock Creek near Goodyears Bar was operated throughout 1939 and was the most productive drift placer in the State.

Pike district.—The Sierra Alaska mine was the leading producer in the Pike district in 1939.

Sierra City district.—A lessee on the Colombo property mined 1,200 tons of ore during 1939, most of which was shipped direct to smelters; settlement was made for 1,147 ounces of gold and 40 ounces of silver. The Sierra Buttes Tailing Co. treated 1,311 tons of old tailings by cyanide leaching and gravity concentration and recovered 95 ounces of gold and 28 ounces of silver, in bullion, and 20 tons of concentrates, containing 146 ounces of gold and 46 ounces of silver

SISKIYOU COUNTY

Callahan district.—Yuba Consolidated Gold Fields operated a connected-bucket dredge with seventy-two 9-cubic foot buckets on Scott River north of Callahan throughout 1939.

[7] *See also* Averill, Chas. Volney, The Mountain Copper Co., Ltd., Cyanide Treatment of Gossan: Jour. Mines and Geol., State Min. Rept., vol. 34, No. 3, 1938, pp. 312–330.

Greenhorn district.—The Cal Oro Dredging Co. operated a connected-bucket dredge on Greenhorn Creek north of Yreka intermittently in 1939; the company reported that 1,000,000 cubic yards of gravel were treated, with a recovery of 1,653 ounces of gold and 281 ounces of silver. The Yreka Gold Dredging Co. operated a connected-bucket dredge, with sixty-seven 6-cubic foot buckets, 2 miles north of Yreka.

Humbug district.—William Von der Hellen Mines operated a stationary washing plant on the Klamath River in 1939 from April 12 to the end of the year; two shovels, one of 1½ and the other of 1¼ cubic yards capacity, and six trucks were used in excavating and delivering the gravel to the washing plant.

Klamath River district.—The Lincoln Gold Dredging Co. operated two dragline dredges on Klamath River near Happy Camp in 1939 from March 15 to September 13; one dragline excavator had a 2-cubic yard bucket and the other a 1¼-cubic yard bucket, and 485,910 cubic yards of gravel yielded 3,776 ounces of gold and 454 ounces of silver. Larsen Bros. and Harms Bros. operated a dragline dredge at the Scandia mine on Horse Creek throughout the year; the dragline excavator had a 2½-cubic yard bucket. Merriam Mining Merger worked the Buzzard Hill quartz mine.

Liberty district.—Hydraulicking 20,000 cubic yards of gravel at the Banner mine in 1939 from January 1 to July 10 yielded 117 ounces of gold and 18 ounces of silver. Hydraulicking, drifting, and small-scale hand methods were used at the Joubert mine. A lessee worked the S. T. S. mine on Eddy's Gulch by hydraulicking from January to July. The King Solomon Mines Co. operated the King Solomon mine throughout the year; the ore was mined by the open-cut method and treated by amalgamation in a 300-ton mill.

Salmon River district.—Sacchi & Spellenberg operated a dragline dredge in 1939 on the South Fork of Salmon River near Forks of Salmon from February to the end of the year; the dragline excavator used Diesel power and had a 1½-cubic yard bucket.

Scott Bar district.—A lessee worked the Quartz Hill mine during 1939.

STANISLAUS COUNTY

Jenny Lind district.—The California Gold Dredging Co. operated a connected-bucket dredge, with eighty-one 6-cubic foot buckets, throughout 1939. The Placer Properties Co. operated a dragline dredge on the Stanislaus River near Oakdale from July 18 to the end of the year.

La Grange district.—The La Grange Gold Dredging Co. operated a connected-bucket dredge with sixty-two 9½-cubic foot buckets on the Tuolumne River, and the Tuolumne Gold Dredging Corporation operated a connected-bucket dredge with 100 12-cubic foot buckets throughout 1939.

TEHAMA COUNTY

Bend district.—The Midland Co. operated a dragline dredge in the Bend district for a short time in 1939. The Tehama Dredging Co. operated a dragline dredge on the Evans mine from May 10 to the end of the year; the dragline excavator had a ½-cubic yard bucket.

TRINITY COUNTY

Hayfork district.—The Cinco Mineros Co. operated a dragline dredge, equipped with a dragline excavator using a 1½-cubic yard bucket, near Hayfork in 1939 from May 19 to the end of the year. The Hayfork Gold Dredging Co. operated a dragline dredge during the early months of the year, after which the plant was dismantled and shipped to Sonora, Mexico.

Helena district.—A lessee operated the Enterprise mine throughout 1939 except during June and July; from 560 tons of ore treated by amalgamation and flotation 270 ounces of gold and 59 ounces of silver were recovered in bullion, and 41 ounces of gold and 31 ounces of silver were contained in 41 tons of concentrates.

Junction City district.—The Bergin hydraulic mine was operated 3 months in 1939. Canyon Placers, Inc., worked the Canyon Placers in Canyon Creek 8 miles from Junction City from the first of the year until May 19. The Junction City Mining Co. operated an electrically powered connected-bucket dredge, with seventy-two 10-cubic foot buckets, on Trinity River near Junction City throughout the year. The Goldfield Consolidated Mines Co. worked the Red Hill mine from January 1 to June 1 and from December 9 to 31. The Golden Gravel Mining Co. operated a dragline dredge intermittently on the Sourdough Group on Trinity River 8 miles west of Junction City.

Lewiston district.—Interstate Mines, Inc., operated a dragline dredge during 1939. The Lincoln Gold Dredging Co. moved a dragline dredge, with a dragline excavator using a 2-cubic yard bucket, to the Leas & Lowden, Adrian, and Lunden properties late in the year; the treatment of 55,435 cubic yards of gravel yielded 269 ounces of gold and 31 ounces of silver. The Lewiston Gold Dredging Co. operated a connected-bucket dredge from January 1 until the boat was sunk on December 9. The company reported that work would not be resumed. T. D. and C. R. Harris operated a connected-bucket dredge on Trinity River 4 miles above Lewiston throughout the year; the dredge used electric power and had forty-two 11-cubic foot buckets. The Brown Bear lode mine produced from dumps and mill clean-up. The property was worked by E. E. Erich from January until May, when F. E. Yocum, operating as the Mines Exploration Co., took over the lease; during August a 1,000-ton test run was made on dump ore.

New River district.—Johnston Bros. operated the Hazel D property during 1939, and the ore was treated in a 25-ton amalgamation mill.

Salyer district.—The Swanson Mining Corporation hydraulicked a small yardage of high-grade gravel on the South Fork of Trinity River, working intermittently between January 1 and May 29, 1939.

Trinity Center district.—The Carrville Gold Co. operated its connected-bucket dredge through its agent, Yuba Consolidated Gold Fields, from September 15, 1939, to the end of the year.

Weaverville district.—The General Utility Corporation operated a dragline dredge in 1939 on Redding Creek near Douglas City from January 1 to March 18; the Diesel-power dragline excavator had a 1½-cubic yard bucket. The Viking Dredging Co. operated a dragline near the confluence of Redding Creek and Trinity River throughout the year; a dragline excavator with Diesel power and a 2-cubic yard bucket was used. The Sound Gold Co., Inc., operated a dragline washing plant from October 21 to the end of the year; 12,000 cubic yards of gravel yielded 114 ounces of gold and 17 ounces of silver. The Weaver Dredging Co. operated a dragline dredge, using a dragline excavator with a 2½-cubic yard bucket, on Weaver Creek throughout 1939; 1,161,254 cubic yards of gravel yielded 4,263 ounces of gold and 372 ounces of silver. The Oro Trinity Dredging Co. operated a dragline dredge, with a dragline excavator using a 1½-cubic yard bucket, near Weaverville throughout the year.

TUOLUMNE COUNTY

East Belt district.—Moccasin Mines operated a dragline dredge on Moccasin Creek from January 1 to March 15, 1939, when the property was turned over to H. Hellwig, who operated it until August 21; the dragline excavator was equipped with Diesel power and a 2-cubic yard bucket. Under the Hellwig management 438,223 cubic yards of gravel were handled and yielded 2,506 ounces of gold and 431 ounces of silver. The Densmore Gold Mines, Inc., which had been financed by the Reconstruction Finance Corporation, turned the Densmore mine over to a group of lessees on April 1, 1939. The Shoe String Mining Co. operated the Experimental mine during 1939; 350 tons of ore yielded 147 ounces of gold and 20 ounces of silver by amalgamation. The La Guria Gold Mining Co. operated the Liguira mine throughout the year; a 30-ton cyanide mill was installed, but failure of the slimes to leach resulted in discontinuance of the operation. A lessee worked the Ryan mine. The Bald Mountain Mines, Inc., worked the Sugarman mine from May 11 to the end of the year; 150 tons of ore yielded 140 ounces of gold and 8 ounces of silver.

Mother Lode district.—The Barker Corporation operated a dragline dredge on Tuolumne River in 1939 from October 21 to December 31. E. A. Kent operated two dragline dredges (No. 1 and No. 3) in Tuolumne County. Dredge No. 1 worked Curtis Creek 5 miles south of Jamestown from the first of the year until February 7; a dragline excavator with a 1¾-cubic yard bucket was used. Dredge No. 3, equipped with a 1½-cubic yard bucket, operated on Woods Creek from June 16 to August 10, when it was closed down owing to lack of water; operations were resumed October 9 and continued until December 6. Hemming Bros. worked the Alameda mine 2½ miles northwest of Jamestown. The Eagle-Shawmut mine was the largest gold producer in Tuolumne County in 1939; operations began in May and continued to the end of the year. The Delgold Corporation worked the Erin-go-Bragh mine. Gold Diggers Syndicate, operator of the Heslep, App, Dutch, and Sweeney mines, was taken over by Allied Mines, Inc., May 1, and mill operations which had been discontinued in March were resumed October 1 and continued to the end of the year; 6,609 tons of ore, treated by amalgamation and flotation, yielded 161 ounces of gold and 40 ounces of silver in bullion and 563 ounces of gold and 342 ounces of silver in 232 tons of concentrates.

YUBA COUNTY

Bear River district.—The Far West Dredging Co. operated a dragline dredge on Bear River during 1939.

Browns Valley district.—Empire Star Mines Co., Ltd., continued operations at the Pennsylvania mine in 1939.

Smartville district.—The Calmich Mining Co. conducted an exploration campaign at the Blue Point mine and produced some gold in 1939 by drift mining. The Williams Bar Dredging Co. operated a connected-bucket dredge throughout the year on the Mammoth, Archimedes, Montclair, and Forbes properties in the bed of Yuba River near Smartville. A large number of snipers, camped along Yuba River, worked gravel by small-scale hand methods.

Strawberry Valley district.—The Poverty Hill hydraulic mine was active in 1939, and production was reported from the Mount de Oro quartz mine.

Yuba River district.—Yuba Consolidated Gold Fields operated a fleet of six dredges at its property in the Yuba River Basin near Hammonton. All the dredges were equipped with 18-cubic foot buckets and electric power; two of them had 87 buckets each, two had 100 buckets each, one had 126 buckets, and one had 135 buckets.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN COLORADO

(MINE REPORT)

By Chas. W. Henderson and A. J. Martin

SUMMARY OUTLINE

Gold production in Colorado in 1939 varied little (0.2-percent decrease) in quantity and value from that in 1938, but the total value of the recovered gold, silver, copper, lead, and zinc increased (1 percent) to $22,319,041, the highest value in any year since 1918. Silver production increased for the seventh consecutive year, but copper, lead, and zinc each decreased from 1938. As silver ranks next to gold as a source of revenue from Colorado ores, the Act of Congress approved July 6, 1939, dealing with the coinage of silver and authorizing a 10-percent increase in payments for newly mined domestic silver, helped materially to stabilize employment in the industry and furnished the incentive for the expansion that followed in some sections of the State. Moreover, the stimulus afforded by the $35 price for gold continued, and several large-scale development operations were in progress during the year, notably in the Cripple Creek, San Juan, and Leadville areas.

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, 1935–39

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1935	$35.00	$0.71875	$0.083	$0.040	$0.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052

[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] 1935–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–39: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464.
[5] $0.67878787.

Annual figures for the 5 years ended with 1939 and total production from 1858 to 1939 are given in the table that follows. Colorado has produced more silver in the past than any other State and ranks second in total recorded output of gold.

Mine production of gold, silver, copper, lead, and zinc in Colorado, 1935–39, and total, 1858–1939, 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
1935	870	842	1,770,984	349,280.80	$12,224,828	4,696,064	$3,375,296
1936	714	601	2,151,849	366,607.00	12,831,245	5,902,776	4,571,700
1937	655	490	2,068,619	368,905.00	12,911,675	6,260,693	4,842,646
1938	669	592	1,996,095	367,468.00	12,861,380	7,932,095	5,127,819
1939	758	583	1,914,593	366,852.00	12,839,820	8,496,488	5,767,313
1858–1939			(1)	37,549,390.00	808,105,614	700,938,158	546,383,465

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1935	14,654,000	$1,216,282	11,345,000	$453,800	2,403,000	$105,732	$17,375,938
1936	17,730,000	1,631,160	14,534,000	668,564	2,344,000	117,200	19,819,869
1937	21,868,000	2,646,028	19,572,000	1,154,748	8,494,000	552,110	22,107,207
1938	28,342,000	2,777,516	18,910,000	869,860	9,106,000	437,088	22,073,663
1939	26,430,000	2,748,720	16,444,000	772,868	3,660,000	190,320	22,319,041
1858–1939	[2] 225,394	60,160,319	[2] 2,352,841	222,114,677	[2] 1,130,232	158,590,836	1,795,354,911

[1] Figures not available.
[2] Short tons.

Gold and silver produced at placer mines in Colorado, 1935–39, in fine ounces, in terms of recovered metals

Year	Sluicing and hydraulic		Drift mining		Dredges						Total	
					Dry-land [1]		Dragline floating		Floating bucket			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1935	[2] 7,058.74	[2] 1,523	(2)	(2)	7,998.55	1,329			4,305.71	1,116	19,363.00	3,968
1936	2,307.74	573	1,990.14	403	7,754.79	1,365			1,528.33	364	13,581.00	2,705
1937	1,948.21	401	2,020.13	411	6,212.24	1,033	2,780.35	286	1,910.07	434	14,871.00	2,565
1938	2,285.00	433	1,362.00	279	10,201.00	2,020	3,166.00	279	1,027.00	239	18,041.00	3,250
1939	2,535.00	498	15.00	1	10,631.00	2,436	1,950.00	178	4,688.00	1,012	19,819.00	4,125

[1] Dragline and power-shovel excavators with sluices or special amalgamators.
[2] Figures for sluicing and hydraulic include those for drift mining.

Gold.—In total value gold was the leading metal produced in Colorado from 1858 to 1939, but in annual value it was surpassed by silver from 1874 to 1896 and by molybdenum from 1937 to 1939. The principal gold-producing districts in 1939, in order, were: Cripple Creek, Teller County; Mosquito, Park County; Upper San Miguel, San Miguel County; Red Cliff, Eagle County; Gold Hill, Boulder County; Empire, Clear Creek County; Animas, San Juan County; Summitville, Rio Grande County; and Sneffels, Ouray County. The largest gold-producing properties, in order, were the United Gold Mines and Cresson at Cripple Creek, London in the

Mosquito district, Eagle in the Red Cliff district, and Smuggler Union at Telluride. Important gains in gold production were made in San Miguel, Boulder, Eagle, and Park Counties; the largest decreases were in Teller, San Juan, Rio Grande, Gilpin, and Lake Counties. Dry and siliceous ores yielded 87 percent of the total gold; copper ore 6 percent; lead, lead-copper, zinc, and zinc-lead ores slightly more than 1 percent; and placers nearly 6 percent.

Silver.—Silver production in Colorado has increased annually since 1932, when the output (1,860,408 ounces) was the lowest in 59 years; the output in 1939 (8,496,488 ounces, in terms of recovered metal) was the highest since 1914. Eagle County contributed 71 percent of the total in 1939, Mineral County 7 percent, San Miguel 7 percent, San Juan 3 percent, and other counties (chiefly Pitkin, Ouray, Lake, and Clear Creek) 12 percent. The principal silver-producing properties were: Eagle mine, Eagle County; New York-Pittsburg-Last Chance-Del Monte group, Mineral County; Smuggler Union group,

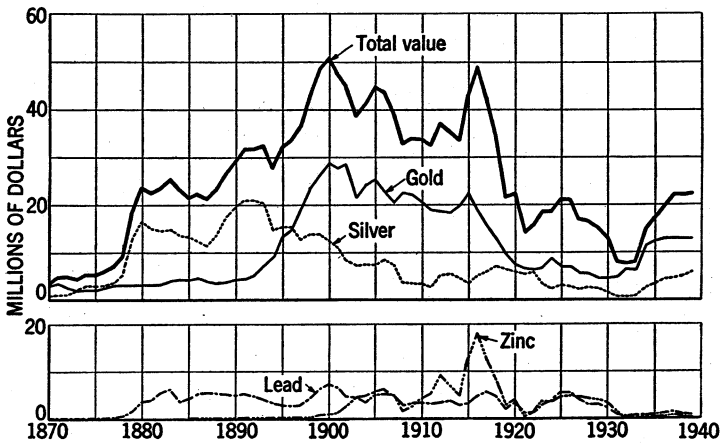

FIGURE 1.—Value of mine production of gold, silver, lead, and zinc and total value of gold, silver, copper, lead, and zinc in Colorado, 1870–1939. The value of copper has been less than $2,000,000 annually, except in a few years.

San Miguel County; Shenandoah-Dives-Mayflower group, San Juan County; and Butterfly group, San Miguel County. Copper ore yielded 72 percent of the total silver; dry and siliceous ores 23 percent; and other types of ore, together with a very small quantity of silver from placer mines, 5 percent.

Copper.—In 1939 the mine output of recoverable copper in Colorado decreased 7 percent from the record annual output of 28,342,000 pounds in 1938. Eagle County produced 90 percent of the State total; the remainder came chiefly from San Juan, Ouray, Saguache, Clear Creek, and San Miguel Counties. The only sizable copper producer in the State was the Empire Zinc Division (Eagle mine) of the New Jersey Zinc Co. at Gilman, Eagle County, which shipped copper-iron-silver-gold-lead ore direct to the copper smelter at Garfield, Utah.

Lead.—Although the total recorded production of lead in Colorado from 1858 through 1939 was more than 10 times that of copper, the annual recovered output from 1932 to 1939 was less than that of copper; the average over the 8 years was 12,292,750 pounds for lead and 17,172,875 pounds for copper. Of the 16,444,000 pounds of lead recovered in 1939, 54 percent was contained in concentrates made from dry and siliceous gold, gold-silver, and silver ores, mostly from San Miguel, San Juan, Park, Clear Creek, Ouray, Mineral, and Pitkin Counties; 9 percent was in concentrates from zinc-lead ore, mostly from Dolores County; and the remainder was recovered principally from copper and lead ores shipped from Eagle and Lake Counties direct to smelters.

Zinc.—Of the 3,660,000 pounds of zinc recovered from Colorado ores in 1939, Dolores County contributed 47 percent, San Juan 32 percent, Lake 10 percent, and Summit 5 percent; Pitkin, Ouray, San Miguel, Gunnison, and Hinsdale Counties together contributed 6 percent. The principal producers of zinc were the Rico Argentine Mining Co. at Rico, Dolores County, which began treating zinc-lead-silver-copper ore in its new 135-ton flotation mill in September; and the Shenandoah-Dives Mining Co. at Silverton, San Juan County, a large producer of dry and siliceous gold-silver ore containing some lead, copper, and zinc and a buyer of custom complex lead and zinc-lead ores for treatment in its 750-ton selective-flotation mill.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1939, 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		12	317	$11,095	53	$36
Arapahoe		8	13	455		
Boulder	166	12	28,934	1,012,690	40,045	27,182
Chaffee	18	26	699	24,465	3,991	2,709
Clear Creek	110	33	34,930	1,222,550	113,174	76,821
Costilla		3	19	665	1	1
Custer	6		119	4,165	2,690	1,826
Denver		9	9	315		
Dolores	8	1	123	4,305	41,356	28,072
Douglas		17	80	2,800		
Eagle	11	5	22,949	803,215	6,074,024	4,122,974
Elbert		2	23	805		
Fremont	1	1	4	140		
Garfield	1		322	11,270	159	108
Gilpin	85	102	10,894	381,290	51,209	34,760
Grand	2	1	6	210	1,102	748
Gunnison	14	8	1,908	66,780	4,315	2,929
Hinsdale	3		56	1,960	2,649	1,798
Jackson		1	2	70		
Jefferson		58	154	5,390	31	21
Lake	82	19	9,987	349,545	131,514	89,270
La Plata	8		674	23,590	5,999	4,072
Mineral	10		709	24,815	596,858	405,140
Moffat		8	149	5,215	9	6
Montezuma	3		943	33,005	1,102	748
Montrose	2	18	113	3,955	103	70
Ouray	14	3	12,586	440,510	158,798	107,790
Park	26	112	43,467	1,521,345	38,691	26,263
Pitkin	5		1	35	210,176	142,665
Rio Grande	1		14,445	505,575	53,460	36,288
Routt		7	24	840	13	9
Saguache	10		89	3,115	48,794	33,121
San Juan	20		16,152	565,320	286,150	194,235
San Miguel	19	18	29,955	1,048,425	577,004	391,663
Summit	29	93	1,994	69,790	35,310	23,968
Teller	104	6	134,003	4,690,105	17,708	12,020
	758	583	366,852	12,839,820	8,496,488	5,767,313
Total, 1938	669	592	367,468	12,861,380	7,932,095	5,127,819

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1939, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Adams							$11,131
Arapahoe							455
Boulder	162,000	$16,848	83,000	$3,901			1,060,621
Chaffee	4,500	468	85,000	3,995			31,637
Clear Creek	226,000	23,504	910,000	42,770			1,365,645
Costilla							666
Custer	1,800	187	23,000	1,081			7,259
Denver							315
Dolores	129,000	13,416	1,504,000	70,688	1,734,000	$90,168	206,649
Douglas							2,800
Eagle	23,842,000	2,479,568	2,274,000	106,878			7,512,635
Elbert							805
Fremont							140
Garfield	600	62					11,440
Gilpin	108,000	11,232	188,000	8,836			436,118
Grand			3,000	141			1,099
Gunnison	19,000	1,976	17,000	799	6,000	312	72,796
Hinsdale	3,000	312	62,000	2,914	4,000	208	7,192
Jackson							70
Jefferson							5,411
Lake	12,000	1,248	2,208,000	103,776	351,000	18,252	562,091
La Plata			4,600	216			27,878
Mineral	1,300	135	718,000	33,746			463,836
Moffat							5,221
Montezuma	500	52					33,805
Montrose	15,000	1,560					5,585
Ouray	358,400	37,274	654,400	30,757	13,000	676	617,007
Park	69,000	7,176	1,078,000	50,666			1,605,450
Pitkin	1,200	125	532,000	25,004	176,000	9,152	176,981
Rio Grande							541,863
Routt							849
Saguache	248,000	25,792	240,000	11,280			73,308
San Juan	1,013,000	105,352	2,092,000	98,324	1,166,000	60,632	1,023,863
San Miguel	210,000	21,840	3,529,000	165,863	12,000	624	1,628,415
Summit	5,700	593	239,000	11,233	198,000	10,296	115,880
Teller							4,702,125
	26,430,000	2,748,720	16,444,000	772,868	3,660,000	190,320	22,319,041
Total, 1938	28,342,000	2,777,516	18,910,000	869,860	9,106,000	437,088	22,073,663

Gold and silver produced at lode mines in Colorado in 1939, by counties, in terms of recovered metals

County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
Boulder	101,740	28,857	40,036
Chaffee	911	347	3,938
Clear Creek	156,210	34,892	113,168
Custer	1,420	119	2,690
Dolores	12,317	121	41,356
Eagle	340,464	22,921	6,074,023
Fremont	2	1	
Garfield	199	322	159
Gilpin	21,645	5,112	50,135
Grand	41	3	1,102
Gunnison	6,750	1,897	4,312
Hinsdale	1,066	56	2,649
Lake	53,441	7,606	130,811
La Plata	2,604	674	5,999
Mineral	37,083	709	596,858
Montezuma	839	943	1,102
Montrose	97		75
Ouray	35,711	12,580	158,795
Park	128,753	34,597	36,926
Pitkin	24,088	1	210,176
Rio Grande	43,039	14,445	53,460
Saguache	2,546	89	48,794
San Juan	199,271	16,152	286,150
San Miguel	202,616	29,891	576,964
Summit	3,602	731	34,980
Teller	538,138	133,967	17,705
	1,914,593	347,033	8,492,363
Total, 1938	1,996,095	349,427	7,928,845

Gold and silver produced at placer mines in Colorado in 1939, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Drift mining		Dredges						Total	
					Dry-land [1]		Dragline floating		Floating bucket			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Adams	317	53									317	53
Arapahoe	13										13	
Boulder	45	5			32	4					77	9
Chaffee	102	16	5	1	245	36					352	53
Clear Creek	38	6									38	6
Costilla	19	1									19	1
Denver	9										9	
Dolores	2										2	
Douglas	72		8								80	
Eagle	28	1									28	1
Elbert	1				22						23	
Fremont	3										3	
Gilpin	548	109	2		3,282	787	1,950	178			5,782	1,074
Grand	3										3	
Gunnison	11	3									11	3
Jackson	2										2	
Jefferson	154	31									154	31
Lake	95	20			2,286	683					2,381	703
Moffat	21	1			128	8					149	9
Montrose	35	10			78	18					113	28
Ouray	6	3									6	3
Park	466	81			4,152	784			4,252	900	8,870	1,765
Routt	24	13									24	13
San Miguel	64	40									64	40
Summit	421	102			406	116			436	112	1,263	330
Teller	36	3									36	3
	2,535	498	15	1	10,631	2,436	1,950	178	4,688	1,012	19,819	4,125
Total, 1938	2,285	433	1,362	279	10,201	2,020	3,166	279	1,027	239	18,041	3,250

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

MINING INDUSTRY

The output of dry and siliceous gold, gold-silver, and silver ores from mines and dumps in Colorado in 1939 increased 1 percent over 1938 and copper ore 3 percent; lead ore decreased 25 percent, zinc-lead ore 88 percent, and the total for all classes of ore 4 percent. The Sunnyside mine in San Juan County, the only important producer of zinc-lead ore in Colorado in 1938, was closed June 30 of that year and very little zinc-lead ore was mined in the State during the next 15 months; in September 1939 the Rico Argentine Mining Co. began producing zinc-lead-silver-copper ore at Rico, Dolores County, and mined and treated about 100 tons daily to the end of the year. Nearly all the large producers of gold and silver ores that were active in 1938 continued operations throughout 1939. The statutory requirement that assessment work be done on claims held by location (suspended annually from 1933 to 1938 by acts of Congress) was in effect again in 1939 and apparently caused the increase over 1938 in the number of producing lode mines, as the aggregate of small lots of ore reported mined and shipped while assessment work was being done did not materially affect the total tonnage output of the State.

The quantity of gravel handled in 1939 by 2 floating connected-bucket dredges, 1 dragline floating dredge, and 26 dry-land dredges was approximately 2,430,964 cubic yards; specific data on yardage handled at small-scale placer operations are not obtainable because of lack of knowledge by the operators of the quantity of gravel sluiced.

On April 2, 1940, the Wage and Hour Division of the United States Department of Labor declared the open-cut mining of placer gold in

Colorado to be an industry of a seasonal nature and thus entitled to certain exemptions under the wage-hour law. Figures supplied by the Bureau of Mines showed that approximately 80 percent of the placer gold output of Colorado in 1938 and 81 percent in 1939 were produced between May 1 and November 1.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Colorado in 1939, with content in terms of recovered metals

Source	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	1,224,849	299,907	736,547	871,830	5,476,230	9,000
Dry and siliceous gold-silver ore	242,178	19,204	516,653	1,162,445	3,102,540	1,098,000
Dry and siliceous silver ore	75,208	820	731,974	20,380	1,295,575	176,000
	1,542,235	319,931	1,985,174	2,054,655	9,874,345	1,283,000
Copper ore	342,499	22,653	6,114,224	24,169,380	2,332,545	
Lead ore	14,700	3,712	320,657	37,545	2,407,465	
Lead-copper ore	1,464	445	26,670	93,705	266,435	
Zinc ore	344	16	8,078	800	7,000	160,000
Zinc-lead ore	13,351	276	37,560	73,915	1,556,210	2,217,000
	372,358	27,102	6,507,189	24,375,345	6,569,655	2,377,000
Total, lode mines	1,914,593	347,033	8,492,363	26,430,000	16,444,000	3,660,000
Total, placers		19,819	4,125			
	1,914,593	366,852	8,496,488	26,430,000	16,444,000	3,660,000
Total, 1938	1,996,095	367,468	7,932,095	28,342,000	18,910,000	9,106,000

METALLURGIC INDUSTRY

Ore treated in 1939 by all mills in Colorado handling ores of gold, silver, copper, lead, and zinc totaled 1,511,792 tons, of which 920,834 tons were treated in company mills at mines; 545,323 tons by the Golden Cycle custom roast-amalgamation-cyanidation-flotation mill at Colorado Springs; and 45,635 tons by custom flotation mills in or near the mining districts (some of which also treated company ore included above), comprising the following: Boston mill at Ward in Boulder County; Clear Creek-Gilpin, Clear Creek Consolidated, Dumont, Hoosac, Ruth, and Silver Leaf in Clear Creek County; Creede Mills in Mineral County; Banner American in Ouray County; Shenandoah-Dives in San Juan County; and Smuggler Union mill in San Miguel County. All these custom mills except the Shenandoah-Dives treated only gold, gold-silver, silver, or silver-lead-gold-copper ores. Zinc-lead ore containing gold and silver from Dolores, Gunnison, Hinsdale, Lake, Ouray, San Juan, San Miguel, and Summit Counties was shipped to custom mills at Midvale, Tooele, and Bauer, Utah. The samplers at Boulder and Idaho Springs each operated about 5 months during the year.

Direct-smelting ores comprised 21 percent of the State total output of ore in 1939. The Arkansas Valley lead bullion-leady copper matte smelter at Leadville purchased most of the gold, silver, and gold-silver-lead-copper ores and concentrates shipped to smelters during the year. Some ores and concentrates (containing appreciable amounts of copper) from Boulder, Clear Creek, and Gilpin Counties were smelted in the 25-ton Forks copper smelter in Gilpin County, built in 1939 and operated 53 days beginning about October 1. Ore and concentrates were shipped to smelters in other States, as follows: Zinc-lead sulfide and zinc-lead carbonate ores from Lake County to Coffeyville, Kans.; zinc concentrates from Dolores, Pitkin, and San Juan Counties to Amarillo, Tex.; copper-iron-silver-gold ore from Eagle County, copper-silver ore from Montrose County, and gold-silver-lead-copper ores and concentrates from the San Juan region to Utah smelters; and copper-gold-silver concentrates from San Juan County to El Paso, Tex.

Mine production of metals in Colorado in 1939, 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]	780,064	72,095	27,684	----------	----------	----------
Ore, old tailings, concentrates, sands, and slimes cyanided [2]	[3] 636,969	135,813	78,181	----------	----------	----------
Concentrates smelted	62,389	102,600	1,690,469	2,159,530	10,570,435	3,179,000
Ore smelted	401,310	36,525	6,696,029	24,270,470	5,873,565	481,000
Placer [1]	----------	19,819	4,125	----------	----------	----------
Total	----------	366,852	8,496,488	26,430,000	16,444,000	3,660,000
1938	----------	367,468	7,932,095	28,342,000	18,910,000	9,106,000

[1] Quicksilver purchased (which is close to quantity used) by amalgamation mills was 3,870 pounds. Placer mines used approximately 400 pounds.
[2] Cyanide (in terms of 96- to 98-percent NaCN) used was 1,140,514 pounds.
[3] Comprises 350,800 tons of sands and slimes from ore and iron concentrates first roasted and amalgamated, 194,218 tons of tailings from ore first floated, 42,280 tons of tailings from ore first treated by jigging, and 49,671 tons of combined flotation concentrates, crude ore, and old tailings cyanided direct.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Colorado in 1939, by counties, in terms of recovered metals

County	Ore treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal					
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Boulder	83,556	21,165	6,037	3,532	4,929	24,063	154,240	70,000	----------
Chaffee	31	9	----------	----------	----------	----------	----------	----------	----------
Clear Creek	141,907	21,234	5,557	6,084	11,433	70,649	185,725	677,515	----------
Custer	1,351	119	882	----------	----------	----------	----------	----------	----------
Eagle	1	3	18	----------	----------	----------	----------	----------	----------
Fremont	2	1	----------	----------	----------	----------	----------	----------	----------
Gilpin	16,739	3,084	11,589	952	858	3,080	11,235	8,970	----------
Gunnison	5,968	1,687	1,067	46	65	1,204	----------	4,300	----------
Lake	8,501	385	1,631	509	317	1,772	----------	34,700	9,000
La Plata	9	7	----------	----------	----------	----------	----------	----------	----------
Montezuma	724	625	122	----------	----------	----------	----------	----------	----------
Ouray	30,055	8,223	2,248	3,012	3,621	77,680	304,100	353,410	----------
Park	30,366	698	118	1,306	3,753	4,147	600	101,500	----------
Rio Grande	43,039	10,724	49,759	759	3,721	3,701	----------	----------	----------
Saguache	39	42	22	----------	----------	----------	----------	----------	----------
San Juan	20	19	10	----------	----------	----------	----------	----------	----------
San Miguel	179,353	8,982	10,629	18,235	19,494	387,253	118,200	2,971,640	----------
Summit	45	4	2	----------	----------	----------	----------	----------	----------
Teller	513,134	130,897	16,174	----------	----------	----------	----------	----------	----------
Total	1,054,840	207,908	105,865	34,435	48,191	573,549	774,100	4,222,035	9,000
1938	991,477	212,016	113,963	29,109	39,581	435,308	856,355	2,551,120	----------

Mine production of metals from concentrating mills in Colorado in 1939, by counties, in terms of recovered metals

County	Ore treated (short tons)	Concentrates smelted and recovered metal					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Boulder	17,660	1,335	2,516	3,623	3,830	1,200	----------
Chaffee	535	39	180	103	500	100	----------
Clear Creek	13,513	1,570	1,773	25,436	28,105	182,810	----------
Dolores	11,858	3,105	64	32,047	120,700	1,352,130	1,669,000
Gilpin	3,313	418	352	6,677	16,430	31,740	----------
Grand	8	1	1	96	----------	65	----------
Gunnison	569	19	122	320	300	4,400	----------
Hinsdale	1,003	76	9	2,572	3,000	62,000	4,000
Lake	14,438	1,894	1,002	27,035	5,590	261,155	32,000
La Plata	2,500	80	332	4,353	----------	575	----------
Mineral	34,748	1,322	632	408,385	1,300	445,450	----------
Ouray	4,808	362	92	28,314	42,750	141,475	13,000
Park	97,162	7,069	27,715	27,538	64,465	895,995	----------
Pitkin	7,850	522	----------	100,157	1,200	318,955	176,000
Saguache	25	6	----------	66	10	4,280	----------
San Juan	198,741	6,372	15,345	269,736	1,006,750	1,991,050	1,166,000
San Miguel	23,119	2,505	1,230	174,168	88,500	545,800	12,000
Summit	1,624	356	54	4,797	2,000	109,220	98,000
Teller	24,969	903	2,990	1,497	----------	----------	----------
	458,443	27,954	54,409	1,116,920	1,385,430	6,348,400	3,170,000
Total, 1938	627,298	48,784	63,123	1,582,413	2,614,735	11,208,042	9,064,000

Gross metal content of concentrates produced from ores mined in Colorado in 1939, by classes of concentrates smelted

Class of concentrates	Concentrates produced (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (wet assay) (pounds)	Lead (wet assay) (pounds)	Zinc (pounds)
Dry gold	17,141	31,055	124,417	345,126	698,167	205,006
Dry gold-silver	486	358	5,889	12,175	23,422	760
Copper	2,146	2,794	61,761	576,992	142,660	154,926
Lead	33,067	57,083	1,215,739	412,438	8,831,333	3,543,704
Lead-copper	6,325	11,186	269,926	1,174,720	2,062,350	1,362,769
Zinc	3,224	171	19,405	70,967	141,319	3,521,290
	62,389	102,647	1,697,137	2,592,418	11,899,251	8,788,455
Total, 1938	77,893	102,932	2,040,977	4,150,762	16,156,177	15,895,539

Mine production of metals from Colorado concentrates shipped to smelters in 1939, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Boulder	4,867	7,445	27,686	158,070	71,200	
Chaffee	39	180	103	500	100	
Clear Creek	7,654	13,206	96,085	213,830	860,325	
Dolores	3,105	64	32,047	120,700	1,352,130	1,669,000
Gilpin	1,370	1,210	9,757	27,665	40,710	
Grand	1	1	96		65	
Gunnison	65	187	1,524	300	8,700	
Hinsdale	76	9	2,572	3,000	62,000	4,000
Lake	2,403	1,319	28,807	5,590	295,855	41,000
La Plata	80	332	4,353		575	
Mineral	1,322	632	408,385	1,300	445,450	
Ouray	3,374	3,713	105,994	346,850	494,885	13,000
Park	8,375	31,468	31,685	65,065	997,495	
Pitkin	522		100,157	1,200	318,955	176,000
Rio Grande	759	3,721	3,701			
Saguache	6		66	10	4,280	
San Juan	6,372	15,345	269,736	1,006,750	1,991,050	1,166,000
San Miguel	20,740	20,724	561,421	206,700	3,517,440	12,000
Summit	356	54	4,797	2,000	109,220	98,000
Teller	903	2,990	1,497			
	62,389	102,600	1,690,469	2,159,530	10,570,435	3,179,000
Total, 1938	77,893	102,704	2,017,721	3,471,090	13,759,162	9,064,000

BY CLASSES OF CONCENTRATES SMELTED

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	17,141	31,055	124,417	276,490	628,720	
Dry gold-silver	486	358	5,889	9,715	21,050	
Copper	2,146	2,794	61,761	539,880	79,675	
Lead	33,067	57,083	1,215,739	334,795	7,974,070	2,000
Lead-copper	6,325	11,186	269,926	941,460	1,855,315	
Zinc	3,224	124	12,737	57,190	11,605	3,177,000
	62,389	102,600	1,690,469	2,159,530	10,570,435	3,179,000

Gross metal content of Colorado crude ore shipped to smelters in 1939, by classes of ore

Class of ore	Ore		Gross metal content				
	Short tons	Percent of total	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	18,862	4.70	9,051	41,396	37,438	431,518	52,313
Dry and siliceous gold-silver	3,523	.88	703	19,972	4,205	271,072	155,540
Dry and siliceous silver	20,386	5.08	73	176,622	6,862	345,848	52,429
Copper	341,487	85.09	22,649	6,112,144	24,884,221	4,640,203	4,319,291
Lead	13,572	3.38	3,585	308,693	32,725	2,462,468	541,047
Lead-copper	1,464	.36	445	26,670	116,438	296,427	85,466
Zinc	344	.09	16	8,078	968	8,096	186,028
Zinc-lead	1,672	.42	3	2,454	3,205	133,835	403,274
	401,310	100.00	36,525	6,696,029	25,086,062	8,589,467	5,795,388
Total, 1938	377,320	100.00	34,707	5,797,161	25,701,459	7,107,357	6,214,441

Mine production of metals from Colorado crude ore shipped to smelters in 1939, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Boulder	524	247	6,313	3,930	11,800	
Chaffee	345	158	3,835	4,000	84,900	
Clear Creek	790	452	11,526	12,170	49,675	
Custer	69		1,808	1,800	23,000	
Dolores	459	57	9,309	8,300	151,870	65,000
Eagle	340,463	22,918	6,074,005	23,842,000	2,274,000	
Garfield	199	322	159	600		
Gilpin	1,593	818	28,789	80,335	147,290	
Grand	33	2	1,006		2,935	
Gunnison	213	23	1,721	18,700	8,300	6,000
Hinsdale	63	47	77			
Lake	30,502	5,902	100,373	6,410	1,912,145	310,000
La Plata	95	335	1,646		4,025	
Mineral	2,335	77	188,473		272,550	
Montezuma	115	318	980	500		
Montrose	97		75	15,000		
Ouray	848	644	50,553	11,550	159,515	
Park	1,225	2,431	5,123	3,935	80,505	
Pitkin	16,238	1	110,019		213,045	
Saguache	2,482	47	48,706	247,990	235,720	
San Juan	510	788	16,404	6,250	100,950	
San Miguel	144	185	4,914	3,300	11,560	
Summit	1,933	673	30,181	3,700	129,780	100,000
Teller	35	80	34			
	401,310	36,525	6,696,029	24,270,470	5,873,565	481,000
Total, 1938	377,320	34,707	5,797,161	24,870,910	5,150,838	42,000

BY CLASSES OF ORE

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	18,862	9,051	41,396	32,775	387,360	
Dry and siliceous gold-silver	3,523	703	19,972	3,420	243,920	
Dry and siliceous silver	20,386	73	176,622	5,535	311,345	
Copper	341,487	22,649	6,112,144	24,106,080	2,326,415	
Lead	13,572	3,585	308,693	25,655	2,222,290	
Lead-copper	1,464	445	26,670	93,705	266,435	
Total to copper and lead plants	399,294	36,506	6,685,497	24,267,170	5,757,765	
Zinc	344	16	8,078	800	7,000	160,000
Zinc-lead	1,672	3	2,454	2,500	108,800	321,000
Total to zinc plants	2,016	19	10,532	3,300	115,800	481,000
	401,310	36,525	6,696,029	24,270,470	5,873,565	481,000

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1939, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Adams County		12			317	317		53	53				$11,131
Arapahoe County		8			13	13							455
Boulder County:													
Central	18		7,724	3,376		3,376	1,015		1,015	500			118,901
Gold Hill	63	2	72,494	17,781	2	17,783	29,663		29,663	154,200	72,000		661,961
Grand Island	7	2	1,297	315	18	333	1,868	3	1,871	100	4,100		13,128
Magnolia	14		2,664	841		841	56		56				29,473
Sugar Loaf	37	8	9,975	4,310	57	4,367	5,685	6	5,691	900	5,000		157,037
Ward	27		7,586	2,234		2,234	1,749		1,749	6,300	1,900		80,121
Chaffee County:													
Brown Canyon		1			2	2							70
Chalk Creek	4		163	142		142	1,918		1,918	1,000	27,600		7,673
Granite	5	25	547	189	350	539	237	53	290	500	1,000		19,161
La Plata	1		5	1		1	311		311				246
Monarch	5		165	6		6	1,472		1,472	3,000	56,400		4,172
Riverside	1		16	3		3							105
Trout Creek	1		5	2		2							70
Turret	1		10	4		4							140
Clear Creek County:													
Alice	4		709	527		527	109		109				18,519
Argentine	2		771	162		162	3,191		3,191	7,500	31,600		10,101
Empire	11	2	75,124	16,386	1	16,387	2,870		2,870	700	700		575,599
Geneva Creek	1		2	1		1	9		9		100		46
Griffith	10		3,065	355		355	7,033		7,033	8,000	49,800		20,372
Idaho Springs	62	31	50,371	10,841	37	10,878	68,435	6	68,441	129,700	693,400		473,266
Montana	9		9,617	1,279		1,279	22,692		22,692	77,300	57,200		70,895
Trail Creek	11		16,551	5,341		5,341	8,829		8,829	2,800	77,200		196,847
Costilla County		3			19	19		1	1				666
Custer County: Hardscrabble	6		1,420	119		119	2,690		2,690	1,800	23,000		7,259
Denver County		9			9	9							315
Dolores County: Pioneer	8	1	12,317	121	2	123	41,356		41,356	129,000	1,504,000	1,734,000	206,649
Douglas County		17			80	80							2,800
Eagle County:													
Burns-McCoy		4			5	5							175
Holy Cross	1		2	3		3	99		99	200	400		212
Mount Egley		1			23	23		1	1				806
Red Cliff	10		340,462	22,918		22,918	6,073,924		6,073,924	23,841,800	2,273,600		7,511,442
Elbert County		2			23	23							805
Fremont County	1	1	2	1	3	4							140
Garfield County: Rifle Creek	1		199	322		322	159		159	600			11,440

Gilpin County:												
Southern	68	91	17,228	4,412	3,807	8,219	49,616	890	50,506	106,200	187,400		341,801
Northern	17	11	4,417	700	1,975	2,675	519	184	703	1,800	600		94,317
Grand County	2	1	41	3	3	6	1,102		1,102		3,000		1,099
Gunnison County:													
Box Canyon	1		347	47		47	7		7				1,650
Elk Mountain	4	3	158	7	2	9	1,093		1,093	18,700	6,900	6,000	3,638
Gold Brick	6		5,890	1,817		1,817	2,581		2,581	300	8,700		65,787
Goose Creek	1		9				174		174		1,400		184
Green Mountain	1		326	26		26	6		6				914
Taylor Park (Tin Cup)		5			9	9		3	3				317
Tomichi	1		20				451		451				306
Hinsdale County:													
Galena	2		1,003	9		9	2,572		2,572	3,000	62,000	4,000	5,495
Lake	1		63	47		47	77		77				1,697
Jackson County		1			2	2							70
Jefferson County		58			154	154		31	31				5,411
Lake County:													
California (Leadville)	73	10	53,006	7,409	35	7,444	129,376	9	129,385	11,400	2,176,800	344,000	469,749
Other districts [1]	9	9	435	197	2,346	2,543	1,435	694	2,129	600	31,200	7,000	92,342
La Plata County: California	8		2,604	674		674	5,999		5,999		4,600		27,878
Mineral County: Creede	10		37,083	709		709	596,858		596,858	1,300	718,000		463,836
Moffat County: Fourmile (Timberlake)		8			149	149		9	9				5,221
Montezuma County	3		839	943		943	1,102		1,102	500			33,805
Montrose County:													
La Sal	2	6	97		83	83	75	19	94	15,000			4,529
Naturita		12			30	30		9	9				1,056
Ouray County:													
Red Mountain	5		2,452	80		80	9,809		9,809	40,500	87,700	13,000	18,468
Ridgway		3			6	6		3	3				212
Sneffels	3		29,100	11,749		11,749	80,866		80,866	301,200	362,600		514,473
Uncompahgre	6		4,159	751		751	68,120		68,120	16,700	204,100		83,854
Park County:													
Alma Placers		49			3,154	3,154		663	663				110,840
Beaver Creek		7			4,300	4,300		903	903				151,113
Buckskin	4	6	56	22	16	38	408	3	411	700	6,800		2,002
Consolidated Montgomery	4	1	2,784	929	8	937	3,129	3	3,132	500	1,000		35,020
Fairplay		19			663	663		137	137				23,298
Hall Valley	1		7				50		50	100	1,000		91
Mosquito	15		125,894	33,638		33,638	33,317		33,317	67,700	1,069,200		1,257,238
Tarryall	2	30	12	8	729	737	22	56	78				25,848
Pitkin County:													
Lincoln Gulch	1		5	1		1	38		38		1,800		146
Roaring Fork	4		24,083				210,138		210,138	1,200	530,200	176,000	176,835
Rio Grande County: Summitville	1		43,039	14,445		14,445	53,460		53,460				541,863
Routt County: Hahns Peak		7			24	24		13	13				849

[1] Includes Alicante, Granite, Lackawanna Gulch, St. Kevin, Tennessee Pass, and Twin Lakes districts.

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1939, 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				
Saguache County:													
Blake	1		3	1		1	1		1	200			$57
Crestone	1		39	42		42	22		22				1,485
Kerber Creek	8		2,504	46		46	48,771		48,771	247,800	240,000		71,766
San Juan County:													
Animas	14		198,036	15,278		15,278	268,769		268,769	995,000	1,915,300	1,147,000	970,310
Eureka	4		442	781		781	6,298		6,298	6,800	28,400	19,000	34,640
Ice Lake Basin	2		793	93		93	11,083		11,083	11,200	148,300		18,913
San Miguel County:													
Iron Springs	4	1	23,161	1,247	2	1,249	174,567		174,567	88,800	550,700	12,000	197,951
Klondyke	1		5				62		62	1,700			219
Lower San Miguel		11			10	10		9	9				356
Mount Wilson	3		15	103		103	286		286	200	900		3,862
Upper San Miguel	11	6	179,435	28,541	52	28,593	402,049	31	402,080	119,300	2,977,400		1,426,027
Summit County:													
Breckenridge	16	92	1,748	632	1,260	1,892	10,224	329	10,553	2,500	71,000	98,000	82,076
Montezuma	7		252	5		5	5,071		5,071	1,500	73,700		7,237
Ten Mile	5	1	1,239	61	3	64	2,755	1	2,756		79,300		7,838
Wilkinson	1		363	33		33	16,930		16,930	1,700	15,000	100,000	18,729
Teller County: Cripple Creek	104	6	538,138	133,967	36	134,003	17,705	3	17,708				4,702,125
Total Colorado	758	583	1,914,593	347,033	19,819	366,852	8,492,363	4,125	8,496,488	26,430,000	16,444,000	3,660,000	22,319,041

ADAMS COUNTY

Sand and gravel handled in the washing plant of the Brannan Sand & Gravel Co. on Clear Creek north of Denver yielded gold as a by-product in sluices operated throughout 1939 by a lessee. Individuals working intermittently with sluices and pans at other points on Clear Creek in Adams County produced small lots of dust, most of which were sold to dealers in Denver.

ARAPAHOE COUNTY

Sluicing on Platte River and Cherry and Dry Creeks south of Denver recovered small lots of placer gold in 1939.

BOULDER COUNTY

Boulder County recorded a gain of 26 percent in 1939 over 1938 in output of gold, the chief metal in value produced in the county in both years; although part of the gain resulted from an increase in quantity of dump ore shipped, the output from newly mined ore also increased substantially. Boulder, as usual, had more producing lode mine operations than any other county in the State; however, many of those counted are prospects and dumps, inactive mines under investigation, and others producing in general less than 25 tons of ore. Space does not permit mention of these operations or of small placer mines in the following review by districts.

Central (Jamestown) district.—The Wano mine was operated throughout 1939 by the owner and several sets of lessees, who continued to ship the ore to the Golden Cycle mill at Colorado Springs. Associated Metal Mines, Inc., drove 175 feet of drifts and a 50-foot winze at the John Jay mine and shipped 149 tons of gold ore; by consolidation with the Acme Mining & Milling Co. as of December 31, 1939, the company acquired the 40-ton flotation mill adjacent to the mine. Lessees at the Alice, Black Rose, Gray Eagle, Monitor, and Rip Van Dam mines and the owner of the Gold Leaf mine were the other principal shippers from the Central district.

Gold Hill district.—In 1939 Gold Hill was again the largest gold-producing district in Boulder County. The Slide-Klondike group of mines, operated continuously by Slide Mines, Inc., ranked first among the individual properties of the district and county in production of gold, silver, copper, and lead. The ore was treated in the company mill by combined gravity and flotation concentration; free gold caught on burlap tables between the classifier and Wilfley tables was amalgamated, retorted, and sold to the Denver Mint, and the concentrates were shipped to smelters. Mining Associates, Inc., operated its flotation mill at Salina from February 28 to September 2 on ore from a leased section of the Sunshine mine; the company operated at the mine throughout the year, shipping part of the ore to the Golden Cycle mill. Other lessees at the Sunshine also shipped considerable ore. The Sunshine mine ranked second in the Gold Hill district in gold production; the Emancipation group, also operated continuously by lessees, ranked third; the American-Interocean, fourth; and the Melvina, fifth. They were followed by the Ingram, Cash (mine and dump), Golden Harp, Atchison, Cold Spring, St. Joe, King, Fisk, Richmond, and Myrtle. These 15 mines and dumps produced 95 percent of the district total gold in 1939; the remainder came from 48 small lode operations and 2 placers.

Grand Island district.—A lessee worked the St. Louis mine from April 1 to December 31, 1939, and shipped 586 tons of ore to custom plants. Lessees operated the Amy Paul mine throughout the year and shipped 215 tons of ore. Other producers included the Cross and Enterprise-Mogul groups.

Magnolia district.—The American X, Ben C. Lowell, Cash-Rebecca, India, Keystone, Senator Hill, Pickwick, Poorman, Rusty Dime, and Sac and Fox-Dunraven groups comprised those producing 25 tons or more of mine and dump ore in the Magnolia district in 1939. All the ore was shipped to the Golden Cycle mill at Colorado Springs or the sampler at Boulder, except 1,000 tons of dump material treated in the 50-ton flotation- and gravity-concentration mill at the Keystone mine.

Sugar Loaf district.—The Poorman mine, worked throughout 1939 by lessees, continued to be the principal producer of gold in the Sugar Loaf district; the bulk of the ore was shipped to the Golden Cycle mill. The Yellow Pine group, which yielded silver ore containing some lead, gold, and copper, produced most of the district output of silver. At the Logan mine a 75-ton flotation mill, equipped with carpeted launders in the ball mill-classifier circuit to recover free gold, was built; it treated 2,300 tons of ore during the year. The 25-ton Orphan Boy amalgamation-flotation mill was operated intermittently. Other important producing mines included the Alpine Horn, Empress, Grand Republic, Nancy, and Wood Mountain. A dragline and sluicing plant operated on the Giggy and Colby placers from April 1 to May 30 produced nearly all the district output of placer gold.

Ward district.—Kissell & Co. drove 500 feet of development drifts in 1939 at the B & M mine and continued to ship part of the ore produced from underground operations to the Golden Cycle mill; the remainder of the ore and 3,775 tons of dump material were treated by flotation in a leased mill near Ward. The other principal producers of gold in the Ward district were, in order of output, the Utica group, Boston, Golden Queen, Humboldt (mine and dump), Rose, Columbia-Big Five, and Brock No. 5. Most of the ore was sold to the Golden Cycle mill.

CHAFFEE COUNTY

Brown Canyon district.—A placer miner sluicing on the Kelly ranch on the Arkansas River recovered a little gold in 1939.

Chalk Creek district (*Romley, St. Elmo*).—Lessees continued to work the Mary Murphy mine on a small scale in 1939 and shipped gold-silver-lead-copper-[zinc] ore to the Leadville smelter. A few lots of smelting ore were shipped from the Allie Bell group, Philip Carey Mining & Milling Co. group, and Flora Bell claim.

Granite district (*see also Lake County*).—The Granite Tunnel property, which has been under development for several years and which was equipped with a 50-ton flotation mill in 1939, was the only producer of more than 4 tons of ore in the Chaffee County part of the Granite district during the year; the mill was run part of 1939 and produced gold-silver-copper concentrates, which were sold to the Leadville smelter. Wolfe and Hesser operated a ¾-cubic yard power shovel and screening and sluicing plant on the Driscoll Construction

Co. placer ground in Lost Canyon from July 12 to October 8 and handled 20,000 cubic yards of gravel from which were recovered 186 fine ounces of gold and 28 fine ounces of silver. Len Savage operated his placer in Lost Canyon from June 15 to November 20, using a hand sluice part of the time and a power shovel and screening-sluicing plant the rest. The Independent placer, also in Lost Canyon, was worked during the open season with a small placer machine. Individuals sluicing on the Arkansas River near Granite recovered a little gold.

La Plata district.—Lessees at the Meta mine shipped 5 tons of silver ore to the Leadville smelter in 1939.

Monarch district.—The output of the Monarch district in 1939 comprised chiefly lead-silver-gold ore from the Garfield and Hawkeye mines and lead-copper-silver ore from the Lilly group, all shipped to the Leadville smelter.

Riverside district.—The Victory Mining Co. shipped 16 tons of gold ore in 1939 from the Big Chief claim to the Golden Cycle mill at Colorado Springs.

Trout Creek district.—A lessee prospecting at the Nelly Bly claim shipped two small lots of gold ore in 1939.

Turret district.—Three truckloads of gold ore were shipped in October 1939 from the Monongahela group to the Golden Cycle mill.

CLEAR CREEK COUNTY

Alice district (Yankee, Lincoln).—Porphyry Mines, Inc., did 321 feet of churn drilling in 1939 at the Alice group, an important producer of gold, silver, and copper from 1935 until it was closed October 22, 1938; the only output in 1939 came from a clean-up of the mill. The Glacier Gold Mining Co. operated the Reynolds group part of the year and treated some ore in the stamp-amalgamation mill on the property. At the San Juan mine 50 tons of ore were treated by amalgamation. Lessees at the Gold King mine shipped several hundred tons of ore to the Golden Cycle mill.

Argentine district.—Lessees working the Santiago and Waldorf groups on a small scale in 1939 shipped ore to custom plants in Clear Creek County and to the Leadville smelter.

Empire district.—In 1939 Minnesota Mines, Inc., operated continuously its consolidated group of claims in the area north of Empire; since 1935 this company has been the largest producer of gold in Clear Creek County. The ore is treated in the 250-ton mill at the mine by concentration on mats in launders and by flotation followed by cyanidation of the flotation concentrates. After being treated the flotation concentrates, containing chiefly iron sulfide, are sold to the General Chemical Co. of Denver; the mat concentrates, containing mostly free gold, are amalgamated. Three Leasers worked the Conqueror group under a sublease from the Viking Gold Mines Corporation throughout 1939 and continued to ship the ore to the Golden Cycle mill until September, after which they had it treated in the Clear Creek-Gilpin mill adjacent to the sampler at Idaho Springs. Lessees operated the Tenth Legion-Gold Dirt-Sprankel-Empress Tunnel group throughout the year; part of the ore produced was sold to the Golden Cycle mill at Colorado Springs, part was treated in local custom mills, and part in the Gold Dirt mill which was reconditioned during the year. Other producers in the Empire district included the Gold Bug, Gold Fissure (or Badger), Mint, Omaha No. 2, and Pioneer.

Geneva Creek district.—In 1939 the Twin Basin Mining & Milling Syndicate built a small cyanide plant at the Sill mine and treated a little ore to test the equipment.

Griffith (*Georgetown-Silver Plume*) *district.*—The Capital Tunnel group was operated part of 1939 by J. M. O'Connor, who shipped the ore to custom mills for treatment. Ore from the Corry City dump was treated in the Silver Leaf mill. Lessees at the Lebanon mine treated some ore from the mine and dump in the Lebanon mill. Direct-smelting ore was shipped from the Johnny Bull, St. George, and a few other mines and dumps in the Griffith district.

Idaho Springs district.—The Alma-Lincoln Mining Co. operated its group of mines continuously in 1939 and treated 35,115 tons of ore by mat concentration and flotation in the company mill. The old Lincoln adit and 450-foot interior incline shaft on the Lincoln vein were cleaned out and reconditioned, and considerable ore was extracted from stopes on this vein. A large part of the ore, however, continued to come from the South Lincoln-Barber Elliott veins. During the year the company installed four slushers for underground loading of chutes. The Dixie mine on Ute Creek was a substantial producer of gold; the ore was treated in the Ruth custom mill at Idaho Springs. This mill was operated continuously and received ores from both Clear Creek and Gilpin Counties. The Williams Mining Co., operating the Williams mine, was a steady shipper throughout the year to the Golden Cycle mill. Ore from the Metropolitan group was treated in the Hoosac mill. Colorado Silver Mines, Inc., operated the Bald Eagle mine under lease from June 15 to December 31, treating the ore in the company mill near Blackhawk, Gilpin County. Other sizable producers of ore shipped to custom plants were the Castleton, Golden Edge, Idaho Bride, Santa Fe, Stephens Placer, and Shafter mines. The Clear Creek-Gilpin sampler at Idaho Springs was operated from April to September; it purchased ore, mostly in small lots, from mines and prospects in the Idaho Springs and nearby districts. Placer gold was recovered by individuals sluicing on Clear Creek.

Montana district (*Lawson, Dumont*).—From January 1 to June 9, 1939, the Clear Creek Consolidated Mining Co. operated the Brown-Jenks-Equinox group of claims opened by the Clear Creek and Gilpin adit just east of Dumont and treated 6,742 tons of gold-silver-copper-lead ore in the company mill by amalgamation, flotation, and tabling; the mine was inactive the remainder of the year, but the mill was used to treat custom ore from the Eagle and Red Elephant mines in the Montana district and the Badger, Capital Prize, Lord Byron, Stanley, and Stephens properties in nearby districts. The Red Elephant group was operated continuously by Red Elephant Metals, Inc., and yielded 2,460 tons of silver-lead ore. Other producers included the Earl of Kent, Franklin D, and Milton claims. The Dumont mill was run as a custom plant most of the year and treated 4,116 wet tons of ore from 20 mines in Clear Creek County and 1 mine in Gilpin County.

Trail Creek district.—The Lamartine-Falcon group of mines on Trail Creek 5½ miles southwest of Idaho Springs, which has been under development by Lamartine Mines, Inc., since 1937, was the third-largest producer of gold in Clear Creek County in 1939. Before its mill was completed in July the company shipped 517 tons of ore to the Golden Cycle mill; the company mill began operating on July 31 and from that time until December 31 treated 10,672 tons. Treatment was by flotation supplemented by jigs in the ball mill-classifier circuit to extract free gold for amalgamation. Lessees worked part of the Freeland group intermittently and treated some ore in the Freeland mill. The Phoenix-Trail Mining Co. operated the Phoenix mine part time; the ore produced was concentrated in the Dumont mill. Ore was shipped to local custom plants and to the Golden Cycle mill from the Donaldson (Wheatland)-Little Champion group, Empress, Diamond Mountain, Freeland Extension, Lone Tree, Mendic, Miller Tunnel, and Oneida groups.

COSTILLA COUNTY

Sluicing in Grayback Gulch on the property of the Drum Estate and on the Griffith and one other placer in Costilla County recovered small lots of placer gold in 1939.

CUSTER COUNTY

Hardscrabble district (Westcliffe, Silver Cliff).—Intermittent small-scale operations in 1939 at the Defender, Little Annie, and other mines and prospects in the Hardscrabble district resulted in the shipment of a few lots of lead-silver and copper-lead-silver ore to the Leadville smelter. Shore, Kettle, Henning & Stroehlke operated their 10-ton cyanide plant at Silver Cliff on material trucked 8 miles from a tailings dump on the Nemaha-William property; gold-silver precipitates produced were shipped to the Midvale (Utah) refinery.

DENVER COUNTY

Individuals sluicing on Platte River and Cherry Creek in Denver recovered a little placer gold in 1939.

DOLORES COUNTY

Pioneer district (Rico).—The Rico Argentine Mining Co., which carried on a development campaign at its property in 1937, 1938, and 1939 and constructed a 135-ton selective-flotation mill, began mining and treating ore in September 1939 and maintained production at an average of 100 tons of ore daily to the end of the year. The products of the mill were copper-iron-silver concentrates (carrying some lead and zinc and a little gold) shipped to the Garfield (Utah) smelter; lead-silver concentrates (containing some zinc and copper and a little gold) shipped to the Leadville smelter; and zinc concentrates (carrying also silver, lead, copper, and a little gold) shipped to the Amarillo (Tex.) smelter. Other output from Rico included zinc-lead-silver and copper-gold-silver ores from the Falcon, Gold Anchor, Nora Lilly, and Pigeon claims and Rico Townsite shipped to custom flotation plants and smelters in Utah. The St. Louis Smelting & Refining Co. did development work at its property during part of the year and shipped several cars of zinc-lead-silver ore.

DOUGLAS COUNTY

Individuals sluicing and drift mining on Cherry and Dry Creeks and Newlin, Russellville, and other gulches near Parker and Franktown in 1939 recovered small lots of gold dust, most of which were sold to dealers in Denver; two lots sold to the Denver Mint averaged 0.993 fine in gold.

EAGLE COUNTY

Burns-McCoy district.—Sluicing on Colorado River near Burns recovered a little placer gold in 1939.

Holy Cross district.—Thos. E. Knight worked his Glengarry claim 30 days in August 1939 and shipped two 1-ton test lots of lead-copper-silver-gold ore to the Leadville smelter.

Mount Egley district.—Lessees on the Norgaard property produced placer gold in 1939.

Red Cliff district (*Battle Mountain*).—The Red Cliff or Battle Mountain district contributed the bulk of the Colorado output of silver and copper in 1939 and ranked first among the districts of the State in combined value of gold, silver, copper, and lead. The chief producer, as usual, was the New Jersey Zinc Co. Empire Zinc Division, which continued to ship large quantities of copper-iron-silver-gold sulfide ore from its Eagle mine at Gilman to the Garfield (Utah) smelter. The company 600-ton underground flotation mill in Eagle Canyon, used in 1930–31 to treat zinc-lead ore (large reserves of which are also developed in the mine), was idle from 1932 to 1939, inclusive. The Ben Butler Corporation continued to ship gold-silver-copper ore to the Garfield smelter from the Ben Butler mine and installed an ore washing and sorting plant. Other producers included the Evening Star, Golden Comet-Pacific group, Groundhog, Star of the West, and Tip Top.

ELBERT COUNTY

A floating "pony dredge" using 23 buckets (7 by 7 by 12 inches) was run 4½ months in 1939 on the Crail ranch on Ronk Creek near Elizabeth and handled 3,000 cubic yards of gravel, which yielded 22.23 fine ounces of gold. A small lot of placer gold was recovered by an individual sluicing on Gold Run Creek.

EL PASO COUNTY

GOLDEN CYCLE MILL

The Golden Cycle custom mill at Colorado Springs recovered 44 percent of the total Colorado output of gold from lode mines in 1939. It treated 545,323 tons of ore averaging 0.31216 ounce of gold to the ton, of which 477,464 tons were gold-[silver]-sulfotelluride ores from the Cripple Creek district (Teller County) and 67,859 tons comprised miscellaneous gold, gold-silver, and gold-silver-lead ores from other districts, mainly in Boulder, Clear Creek, and Gilpin Counties. Ores purchased vary in character and grade; therefore, all are not treated by the same methods. Average-grade Cripple Creek ores, comprising most of the mill feed, together with iron concentrates made from low-grade ores treated by flotation, are roasted, amalgamated,[1]

[1] Free gold saved on lightweight canton-flannel blankets and amalgamated in iron arrastre.

and cyanided. Miscellaneous ores containing appreciable quantities of base metals are treated by selective flotation. The tailings from all operations are separated into sand and slime fractions and cyanided. In 1939 the mill recovered more than 98 percent of its total gold output in the form of gold-silver bullion; the remainder was contained in lead-copper concentrates shipped to the Leadville smelter. The revised schedule of gold payments and treatment and freight rates, effective December 1, 1938, proved successful in stimulating production of low-grade ore, and the total tonnage treated in 1939 was the highest in any year in the history of the mill. Among the additions to the plant equipment in 1939 is a Cottrell electric dust-precipitation system.

The Mill Tailings Recovery Co. installed an 80-ton cyanide plant at the old Portland mill tailings dump near Colorado Springs and began treating the tailings in April 1939; the plant, most of which is outdoors, was run until the open season ended in December. The output from this dump is included in the figures for the Cripple Creek district (Teller County), where the material originated.

FREMONT COUNTY

A 2-ton lot of gold ore was shipped from the Little Rose prospect in the Whitehorn district to the Golden Cycle mill in 1939. A little placer gold was recovered by sluicing at the old Dorcas millsite at Florence.

GARFIELD COUNTY

Rifle Creek district.—The lessee at the Gray Eagle mine 8½ miles from New Castle continued to ship gold-silver-copper sulfide ore to smelters in 1939.

GILPIN COUNTY

Southern districts (Blackhawk, Central City, Nevadaville, Russell Gulch).—Frontenac, Inc., operated the Frontenac-Aduddell group in Russell Gulch continuously in 1939 and was the leading lode producer of gold, silver, lead, and copper in Gilpin County. About half the ore produced was sold to the Golden Cycle mill; part was treated in the Gold Ridge mill and part in the Ruth mill (at Idaho Springs, Clear Creek County); and part was shipped crude to the Leadville smelter. The New Brunswick mine and 15-ton stamp amalgamation-table concentration mill were operated throughout the year. Lessees at the Mineral, Powell, Carr, Granite, Mammoth West, and Phoenix claims in the consolidated group owned by the California-Hidden Treasure Mines Co. shipped several hundred tons of ore. Material from dumps on this company's property at Nevadaville was treated by the Continental Mining Co., lessee, which rebuilt the old Monmouth-Kansas mill and installed equipment for amalgamation and flotation; the new plant has a capacity of about 175 tons daily and treated 2,377 tons during the year. The Monmouth-Kansas mine was worked from April 15 to December 31 by lessees who shipped 1,092 tons of ore containing 749 ounces of gold and 2,928 ounces of silver. The Gold Ridge Mining Co. operated its 75-ton flotation mill the first few months of the year on ore from the Clay County group. The Old Town Mining Co. erected a 50-ton flotation mill at the Old Town group and operated it several weeks after July. Ore was shipped to custom plants, chiefly the Golden Cycle mill at Colorado Springs, from other mines, prospects, and dumps in the southern districts; the principal producers were the Champion, Chase, Druid, Federal, Golden Dollar-Stewart, Lotus, National, Pewabic group, and War Dance.

The Manion Placer Co. operated a 1¼-cubic yard dragline and portable land dredge on the Eugene placer 223 days in 1939. The Dunfield-James partnership ran a ¾-cubic yard dragline and portable washing plant from May 1 to July 1 on placer ground in Russell Gulch, and the Johnson Mining Co. operated similar equipment on the Pot O'Gold placer from May 1 to September 10. A lessee worked the Missions Mines Co. placer in Russell Gulch with a ⅝-cubic yard power shovel, sand pump, and concentrating table. Individuals continued sluicing and panning during the open season on North Clear Creek.

Northern districts.—Lessees operated the We Got Em and Cowboy group during November and December 1939 and treated 1,000 tons of ore in the flotation mill on the property. The Dalham Leasing Co. worked the Dirigo mine from February 15 to April 15 and shipped several cars of ore to the Golden Cycle mill. A lessee at the Lone Star group shipped 297 tons of ore. Several claims in the Perigo group were worked intermittently by lessees who shipped part of the ore produced to the Golden Cycle mill and treated part in the mill at the mine. Other small lode producers included the Golden Flint, Long John, and Victoria properties.

The Cooley Gravel Co. worked the Pactolus placer near Pinecliff with a rated 2,000- to 2,500-cubic yard floating dredge fed by a 1½-cubic yard dragline for its third season, which lasted from April 4 to November 30. The yield from 348,718 cubic yards of gravel handled was 1,950 fine ounces of gold and 178 fine ounces of silver. The company exhausted the gravel in 1939 and removed its equipment. Individuals recovered some gold by sluicing in Gamble and Lump Gulches.

GRAND COUNTY

The Wolverine Syndicate shipped 25 tons of lead-silver-gold ore to the Leadville smelter from the Wolverine group, about 22 miles north of Granby, which was operated 1 month in 1939. Owners operated the La Plata claim 18 miles west of Empire 60 days and shipped 16 tons of silver-gold-lead ore. Placer gold was recovered by sluicing at the Jerry claim on Broncho Creek.

GUNNISON COUNTY

Box Canyon district.—J. C. Ternahan worked the Independent mine 6 miles south of Pitkin under lease throughout 1939 and produced 347 tons of ore, which he treated in his 10-ton stamp-amalgamation mill on the nearby Northern Light claim.

Elk Mountain district.—Superior Metal Mines, Inc., operated the Shakespear-North Pole group from June 8 to October 8, 1939, and shipped 112 tons of copper-silver ore to the Garfield (Utah) smelter. A few lots of ore were shipped to smelters from the Kebler Creek property and the Little Willie and White Star claims. A little gold was recovered from placers in Washington Gulch.

Gold Brick district.—The Carter Mines Co. continued operations at its mine and mill on Gold Creek. The mine is opened by an 8,800-foot adit, a 1,200-foot vertical four-compartment raise, and numerous drifts. Water from Gold Creek furnishes power to run the mill. During the past few years the ore has been treated by amalgamation and gravity concentration, although the mill is equipped with flotation machines; in 1939 flotation was used in combination with tables following amalgamation, and about 6,000 tons of ore were treated. On April 3 Burleson Mines, Inc., began work at the Raymond group under a lease and continued operations to the end of the year. The old tunnel was extended 1,000 feet, making it 4,200 feet long, and 600 feet of drifts were driven. A 65-ton mill—comprising a crusher, ball mill, jig, classifier, conditioner, six-cell flotation machine, and table—was installed in an old mill building on the property and operated 28 shifts (8 hours each) late in the year; it treated 569 tons of ore. Small tonnages of ore were amalgamated at the Chicago-Climax, Idoline, and Wayne properties, and 4 tons were shipped from the Gold Pink claim.

Goose Creek district.—A 9-ton lot of lead-silver ore mined while assessment work was being done on a claim southwest of Iola was shipped to the Leadville smelter in 1939.

Green Mountain district.—Development work was done and some ore produced in 1939 at the Lulu-Lucky Strike group, which is equipped with a small mill.

Taylor Park (Tin Cup) district.—Individuals sluicing on Illinois Creek and other streams in Taylor Park in 1939 recovered some placer gold.

Tomichi district.—Twenty tons of dry silver ore were shipped in 1939 from the Little Dick claim to the Leadville smelter.

HINSDALE COUNTY

Galena district.—The M. B. Burke Mining & Investment Co. operated the Ute and Ulay group and flotation mill on a small scale from May 17 to December 23, 1939. From the Mill placer material containing zinc, lead, gold, silver, and copper was shipped to the custom concentrator at Midvale, Utah.

Lake district.—Golden Mammoth Mines, Inc., shipped 63 tons of gold ore from the Golden Wonder group to the Leadville smelter in 1939.

JACKSON COUNTY

Lessees worked the Pure Gold placer on Independence Mountain in 1939 with a small placer machine to which the gravel was hauled by truck. Lack of water prevented operation for more than a few weeks.

JEFFERSON COUNTY

Placer miners worked gravel bars along Clear Creek intermittently in 1939 and recovered many small lots of dust, which were sold to dealers and to the mint in Denver. The Tate Sand & Gravel Co. property near Arvada yielded the largest individual output.

LAKE COUNTY

LEADVILLE DISTRICT

The Arkansas Valley lead bullion-leady copper matte custom smelter of the American Smelting & Refining Co. at Leadville was operated continuously (one furnace) in 1939. Receipts of ore and concentrates totaled 111,526 tons (all but 50 tons from Colorado mines) compared with 107,423 tons (including 88 tons from outside the State) in 1938.

The largest mining enterprise in the Leadville district was that of the Resurrection Mining Co., which carried on an extensive development campaign at the Resurrection and adjacent properties; much of the ore shipped by the company was removed in development. Lessees continued to ship ore from the Ibex group. The H. G. N. mill was remodeled and operated for a period on ore from the Garbutt, Fanny Rawlings, and Maid of Erin dumps. Treatment was by crushing, grinding, jigging, tabling, and amalgamating the high-grade concentrates; the other concentrates were sold to smelters. The London Deep Mines Co. operated the First National mine and 100-ton mill part of the year. The California Gulch Milling Co. erected a 75-ton flotation- and gravity-concentration mill in California Gulch near Leadville and operated it from November 10 through December on ore trucked from the Venir dump. Zinc-lead ore from the North Moyer and South Moyer dumps was shipped to the Ozark pigment plant at Coffeyville, Kans. Some ore from the Triumph and Highland Chief mines was sent to the Golden Cycle mill, but most of the district output was sold to the Leadville smelter. Other producing mines and dumps included the Adelaide, Black Prince, Breece, Chippewa, Commerce, Dolly B, Highland Mary, Humboldt and Flagstaff dumps, Lilian, Little Sliver dump, New Monarch, Ollie Reed, President dump, St. Louis Tunnel, Tenderfoot, Triumph, and Valley. Placer gold was recovered in California and Buckeye Gulches.

OTHER DISTRICTS

Alicante district.—The Alicante and John Reed mines were worked as one unit by lessees about 6 months in 1939 and yielded zinc-lead-gold-silver-copper ore, of which part was sold to the Leadville smelter and part to the custom concentrator at Midvale, Utah.

Granite district (*see also Chaffee County*).—Burns Mines, Inc., shipped about a car of gold ore from its property in 1939. The Raeanna Mining Co. worked the Oregon placer in Long Gulch west of Granite 40 days with draglines and washing plants. Individuals continued small-scale sluicing on the Arkansas River.

Lackawanna Gulch district.—The lease of the Eureka Saturday Night Mining Co. on the Eureka-Saturday Night group was canceled in May 1939, and the only output from the property during the year was a few tons of gold concentrates shipped to the Leadville smelter. A lessee at the Mt. Champion mine shipped some gold ore.

St. Kevin-Sugar Loaf district.—Several lots of ore were shipped to the Leadville smelter in 1939 from the Amity, Dinero, and Griffen mines.

Tenmile (*Climax, Fremont Pass*) *district.*—The Climax Molybdenum Co. at Climax, 13 miles north of Leadville, operated its 12,000-ton flotation mill continuously in 1939 (averaging 9,400 tons of ore daily for the year) and produced molybdenum sulfide concentrates containing 21,796,116 pounds of elemental molybdenum.

Tennessee Pass district.—Testing with sluice boxes at the Wye placer yielded a little gold in 1939.

Twin Lakes district.—The Brown Brothers Mining Co. shipped 58 tons of lead-gold-silver-copper ore from the Gordon-Tiger group in 1939, and a lessee at the Columbine recovered a little gold by amalgamation and shipped 1 ton of lead-gold-silver ore. The dry-land dredge of the Mt. Elbert Mining Corporation on the Derry Ranch placers 12 miles south of Leadville was operated from April 15 to December 26.

LA PLATA COUNTY

The American Smelting & Refining Co. lead bullion-leady copper matte smelter at Durango, which was closed November 30, 1930, remained idle in 1939.

California (or La Plata) district (Hesperus, La Plata).—The May Day mine and flotation mill were operated on a small scale in 1939. Two lessees worked part of the Gold King group from April to October and shipped ore to the Leadville smelter. Miscellaneous lots of ore were shipped to smelters from the Bessie G, Bonner, Durango Girl, Non Pariel, and Sara S properties, and test lots were shipped to the Golden Cycle mill at Colorado Springs from the White Diamond group.

MINERAL COUNTY

Creede district.—Silver production in the Creede district increased 30 percent in 1939 over 1938, following an increase of 42 percent in 1938 over 1937. The principal market for the ore continued to be the custom flotation mill of Creede Mills, Inc., at Creede. During the year the mill treated 34,748 tons of ore averaging 0.031 ounce of gold and 17.2 ounces of silver to the ton and 2.71 percent lead. The ratio of concentration was 26 tons into 1, and the concentrates averaged 0.478 ounce of gold and 309 ounces of silver to the ton and 18.7 percent lead; they were shipped to the Leadville smelter. Besides running its custom mill the company operated several leased mines in 1939; it took over the Amethyst and Creede Mines group early in February and part of the Pittsburg group later in the year. The Emperius Mining Co., operating the Del Monte-New York-Last Chance-Pittsburg group under a sublease from Morgan & Sloan, was the largest individual shipper of custom ore to the mill. The company also shipped rich silver ore direct to the Leadville smelter. Other producing mines included the Commodore-Bachelor, Corsair, Manitoba, and Monon.

MOFFAT COUNTY

Fourmile (or Timberlake) district.—The Gooldy group of placers 29 miles north of Craig was worked by Eldorado Gold Placer Mines during the early summer of 1939 and by Paul J. Kruesel and A. T. Willett later in the year. The equipment used included a gasoline-powered dragline excavator and dry-land dredge. Sluicing was done at other placers in the Fourmile district.

MONTEZUMA COUNTY

In 1939 the Red Arrow Gold Corporation built a 20-ton amalgamation-flotation mill at its Red Arrow mine in the East Mancos River area and treated 724 tons of ore averaging 0.869 ounce of gold and 13.88 ounces of silver to the ton; in addition, the company shipped some high-grade ore to the Leadville smelter. Development work done in the mine during the year totaled 1,000 feet of drifts and tunnel. The Outwest Mining Co. worked its mine adjoining the Red Arrow on a small scale from May to December and shipped high-grade gold ore to smelters. The Barr-Menefee Mining Co., lessee on the Stafford group, shipped 8 tons of gold-silver-copper-lead ore.

MONTROSE COUNTY

La Sal district.—Lessees at the Cashin and Independence No. 7 claims shipped copper-silver ore to the Garfield (Utah) smelter in 1939. The Hardscrabble and Red Canon placers on Dolores River were worked with bulldozers and sluices part of the year and produced most of the output of placer gold from the La Sal district.

Naturita district.—Individuals sluicing on San Miguel River in 1939 recovered small lots of placer gold.

Paradox Valley district.—The United States Vanadium Corporation operated its vanadium mines and roasting and leaching plant at Uravan throughout 1939 at the rate of approximately 240 tons of ore daily. The company extracts its own salt in the vicinity and owns and operates its own coal mines.

OURAY COUNTY

Red Mountain district.—San Juan Metals, Inc., operated its flotation mill at the Treasury Tunnel group about 15 days early in 1939 and then closed the mine and mill; they were taken over later in the year by the Idarado Mining Co., which worked about 2 months getting the property in shape for further development. Ore from the Yankee Girl group was treated in the Banner American (G. A. Franz) mill near Ouray. Several lots of zinc-lead ore from the Dauntless and copper ore from the Kentucky Giant and Paymaster claims were shipped to custom plants at Midvale, Utah.

Ridgway district.—Sluicing at small placers on Uncompahgre River near Ridgway recovered a little gold in 1939.

Sneffels district.—King Lease, Inc., operated the Camp Bird mine and the King Lease 75- to 100-ton amalgamation-flotation mill continuously in 1939. The expansion of the company mining operations (until 1938 confined to the upper levels of the mine) to include the lower levels resulted in important changes in the conduct of operations at the end of 1939. The third level, the main haulage adit to the King Lease mill in Imogene Basin, was connected by shafts and raises with the lower adit 1,450 feet below the third level, and equipment was installed to lower the ore from the upper levels to the lower adit, through which it will be transported about 11,000 feet to the old Camp Bird, Ltd., camp for treatment. A new 100- to 125-ton amalgamation-flotation mill was built within the old Camp Bird stamp-mill building and made ready for operation in 1940. With the new transportation system, employees can live in the Camp Bird, Ltd., camp at a lower altitude than the other camp in Imogene Basin. Lessees worked the Atlas mine from May to December and shipped some ore to the Midvale (Utah) smelter. The New Trust Ruby Mining & Milling Co. treated 900 tons of ore from the Trust Ruby mine in a 15-ton amalgamation mill.

Uncompahgre district.—Lessees at the Syracuse Tunnel group continued to ship ore, containing chiefly silver and lead, to smelters and had 1,511 tons concentrated in the Banner American 100-ton flotation mill. The mill was operated intermittently in 1939, part of the time by G. A. Franz Mines and part by G. A. Franz, Inc.; it also treated company ore from the Pony Express group and some ore from the Yankee Girl (Red Mountain district). The McCullough lease continued to ship gold-silver-copper ore to the Leadville smelter from the American Nettie and Wanakah groups, worked as a unit, and treated 1,000 tons of old tailings from the Wanakah mill dump in the 30-ton flotation mill on the property. Ore was shipped to smelters in Utah from the Senorita group, to the Shenandoah-Dives mill at Silverton (San Juan County) from the Columbo claim, and to the Leadville smelter from a clean-up of the old Munn sampler.

PARK COUNTY

Alma Placers district.—Most of the output from the Rhodes property in 1939 came from blocks of ground worked by the Alplaco Mining Co., R. L. & W. Co., and Snelling lease. All three operators used central sluicing plants, to which gravel dug from open pits by power shovels was hauled by trucks. The London Extension Mining Co. placer adjoining the Rhodes property on the east was worked by the Placer Operating Co. with a dry-land dredge fed by a 1¾-yard dragline.

Beaver Creek district.—The Timberline Dredging Co. operated its electric floating connected-bucket dredge on Beaver Creek near Fairplay from April 4 to December 31, 1939, and handled 776,000 cubic yards of gravel yielding 4,252 fine ounces of gold and 900 fine ounces of silver; the dredge is equipped with 84 buckets, each with a capacity of 7½ cubic feet. Small-scale sluicing was done by individuals on upper Beaver Creek.

Buckskin district.—A few lots of ore were shipped to the Leadville smelter from the Golden Era, Home Sweet Home, and Wyandotte-Apex groups in 1939. Seven tons of ore extracted while a tunnel was being driven at the Funston-Lucky Strike group were amalgamated at the mine. Sluicing in Buckskin Gulch recovered a little placer gold.

Consolidated Montgomery district.—The Magnolia Gold Mining Co. operated the Magnolia mine and 50-ton flotation mill at the rate of about 400 tons of ore monthly from January to June 1939. Production was interrupted early in July when the mill was struck by lightning and burned, but rebuilding was nearly completed before the year ended; meanwhile, some ore was shipped crude to the Leadville smelter. Small lots of smelting ore were shipped from the Columbia, Nova Zembla, and Wheeler claims. A placer miner recovered some gold in Montgomery Gulch.

Fairplay district.—Miles O. Deatherage worked placer ground on the west bank of Platte River with a 1-cubic yard gasoline shovel, two trucks, and a central sluicing plant from June to October 1939; water was obtained from a ditch reaching to Sacramento Gulch 3 or 4 miles away. Gow, Burton, and Walley operated a power shovel and central sluicing plant on Platte River about 4 months. A small caterpillar shovel and sluice were used intermittently at the Snowstorm placer. Other operators produced some gold from placers, mostly by sluicing.

Hall Valley district.—A lessee at the Ypsilanti claim shipped test lots of ore to the Ruth mill in Clear Creek County and the Leadville smelter in 1939.

Mosquito district.—The London Mines & Milling Co. operated its consolidated group of mines on London Mountain continuously in 1939. The mine workings are reached through the 4,400-foot London Extension tunnel, and the ore is sorted before being treated in the company 200-ton flotation- and gravity-concentration mill. Besides gold, the concentrates contained some silver, a little copper, and considerable lead and zinc; they were sold to the Leadville smelter. The London-Butte Gold Mines Co. worked the Butte mine throughout 1939 and treated 17,881 tons of ore in the company 100-ton flotation mill. From heads averaging 0.2547 ounce of gold and 0.137 ounce of silver to the ton, 0.04 percent lead, and 0.02 percent zinc the mill made 1,438 tons of concentrates containing 4,322 ounces of gold, 2,463 ounces of silver, 140,607 pounds of lead, and 71,889 pounds of zinc. The Chicago Mines Co., operating the Record mill for the third season, treated 28,036 tons of ore from the South London mine dump and 1,769 tons of custom ore from the American mine. The American was operated by W. A. Ellis, Inc., owner, which continued to ship high-grade gold ore to the Leadville smelter. Some ore was shipped also from the Evening Star, Good Samaritan, Little Fool, and other mines and prospects in the Mosquito district. Ore from the Ophir mine was treated in a small mill erected by lessees.

Tarryall district.—The Peerless Mining Co. operated its gasoline-powered 1¼-cubic yard shovel and portable four-bowl washing machine in 1939 for the sixth consecutive season in Park Gulch. The equipment was run on the Hogg placer from April 19 to November 12 and handled 104,120 cubic yards of gravel, from which were recovered 499 fine ounces of gold and 35 fine ounces of silver. The Sterling Mining Co. also worked on the Hogg placer from July 15 to October 30, using a dragline and sluicing plant. Individuals sluicing on Tarryall Creek recovered small lots of placer gold. A little ore was shipped from the Black Butterfly lode claim and an unidentified prospect.

PITKIN COUNTY

Lincoln Gulch district.—A 5-ton lot of gold-silver-lead ore was shipped to the Leadville smelter from the Three Brothers claim in 1939.

Roaring Fork district (Aspen).—About half of the silver output of Pitkin County in 1939 came from lime fluxing material, carrying 4 to 10 ounces of silver to the ton (averaging 6.61 ounces) and some lead, shipped to the Leadville smelter from the Smuggler, Spar Consolidated, and other groups under the management of D. P. Rohlfing; in general, payment for lime in this material exceeds that for silver. The Midnight Mining Co. operated the Midnight group continuously 6 days a week. The ore mined (7,500 tons) was treated in the company 50-ton flotation mill. Besides lead-silver concentrates, which are the main product of the mill and are sold to the Leadville smelter, some byproduct zinc concentrates were produced and shipped to the Amarillo (Tex.) zinc smelter. Lessees treated 350 tons of ore from the Mollie Gibson dump with jigs and tables, and a car of lead-silver ore was shipped from another property in the Roaring Fork district.

RIO GRANDE COUNTY

Summitville district.—Summitville Consolidated Mines, Inc., operated its consolidated group of mines and 125- to 150-ton mill at Summitville continuously in 1939. During the past 3 years the company has mined substantial quantities of ore during the summer months by the glory-hole system from veins uncovered in development work carried into new ground. It operates three groups of underground workings which, together with the glory holes, furnish enough ore to keep the mill running throughout the year. The ore is ground in a ball mill with cyanide solution to minus 100-mesh. A jig between the ball mill and classifier removes coarse high-grade gold-silver-pyrite concentrates, which are shipped to the Leadville smelter. The classifier overflow goes to primary thickeners to remove pregnant solution; the primary thickener underflow goes to agitators and from them to three stages of countercurrent decantation. The pregnant solution is precipitated in Merrill-Crowe units, and the precipitates are acid-treated and reduced to bullion for shipment to the Denver Mint.

ROUTT COUNTY

Individuals recovered some gold and silver in 1939 from placers in the Hahns Peak area.

SAGUACHE COUNTY

Blake district.—The Tripple-T Mining Co. drove 250 feet of tunnel at the Copper Head group of claims in 1939 and shipped a test lot of ore to the Midvale (Utah) smelter. Other work included the building of roads and installation of mill machinery and power units.

Crestone district.—Sublessees on the Independent, Alamosa, and Fanton claims, in a group on the mineral section of Baca Grant No. 4 under lease to the Luis Maria Baca Mining & Development Co., shipped several lots of ore to the Golden Cycle mill in 1939.

Kerber Creek district (Bonanza).—Rawley Mines, a limited partnership, continued to work the Rawley mine from January 1 to April 19, 1939, when it surrendered the lease; most of the ore was shipped to the copper smelter at Garfield, Utah, and the remainder to the Leadville smelter. Other lessees at the Rawley group shipped some ore during the year. Other producers of occasional lots of ore shipped to the Leadville smelter included the Essie group, Joe Wheeler, Jupiter, and Warwick. A little ore was treated by table concentration at the Paragon-Michigan group.

SAN JUAN COUNTY

Animas district.—The Shenandoah-Dives Mining Co. continued operations at its Mayflower Tunnel group on King Solomon Mountain and 750-ton selective-flotation mill on Animas River near Silverton from January 1 to June 15, 1939, when a strike of company employees caused a shut-down of both mine and mill until September 5. An agreement between the company and the men resulted in the reopening of the property on September 7 and continuous operation of it the remainder of the year. As the Shenandoah-Dives mill treats custom ore as well as company ore, the shut-down caused a decrease in the output from other mines in the vicinity. Company ore treated in 1939 totaled 195,006 tons and yielded 5,722 tons of combined lead, lead-copper, copper, and zinc concentrates, containing in all 14,867 ounces of gold, 240,003 ounces of silver, 1,968,193 pounds of lead (wet assay), 1,132,012 pounds of copper (wet assay), and 1,838,311 pounds of zinc; the lead and lead-copper concentrates were shipped to the Leadville smelter, the copper concentrates to the El Paso (Tex.) smelter, and the zinc concentrates to the Amarillo (Tex.) smelter. The custom ore treated amounted to 3,241 tons; most of it came from the Bandora, Champion, Highland Mary, Little Fannie-Philadelphia, Mystery, and North Star-Sultan groups—all in the Animas district except the Bandora, which is in the Ice Lake Basin district. Other small producers included the Coming Wonder, Copper Bell group, Molas-Senior Warden group, Silver Ledge, and Sylvanite. The American Smelting & Refining Co. continued development of the Silver Lake group.

Eureka district.—The Sunnyside mine and 1,000-ton selective-flotation mill at Eureka, closed June 30, 1938, remained idle throughout 1939. Shipments of ore from the Brooklyn group 8 miles northwest of Silverton to the Leadville smelter totaled 253 tons containing 724 ounces of gold, 5,539 ounces of silver, and some lead, copper, and iron. The other producers of small tonnages of ore were the Lead Carbonate mine, Lucky Jacks group, and St. Paul. Development work was continued at the Sandiago-Golden Fleece-Scotia group.

Ice Lake Basin district.—In 1939 the Blanco Mining Co. continued to ship ore from the Bandora group to the Shenandoah-Dives mill and the Leadville smelter. Two tons of silver ore were shipped from an unidentified property, presumably a prospect.

SAN MIGUEL COUNTY

Iron Springs district (Ophir).—Butterfly Consolidated Mines, Inc., continued developing the Butterfly-Terrible-Silver Bell group of mines and increased the daily capacity of the mill (formerly 100 tons) to 250 tons. In 1939 the mill treated 23,000 tons of ore, which yielded 2,470 tons of combined table and flotation concentrates containing 1,101 ounces of gold, 172,865 ounces of silver, 554,531 pounds of lead (wet assay), 101,056 pounds of copper (wet assay), 77,225 pounds of zinc, and 1,348,640 pounds of iron. The concentrates were shipped to the Midvale (Utah) smelter. J. M. Belisle shipped several cars of zinc-lead-gold-silver-copper ore from the New Dominion mine to the custom concentrator at Midvale, Utah. Small lots of ore were shipped to smelters from the Carbonero mine and Sulphurette dump. A little placer gold was produced at the Waterfall placer.

Klondyke district.—In 1939 the owner of the Hidden Treasure group shipped 5 tons of material containing copper and silver to the smelter at Tooele, Utah.

Lower San Miguel district (Sawpit, Vanadium).—Placer miners recovered some gold in 1939 by sluicing at the Little Donnie, Southern Boy, and other placers along San Miguel River and its tributaries.

Mount Wilson district.—The Chindey-Special Sessions group, Shenandoah claim, and Silver Pick group were worked on a small scale during the summer of 1939 and yielded small lots of high-grade gold ore which were shipped to the Midvale (Utah) smelter.

Upper San Miguel district (*Telluride*).—The Smuggler Union group, operated since December 15, 1936, by Veta Mines, Inc., was the largest producer of gold in the San Juan region in 1939 and ranked fifth in the State. While increasing production steadily, the company has carried on an extensive program of development below the Pennsylvania or fifteenth level, the former lowest workings, which has resulted in opening additional productive ground. In 1939 mining on the new sixteenth level was continued, and development of the seventeenth level was begun. The combined output of ore from the upper and lower levels was treated in the company amalgamation-flotation mill, recently enlarged and equipped to handle 500 tons daily; the average for 365 days in 1939 was 375 tons compared with 188 tons in 1938. The mill feed in 1939 included 44 tons of custom ore from the Tomboy mine and 30 tons from four other properties. A new project undertaken by the company in 1939 is the driving of a crosscut from the Pennsylvania Tunnel to heretofore unexplored ground under the old workings of the Montana claim in the Tomboy group. The company nearly completed the driving of a 1,500-foot tunnel under Blue Lake at an elevation of 12,500 feet to tap the lake 120 feet below the surface in order to develop a year-round supply of water with which to run the power plant. Alta Mines, Inc., continued production from the Alta-St. Louis group throughout 1939. The mine is developed by a tunnel 6,650 feet long on the Alta vein. The ore is treated in the company 150-ton mill by jig, flotation, and table concentration; the jig concentrates are amalgamated, and the flotation and table concentrates are shipped to the Leadville smelter. Lessees on the Gold Run placer concentrated old tailings with screens, jigs, and mat-lined launders. Old tailings and dirt were cleaned up around the Cimarron mill and treated in a small stamp mill. A little gold was recovered by hand methods at the Wasatch claim. Individuals sluicing along San Miguel River recovered small quantities of placer gold.

SUMMIT COUNTY

Breckenridge district.—Small-scale operations only were carried on at lode mines in the Breckenridge district in 1939, and most of the ore produced was shipped direct to the Leadville smelter. Producing mines included the Bullion King, Cross Mountain, Dunkin, Fredonia, Jumbo, Laurium (Blue Flag), Mountain Mary, and Royal Tiger group (Greenwood, Jessie, and Sallie Barber claims). Part of the output from the Royal Tiger group was zinc-lead ore, shipped to the custom concentrator at Midvale, Utah.

The Blue River Co. operated its floating connected-bucket dredge at Breckenridge from May 9 to August 6, 1939; the dredge is equipped with eighty-eight 9-cubic-foot buckets, screens, jigs, sluices, ball mill, and mechanical amalgamator. Power shovels, trucks, and central sluicing plants were used to work the Bemrose-Bostwick and Louis D placers. Other placers along French Gulch and on Blue and Swan Rivers were worked by sluicing and hydraulicking.

Montezuma district.—Lessees at the Florado-Sts. John group treated ore, mostly from the dump, by jigging during part of 1939; the concentrates produced and some crude ore were shipped to the Leadville smelter. The Bullion mine was operated by a lessee during June and July; part of the ore produced was shipped direct to the Leadville smelter, and part was concentrated in a small gravity-concentration mill near the mine before shipment. A few lots of smelting ore were shipped from the Pennsylvania group, Silver King, Tip Top, and other properties.

Ten Mile (Kokomo, Robinson) district.—A lessee of the Wilfley mine and mill treated 1,200 tons of material from the dump by table concentration in 1939. Small lots of smelting ore were shipped from the Boston and three unidentified properties. A little gold was recovered from a placer near Dillon.

Wilkinson district.—Walter McDaniel operated his Big Four claim on Green Mountain 250 days in 1939 and continued to ship silver-lead-zinc-gold-copper ore, part of which was sold to the Leadville smelter and part to the Combined Metals Reduction Co. at Bauer, Utah.

TELLER COUNTY

CRIPPLE CREEK DISTRICT

Cripple Creek is the leading gold-producing district in Colorado. From 1891, when gold was discovered in that area, through 1939 it has yielded a total of 18,053,874 fine ounces valued at $385,460,527, or 48 percent of the State total output of gold from 1858 to 1939, inclusive. In 1939 the district produced 134,003 ounces (37 percent of the State total) compared with 145,215 ounces (40 percent) in 1938. The decrease in 1939 resulted from a decline in the average grade of the ore, as the number of producing mines and dumps was about the same as in 1938 and the total tonnage of ore handled was larger. The quantity of ore shipped to the Golden Cycle mill at Colorado Springs (operations reviewed under El Paso County) decreased slightly, but the increased tonnage treated locally by flotation in the Cameron mill in its first full year of operation, together with the usual tonnage treated in the Kavanaugh cyanide leaching plant, raised the total output of ore from mines and dumps in the district proper to 522,538 tons, an increase of 24,181 tons over 1938. Other output credited to the Cripple Creek district in 1939 is 15,600 tons of tailings from the old Portland mill dump at Colorado Springs, treated in the Mill Tailings Recovery Co. cyanide plant. This dump is composed entirely of tailings from ore shipped from the Cripple Creek district many years ago. Cripple Creek ores generally contain gold as the only commercial metal, but some silver ore has been shipped from two or three veins in the district; a small quantity of silver is recovered annually in bullion produced from the gold ores.

MINES REVIEW

The Golden Cycle Corporation operated its Ajax and Anchoria Leland groups of mines throughout 1939 and in December purchased the Index group. Less ore of better-than-average grade was produced from the Ajax group in 1939 than in 1938 owing to temporary suspension of operations below the 2,000-foot or Roosevelt drainage tunnel level pending completion of the new 6-mile Carlton drainage tunnel (for the driving of which the corporation on March 27 authorized the expenditure of not to exceed $1,000,000). Some of the benefits expected from the tunnel, the remarkable progress made after actual driving was begun in July, and the production of the Ajax and Anchoria Leland properties are shown in the following extract from the corporation annual report to stockholders for the year ended December 31, 1939:

The new Carlton Tunnel is the most important mining operation now being carried on by the Golden Cycle Corporation. This tunnel will be 32,000 feet in length and will give 1,100 feet of additional drainage to the Cripple Creek district. The Roosevelt Tunnel, which was completed in about 1918, permitted the mining of millions of tons of ore that could not have been profitably mined had it been necessary to pump the water which this tunnel drained. It is hoped that the new Carlton Tunnel will prove to be as successful and be the means of maintaining the tonnage of ore the mill must have to operate successfully.

The Portland, Vindicator, Ajax, and Cresson have all worked below the present water level of the district, and all have had the same experience with the water problem. That is, the heavy expense of pumping has rendered mining below the Roosevelt Tunnel unprofitable and unsatisfactory in every way. When this tunnel is completed and drainage takes place it will be permanent. This will result in far more development work in depth than could ever be accomplished under pumping operations. The driving of the Carlton Tunnel by the Golden Cycle Corporation was a step that had to be taken if tonnage was to be maintained in the future. The Carlton Tunnel will permit the development of the deeper areas, in the most productive territories in the Cripple Creek district, and it is in this area that I believe we must look for the greater part of the future tonnage for the mill. We do know that there is a considerable amount of ore now under water that can be mined when drainage takes place.

The monthly progress and average footage per day is as follows:

Month	Monthly	Average daily	Total distance
	Feet	*Feet*	*Feet*
July	345	21.5	345
August	1,201	38.7	1,546
September	1,367	48.8	2,913
October	1,534	49.5	4,447
November	1,474	49.1	5,921
December	1,387	47.8	7,308

The average, over-all costs per foot of tunnel driven is $29.925. In this is included $4.035 depreciation on buildings, equipment, road work, and all other preliminary expense.

The Ajax shipped 32,512 tons of an average value of $16.41 per ton. This operation showed a net profit of $18,439.43 before income taxes. 9,485 feet of development was done, by both company and lessees, during the year. The pumps were pulled from the 2,600 level on July 1, and all levels below the 2,000 were allowed to flood. The lower levels can be worked, without the heavy expense of pumping, when drained by the Carlton Tunnel.

The new washing plant finished in March 1939 is working very satisfactorily. At the present time the ore-house dump is being handled through this plant, with good results. Some development work is being carried on by the company on the 2,000 level, in hopes of finding ore in undeveloped territory; and every effort is made to encourage leasing on the upper levels in order to maintain some production until the tunnel is completed and the deeper workings are drained.

At the present time, considerable repair work is being done to the buildings and shaft, and we are also removing some large wooden structures that constitute a big fire hazard.

The Anchoria Leland mine shipped 7,568 tons of an average value of $13.64 per ton. This operation showed a net profit of $16,948.49 for 1939 before income taxes. Development work by both company and lessees amounted to 2,260 feet. Two new ore bins were erected in order to take care of more lessees' ore, and increase production, if possible.

The main shaft on the Index property, which was very recently acquired by the Golden Cycle Corporation, is being repaired and it is hoped that underground operations will be started in a short time. This property has not been worked extensively for a great many years, and I feel that it has good possibilities.

The largest producers of gold in the Cripple Creek district and in the State in 1939 were the United Gold Mines Co., an operating and holding company for property scattered throughout the district, and the Cresson Consolidated Gold Mining & Milling Co., operating the Cresson, Dante, and Gold Sovereign mines.

The annual report of the United Gold Mines Co. for the year ended December 31, 1939 (dated February 15, 1940), includes a report of the mine superintendent, which gives the following details on operations at individual mines:

The Vindicator, Portland, and Rose Nicol Groups are the three largest operations of the United Gold Mines and account for approximately 70 percent of the total ore shipped. The greater part of this ore was produced by lessees. The company operated seven working shafts, mainly for the accommodation of split-check lessees. Some development work was done on company account, mainly on the Portland and Rose Nicol mines.

On the 1,700-foot level of the Portland No. 2 shaft an ore body, some 75 feet long, has been discovered in undeveloped territory. Preparations are now being made to mine this ore, and at this date it looks very promising.

Portland No. 1 ore house was completely destroyed by fire, of undetermined origin, in January 1940. We were very fortunate in not losing the head frame and other structures. This ore house is being replaced by a steel structure, and it is planned eventually to handle the ore from both Portland No. 1 and No. 2 shafts through the new steel ore house. No. 2 shaft is of the utmost importance to the United Gold Mines at this time, on account of the driving of the New Carlton Drainage Tunnel, which will provide 1,100 feet of additional drainage deeper than is now afforded by the Roosevelt Tunnel. This increased depth of drainage is of importance to the Portland and Vindicator, in that the ultimate depth of profitable mining will be increased. Portland No. 2 shaft is the deepest shaft in the Cripple Creek district.

The Carlton Tunnel will be 32,000 feet in length. The portal is situated 8½ miles south of Cripple Creek and Victor; from that point it is being driven directly toward a point under Portland No. 2 shaft. This should completely drain the Portland to the new tunnel level and permit mining operations to be carried on 1,100 feet deeper than we are now working. While there is no known ore existing below the present water level on the Portland, some of the best territory in the district, for development work at depth, is located on this property and new ore bodies should be opened.

The Golden Cycle Corporation is financing the tunnel until it reaches the Portland. In order to drain the Vindicator it will be necessary for the United Gold Mines Co. to drive a 5,000-foot lateral from the Portland to the Vindicator.

Production of company ore by United Gold Mines Co. in 1939

Mine	Net tons	Gross value	Company ore cash receipts	Average gross value per ton
Vindicator	8,270	$34,906.39	$10,890.58	$4.22
Rose Nicol	2,010	43,993.51	30,670.90	21.89
	10,280	78,899.90	41,561.48	7.68

Production of lessee ore of United Gold Mines Co. in 1939

Group	Net tons	Gross value	Royalties received	Lessees' receipts	Average gross value per ton
Vindicator	36,157	$306,770.47	$69,901.31	$98,602.46	$8.48
Rose Nicol	8,603	93,804.38	23,805.28	31,545.07	10.90
Theresa	8,476	105,687.56	34,801.21	32,269.28	12.47
W. P. H. lessees	545	6,045.60	730.46	2,672.04	11.10
Deadwood group	32,293	287,757.60	28,819.15	125,361.50	8.91
Londonderry group	2,954	20,672.80	1,323.61	7,224.36	7.00
Hardwood group	5,196	58,342.62	5,116.84	27,267.86	11.23
Empire group	1,551	14,269.63	299.23	6,024.33	9.20
Portland lessees	21,599	280,015.31	74,909.20	96,583.44	12.96
Last Dollar lessees	10,773	84,100.38	21,973.10	20,329.88	7.81
Hull City	3,951	31,813.75	8,751.83	8,070.00	8.05
	132,098	1,289,280.10	270,431.22	455,950.22	9.76

Production of properties of United Gold Mines Co. before and after organization of the company (May 15, 1902) to Dec. 31, 1939

	Net tons	Gross value
Ore mined before consolidation	26,310	$456,806.19
Production under operation of United Gold Mines Co	1,885,280	20,481,282.18
Total to Dec. 31, 1939	1,911,590	20,938,088.37

The annual report of the Cresson Consolidated Gold Mining & Milling Co. for the 12 months ended December 31, 1939 (dated February 15, 1940), says—

The following is a summary of the development work for the 12 months ending December 31, 1939:

Development

	Feet	Feet
Drifts and crosscuts:		
Company	3,310	
Lessees	1,692	
		5,002
Raises and winzes:		
Company	892	
Lessees	1,784	
		2,676
		7,678

Tonnage of ore and waste, hoisted through the Cresson shaft, kept the plant running to full capacity during the year. When it is considered that the Cresson shaft has only one hoisting compartment and it is necessary to handle all men and supplies through this shaft, the amount of both ore and waste that is handled by one skip is phenomenal.

Development work was maintained throughout the year, and some ore bodies of various sizes discovered. However, the main ore-bearing zone above the present drainage tunnel level is beginning to be pretty well prospected, and if production is to be maintained in the future it will probably have to come from the area that is now under water.

The driving of the new Carlton drainage tunnel, by the Golden Cycle Corporation, is of the utmost importance to the Cresson mine. The main tunnel will be 32,000 feet in length, to a point under the Portland No. 2 shaft of the United Gold Mines Co. From this point, after connection is made with this shaft, it will probably be necessary for the Cresson Co. to drive a lateral of some 4,000 feet, in order to afford complete drainage of the Cresson area to the new tunnel level. However, it is expected, when the main tunnel cuts the water courses it will encounter in the last 5,000 feet, some drainage will begin to take place on the Cresson mine.

The Carlton Tunnel will afford 1,100 feet of additional drainage to the district and will be 700 feet below the twentieth level of the Cresson mine. The 18th, 19th, and 20th levels, which are below the present drainage tunnel, were abandoned some 11 years ago, due to the heavy pumping expense.

Plans are being made to do some development on the Hart group of claims, which this company recently acquired. These claims are entirely undeveloped and lie in a very favorable territory on the North Slope of Bull Hill.

The average cost per ton shipped by company and the lessees during 1939 was $2.755 on a total of 128,404 tons.

Federal taxes	$0.097
State income taxes	.020
State and county taxes	.093
Capital stock taxes	.007
Social-security taxes	.030
Unemployment taxes	.045
Compensation insurance	.078
Insurance	.005
Salaries of officers and directors	.033
Mining operations	2.286
Pumping	.025
General expense	.036

Production of Cresson Consolidated Gold Mining & Milling Co., 1903 to Dec. 31, 1939

Period	Dry short tons	Gross value	Freight and treatment	Net value
1903 to Dec. 31, 1938	2,720,230	$41,402,871.00	$13,319,409.83	$28,083,461.17
1939:				
Company ore	60,048	451,225.53	215,651.37	235,574.16
Lessee ore	68,356	808,200.95	306,918.77	501,282.18
1903 to Dec. 31, 1939	2,848,634	42,662,297.48	13,841,979.97	28,820,317.51

Period	Royalties received by company	Amount paid lessees	Average gross value per ton	Average net value per ton	Dividends
1903 to Dec. 31, 1938			$15.22	$10.32	$13,186,472.50
1939:					
Company ore			7.51	3.92	97,600.00
Lessee ore	$234,572.03	$266,710.15	11.82	7.33	
1903 to Dec. 31, 1939			14.98	10.12	[1] 13,284,072.50

[1] Represents 31.14 percent of gross value and 46.09 percent of net value.

During the year the Golden Cycle Corporation and other Carlton companies operating in the Cripple Creek district and the Stratton-Cripple Creek Mining & Development Co., another large owner of mining properties in the district, acting to remove one of the common causes of litigation and to stimulate mining, entered into agreements under the terms of which the boundaries of claims, instead of the apex of the veins, determine the ownership of the ore; and royalties on low-grade ore mined by lessees on the properties involved are reduced.

The principal producers in 1939 among the Stratton properties were Block 107, American Eagles, Orpha May, Logan, Longfellow, Favorite, and Geneva; the other producers comprised Blocks 47, 140, and 219, Colorado King, Globe Hill, Los Angeles, Pikes Peak, and Matoa dump. Development work done at all mines on the Stratton Estate in 1939 totaled 9,989 feet.

The Free Coinage group, operated by lessees, continued to be an important producer in 1939. The Lark Mining Co. maintained a steady output of ore from the Queen group until it surrendered the lease on September 30 and from the Forest Queen group until October 19. The Elkton, Jerry Johnson, New Gold Dollar, Empire Lee, Acacia, Doctor Jack Pot, Atlas (Midget Bonanza King), and Joe Dandy groups were substantial producers. Gold Producers, Inc., continued operations at the Victor mine on the Smith Moffat property under lease and the company-owned El Paso group. The Tenderfoot Mining Co. continued developing the Mollie Kathleen, Sangre de Cristo, and other groups on Tenderfoot Hill and shipped considerable ore. Cameron Mines, Inc., operated its flotation mill at the Cameron shaft throughout the year on ore from the Cameron and Pinnacle groups, which were consolidated into a one-unit operation. The mill has a capacity of 100 tons of ore per 24 hours, but owing to a drought which hindered operation it was run only two shifts for several months and three shifts for the remainder of the year. The concentrates were shipped to the Leadville smelter. Some of the other producing mines and dumps in the Cripple Creek district in 1939 were the Ben Hur, Bogart-Blue Flag (Twin Sisters shaft), Buckeye, Cardinal-Great West, Delmonico, Economic Dump, Friday, Gold King, Golden Swan, Hiawatha, Irving Howbert (Ethel Louise), Le Clair (Mary McKinney), Mary Nevin, Prince Albert, Rainbow, School Section, Strong, and Teutonic.

Placer gold and high-grade specimen ore from the district, sold to assayers, refiners, and the Denver Mint in 1939, yielded 44 fine ounces of gold.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE EASTERN AND CENTRAL STATES

(MINE REPORT)

By J. P. Dunlop and H. M. Meyer

SUMMARY OUTLINE

There were no outstanding developments in mining and milling in the Eastern States in 1939, unless the brief furore in the Dahlonega district of Georgia could be termed significant. The total output of gold was 2,514 fine ounces less than in 1938, notwithstanding an increase of 2,152 ounces in South Carolina; production in each of the other Eastern States except Pennsylvania declined. There was little change from 1938 in output of silver or copper, but shipments of galena decreased considerably. The output of recovered zinc increased 8,454 short tons, but this rise was proportionately much smaller than that in the Tri-State region and in some districts in the Western States.

The dominating events in the Central States in 1939 were the greatly augmented production of lead concentrates in southeastern Missouri, the increase in shipments (not production) of galena from the Tri-State region, and the publicity given to health and living conditions prevailing in the latter region (actually the situation probably is no worse than in mining or industrial areas elsewhere).

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, 1935–39

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1935	$35.00	$0.71875	$0.083	$0.040	$0.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052

[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] 1935–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–39: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787.

Mine production of gold, silver, copper, lead, and zinc in the Eastern and Central States in 1939, by States, in terms of recovered metals

State	Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)		Copper		Lead		Zinc		Total value
		Fine ounces	Value	Fine ounces	Value	Pounds	Value	Short tons	Value	Short tons	Value	
Eastern States:												
Alabama	10	3	$105									$105
Georgia	730	670	23,450	58	$39							23,489
Maryland	220	71	2,485	2	1							2,486
New Jersey	606,504									88,716	[1] $11,507,318	[1] 11,507,318
New York	420,000			37,250	25,285			(2)	(2)	36,014	3,745,456	[3] 3,770,741
North Carolina	16,740	495	17,325	3,961	2,689	(4)	(4)					[5] 20,014
Pennsylvania	(6)	1,815	63,525	13,558	9,203	(4)	(4)					[5] 72,728
South Carolina	114,514	13,833	484,155	5,480	3,720							487,875
Tennessee	1,597,320	163	5,705	31,994	21,717	[4] 21,295,000	[4] $2,214,680	[2] 6,284	[2] $590,696	[7] 56,225	[7] 5,847,400	[8] 8,680,198
Virginia	653,581	364	12,740	1,780	1,208			(2)	(2)	(7)	(7)	[9] 13,948
	[10] 3,409,619	17,414	609,490	94,083	63,862	21,295,000	2,214,680	6,284	590,696	180,955	21,100,174	24,578,902
Total, 1938	[10] 3,159,880	19,928	697,480	94,945	61,380	21,079,160	2,065,758	7,900	726,800	172,501	19,211,235	22,762,653
Central States:												
Arkansas	(11)									123	12,792	12,792
Illinois	(11)			675	458			308	28,952	334	34,736	64,146
Indiana		4	140									140
Kansas	3,701,300							13,697	1,287,518	68,971	7,172,984	8,460,502
Kentucky	(11)							87	8,178	909	94,536	102,714
Michigan	4,603,751			101,878	69,154	87,970,000	9,148,880					9,218,034
Missouri	5,650,800			213,400	144,853			156,281	14,690,414	15,096	1,569,984	16,405,251
Oklahoma	8,802,900							27,720	2,605,680	140,379	14,599,416	17,205,096
Wisconsin	213,400							388	36,472	5,904	614,016	650,488
	22,972,151	4	140	315,953	214,465	87,970,000	9,148,880	198,481	18,657,214	231,716	24,098,464	52,119,163
Total, 1938	19,037,105			386,210	249,671	93,486,000	9,161,628	158,873	14,616,316	198,721	19,077,216	43,104,831

[1] Estimated smelting value of recoverable zinc content of ore after freight, haulage, smelting, and manufacturing charges are added.
[2] New York and Virginia included under Tennessee; Bureau of Mines not at liberty to publish separate figures.
[3] Excludes value of lead, which is included under Tennessee.
[4] North Carolina and Pennsylvania included under Tennessee; Bureau of Mines not at liberty to publish separate figures.
[5] Excludes value of copper, which is included under Tennessee.
[6] Ore is magnetite-pyrite-chalcopyrite, flotation copper concentrates from which yielded gold, silver, and copper; Bureau of Mines not at liberty to publish figures for ore and copper.
[7] Virginia included under Tennessee; Bureau of Mines not at liberty to publish separate figures.
[8] Includes also value of copper from North Carolina and Pennsylvania, lead from New York and Virginia, and zinc from Virginia.
[9] Excludes value of lead and zinc, which is included under Tennessee.
[10] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.
[11] No figures available for small quantity of ore treated in Arkansas, Illinois, or Kentucky.

Number of lode and placer mines producing and yield of gold and silver in the Eastern States in 1939, by States

State	Number of mines		Gold (fine ounces)		Silver (fine ounces)	
	Lode	Placer	Lode [1]	Placer	Lode [1]	Placer
Alabama	1		3			
Georgia	8	17	277	393	23	35
Maryland	3		71		2	
New Jersey	2					
New York	2				37,250	
North Carolina	13	4	488	7	3,961	
Pennsylvania	1		1,815		13,558	
South Carolina	5	1	13,825	8	5,480	
Tennessee	8		163		31,994	
Virginia	4	2	359	5	1,780	
	47	24	[1] 17,001	413	[1] 94,048	35
Total, 1938	51	26	[1] 19,261	667	[1] 94,906	39

[1] 1939: Dry and siliceous gold ores (120,274 tons) yielded 14,949 ounces of gold and 6,023 ounces of silver; copper ore (528,710 tons) yielded 237 ounces of gold and 35,073 ounces of silver; magnetite-pyrite-chalcopyrite ore yielded 1,815 ounces of gold and 13,558 ounces of silver; zinc ore (1,787,404 tons) yielded no gold or silver; and zinc-lead ore (973,231 tons) yielded 39,394 ounces of silver.
1938: Dry and siliceous gold ores (88,671 tons) yielded 17,441 ounces of gold and 4,813 ounces of silver; copper ore (615,403 tons) yielded 375 ounces of gold and 42,470 ounces of silver; magnetite-pyrite-chalcopyrite ore yielded 1,422 ounces of gold and 9,360 ounces of silver; zinc ore (1,530,295 tons) yielded no gold or silver; and zinc-lead ore (925,511 tons) yielded 23 ounces of gold and 38,263 ounces of silver.

Gold.—The production of gold in the Eastern States totaled 17,414 fine ounces in 1939, or 2,514 ounces less than in 1938. The output from siliceous ores decreased from 17,441 to 14,949 ounces and that from placer mines from 667 to 413 ounces; that from the refining of copper bullion increased from 1,797 to 2,052 ounces. Fewer lode mines and placers were operated in 1939 than in 1938, and only two of the placers yielded more than 100 ounces of gold. The estimated output of gold in the Southern Appalachian States from 1799 to 1939, inclusive, is recorded as 2,548,375 fine ounces valued at $53,649,210.

Of the 120,274 tons of siliceous ores (from mines in Alabama, Georgia, Maryland, North Carolina, South Carolina, Tennessee, and Virginia) treated in 1939, 120,047 tons went to gold and silver mills. Gold concentrates (95 tons) shipped to smelters yielded 173 fine ounces of gold, whereas bullion from gold milling plants yielded 14,656 ounces. Ore amalgamated (5,437 tons) yielded in bullion 945 ounces of gold, and ore cyanided (114,610 tons) yielded 13,711 ounces. The 227 tons of dry and siliceous ores shipped crude to smelters yielded 120 ounces of gold.

Copper concentrates shipped to smelters in 1939 yielded 1,976 ounces of gold.

The only output of gold reported from the Central States for 1939—4 fine ounces valued at $140—was from small placer prospecting in Vigo County, Ind.

Silver.—Of the silver (94,083 fine ounces) produced in 1939 in the Eastern States, 35 ounces came from placer bullion, 5,696 ounces from bullion recovered at gold and silver mills, 84,480 ounces from concentrates smelted, and 3,872 ounces from ore shipped crude to smelters. Siliceous ores yielded 6,023 ounces of the silver; zinc-lead ores from New York, Virginia, and Tennessee 39,394 ounces; copper ore 35,073 ounces; and copper concentrates recovered by flotation from magnetite-pyrite-chalcopyrite ore 13,558 ounces.

The production of silver in the Central States in 1939 was 315,953 ounces. The output of Illinois (675 ounces) came from galena concentrates recovered in milling fluorspar, that of Missouri (213,400 ounces) from the refining of lead bullion, and that of Michigan (101,878 ounces) from copper ore.

Copper.—The mine production of recoverable copper in the Eastern States was 21,295,000 pounds valued at $2,214,680 in 1939 compared with 21,079,160 pounds valued at $2,065,758 in 1938. The output from Tennessee was considerably less than in 1938 and that from Pennsylvania increased nearly 40 percent, but the Bureau of Mines is not at liberty to show the copper production of each State. Copper ore yielded about 0.0004 ounce of gold and 0.07 ounce of silver to the ton of crude ore. Copper concentrates from the magnetite-pyrite-chalcopyrite ore mined at the Cornwall mine in Pennsylvania contained about 25 percent copper and 0.10 ounce of gold and 0.78 ounce of silver to the ton.

The copper output of the Central States in 1939 came entirely from Michigan copper mines. The State output of refined copper decreased from 93,486,000 pounds in 1938 to 87,970,000 pounds in 1939 and the average recovery per ton of rock from 24.9 to 19.1 pounds.

Lead.—The recoverable lead produced from mines in the Eastern States in 1939 came from zinc-lead ores from the Austinville mine in Virginia, the Balmat mine in New York, and the Embree mine in Tennessee. Shipments of galena or lead carbonate concentrates totaled 9,953 tons and yielded 6,284 tons of lead, or 1,616 tons less than in 1938.

Lead recovered from shipments of lead ore and concentrates in the Central States increased from 158,873 tons in 1938 to 198,481 tons in 1939, owing mainly to the increase in shipments from southeastern Missouri (the largest lead-producing region in the United States) from 118,870 to 153,522 tons. Mines in the Tri-State or Joplin region shipped 57,941 tons of lead concentrates in 1939 compared with 51,751 tons in 1938.

Zinc.—The recoverable zinc in ore and concentrates shipped from mines in the Eastern States totaled 180,955 tons valued at $21,100,174 in 1939 compared with 172,501 tons valued at $19,211,235 in 1938. Mines in New Jersey yielded 88,716 tons as metal or in oxide.

[N. B.—The value of the zinc in New Jersey is the estimated smelting value of the recoverable zinc content of the ore after freight, haulage, smelting, and manufacturing charges are added.]

The output of recoverable zinc from New York mines rose from 29,896 tons in 1938 to 36,014 tons in 1939; it was derived from zinc ore and zinc-lead ore. Zinc sulfide ores yielded all the zinc produced in Tennessee except that from zinc-lead carbonate ore of the Embree mine and copper ore of the Tennessee Copper Co. The recovered zinc content of sphalerite concentrates shipped from mines in Virginia may not be disclosed, but the total from concentrates shipped from Tennessee and Virginia in 1939 was 56,225 tons; the output of Tennessee increased about 2,565 tons.

Zinc concentrates shipped from mines in the Central States had a recoverable zinc content of 231,716 tons in 1939 compared with 198,721 tons in 1938. Mines in the Tri-State region shipped ore and concentrates yielding 224,446 tons of zinc, Oklahoma contributing 62.5 and Kansas 30.7 percent of the total. Stocks of sphalerite were negligible at the end of 1939. The recoverable zinc in shipments from Missouri mines increased from 10,226 to 15,096 tons; in 1939, as in 1938, the entire output came from southwestern Missouri.

MINE PRODUCTION IN THE EASTERN STATES

Alabama.—Gold production in Alabama from 1830 to 1939, inclusive, has totaled 49,453 fine ounces. The output in 1939 was only 3 ounces, recovered in prospecting at the Blue Hill mine in Tallapoosa County; the Gold Log and Hog Mountain mines were not operated.

Georgia.—From 1830 to 1939, inclusive, Georgia is reported to have produced 869,207 fine ounces of gold. In 1939, 17 placers and 8 lode mines yielded 670 ounces of gold and 58 ounces of silver. Of the 393 ounces of placer gold produced, 61 ounces came from mines near Dahlonega and Auraria in Lumpkin County; 316 ounces from mines near Sautee, Helen, and Nacoochee in White County; and the rest (16 ounces) from mines in Dawson, Hall, and Cherokee Counties. The larger producers of placer gold were the Ferey Gold Mining Co., Loud Gold Mines Co., and Dixie Gravel Co., all in White County. Gold recovered from 730 tons of siliceous ore amounted to 277 ounces and came mainly from the Hamilton mine in McDuffie County, operated by W. T. Fluker. The 5-stamp amalgamation-concentration mill was operated throughout the year on ore taken from two shafts; development work totaled about 150 feet. The Ferey Gold Mining Co. at Nacoochee, White County, operated its mine steadily by means of a dragline, trommel screen, and sluice boxes. Various properties at Dahlonega controlled by Dr. Craig R. Arnold were reported under lease or option for development in 1940. The Simmons prospect near Buford in Gwinnett County was not worked, but some old tailings were treated by G. D. McKay. The Dixie Gravel Co. made a good output from the Dukes Creek placer by means of a hydraulic elevator. The Loud Gold Mines Co. operated its placer at Helen in White County. Gold bullion was shipped to the mint by the Rex Mining & Development Co., Southern Mining & Development Co., J. S. Speer, T. F. Christian, and J. P. McDonald from various small placer operations in Lumpkin and Dawson Counties. R. H. Stumann shipped bullion purchased from small placer operations in Cherokee County. The Turkey Hill 5-stamp mill at Dahlonega was operated by A. H. Head on a small quantity of ore extracted in sinking a 110-foot shaft. Small shipments of crude ore were made to the Tennessee Copper Co. from the Hartman and the Cherokee mines at Holly Springs.

Considerable publicity was given to the Dahlonega district in Lumpkin County in November 1939 by the discovery of a pocket of free gold at the Calhoun mine. Ore was reported as averaging $60,000 to $200,000 to the ton. Naturally such news on the front pages of many newspapers revived speculative interest in the old district. The discovery of rich pockets of gold in Georgia, Maryland, and other Southern States has not been unusual, but the discovery at the Calhoun mine had superlative press notices. No report was made to the Bureau of Mines regarding the quantity of gold recovered in 1939, and none of the bullion was received by the Bureau of the Mint.

Maryland.—The total gold production of Maryland to the end of 1939 is estimated at 6,102 fine ounces. The Maryland mine in Montgomery County was worked only 3 months in 1939. It is equipped with a 200-foot three-compartment shaft, and ore is mined at the 150- and 200-foot levels and treated at the 10-stamp amalgamation mill; the 30-ton ball mill and concentrating table were not used in 1939. Prospecting and development work was done by Kirk & McNamara at the Harrison and Sawyer mines and other prospects, also in Montgomery County. Two shafts were sunk, and some open-cuts were made. The property is equipped with a 10-stamp mill, and bullion was sent to the Philadelphia Mint. No work was done at any of these mines in 1939 after October.

New Jersey (see also second table of this chapter, footnote 1).—The production of zinc ore in New Jersey in 1939 was 606,504 tons containing 88,716 tons of recoverable zinc as metal or in oxide. The producing properties were the Sterling and Mine Hill mines; they were operated about 280 days in 1939 and have a much larger potential output.

New York.—The quantity of zinc ore mined and treated in New York rose from 105,000 tons in 1938 to 115,000 tons in 1939 and that of zinc-lead ore from 280,600 to 305,000 tons. The total concentrates shipped yielded 36,014 tons of zinc and nearly 2,400 tons of lead; the lead concentrates from the Balmat mine contain considerable silver also. The Balmat mine near Sylvan Lake produces zinc-lead ore, is equipped with a 1,000-ton all-flotation concentration plant, and has an inclined shaft 1,300 feet deep. The Edwards mine has a vertical shaft 1,500 feet deep and an inclined shaft from the 1,500- to the 2,100-foot level. The all-flotation plant has a capacity of 500 tons. It is reported that the Universal Exploration Co. continued drilling and exploration near Hyatt in St. Lawrence County.

North Carolina.—The gold output of North Carolina from 1799 to 1939, inclusive, is recorded as 1,155,172 fine ounces. The yield in 1939 was 495 ounces—488 ounces from 13 lode mines and 7 ounces from 4 placers. The output of silver was 3,961 ounces, of which 134 ounces came from dry gold ores and the remainder from copper ore. The Fontana copper mine in Swain County, the only producer of copper, the largest producer of silver, and the second-largest producer of gold in the State in 1939, was operated steadily by the North Carolina Exploration Co.; the high-grade copper ore was shipped to the Tennessee Copper Co. at Copperhill, Tenn. The crude ore is mined through a 2,600-foot inclined shaft. The largest producer of gold in North Carolina was the Capps mine in Mecklenburg County; about 44 percent of the State total in 1939 came from this mine and the 125-ton cyanide plant near Charlotte, although the property was operated only a few months early in the year and later was reported idle and in the hands of a receiver. The old Silver Hill mine in Davidson County, which yields a lead-zinc ore containing copper, gold, and silver and which was reopened in 1938, was idle in 1939. It is equipped with a 10-stamp mill and Deister slime tables. Flotation should be added to the plant. The Tribro mine in Halifax County was worked 98 days by Passavant Bros. by means of an open-cut, and the ore was treated at a 3-ton amalgamation mill. Some small producing properties were the East Hill in Union County, the Sedberry in Montgomery County, and the Calhoun in Gaston County. The Sobel Mining

Co. operated a small mill on its property near Union Mills in Rutherford County; bullion was shipped to the Philadelphia Mint and concentrates to Carteret, N. J. The Mary B. mine near Essex in Halifax County was prospected by open pits, and a small quantity of ore was treated. Payne & Stepp shipped a small carload of ore from a prospect in Swain County to Copperhill, Tenn. Shipments of small lots of crude ore were made to Carteret, N. J., by Mrs. Gordon Wilfong from a prospect in Catawba County, by George V. Patterson from the Ferguson mine in Gaston County, and by R. M. Hutchinson from a prospect near Kings Mountain. A few tons of crude ore were shipped by B. M. Nicholson of Enfield, Halifax County, to Perth Amboy, N. J. The meager production of placer gold came from prospects in Burke, Guilford, Stanly, and Wilkes Counties.

Pennsylvania.—The Cornwall mine and mill in Lebanon County were operated at capacity in 1939; the mine has an open-cut and three inclined shafts 1,300 feet deep. The ore (magnetite-pyrite-chalcopyrite) is treated by magnetic separation and the tailings from the iron concentrates go to the 2,000-ton flotation plant; the copper concentrates, which contained about 25 percent copper and 0.10 ounce of gold and 0.78 ounce of silver to the ton, were shipped to the Nichols Copper Co.

South Carolina.—From 1829 to 1939, inclusive, mines in South Carolina produced 282,246 fine ounces of gold. In 1939 the output from five lode mines and one placer was 13,833 ounces, of which only 8 ounces came from the placer. Gold milling plants recovered 13,754 ounces of gold and 5,475 ounces of silver; concentrates shipped to smelters yielded 34 ounces of gold and 5 ounces of silver; and 54 tons of ore were shipped crude to smelters. The old Haile mine, with the reputation of having been the largest gold producer in the Southern Appalachian States, was worked throughout the year; its output in 1938 and 1939 was largely responsible for the notable increase in that region in each year. In 1939 it yielded 13,551 fine ounces of gold and 5,452 ounces of silver.

Haile Gold Mines, Inc., operated its mines and countercurrent-decantation cyanide plant throughout 1939. The daily capacity of the mill is 400 tons, and the ore (about 113,700 tons milled in 1939) is a mixture of quartz and pyrite. Ore from the old pits and 55,885 tons from the recently developed Red Hill pit were cyanided, and good recoveries were made from the low-grade ore (of which reserves are ample) developed by geophysical exploration and drilling. The history of the Haile mine and its development and operation by the present owners have been described by Brodt and Newton.[1]

The Dorothy mine in York County was operated by W. K. Hunter, and 2 cars of crude ore were shipped in 1939 to the Tennessee Copper Co. at Copperhill, Tenn. The Ross-Carroll mine in York County was operated by W. E. Tummon by means of a 70-foot shaft, and the ore was treated at a small mill; bullion recovered was sent to the Philadelphia Mint and concentrates were shipped to Carteret, N. J. Other production included a small output of gold from the old Hegeler mine in Lancaster County and from prospects in Chesterfield County operated by A. M. Miller of Jefferson. The small output of placer gold came from the Brewer mine in Chesterfield County, operated by the Wandelyn Mining Co.

[1] Brodt, H. H., and Newton, Edmund, Gold Mining at the Haile Mine in South Carolina: Min. Cong. Jour., vol. 24, No. 10, October 1938, pp. 20–27.

Tennessee.—Mines in Tennessee produced 19,638 fine ounces of gold from 1831 to 1939, inclusive; almost the entire output since 1906 has come from copper ore, and copper bullion was the source of 161 ounces in 1939. The quantity of silver recovered in 1939 was 31,246 ounces from copper ore and 748 ounces from zinc-lead ore. The Embree Iron Co., the only producer of lead in Tennessee, shipped lead carbonate concentrates. The production of copper from Tennessee mines decreased about 835 tons from 1938, but that of zinc increased about 2,565 tons.

The total output of copper from mines in Tennessee, Pennsylvania, and North Carolina was 10,648 tons in 1939 compared with a total of 10,540 tons from the Eastern States in 1938; production in Pennsylvania increased about 1,250 tons. The total lead recovered from mines in Virginia, New York, and Tennessee was 6,284 tons in 1939 compared with 7,896 tons in 1938. The total zinc recovered from mines in Tennessee and Virginia was 56,225 tons in 1939 compared with 56,766 tons in 1938. The Bureau of Mines is not at liberty to publish figures for the foregoing States separately.

The Tennessee Copper Co. ran its 1,200-ton (daily) flotation plant and its smelter in 1939, but not at capacity, on ore from the Burra Burra, Eureka, and Isabella mines in Tennessee and on sulfide ore from the Fontana mine in Swain County, N. C.; about 136 tons contained in six shipments of ore were received from other States. Some 48-percent zinc concentrates were produced at the mill and shipped to Donora, Pa., and the copper bullion was sent to the Nichols Copper Co. The Mascot mine and 2,800-ton concentrating plant of the American Zinc Co. of Tennessee were operated steadily in 1939; the mine is opened by a 520-foot shaft and an inclined shaft from the 520-foot level to the maximum depth of 850 feet. The output was larger in 1939 than in 1938. The company also worked the Grasselli mine, where operations were conducted at the 350-foot level. The crude ore from both mines was treated at the Mascot mill, which is equipped with a differential-tension density cone that considerably increases the capacity of the plant. The Universal Exploration Co. worked steadily in 1939 at both the mine and 800-ton all-flotation mill, but the plant for treating zinc carbonate ore was idle throughout 1939. Two shafts were used in 1939. The average grade of the sphalerite shipped in 1939 was 64.329 percent zinc, which is considerably higher than that from any other mine in the United States. The Embree Iron Co. in Washington County shipped some zinc carbonate concentrates and increased its shipments of lead carbonate slightly. A log washing plant was used to treat the crude ore.

Virginia.—Mines in Virginia produced 166,557 fine ounces of gold from 1828 to 1939, inclusive, but only 7,440 ounces have been produced during the last 29 years. In 1939 the output of the State was 364 ounces of gold and 1,780 ounces of silver from four lode mines and two placers. Shipments of lead and zinc concentrates decreased, but the Bureau of Mines is not at liberty to publish figures for lead and zinc output, as the Austinville mine of the New Jersey Zinc Co. is the only producer of zinc-lead ore in Virginia. The mine and 2,000-ton concentration-flotation mill were operated throughout the year.

The Vaucluse mine near Wilderness in Orange County, which has a 325-foot shaft and is equipped with a 75-ton all-flotation plant, was idle in 1939; the only shipment during the year was a few tons of concentrates that had been made in 1938. The Red Bank mine near Virgilina, Halifax County, operated by Joseph Hamme, was the largest producer of gold in Virginia in 1939; the property is equipped with a small amalgamation mill. Amos V. Pankey operated the London and Virginia gold mine near Dillwyn in Buckingham County; bullion was shipped to the Philadelphia Mint and concentrates to Carteret, N. J. The ore was obtained from an open pit and was milled at the Booker mill, but plans have been made for a new milling plant in 1940. The Nassog copper prospect in Floyd County was not worked in 1939 but is to be developed in 1940. The output of placer gold in Virginia in 1939 came mainly from the Bertha and Edith mines in Goochland County operated by H. H. Walton, of Pendletons.

MINE PRODUCTION IN THE CENTRAL STATES

Quantity and tenor of ores.—One basis for comparing the relative magnitude of mining in different States is the quantity of crude ore or "dirt." The metal content of the ores of the several mining regions and States exhibits marked differences; therefore, comparison of tenor of the ores is interesting and significant. Virtually all the ore from the Central States is of such low tenor as to require concentration. In Kentucky and southern Illinois most of the lead and zinc concentrates are recovered as byproducts in the concentration of the fluorspar that they accompany, and the metal content of the crude ore raised cannot be calculated. In Arkansas very little ore has been mined for several years, and the average tenor calculated from the output of ore during these years would not offer accurate comparison with that during a period of active mining.

Quantity and tenor of copper, lead, and zinc ores, old tailings, etc., produced in the Central States, 1937–39, by States

State [1]	1937		1938		1939	
	Ore, etc.	Metal content [2]	Ore, etc.	Metal content [2]	Ore, etc.	Metal content [2]
	Short tons	*Percent*	*Short tons*	*Percent*	*Short tons*	*Percent*
Kansas	5, 607, 900	1. 90	3, 751, 300	2. 58	3, 701, 300	2. 45
Michigan	4, 197, 881	1. 13	3, 757, 705	1. 24	4, 603, 751	. 96
Missouri	5, 992, 731	3. 07	4, 148, 000	3. 28	5, 650, 800	3. 12
Oklahoma	10, 432, 000	1. 77	7, 321, 400	1. 71	8, 802, 900	2. 00
Wisconsin	285, 000	3. 41	58, 700	4. 46	213, 400	3. 26
	26, 515, 512		19, 037, 105		22, 972, 151	

[1] No figures available for small quantity of ore treated in Arkansas, Illinois, or Kentucky.
[2] The percentages represent the metal content of the ore insofar as it is recovered in the concentrates. In Michigan the metal so recovered is copper; in other Central States the metals are lead and zinc combined, the relative proportions of which are shown in the second table of this chapter and in the tables of tenor of ore given in the sections devoted to the respective States.

Production of lead and zinc by regions.—The report of this series for 1930 (chapter of Mineral Resources of the United States, 1930, pt. I) gives the areas included in the seven lead- and zinc-producing regions of the Central States. Mineral Resources, 1914, contains brief reviews of the history of lead and zinc mining in the Central States, the yearly production of each State from 1907 to 1914, inclusive, and historical notes and estimates of the total production of lead and zinc in each

State before 1907. Subsequent records may be found in annual issues of Mineral Resources and Minerals Yearbook.

Of a total of 412,190 tons of blende concentrates produced in 1939 in the Tri-State region 72,931 tons, or 12,944 tons more than in 1938, were derived from old tailings.

Mine production of lead and zinc in the Central States in 1939, by regions

Region	Lead [1]		Zinc [2]		Total value
	Short tons	Value	Short tons	Value	
Concentrates:					
Joplin or Tri-State	57,941	$3,399,068	413,139	$14,199,263	$17,598,331
Southeastern Missouri	210,526	12,339,360			12,339,360
Upper Mississippi Valley [3]	567	29,327	[4] 10,169	355,915	385,242
Kentucky-southern Illinois	657	25,589	2,832	67,430	93,019
Northern Arkansas			382	5,800	5,800
	269,691	15,793,344	426,522	14,628,408	30,421,752
Total, 1938	216,244	11,759,610	366,647	11,242,633	23,002,243
Metal:					
Joplin or Tri-State	44,176	4,152,544	224,446	23,342,384	27,494,928
Southeastern Missouri	153,522	14,431,068			14,431,068
Upper Mississippi Valley [3]	388	36,472	5,904	614,016	650,488
Kentucky-southern Illinois	395	37,130	1,243	129,272	166,402
Northern Arkansas			123	12,792	12,792
	198,481	18,657,214	231,716	24,098,464	42,755,678
Total, 1938	158,873	14,616,316	198,721	19,077,216	33,693,532

[1] Includes galena and a small quantity of lead carbonate concentrates.
[2] Includes sphalerite and a small quantity of zinc carbonate and zinc silicate concentrates.
[3] Includes Iowa, northern Illinois, and Wisconsin.
[4] The zinc concentrates shipped in 1939 were a flotation product. No raw concentrates were shipped in 1939; about 32,360 tons were produced.

REVIEW BY STATES

Arkansas.—Most of the small mines in Arkansas were inactive in 1939 until fall, and little development was done. Higher prices in September brought about the reopening of mines in various districts, but all operations were on a very small scale and there was no shipment of galena. A total of 382 tons of zinc carbonate was shipped from about 11 mines in Arkansas in 1939; the recoverable zinc content was 123 tons. None of the mines gave any data for 1939 on their shipments, but the smelters that purchased the concentrates gave the information. Shipments of zinc carbonate were made from the Edith, Yellow Rose, Philadelphia, McIntosh, Silver Hollow, Monte Cristo, and Red Cloud mines in the Rush district; the Brewer, Eleventh Hour, and Bonanza mines in Newton County; and the Jack Pot mine near Zinc. Virtually all the zinc concentrates obtained in small lots by L. A. Watkins, of Harrison, Ark., were sold to the Ozark Smelting Co. at Coffeyville, Kans.

Illinois.—Most of the lead and zinc produced in southern Illinois is recovered from fluorspar-lead-zinc mining, and shipments of galena and blende concentrates were much larger in 1939 than in 1938. The shipments of galena were mainly from properties of the Aluminum Ore Co., Hillside Fluor Spar Mines, and Mahoning Mining Co. and amounted to 529 tons having an average lead content of 59.4 percent; 308 tons of lead and 675 fine ounces of silver were recovered from these shipments compared with 175 tons of lead and 576 ounces of silver in 1938. The Mahoning Mining Co. operated its property near

Cave in Rock, Hardin County; two shafts were used. The ore mined contains more lead and zinc than is normally found with fluorspar, and tests showed that the crude ore is amenable to treatment.[2] The 200-ton all-flotation plant built at Rosiclare was put in operation in June 1939; lead concentrates, blende concentrates, and fluorspar were shipped. The galena averaged 45 percent lead and the sphalerite 61 percent zinc. The crude ore from the mine is trucked 18 miles to the concentrating plant, which has direct rail facilities.

Indiana.—Four fine ounces of gold valued at $140 were recovered in 1939 from small placer prospecting in Vigo County.

Kansas.—Shipments of galena concentrates from mines in Kansas in 1939 totaled 17,845 tons with a recovered lead content of 13,697 tons compared with 19,909 and 15,239 tons, respectively, in 1938. Shipments of sphalerite concentrates amounted to 126,235 tons with a recovered zinc content of 68,971 tons compared with 133,546 and 73,024 tons, respectively, in 1938. About 530,900 tons of Kansas crude ore were concentrated at mills in Oklahoma and yielded 41,402 tons of sphalerite concentrates and 3,601 tons of galena concentrates. In all, about 30 mines and 23 mills were operated in Kansas in 1939.

No output for 1939 was reported from the Lawton or Crestline camps, and scrapping only was done at Galena. The Peacock mine at Badger-Peacock was operated throughout the year by L. W. Goings & Co. Production in the Kansas part of the Waco district was from tailings and ore from the Acme and Butte Kansas properties of the R. H. & G. Mining Co. The total output of the Waco area in 1939 was 56 tons of galena and 6,627 tons of sphalerite, of which properties in Kansas yielded 44 tons of galena and 4,713 tons of sphalerite. Considerable development work was done by the St. Louis Smelting & Refining Co. at Waco, but the 800-ton mill was not operated until early in January 1940. Mines and mills near Baxter Springs shipped 4,039 tons of galena and 17,774 tons of sphalerite. The St. Louis Smelting & Refining Co. (various mines and the Ballard mill) was much the largest producer of both lead and zinc, and the Sunflower mine also had a large output. Ore was mined and milled or shipped to custom mills from the Robob, Bilharz, Wade, and Iron Mountain mines. Mines and mills in the Blue Mound-Treece area shipped 13,492 tons of galena and 103,447 tons of sphalerite. Mines in Kansas that shipped ore to the Central mill at Cardin, Okla., included the Mid-Continent, Wright, Bendelari, Big John, Black Eagle, Chubb, Robob, and Kansouri. The Muncie and the Jarrett mines and mills of the Federal Mining & Smelting Co. were operated and made large shipments of concentrates. Other large producers in this area were the Vinegar Hill Zinc Co. (Barr mine), J. P. Dines Mining Co., Eagle-Picher Mining & Smelting Co. (Wilbur and Webber mills), Kansas Explorations, Inc. (Robinson and Jarrett mills), Oklahoma Interstate Mining Co. (Cherokee mine), and New Blue Mound Mining Co. The five large producers of sphalerite from old tailings were the Captain Milling Co., J. L. Smith Chat Co., Youngman & Youse, C. Y. Semple, and Youngman Milling Co. These five tailing mills treated about 1,922,000 tons of material and shipped 262 tons of galena and 17,622 tons of sphalerite.

[2] Clemmer, J. B., Duncan, W. E., DeVaney, F. D., and Guggenheim, M., Flotation of Southern Illinois Lead-zinc-fluorspar Ores: Bureau of Mines Rept. of Investigations 3437, 1939, 31 pp.

Mine shipments of lead and zinc in Kansas, 1935–39

Year	Lead concentrates		Zinc concentrates		Metal content [1]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1935	14,301	$579,690	102,078	$2,948,509	10,892	$871,360	54,110	$4,761,680
1936	14,789	765,746	149,095	5,473,457	11,409	1,049,628	79,017	7,901,700
1937	20,559	1,454,507	151,646	6,476,064	16,008	1,888,944	80,300	10,439,000
1938	19,909	1,023,851	133,546	4,132,248	15,239	1,401,988	73,024	7,010,304
1939	17,845	1,010,106	126,235	4,300,365	13,697	1,287,518	68,971	7,172,984

[1] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the value of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and old tailings milled and concentrates produced in Kansas, 1938–39

	1938		1939	
	Crude ore	Old tailings	Crude ore	Old tailings
Total ore and old tailings milled ... short tons	2,044,500	1,706,800	1,764,300	1,937,000
Total concentrates shipped:				
Galena ... do	19,869	40	17,583	262
Sphalerite ... do	116,213	17,333	108,423	17,812
Ratio of concentrates to ore, etc.:				
Lead ... percent	0.97	------------	.98	.01
Zinc ... do	5.15	1.01	6.27	.92
Metal content of ore, etc.:				
Lead ... do	.76	------------	.78	.01
Zinc ... do	3.46	.61	3.75	.56
Average lead content of galena concentrates ... do	78.0	60.6	78.5	66.4
Average zinc content of sphalerite concentrates ... do	60.8	60.0	60.7	60.6
Average value per ton:				
Galena concentrates	$51.45	$40.00	$56.67	$52.05
Sphalerite concentrates	30.60	33.22	34.39	32.11

Kentucky.—Six mines in Kentucky shipped 612 tons of zinc carbonate, 1,614 tons of sphalerite, and 128 tons of galena in 1939. The zinc carbonate sold was shipped mainly by Avery H. Reed of Marion, C. F. Lester of Princeton, and the Hickory Cane Mining Co. of Marion; the sphalerite came from the Eagle Fluor Spar Co. property. Most of the lead concentrates were shipped by Roberts & Frazer (Kentucky Fluor Spar Co.) and the National Fluorspar Co. The galena averaged about 69 percent lead and the sphalerite about 47 percent zinc. The recovered content of the concentrates shipped was 87 tons of lead and 909 tons of zinc. The Reed shipments were from a 150-foot shaft on land owned by the K–K–Mining Co. in Crittenden County. The Eagle Fluor Spar Co. is near Salem in Livingston County and is equipped with a concentrating plant; the concentrates shipped in 1939 came from stocks, as the property was idle. The Hickory Cane Mining Co. shipments were derived from development done at the 250-foot level.

Michigan.—Production of copper in Michigan declined to 87,970,000 pounds in 1939 from 93,486,000 pounds in 1938, or 6 percent. The drop was due to the closing in October of the famous Conglomerate lode of the Calumet and Hecla Consolidated Copper Co. owing to exhaustion of ore reserves. This mine has produced almost continuously since 1866, when operations began, and has been responsible for the principal part of Calumet and Hecla's total output. The company states that over a period of 73 years the mine contributed more than 3,275,000,000 pounds of copper to the country's total. As a result of the shut-down of the Conglomerate mine a considerably larger proportion of Calumet and Hecla's production in 1939 was from tailings, and the yield of copper from Michigan ore and tailings (0.96 percent) was the smallest since 1918 and one of the lowest on record. The proportion of copper from tailings to copper from ore in the State in 1939 is believed to have been the highest in Michigan's history.

Copper was produced in 1939 from the same mines as in 1938, that is, Calumet and Hecla, Copper Range Co., Quincy Mining Co., and Isle Royale Copper Co. The property of the Peninsula Copper Co. (formerly known as the Seneca mine) was optioned to Calumet and Hecla, and its production was covered by the report for the latter company.

Output of silver in Michigan in 1939 (101,878 fine ounces) was the highest recorded since 1933, when 125,926 ounces were produced, and except for 1933 was larger than in any year since 1926. In 1916, however, silver production totaled 716,640 ounces.

Mine production of gold, silver, and copper in Michigan, 1935–39 [1]

Year	Gold (fine ounces)	Silver (fine ounces)	Copper [2]			Concentrate ("mineral") [3]		Ore ("rock") (short tons) [4]
			Pounds	Yield				
				Pounds per ton of ore ("rock")	Percent	Pounds	Yield (percent copper)	
1935		4,219	64,108,689	46.6	2.33	95,509,256	67.1	1,376,803
1936			95,968,019	29.8	1.49	141,166,376	68.0	3,225,600
1937	51.44	25,454	94,928,000	22.6	1.13	148,172,000	64.1	[5] 4,197,881
1938		93,634	93,486,000	24.9	1.24	144,964,890	64.5	3,757,705
1939		101,878	87,970,000	19.1	.96	136,771,339	64.3	4,603,751

[1] Figures based on actual recovery of copper from "mineral" smelted and estimated recovery from "mineral" not smelted during year.
[2] Includes copper from sands.
[3] Includes "mineral" from sands.
[4] Includes sands.
[5] Excludes 600 tons of siliceous ore.

Value of silver and copper produced in Michigan mines, 1935–39

Year	Silver	Copper		Total	Year	Silver	Copper		Total
		Total	Per ton of ore ("rock")				Total	Per ton of ore ("rock")	
1935	$3,032	$5,321,021	$3.86	$5,324,053	1938	$60,531	$9,161,628	$2.44	$9,222,159
1936		8,829,058	2.74	8,829,058	1939	69,154	9,148,880	1.99	9,218,034
1937	19,689	11,486,288	2.74	11,505,977					

The following data are abstracted from reports of the companies to their stockholders.

Production of copper by the Calumet and Hecla Consolidated Copper Co. in 1939 totaled 28,915,000 pounds at an average cost sold (excluding depreciation and depletion) of 8.81 cents a pound. The Lake Linden and Tamarack reclamation plants worked throughout the year under normal conditions and treated sand below the average grade of reserves. Together they recovered 23,400,000 pounds of copper at an average cost sold (excluding depreciation and depletion) of 6.19 cents a pound. In 1938 the mines produced 48,264,000 pounds at an average cost of 7.37 cents a pound and the reclamation plants 16,619,000 pounds at 6.86 cents. The average price received advanced from 10.03 cents in 1938 to 10.81 cents in 1939. This small increase was largely offset by increased mining costs.

Of the 1939 recovery 7,269,000 pounds were from table treatment following grinding, 12,909,000 pounds from leaching, and 3,222,000 pounds from flotation. At the current rate of recovery the remaining Conglomerate sands should last 4 to 4½ years. Mining at the Conglomerate lode was continued through October, by which time all the commercial rock had been mined. Active mining was begun on this lode in 1866 and has continued almost uninterruptedly for 73 years, during which time the lode has produced more than 3,275,000,000 pounds of copper. At the Calumet mill at Lake Linden 164,526 tons of Conglomerate rock were stamped. The mill and its auxiliary grinding plant ceased operations with the closing of the Conglomerate mine, but for the present they are being maintained in serviceable condition. At the Ahmeek mill 759,301 tons of Kearsarge amygdaloid rock from the Ahmeek mine and 30,996 tons from the Peninsula Copper Co. area were stamped. The mill is operating at its best metallurgical efficiency but at only about 50 percent of capacity. The smelter received 43,716 tons of concentrates, smelted 42,429 tons, and produced 54,187,766 pounds of refined copper. Copper oxide totaling 1,855 tons and containing 2,832,335 pounds of copper was shipped to customers. Results of exploration in the Mass-Michigan area in Ontonagon County were generally unfavorable, and exploration was abandoned in December. Exploration work in Houghton and Keweenaw Counties was generally discouraging.

Operations at the Calumet and Hecla reclamation plants at Lake Linden and Hubbell in 1939 and for the entire period of their operation

	1939	Since beginning
Quantity treated ... short tons	2,574,000	33,672,000
Assay headings ... percent	0.548	0.657
Assay tailings ... do	.092	.125
Refined copper produced ... pounds	23,400,000	357,343,000
Refined copper produced per ton treated ... do	9.09	10.61

The mine production of copper by the Copper Range Co. was 17,856,237 pounds, and copper produced at the tailings recovery plant amounted to 253,172 pounds, a total of 18,109,409 pounds. Of the copper produced, 1,075,582 pounds were from the Globe mine and the remainder from the Champion mine. The company expects that production at the Globe mine will show substantial improvement in 1940. Ore reserves at the Champion mine were reported to be about 10 percent below those on hand at the beginning of the year, but minable areas were more spotty and scattered. These conditions made mining more difficult and costs higher. The tailings recovery plant operated on an experimental basis 1½ months. It was hoped that operations at the plant would be resumed in the spring of 1940. The average cost of production for the company rose from 9.50 cents a pound in 1938 to 10.12 cents in 1939, and as the average selling price advanced from 9.80 to 10.81 cents there was a slight increase in net realization per pound. Concentrates treated at the smelter totaled nearly 26,800 tons, or 16 percent more than in 1938. The rise was due to the handling of larger quantities of custom material. Operations of the company for 5 years are shown in the following table:

Copper produced by the Champion mine of the Copper Range Co., 1935–39

Year	Rock stamped	Copper produced	Yield per ton	Cost per pound [1]	Price received
	Short tons	*Pounds*	*Pounds*	*Cents*	*Cents*
1935	280, 500	16, 759, 889	57. 56	8. 26	8. 68
1936	320, 815	17, 486, 019	54. 51	8. 87	9. 59
1937	[2] 306, 075	16, 131, 277	[3] 51. 59	11. 45	12. 375
1938 [4]	[5] 333, 190	18, 066, 891	[3] 54. 06	9. 50	9. 80
1939 [4]	[6] 330, 605	18, 109, 409	[3] 54. 01	10. 12	10. 81

[1] Excludes depreciation and depletion.
[2] Excludes 133,594 tons of tailings treated.
[3] Yield from ore only.
[4] Includes Globe mine.
[5] Excludes small unstated quantity of tailings treated.
[6] Excludes 85,842 tons of tailings treated.

Missouri.—The following tables show the shipments of lead and zinc in southwestern Missouri, which is part of the Tri-State region, and in southeastern Missouri. The tenor of the crude ore and concentrates is given for each area.

Mine production of lead and zinc in southwestern Missouri, 1935–39

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
1935	490	$19, 600	345	$10, 350	13, 020	$371, 980	1, 400	$20, 561	552	$44, 160	7, 263	$639, 144
1936	2, 340	113, 912	294	10, 497	34. 068	1, 085, 455	621	10, 762	2, 006	184, 552	18, 665	1, 866, 500
1937	5, 587	368, 231	173	8, 160	37, 715	1, 611, 158	1, 690	43, 411	4, 426	522, 268	20, 589	2. 676, 570
1938	4, 130	209, 758	104	3, 100	18, 474	560. 089	1, 022	17. 931	3, 157	290, 444	10, 226	981, 696
1939	3, 674	199, 885	-------	-------	27, 741	944, 587	949	16, 757	2, 759	259, 346	15, 096	1, 569, 984

[1] In calculating the 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 treated and concentrates produced in southwestern Missouri, 1935–39

	1935	1936	1937	1938	1939
Total ore and old tailings treated short tons	[1] 554,300	[2] 871,200	[3] 980,100	[4] 479,600	[5] 523,800
Total concentrates in ore:					
Lead percent	0.15	0.27	1.02	0.88	0.70
Zinc do	2.60	3.95	5.82	4.07	5.48
Metal content of ore:					
Lead do	.10	.20	.78	.67	.54
Zinc do	1.49	2.40	3.47	3.00	3.20
Average lead content of galena concentrates do	73.7	77.0	79.0	77.0	76.6
Average lead content of lead carbonate concentrates percent	60.0	63.0	63.0	50.0	
Average zinc content of sphalerite concentrates do	59.4	61.1	60.7	58.5	53.9
Average zinc content of silicates and carbonates do	38.0	40.1	40.5	44.4	45.0
Average value per ton:					
Galena concentrates	$40.00	$50.53	$66.00	$50.79	$54.41
Lead carbonate concentrates	30.00	35.70	47.16	31.14	
Sphalerite concentrates	28.57	32.20	43.30	30.26	34.05
Zinc silicates and carbonates	14.62	17.33	25.69	17.54	17.66

[1] Includes 364,000 tons of old tailings and slimes yielding 16 tons of galena concentrates and 5,840 tons of 58.3-percent sphalerite concentrates.
[2] Includes 408,700 tons of old tailings and slimes yielding 5 tons of galena concentrates and about 6,200 tons of 59.8-percent sphalerite concentrates.
[3] Includes 422,000 tons of old tailings yielding 40 tons of galena concentrates and 6,932 tons of 57.9-percent sphalerite concentrates.
[4] Includes 126,600 tons of old tailings and slimes yielding 1,420 tons of 55.8-percent sphalerite concentrates.
[5] No tailings treated in 1939.

Mine production of lead and zinc in southeastern Missouri, 1935–39

Year	Lead concentrates (galena)		Zinc concentrates (sphalerite)		Metal content [1]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1935	131,405	$5,638,005			96,941	$7,755,280		
1936	145,575	7,278,750	112	$2,016	108,422	9,974,824	44	$4,400
1937	209,937	14,360,271	24	720	153,205	18,078,190	11	1,430
1938	163,500	9,040,593			118,870	10,936,040		
1939	210,526	12,339,360			153,522	14,431,068		

[1] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead ore and concentrates in southeastern Missouri disseminated-lead district, 1935–39

	1935	1936	1937	1938	1939
Total lead ore short tons	3,082,300	3,418,800	5,012,631	3,668,400	5,127,000
Galena concentrates in ore percent	4.26	4.26	4.18	4.45	4.11
Zinc content of ore do					
Average lead content of galena concentrates do	73.3	76.0	74.5	74.8	74.4
Average value per ton of galena concentrates	$42.91	$50.00	$68.42	$55.29	$58.61
Average zinc content of sphalerite concentrates percent		45.0	51.6		
Average value per ton of sphalerite concentrates		$18.00	$30.00		

The value of the silver, lead, and zinc shipped from Missouri mines was $16,405,251 in 1939 compared with $12,396,948 in 1938. The silver in 1939 (213,400 fine ounces) was recovered from lead refining. Lead ore yielded no copper. The quantity of recovered lead increased from 122,027 to 156,281 tons and that of recoverable zinc from 10,226 to 15,096 tons.

Shipments of lead concentrates from Missouri mines were 214,200 tons in 1939 compared with 167,734 tons in 1938; of the total, 210,526 tons were shipped from mines in southeastern Missouri compared with 163,500 tons in 1938, of which the recovered lead content was 153,522 and 118,870 tons, respectively. No sphalerite was shipped from southeastern Missouri in either year. Shipments of lead concentrates from southwestern Missouri mines in 1939 comprised 3,674 tons of galena, most of which came from mines in the Spring City, Oronogo, and Webb City camps.

The total value given for all concentrates is based on actual receipts by the sellers and not on quoted prices. In 1939, as in 1938, the quoted price was that paid for medium quantities or carlots; small lots brought less. The quoted prices of all sphalerite concentrates in 1939 ranged from \$29 to \$44 a ton. The opening quotations were \$29; in the eleventh week the price increased to \$30, which held for 18 weeks. Early in July the price advanced to \$31 and early in August to \$31.50. During the second week of August it jumped to \$40 a ton, in the third week of September to \$42, and in the last week of September to \$44, the highest quotation of the year. This price held steadily until the second week of December, when there was a sharp break to \$39.50. This price prevailed until the end of 1939. No prices were quoted in 1939 for zinc silicate or lead carbonate. The price quotation for 80-percent galena concentrates for the first 3 weeks of 1939 was \$54.38 a ton; early in February it fell to \$52.94. There were only slight changes in weekly price from March until June. The price in July was \$55.18 and in the first week of August jumped to \$58.06, where it was steady for 5 weeks. The highest price of the year (\$64.54) was reached in the second week of September, and it held until the end of December. The average price paid for zinc silicate in 1939 was about \$17.60 a ton.

The foregoing quoted prices apply to all mines in the Tri-State or Joplin region of Kansas, Missouri, and Oklahoma.

Of the 413,139 tons of zinc concentrates shipped from the Tri-State region in 1939, it is estimated that flotation concentrates comprised 199,249 tons; flotation lead concentrates are estimated at 11,500 tons. The extension of flotation has increased the zinc content of the sphalerite concentrates, but the average grade of galena concentrates has decreased. Most of the galena from jigs and tables has a lead content of 80 percent (and above), but the flotation galena does not average as much as 70 percent lead. The small quantity of galena produced at tailing mills is generally of low grade for Missouri type, the lead content averaging 35 to 69 percent. About 43 large and small mines were worked in southwestern Missouri in 1939; only 13 mills were operated.

Until about September 1939 small mine development and churn drilling were handicapped by low prices for ore and scarcity of capital for investment. Few ore bodies of consequence were located, and most of the ore treated came from old mines that had been reopened. Drilling at Aurora was not very successful, and little ore came from the Alba-Neck City camp. Old mines were reopened at Racine, Seneca, and Duenweg. Mines near Oronogo and Stark City yielded a large part of the concentrates from southwestern Missouri. The Eagle-Picher Mining & Smelting Co. continued shipments from Stark City to the Central mill at Cardin, Okla., and a new shaft was sunk on the Dungy land. Operations were continued at the old Oronogo Circle open pit by means of power shovels and trucks. The mining was done by the Oronogo Mutual Mining Co., and the crude ore was milled at the American mill (800 tons daily). Other shipments to this mill were made from the Wingfield, Red Dog, Lucky Tiger, and Hickam mines. The Oronogo Circle, in addition to sending ore to the American mill, moved more than 125,000 tons of waste from the open pit where operations were limited to about the 100-foot level. Eventually operations will extend to the old workings below 220 feet. The F and M Mining Co. operated several shafts and its 200-ton mill throughout 1939. The Playter custom mill at Waco received crude ore from various camps, in addition to the mines at Waco. Other producers of lead or zinc concentrates in 1939 were the Burton Mining Co., Boulder Lead & Zinc Co., Eunamar Mining Co., Little Six Mining Co., and Deer Park Mining Co., all near Joplin; the Mary Arnold Mining Co. at Ozark; L. Eakins (custom mill) at Webb City; Midwestern Mining & Milling Co. at Wentworth; Ritter Mining Co. at Waco; Pilant & Ogle and R. Nunn & Co. at Granby; and Lemons Mining Co. at Seneca. About 66,000 tons of crude ore from Missouri mines were shipped to the Central mill in Oklahoma in 1939.

The lead ore (5,127,000 tons) mined in southeastern Missouri in 1939 yielded 4.11 percent in galena concentrates averaging 74.4 percent lead. The quantity of ore mined and milled was 1,458,600 tons more than in 1938 but the recovery slightly less. The mines and mills of the St. Joseph Lead Co., with a daily capacity of 20,500 tons, were operated at a much higher rate than in 1938, and the Mine La Motte Corporation mill treated 33 percent more ore than in 1938. The Annapolis mine and mill in Iron County were worked part of the year by the Basic Metals Mining Co. The Ozark Lead Co. on the Fleming tract at Fredericktown had a much larger output than in 1938; its crude ore is treated at the Clark & Hallock mill. Of the 210,526 tons of concentrates made in southeastern Missouri, 94,488 tons were flotation galena concentrates compared with 73,884 tons in 1938. No sphalerite or zinc carbonate concentrates were shipped from southeastern Missouri in 1939, and less than 300 tons of galena were purchased and shipped by buyers of small lots recovered in shallow workings.

Oklahoma.—Events in 1939 of greatest importance to Oklahoma mine operators and others in the Tri-State lead and zinc region were the war in Europe, which caused prices of sphalerite concentrates to advance rapidly in September; the realization in December that Europe had no urgent need of imported zinc metal or concentrates; and the increase in imports of metal concentrates from Mexico and South America fostered by the lower import tariff on zinc and by lack of facilities to ship zinc to its normal market, which especially affected the Tri-State region.

Operators of mines in the Tri-State area have long been aware that health and housing conditions in the region are not perfect, although much improvement has been made in recent years. The mine management had studied various phases of health and safety in the mines and plants and had complied with regulations as well as with procedures beyond the requirements of law in protecting the health and safety of the workers in mines and mills. However, the operators have very little control over housing conditions but have contributed liberally to improvement of health and hospital facilities. Undoubtedly some dust disease still exists in the region, but most of the cases of silicosis originated under conditions of 20 or more years ago, and few new cases occur with modern equipment and rules. The operators do not believe that dust from tailing piles or other sources has caused silicosis to workers above ground or to travelers on highways; moreover, they think that while some poor housing facilities can be found, this condition exists in almost every community, large or small, and they are very willing to assist in every way Federal, State, and local authorities to remedy all objectionable features.

Several reports on silicosis have been published, including a recent article by H. C. Chellon.[3]

Nearly all the tailings treated at mills in the Tri-State region (7,274,000 tons in 1939) are moved by truck; in addition, a large part of the crude ore is transported by truck, including part of that treated at custom or central mills. The average truck haul is said to be 2 miles, and the cost, of course, varies with the distance the material is moved. Some data relating to the increased quantity hauled by truck in the Tri-State area have been published by Netzeband.[4]

About 23 mills of various sizes were operating in Oklahoma at the end of 1939. At least 100 operators, large and small, did not mill their crude ore but shipped it to custom mills or central mills. The Tri-State Zinc & Lead Ore Producers Association reported at the end of the year that stocks at mines in the Tri-State region totaled 12,022 tons of sphalerite and 491 tons of galena. Stocks of sphalerite increased 3,600 tons compared with December 31, 1938, but stocks of galena decreased nearly 8,000 tons.

A large part of the blende concentrates from the tailing mills and from the central mills is a flotation product, but the tailing mills produce only a small quantity of low-grade galena. The proportion of flotation sphalerite at the large central mills has shown a substantial increase. Except at a few large mills there has been no great increase in flotation galena concentrates.

About 1,871,000 tons more old tailings than crude ore were treated in Oklahoma in 1939, and the tailings yielded about 21 percent of the total sphalerite.

There was no production from the Peoria or Davis camps in 1939 or 1938. Mines near Commerce were operated part of the year, and the Midas, Mispah, Crabapple, and Lost Trail leases produced concentrates at small mills or shipped crude ore to custom mills. The shippers in the Sunnyside-Quapaw area were the Atlas Milling Co., Century Zinc Co. (Scott), and St. Louis Smelting & Refining Co. (No. 4).

In the central part of the Oklahoma section of the Tri-State region, the Lawyers Lead & Zinc Co. and Skelton Lead & Zinc Co. ran partly on ore in 1939 and partly on old tailings. The following mills ran tailings only: Rialto Mining Corporation, Cardin Mining & Milling Co. (Nos. 2 and 3), Eagle-Picher Mining & Smelting Co.

[3] Chellon, H. C., Dust Count Technique in Tri-State Mines: Eng. and Min. Jour., December 1939, pp. 29–33.

[4] Netzeband, W. F., Truck Transport Serves Tri-State Mining: Eng. and Min. Jour., January 1940, p. 34.

(Beaver), Britt Mining Co., Tri-State Zinc, Inc. (Sooner and Ottawa), Cortez King Brand Mining Co. (New York), and C. Y. Semple (Martin).

The Eagle-Picher Mining & Smelting Co. treated more crude ore in 1939 than any other Tri-State operator; among company-operated mines shipping to the Central mill were the Admiralty, Blue Goose, Crystal, Grace Walker, How-bah-wah-tah 1, 2, and 3, La Salle, Southside, See Sah, and Swift. Other large shippers to the Central mill were the Davis Big Chief Mining Co., Craig Mining Co., Cameron & Henderson, J. Dryer, Childress Mining Co. (Acme), Romo Mining Co., Gray Wolf Mining Co., Needmore Mining Co., Carpenter Mining Co., Commerce Tulsa Mining Co., Imperial Mining Co., W. H. Mining Co., and Ottawa Mines Corporation. The Bird Dog 800-ton mill received ore from many of the old Commerce leases but has since been used to crush crude ore for the Central mill. Other large operations in Oklahoma included Evans Wallower Zinc, Inc. (4 and 7), Oklahoma Interstate Mining Co. (Woodchuck and Townsite mines), United Zinc Smelting Corporation, Kansas Exploration Co. (Ritz), Guaranty Mining & Royalty Co., Indian Mining & Milling Co., Lulu Belle Mining Co., Baird Mining Co., Blue Ribbon Mining Co., Lavrion Mining Co., Federal Mining & Smelting Co. (Gordon), and Mission Mining & Royalty Co. The Guaranty mill treated ore from the Sherida, Sante Fe, and Blue Ribbon mines; the Gordon mill, from seven or eight mines of the Federal Mining & Smelting Co.; and the Beck No. 2 mill, from numerous mines but principally from the Dobson, Pioneer, and St. Louis No. 10 mines.

The total quantity of crude ore milled at the Central mill in 1939 was 1,881,079 tons, and the total ore milled at the See Sah, Bird Dog, and Blue Goose mills was 567,100 tons. About 72 percent of the sphalerite and 36 percent of the galena milled at the Central mill were flotation products. Numerous improvements were made at the Central mill in 1939, and the plant operates smoothly with a capacity up to 10,000 tons daily. A large cone crusher has been installed at the foot of the tailings conveyor to reduce the size of the cone-plant tailings product to meet commercial demands, which are mainly for the smaller sizes of material. Some of the old Commerce mills may be operated occasionally, but most of the Eagle-Picher Mining & Smelting Co. crude ore will be treated at its Central mill.

Mine shipments of lead and zinc in Oklahoma, 1935–39

Year	Lead concentrates (galena)		Zinc concentrates (sphalerite)		Metal content [1]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1935	30,790	$1,329,656	246,131	$7,047,052	23,405	$1,872,400	129,763	$11,419,144
1936	34,833	1,735,732	244,740	7,628,448	25,427	2,339,284	129,175	12,917,500
1937	39,446	2,729,690	255,839	10,428,354	29,840	3,521,120	135,696	17,640,480
1938	27,608	1,446,058	208,484	6,390,422	21,004	1,932,368	112,924	10,840,704
1939	36,422	2,189,077	258,214	8,937,554	27,720	2,605,680	140,379	14,599,416

[1] In calculating the 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, 1938–39

	1938		1939	
	Crude ore	Old tailings and slimes	Crude ore	Old tailings and slimes
Total ore, etc., milled ... short tons	3,072,400	4,249,000	3,465,900	5,337,000
Total concentrates shipped:				
Galena ... do	27,208	400	35,820	602
Sphalerite ... do	167,250	41,234	203,095	55,119
Ratio of concentrates to ore, etc.:				
Lead ... percent	0.91	0.01	0.80	0.01
Zinc ... do	5.30	.97	5.97	1.03
Metal content of ore, etc.:				
Lead ... do	.71	------------	.62	.01
Zinc ... do	3.19	.58	3.64	.60
Average lead content of galena concentrates ... do	78.0	52.0	78.1	51.7
Average zinc content of sphalerite concentrates ... do	60.2	60.1	61.1	59.5
Average value per ton:				
Galena concentrates	$52.62	$35.79	$60.52	$35.10
Sphalerite concentrates	30.61	30.83	34.96	33.33

Mine production of lead and zinc concentrates in Oklahoma, 1891–1939, by districts

District	Lead concentrates (mainly galena)		Zinc concentrates			
			Sphalerite		Zinc silicate and carbonate	
	Short tons	Value	Short tons	Value	Short tons	Value
Davis	------------	------------	558	$27,399	899	$24,592
Miami [1]	1,277,003	$103,959,345	7,339,697	286,292,623	164	2,692
Peoria	2,639	127,163	220	8,289	3,120	79,649
	1,279,642	104,086,508	7,340,475	286,328,311	4,183	106,933

[1] Including Quapaw and Sunnyside.

Wisconsin.—The output of galena concentrates in Wisconsin in 1939 was 74 tons more than in 1938; shipments of sphalerite increased substantially, and the recovered zinc rose 3,831 tons. All the low-grade concentrates made were re-treated at flotation plants. The Vinegar Hill Zinc Co. worked only the Winskill-Petersen mine. Low-grade concentrates were made at the Winskill mill and then sent to the all-flotation plant. Small lots of ore and concentrates were shipped to these plants from at least 50 small mines near Shullsburg, New Diggings, Linden, Leadmine, Platteville, Highland, Hazel Green, Dodgeville, Cuba City, and Benton; the shippers included the McKinley Mining Co., which did not operate its mill in 1939. The Badger mine at Linden was operated part of the year by W. E. Faithorn, and lead and zinc concentrates were made at the flotation plant built several years ago by the Badger Zinc Co.

Mine production of lead and zinc in Wisconsin, 1935–39

Year	Lead concentrates		Zinc concentrates (sphalerite)		Metal content [1]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1935	398	$16,963	33,027	$379,262	286	$22,880	8,923	$785,224
1936	1,277	61,198	38,276	400,899	904	83,168	8,126	812,600
1937	1,590	109,468	37,060	444,531	1,091	128,738	6,938	901,940
1938	493	21,050	[2] 3,895	[2] 121,180	320	29,440	2,073	199,008
1939	567	29,327	[3] 10,169	[3] 355,915	388	36,472	5,904	614,016

[1] In calculating the metal content of the ores from assays allowance has been made for roasting and smelting losses of both lead and zinc. In comparing the values of ores and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.
[2] The zinc concentrates shipped in 1938 were a flotation product of raw concentrates roasted at Cuba City, Wis. No raw concentrates were shipped in 1938; about 13,000 tons were produced.
[3] Virtually all the raw concentrates in 1939 were milled at the Winskill-Petersen mill and re-treated at the flotation plant of the Vinegar Hill Zinc Co., yielding 10,169 tons of 60-percent zinc concentrates. No raw concentrates were shipped in 1939; about 32,360 tons were produced.

Tenor of lead and zinc ore and concentrates produced in Wisconsin, 1935–39

	1935	1936	1937	1938	1939
Total ore ... short tons	236,000	284,800	285,000	58,700	213,400
Total concentrates in ore:					
Lead ... percent	0.17	0.45	0.56	0.84	0.26
Zinc ... do	14.00	13.44	13.00	[1] 22.15	[2] 15.15
Metal content of ore:					
Lead ... do	.12	.32	.29	.55	.19
Zinc ... do	4.85	3.61	3.12	3.91	3.07
Average lead content of galena concentrates ... do	73.3	72.2	70.1	67.0	70.0
Average zinc content of sphalerite concentrates percent	34.6	27.0	24.0	18.5	20.2
Average value per ton:					
Galena concentrates	$42.62	$48.08	$68.85	$42.70	$51.72
Sphalerite concentrates	11.48	10.47	11.99	[3] 31.11	[4] 35.00

[1] The zinc concentrates shipped in 1938 (3,895 tons) were a flotation product or raw concentrates roasted at Cuba City, Wis. No raw concentrates were shipped in 1938; about 13,000 tons, averaging 18.5 percent zinc, were produced.
[2] All sphalerite shipped in 1939 (10,169 tons) was a flotation product. No raw concentrates were shipped in 1939; 32,360 tons, averaging 20.2 percent zinc, were produced.
[3] Value is that of roasted or flotation concentrates shipped. No value can be assigned for zinc concentrates prior to roasting or re-treatment by flotation.
[4] Value is that of flotation concentrates shipped, which averaged 60 percent zinc.

The sphalerite concentrates averaged before treatment by flotation about 20.2 percent zinc, and the finished product shipped in 1939 to smelters (10,169 tons) averaged about 60 percent zinc. The flotation lead concentrates made totaled 318 tons.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN IDAHO

(MINE REPORT)

By T. H. Miller and Paul Luff

SUMMARY OUTLINE

The total value of the metal output from mines in Idaho was $29,794,144 in 1939 compared with $29,028,103 in 1938, an increase of nearly 3 percent. The total value of each metal except silver increased; zinc increased $718,216 and gold $460,215, but silver declined $588,404. Production of gold in Idaho in 1939 (116,662 fine ounces) was the largest since 1895; the gain over 1938 was due to increased output from lode mines as the output from placers declined. The quantity of silver decreased 9 percent and that of lead 1 percent; copper increased 18 percent in quantity and zinc 8 percent. Most of the decrease in total output of silver was at the Sunshine mine, and most of the increase in that of zinc was at the Morning mine, both in the Coeur d'Alene region, chief metal-producing area in Idaho.

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, 1935–39

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1935	$35.00	$0.71875	$0.083	$0.040	$0.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052

[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] 1935–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–39: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787.

Mine production of gold, silver, copper, lead, and zinc in Idaho, 1935–39, and total, 1863–1939, 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
1935	289	1,079	1,520,945	83,823.06	$2,933,807	10,240,953	$7,360,685
1936	281	828	1,807,530	80,291.40	2,810,199	14,537,530	11,259,317
1937	347	741	2,075,402	81,861.00	2,865,135	19,587,766	15,151,137
1938	305	463	1,999,147	103,513.00	3,622,955	18,993,676	12,278,740
1939	362	465	2,108,445	116,662.00	4,083,170	17,222,370	11,690,336
1863–1939			(1)	7,332,862.00	159,789,573	435,350,307	297,862,558

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1935	2,095,867	$173,957	158,040,250	$6,321,610	62,105,568	$2,732,645	$19,522,704
1936	2,954,000	271,768	182,678,000	8,403,188	98,200,000	4,910,000	27,654,472
1937	4,464,000	540,144	207,422,000	12,237,898	108,398,000	7,045,870	37,840,184
1938	4,278,000	419,244	184,354,000	8,480,284	88,060,000	4,226,880	29,028,103
1939	5,032,000	523,328	181,962,000	8,552,214	95,098,000	4,945,096	29,794,144
1863–1939	[2] 90,789	28,701,317	[2] 5,308,306	565,487,466	[2] 723,682	98,034,957	1,149,875,871

[1] Figures not available. [2] Short tons.

Gold and silver produced at placer mines in Idaho, 1935–39, in fine ounces, in terms of recovered metals

Year	Sluicing and hydraulic		Drift mining		Dragline and dry-land dredges [1]		Floating (bucket) dredges		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1935	[2] 8,134.07	[2] 2,641	(2)	(2)			23,616.96	9,544	31,751.03	12,185
1936	[2] 8,282.46	[2] 1,473	(2)	(2)	49.15	19	26,098.19	9,661	34,429.80	11,153
1937	4,286.00	1,399	433.00	65	6,859.00	1,652	28,962.00	9,171	40,540.00	12,287
1938	4,987.00	969	410.00	57	17,448.00	6,202	31,234.00	10,100	54,079.00	17,328
1939	5,443.00	1,638	196.00	26	14,051.00	5,721	28,973.00	7,490	48,663.00	14,875

[1] A floating washing plant supplied with gravel by a dragline excavator is called a "dragline dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."
[2] Figures for sluicing and hydraulic include those for drift mining.

Gold.—The output of recoverable gold in Idaho was 13 percent greater in 1939 than in 1938; it was the largest since 1895, when 125,517 ounces were produced. The output of gold from lode mines increased 37 percent over 1938 and was the largest since 1901; most of the increase came from gold ore and gold-silver ore. The output of gold from placers declined 10 percent, owing to the decreased output of gold from dredging. Nearly 54 percent of the State gold output in 1939 came from siliceous ore and 37 percent from all types of dredging operations. Eight floating (bucket) dredges treated 6,626,356 cubic yards of gravel and recovered 28,973 ounces of gold, a decrease of 2,261 ounces from 1938; 6 dragline dredges and 17 dry-land dredges treated 2,094,600 cubic yards of gravel and recovered 14,051 ounces of gold, a decrease of 3,397 ounces. Of the total placer gold, 85 percent came from the Boise Basin, Warren, Newsome, Carson, Elk City, Pierce, Orogrande, and Riggins districts where dredges were operated. Of the total lode gold, 89 percent came from the Warm Springs, Middle Boise, Burgdorf-Marshall Lake, Yellow Pine, Mineral Hill, Carson, Boise Basin, Ramey Ridge, Ten Mile, and Yankee Fork districts and the Coeur d'Alene region. Substantial increases in output of gold were recorded in the Warm Springs, Burgdorf-Marshall Lake, Middle Boise, Yellow Pine, Yankee Fork, and Mineral Hill districts and the Coeur d'Alene region, but large decreases in the Boise Basin, West View (Montour), Ten Mile, and Carson districts.

Snyder Mines, Inc., operating lode property near Ketchum, was the largest gold producer in Idaho in 1939. It was followed by the Fisher-Baumhoff Co., which operated two bucket dredges near Centerville; the Golden Anchor mine at Burgdorf; the Boise-Rochester property at Atlanta; the Warren Dredging Co. at Warren; the Yellow

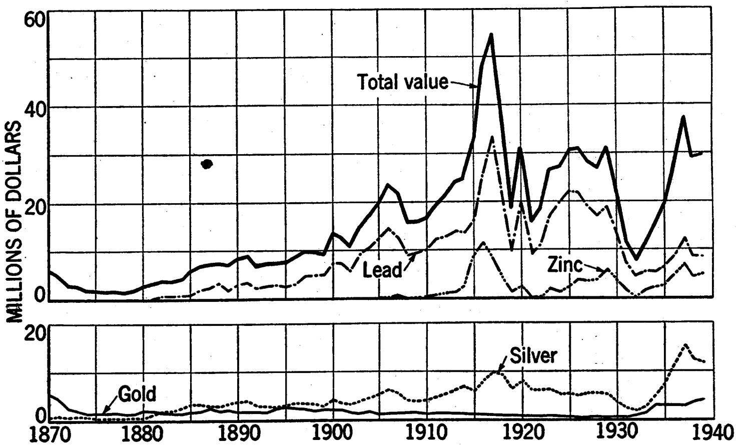

FIGURE 1.—Value of mine production of gold, silver, lead, and zinc and total value of gold, silver, copper, lead, and zinc in Idaho, 1870–1939. The value of copper has been less than $2,000,000 annually except in a few years.

Pine mine at Stibnite; Newsome Creek Placers near Golden; Idaho Canadian Dredging Co. (formerly Moores Creek Dredging Co.) at Idaho City; Consolidated Gold Mines, Inc., at Murray; De Lamar Milling Corporation at De Lamar; and Gold Producers, Inc., at Shoup.

Silver.—The output of recoverable silver in Idaho was 17,222,370 fine ounces in 1939, a decrease of 9 percent from 1938. Production from the Sunshine mine declined from 11,352,154 to 9,414,514 ounces; there were also large decreases in silver output from the Polaris, Hecla, and Crescent mines, but increases were reported at the Morning and Mineral Point properties. The Coeur d'Alene region produced 88 percent of the State total silver in 1939; the rest came chiefly from the Warm Springs, Bayhorse, Carson, Port Hill, Pend d'Oreille, Blue Wing, Burgdorf-Marshall Lake, and Boise Basin districts. Silver ore yielded 65 percent of the State total silver; zinc-lead ore, 24 percent; lead ore, 5 percent; and gold-silver ore, 4 percent. The yield of silver from silver ore decreased 2,358,552 ounces and that from lead ore also declined, but the output from zinc-lead ore increased 508,520 ounces and that from gold-silver ore, 632,251 ounces.

Nine mines—the Sunshine, Bunker Hill & Sullivan, Triumph, Polaris, Morning, Hecla, Crescent, Page, and Mineral Point—produced 92 percent of the silver output of the State in 1939. All these mines, except the Triumph, are in the Coeur d'Alene region.

Copper.—The output of recoverable copper in Idaho was 5,032,000 pounds in 1939, an increase of 18 percent over 1938. The gain resulted chiefly from increased output of silver-copper ore from the Mineral Point mine and from shipments of copper ore from the Empire (Mackay Metals) mine. Silver ore (chiefly from mines in the Coeur d'Alene region) yielded nearly 67 percent of the State total copper; zinc-lead ore, 20 percent; gold ore, 6 percent; and copper ore and lead ore together, 7 percent.

The Sunshine mine produced nearly half of the total copper output of the State in 1939; most of the remainder came from the Mineral Point, Polaris, Copper Queen, Hecla, Bunker Hill & Sullivan, Triumph, Morning, and Empire properties.

Lead.—The output of recoverable lead in Idaho was 181,962,000 pounds in 1939, a decline of 1 percent from 1938, but the total value increased slightly in consequence of the higher average sales price. The marked decrease in output of lead from the Hecla, Triumph, and Bunker Hill & Sullivan mines more than offset an increase of about 12,000,000 pounds in lead from the Morning mine. Nearly 90 percent of the State total lead came from the Coeur d'Alene region and 6 percent from the Warm Springs district; considerable lead was produced also in the Port Hill, Bayhorse, Texas, and Pend d'Oreille districts. Zinc-lead ore from the Coeur d'Alene region and the Warm Springs district yielded 87 percent of the State total lead; lead ore, chiefly from the Coeur d'Alene region, yielded 11 percent. Lead recovered from lead ore decreased 23,515,438 pounds, but that from zinc-lead ore increased 18,770,583 pounds.

The combined lead output in 1939 of the three largest producers—Morning, Bunker Hill & Sullivan, and Hecla—was 135,073,600 pounds (134,740,600 pounds in 1938), or 74 percent of the State total; other large producers were the Page, Triumph, Star, Blackhawk, Idaho-Continental, Jack Waite, Gold Hunter, and Clayton properties.

Zinc.—The output of recoverable zinc in Idaho was 95,098,000 pounds in 1939, an increase of 8 percent over 1938. The gain was due entirely to increased output of zinc from mines in the Coeur d'Alene region, as production in the Warm Springs district declined 9,213,480 pounds. The largest increase (8,593,700 pounds) in zinc output was recorded from the Morning mine, but substantial increases were made also at the Hecla and Bunker Hill & Sullivan properties. More than 84 percent of the State total zinc in 1939 came from the Coeur d'Alene region, and nearly all the remainder came from the Warm Springs district. Zinc-lead ore concentrated yielded virtually all the zinc in 1939; only 78,114 pounds of recoverable zinc came from crude ore shipped to smelters.

Three mines—the Morning, Bunker Hill & Sullivan, and Triumph—produced 73 percent of the State total zinc in 1939; the rest came chiefly from the Star, Hecla, Page, and Frisco mines.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1939, 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	8	621	$21,735	37	$25
Adams	2	2	543	19,005	361	245
Benewah		1	3	105		
Blaine	30	2	13,539	473,865	1,211,925	822,640
Boise	53	70	21,973	769,055	49,737	33,761
Bonner	7		38	1,330	69,630	47,264
Bonneville		4	92	3,220		
Boundary	4		67	2,345	68,254	46,330
Butte	4		7	245	1,211	822
Camas	12	5	304	10,640	5,065	3,438
Canyon		2	642	22,470	47	32
Cassia	1		2	70	106	72
Clark	1				31	21
Clearwater	1	34	2,101	73,535	411	279
Custer	36	11	1,976	69,160	216,623	147,041
Elmore	19	33	12,352	432,320	39,734	26,971
Gem	4	5	151	5,285	2,307	1,566
Gooding		3	19	665		
Idaho	65	134	36,031	1,261,085	58,441	39,669
Jerome		7	179	6,265	6	4
Latah		6	14	490		
Lemhi	44	48	6,907	241,745	95,837	65,053
Lewis		3	31	1,085	3	2
Nez Perce		8	94	3,290	19	13
Owyhee	35	17	6,548	229,180	172,073	116,801
Power		8	32	1,120		
Shoshone	34	18	5,928	207,480	15,204,934	10,320,925
Twin Falls		11	132	4,620	3	2
Valley	6	21	6,297	220,395	17,537	11,904
Washington	2	4	39	1,365	8,038	5,456
	362	465	116,662	4,083,170	17,222,370	11,690,336
Total, 1938	305	463	103,513	3,622,955	18,993,676	12,278,740

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Ada							$21,760
Adams	14,154	$1,472					20,722
Benewah							105
Blaine	242,798	25,251	11,188,660	$525,867	14,934,673	$776,603	2,624,226
Boise	2,721	283	90,021	4,231			807,330
Bonner	6,096	634	1,205,958	56,680	27,596	1,435	107,343
Bonneville							3,220
Boundary	17,750	1,846	2,249,255	105,715			156,236
Butte	1,904	198	234	11			1,276
Camas	1,029	107	16,575	779	5,769	300	15,264
Canyon							22,502
Cassia	260	27	8,085	380			549
Clark			5,915	278			299
Clearwater							73,814
Custer	217,942	22,666	2,176,361	102,289			341,156
Elmore	3,846	400	42	2			459,693
Gem	356	37	3,235	152			7,040
Gooding							665
Idaho	20,269	2,108	18,106	851			1,303,713
Jerome							6,269
Latah							490
Lemhi	362,827	37,734	1,567,915	73,692			418,224
Lewis							1,087
Nez Perce							3,303
Owyhee			21	1			345,982
Power							1,120
Shoshone	4,136,115	430,156	163,397,979	7,679,705	80,129,962	4,166,758	22,805,024
Twin Falls							4,622
Valley	779	81	27,170	1,277			233,657
Washington	3,154	328	6,468	304			7,453
	5,032,000	523,328	181,962,000	8,552,214	95,098,000	4,945,096	29,794,144
Total, 1938	4,278,000	419,244	184,354,000	8,480,284	88,060,000	4,226,880	29,028,103

Gold and silver produced at lode mines in Idaho in 1939, by counties, in terms of recovered metals

County	Ore sold or treated	Gold	Silver	County	Ore sold or treated	Gold	Silver
	Short tons	*Fine ounces*	*Fine ounces*		*Short tons*	*Fine ounces*	*Fine ounces*
Ada	28	27	3	Custer	41,752	1,817	215,954
Adams	401	507	358	Elmore	57,377	11,803	39,628
Blaine	114,990	13,536	1,211,925	Gem	264	108	2,288
Boise	17,299	3,258	45,369	Idaho	32,340	15,417	53,183
Bonner	12,386	38	69,630	Lemhi	97,506	5,730	95,728
Boundary	15,847	67	68,254	Owyhee	46,955	3,551	168,359
Butte	73	7	1,211	Shoshone	1,611,068	5,350	15,204,831
Camas	509	288	5,062	Valley	56,695	6,130	17,462
Cassia	13	2	106	Washington	169	6	8,035
Clark	15		31				
Clearwater	2,758	357	78		2,108,445	67,999	17,207,495
				Total, 1938	1,999,147	49,434	18,976,348

Gold and silver produced at placer mines in Idaho in 1939, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Drift mining		Dragline and dry-land dredges [1]		Floating (bucket) dredges		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Ada	31	3			563	31			594	34
Adams	36	3							36	3
Benewah	3								3	
Blaine	3								3	
Boise	839	203	52	12	37	13	17,787	4,140	18,715	4,368
Bonneville	92								92	
Camas	16	3							16	3
Canyon	5				637	47			642	47
Clearwater	203	42			20	6	1,521	285	1,744	333
Custer	91	629			68	40			159	669
Elmore	323	89			226	17			549	106
Gem	43	19							43	19
Gooding	19								19	
Idaho	1,634	326	105	14	9,210	1,853	9,665	3,065	20,614	5,258
Jerome	179	6							179	6
Latah	14								14	
Lembi	1,086	99	16		75	10			1,177	109
Lewis	31	3							31	3
Nez Perce	94	19							94	19
Owyhee	145	83			2,852	3,631			2,997	3,714
Power	32								32	
Shoshone	198	30	17		363	73			578	103
Twin Falls	132	3							132	3
Valley	167	75							167	75
Washington	27	3	6						33	3
	5,443	1,638	196	26	[2] 14,051	[2] 5,721	[3] 28,973	[3] 7,490	48,663	14,875
Total, 1938	4,987	969	410	57	17,448	6,202	31,234	10,100	54,079	17,328

[1] A floating washing plant supplied with gravel by a dragline excavator is called a "dragline dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."
[2] Recovered from 2,094,600 cubic yards of gravel treated by 6 dragline and 17 dry-land dredges.
[3] Recovered from 6,626,356 cubic yards of gravel treated by 8 connected-bucket dredges.

MINING INDUSTRY

Increased activity at gold properties in Idaho in 1939, which was centered chiefly at mines near Burgdorf, Atlanta, Stibnite, Shoup, Murray, and De Lamar, resulted in the largest output of gold in the State since 1895 and the largest output of gold from lode mines since 1901. However, production of silver and lead declined, despite gains in average sales price of both metals in 1939. The average sales price of zinc increased from 4.8 to 5.2 cents a pound, resulting in a gain of 8 percent in quantity and 17 percent in total value of zinc output over 1938. Production of copper rose 18 percent in quantity and 25 percent in total value. There was a substantial increase in output of zinc-lead ore from mines in the Coeur d'Alene region, but a decrease from the Triumph property near Ketchum in the Warm Springs district.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Idaho in 1939, with content in terms of recovered metals

Source	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold ore	223	245,001	48,646	159,570	316,470	181,006	
Dry and siliceous gold-silver ore	23	88,044	13,261	722,943	13,544	3,101,003	
Dry and siliceous silver ore	39	451,381	633	11,241,260	3,355,093	1,332,657	
	[1] 276	784,426	62,540	12,123,773	3,685,107	4,614,666	
Copper ore	11	1,416	600	44,278	226,600	17,277	
Lead ore	68	125,964	661	824,618	122,971	19,150,421	
Zinc ore	3	144	6	1,754	1,448	4,443	78,114
Zinc-lead ore	21	1,196,495	4,192	4,213,072	995,874	158,175,193	95,019,886
Total, lode mines	[1] 362	2,108,445	67,999	17,207,495	5,032,000	181,962,000	95,098,000
Total, placers	465		48,663	14,875			
	827	2,108,445	116,662	17,222,370	5,032,000	181,962,000	95,098,000
Total, 1938	768	1,999,147	103,513	18,993,676	4,278,000	184,354,000	88,060,000

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

METALLURGIC INDUSTRY

Of the 2,108,445 tons of ore produced in 1939 in Idaho, 1,919,136 tons (91 percent) were treated at concentration plants, 121,898 tons (6 percent) were treated at amalgamation and cyanidation mills, and 67,411 tons (3 percent) were shipped crude to smelters.

Ore treated at concentration plants in 1939 comprised 120,940 tons of gold ore, 45,393 tons of gold-silver ore, 446,656 tons of silver ore, 109,652 tons of lead ore, and 1,196,495 tons of zinc-lead ore.

Ore treated at straight amalgamation mills in 1939 comprised 2,594 tons, yielding 737 ounces of gold and 313 ounces of silver. Ore treated at combined amalgamation and concentration plants comprised 108,886 tons, yielding 17,271 ounces of gold and 9,508 ounces of silver in amalgamation bullion and 1,572 tons of concentrates yielding 9,912 ounces of gold and 84,330 ounces of silver. About 700 pounds of quicksilver were consumed at amalgamation plants in Idaho.

Ore (10,418 tons) treated at straight cyanidation plants in 1939 contained 1,790 ounces of gold and 4,000 ounces of silver, indicating cyanide extraction of 87 percent of the gold and 77 percent of the silver; the plants used about 24,000 pounds of sodium cyanide (91-percent grade), 3,500 pounds of zinc dust, 117,800 pounds of lime, and 185 pounds of lead acetate.

The lead smelter and refinery of the Bunker Hill & Sullivan Mining & Concentrating Co. at Bradley were operated continuously in

1939 on ore and concentrates, chiefly from the Bunker Hill & Sullivan, Hecla, Sunshine, Polaris, and Crescent mines. During the fall the company began construction of an antimony-bismuth plant designed to handle ores and concentrates from the "Dry-Belt" section of the Coeur d'Alene region, eliminating these metals from the regular lead-smelting operations; the new plant was put in operation early in 1940. The electrolytic zinc plant of the Sullivan Mining Co. near Bradley operated throughout the year at a normal rate, chiefly on zinc concentrates from the Bunker Hill & Sullivan, Hecla, and Star mills.

Details of the treatment of all ores produced in Idaho in 1939 are given in the tables that follow.

Mine production of metals in Idaho in 1939, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore amalgamated	111,480	18,008	9,821			
Ore cyanided	10,418	1,559	3,071			
Concentrates smelted	246,821	33,159	15,895,169	4,676,079	167,781,272	95,019,886
Ore smelted	67,411	15,273	1,299,434	355,921	14,180,728	78,114
Placer		48,663	14,875			
		116,662	17,222,370	5,032,000	181,962,000	95,098,000
Total, 1938		103,513	18,993,676	4,278,000	184,354,000	88,060,000

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Idaho in 1939, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Material treated	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Ada	28	27	3					
Blaine	95	7	3					
Boise	1,888	403	196	11	92	151		191
Camas	10	12	4					
Custer	1	1	4					
Elmore	57,063	7,445	5,001	744	3,904	31,569	3,846	42
Idaho	29,426	9,489	4,402	343	4,576	47,025	18,531	10,356
Lemhi	22,024	478	94	435	1,221	3,833	280,108	4,636
Owyhee	834	108	107	39	119	1,752		
Shoshone	100	31	6					
Valley	1	2	1					
Washington	10	5						
	111,480	18,008	9,821	1,572	9,912	84,330	302,485	15,225
Total, 1938	72,477	13,459	6,311	616	3,389	34,056	182,742	9,142

CYANIDATION MILLS

County	Material treated	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
Adams	370	495	160					
Blaine	6,600	645	2,663					
Clearwater	2,758	357	78					
Idaho	140	15	3					
Shoshone	50	3	2					
Valley	500	44	165					
	10,418	1,559	3,071					
Total, 1938	113,686	2,855	1,878					
Grand total: 1939	121,898	19,567	12,892	1,572	9,912	84,330	302,485	15,225
1938	186,163	16,314	8,189	616	3,389	34,056	182,742	9,142

Mine production of metals from concentrating mills in Idaho in 1939, by counties, in terms of recovered metals

County	Ore treated	Concentrates smelted and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Blaine	65,034	22,366	2,763	596,169	221,024	7,824,178	14,926,520
Boise	14,818	532	1,813	15,720	566	69,860	----------
Bonner	11,989	798	4	43,670	1,255	1,009,300	----------
Boundary	15,780	1,579	16	67,536	17,050	2,222,739	----------
Camas	27	11	15	599	----------	2,342	5,769
Custer	38,900	1,370	31	119,487	14,260	1,757,967	----------
Elmore	36	1	6	6	----------	----------	----------
Gem	200	41	70	1,162	118	2,016	----------
Idaho	2,646	55	1,134	1,165	1,694	7,673	----------
Lemhi	73,255	2,007	3,614	65,556	57,273	201,291	----------
Owyhee	45,557	421	2,789	132,974	----------	----------	----------
Shoshone	1,594,820	213,391	5,182	14,751,951	4,060,008	154,668,681	80,087,597
Valley	56,074	2,677	5,810	14,844	346	----------	----------
	1,919,136	245,249	23,247	15,810,839	4,373,594	167,766,047	95,019,886
Total, 1938	1,779,815	259,846	22,641	18,065,739	3,903,414	170,766,396	88,060,000

Gross metal content of concentrates produced from ores mined in Idaho in 1939, by classes of concentrates smelted

Class of concentrates	Concentrates produced	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	4,771	20,456	97,956	16,827	82,890	----------
Dry gold-silver	431	2,832	134,891	223	1,000	----------
Dry silver	1,665	12	109,594	51,813	60,542	----------
Copper	10,632	2,573	9,689,954	3,535,434	347,908	----------
Lead	127,899	4,353	4,318,605	910,375	167,902,149	14,266,171
Lead-copper	2,606	193	1,158,489	407,458	646,146	----------
Zinc	97,825	918	368,401	356,550	5,319,211	105,405,109
Iron (from zinc-lead ore)	992	1,822	17,279	46,100	24,550	405,655
	246,821	33,159	15,895,169	5,324,780	174,384,396	120,076,935
Total, 1938	260,462	26,030	18,099,795	5,064,759	178,055,964	111,467,047

Mine production of metals from Idaho concentrates shipped to smelters in 1939, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Blaine	22,366	2,763	596,169	221,024	7,824,178	14,926,520
Boise	543	1,905	15,871	566	70,051	----------
Bonner	798	4	43,670	1,255	1,009,300	----------
Boundary	1,579	16	67,536	17,050	2,222,739	----------
Camas	11	15	599	----------	2,342	5,769
Custer	1,370	31	119,487	14,260	1,757,967	----------
Elmore	745	3,910	31,575	3,846	42	----------
Gem	41	70	1,162	118	2,016	----------
Idaho	398	5,710	48,190	20,225	18,029	----------
Lemhi	2,442	4,835	69,389	337,381	205,927	----------
Owyhee	460	2,908	134,726	----------	----------	----------
Shoshone	213,391	5,182	14,751,951	4,060,008	154,668,681	80,087,597
Valley	2,677	5,810	14,844	346	----------	----------
	246,821	33,159	15,895,169	4,676,079	167,781,272	95,019,886
Total, 1938	260,462	26,030	18,099,795	4,086,156	170,775,538	88.060,000

Mine production of metals from Idaho concentrates shipped to smelters in 1939, in terms of recovered metals—Continued

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	4,771	20,456	97,956	14,784	64,668	
Dry gold-silver	431	2,832	134,891	216	600	
Dry silver	1,665	12	109,594	45,500	54,449	
Copper	10,632	2,573	9,689,954	3,185,026	319,127	
Lead	127,899	4,353	4,318,605	739,749	161,684,230	
Lead-copper	2,606	193	1,158,489	328,500	613,848	
Zinc	97,825	918	368,401	317,604	5,029,150	95,019,886
Iron (from zinc-lead ore)	992	1,822	17,279	44,700	15,200	
	246,821	33,159	15,895,169	4,676,079	167,781,272	95,019,886

Gross metal content of Idaho crude ore shipped to smelters in 1939, by classes of ore

Class of ore	Ore	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold	2,492	3,520	23,757	4,420	31,511	
Dry and siliceous gold-silver	42,322	10,417	588,031	16,721	3,672,795	
Dry and siliceous silver	4,725	116	229,557	45,696	193,426	
Copper	1,416	600	44,278	234,644	25,377	
Lead	16,312	614	412,057	94,784	11,320,009	
Zinc	144	6	1,754	1,888	4,816	89,378
	67,411	15,273	1,299,434	398,153	15,247,934	89,378
Total, 1938	33,169	7,090	868,364	235,862	14,188,397	

Mine production of metals from Idaho crude ore shipped to smelters in 1939, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Adams	31	12	198	14,154		
Blaine	43,261	10,121	613,090	21,774	3,364,482	8,153
Boise	593	950	29,302	2,155	19,970	
Bonner	397	34	25,960	4,841	196,658	27,596
Boundary	67	51	718	700	26,516	
Butte	73	7	1,211	1,904	234	
Camas	472	261	4,459	1,029	14,233	
Cassia	13	2	106	260	8,085	
Clark	15		31		5,915	
Custer	2,851	1,785	96,463	203,682	418,394	
Elmore	278	448	3,052			
Gem	64	38	1,126	238	1,219	
Idaho	128	203	588	44	77	
Lemhi	2,227	417	26,245	25,446	1,361,988	
Owyhee	564	535	33,526		21	
Shoshone	16,098	134	452,872	76,107	8,729,298	42,365
Valley	120	274	2,452	433	27,170	
Washington	159	1	8,035	3,154	6,468	
	67,411	15,273	1,299,434	355,921	14,180,728	78,114
Total, 1938	33,169	7,090	868,364	191,844	13,578,462	

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous gold	2,492	3,520	23,757	3,506	26,226	
Dry and siliceous gold-silver	42,322	10,417	588,031	13,298	3,099,929	
Dry and siliceous silver	4,725	116	229,557	36,910	175,887	
Copper	1,416	600	44,278	226,600	17,277	
Lead	16,312	614	412,057	74,159	10,856,966	
Zinc	144	6	1,754	1,448	4,443	78,114
	67,411	15,273	1,299,434	355,921	14,180,728	78,114

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1939, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Ada County:													
Black Hornet	2	----	28	27	----	27	3	----	3	----	----	----	$947
Boise	----	1	----	----	3	3	----	----	----	----	----	----	105
Highland (Boise River)	----	5	----	----	28	28	----	3	3	----	----	----	982
Snake River	----	2	----	----	563	563	----	31	31	----	----	----	19, 726
Adams County:													
Rock Flat	----	1	----	----	26	26	----	3	3	----	----	----	912
Seven Devils	2	----	401	507	----	507	358	----	358	14, 154	----	----	19, 460
Snake River	----	1	----	----	10	10	----	----	----	----	----	----	350
Benewah County: Tyson Creek	----	1	----	----	3	3	----	----	----	----	----	----	105
Blaine County:													
Little Wood River	1	----	12	----	----	----	137	----	137	19	2, 681	----	221
Mineral Hill and Camas	20	----	7, 258	933	----	933	9, 542	----	9, 542	1, 106	49, 851	8, 153	42. 014
Sawtooth	3	----	241	129	----	129	5, 037	----	5, 037	----	6, 681	----	8, 248
Warm Springs	6	2	107, 479	12, 474	3	12, 477	1, 197, 209	----	1, 197, 209	241, 673	11, 129, 447	14, 926, 520	2, 573, 743
Boise County:													
Banner	1	2	166	13	5	18	4, 147	----	4, 147	38	----	----	3, 449
Boise Basin	41	62	15, 444	2, 883	18, 680	21, 563	40, 064	4, 365	44, 429	2, 606	89, 575	----	789, 344
Eight Mile Creek	1	----	269	20	----	20	6	----	6	----	----	----	704
Garden Valley	----	2	----	----	10	10	----	----	----	----	----	----	350
Grimes Pass	3	----	866	195	----	195	274	----	274	----	298	----	7, 025
North Fork	2	----	10	----	----	----	800	----	800	77	148	----	558
Shaw Mountain	1	----	1	2	----	2	----	----	----	----	----	----	70
South Fork of Payette River	----	4	----	----	20	20	----	3	3	----	----	----	702
Summit Flat	4	----	543	145	----	145	78	----	78	----	----	----	5, 128
Bonner County:													
Lakeview	1	----	188	31	----	31	3, 048	----	3, 048	2, 346	21, 915	27, 596	5, 863
Pend d'Oreille	6	----	12, 198	7	----	7	66. 582	----	66, 582	3, 750	1, 184, 043	----	101, 480
Bonneville County: Mt. Pisgah	----	4	----	----	92	92	----	----	----	----	----	----	3, 220
Boundary County:													
Moyie Yahk	3	----	217	65	----	65	794	----	794	750	27, 766	----	4, 197
Port Hill	1	----	15, 630	2	----	2	67, 460	----	67, 460	17, 000	2, 221, 489	----	152, 039
Butte County:													
Antelope Creek	1	----	20	----	----	----	296	----	296	1, 904	43	----	401
Lava Creek	3	----	53	7	----	7	915	----	915	----	191	----	875

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1939, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Camas County:													
Beaver Creek	1		300	150		150	1,818		1,818		3,000		$6,625
Little Smoky and Carrietown	7	4	166	27	13	40	3,194	3	3,197	1,029	13,426	5,769	4,608
Skeleton Creek	4		43	111		111	50		50		149		3,926
South Fork of Boise River		1			3	3							105
Canyon County: Snake River		2			642	642		47	47				22,502
Cassia County: Stokes	1		13	2		2	106		106	260	8,085		549
Clark County: Birch Creek	1		15				31		31		5,915		299
Clearwater County:													
Burnt Creek		3			8	8							280
Clearwater River		3			18	18		3	3				632
Moose Creek and Independence Creek		8			24	24		3	3				842
North Fork of Clearwater River		3			12	12		3	3				422
Pierce	1	17	2,758	357	1,682	2,039	78	324	402				71,638
Custer County:													
Alder Creek	6		1,151	208		208	4,900		4,900	176,250	83,106		32,842
Bayhorse	9		39,488	32		32	168,882		168,882	33,288	1,997,788		213,113
Boulder	1		86	5		5	3,051		3,051		56,511		4,902
East Fork	2		3	9		9	134		134	19	1,553		481
Loon Creek		1			3	3							105
Rough Creek		1			21	21		3	3				737
Seafoam	3		226	54		54	8,085		8,085	289	29,021		8,772
Stanley and Stanley Basin		6			107	107		56	56				3,783
Yankee Fork	15	3	798	1,509	28	1,537	30,902	610	31,512	8,096	8,382		76,421
Elmore County:													
Bear Creek	10	4	941	198	13	211	103	3	106		42		7,459
Black Warrior	1		1	3		3							105
Boise River		4			150	150		50	50				5,284
Middle Boise	4	16	56,418	11,594	131	11,725	39,522	34	39,556	3,846			437,625
Neal	2	1	6	3	4	7							245
Pine Grove	2		11	5		5	3		3				177
Snake River		6			248	248		19	19				8,693
South Fork of Boise River		2			3	3							105
Gem County: West View	4	5	264	108	43	151	2,288	19	2,307	356	3,235		7,040
Gooding County: Snake River		3			19	19							665
Idaho County:													
American Creek		3			24	24		3	3				842
Burgdorf-Marshall Lake	6	9	16,392	10,266	494	10,760	45,923	84	46,007	3,404	6,064		408,468
Camp Howard		11			459	459		81	81				16,120
Clearwater River		1			14	14		3	3				492

Dixie	8	10	245	129	680	809	59	137	196				28,448
Elk City	16	15	1,727	295	2,365	2,660	984	405	1,389	77	553		94,077
Florence and French Creek	4	22	111	106	289	395	56	106	162				13,935
Kitchen Creek		1			14	14							490
Lolo Creek		2			4	4							140
Lower Salmon River		6			78	78		19	19				2,743
Maggie and Pete King Creeks	1	2	5	4	7	11	333		333				611
Newsome		3			5,099	5,099		1,052	1,052				179,179
Orogrande	5	5	821	86	1,527	1,613	131	308	439				56,753
Ramey Ridge	2		4,130	1,715		1,715	2,920		2,920	15,000	3,127		63,714
Riggins		3			1,000	1,000		224	224				35,152
Robbins	3		807	804		804	735		735	1,644	7,277		29,152
Salmon River (Shoup)		7			91	91		22	22				3,200
Selway River		2			11	11							385
Seven Devils		1			2	2							70
Simpson		9			90	90		3	3				3,152
Snake River		1			16	16							560
South Fork of Clearwater River		1			5	5							175
Ten Mile	6	8	7,507	1,671	52	1,723	1,108	6	1,114	144	958		61,121
Warren	14	12	595	341	8,293	8,634	934	2,805	3,739		127		304,734
Jerome County: Snake River		7			179	179		6	6				6,269
Latah County:													
Gold Creek		3			4	4							140
Hoodoo		1			3	3							105
Moscow Mountain		2			7	7							245
Lemhi County:													
Blackbird	2		164	87		87	47		47	14,432			4,578
Blue Wing	1		38,778	13		13	60,315		60,315	54,500	172,510		55,172
Boyle Creek and Carmen Creek	1		8,000	390		390	2,360		2,360	846	9,447		15,784
Eldorado	1	2	4	3	6	9	3		3	58			323
Eureka	6	4	277	66	37	103	59	19	78	1,414	702		3,838
Gibbonsville	8	8	118	101	614	715	62	34	96	346	234		25,137
Indian Creek	2		498	32		32	9		9				1,126
Junction	1		3				56		56		2,745		167
Kirtley Creek		4			118	118		9	9				4,136
McDevitt	1		15,500	838		838	3,297		3,297	280,000			60,688
Mackinaw	3	17	36	35	270	305	215	25	240	67	5,660		11,111
Mineral Hill	4	5	30,805	3,508	27	3,535	3,101		3,101	981	22,276		126,979
Pratt Creek and Sandy Creek	3		510	93		93	106		106	86	2,085		3,434
Rattlesnake	1		4				78		78	289	319		98
Salmon River		6			88	88		22	22				3,095
Spring Mountain	2		27				311		311	154	24,192		1,364
Texas	3		1,687	62		62	25,267		25,267	7,356	1,327,149		82,462
Yellow Jacket	5	2	1,095	502	17	519	442		442	2,298	596		18,732
Lewis County: Salmon River		3			31	31		3	3				1,087
Nez Perce County:													
Salmon River		2			10	10							350
Snake River		6			84	84		19	19				2,953

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1939, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Owyhee County:													
Carson	27	8	46,125	3,437	2,493	5,930	141,022	3,686	144,708	-------	-------	-------	$305,776
Castle Creek	6	-------	817	105	-------	105	27,275	-------	27,275	-------	21	-------	22,190
Snake River	-------	8	-------	-------	500	500	-------	28	28	-------	-------	-------	17,519
Steele	2	1	13	9	4	13	62	-------	62	-------	-------	-------	497
Power County: Snake River	-------	8	-------	-------	32	32	-------	-------	-------	-------	-------	-------	1,120
Shoshone County:													
Beaver	2	5	3,361	38	375	413	4,729	75	4,804	423	264,148	647,000	63,819
Coeur d'Alene	1	7	100	31	76	107	6	9	15	-------	-------	-------	3,755
Eagle	1	1	10,650	17	3	20	7,425	-------	7,425	8,346	1,875,490	232,346	106,838
Evolution	5	-------	391,422	492	-------	492	10,768,896	-------	10,768,896	3,189,683	845,660	-------	7,698,489
Hunter	6	-------	480,820	378	-------	378	1,270,226	-------	1,270,226	240,346	57,010,149	41,855,365	5,756,396
Lelande	5	-------	243,385	374	-------	374	1,058,687	-------	1,058,687	270,904	36,583,191	10,208,000	3,010,114
Placer Center	3	-------	17,291	41	-------	41	83,154	-------	83,154	28,057	2,213,596	1,268,693	230,808
St. Joe	-------	4	-------	-------	44	44	-------	-------	-------	-------	-------	-------	1,540
Summit	3	1	12,451	3,211	80	3,291	2,531	19	2,550	5,154	75,447	22,693	122,178
Yreka	8	-------	451,588	768	-------	768	2,009,177	-------	2,009,177	393,202	64,530,298	25,895,865	5,811,087
Twin Falls County: Snake River	-------	11	-------	-------	132	132	-------	3	3	-------	-------	-------	4,622
Valley County:													
Big Creek	2	5	17	106	26	132	498	3	501	173	6,362	-------	5,277
Deadwood Basin	1	3	500	44	4	48	165	-------	165	-------	-------	-------	1,792
Lake City	-------	2	-------	-------	19	19	-------	3	3	-------	-------	-------	667
Middle Fork of Salmon River	-------	2	-------	-------	3	3	-------	-------	-------	-------	-------	-------	105
Pistol Creek	1	-------	103	170	-------	170	1,927	-------	1,927	260	20,617	-------	8,254
Silver Creek	1	-------	1	-------	-------	-------	28	-------	28	-------	191	-------	28
South Fork of Salmon River	-------	6	-------	-------	67	67	-------	19	19	-------	-------	-------	2,358
Thunder Mountain	-------	3	-------	-------	48	48	-------	50	50	-------	-------	-------	1,714
Yellow Pine	1	-------	56,074	5,810	-------	5,810	14,844	-------	14,844	346	-------	-------	213,462
Washington County:													
Monroe Creek (Weiser)	1	-------	10	5	-------	5	-------	-------	-------	-------	-------	-------	175
Snake River	-------	4	-------	-------	33	33	-------	3	3	-------	-------	-------	1,157
Washington	1	-------	159	1	-------	1	8,035	-------	8,035	3,154	6,468	-------	6,121
Total Idaho	362	465	2,108,445	67,999	48,663	116,662	17,207,495	14,875	17,222,370	5,032,000	181,962,000	95,098,000	29,794,144

ADA COUNTY

Black Hornet district.—Virtually all the output from the Black Hornet district in 1939 was gold ore from the Adelmann mine treated by amalgamation.

Highland (Boise River) district.—The entire output of the Highland district in 1939 was recovered by sluicing, chiefly at the Pick & Shovel, Pinto, Sheep Gulch, and Stout placers.

Snake River district.—Dry-land washers were operated in 1939 at the Osborn and Hot Shot properties near Grand View on the Snake River. The Gold Flour Mining Co. operated the Osborn claim, by far the largest producer.

ADAMS COUNTY

Rock Flat (Thorn Creek) district.—Placer gold and silver were recovered in 1939 by hydraulicking at the Victory placer on Thorn Creek.

Seven Devils district.—The metal output of the Seven Devils district in 1939 came from 372 tons of gold ore from the Placer Basin mine and 29 tons of copper ore from the Helena claim.

Snake River district.—Placer gold was recovered in 1939 by sluicing at various bars along the Snake River in Adams County.

BENEWAH COUNTY

The entire output of Benewah County in 1939 was placer gold recovered from stream gravel from Tyson Creek.

BLAINE COUNTY

Little Wood River district.—A small lot of silver-lead ore was shipped from the Idaho Muldoon dump in 1939.

Mineral Hill and Camas district.—The value of the metal output from the Mineral Hill and Camas district in 1939 was nearly double that in 1938, owing to increased output of gold recovered from old tailings at the Daisy dump, from which 6,600 tons of old tailings were treated in a 100-ton cyanide plant by the Gold Recovery Co. The rest of the district output comprised gold ore from the Bellevue, Champlain, Gold Bottom, Happy Day, Jumbo, Golden Arrow, Treasure Vault, and Walla Walla properties; lead ore from the Eureka and Clearwater & Wolverine properties; silver ore from the Liberty, Bullion-Ophir, and Kelley mines; and zinc ore from the Red Elephant mine.

Sawtooth district.—The Vienna mine was the chief producer in the Sawtooth district in 1939; several cars of siliceous ore were shipped by a lessee to smelters in Utah.

Warm Springs district.—Nearly all the output from the Warm Springs district in 1939 was that from the Triumph-North Star-West Shore groups operated by Snyder Mines, Inc., which comprised about 65,000 tons of zinc-lead ore shipped to the flotation plant of the Combined Metals Reduction Co. at Bauer, Utah, and 41,461 tons of gold-silver ore and 682 tons of lead ore shipped to the smelter at Tooele, Utah. This company was the largest producer of gold in Idaho in 1939 and ranked third in output of zinc, fourth in silver, and fifth in lead. Other producers in the Warm Springs district included the Valley Creek No. 2, Mascot, and Homestake mines. A little placer gold was recovered from claims on Placer Creek.

BOISE COUNTY

Banner district.—A lessee shipped 166 tons of silver ore in 1939 from the Edna mine near Idaho City. Placer gold was recovered from stream gravel from Gold Fork and Edna Creeks.

Boise Basin district (Centerville, Placerville, Idaho City, Pioneerville, Quartzburg).—In 1939 the Boise Basin district again was the chief gold-producing area in Idaho, but its output was 21 percent less than in 1938. Nearly 87 percent of the gold was recovered from placer operations, mostly by bucket dredges. Four bucket dredges treated 4,346,382 cubic yards of gravel in 1939 and recovered 17,787 ounces of gold compared with 18,549 ounces in 1938. The Fisher-Baumhoff Co. continued to operate two bucket dredges (one 2½-cubic foot and one 6-cubic foot) near Centerville and was the largest producer of placer gold in Idaho. The Idaho-Canadian Dredging Co. (formerly the Moores Creek Dredging Co.) operated its 7½-cubic foot bucket dredge at Idaho City throughout the year. Considerable gold was also recovered by the 4-foot bucket dredge at Pioneerville operated by The Grimes Co. Other important sources of placer gold were the Gold Hill, Leary-Brogan, Lucky Boy, and Elk Creek properties. The Lord & Bishop Co., a large producer of placer gold in 1938, suspended operations on Fall Creek late in that year and moved its dragline equipment to a property in California. Most of the lode production of the district in 1939 was gold ore from the Mayflower mine; the Texas-Owyhee Mining & Development Co. operated the mine continuously and treated 12,818 tons of gold ore in the 150-ton flotation plant. Rich gold-silver ore from the Come Back property at Pioneerville was shipped to a smelter, and lessees treated by concentration several hundred tons of gold ore from the Gold Hill & Iowa dumps. Most of the remainder of the district lode output was gold ore from the Black Eagle, Illinois, Enterprise, Golden Age, Twin Sister, and Native Missourian properties.

Eight Mile Creek district.—The Birthday Consolidated Gold Mines, Inc., treated 264 tons of gold ore in 1939 in a small concentration plant built during the year and shipped 5 tons of high-grade gold ore to a smelter.

Garden Valley district.—The entire output of the Garden Valley district in 1939 was placer gold from the Wash Creek and Gold Dollar claims.

Grimes Pass district.—Gold ore from the Golden Eagle and Homestake properties was concentrated in 1939, and gold ore from the Grandview group was amalgamated and concentrated. The Grandview property was operated by the Buckhorn Mining Co. and was the chief producer.

North Fork district.—A little silver ore from the Packer John claim and from a prospect was shipped to a smelter in 1939.

South Fork of Payette River district.—Placer gold and silver were recovered by sluicing in 1939 at properties near Grimes Pass and Lowman.

Summit Flat district.—Gold ore from the Golden Cycle, Jessie, King, and Rock Creek properties was treated by amalgamation in 1939.

BONNER COUNTY

Lakeview district.—Several cars of silver-lead ore from the Keep Cool dump and a small lot of zinc concentrates from former milling operations were marketed in 1939.

Pend d'Oreille district.—The Hope (Elsie K.) and Whitedelf properties near Clark Fork again were the chief producers in the Pend d'Oreille district; several thousand tons of silver-lead ore from each property were treated by flotation in 1939. Rich silver ore from the Brown Bear, Katherine, and Keystone claims was shipped to a smelter.

BONNEVILLE COUNTY

Placer gold was recovered by hydraulicking in 1939 at the Rosana, James, Lottie, and McCoy Creek properties in the Mt. Pisgah district.

BOUNDARY COUNTY

Moyie Yahk district.—Gold ore from the Buckhorn mine was treated by concentration in 1939, and lead ore from the Regal and Midas properties was shipped to a smelter.

Port Hill district.—The Idaho-Continental mine, operated by the Idaho-Continental Mining Co., was the only producer in the Port Hill district in 1939; 15,630 tons of silver-lead ore were treated by flotation in 1939, compared with 4,000 tons in 1938.

BUTTE COUNTY

Antelope Creek district.—A little copper ore from the Copper Queen claim was shipped to a smelter in 1939.

Lava Creek district.—Virtually all the output from the Lava Creek district in 1939 was gold-silver ore from the Hornsilver mine near Arco, operated by the Era Mining & Development Co., Inc.

CAMAS COUNTY

Beaver Creek (Mineral Hill) district.—Lessees shipped several cars of gold ore from the Princess mine in 1939.

Little Smoky and Carrietown district.—The decrease in output of gold from the Little Smoky and Carrietown district in 1939 resulted from suspension of dredging operations by the Baumhoff-Fisher Co. Most of the district output was silver ore and lead ore from the Silver Star property and gold ore from the Five Points mine.

Skeleton Creek district.—Gold ore was produced at the El Oro, Red Horse, Gold Mountain, and Tip Top properties in 1939.

CANYON COUNTY

J. R. Rhodes operated a ⅜-cubic yard power shovel and stationary washer in 1939 from March 24 to October 12 at a placer on the Snake River near Wilder and treated 32,178 cubic yards of gravel.

CASSIA COUNTY

A little lead ore was produced at the Alice & Badger group in the Stokes district in 1939.

CLEARWATER COUNTY

Burnt Creek district.—A little placer gold was recovered in 1939 from stream gravel by small-scale operators near Elk River.

Clearwater River district.—Various placer operators on the Clearwater River near Orofino and Greer recovered small lots of gold and silver in 1939.

Moose Creek and Independence Creek district.—The entire output of the district in 1939 was placer gold and silver recovered chiefly from the Lilly, Simplex, First Chance, and White Diamond claims.

North Fork of Clearwater River district.—Small-scale operators recovered a little placer gold and silver from stream gravel near Dent in 1939.

Pierce district.—The output of gold in the Pierce district in 1939 was more than double that in 1938 owing to operation of a new 2½-cubic foot bucket dredge by the Quartz Creek Dredging Co. The dredge was active from July 8 to the end of the year and handled 495,639 cubic yards of gravel. The Dividend Placer Mining Co. placed a 1½-cubic yard dragline and floating washer on the American property, but operations were suspended after a short run. Small-scale placering was continued on various creeks. The Silver Creek Gold Mining Co. was the only lode operator in the district; 2,758 tons of gold ore were treated by cyanidation.

CUSTER COUNTY

Alder Creek district.—Most of the increase in the value of the metal output of the Alder Creek district in 1939 was due to reopening of the Empire property by the Mackay Exploration Co.; 996 tons of copper ore were shipped. The remainder of the district output was principally silver-lead ore from the Bluebird, Horseshoe, and White Knob properties.

Bayhorse district.—The Clayton Silver Mines was in 1939, as usual, the chief producer in the Bayhorse district. The company operated its mine and 100-ton flotation plant throughout the year and shipped rich silver-lead concentrates to a smelter in Utah; 38,900 tons of silver-lead ore were milled, about the same quantity as in 1938. The rest of the district output was chiefly copper ore and lead ore containing considerable silver from the Ramshorn mine operated by lessees.

Boulder district.—Several cars of silver-lead ore were shipped from the Livingston mine in 1939.

East Fork (Washington Basin) district.—A little gold ore from the Dewey claim and a small lot of silver-lead ore from the Fuller prospect were marketed in 1939.

Rough Creek district.—Placer gold and silver were recovered in 1939 by sluicing operations at the Grubstake claim near Stanley.

Seafoam district.—The metal output of the Seafoam district in 1939 came from siliceous ore from the Greyhound mine and silver-lead ore from the Mountain King and Josephus Lake properties.

Stanley and Stanley Basin district.—A ¾-cubic yard dry-land excavator was operated a short time in 1939 at Stanley Creek Placers by the Stanley Basin Placer Mining Corporation; equipment for recovering the gold includes a vibrating screen, riffles, and special amalgamators. Other placer producers were the Lucky Strike, Golden Rule & Hot Stuff, Progressive, Bessie, and Nip & Tuck claims.

Yankee Fork district.—The chief output from mines in the Yankee Fork district in 1939 was rich gold ore from the General Custer-Lucky Boy group and copper ore rich in gold and silver from the Why Not mine. Other lode producers included the Jordan, Peak, Yankee Fork, Fourth of July, Snowdrift, P. & G. No. 2, and Fuller properties. Most of the placer output came from the Horse Trail property.

ELMORE COUNTY

Bear Creek district.—The Avalanch-Richmond, Passover, and Empire lode properties were the chief producers in the Bear Creek district in 1939; most of the output was gold ore amalgamated and concentrated. Other producers of gold ore included the Vishnue, Daly, and Black Ribbon mines. A little placer gold and silver was produced from various claims near Rocky Bar.

Boise River district.—Most of the placer output from the Boise River district in 1939 came from the Five Bars and Sunflower properties near Twin Springs.

Middle Boise (Atlanta) district.—The increase of $206,186 in value of metal output in the Middle Boise district in 1939 resulted from the large gain in output of gold ore from the Boise-Rochester property. Talache Mines, Inc., operated the property throughout the year and treated 41,634 tons of gold ore and 6,000 tons of old tailings in a 150-ton amalgamation and flotation plant. The Last Chance Mining Co., operating Atlanta Mines (Monarch), continued to be a large producer of gold ore; about 8,500 tons of ore were treated by amalgamation and concentration, and 273 tons of rich gold ore were shipped to a smelter. The property was acquired by Talache Mines, Inc., in November. The remainder of the district output was nearly all placer gold recovered chiefly from the Boise Bar, Buck Creek, McKibbin, Honey Bee, and Rex properties.

Neal district.—Small amounts of placer and lode gold were produced from various properties in the Neal district in 1939.

Pine Grove district.—Small lots of gold ore were produced in 1939 at the Elk Horn and Owens claims at Pine.

Snake River district.—Stationary washers were operated for a short time in 1939 at the Mathis placer property near Bruneau and at the Rose claim near King Hill; nearly all the gold output from the district was recovered from these two properties.

GEM COUNTY

West View district.—The total value of the metal output of the West View district declined from $144,736 in 1938 to $7,040 in 1939, owing to suspension late in 1938 of dragline operations at the Gatfield & Montour property by Ralph Davis, Inc.; a little gold was recovered by hydraulicking at the property in 1939. Most of the output of the district was siliceous ore from the Lulu mine near Pearl.

GOODING COUNTY

Most of the placer output from properties on the Snake River near Hagerman in 1939 came from the Lucky Strike and Padgett claims.

IDAHO COUNTY

American Creek (Bully, Mill, and Castle Creeks) district.—Small amounts of placer gold and silver were recovered in 1939 by sluicing operations at the Holmes, Golden Eagle, and John's Creek properties.

Burgdorf-Marshall Lake district.—There was a large increase in output of gold and silver in the Burgdorf-Marshall Lake district in 1939 owing to a gain in output of gold ore from the Golden Anchor mine; the property was operated throughout the year by the Golden Anchor Mining Co., and 16,301 tons of gold ore were treated in the 50-ton amalgamation and concentration mill. The rest of the district output was chiefly placer gold recovered by hydraulic and sluicing operations at the Golden Rule and Laughing Water properties and gold ore from the Leadville and Old Kentuck mines.

Camp Howard (Salmon River) district (White Bird).—Green & Kuney operated a power shovel and stationary washer at the Large Bar in 1939 from January 15 to April 10, when work was suspended, and was by far the most important producer in the Camp Howard district. Other placer producers included the Rosebud, Burgund, White Bird, and Snure properties.

Clearwater River district.—Small amounts of placer gold and silver were recovered in 1939 by sluicing operations at the Lindgren claim near Pardee.

Dixie district.—The output of gold in the Dixie district increased 325 ounces in 1939, owing to the gain at the Dixie and Alpha properties. About 65,000 cubic yards of gravel were handled by the ¾-cubic yard dragline and stationary washer at Dixie Placers, and it was by far the most important producer in the district. The rest of the district output was principally gold ore from the Ontario mine and placer gold from the Capitol claim.

Elk City district.—The 1½-cubic yard dragline and floating washer of the American River Mining Co. handled 246,500 cubic yards of gravel in 1939 and accounted for most of the gain in the Elk City district; other placer producers included the Lucky Coin (power shovel and dry-land dredge), Little Million (power shovel and stationary washer), Columbus, and Gold Hill properties. The lode output of the district was chiefly gold ore from the Blue Ribbon, Mary K., Black Lady, Buster, Stickner Quartz, and Last Chance mines.

Florence and French Creek district.—Most of the placer gold produced in 1939 was recovered by the dragline and floating washer at the Sterling property on Sand Creek and by sluicing operations at various claims on Salmon River near French Creek. The chief producers of lode gold were the Gold Bug, Golden Dyke, and Waverly mines.

Kitchen Creek district.—A little placer gold was recovered in 1939 by sluicing operations at the Kitchen Creek claim.

Lolo Creek district.—Small lots of placer gold were marketed in 1939 from the Alice and Lolo claims.

Lower Salmon River district.—Most of the output from placers along the Salmon River in 1939 came from drift mining and sluicing operations at the Frank Hatke, Grubstake, and Sunshine properties.

Maggie and Pete King Creeks district.—In 1939 a little gold-silver ore from the Selway mine was shipped to a smelter, and a little placer gold was produced from the Nugget and Sunnyside claims.

Newsome district.—The Newsome Creek Mining Co. continued dredging operations on Newsome Creek in 1939 and again was a large producer of gold. The company operated its 3-cubic yard dragline and floating washing plant from March 25 to December 31 and treated 841,901 cubic yards of gravel; at the end of the year the property was acquired by the Ferris Mining Co.

Orogrande district.—The Mount Vernon Mining Co. was the largest producer of gold in the Orogrande district in 1939; the company operated the 2-cubic foot bucket dredge on Crooked River from April 14 to November 22 and treated 218,335 cubic yards of gravel. The Orogrande-Frisco Gold Mines, Inc., largest producer of gold in the district in 1938, was idle in 1939. The lode output of the district was chiefly gold ore from the Penman mine treated by flotation.

Ramey Ridge district.—The Snowshoe property, by far the most important producer in the Ramey Ridge district, was operated throughout 1939 by the Pierce Metals Development Co., and 4,125 tons of gold ore were treated in a 25-ton concentration plant. In January a fire destroyed the compressor building and power plant, but the building was rebuilt and new equipment installed.

Riggins (Salmon River) district.—The Shorts Bar Mining Co. operated a 2½-cubic yard dragline and floating washing plant on property 3 miles above Riggins on the Salmon River in 1939 and treated 360,000 cubic yards of gravel from July 10 to December 23.

Robbins (Buffalo Hump) district.—Nearly all the output from the Robbins district in 1939 was gold ore from the St. Louis mine; a new 25-ton flotation plant, erected by a lessee, was operated a short time during the last quarter of the year.

Salmon River (Shoup) district.—Placer gold and silver were recovered in 1939 by drift mining and sluicing operations at claims along the Salmon River west of Shoup; most of the output came from the Paradise Bar, Leyrer, Rutherford, and Willoughby properties.

Selway River district.—A little placer gold was recovered in 1939 by sluicing operations at the Happy Day and Maytag claims.

Simpson (Salmon River) district (Lucile).—Various small-scale placer operators continued to work bars along the Salmon River near Lucile. The chief producers in 1939 were the Katie B., Butcher Bar, and Betty Jean properties.

Snake River district.—Gold was recovered by sluicing operations in 1939 at the Bonanza placer.

South Fork of Clearwater River district.—A little placer gold was recovered in 1939 from stream gravel near Stites.

Ten Mile district (Golden).—The output of gold from both lode and placer properties in the Ten Mile district decreased in 1939. The decline in output of gold ore from the Blackbird mine, operated by the Clearwater Mining Co., accounted for most of the loss at lode mines, and the drop in placer production was due to suspension in August 1938 of dragline dredging at the Lena B-Komo property. The Lone Pine mine continued to be the largest producer of gold in the district; about 6,150 tons of gold ore were treated by amalgamation and concentration. Other fairly large producers of gold ore were the Center Star, Blackbird, and Shamrock properties. Most of the placer gold produced in the district was recovered by hydraulic and sluicing operations at the Key claim.

Warren district.—Bucket dredging continued in 1939 to be the chief source of gold in the Warren district. The Warren Dredging Co. operated its 3½-cubic foot bucket dredge throughout the year and treated 1,134,000 cubic yards of gravel; it was the largest producer of placer gold in Idaho County. The Baumhoff-Fisher Co., also a large producer of placer gold, operated its 3½-cubic foot bucket dredge from March 21 to August 6 and treated 432,000 cubic yards of gravel; the dredge was moved late in the year and will operate in 1940 on Moose Creek near Salmon City in Lemhi County. Most of the remainder of the district output in 1939 was gold ore from the Rescue, Gold King, Little Giant (Unity), Harding, and Silver King properties and placer gold from the Poorman, Buck Diggins, and Smith Gulch claims.

JEROME COUNTY

In 1939, as usual, the entire metal output of Jerome County was placer gold and silver recovered by various sluicing operations along the banks of the Snake River near Jerome, Murtaugh, and Hansen.

LATAH COUNTY

Placer gold was recovered in 1939 from claims in the Gold Creek, Hoodoo, and Moscow Mountain districts.

LEMHI COUNTY

Blackbird district.—The output of the Blackbird district in 1939 comprised gold ore from the Meadow property and copper ore from the Uncle Sam mine.

Blue Wing district.—The Ima Mines Corporation in 1939 again was the only producer in the Blue Wing district. The company treated 38,778 tons of tungsten ore by flotation and magnetic separation; several hundred tons of silver-lead-copper concentrates were shipped to the smelter at Midvale, Utah, and tungsten concentrates were shipped to eastern markets.

Boyle and Carmen Creeks district.—The metal output from the Boyle and Carmen Creeks district rose in 1939 owing to increased output of low-grade gold ore from the Silver Star-Contact group by the Gibbonsville Mining & Exploration Co.

Eldorado district.—A small lot of gold ore was produced from the Gold Bond mine in 1939, and a little placer gold was recovered from a claim on Bohannon Creek.

Eureka district.—About 200 tons of gold ore from the Queen of the Hills mine were treated by amalgamation in 1939; other producers of gold ore included the Tendoy, Lynch, and Poorman's Luck properties. Most of the placer gold was recovered by sluicing operations at the Greenhorn claim.

Gibbonsville district.—The North Fork Placers, operating four hydraulic giants at the Sundown property, was the most important producer in the Gibbonsville district in 1939; about 520 ounces of gold were recovered from 100,000 cubic yards of gravel. Hydraulic giants were operated at the Sheep Creek property by the Golden Dawn Mining Co. The district output of lode gold was considerably less than in 1938; the chief producers were the Bingham, Cross, and Providencia properties.

Indian Creek district.—About 100 tons of gold ore were produced in 1939 from the old Kittie Burton & Ulysses property operated by the Good Hope Mining Co., Inc., and 400 tons of old tailings from the Kittie Burton dump were amalgamated by the Idaho Gold Recovery Corporation.

Kirtley Creek district.—Small-scale placer operations in 1939 were reported at several properties on Kirtley Creek.

McDevitt district.—In 1939, as in 1938, the entire output of the McDevitt district was gold ore from the Copper Queen mine near Tendoy. The Tendoy Copper Queen Syndicate operated the property throughout the year and treated about 15,500 tons of ore by amalgamation and concentration.

Mackinaw district.—Most of the metal output of the Mackinaw district in 1939 was placer gold recovered by hydraulicking and sluicing and by dragline dredging. The output from lode mines in the district comprised lead ore from the Ringbone Cayuse claim and gold ore from the Shoo Fly and P. M. & B. properties. The chief production from hydraulicking and sluicing came from the K. G. W., Mae Belle, Big Jureano, Last Chance, and Best Bet properties. Dragline excavators and dry-land dredges were operated at the Camp Creek and Richardson properties.

Mineral Hill district.—Production of gold from the Mineral Hill district in 1939 increased about 1,300 ounces over 1938, owing chiefly to the gain in output of gold ore from the Grunter and Gold Hill properties at Shoup. The Grunter mine, operated throughout the year by Gold Producers, Inc., was by far the largest gold producer in Lemhi County; 24,947 tons of gold ore were treated by concentration. A lessee treated about 5,500 tons of gold ore from the Gold Hill mine by amalgamation and concentration. Other producers of gold ore were the Monolith and Billy Boy properties. Most of the district output of placer gold was recovered from the Cove Creek and Rattlesnake claims.

Pratt and Sandy Creeks district.—Fire destroyed the milling plant of the Goldstone Mining Co. early in 1939, resulting in a substantial decrease in the gold output of the district; the company shipped only 5 tons of high-grade gold-lead concentrates. Other producers were the Sick Horse and Dictator claims.

Salmon River district.—Small-scale placer operations in 1939 were reported at several properties along the Salmon River from Shoup to the county line.

Spring Mountain district.—Lessees shipped a little silver-lead ore from the Red Warrior and South Gilmore properties in 1939.

Texas district.—The value of the metal output of the Texas district was $82,462 in 1939, a gain of $49,064 over 1938, caused by increased shipments of silver-lead ore from the Latest Out mine at Gilmore. A little silver-lead ore was shipped also from the Allie and Snow Slide properties.

Yellow Jacket district.—The Condor Gold Mining Co. operated the Yellow Jacket property near Forney and treated several hundred tons of gold ore in a flotation plant in 1939, an increase over 1938. Gold ore was produced also from the Bryan and Tin Cup claims and placer gold from the Yellow Jacket Placers.

LEWIS COUNTY

Several placer operators worked stream gravel along the Salmon River in Lewis County in 1939.

NEZ PERCE COUNTY

In 1939, as in 1938, the metal output of Nez Perce County was placer gold and silver recovered by small-scale placer operations along the Salmon and Snake Rivers.

OWYHEE COUNTY

Carson district (Silver City, De Lamar).—Production of gold from placer properties in the Carson district declined in 1939, but that from lode mines increased. The decrease in placer gold resulted from suspension in December 1938 of bucket dredging at De Lamar by Jordan Creek Placers, largest producer of gold in Owyhee County from 1936 to 1938. The gain in output of lode gold and silver resulted from the treatment of a large tonnage of old tailings (gold-silver) by the De Lamar Milling Corporation; about 45,200 tons were treated in a 200-ton flotation plant, and the company was the largest producer of gold and silver in Owyhee County. Several cars of rich gold ore were shipped from the Adelaide-Empire group by the Ymir Consolidated Mining Co., and gold-silver ore from the Addie mine was amalgamated and concentrated. Other producers of gold ore included the Pauper, South Central, Tango, Dewey, and Gold Bug mines. The De Lamar Placers operated its dragline and floating washer at property on Jordan Creek 6 months in 1939 and treated 250,000 cubic yards of gravel. The Morrison-Knudsen Co., Inc., a new operator in the district, worked the Lewis group near Silver City and treated 47,000 cubic yards of gravel with a power shovel and dry-land washer.

Castle Creek district.—Nearly all the output from the Castle Creek district in 1939 was rich silver ore from the Silver Rock mine and gold ore from the Overall-Lucky Boy group.

Snake River district.—Considerable placer gold was recovered in 1939 from gravel along the Snake River near Hammett and Grand View. Most of the output came from dry-land dredging at the Gray, Dollar, and Grand View (Murphy) properties by J. R. Rhodes and Grand View Mines.

Steele district.—Most of the output from the Steele district in 1939 was gold ore from the Morning Glory mine near Triangle.

POWER COUNTY

The metal output of Power County in 1939 was, as usual, placer gold from small operations along the Snake River near American Falls.

SHOSHONE COUNTY

COEUR D'ALENE REGION

The value of the metal output of the Coeur d'Alene region increased 2 percent in 1939, chiefly as a result of the gain in production of zinc. The output of silver dropped more than 2,100,000 ounces owing to marked decreases at the Sunshine and Polaris mines, and the output of lead also declined. Large decreases in output of lead at the Hecla and Bunker Hill & Sullivan properties more than offset a substantial increase at the Morning mine. However, the output of zinc from the region increased 25 percent owing to large gains at the Morning, Hecla, and Bunker Hill & Sullivan mines; the output of gold increased nearly 2,000 ounces owing to increased output of gold ore from the Golden Chest mine at Murray; and the output of copper also rose. About 70 percent of the material produced in Shoshone County in 1939 was zinc-lead ore, 26 percent silver ore, and 3 percent lead ore. There was a marked increase in output of zinc-lead ore but a decided decline in output of lead ore.

The following table gives production of gold, silver, copper, lead, and zinc in the Coeur d'Alene region in 1938 and 1939 and the total for 1884 to 1939.

Mine production of gold, silver, copper, lead, and zinc in the Coeur d'Alene region, Shoshone County, 1938–39, and total, 1884–1939, in terms of recovered metals

Year	Lode mines	Placers	Ore	Gold (lode and placer)	Silver (lode and placer)	Copper	Lead	Zinc	Total value
			Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1938	43	20	1, 514, 278	4, 053	17, 325, 379	3, 765, 795	164, 547, 979	63, 874, 125	$22, 346, 313
1939	34	18	1, 611, 068	5, 928	15, 204, 934	4, 136, 115	163, 397, 979	80, 129, 962	22, 805, 024
Total 1884–1939			(1)	372, 092	357, 271, 400	(2) 51, 609	(2) 4, 947, 851	(2) 676, 964	877, 368, 126

1 Figures not available. 2 Short tons.

Beaver district.—The Interstate Lease operated the Interstate-Callahan group in 1939 and shipped 3,200 tons of zinc-lead ore to the Golconda custom mill near Wallace. Most of the remainder of the Beaver district output was placer gold recovered chiefly from the Big 4 group by a dragline and dry-land dredge.

Coeur d'Alene district.—In 1939 a little gold ore from the Mountain Lion mine was treated by amalgamation; placer gold and silver were recovered from the Grove Walker, Old Dunn, Badger, Joe Gandy, Beehive Bar, Tiger Bar, and Nelson properties.

Eagle district.—Zinc-lead ore and lead ore from the Jack Waite mine continued in 1939 to be the chief output of the Eagle district. The American Smelting & Refining Co. worked the mine throughout the year, treated 10,352 tons of zinc-lead ore by flotation, and shipped 298 tons of high-grade lead ore to a smelter.

Evolution district.—The value of the metal production of the Evolution district was $7,698,489 in 1939, a decrease of $1,043,254 from 1938. The loss was caused by a substantial decline in output of silver from both the Sunshine and Polaris properties. However, the Sunshine Mining Co. remained the largest producer of silver in the United States; the company treated 320,990 tons of silver ore in its flotation plant compared with 321,605 tons in 1938, and the output of silver fell from 11,352,154 to 9,414,514 ounces. The Polaris Mining Co. operated its mine throughout the year, but production of silver ore dropped from 64,405 to 48,815 tons and that of silver from 1,583,721 to 1,085,023 ounces. The Coeur d'Alene Mines Corporation, operating the Mineral Point mine near Osburn, became a large producer of silver-copper ore in 1939; about 17,500 tons of ore were treated in the Hercules custom mill. The rest of the district output comprised

4,068 tons of silver ore from the Silver Dollar property and 47 tons of lead ore from the Western Union mine.

Hunter district (*Mullan*).—The value of the metal output of the Hunter district was $5,756,396 in 1939, a gain of $1,509,747 over 1938, due to a substantial increase in output of zinc-lead ore from the Morning mine and to resumption of operations in September at the Star mine, a large producer of zinc and lead. The Morning mine was operated continuously by the Federal Mining & Smelting Co.; 363,122 tons of zinc-lead ore were treated by flotation (compared with 262,329 tons in 1938), 601 tons of first-class silver-lead ore were smelted, and about 14,000 tons of old tailings (zinc-lead) were shipped by lessees to the Golconda custom mill. The property was the largest producer of lead and zinc in the State. The Sullivan Mining Co. operated its 800-ton flotation mill the last quarter of the year and treated 48,860 tons of zinc-lead ore from the Star mine. Lessees continued to operate the Gold Hunter and Golconda properties; 34,500 tons of silver-lead ore from the Gold Hunter and 5,471 tons of zinc-lead-silver ore from the Golconda were concentrated. Nearly all the rest of the district output was old tailings (zinc-lead) treated in the Golconda custom mill.

Lelande district (*Burke, Mace, Frisco*).—The Hecla mine, by far the most important producer in the Lelande district, was operated continuously in 1939 by the Hecla Mining Co.; 200,175 tons of zinc-lead ore were treated in the company flotation plant, and 9,066 tons of first-class silver-lead ore were shipped to a smelter. The Hull Leasing Co. continued to work the Frisco property and treated 23,708 tons of zinc-lead ore in its 100-ton flotation plant. The rest of the district output comprised 3,996 tons of silver-lead ore from the Sherman mine, 1,100 tons of zinc-lead ore from the Mace mine, and 5,340 tons of old tailings (zinc-lead) from deposits along Canyon Creek.

Placer Center district.—The value of the metal output of the Placer Center district increased 26 percent in 1939 owing to steady operations at the Tamarack and Dayrock properties. The Tamarack & Custer Consolidated Mining Co. worked the Tamarack mine throughout the year and shipped 10,974 tons of zinc-lead ore to the Hercules custom mill at Wallace. The company began to construct a 300-ton flotation plant at the mine in October. The Dayrock mine was operated continuously by the Dayrock Mining Co., and 6,208 tons of silver-lead ore were shipped to the Hercules mill. Most of the remainder of the district output was zinc-lead ore from the Success mine.

St. Joe district.—Placer gold was recovered in 1939 from the Gold Producer, Haystack, Grizzly-Cooley, and Iron Hill properties.

Summit district (*Murray*).—Production of gold from the Summit district increased to 3,291 ounces in 1939, owing to the large gain in output of gold ore from the Golden Chest mine operated by Consolidated Gold Mines, Inc.; 12,190 tons of ore were treated by flotation. The rest of the district output was principally zinc-lead ore from the Anchor group and placer gold and silver recovered by various operators working property owned by the Coeur d'Alene Placer Mining Co.

Yreka district (*Kellogg*).—The value of the metal output of the Yreka district was $5,811,087 in 1939, a gain of 3 percent over 1938. As usual, zinc-lead ore from the Bunker Hill & Sullivan property was the most important product in the district; 343,019 tons were concentrated in 1939 compared with 347,315 tons in 1938. The property ranked second in output of silver, lead, and zinc in Idaho in 1939. The Bunker Hill & Sullivan Mining & Concentrating Co. continued operations at the Crescent group, treated 16,503 tons of silver ore by flotation, and shipped 2,740 tons of rich silver ore to a smelter; the total output of ore was much less than in 1938. The Page and Blackhawk properties were operated continuously by the Federal Mining & Smelting Co., and 71,852 tons of zinc-lead ore from the Page and 15,950 tons of similar ore from the Blackhawk were treated in the Page flotation plant; the total output of ore from the two properties in 1938 was 82,895 tons. The rest of the district output in 1939 was chiefly silver ore and lead ore from the Caledonia mine.

TWIN FALLS COUNTY

In 1939, as in 1938, the output of Twin Falls County was placer gold and silver recovered by sluicing at various properties along the Snake River.

VALLEY COUNTY

Big Creek district.—A little lead ore containing considerable gold was produced in 1939 from the Sunday claim, and placer gold was marketed chiefly from the Smith Creek, Freezeout, and Blue Monday properties.

Deadwood Basin district.—Nearly all the output from the Deadwood Basin district in 1939 was old tailings (gold) from the Merry Blue property treated by cyanidation.

Lake City (McCall) district.—Placer gold and silver were recovered in 1939 by hydraulic and sluicing operations at the Neely Hill and New Deal Queen claims.

Pistol Creek district.—Operations continued at the Lucky Boy mine in 1939, and rich gold-lead ore was shipped to smelters in Utah.

South Fork of Salmon River district.—Several small-scale placer operators sluiced stream gravel in 1939 along the South Fork of Salmon River near Warren.

Thunder Mountain district.—Production from the Thunder Mountain district in 1939 was mostly gold recovered by the sluicing of eroded-vein material from the Sunnyside property, operated by lessees; the mine was formerly worked by the Thunder Mountain Mining & Milling Co., but operations by the company were suspended late in 1938.

Yellow Pine district.—The Yellow Pine mine was in 1939, as usual, the only producer in the Yellow Pine district. The Bradley Mining Co. operated the property continuously and treated 56,074 tons of antimony-gold ore by flotation, a substantial increase over the 35,880 tons treated in 1938; the concentrates, containing considerable antimony, were shipped to the smelter at Midvale, Utah.

WASHINGTON COUNTY

Monroe Creek (Weiser) district.—A little gold ore was produced in 1939 from the Blue Dog claim.

Snake River district.—Placering in 1939 was reported at several properties along the Snake River in Washington County.

Washington district.—Operations continued at the Silver Still mine near Mineral in 1939, and several cars of silver ore containing lead and copper were shipped to smelters in Utah.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN MONTANA

(MINE REPORT)

By T. H. Miller and Paul Luff

SUMMARY OUTLINE

The total value of the output of recoverable metals in Montana in 1939 increased $12,841,124, or 46 percent, over 1938. Substantial gains were recorded in both quantity and value of each of the five metals; the value of copper increased $5,214,268, zinc $2,770,072, gold $2,130,100, silver $2,028,598, and lead $698,086. The gain of $9,376,536 in Silver Bow County (from $18,300,823 in 1938 to $27,677,359 in 1939) represented 73 percent of the total State gain and was made possible by reopening of the zinc mines and increased output from the copper mines of the Anaconda Copper Mining Co. at Butte. There were important increases in output of siliceous ores, chiefly gold ore, from several counties. The gain from placer mines was notable.

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, 1935–39

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1935	$35.00	$0.71875	$0.083	$0.040	$0.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052

[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] 1935–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–39: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787.

Mine production of gold, silver, copper, lead, and zinc in Montana, 1935–39, and total, 1862–1939, 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
1935	681	551	2,412,113	151,088.03	$5,288,081	9,322,951	$6,700,871
1936	570	284	3,853,116	180,209.20	6,307,322	11,600,563	8,984,636
1937	615	406	4,898,009	202,252.00	7,078,820	11,812,093	9,136,654
1938	482	265	2,724,466	203,313.00	7,115,955	6,403,962	4,139,935
1939	594	282	3,792,780	264,173.00	9,246,055	9,087,571	6,168,533
1862–1939			(1)	16,161,441.00	350,103,647	688,454,935	503,598,112

Year	Copper: Pounds	Copper: Value	Lead: Pounds	Lead: Value	Zinc: Pounds	Zinc: Value	Total value
1935	154,957,470	$12,861,470	31,177,525	$1,247,101	109,561,477	$4,820,705	$30,918,228
1936	219,088,000	20,156,096	38,118,000	1,753,428	99,434,000	4,971,700	42,173,182
1937	289,056,000	34,975,776	35,914,000	2,118,926	78,336,000	5,091,840	58,402,016
1938	154,426,000	15,133,748	18,654,000	858,084	17,688,000	849,024	28,096,746
1939	195,654,000	20,348,016	33,110,000	1,556,170	69,598,000	3,619,096	40,937,870
1862–1939	(2) 5,783,030	1,699,118,600	(2) 582,947	61,780,542	(2) 1,586,370	239,058,968	2,853,659,869

(1) Figures not available. (2) Short tons.

Gold and silver produced at placer mines in Montana, 1935–39, in fine ounces, in terms of recovered metals

Year	Sluicing, hydraulic, and drift: Gold	Sluicing, hydraulic, and drift: Silver	Dragline and dry-land dredges (1): Gold	Dragline and dry-land dredges (1): Silver	Floating (bucket) dredges: Gold	Floating (bucket) dredges: Silver	Total: Gold	Total: Silver
1935	4,586.48	647	9,031.88	1,554	12,680.87	1,294	26,299.23	3,495
1936	2,803.02	338	18,312.43	3,393	19,300.35	1,923	40,415.80	5,654
1937	2,989.00	369	15,844.00	4,249	17,564.00	1,797	36,397.00	6,415
1938	3,896.00	351	10,096.00	2,943	21,356.00	3,240	35,348.00	6,534
1939	2,283.00	252	18,901.00	4,659	33,815.00	6,723	54,999.00	11,634

(1) A floating washing plant supplied with gravel by a dragline excavator is called a "dragline dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."

Gold.—The output of gold in Montana increased to 264,173 fine ounces in 1939—the largest output since 1887, when 289,212 ounces were produced. Gold from lode mines increased 41,209 ounces and that from placers 19,651 ounces. Gold from Jefferson County increased 11,804 ounces, from Madison County 11,505 ounces, and from Lewis and Clark County 10,997 ounces; substantial gains were recorded also in Broadwater, Deer Lodge, Granite, and Silver Bow Counties. Most of the gain from placer mines came from the new bucket dredges of the Winston Bros. Co. and the Perry-Schroeder Mining Co., which were placed in operation late in 1938. Large gains in output of gold were reported at the Southern Cross, Victoria, Ohio Keating, and Golden Sunlight mines and at the Butte properties of the Anaconda Copper Mining Co. Siliceous ores yielded 72 percent of the State total gold in 1939 and placers 21 percent. Ore treated at amalgamation and cyanidation mills yielded 31 percent of the gold, crude ore shipped direct to smelters 33 percent, and ores treated at concentration mills 15 percent. The output of gold ore increased to 815,949 tons in 1939 (compared with 756,223 tons in 1938); it comprised 82,359 tons treated at amalgamation plants, 490,429 tons treated at cyanidation plants, 148,138 tons treated at concentration plants, and 95,023 tons shipped crude to smelters.

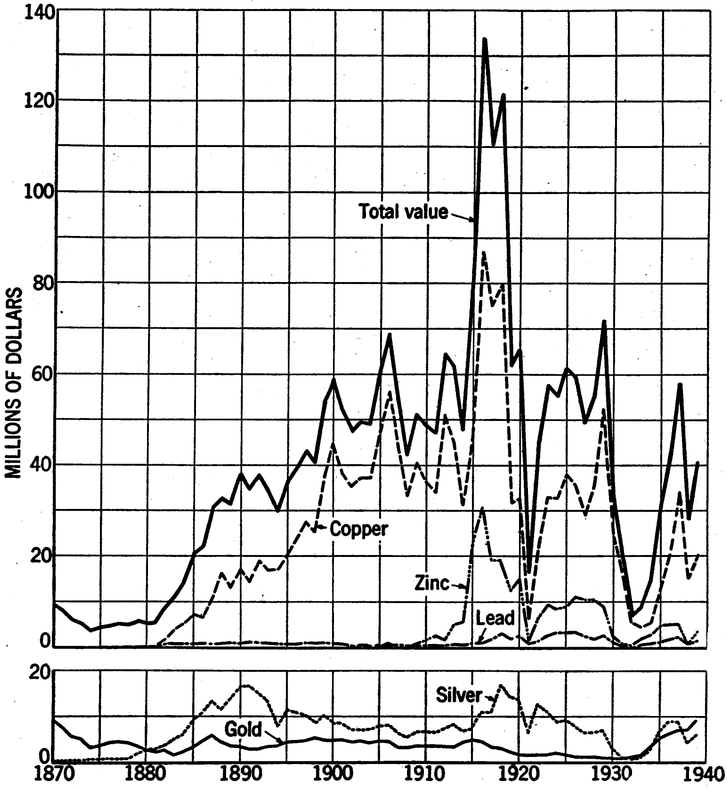

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value in Montana, 1870–1939.

The West Mayflower property (Madison County) of the Anaconda Copper Mining Co. in 1939 again was the largest gold producer in Montana; it was followed by the Winston dredge near Clancey, the Ruby Gulch mine at Zortman, the Victoria mine at Silver Star, the Butte Highlands mine in Silver Bow County, the Butte properties of the Anaconda Copper Mining Co., the Porter dredge at Helena, the Jardine mine in Park County, the Golden Messenger mine in Lewis and Clark County, and the Southern Cross mine in Deer Lodge County. These 10 properties yielded 105,665 ounces of gold in 1939.

Silver.—The output of recoverable silver in Montana was 9,087,571 fine ounces in 1939 compared with 6,403,962 ounces in 1938 and 11,812,093 ounces in 1937. Most of the gain in 1939 was in Silver Bow County (6,114,455 ounces produced in 1939 compared with 4,018,192 ounces in 1938) and was due to reopening of the zinc mines and to increased output from the copper mines of the Anaconda Copper Mining Co. The production of silver from Jefferson, Cascade, and Granite Counties also increased substantially. Copper ore yielded 52 percent of the State total silver in 1939, zinc-lead ore 20 percent, and silver ore 18 percent. Nearly 79 percent of the silver came from ores treated by concentration and 19 percent from ore sent direct to smelters. Silver from zinc-lead ore increased 1,331,843 ounces and that from copper ore 838,344 ounces. The output of silver ore increased 26,962 tons and that of gold-silver ore 48,172 tons.

The Anaconda Copper Mining Co. was in 1939, as usual, the chief silver producer in Montana—the copper and zinc units at Butte and the Flathead mine yielding nearly 70 percent of the State total. Other important silver producers included the Comet mine near Basin, the Granite Bimetallic and Silver Prince mines near Philipsburg, the Big Seven and Florence mines at Neihart, the Hecla mine in Beaverhead County, and the West Mayflower mine in Madison County.

Copper.—Copper ore, the most valuable mineral product of Montana, yielded recoverable gold, silver, and copper valued in all at $23,621,484 in 1939, or 58 percent of the total value of the metal output of the State. The Anaconda Copper Mining Co. was, as usual, the only important producer of copper in Montana; the output of recoverable copper from company mines at Butte increased 27 percent over 1938, owing to increased rate of operations during the last 4 months of 1939, but it was considerably less than the output in 1937. The company shipped 2,197,863 tons of copper ore to the mill at Anaconda compared with 1,561,186 tons in 1938 and 3,068,665 tons in 1937.

Lead and zinc.—The Anaconda Copper Mining Co. resumed production of zinc-lead ore from the zinc mines at Butte in March 1939, after a shut-down of more than a year; zinc shipments were resumed in December at the Emma mine, leased by the company. As a result, the output of zinc-lead ore in Montana increased to 320,248 tons in 1939 from 114,769 tons in 1938, with proportionate increases in production of all five metals. There was a decrease in zinc-lead ore from the Jack Waite mine, but an increase from the Comet mine. Zinc-lead ore from Granite County increased slightly but was much less than in 1937, as no zinc-lead ore was produced at the Trout property. Concentrates smelted yielded 60 percent of the State total lead and 64 percent of the zinc in 1939, crude ore smelted yielded 32 percent of the lead, and slag fumed yielded nearly 8 percent of the lead and 36 percent of the zinc. There was an increase in lead from crude ore smelted, chiefly from the Flathead mine in Flathead County and the Glendennin property in Judith Basin County.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Montana in 1939, 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	40	11	11,570	$404,950	181,718	$123,348
Broadwater	48	28	19,901	696,535	31,179	21,164
Carbon		1	1	35		
Cascade	11		2,078	72,730	438,374	297,563
Deer Lodge	13	5	9,866	345,310	11,251	7,637
Fergus	8	3	3,185	111,475	3,465	2,352
Flathead	3		614	21,490	473,846	321,641
Gallatin	2	1	6	210	9	6
Granite	50	17	14,283	499,905	693,028	470,419
Jefferson	96	18	30,984	1,084,440	553,192	375,500
Judith Basin	3		109	3,815	38,529	26,153
Lewis and Clark	62	41	45,854	1,604,890	122,265	82,992
Lincoln	5	9	1,944	68,040	11,024	7,483
Madison	153	24	61,875	2,165,625	231,308	157,009
Meagher	2	16	395	13,825	112	76
Mineral	4	20	1,072	37,520	56	38
Missoula	12	22	2,258	79,030	2,805	1,904
Park	5	5	8,627	301,945	7,375	5,006
Phillips	2	3	18,196	636,860	74,443	50,531
Powell	24	28	8,895	311,325	68,475	46,480
Ravalli	5	3	171	5,985	3,306	2,244
Sanders	8	2	155	5,425	27,219	18,476
Silver Bow	37	20	22,036	771,260	6,114,455	4,150,418
Sweet Grass	1		29	1,015	134	91
Toole		5	69	2,415	3	2
	594	282	264,173	9,246,055	9,087,571	6,168,533
Total, 1938	482	265	203,313	7,115,955	6,403,962	4,139,935

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaverhead	199,394	$20,737	763,064	$35,864			$584,899
Broadwater	22,731	2,364	422,319	19,849			739,912
Carbon							35
Cascade	9,250	962	586,425	27,562	10,000	$520	399,337
Deer Lodge							352,947
Fergus	38	4	383	18			113,849
Flathead	3,404	354	5,533,553	260,077			603,562
Gallatin	58	6	5,830	274			496
Granite	134,981	14,038	445,192	20,924	1,326,404	68,973	1,074,259
Jefferson	391,721	40,739	4,003,787	188,178	2,142,308	111,400	1,800,257
Judith Basin	11,231	1,168	1,566,745	73,637	22,000	1,144	105,917
Lewis and Clark	39,173	4,074	3,324,531	156,253	25,278,000	1,314,456	3,162,665
Lincoln	4,798	499	83,809	3,939			79,961
Madison	91,606	9,527	211,383	9,935			2,342,096
Meagher	1,500	156	1,532	72			14,129
Mineral							37,558
Missoula	17,461	1,816	8,639	406			83,156
Park	58	6	30,318	1,425			308,382
Phillips	1,760	183					687,574
Powell	3,875	403	127,000	5,969			364,177
Ravalli	2,308	240	21,234	998			9,467
Sanders	184,182	19,155	6,558,915	308,269	787,000	40,924	392,249
Silver Bow	194,533,471	20,231,481	9,415,341	442,521	40,032,288	2,081,679	27,677,359
Sweet Grass	1,000	104					1,210
Toole							2,417
	195,654,000	20,348,016	33,110,000	1,556,170	69,598,000	3,619,096	40,937,870
Total, 1938	154,426,000	15,133,748	18,654,000	858,084	17,688,000	849,024	28,096,746

Gold and silver produced at lode mines in Montana in 1939, by counties, in terms of recovered metals

County	Ore sold or treated	Gold	Silver	County	Ore sold or treated	Gold	Silver
	Short tons	*Fine ounces*	*Fine ounces*		*Short tons*	*Fine ounces*	*Fine ounces*
Beaverhead	57,246	9,497	181,553	Meagher	10		31
Broadwater	70,329	17,333	30,718	Mineral	204	25	3
Cascade	44,432	2,078	438,374	Missoula	1,600	602	2,671
Deer Lodge	29,825	9,842	11,251	Park	52,919	8,416	7,347
Fergus	51,695	3,168	3,465	Phillips	129,785	18,179	74,443
Flathead	26,860	614	473,846	Powell	13,319	4,393	67,974
Gallatin	26	1	9	Ravalli	234	63	3,303
Granite	123,405	13,281	692,941	Sanders	37,491	140	27,219
Jefferson	128,423	14,455	546,595	Silver Bow	2,498,922	21,912	6,114,433
Judith Basin	2,733	109	38,529	Sweet Grass	144	29	134
Lewis and Clark	327,990	25,676	119,684				
Lincoln	14,569	1,695	11,018		3,792,780	209,174	9,075,937
Madison	180,619	57,666	230,396	Total, 1938	2,724,466	167,965	6,397,428

Gold and silver produced at placer mines in Montana in 1939, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Drift mining		Dragline and dry-land dredges [1]		Floating (bucket) dredges		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Beaverhead	63	5	4		2,006	160			2,073	165
Broadwater	186	31	25	2	2,357	428			2,568	461
Carbon	1								1	
Deer Lodge	24								24	
Fergus	17								17	
Gallatin	5								5	
Granite	94	10	24		127	6	757	71	1,002	87
Jefferson	78	20			6,330	2,873	10,121	3,704	16,529	6,597
Lewis and Clark	290	60			4,682	881	15,206	1,640	20,178	2,581
Lincoln	93				156	6			249	6
Madison	169	19	80	17	10	2	3,950	874	4,209	912
Meagher	94	12	7		294	69			395	81
Mineral	243	6	23		781	47			1,047	53
Missoula	71		1		1,584	134			1,656	134
Park	211	28							211	28
Phillips	6				11				17	
Powell	259	17	5		457	50	3,781	434	4,502	501
Ravalli	2				106	3			108	3
Sanders	15								15	
Silver Bow	124	22							124	22
Toole	30	2	39	1					69	3
	2,075	232	208	20	18,901	4,659	33,815	6,723	54,999	11,634
Total, 1938	[2] 3,896	[2] 351	(2)	(2)	10,096	2,943	21,356	3,240	35,348	6,534

[1] A floating washing plant supplied with gravel by a dragline excavator is called a "dragline dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."
[2] Figures for sluicing and hydraulic include those for drift mining.

MINING INDUSTRY

Reopening of the zinc mines and increased output from the copper mines of the Anaconda Copper Mining Co. at Butte accounted for most of the gains in metal output in Montana in 1939; however, increases were reported in gold ore treated at amalgamation and cyanidation mills, and there was a marked increase in crude gold ore shipped direct to smelters.

Gold recovered at placer mines in Montana increased 19,651 fine ounces over 1938. Seven connected-bucket dredges were in operation during 1939 and handled 7,435,147 cubic yards of gravel yielding 33,815 ounces of gold and 6,723 ounces of silver; the recovered gold was valued at $1,183,525, indicating an average value of 15.9 cents to the cubic yard of gravel treated. Dragline or power-shovel excavators with dry-land or floating washing plants were reported in operation at 49 properties; the plants treated 4,377,813 cubic yards of gravel, which yielded 18,901 ounces of gold and 4,659 ounces of silver; the gold recovered was valued at $661,535, indicating an average value of 15.1 cents to the cubic yard.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Montana in 1939, with content in terms of recovered metals

Source	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold ore	379	815, 949	179, 610	448, 893	172, 622	848, 853	
Dry and siliceous gold-silver ore	36	55, 620	5, 491	287, 304	94, 266	142, 512	
Dry and siliceous silver ore	82	177, 892	5, 477	1, 606, 840	282, 386	1, 461, 541	
	[1] 495	1, 049, 461	190, 578	2, 343, 037	549, 274	2, 452, 906	
Copper ore	9	2, 253, 270	7, 636	4, 697, 920	[2] 193,897, 430		
Lead ore	91	23, 096	2, 296	214, 368	51, 271	9, 831, 863	
Zinc ore	3	[3] 146, 705	16	38, 482	5, 631	2, 518, 573	25, 399, 604
Zinc-lead ore	19	320, 248	8, 648	1, 782, 130	1, 150, 394	18, 306, 658	44, 198, 396
Total, lode mines	[1] 594	3, 792, 780	209, 174	9, 075, 937	[2] 195,654, 000	33, 110, 000	69, 598, 000
Total, placers	282		54, 999	11, 634			
	876	3, 792, 780	264, 173	9, 087, 571	[2] 195,654, 000	33, 110, 000	69, 598, 000
Total, 1938	747	2, 724, 466	203, 313	6, 403, 962	[4] 154,426, 000	18, 654, 000	17, 688, 000

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[2] Includes 4,004,361 pounds recovered from precipitates.
[3] Includes 145,638 tons of current slag fumed.
[4] Includes 5,563,800 pounds recovered from precipitates.

METALLURGIC INDUSTRY

Lode mines in Montana produced 3,792,780 tons of ore and old tailings in 1939 compared with 2,724,466 tons in 1938. The output in 1939 comprised 82,359 tons treated at amalgamation mills, 490,429 tons treated at cyanidation mills, 2,836,478 tons treated at concentration plants, 237,876 tons shipped crude to smelters, and 145,638 tons treated at a slag-fuming plant.

Two combined cyanidation and concentration mills and 19 straight cyanidation mills were operated in Montana in 1939; the ore and old tailings treated increased from 433,233 tons in 1938 to 490,429 tons in 1939. The material treated in 1939 contained 79,132 ounces of gold and 223,654 ounces of silver and the bullion and concentrates produced yielded 68,349 ounces of gold and 126,153 ounces of silver, indicating average recoveries of 86 percent of the gold and 56 percent of the silver. Fifteen of the mills, treating 464,412 tons of material, reported the consumption of 286,302 pounds of 91-percent sodium cyanide, 69,876 pounds of calcium cyanide, 80,560 pounds of zinc dust (including zinc shavings used at one plant), and 3,725,537 pounds of lime; in addition, two plants used 1,103 pounds of lead acetate and one plant used 5,270 pounds of manganese dioxide.

Ore treated at straight concentration plants increased from 1,976,828 tons in 1938 to 2,836,478 tons in 1939. The 1939 total comprised 148,138 tons of gold ore, 43,600 tons of gold-silver ore, 125,262 tons of silver ore, 2,197,863 tons of copper ore, 300 tons of lead ore, 1,067 tons of zinc ore, and 320,248 tons of zinc-lead ore.

Details of the treatment of all ores produced in Montana in 1939 are given in the tables that follow.

Mine production of metals in Montana in 1939, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore amalgamated	82,359	9,354	2,042			
Ore cyanided	490,429	68,278	126,015			
Concentrates smelted [1]	500,204	44,614	7,177,059	187,498,271	19,914,836	44,320,000
Copper precipitates smelted	2,007			4,004,361		
Ore smelted	237,876	86,928	1,747,220	4,151,368	10,683,164	
Slag fumed	145,638		23,601		2,512,000	25,278,000
Placer		54,999	11,634			
		264,173	9,087,571	195,654,000	33,110,000	69,598,000
Total, 1938		203,313	6,403,962	154,426,000	18,654,000	17,688,000

[1] Includes zinc concentrates treated at electrolytic plants.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Montana in 1939, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Material treated	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Beaverhead	50	21	2					
Broadwater	1,442	1,032	189	59	131	327	242	840
Deer Lodge	2,391	122	17					
Granite	355	70	41	6	21	8		
Jefferson	1,030	135	38	64	98	600	921	6,104
Lewis and Clark	770	129	31					
Lincoln	14,485	1,145	257	366	415	10,573	4,618	75,196
Madison	7,914	1,501	600	146	506	1,087	1,105	438
Mineral	175	2		7	10			
Missoula	900	178	33	18	122	31	46	
Park	52,295	4,908	797	2,128	3,291	825		
Powell	451	71	35					
Ravalli	66	33						
Sanders	35	7	2	6	26	35		
	82,359	9,354	2,042	2,800	4,620	13,486	6,932	82,578
Total, 1938	77,478	9,492	2,050	1,599	2,639	5,687	1,559	20,158

CYANIDATION MILLS

County	Material treated	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
Beaverhead	38,195	7,365	1,988	6	60	12		
Deer Lodge	18,986	2,908	327					
Fergus	51,552	3,089	1,927					
Granite	12,612	2,965	103					
Lewis and Clark	158,243	18,683	40,969	16	11	126	40	9,860
Madison	62,356	8,083	16,245					
Phillips	128,981	15,249	63,592					
Silver Bow	19,504	9,936	864					
	490,429	68,278	126,015	22	71	138	40	9,860
Total, 1938	433,233	64,759	120,062					
Grand total: 1939	572,788	77,632	128,057	2,822	4,691	13,624	6,972	92,438
1938	510,711	74,251	122,112	1,599	2,639	5,687	1,559	20,158

Mine production of metals from concentrating mills in Montana in 1939, by counties, in terms of recovered metals

County	Ore treated	Concentrates smelted and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Broadwater	63,622	7,786	10,846	6,799	13,858	88,871	
Cascade	44,117	1,543	1,465	355,567	7,525	559,084	10,000
Granite	82,612	26,382	2,508	385,489	105,445	381,203	1,326,404
Jefferson	108,736	15,288	5,584	479,192	357,904	3,664,727	2,142,308
Judith Basin	54	37		251		11,800	22,000
Lewis and Clark	14,065	459	2,032	5,069	14,515	344,862	
Madison	65,941	3,304	7,351	15,255	78,863	1,591	
Park	500	47	2	5,673	58	30,318	
Powell	5,000	496	535	4,145	1,112	75,527	
Sanders	36,028	3,744	51	21,334	28,975	5,249,074	787,000
Silver Bow	2,415,693	438,277	9,523	5,884,547	186,882,044	9,415,341	40,032,288
Sweet Grass	110	19	26	114	1,000		
	2,836,478	497,382	39,923	7,163,435	187,491,299	19,822,398	44,320,000
Total, 1938	1,976,828	351,779	32,061	4,718,975	145,431,136	11,237,033	5,561,167

Gross metal content of concentrates produced from ore mined in Montana in 1939, by classes of concentrates smelted

Class of concentrates	Concentrates	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	11,720	18,467	12,578	28,305	95,674	
Dry gold-silver	23,753	1,881	156,791	78,517	58,738	
Dry silver	1,408	2,001	323,060	6,022	67,331	
Copper	384,480	9,882	4,598,779	190,572,750		
Lead	15,123	5,592	761,328	547,848	16,167,608	412,837
Zinc	44,743	2,961	1,140,326	625,687	3,610,356	49,243,452
Iron (from zinc-lead ore)	18,977	3,830	184,197	222,084	1,026,757	1,984,502
	500,204	44,614	7,177,059	192,081,213	21,026,464	51,640,791
Total, 1938	353,378	34,700	4,724,662	148,646,904	11,740,075	7,682,163

Mine production of metals from Montana concentrates shipped to smelters in 1939, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaverhead	6	60	12			
Broadwater	7,845	10,977	7,126	14,100	89,711	
Cascade	1,543	1,465	355,567	7,525	559,084	10,000
Granite	26,388	2,529	385,497	105,445	381,203	1,326,404
Jefferson	15,352	5,682	479,792	358,825	3,670,831	2,142,308
Judith Basin	37		251		11,800	22,000
Lewis and Clark	475	2,043	5,195	14,555	354,722	
Lincoln	366	415	10,573	4,618	75,196	
Madison	3,450	7,857	16,342	79,968	2,029	
Mineral	7	10				
Missoula	18	122	31	46		
Park	2,175	3,293	6,498	58	30,318	
Powell	496	535	4,145	1,112	75,527	
Sanders	3,750	77	21,369	28,975	5,249,074	787,000
Silver Bow	438,277	9,523	5,884,547	186,882,044	9,415,341	40,032,288
Sweet Grass	19	26	114	1,000		
	500,204	44,614	7,177,059	187,498,271	19,914,836	44,320,000
Total, 1938	353,378	34,700	4,724,662	145,432,695	11,257,191	5,561,167

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
Dry gold	11,720	18,467	12,578	21,369	92,046	
Dry gold-silver	23,753	1,881	156,791	76,063	29,539	
Dry silver	1,408	2,001	323,060	5,118	64,638	
Copper	384,480	9,882	4,598,779	186,131,629		
Lead	15,123	5,592	761,328	465,665	15,520,349	
Zinc	44,743	2,961	1,140,326	594,385	3,429,816	44,320,000
Iron (from zinc-lead ore)	18,977	3,830	184,197	204,042	778,448	
	500,204	44,614	7,177,059	187,498,271	19,914,836	44,320,000

Gross metal content of Montana crude ore shipped to smelters in 1939, by classes of ore

Class of ore	Ore	Gross metal content			
		Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry and siliceous gold	95,023	76,564	277,484	132,857	293,934
Dry and siliceous gold-silver	12,020	3,610	130,513	44,494	117,668
Dry and siliceous silver	52,630	2,796	1,018,344	218,257	842,293
Copper	55,407	1,682	109,817	4,040,027	----------
Lead	22,796	2,276	211,062	60,887	10,204,938
	237,876	86,928	1,747,220	4,496,522	11,458,833
Total, 1938	160,118	59,014	1,541,297	3,612,552	6,262,349

Mine production of metals from Montana crude ore shipped to smelters in 1939, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Beaverhead	19,001	2,051	179,551	199,394	763,064
Broadwater	5,265	5,324	23,403	8,631	332,608
Cascade	315	613	82,807	1,725	27,341
Deer Lodge	8,448	6,812	10,907	----------	----------
Fergus	143	79	1,538	38	383
Flathead	26,860	614	473,846	3,404	5,533,553
Gallatin	26	1	9	58	5,830
Granite	27,826	7,717	307,300	29,536	63,989
Jefferson	18,657	8,638	66,765	32,896	332,956
Judith Basin	2,679	109	38,278	11,231	1,554,945
Lewis and Clark	9,274	4,821	49,888	24,618	457,809
Lincoln	84	135	188	180	8,613
Madison	44,408	40,225	197,209	11,638	209,354
Meagher	10	----------	31	1,500	1,532
Mineral	29	13	3	----------	----------
Missoula	700	302	2,607	17,415	8,639
Park	124	215	52	----------	----------
Phillips	804	2,930	10,851	1,760	----------
Powell	7,868	3,787	63,794	2,763	51,473
Ravalli	168	30	3,303	2,308	21,234
Sanders	1,428	56	5,848	155,207	1,309,841
Silver Bow	63,725	2,453	229,022	3,647,066	----------
Sweet Grass	34	3	20	----------	----------
	237,876	86,928	1,747,220	4,151,368	10,683,164
Total, 1938	160,118	59,014	1,541,297	3,429,505	5,977,679

BY CLASSES OF ORE

Dry and siliceous gold	95,023	76,564	277,484	56,365	245,919
Dry and siliceous gold-silver	12,020	3,610	130,513	18,203	112,973
Dry and siliceous silver	52,630	2,796	1,018,344	189,890	520,351
Copper	55,407	1,682	109,817	3,835,740	----------
Lead	22,796	2,276	211,062	51,170	9,803,921
	237,876	86,928	1,747,220	4,151,368	10,683,164

Mine production of gold, silver, copper, lead, and zinc in Montana in 1939, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Beaverhead County:													
Argenta	15	1	34,814	6,986	4	6,990	7,313	-----	7,313	884	37,915	-----	$251,488
Bald Mountain	2	-----	488	100	-----	100	333	-----	333	327	10,298	-----	4,244
Bannack	6	4	4,995	1,338	2,031	3,369	1,108	159	1,267	29	-----	-----	118,778
Big Hole	5	5	679	200	25	225	1,230	3	1,233	1,481	161,872	-----	16,474
Blue Wing	5	-----	1,974	65	-----	65	30,631	-----	30,631	96	1,042	-----	23,126
Bryant	1	-----	13,521	798	-----	798	126,692	-----	126,692	194,039	551,787	-----	160,041
Elkhorn	2	-----	45	3	-----	3	1,102	-----	1,102	2,538	150	-----	1,124
Horse Prairie Creek	-----	1	-----	-----	13	13	-----	3	3	-----	-----	-----	457
Polaris	1	-----	8	-----	-----	-----	436	-----	436	-----	-----	-----	296
Vipond	3	-----	722	7	-----	7	12,708	-----	12,708	-----	-----	-----	8,871
Broadwater County:													
Backer	5	23	234	783	2,498	3,281	548	442	990	452	213	-----	115,564
Beaver	15	-----	15,979	2,891	-----	2,891	10,112	-----	10,112	7,779	116,936	-----	114,354
Cedar Plains	12	-----	50,932	11,539	-----	11,539	2,126	-----	2,126	10,413	4,596	-----	406,607
Park	16	5	3,184	2,120	70	2,190	17,932	19	17,951	4,087	300,574	-----	103,387
Carbon County: Clark Fork	-----	1	-----	-----	1	1	-----	-----	-----	-----	-----	-----	35
Cascade County: Montana	11	-----	44,432	2,078	-----	2,078	438,374	-----	438,374	9,250	586,425	10,000	399,337
Deer Lodge County:													
French Gulch	-----	3	-----	-----	16	16	-----	-----	-----	-----	-----	-----	560
Georgetown	7	-----	29,136	9,676	-----	9,676	1,077	-----	1,077	-----	-----	-----	339,391
Lost Creek	-----	1	-----	-----	6	6	-----	-----	-----	-----	-----	-----	210
Oro Fino	4	-----	346	161	-----	161	4,262	-----	4,262	-----	-----	-----	8,528
Silver Lake	2	-----	343	5	-----	5	5,912	-----	5,912	-----	-----	-----	4,188
Warm Springs	-----	1	-----	-----	2	2	-----	-----	-----	-----	-----	-----	70
Fergus County:													
Cone Butte	2	-----	25	18	-----	18	78	-----	78	9	-----	-----	684
North Moccasin	1	3	51,552	3,089	17	3,106	1,927	-----	1,927	-----	-----	-----	110,018
Warm Springs	5	-----	118	61	-----	61	1,460	-----	1,460	29	383	-----	3,147
Flathead County: Hog Heaven	3	-----	26,860	614	-----	614	473,846	-----	473,846	3,404	5,533,553	-----	603,562
Gallatin County:													
Eldridge	-----	1	-----	-----	5	5	-----	-----	-----	-----	-----	-----	175
Elk Creek	1	-----	6	1	-----	1	-----	-----	-----	19	-----	-----	37
Johnson Gulch	1	-----	20	-----	-----	-----	9	-----	9	39	5,830	-----	284

Granite County:													
Alps	1		29	16		16	3		3	48			567
Boulder	9	3	754	509	38	547	1,174	3	1,177	2,856	6,894		20,565
Dunkleberg	3		23	6		6	283		283				402
First Chance	12	6	2.857	2,782	796	3,578	2,883	75	2,958	1,827	489		127,451
Flint Creek	9		104,470	5,071		5,071	681,752		681,752	129,154	436,809	1,326,404	743,185
Gold Creek	3	4	75	53	41	94	31	3	34				3,313
Henderson	1	1	205	82	104	186	196	3	199	952			6,744
Maxville	3		544	99		99	5,959		5,959	19	256		7,524
Moose Lake	2		23	15		15	196		196		744		693
Red Lion	2		12,618	2,976		2,976	106		106				104,232
Rock Creek	4	3	1,803	1,669	23	1,692	352	3	355	125			59,474
Stony	1		4	3		3	6		6				109
Jefferson County:													
Amazon	5		127	33		33	1,457		1,457	211	16,787		2,955
Bigfoot	2		26	29		29	249		249	212	1,213		1,263
Boulder	6	1	178	24	63	87	1,622	9	1,631	134	9,086		4,593
Cataract	24	8	63,517	6,125	71	6,196	403,889	19	403,908	278,952	3,343,383	2,140,500	788,484
Clancey	3	7	31	17	12,955	12,972	212	4,536	4,748	125	297		457,270
Colorado	14		51,866	1,256		1,256	123,171		123,171	107,385	517,851	1,808	163,168
Elkhorn	10		745	323		323	2,136		2,136	875	17,809		13,683
Golconda	1		15	7		7	59		59	10	957		331
Homestake	3		8	9		9	25		25				332
Lowland	1	1	50	17	3,245	3,262	3	2,005	2,008				115,533
McClellan Creek	1		21	2		2	554		554	163	234		474
Mitchell	3	1	318	337	195	532	831	28	859	616	128		19,273
Warm Springs	5		264	216		216	856		856	923	2,915		8,374
Whitehall	17		10,947	5,998		5,998	11,416		11,416	1,827	90,553		222,125
Willow Creek	1		310	62		62	115		115	288	2,574		2,399
Judith Basin County:													
Barker	2		2,719	109		109	38,454		38,454	11,183	1,560,299	22,000	105,558
Running Wolf Creek	1		14				75		75	48	6,446		359
Lewis and Clark County:													
Dry Gulch	2	7	46,337	8,278	39	8,317	8,216	3	8,219	221	511		296,721
Greenhorn	2	4	23	4	141	145	140	19	159	57	2,872		5,324
Heddleston	1		1,397	280		280	12,394		12,394	8,481	14,596		19,781
Helena	14	7	57,512	3,105	9,341	12,446	6,821	878	7,699	1,760	111,425		446,256
Jefferson Gulch	1		9	13		13	9		9				461
Lake Helena	1		49	13		13	62		62	86	2,235		611
Lincoln	1	7	40	57	211	268	22	28	50	183			9,433
Marysville	18	6	40,680	6,744	3,953	10,697	27,552	750	28,302	17,106	363,233		412,457
Missouri River		6			6,396	6,396		850	850				224,437
Rimini	8	3	1,772	348	95	443	18,091	53	18,144	10,019	315,766		43,704
Scratch Gravel	6		454	456		456	1,737		1,737	779	574		17,247
Smelter	1		145,638				23,601		23,601		2,512,000	25,278,000	1,448,540
Spokane Hills	1		55	47		47	59		59	96	319		1,710
Stemple	5	1	34,022	6,331	2	6,333	20,893		20,893	356	915		235,917
Wolf Creek	1		2				87		87	29	85		66
Lincoln County:													
Libby	1	8	64	123	236	359	50	6	56	96	149		12,620
Sylvanite	4		14,505	1,572		1,572	10,968		10,968	4,702	83,660		66,886
Ural		1			13	13							455

Mine production of gold, silver, copper, lead, and zinc in Montana in 1939, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Madison County:													
Cherry Creek	3		204	341		341	8,443		8,443				$17,666
Norris	31	3	32,386	8,393	1,169	9,562	13,717	168	13,885	2,221	43,022		346,348
Pony	18		65,170	7,397		7,397	12,394		12,394	78,904	5,276		275,762
Renova	7		21,742	20,180		20,180	113,501		113,501	231			783,367
Rochester	9		1,985	480		480	3,527		3,527	625	88,277		23,408
Sheridan	25	11	2,012	1,641	150	1,791	8,079	28	8,107	1,413	27,362		69,621
Silver Star	13		43,993	13,163		13,163	19,931		19,931	2,144	12,021		475,022
Tidal Wave	15	3	1,511	2,241	8	2,249	6,441		6,441	4,606	24,234		84,705
Virginia City	26	6	9,840	3,317	87	3,404	41,110	9	41,119	1,135	8,510		147,569
Washington	5	1	1,731	513	2,795	3,308	1,544	707	2,251	327	2,681		117,468
Willow Creek	1		45				1,709		1,709				1,160
Meagher County:													
Atlanta Creek		1			5	5							175
Beaver Creek		10			354	354		75	75				12,441
Camas Creek		1			14	14		3	3				492
Castle Mountain	2		10				31		31	1,500	1,532		249
Thompson Gulch		4			22	22		3	3				772
Mineral County:													
Cedar Creek	1	20	23	10	1,047	1,057	3	53	56				37,033
Gold Mountain	1		175	12		12							420
St. Regis	2		6	3		3							105
Missoula County:													
Coloma	8		1,026	490		490	296		296	346	22		17,388
Elk Creek		9			1,420	1,420		131	131				49,789
Nine Mile	1	13	220	95	236	331	34	3	37				11,610
Wallace	3		354	17		17	2,341		2,341	17,115	8,617		4,369
Park County:													
Crevasse	1		1,165	134		134	25		25				4,707
Emigrant Creek		3			196	196		28	28				6,879
New World	3		513	7		7	5,694		5,694	58	30,318		5,541
Sheepeater (Jardine)	1		51,241	8,275		8,275	1,628		1,628				290,730
Yellowstone River		2			15	15							525
Phillips County: Little Rockies	2	3	129,785	18,179	17	18,196	74,443		74,443	1,760			687,574
Powell County:													
Big Blackfoot	3	4	226	200	30	230	442	3	445	135	298		8,380
Douglas Creek		1			6	6							210
Nigger Hill	9	3	5,382	669	12	681	7,696		7,696	1,615	87,085		33,320
Ophir		1			58	58		3	3				2,032
Pioneer	1	9	450	64	3,903	3,967	34	442	476				139,168

Race Track	2	-------	38	26	-------	26	25	-------	25	-------	-------	-------	927
Washington Gulch	3	10	50	56	493	549	78	53	131	1, 029	-------	-------	19, 411
Zozell	6	-------	7, 173	3, 378	-------	3, 378	59, 699	-------	59, 699	1, 096	39, 617	-------	160, 729
Ravalli County:													
Curlew	2	-------	147	27	-------	27	3, 300	-------	3, 300	2, 308	21, 234	-------	4, 423
Eight Mile	1	-------	21	3	-------	3	3	-------	3	-------	-------	-------	107
Overwich	2	3	66	33	108	141	-------	3	3	-------	-------	-------	4, 937
Sanders County:													
Eagle	1	-------	37, 041	57	-------	57	25, 706	-------	25, 706	30, 827	6, 503, 298	787, 000	369, 229
Plains	2	-------	14	3	-------	3	140	-------	140	19	1, 128	-------	255
Revais Creek	1	-------	287	46	-------	46	389	-------	389	153, 336	-------	-------	17, 821
Trout Creek	4	-------	149	34	-------	34	984	-------	984	-------	54, 489	-------	4, 419
Vermillion	-------	2	-------	-------	15	15	-------	-------	-------	-------	-------	-------	525
Silver Bow County:													
Butte or Summit Valley	29	-------	2, 478, 557	11, 899	-------	11, 899	6, 097, 933	-------	6, 097, 933	194, 532, 961	9, 415, 341	40, 032, 288	27, 311, 296
Divide Creek	4	-------	180	22	-------	22	2, 920	-------	2, 920	510	-------	-------	2, 805
German Gulch	-------	5	-------	-------	72	72	-------	3	3	-------	-------	-------	2, 522
Highland	3	4	19, 563	9, 945	7	9, 952	1, 488	-------	1, 488	-------	-------	-------	349, 330
Independence	1	-------	622	46	-------	46	12, 092	-------	12, 092	-------	-------	-------	9, 818
Lost Child	-------	1	-------	-------	2	2	-------	-------	-------	-------	-------	-------	70
Silver Bow Creek	-------	10	-------	-------	43	43	-------	19	19	-------	-------	-------	1, 518
Sweet Grass County: Independence	1	-------	144	29	-------	29	134	-------	134	1, 000	-------	-------	1, 210
Toole County: Gold Butte	-------	5	-------	-------	69	69	-------	3	3	-------	-------	-------	2, 417
Total Montana	594	282	3, 792, 780	209, 174	54, 999	264, 173	9, 075, 937	11, 634	9, 087, 571	195, 654, 000	33, 110, 000	69, 598, 000	40, 937, 870

BEAVERHEAD COUNTY

Argenta district.—The value of the metal output from mines near Argenta decreased $50,817 in 1939, owing chiefly to a decrease of nearly 1,000 ounces in gold from the Ermont property. The mine and 100-ton cyanidation mill were operated regularly by Ermont Mines, Inc.; 33,163 tons of gold ore were milled, but the gold content was considerably lower than 1938. Despite the smaller output of gold, the mine was again the chief producer in Beaverhead County. Shipments of gold ore from the Shafer mine were continued, but the output was much less than in 1938. Other producing lode mines in the Argenta district (all producing ore shipped crude to smelters) included the Goldfinch, Ground Hog, Iron Mountain, Jack & Rosemont, Lookout, May Day, Midnight, Oro Fino, Pay Day, Pine Tree, and Silver Horn. The placer output of the district came from sluicing about 400 cubic yards of gravel at the Watson Gulch property.

Bald Mountain district.—In 1939 lessees operating the Faithful group shipped gold ore to a custom cyanidation mill at Bannack and gold ore and lead ore to smelters.

Bannack district.—There was an increase in gold from placer operations in the Bannack district in 1939, but this gain was more than offset by decreased output from lode mines. The Golden Messenger Corporation surrendered its lease on the Sleeping Princess (I. B.) property of the New York-Montana Mines Co. at the end of 1939; the output during the year comprised 305 tons of gold ore shipped to smelters and 570 tons treated in the cyanidation mill, but the output of gold decreased more than 1,300 ounces. The Bannack-Apex Mining Co. operated the Hendricks (Graeter) property the entire year and treated 3,975 tons of ore in the 50-ton cyanidation mill; the mill also handled custom ore from several mines in the area. Other producing lode mines in the Bannack district included the Garnet, Gold Bug, Gold Crown, and Wallace. The Ralph E. Davis Syndicate operated the dragline and floating washing plant on Grasshopper Creek from April to December, treating 1,125,000 cubic yards of gravel; the equipment used comprised a 5-cubic yard dragline and a 1¼-cubic yard dragline and two electric-powered washing plants with a combined capacity of 7,000 cubic yards a day. Nearly 2,000 ounces of gold were produced in 1939, a marked increase over 1938, but the gravel handled was of unusually low grade, as about 75 percent of the 1939 yardage was old dredge tailings. A small hydraulic plant at the Dark Horse placer washed about 20,000 cubic yards of gravel. Placer gold was recovered also from small-scale sluicing operations at two properties on Grasshopper Creek.

Big Hole district.—In 1939 lessees operating the Star property on Meadow Creek 3 miles west of Wise River shipped 200 tons of gold ore to the smelter at Anaconda; crude ore was shipped to smelters from the Dark Horse and S. S. & R. mines; and a little gold ore from the North Star mine was amalgamated. Small-scale placer operations were reported at the Carlin, Pierce Arrow, Rabbit Gulch, and Cherry Blossom properties.

Blue Wing district.—The entire output from the Blue Wing district in 1939 was siliceous silver ore shipped to smelters from the Blue Wing, Del Monte (Bonaparte), Ingersoll, New Departure, and Randall properties.

Bryant district.—The Hecla mine west of Melrose was in 1939, as usual, the only producer in the Bryant district; the output comprised 13,350 tons of silver ore and 171 tons of lead ore shipped to smelters, a marked increase over 1938.

Elkhorn district.—A car of copper ore was shipped from the Old Elkhorn mine in 1939, and a test lot of silver ore was produced at the Up Two property.

Horse Prairie Creek district.—Several hundred cubic yards of gravel were treated in a power loader and stationary washing plant at the Golden Leaf placer late in 1939.

Vipond district.—Lessees at the Lone Pine & Argyle Silver property of the Quartz Hill Mining Co. shipped 712 tons of silver ore in 1939 to the smelter at Anaconda; silver ore was shipped also from the Monte Cristo and Triangle mines.

BROADWATER COUNTY

Backer district.—The value of the metal output from the Backer district increased $76,802 in 1939; most of the gain was in gold from placer mines. The Fair Play Placers, Inc., was the chief placer producer in the district; the company operated a 2½-cubic yard dragline and floating washer, having a daily capacity of 4,000 cubic yards, at property in Confederate Gulch from March 1 to December 23 and treated about 600,000 cubic yards of gravel. The Empire Gulch Mining Co. (formerly Charles L. Sheridan) operated a 2½-cubic yard dragline and dry-land washing plant at the Boulder Bar placer from April 10 to September 10 and treated 100,000 cubic yards of gravel. Other producing placers in the district included the Antler, Armstrong, Boulder, Bourbon, Eldorado Bar, Homestead, Magpie Gulch, North Star, Rattlesnake Bench, Rose, and Tenderfoot properties. Most of the output from lode mines in the district came from the Superior mine, where unusually rich gold ore was treated in a small amalgamation plant; gold ore was shipped to smelters from the Cooper, Harriett, and Satellite mines.

Beaver district.—Lessees continued to operate at the Custer mine near Winston in 1939; the output of gold from crude ore and from concentrates from the 60-ton flotation plant was more than double that in 1938. The rest of the Beaver district output was crude ore shipped to smelters; it comprised gold ore from the Black Tail, Chicago, East Pacific, Edna, Iron Age, Martha Washington, Midas, Mystery, Stolen Sweets, Triumph, and Vosburg mines and lead ore from the Monte Cristo and Stray Horse mines.

Cedar Plains district.—The value of the metal output from mines in the Cedar Plains (Radersburg) district in 1939 increased $183,077 over 1938, owing chiefly to marked increase in gold from the Ohio Keating mine; the property was operated the entire year by the M & M Mining Co., and 25,321 tons of gold ore were treated in the rebuilt (80-ton) flotation plant. The C. G. Gold Corporation continued regular operations at the Keating group; the output comprised 3,473 tons of concentrates (from 23,301 tons of gold ore treated in the 100-ton flotation plant) and 2,210 tons of crude gold ore shipped to smelters. Other producers in the district included the Apex, Black Friday, Comstock, Cyclone, Emma, Gopher, and Spar mines.

Park district.—The Marietta mine in 1939 again was the chief producer in the Park, or Indian Creek, district; the mine was operated by lessees, and the output comprised 257 tons of gold ore and 502 tons of lead ore shipped to smelters. At the Blacksmith property 504 tons of gold ore were treated in the 25-ton amalgamation and concentration mill, and 218 tons of gold ore were shipped direct to smelters. As in 1938, gold ore from the Speculator mine was treated in a small amalgamation mill. Other producing lode mines in the district included the Crosscut, Don L., Independent, Iron Mask, Justice, Little Giant, Mississippi, Monarch, Silver Wave, Sparrow, W. A. Clark, and West Park & Venezuela properties. Poston Bros. operated a 2-cubic yard dragline and stationary washer and tested about 1,500 cubic yards of gravel from properties along Indian Creek during October; small-scale sluicing was reported at several placers in the district, including the Whip-poor-will property.

CARBON COUNTY

Testing operations at bars along the Clark Fork River near Belfry yielded a small lot of placer gold in 1939.

CASCADE COUNTY

Montana district.—The total value of the metal output from mines in Cascade County in 1939 increased $139,815 over 1938, owing chiefly to larger output of silver ore from the Big Seven property; the mine and 50-ton flotation mill were operated the entire year by the Montana Silver Queen Mining Co., and the output comprised nearly 600 tons of rich silver concentrates from the mill and nearly 300 tons of crude silver ore shipped to the smelter at East Helena. Output of silver ore from the Florence mine also increased. Silver ore was treated also in small flotation mills at the Benton and Hartley properties, and a little lead ore was milled by the New London Mining Corporation. The remainder of the district output comprised zinc-lead ore shipped to the zinc mill at Anaconda from the Minute Man property, and crude ore shipped to smelters from the Commonwealth, Lucky Strike, Peabody, Silver Belt, and Star mines. In addition, a test lot of lead ore was shipped from the Silver Dyke property; however, no work was done at the property by the Silver Dyke Mining Co., and the milling plant, formerly the largest mill in the Neihart area, was dismantled.

DEER LODGE COUNTY

Georgetown district.—The marked increase in output of gold from mines in the Georgetown district in 1939 was the result of increased output of gold ore from the Southern Cross mine; the property, owned by the Anaconda Copper Mining Co., was operated under lease by the Quarry Mining Co., and shipments of gold ore to the smelter at Anaconda increased to 7,721 tons containing 6,588 ounces of gold. Thomas H. Sheridan operated the full year at the Holdfast property, but the output of gold ore treated in the 50-ton cyanidation mill decreased slightly to 13,866 tons. The Gold Coin Mines Co. continued operations at the Gold Coin mine and amalgamation mill throughout the year, and in addition, during the summer months, the cyanidation plant treated old tailings; the combined output of the two plants, however, was considerably less than in 1938. Other producing mines in the district included the Cable, Hub, and Revenue properties.

Oro Fino district.—Crude ore was shipped to smelters in 1939 from the American, Cashier, Grizzly Bear, and Independence mines.

Silver Lake district.—A lessee operating the Silver Reef mine 13 miles west of Anaconda shipped 342 tons of silver ore to smelters in 1939. A test lot of silver ore was shipped from the Chloride Silver property.

FERGUS COUNTY

Cone Butte district.—Small lots of gold ore were shipped to smelters in 1939 from the Golden Armells and Golden Jack properties.

North Moccasin district.—The North Moccasin Mines Syndicate continued operations in 1939 at the Barnes-King mine 20 miles north of Lewistown; ore treated in the 150-ton cyanidation mill increased over 1938, and the output of gold increased more than 300 ounces. Small lots of placer gold were recovered by sluicing at three properties; most of it came from the Grubstake placer in Iron Gulch.

Warm Springs district.—All the output from mines in the Warm Springs district in 1939 was crude ore shipped to smelters; it comprised gold ore from the Maginnis group, silver ore from the Argentite, Bay Horse, and Silver Queen mines, and a little lead ore from the Globe property.

FLATHEAD COUNTY

Hog Heaven district.—The Anaconda Copper Mining Co. continued regular operations in 1939 at the Flathead mine south of Kila; the output of silver ore decreased slightly (from 15,797 tons in 1938 to 13,447 tons in 1939), but the output of crude lead ore sent to the East Helena smelter increased from 4,997 to 13,201 tons. A little silver ore was shipped to the smelter at Tacoma, Wash., from the Eudora property and from prospects.

GALLATIN COUNTY

A test lot of gold ore was sent in 1939 to the East Helena smelter from the Beacon mine, a little lead ore was shipped from the Last Chance mine, and a little gold was recovered by sluicing at the Jewel placer. No production in 1938 was reported from mines in Gallatin County.

GRANITE COUNTY

Alps district.—A car of gold ore from the Alps group south of Clinton was shipped to the East Helena smelter in 1939.

Boulder district.—Most of the increase in gold from the Boulder district in 1939 resulted from shipments of gold ore from the Gold King & Gold Mountain mine, where the output comprised 354 tons of ore containing 346 ounces of gold. Crude ore from the Blue Bird, Brooklyn, Golden Summit, Moonlight, and Sunday mines was shipped to smelters, and ore from the Royal Gold property was treated in a small amalgamation and concentration mill. Most of the placer output came from drift mining at the Montana-Tonopah placer.

Dunkleberg district.—Small lots of crude ore were shipped to smelters in 1939 from the Murrial, Ruth, and Standby properties.

First Chance district.—The entire output from lode mines in the First Chance (Garnet) district in 1939 was crude gold ore shipped to smelters. Most of it came from leasing operations of the Mitchell-Mussigbrod group (including the Fairview, Fourth of July, Free Coinage, International, Lead King, Red Cloud, Robert Emmett, and San Jose claims). Other producers included the Fluker, Forest, Hobo & Gold Leaf, Grant & Hartford, Laddy Buck, Lynx, Peggy Ann, Sierra, Sunrise, and Tiger mines.

During 1939 the Star Pointer Exploration Co. completed the erection of a 6-cubic foot connected-bucket dredge at the mouth of Bear Creek near Bearmouth; the dredge is electric-powered and equipped with 88 buckets. The new plant was placed in operation October 29 and dredged 349,131 cubic yards of gravel before the end of the year. Small-scale sluicing was reported at the Alma (Cave Gulch), Dixie, Little Dick, and Ten Mile placers.

Flint Creek district.—The total value of the metal output from mines in the Flint Creek (Philipsburg) district in 1939 increased $261,529 over 1938 owing to increased output by the Philipsburg Mining Co. Operations at the Granite-Bimetallic mine and 165-ton flotation plant were suspended in September, after producing 841 tons of rich silver concentrates and 388 tons of crude silver ore that were shipped to smelters. During the summer, however, a plant was built to treat the old tailings dumps near Philipsburg. The tailings were accumulated from the treatment of several hundred thousand tons of Granite-Bimetallic ore in the old chloridizing-roast, pan-amalgamation mill. Considerable experimentation preceded construction of the new 300-ton mill, which is essentially a desliming plant using jigs and classifiers. The deslimed, highly siliceous product was shipped to the Tacoma smelter under a special freight and treatment schedule; the mill handled about 43,000 tons of tailings after it was put in operation in August.

The Contact Mines Corporation operated throughout 1939 at the Silver Prince property at Philipsburg; its output comprised 6,716 tons of silver ore shipped to smelters and 6,589 tons of zinc-lead ore sent to the mill at Anaconda, a marked increase over 1938. The Taylor-Knapp Co. (Taylor, Nelson & Knapp, Inc., before June 1939) shipped 2,345 tons of crude silver ore and 1,023 tons of zinc-lead ore from the Two Percent mine during the year. The Trout Mining Division of American Machine & Metals, Inc., shipped 3,567 tons of crude silver ore from the Trout & Algonquin group in 1939, but no zinc-lead ore was produced. The remainder of the output from the Flint Creek district was crude ore shipped to smelters, chiefly from the Headlight, Hobo, and Shannon mines.

Gold Creek district.—Gold ore was shipped to smelters in 1939 from the Clear Grit and Yaller Boy properties, and gold ore was amalgamated at property operated by Schmuck & Whitty. Most of the placer output from the Gold Creek district came from a power shovel and stationary washing plant operated by the Master Mining Co. at the Tibbits & Fowler property; the Triangle and Willow Creek placers also were operated in 1939.

Henderson district.—H. J. Schneider & Bros. operated a ½-cubic yard dragline and stationary washer at the New Deal placer in 1939 and treated about 12,000 cubic yards of gravel. Gold ore was shipped to a smelter from the Sunrise group.

Maxville district.—Siliceous ore was shipped to smelters in 1939 from the Copper Queen, Hoffman (Goldonna), and White Horse properties.

Moose Lake district.—A little gold ore was shipped from the Moose property in 1939, and a test lot of silver ore was shipped from the Mahoney mine.

Red Lion district.—There was a marked decrease in gold from the Red Lion district in 1939, as the output from the Hidden Lake mine was less than in 1938. The mine was operated until May 25 by Hidden Lake Venture, Inc., and later by the Red Lion Mining Co.; the total output comprised 12,612 tons of ore treated by cyanidation in 1939 compared with 24,139 tons in 1938. A small lot of gold ore was shipped to a smelter from the Olympic property.

Rock Creek district.—Nearly 1,700 tons of gold ore were shipped to a smelter in 1939 from the Ella (MacDonald) property, a new producer in the Rock Creek district; siliceous ore was shipped to smelters also from the Mountain Ram, Ozark, and Shakespeare mines. Most of the placer output of the district came from sluicing operations at the Basin and Quartz Gulch properties.

JEFFERSON COUNTY

Amazon district.—Crude ore was shipped to smelters in 1939 from the Adolphus, Amazon & Deadwood, Boulder, Schevers, and Wilbur Silver mines.

Bigfoot district.—Small lots of gold ore were shipped from the Bald Eagle and State properties in 1939.

Boulder district.—Crude ore was shipped in 1939 from several mines near Boulder, including the Baltimore, Ida, Davis-Eureka, Molly McGregor, and Red Eagle properties. A scraper and dry washer were used in treating 7,350 cubic yards of gravel from the Boulder placer.

Cataract district.—The value of the metal output from the Cataract district in 1939 increased $246,508 over 1938 owing to increased output of zinc-lead ore at the Comet property; the mine and flotation mill were operated the entire year by the Basin Montana Tunnel Co., and the ore mined increased from 38,170 to 59,420 tons; small lots of custom ore from several mines in the district were also milled, including ore from the Buckeye & Boston, Crystal, Golconda, and Sylvan mines. In addition to the zinc-lead ore sent to the Comet mill, lessees shipped 1,515 tons of siliceous ore from the Comet mine to smelters. Basin Goldfields, Ltd., operated the Boulder mine from January through September and shipped 1,141 tons of gold ore to the Anaconda smelter. Ore was also shipped to smelters from the Basin Bell, Blue Bird, Congo, Crescent, Dickerson, Mae Lilly, Mayflower, Mantle, Minneapolis, Morning, Saturday Night, and Sirius mines. Gold ore was treated by amalgamation and concentration at the Gray Lead and Hope & Katie (Jib) properties. Small-scale sluicing was reported at several placers near Basin, including the Big Rock, Gold Hill, Nancy, and Park & Anderson properties.

Clancey district.—The output of gold from the Clancey (Prickly Pear Creek, Montana City, etc.) district in 1939 increased 5,526 ounces over 1938, owing to increased output by Winston Bros. Co., largest placer producer in Montana, whose new 6-cubic foot floating dredge (put in operation in August 1938) operated during the entire year 1939 and handled 1,787,413 cubic yards of gravel. In addition, the company operated the 4-cubic yard dragline and floating washer on Prickly Pear Creek from January until June 24, 1939, when the plant was closed and dismantled after all available ground had been dredged; the dragline plant handled 353,643 cubic yards of gravel. The Holmes Gulch Mining Co. produced several hundred ounces of gold at a dragline and dry-land washer in Holmes Gulch. The Dutton Ranch dragline and dry-land washer operation of O. A. Barnes produced a little placer gold before the equipment was moved to Marysville in Lewis and Clark County in May. A dragline and dry-land washing plant were operated for 20 days in July at the Weber placers on Buffalo Creek. The output from lode mines in the Clancey district was crude ore shipped to smelters, chiefly from the Eagle's Nest and Liverpool properties.

Colorado district.—The Alta property near Wickes in 1939 again was the chief producer in the Colorado district; the property was operated throughout the year by Eathorne & Fox, and the output comprised 48,632 tons of old tailings treated in the 200-ton flotation plant and 218 tons of crude lead ore shipped direct to a smelter. A small lot of zinc-lead ore from the Bunker Hill mine was trucked to the Comet mill. Silver tailings at the Frohner property were treated in a small jig mill. The rest of the district output was crude ore shipped to smelters from the Arogon, Blizzard, Blue Bird, Buckeye, Gregory, Henna, Minah, Minnesota, Mount Washington, Offset, and Pen Yan properties.

Elkhorn district.—The Center Reef mine was operated during 1939 by lessees, who shipped 159 tons of gold ore to a smelter and treated about 200 tons of ore in a small amalgamation plant. A little gold ore from the Klondyke mine was amalgamated. Siliceous ore was shipped to smelters from the C & D, Golden Curry, Hard Cash, Little Goldie, Moreau, New Elkhorn, Queen, and Wildcat properties.

Golconda district.—A lessee shipped small lots of gold ore from the Wonder mine to a smelter in 1939.

Homestake district.—Small lots of gold ore were shipped to smelters in 1939 from the Golden Valley, Martha, and Sleeping Beauty mines.

Lowland district.—Kit Carson Placers operated the dragline and dry-land washer equipment on Lowland Creek from April 20 to October 31, 1939, and treated about 630,000 cubic yards of gravel, a marked increase over 1938. A little gold ore from the Infinite property was treated in 1939 in a small amalgamation mill.

McClellan Creek district.—Small lots of silver ore were shipped in 1939 from the Shaw mine to the East Helena smelter.

Mitchell district.—E. A. Studer & Son operated a ½-cubic yard power shovel and stationary washing plant at the Lewis placer in Mitchell Gulch from June to November 1939 and treated about 25,000 cubic yards of gravel. The John & Jim group of the Economy Mines Co. was operated by lessees in 1939, and 298 tons of gold ore were shipped to a smelter. A small lot of gold ore mined at the Haystack Butte mine in 1938 was shipped to a smelter in 1939.

Warm Springs district.—The value of the metal output from the Warm Springs district decreased from $76,260 in 1938 to $8,374 in

1939 owing to the closing of the mill at the Fleming property of the Newburg Mining & Milling Co. late in 1938; the property was idle in 1939, and one small lot of clean-up material was shipped to a smelter. The Alhambra Gold Mines, Inc., operated the Katie & Pilot group throughout 1939 and shipped 160 tons of gold ore to the East Helena smelter. Gold ore was also shipped to smelters from the Badger, Green Leaf, and Iron King mines.

Whitehall district.—The value of the metal output from the Whitehall district in 1939 increased $124,293 over 1938 owing to the larger output of gold ore from the Golden Sunlight mine; the property was operated by the A. O. Smith Corporation and various sublessees, and the output of ore shipped to smelters increased from 3,425 to 9,621 tons. Other shipments from the district comprised gold ore from the Claxton, Gold Star, Jack Benny, Lone Eagle, Lucky Hit, Maid of Erin, Morning Glory, New Year, Pay Day, and Sunnyside mines and lead ore from the Blue Bell, Carbonate, Mary Lucile, Midnight, and Surprise properties.

Willow Creek district.—The Callahan (Deer Horn) mine of the Golden Age Mining Co. was operated only a short time in 1939, and the output of gold ore treated in the amalgamation and concentration plant decreased to 310 tons.

JUDITH BASIN COUNTY

Barker district.—Thorson Bros. continued leasing operations in 1939 at property of Glendennin Mines, Inc., in the Barker district; the output comprised 2,659 tons of crude lead ore shipped to a smelter and 54 tons of zinc-lead ore shipped to the mill at Midvale, Utah. A test lot of lead ore was shipped from the Champion mine.

Running Wolf Creek district.—One lot of lead ore from the Morro mine south of Stanford was shipped to the East Helena smelter in 1939.

LEWIS AND CLARK COUNTY

Dry Gulch district.—The Golden Messenger Corporation operated throughout 1939 at the mine and 130-ton cyanidation plant at York; the mill treated 46,268 tons of ore, which yielded 8,234 ounces of gold and 8,168 ounces of silver in cyanide bullion. The rest of the Dry Gulch district output comprised gold ore shipped to a smelter from the Blue Bird mine and small lots of placer dust from small-scale sluicing operations at several properties, including the Franklin, Maude, and Oro placers.

Greenhorn district.—A lessee operated a 1-cubic yard dragline and dry-land washer in 1939 at the Austin Mountain placer and treated about 10,000 cubic yards of gravel. Sluicing was reported at the Con Kelly and Potter placers. Small lots of lead ore were shipped from the Humboldt and King Tut lode mines.

Heddleston district.—Lessees shipped nearly 1,400 tons of siliceous ore to smelters in 1939 from the dump at the Anaconda property at the head of the Blackfoot River 35 miles northwest of Helena.

Helena district.—The Montana Consolidated Mines Corporation resumed production at the Spring Hill mine in March 1939, after completion of the new 30-ton concentrate-cyaniding plant. In 1939 the company treated about 56,000 tons of ore in the 300-ton straight-flotation plant; the flotation concentrates were treated by cyanidation in the new 30-ton plant, and the cyanide tailings were re-treated by flotation to recover lead concentrates. The output of gold from the property decreased more than 800 ounces compared with 1938. Other producing lode mines in the Helena district included the Court House, Eula, Little Wonder, Lockey, Lone Star, Old Dominion, San Juan, Sky, and Whitlatch properties. The Porter Bros. Corporation operated the 6-cubic foot dredge north of Helena throughout the year and treated 1,805,983 cubic yards of gravel, about the same yardage as in 1938, but the output of gold decreased more than 600 ounces. Placer production was reported at six other properties near Helena.

Jefferson Gulch district.—One small lot of gold ore was shipped by a lessee in 1939 from the Wiggins property 8 miles northeast of Finn.

Lake Helena district.—Lessees shipped small lots of gold ore in 1939 from the Lake Shore (Violet Jane) group north of Lake Helena.

Lincoln district.—The Lincoln Metals Co. shipped 40 tons of gold ore from the Margarets property 6 miles northwest of Lincoln in 1939. Most of the placer output of the Lincoln district came from a dragline and dry-land washer operation at the Stonewall property; a small dragline and dry-land washer were operated at the Blue Cloud property; and sluicing was reported at the Bloom & Old Billy Williams, Blue Bird, Harvey, and Liverpool placers.

Marysville district.—The value of the metal output from mines in the Marysville district increased from $211,213 in 1938 to $412,457 in 1939; gold from lode mines increased 1,295 ounces and that from placer mines 3,806 ounces. The gain from placers was chiefly the result of operations by Ralph Davis, Inc.; the 3½-cubic yard dragline and floating washer were put in operation April 15, 1939, and handled about 705,000 cubic yards of gravel from the Silver Creek placer during the rest of the year; the property was the largest gold producer at Marysville. O. A. Barnes moved the 1-cubic yard dragline and floating washing plant, previously operated at the Dutton Ranch property near Clancey in Jefferson County, to the Esperanza placer in Empire Gulch in May 1939; the plant handled 10,660 cubic yards of gravel at the Marysville location from August 1 to November 15. Other producing placers near Marysville in 1939 included the Chevallier, Deadman Gulch, and Trus-to-luck properties. The Rex Mining Co., operating the Empire group, again was the largest lode producer at Marysville; the company treated 14,065 tons of gold ore in the 50-ton concentration plant and shipped 459 tons of rich gold-lead concentrates to a smelter. The Martin Mining Co. treated more than 11,000 tons of tailings from the Eck property in a new 120-ton roasting and cyanidation mill. The J. C. Archibald Co. operated its cyanide mill from June 1 to October 31 and treated about 10,000 tons of Bald Butte tailings; in addition, lessees shipped nearly 1,200 tons of crude gold ore from the Bald Butte mine to smelters. Gold ore from the Big Ox and Albert Brown properties was treated by cyanidation. Lessees at the Drumlummon property shipped 1,720 tons of gold ore, a decrease from 2,430 tons in 1938. Crude ore was also shipped to smelters from the Belmont, Big Ox, Climax, Eureka, Excelsior, Mount Pleasant, Carbonate, Penobscot, Piegan-Gloster, Shannon, and Three M mines.

Missouri River district.—The 6-cubic foot dredge of the Perry-Schroeder Mining Co., which was put in operation in November 1938, operated throughout 1939 and treated 1,459,010 cubic yards of gravel from the Eldorado property 15 miles northeast of Helena. The Duclo Mining Co. operated a dragline and dry-land washer at the Gruell Bar. Production was also reported at the Golden Ring & Sunset, Howe, and Mable (Easterly) placers.

Rimini district.—All the output from lode mines near Rimini in 1939 was crude ore shipped to smelters; most of it was lead ore from the Anna May & Broadway property, shipped by lessees. Other lode producers included the Aurora, Johnny Tunnel, Lone Pine, Peerless Jennie, and Sunset mines. Most of the placer output came from the Black Eagle and Gould properties.

Scratch Gravel district.—Most of the output from the Scratch Gravel district in 1939 was gold ore shipped to smelters from the Ajax and Franklin mines. Crude ore was also shipped from the Gold Crown, Nettie, Silver Coin, and Umatilla properties.

Smelter district.—The fuming plant of the Anaconda Copper Mining Co., treating slag from the lead smelter of the American Smelting & Refining Co. at East Helena, operated throughout 1939, and the output of zinc-lead fume sent to Great Falls was double that in 1938. The value of the metal output increased $795,123 over 1938 and represented most of the gain in Lewis and Clark County.

Stemple district.—The Standard Silver-Lead Mining Co. operated throughout 1939 at the Gould property near Wilborn; 29,053 tons of ore (about the same quantity as in 1938) were treated in the 80-ton cyanidation plant, but the output of gold decreased from 6,265 to 5,652 ounces. Gold ore from the Prize mine was treated by cyanidation by Granite Butte Mines, Inc., and a car of crude ore was shipped to a smelter. The North Gould Mining Co. treated ore from the American Boy group by amalgamation. Small lots of gold ore were shipped to smelters from the Little Dandy and Red Star mines. A little placer gold was recovered by sluicing at the Diamond & Gem placer on Virginia Creek.

LINCOLN COUNTY

Libby district.—The Davis & White Mining Co. operated a 1-cubic yard power shovel and dry-land washing plant from June 1 to October 20, 1939, and treated about 33,000 cubic yards of gravel from the Liberty placer on Libby Creek. Other producing placers near Libby in 1939 included the Big Cherry Creek, Horsehoe, Last Chance, Libby (Brophy), and Logan (Nugget) properties. Gold ore was shipped to a smelter from the Golden West group.

Sylvanite district.—The Morning Glory Mines, Inc., operated the Sylvanite (Keystone) mine in 1939 and treated more than 14,000 tons of gold ore by amalgamation and concentration; the output of gold decreased slightly from that in 1938. Small lots of crude lead ore were shipped to smelters from the Black Diamond and Grouse Mountain properties.

Ural district.—L. C. Curtis & Sons operated a ⅜-cubic yard dragline and stationary washing plant during December 1939 and treated about 1,100 cubic yards of gravel from the Pioneer placer on the Kootenai River.

MADISON COUNTY

Cherry Creek (Havana) district.—Siliceous ore was shipped to smelters in 1939 from the East Riverside, New Havana, and September Syndicate mines, all on Cherry Creek east of Norris.

Norris district.—The Revenue mine in the Upper Hot Springs section was the largest producer in the Norris district in 1939; the mine and 80-ton cyanidation mill were operated the entire year by Revenue Mine Developing Group, Inc. The new mill, which was placed in operation in October 1938, treated 26,280 tons of ore from the Revenue mine in 1939 (compared with 6,400 tons in 1938), and the output of gold recovered in cyanide bullion increased to 3,997 ounces; in addition, the company shipped 302 tons of gold ore to a smelter; and the total output of gold was 4,180 ounces compared with 1,885 ounces in 1938. Gold produced from the Boaz mine 5 miles east of Norris decreased to 2,511 ounces in 1939, as the output of crude ore shipped to smelters decreased from 1,788 to 775 tons; however, a 60-ton cyanidation plant erected at the mine during 1939 was put in operation late in the year and treated about 1,500 tons of ore before the end of the year. Lessees operating the Lexington mine 5 miles southwest of Norris shipped 644 tons of gold ore to a smelter and sent 1,586 tons of ore to the Revenue mill, but the total output of gold decreased more than 500 ounces. The rest of the output from lode mines in the district was crude gold ore shipped to smelters from the Arctic, Boyles, Betty May, Billy, Bi-Metallic, Black Chief, Devil's Dream, Eldorado, Emperor, Erma & Lucky Strike, Fortuna, Galena, Gold Bug, Golden Link, Grubstake, Headlight, Josephine, Mascot & Pony, Monitor, Montida, New York Belle, Pulverizer, Rosebud, Santa Christo, Valdez, and Water Lode mines; most of it came from the Billy, Emperor, and Montida mines. Homer Wilson operated the 5-cubic foot dredge at the Norwegian placer from March 27 to December 22, 1939, and treated 239,805 cubic yards of gravel; the output of gold increased nearly 500 ounces.

Pony (Mineral Hill) district.—The Liberty Montana Mines Co. operated throughout 1939 at the Mammoth property and treated 28,324 tons of ore in the 120-ton mill compared with 30,862 tons in 1938, but the output of gold (in copper concentrates shipped to a smelter) decreased 1,115 ounces. The Montana Southern Mining Co. treated 36,317 tons of ore from the Atlantic-Pacific mine in the 100-ton flotation plant and produced 3,164 ounces of gold (almost the same quantity as in 1938) in gold concentrates shipped to a smelter. Crude ore was shipped to smelters from the Ben Harrison Fraction, Bozeman, Fraction, Galena, Katie, Keystone-Strawberry, Lone Wolf, McVey, Moonlight, Ridgeway, Whip-poor-will, White Pine, Whiterock, and Wolftone mines; most of it was gold ore from the Bozeman mine.

Renova (Bone Basin) district.—The West Mayflower Mining Co. (Anaconda Copper Mining Co.) in 1939 again was the largest gold producer in Montana; the company shipped 21,308 tons of gold ore, containing 19,734 ounces of gold and 113,084 ounces of silver, to the Anaconda smelter. Gold ore was also shipped to smelters from the Blue Bird, Colorado, Gold Hill, Lakewater, Last Chance Fraction, and Little Nugget properties.

Rochester (Rabbit) district.—The Lively Mining Co. treated 1,411 tons of gold ore in 1939 from the Hidden Treasure mine in a 12-ton amalgamation and concentration mill and shipped 38 tons of crude ore to a smelter. The Commonwealth Lead Mining Co. shipped 198 tons of lead ore from the Calvin mine to the East Helena smelter. Crude ore was also shipped to smelters from the Cooper, Gold Crown, Red Wing, Sandy, Shoemaker, and Struggler mines.

Sheridan district.—The Sheridan Gold Mining & Milling Co. shipped 417 tons of gold ore from the Homestake & Uncle Sam property in 1939 compared with 338 tons in 1938, but the output of gold decreased 340 ounces. The output from the Fairview group (operated by Fairview Gold Mines, Inc.) comprised 188 tons of gold ore and 33 tons of lead ore, a decrease from 457 tons of gold ore in 1938. Other producing lode mines in the Sheridan district included the Compipius, Cousin Jack, Cousin Jennie, Ella Jay, Gold Point, Goldsmith, Jonquil, Klondike, Lake Shore, Leiter, Lone Tree, Noble, North Star, Red Bird, Red Pine, Sage Hen, Silver Bullion, Sunbeam, and Tamarack mines. Most of the placer output came from drift mining at the Cash Boy & Lost Boy property; other producing placers included the Aurum, Blue Bird, Comet, Halloran, and Wisconsin Creek properties.

Silver Star district.—The value of the metal output of the Silver Star district increased from $231,850 in 1938 to $475,022 in 1939, owing chiefly to increased output of gold from the Broadway (Victoria) property operated by Victoria Mines, Inc. The company treated 32,991 tons of ore in the 100-ton cyanide mill (about the same quantity as in 1938), and the output of crude ore shipped direct to smelters increased from 193 to 5,314 tons. The Green Campbell Mining Co. operated the Green Campbell mine the entire year and treated several thousand tons of ore in the 25-ton amalgamation and flotation plant; the output of gold from the property increased 1,200 ounces. The Golden Rod Mining Co. continued to ship rich gold ore from the Golden Rod mine, but the output was less than half that in 1938. Gold ore was also shipped to smelters from the Aurora, Broomtree, Edgerton, Iron Rod, Moonlight, Ohio, Silver King, Stansell, and Wheal Clifford properties.

Tidal Wave district.—Most of the increase in metal output from the Tidal Wave district in 1939 was in gold ore shipped to smelters from the B & H property operated by the Inspiration Gold Mining Co. A little gold ore from the Agitator mine was amalgamated. Crude ore was shipped to smelters from the Corncracker, Hemmingway (Eleanora), Ella, High Ridge, Last Chance, Keynote, Lone Eagle, Lone Pine, Lottie, Pollinger, Silver Dollar, and Smith properties.

Virginia City district.—The value of the metal output of the Virginia City district in 1939 increased $89,941 over 1938, as the output of crude ore shipped to smelters increased. Lessees operating the Bartlett mine shipped 2,525 tons of gold ore to smelters, a marked increase over 1938; there was also an increase at the Mapleton property, as lessees shipped 3,614 tons of gold-silver ore to smelters. Crude ore was also shipped from the Alameda, Apex, Atlas Extension, Bamboo Chief, Bull Frog, Easton Pacific, El Fleda, Hansen, High Up, Homestake, Marietta, Oro Cache, Prospect, Randolph, R. B. P., St. John, Virginia City, and Winnetka properties. Gold ore from the Alder Gulch, Mountain Flower, and Valley View properties was treated in small amalgamation mills, and ore from the Easton Pacific mine was treated by flotation. Most of the placer output came from the Alder Gulch and Chambers properties.

Washington district.—All the placer output from the Washington district in 1939 was recovered by the 4½-cubic foot dredge operated by the Gold Creek Mining Co. at the Washington Bar property. Lessees operating the Missouri-McKee property treated 1,538 tons of gold ore by amalgamation and concentration and shipped 135 tons of gold ore to a smelter. Crude ore was also shipped to smelters from the Diamond Cross, Highland Lady, and Snowslide properties.

Willow Creek district.—The Buena Vista Mining Co. shipped a little silver ore from the Silver Mountain property 21 miles south of Alder to the Anaconda smelter in 1939.

MEAGHER COUNTY

Atlanta Creek district.—A little placer gold was recovered in 1939 from the ground-sluicing of 200 cubic yards of gravel at the Atlanta & Fox property.

Beaver Creek district.—Most of the output from the Beaver Creek district in 1939 came from operation of a 1-cubic yard power shovel and dry-land washing plant, which treated 29,786 cubic yards of gravel from a placer operated by the T. C. Mines. Other producing placers in the district included the Barton Gulch, Benton, and Watson properties.

Castle Mountain district.—A little copper ore was shipped in 1939 from the Bell of Castle mine on Hensley Creek, and a little lead ore was shipped from the Great Eastern prospect.

Thompson Gulch district.—A ¾-cubic yard power shovel and dry-land washer were operated from April 15 to June 15, 1939, and treated 1,050 cubic yards of gravel from the Little Buck property. A little placer gold came from the Camp Robber and Cornerstone properties.

MINERAL COUNTY

Cedar Creek district.—Superior Mines, Inc., operated a 1½-cubic yard power shovel and dry-land washer from April 12 to November 24, 1939, and treated about 90,000 cubic yards of gravel from the Cedar Creek property. Other producing placers in 1939 included the Alibi & Hungary, C. B. & Q., Dakota, Dr. Eddy & Nugget, Golden Sunset, Henrietta & Success, Lost Gulch, Lucky Boy, McFarland, Meadow Creek, No Name & Buck Tail, Oregon, Stemwinder, Stockholm, Sunlight, and Windfall properties. A car of gold ore was shipped from the Last Chance mine to the smelter at Anaconda.

Gold Mountain district.—The Gold Mountain Mines, Inc., treated a little gold ore in a 50-ton flotation- and blanket-concentration mill in 1939.

St. Regis district.—Small lots of gold ore were shipped to smelters in 1939 from the Gold Chrome and Jack mines.

MISSOULA COUNTY

Coloma district.—Gold ore from the Dandy and Mountain View properties was treated in small amalgamation and concentration mills in 1939; gold ore was shipped to smelters from the Clemantha, Dandy, Dixie, I. X. L., Mammoth, Northern Star, and Portia mines.

Elk Creek district.—The yield of placer gold from the Elk Creek district in 1939 increased 849 ounces over 1938, owing to increased output by the Norman Rogers Mining Co.; the company operated a dragline and dry-land washer from April 27 to December 16 and treated about 200,000 cubic yards of gravel. A dragline and floating washer were operated at the Piegan placer by W. S. Grubbs & Co. Other producing placers included the Betty Ann, Bob Cat, and Depression properties.

Nine Mile district.—The Ellis Gold Mines Co. operated a 1¼-cubic yard power shovel and dry-land washer from August 23 to December 23, 1939, and treated about 60,000 cubic yards of gravel from the Boyd placer on Eustache Creek. Other producing placers in the Nine Mile district included the Barrette, Crysalis, Hard Chance, Imperial, Kennedy Creek, Little Marion, Marion Creek, Oro, and The Bench properties. Several cars of gold ore were shipped from the San Martina lode mine.

Wallace district.—Crude copper ore from the Hidden Treasure mine was shipped to the smelter at Anaconda in 1939, and small lots of lead ore were shipped from the Adalin and Conflict properties.

PARK COUNTY

Crevasse district.—The Snowshoe Mining Co. operated its property from June 25 to October 1, 1939, and treated 1,165 tons of gold ore in the 25-ton amalgamation and concentration mill.

Emigrant Creek district.—Small-scale sluicing was continued in 1939 at placers on Emigrant Creek; most of the output came from the treatment of about 5,000 cubic yards of gravel from the Hefferlin property.

New World district.—The Irma Mines, Inc., treated several hundred tons of silver ore from the Irma & Republic property by flotation in 1939 and shipped rich silver-lead concentrates. A lessee shipped a small lot of gold ore from the Homestake mine.

Sheepeater (Jardine) district.—The Jardine Mining Co. operated throughout 1939 at the Jardine property 6 miles north of Gardiner; 51,130 tons of gold ore were treated in the 185-ton amalgamation and concentration plant, and 111 tons of crude gold ore were shipped to the smelter at Anaconda.

PHILLIPS COUNTY

Little Rockies district.—The Ruby Gulch Mining Co. continued regular operations in 1939 at the Ruby Gulch property at Zortman. The output comprised 82,369 tons of ore treated in the 300-ton cyanidation mill and 804 tons of gold ore shipped direct to smelters; the output of gold decreased nearly 600 ounces from 1938. The Little Ben Mining Co. treated 46,612 tons of ore from the August group in the 150-ton cyanidation plant compared with 53,581 tons in 1938; the output of gold decreased slightly. Most of the output of placer gold from the Little Rockies district came from the Big Slide and Dorothy & Snowball properties.

POWELL COUNTY

Big Blackfoot district.—The Hilda Gold Mining Co. operated the Blackfoot property 10 miles northeast of Helmville from April 5 to November 10, 1939, and shipped 217 tons of gold ore to the East Helena smelter. A little gold ore from the Hill Top mine was shipped also to East Helena. A test lot of gold ore from the Sweepstake group was amalgamated. Most of the placer output came from the Blue Jay and Gold Dust properties.

Nigger Hill (Elliston) district.—Ore from the Big Dick mine was treated by flotation in 1939 by Big Dick Mines, Inc., and nearly 500 tons of rich gold-lead concentrates were shipped to the East Helena smelter. Crude ore was shipped to smelters from the Carbonate Boy, Hattie M. & Annie R., Hub Camp, Kierstead, Little Blackfoot Queen, Ontario, Orphan Boy, and Speck mines. Most of the placer gold came from sluicing at the Blackfoot and Little Bear properties.

Ophir district.—In 1939 lessees hydraulicked about 20,000 cubic yards of gravel at the Levi Davis (Harpole) placer in Ophir Gulch.

Pioneer district.—In 1939 the 9-cubic foot dredge of the Pioneer Placer Dredging Co. was operated from January 1 to August 10 and from October 1 to December 31 and treated 1,114,505 cubic yards of gravel from property on Gold Creek; in 1938 the dredge operated the entire year and treated 1,866,840 cubic yards of gravel. The output of gold decreased more than 2,800 ounces. Other producing placers in the Pioneer district included the Cold Springs, Gold Star, Irwin, Murray Patent, Nellie B, and Orphan Boy properties. Gold ore from the Pike's Peak group was treated in a small amalgamation plant.

Race Track district.—Small lots of gold ore were shipped to smelters in 1939 from the Amazon and Dark Horse properties on Race Track Creek.

Washington Gulch district.—The Washington Gulch Leasing Co. and other lessees worked intermittently in 1939 at the Eldorado placer in Washington Gulch; about 42,000 cubic yards of gravel were treated in the dragline and dry-land washer during the year. Other producing placers in the Washington Gulch district included the Beatrice, Gold Bar, Good Luck, New Deal, Old Shoe, Rietz, Toole (Jefferson Creek Placers), and Whitetail properties. Most of the output from lode mines was gold ore from the Grey property. Small lots of crude ore were shipped from the Mascot property and from a prospect.

Zozell (Emery) district.—The entire output of the Zozell district in 1939 was crude ore shipped to smelters, chiefly from the Emery and Bonanza properties; other producers included the Blue Eyed Maggie, Emma Darling, and Hidden Hand properties.

RAVALLI COUNTY

Curlew district.—There was a marked decrease in the value of the metal output of the Curlew district, as the 100-ton flotation plant, which treated nearly 18,000 tons of old tailings from the Curlew dumps in 1938, was not operated in 1939; the district output in 1939 comprised siliceous ore and lead ore from the Curlew mine shipped to smelters and a small lot of silver ore from the Pleasant View mine.

Overwich district.—Placer gold and silver were recovered at the Hogue and Hughes Creek properties in 1939. Gold ore from the Baker-Brickley and Washington mines was amalgamated.

SANDERS COUNTY

Eagle district.—A decrease of $109,271 from 1938 was recorded in the value of the metal output of the Eagle district in 1939, as the output of zinc-lead ore from the Jack Waite mine dropped from 43,390 to 36,028 tons; the property, which extends over the State line into Shoshone County, Idaho, was operated the entire year by the American Smelting & Refining Co. The milling ore was treated in the flotation plant at Duthie, Idaho. In addition, the company shipped 1,013 tons of rich lead ore in 1939, compared with 1,278 tons in 1938.

Revais Creek district.—In 1939 the Green Mountain Mining Co. shipped 287 tons of rich copper ore from the Drake property on Revais Creek near Dixon to the smelter at Anaconda.

Trout Creek district.—The Gold Lode Mining Co. treated a little ore from the Golden Reef mine in a small amalgamation and concentration mill in 1939. Other producers in the Trout Creek district included the Ambassador, Heidelberg, and Montana Standard properties.

Vermillion district.—All the output from the Vermillion district in 1939 came from sluicing at the Mammy Lou & Driftwood and Ogoma placers on the Vermillion River.

SILVER BOW COUNTY

The total value of the metal output from mines in Silver Bow County in 1939 increased $9,376,536 over 1938, as the output of both copper ore and zinc-lead ore from mines at Butte increased. The following table gives the output of mines in Silver Bow County, which includes the Butte or Summit Valley district, in 1938 and 1939 and the total from 1882 (the first year for which detailed records are available) to the end of 1939.

Production of gold, silver, copper, lead, and zinc in Silver Bow County, Mont., 1938–39, and total, 1882–1939, in terms of recovered metals

Year	Mines producing	Ore	Gold (lode and placer)	Silver (lode and placer)	Copper	Lead	Zinc	Total value
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1938	55	1,642,491	15,147	4,018,192	153,709,857	414,978	1,883,417	$18,300,823
1939	57	2,498,922	22,036	6,114,455	194,533,471	9,415,341	40,032,288	27,677,359
1882–1939	--------	(1)	1,898,219	500,017,146	[2] 5,753,806	[2] 198,247	[2] 1,435,922	2,333,039,695

[1] Figures not available. [2] Short tons.

Butte or Summit Valley district.—The output of copper ore from the Butte mines of the Anaconda Copper Mining Co. increased in 1939 owing to increased rate of operations during the last 4 months of the year. The output comprised 2,197,863 tons of ore sent to the copper concentrator at Anaconda (compared with 1,561,186 tons in 1938) and 54,075 tons of crude ore sent direct to the smelter (compared with 45,161 tons in 1938); the output of cement copper from the mine-water precipitation plants decreased slightly. Operations were resumed at the Butte zinc properties of the company in March 1939 after a shutdown of more than a year; during the remainder of the year 200,036 tons of zinc-lead ore were shipped to the zinc concentrator at Anaconda, a marked increase from the output (2,638 tons) in 1938. The output of recoverable metals (from all classes of materials) increased greatly in 1939—gold increased more than 4,900 ounces, silver more than 2,000,000 ounces, copper nearly 41,000,000 pounds, lead about 8,400,000 pounds, and zinc nearly 36,000,000 pounds. Mine development at the copper mines in 1939 comprised 237 feet of shaft sinking, 147,953 feet of drifting, and 8,537 feet of diamond drilling; at the zinc properties 17,775 feet of drifting and 1,939 feet of diamond drilling were reported. Mining of zinc-lead ore was resumed in December 1939 at the Emma mine (owned by the Butte Copper & Zinc Co. but operated under lease by the Anaconda Copper Mining Co.); the mine had been closed since January 1938. The output in 1939 comprised 5,741 tons of zinc-lead ore sent to the mill at Anaconda; in addition, the company produced 6,199 short tons of manganese ore. Other producers of zinc-lead ore shipped to mills included the Amy Silversmith, Amy X, Green Copper, Josephine, Magna Charta, Minnie Jane, Wappello, and Wild Pat properties. The rest of the output from the Butte district was crude ore shipped to smelters from the Alice, Amy Silversmith, Black Rock, Bluebird, Brophy, Eveline & Twilight, Fayal, Green Copper, Illinois, Josephine, Lavena, Lexington, Magna Charta, Margaret Ann, Pittsmont, Quarter Moon, Sailor's Dream, Sunny Dell, Valdemere, and Wild Pat properties.

Divide Creek district.—Siliceous ore was shipped to smelters in 1939 from the Gallinipper, Homestead, Margaret, and Queen of the Hills properties.

German Gulch district.—Most of the output from the German Gulch district in 1939 came from sluicing operations at the Beal placer.

Highland district.—The Butte Highlands Mining Co. operated throughout 1939 at the Highlands property 20 miles southwest of Butte; 19,504 tons of ore were treated in the cyanidation mill, and the output of gold increased to 9,936 ounces from 8,849 ounces in 1938. The rest of the Highland district output comprised crude ore shipped to a smelter from the Highland Queen and North Highland properties and small lots of placer gold from several prospects.

Independence district.—In 1939 lessees shipped 622 tons of silver ore from the Goldflint mine to the smelter at Anaconda.

SWEET GRASS COUNTY

Independence district.—A little gold ore from the Daisy property on Basin Creek 55 miles south of Big Timber was treated in a small table-concentration mill in 1939, and a car of crude gold ore was shipped direct to a smelter.

TOOLE COUNTY

Gold Butte district.—There was a decrease in gold from Toole County in 1939 owing to suspension of operations at Gold Butte Placers late in 1938; the 1939 output came from the Banner, Cummings, Gopher, and Small placers.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEVADA

(MINE REPORT)

By Charles White Merrill and H. M. Gaylord

SUMMARY OUTLINE

In 1939 copper displaced gold as Nevada's most valuable mineral product, but neither the quantity nor the total value of the copper output reached the mark set in 1937. Gold production exceeded in quantity that in each year since 1916 and in value since 1912. The total value of the gold, silver, copper, lead, and zinc (each calculated in terms of recovered metal) produced in Nevada in 1939—$30,480,-870—exceeded that in each year (except 1937) since 1929. Comparing 1939 with 1938, gold increased 22 percent in both quantity and total value, silver decreased 1 percent in quantity but increased 4 percent in value, copper increased 44 percent in quantity and 53 percent in value, lead decreased 9 percent in quantity and 7 percent in value, and zinc decreased 30 percent in quantity and 25 percent in value. The total value of the five metals was 30 percent greater than in 1938; of the total, copper comprised 45 percent, gold 42 percent, silver 10 percent, zinc 2 percent, and lead 1 percent.

White Pine County continued in 1939 to be the largest contributor to the mineral output of the State; it ranked first in both copper and gold and fourth in silver. Esmeralda County was the leading producer of silver and Lincoln County the leading producer of both zinc and lead.

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, 1935–39

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1935	$35.00	$0.71875	$0.083	$0.040	$0.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052

[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] 1935–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–39: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464.
[5] $0.67878787.

Mine production of gold, silver, copper, lead, and zinc in Nevada, 1935–39, and total, 1859–1939, 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
1935	706	149	4,392,819	188,031	$6,581,085	4,393,426	$3,157,775
1936	661	119	6,584,138	286,370	10,022,950	5,068,786	3,925,775
1937	682	117	7,565,466	281,332	9,846,620	4,864,750	3,762,884
1938	795	130	5,880,021	296,434	10,375,190	4,355,471	2,815,658
1939	891	104	6,894,999	361,518	12,653,130	4,316,029	2,929,668
1859–1939[2]			(3)	24,025,110	519,440,526	569,700,164	526,451,794

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1935	74,266,000	$6,164,078	25,352,000	$1,014,080	31,072,000	$1,367,168	$18,284,186
1936	141,392,000	13,008,064	21,424,000	985,504	26,954,000	1,347,700	29,289,993
1937	149,206,000	18,053,926	18,694,000	1,102,946	28,472,000	1,850,680	34,617,056
1938	92,338,000	9,049,124	9,358,000	430,468	17,888,000	858,624	23,529,064
1939	133,194,000	13,852,176	8,472,000	398,184	12,456,000	647,712	30,480,870
1859–1939[2]	[4] 1,308,129	384,140,922	[4] 499,837	53,261,461	[4] 231,877	31,702,976	1,514,997,679

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

[2] Compiled by Chas. W. Henderson, supervising engineer, field offices, Denver, Colo. From 1904 (when first satisfactory annual canvass of mine production was made) to 1939, inclusive, the output was as follows: Gold, 12,198,233.51 ounces, valued at $274,957,293; silver, 281,287,315 ounces, $189,293,571; copper, 1,306,203 short tons, $383,494,294; lead, 262,046 short tons, $30,624,899; zinc, 231,877 short tons, $31,702,976; total value, $910,073,033.

[3] Figures not available.

[4] Short tons.

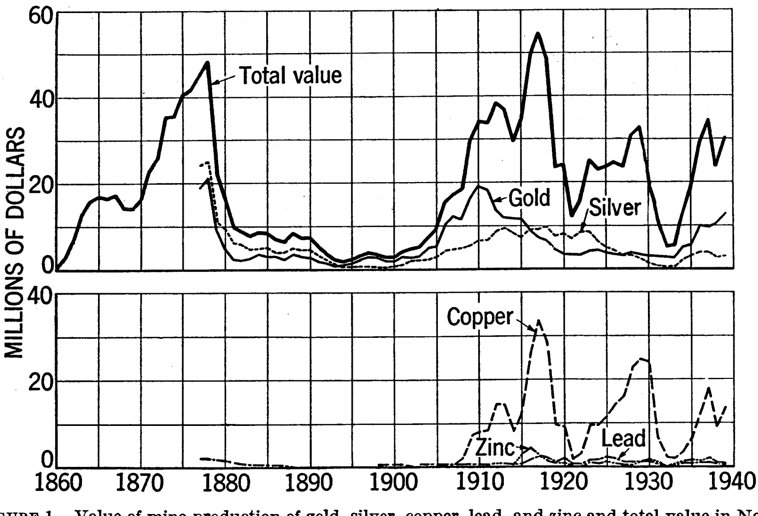

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value in Nevada, 1860–1939.

Gold.—Almost three-fourths of the recoverable gold output of Nevada in 1939 was derived from dry ores, chiefly gold ore, and virtually all the gold from base-metal ores came from copper ore. Placer gold comprised 9 percent of the State total, and the output was more than twice that in 1938. Five companies produced 47 percent of the State total gold, and the 10 leading mines, listed in the following table, supplied 56 percent.

Ten leading gold-producing mines in Nevada in 1939, in order of output

Rank	Mine	District	County	Rank in 1938	Operator	Source of gold
1	Getchell	Potosi	Humboldt	3	Getchell Mine, Inc	Gold ore.
2	Emma Nevada	Robinson	White Pine	2	Consolidated Coppermines Corporation and lessees.	Copper ore.
3	Mary	Silver Peak	Esmeralda	1	Black Mammoth Consolidated Mining Co. and Prescott Lease.	Gold ore.
4	Ruth and Copper Flat Pit.	Robinson	White Pine	4	Nevada Consolidated Copper Corporation.	Copper ore.
5	Manhattan dredge	Manhattan	Nye	(1)	Manhattan Gold Dredging Co.	Dredge.
6	Chiquita	Yellow Pine	Clark	7	Chiquita Mining Co., Ltd	Gold ore.
7	Keystone	Comstock	Storey	47	Dayton Consolidated Mines Co.	Do.
8	Penelas	Phonolite	Nye	9	Penelas Mining Co	Do.
9	Emma E	Cortez	Eureka	16	Greenan & Co., Inc	Do.
10	Silver Hill	Comstock	Storey	14	Silver Hill Mining Co	Do.

1 Operation began November 15, 1938; no regular clean-up made until 1939.

Silver.—The 10 leading silver-producing mines in Nevada in 1939, listed in the following table, produced 54 percent of the State total recoverable silver; the first 3 yielded more than one-third of the total. As in preceding years, most of the silver output was a byproduct of ore mined chiefly for other metals.

Ten leading silver-producing mines in Nevada in 1939, in order of output

Rank	Mine	District	County	Rank in 1938	Operator	Source of silver
1	Nivloc	Silver Peak	Esmeralda	1	Desert Silver, Inc	Silver ore.
2	Mizpah	Tonopah	Nye	2	Lessees of The Tonopah Mining Co. of Nevada.	Gold-silver ore.
3	Pioche Nos. 1 and 2	Pioche	Lincoln	4	Combined Metals Reduction Co.	Zinc-lead ore.
4	Tonopah Belmont	Tonopah	Nye	5	Lessees of Tonopah Belmont Development Co.	Gold-silver ore.
5	Overman	Comstock	Storey	7	Consolidated Chollar Gould & Savage Mining Co.	Do.
6	Ruth and Copper Flat Pit.	Robinson	White Pine	9	Nevada Consolidated Copper Corporation.	Copper ore.
7	Crown Point	Comstock	Storey	8	Sutro Tunnel Coalition, Inc.	Gold-silver ore.
8	Bristol Silver	Jack Rabbit	Lincoln	6	Bristol Silver Mining Co	Silver ore.
9	Jubilee and Techatticup.	Eldorado Canyon.	Clark	14	Diamond Gold Mining Co.	Gold-silver ore.
10	Nevada Wonder	Wonder	Churchill	17	Various lessees	Do.

Copper.—Over 98 percent of the recoverable copper output of Nevada in 1939 came from mines operated by the following companies: Nevada Consolidated Copper Corporation, working the Ruth mine at

Ruth and the open pit at Copper Flat (in the Robinson district, White Pine County); the Consolidated Coppermines Corporation, working the Emma Nevada mine at Kimberly (also in the Robinson district); and the Mountain City Copper Co., working the Mountain City mine at Mountain City (in the Cope district, Elko County). During 1938 a curtailment program was in effect at all these mines, but during 1939 output was expanded.

Lead.—Lincoln County produced over three-fourths of the total recoverable lead output of Nevada in 1939, most of which came from the Pioche district. Three-fifths of the State total lead was derived from zinc-lead ore mined at the Pioche Nos. 1 and 2 mines by the Combined Metals Reduction Co., affiliate of the National Lead Co. Small quantities of lead were reported from many districts, including the Jack Rabbit (Lincoln County), Yellow Pine (Clark County), and Delano, Merrimac, and Spruce Mountain (Elko County).

Zinc.—Over nine-tenths of the recoverable zinc output of Nevada in 1939 was produced by the Combined Metals Reduction Co. from zinc-lead ore mined at the Pioche Nos. 1 and 2 mines in the Pioche district of Lincoln County. The Yellow Pine district of Clark County was the only other area in the State that produced a substantial quantity of zinc.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1939, by counties, in terms of recovered metals

County	Mines producing [1]		Gold						Silver (lode and placer)	
	Lode	Placer	Lode		Placer		Total			
			Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Churchill	32		3,233	$113,155			3,233	$113,155	196,067	$133,088
Clark	60		24,026	840,910			24,026	840,910	315,669	214,272
Douglas	4	(2)	26	910	2	$70	28	980	106	72
Elko	64	4	5,586	195,510	22	770	5,608	196,280	195,505	132,706
Esmeralda	36	7	52,338	1,831,830	56	1,960	52,394	1,833,790	914,720	620,901
Eureka	30	10	10,039	351,365	305	10,675	10,344	362,040	158,376	107,504
Humboldt	54	7	58,106	2,033,710	394	13,790	58,500	2,047,500	56,405	38,287
Lander	56	10	8,613	301,455	2,465	86,275	11,078	387,730	82,735	56,160
Lincoln	35		7,249	253,715			7,249	253,715	514,345	349,131
Lyon	58	5	11,348	397,180	873	30,555	12,221	427,735	58,990	40,042
Mineral	102	2	4,192	146,720	74	2,590	4,266	149,310	104,709	71,075
Nye	126	25	25,051	876,785	25,230	883,050	50,281	1,759,835	733,347	497,787
Ormsby	3		52	1,820			52	1,820	523	355
Pershing	69	27	4,992	174,720	2,205	77,175	7,197	251,895	62,362	42,331
Storey	46	1	33,629	1,177,015	12	420	33,641	1,177,435	415,584	282,093
Washoe	19	3	1,827	63,945	52	1,820	1,879	65,765	2,079	1,411
White Pine	97	3	78,653	2,752,855	868	30,380	79,521	2,783,235	504,507	342,453
	891	104	328,960	11,513,600	32,558	1,139,530	361,518	12,653,130	4,316,029	2,929,668
Total, 1938	795	130	283,475	9,921,625	12,959	453,565	296,434	10,375,190	4,355,471	2,815,658

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Output from property not classed as a "mine."

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1939, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Churchill			96,000	$4,512			$250,755
Clark	36,000	$3,744	402,000	18,894	696,000	$36,192	1,114,012
Douglas							1,052
Elko	28,302,000	2,943,408	680,000	31,960	192,000	9,984	3,314,338
Esmeralda	4,000	416	20,000	940			2,456,047
Eureka	8,000	832	132,000	6,204			476,580
Humboldt	8,000	832	44,000	2,068	6,000	312	2,088,999
Lander	934,000	97,136	68,000	3,196			544,222
Lincoln	682,000	70,928	6,446,000	302,962	11,474,000	596,648	1,573,384
Lyon	12,000	1,248					469,025
Mineral	4,000	416	134,000	6,298			227,099
Nye	4,000	416	132,000	6,204			2,264,242
Ormsby							2,175
Pershing	14,000	1,456	128,000	6,016	16,000	832	302,530
Storey	2,000	208	2,000	94			1,459,830
Washoe							67,176
White Pine	103,184,000	10,731,136	188,000	8,836	72,000	3,744	13,869,404
	133,194,000	13,852,176	8,472,000	398,184	12,456,000	647,712	30,480,870
Total, 1938	92,338,000	9,049,124	9,358,000	430,468	17,888,000	858,624	23,529,064

MINING INDUSTRY

Expansion of production at the three large copper mines in Nevada in 1939 resulted in the increased tonnage of ore treated compared with 1938. Increases were as follows: Copper ore, 22 percent; dry ores, 7 percent; and old tailings, 14 percent. Output of zinc-lead ore decreased 29 percent. The connected-bucket dredge of the Manhattan Gold Dredging Co. in the Manhattan district, Nye County, completed its first full year of operation in 1939; the output of this dredge was the principal cause of the 151-percent increase in yield of placer gold in the State in 1939. Quicksilver consumption at placer mines totaled 871 pounds.

ORE CLASSIFICATION

The following table classifying ores produced in Nevada in 1939 shows that nearly 72 percent of the tonnage of ore (including old tailings) sold or treated was copper ore, 22 percent gold ore, 4 percent gold-silver ore, nearly 2 percent silver ore, and the remainder (less than 1 percent) zinc-lead, lead, lead-copper, and zinc ores.

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore and old tailings sold or treated in Nevada in 1939, with content in terms of recovered metals

Source	Ore and old tailings treated		Gold	Silver	Copper	Lead	Zinc
	Ore	Old tailings					
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold ore	889,273	605,723	219,419	476,795	146,900	102,000	
Dry and siliceous gold-silver ore	293,374	12,419	34,919	1,731,713	16,100	187,500	
Dry and siliceous silver ore	103,053	3,209	4,415	1,340,602	688,000	797,300	189,500
	1,285,700	621,351	258,753	3,549,110	851,000	1,086,800	189,500
Copper ore	4,936,001		68,028	280,654	132,291,600	3,200	
Lead ore	6,725	5	1,266	225,992	26,200	2,166,700	8,200
Lead-copper ore	219		3	2,118	22,400	117,900	
Zinc ore	150			12		1,700	95,800
Zinc-lead ore	44,848		910	248,000	2,800	5,095,700	12,162,500
Total, lode mines	6,273,643	621,356	328,960	4,305,886	133,194,000	8,472,000	12,456,000
Total, placers			32,558	10,143			
	6,273,643	621,356	361,518	4,316,029	133,194,000	8,472,000	12,456,000
Total, 1938	5,334,330	545,691	296,434	4,355,471	92,338,000	9,358,000	17,888,000

METALLURGIC INDUSTRY

Of the 6,894,999 tons of lode material sold or treated in 1939 in Nevada 72 percent was ore sent to concentrating mills, 16 percent was ore sent to amalgamation and cyanidation mills, 9 percent was old tailings sent to amalgamation and cyanidation mills, and 3 percent was ore (including small quantity of old tailings) sent to smelters. The only changes from 1938, aside from a general increase in State total tonnage, was a small gain in the proportion treated in concentrating mills and an attendant loss in the proportion treated in amalgamation and cyanidation mills. In 1939, as in 1938, flotation was employed at concentration mills to the virtual exclusion of gravity concentration. A much larger tonnage of material was cyanided than amalgamated, and cyanidation was used in treating old tailings almost to the exclusion of other methods. Of the gold recovered as bullion, cyanidation accounted for 83 percent and amalgamation 17 percent; of the silver recovered as bullion, 97 percent was derived by cyanidation and 3 percent by amalgamation. The total quantity of crude ore shipped to smelters increased 11 percent over 1938; there was little change in the quantity of dry ores shipped to smelters, but there were substantial increases in copper ore and lead ore. The 500-ton cyanide plant constructed by the

Standard Cyaniding Co. in the Imlay district, Pershing County, was an outstanding addition to the metallurgical equipment of the State; production at this plant began November 7.

Quicksilver consumption in Nevada in 1939 at mills using amalgamation was 5,691 pounds in the recovery of 33,050 ounces of gold and 44,458 ounces of silver from 307,959 tons of material treated.

Data obtained on cyanide consumption in 1939 at Nevada mills are nearly complete. In the treatment of 691,931 tons of the ore and 606,661 tons of the old tailings, 872,668 pounds of 91-percent sodium cyanide and 45,000 pounds of commercial-grade calcium cyanide (50-percent NaCN equivalent) were used, with a recovery of 123,443 ounces of gold and 1,182,347 ounces of silver; in terms of 98-percent NaCN, the consumption was 833,294 pounds, or 0.64 pound per ton of material treated.

Custom mills were operated in various parts of Nevada during 1939. Those of importance were at Silver City, Lyon County; Westgate, Churchill County; Gold Point, Esmeralda County; and Nelson, Clark County. Most of the custom mills obtained part of their mill feed from mines worked by the mill operators. Large quantities of ore and concentrates were shipped out of the State, principally to lead and copper smelters in the Salt Lake Basin. The Bauer (Utah) plant of the Combined Metals Reduction Co. treated all the company zinc-lead ore mined at Pioche, Lincoln County. The McGill copper smelter at McGill in White Pine County, operated by the Nevada Consolidated Copper Corporation, continued in 1939 to be the only smelter and the most important metallurgical plant in the State; the concentrator (18,000 tons daily capacity), operated by the same company, was the largest mill in the State.

Mine production of metals in Nevada in 1939, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore, old tailings, and concentrates amalgamated	307,959	33,050	44,458			
Ore, old tailings, sands, slimes, and concentrates cyanided	1,507,366	162,986	1,626,049	[1] 2,000		
Concentrates smelted:						
Flotation	256,617	80,928	727,591	119,675,400	5,173,900	11,688,000
Gravity	91	460	2,741	700	2,100	
Ore and old tailings smelted	192,735	51,536	1,905,047	13,515,900	3,296,000	768,000
Total, lode mines		328,960	4,305,886	133,194,000	8,472,000	12,456,000
Total, placers		32,558	10,143			
		361,518	4,316,029	133,194,000	8,472,000	12,456,000
Total, 1938		296,434	4,355,471	92,338,000	9,358,000	17,888,000

[1] From cyanide precipitates.

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Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Nevada in 1939, by types of mills and by counties, in terms of recovered metals

County	Material treated		Recovered in bullion		Concentrates smelted and recovered metal				
	Ore [1]	Old tailings	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
AMALGAMATION MILLS									
Churchill	319		38	107					
Clark	24,052	351	3,376	1,322	568	6,406	76,758	2,400	100
Douglas	14		11	1					
Elko	1,475		431	1,083	1	4	120		
Esmeralda	85,441		4,084	1,338					
Humboldt	34,454		7,850	4,090	6	9	10		
Lander	420		169	34					
Lyon	14,837		1,807	2,821					
Mineral	1,622	160	386	329	2	25	104		
Nye	20,372	150	4,373	2,245	207	1,402	957		100
Ormsby		8	1	29					
Pershing	3,542	30	1,254	846	6	15	30		
Storey	115,866	2,858	9,212	29,878	344	1,575	7,279	500	1,000
Washoe	1,374	100	13	317					
White Pine	514		45	18	3	13	19		
	304,302	3,657	33,050	44,458	1,137	9,449	85,277	2,900	1,200
Total, 1938	456,391	2,094	35,151	28,901	3,569	23,718	244,726	6,700	35,600
CYANIDATION MILLS									
Churchill	5,229	2,376	1,537	68,771	1	2	78		
Clark	93,629		11,963	126,483	214	1,346	82,692	600	2,300
Douglas	45		15	105					
Elko	29,200	1,159	2,822	57,173					
Esmeralda	175,759	[2] 414,857	40,922	884,846	270	1,972	1,394		3,800
Eureka	12,220		5,957	1,618					
Humboldt	278,999	165	49,051	3,185					
Lander	11,270		2,113	1,931					
Lincoln		168,966	3,798	16,216					
Lyon	18,939	21,081	9,449	54,600	5	45	50		
Mineral	4,703		2,103	9,728					
Nye	26,091		8,699	17,359	2	17	9		
Ormsby	6	69	47	483					
Pershing	20,684	1,630	1,300	5,378	3	8	50		
Storey	218,470	78	22,493	372,168	1	7	244		
Washoe	23		709	283					
White Pine	18	1,700	8	5,722					
	895,285	[2] 612,081	162,986	1,626,049	496	3,397	84,517	600	6,100
Total, 1938	638,163	[3] 532,977	116,765	1,351,128	113	2,066	7,175		4,800
Grand total:									
1939	1,199,587	[2] 615,738	196,036	1,670,507	1,633	12,846	169,794	3,500	7,300
1938	1,094,554	[3] 535,071	151,916	1,380,029	3,682	25,784	251,901	6,700	40,400

[1] Figures under "Ore" include both raw ore and concentrates amalgamated or cyanided but not raw ore concentrated before amalgamation or cyanidation of concentrates.
[2] Yielded also 2,000 pounds of copper from cyanide precipitates.
[3] Yielded also 1,300 pounds of copper from cyanide precipitates.

Gross metal content of concentrates from concentrating mills treating Nevada ore and old tailings in 1939, by classes of concentrates

Class of concentrates	Concentrates produced	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	8,186	1,228	11,172	1,679	201,426	311,926
Dry gold-silver	257	283	9,455	736	7,806	2,527
Dry silver	30		697	503	1,030	1,534
Copper	230,630	66,274	254,820	126,925,359	412	
Lead	4,434	668	252,431	3,529	4,985,646	668,343
Zinc	11,531	89	31,897	2,241	234,993	12,988,867
Zinc-lead	7		66		1,053	7,655
	255,075	68,542	560,538	126,934,047	5,432,366	13,980,852
Total, 1938	209,618	48,498	876,854	90,588,243	6,605,824	20,033,444

Mine production of metals from concentrating mills in Nevada in 1939, in terms of recovered metals

BY COUNTIES

	Ore treated	Concentrates smelted and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Elko	114,923	36,749	384	55,143	16,383,200	211,900	192,000
Humboldt	1,218	101	246	7,573	200	500	6,000
Lander	3,045	618	131	15,724	110,700	6,300	
Lincoln	43,493	23,434	910	246,310		4,886,500	11,474,000
Lyon	118	2	25	409	300		
Mineral	3,700	23	473	4,332		2,000	
Pershing	187	74		7,284	3,000	31,000	16,000
Storey	5,101	46	195	1,163	1,500	300	
White Pine	4,792,815	194,028	66,178	222,600	103,173,700	30,200	
	4,964,600	255,075	68,542	560,538	119,672,600	5,168,700	11,688,000
Total, 1938	4,134,380	209,618	48,498	876,854	86,873,800	6,306,300	16,836,000

BY CLASSES OF CONCENTRATES

	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
Dry gold	8,186	1,228	11,172	1,500	161,200	
Dry gold-silver	257	283	9,455	700	6,200	
Dry silver	30		697	400	500	
Copper	230,630	66,274	254,820	119,665,700	300	
Lead	4,434	668	252,431	2,675	4,779,700	
Zinc	11,531	89	31,897	1,625	219,800	11,681,100
Zinc-lead	7		66		1,000	6,900
	255,075	68,542	560,538	119,672,600	5,168,700	11,688,000

Gross metal content of concentrates produced from ores mined in Nevada in 1939, by classes of concentrates

Class of concentrates	Concentrates produced	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	9,645	12,870	97,797	2,965	206,763	311,926
Dry gold-silver	430	1,482	92,604	3,704	10,236	2,527
Dry silver	30		697	503	1,030	1,534
Copper	230,630	66,274	254,820	126,925,359	412	
Lead	4,435	673	252,451	3,529	4,985,750	668,343
Zinc	11,531	89	31,897	2,241	234,993	12,988,867
Zinc-lead	7		66		1,053	7,655
	256,708	81,388	730,332	126,938,301	5,440,237	13,980,852
Total, 1938	213,300	74,282	1,128,755	90,598,250	6,648,334	20,033,444

Mine production of metals from Nevada concentrates shipped to smelters in 1939, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Churchill	1	2	78			
Clark	782	7,752	159,450	3,000	2,400	
Elko	36,750	388	55,263	16,383,200	211,900	192,000
Esmeralda	270	1,972	1,394		3,800	
Humboldt	107	255	7,583	200	500	6,000
Lander	618	131	15,724	110,700	6,300	
Lincoln	23,434	910	246,310		4,886,500	11,474,000
Lyon	7	70	459	300		
Mineral	25	498	4,436		2,000	
Nye	209	1,419	966		100	
Pershing	83	23	7,364	3,000	31,000	16,000
Storey	391	1,777	8,686	2,000	1,300	
White Pine	194,031	66,191	222,619	103,173,700	30,200	
	256,708	81,388	730,332	119,676,100	5,176,000	11,688,000
Total, 1938	213,300	74,282	1,128,755	86,880,500	6,346,700	16,836,000

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
Dry gold	9,645	12,870	97,797	2,200	166,100	
Dry gold-silver	430	1,482	92,604	3,500	8,500	
Dry silver	30		697	400	500	
Copper	230,630	66,274	254,820	119,665,700	300	
Lead	4,435	673	252,451	2,675	4,779,800	
Zinc	11,531	89	31,897	1,625	219,800	11,681,100
Zinc-lead	7		66		1,000	6,900
	256,708	81,388	730,332	119,676,100	5,176,000	11,688,000

Gross metal content of Nevada crude ore shipped to smelters in 1939, by classes of ore

Class of ore	Ore	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold	52,540	31,943	87,353	146,015	114,896	
Dry and siliceous gold-silver	67,457	15,272	1,081,116	15,929	150,351	
Dry and siliceous silver	29,323	862	444,523	771,735	656,174	341,738
Copper	29,549	1,759	25,858	13,017,702	4,118	
Lead	6,605	1,264	224,616	33,802	2,276,116	51,345
Lead-copper	219	3	2,118	25,949	125,239	
Zinc	132				2,048	112,452
Zinc-lead	1,262				271,549	847,843
	187,087	51,103	1,865,584	14,011,132	3,600,491	1,353,378
Total, 1938	168,646	[1] 56,597	[1] 1,767,425	5,717,447	3,363,817	1,307,804

[1] Includes gold and silver in 349 tons of gold-silver old tailings, metal content of which was not reported separately.

Mine production of metals from Nevada crude ore shipped to smelters in 1939, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Churchill	4,236	1,656	127,111		96,000	
Clark	2,959	935	28,414	33,000	399,600	696,000
Elko	27,997	1,709	64,698	11,918,800	468,100	
Esmeralda	2,678	5,360	27,127	2,000	16,200	
Eureka	14,973	4,082	156,736	8,000	132,000	
Humboldt	2,486	950	41,494	7,800	43,500	
Lander	16,212	6,200	64,747	823,300	61,700	
Lincoln	18,715	2,458	242,982	681,100	1,501,000	
Lyon	138	22	682	11,700		
Mineral	4,833	1,205	90,172	4,000	132,000	
Nye	29,280	10,560	704,018	4,000	131,900	
Ormsby	2	4	11			
Pershing	2,099	2,415	48,377	11,000	95,000	
Storey	114	147	4,837		700	
Washoe	1,998	1,105	1,438			
White Pine	58,367	12,295	262,740	10,300	157,800	72,000
	187,087	51,103	1,865,584	13,515,000	3,235,500	768,000
Total, 1938	168,646	[1] 56,597	[1] 1,767,425	5,454,100	2,932,800	1,052,000

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous gold	52,540	31,943	87,353	139,700	92,100	
Dry and siliceous gold-silver	67,457	15,272	1,081,116	14,100	118,500	
Dry and siliceous silver	29,323	862	444,523	686,400	570,600	
Copper	29,549	1,759	25,858	12,626,200	2,900	
Lead	6,605	1,264	224,616	26,200	2,141,900	
Lead-copper	219	3	2,118	22,400	117,900	
Zinc	132				1,400	89,800
Zinc-lead	1,262				190,200	678,200
	187,087	51,103	1,865,584	13,515,000	3,235,500	768,000

[1] Includes gold and silver from 349 tons of gold-silver old tailings, metal content of which was not reported separately.

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1939, by counties and districts, in terms of recovered metals [1]

County and district [1]	Mines producing [2]		Ore and old tailings	Gold			Silver (lode and placer) [3]	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Churchill County:											
Alpine	1		26	3		3	1,272				$968
Broken Hills	1		69	1		1	1,236				874
Dixie Valley	6		2,372	376		376	600				13,567
Eagleville [4]	1		3	6		6	1				211
Eastgate	6		881	297		297	3,710				12,913
Fairview	8		2,341	641		641	48,982		89,300		59,880
Holy Cross	1		29	36		36	9,898		6,700		8,294
Sand Springs	3		328	209		209	10,442				14,403
Wonder	4		5,811	1,643		1,643	119,825				138,841
Clark County:											
Crescent	5		338	118		118	5,701		5,400		8,254
Eldorado Canyon	11		71,178	11,538		11,538	305,019	1,300	3,300		611,163
Gold Butte	1		6,235	509		509	174				17,933
Pyramid	2		6	15		15	4		200		537
Searchlight	28		2,035	1,471		1,471	1,682	9,400	14,200		54,272
Yellow Pine	13		41,154	10,375		10,375	3,089	25,300	378,900	696,000	421,853
Douglas County:											
Mt. Siegel		(5)			2	2					70
Mountain House	2		45	15		15	105				596
Elko County:											
Alder	2		14	8		8	311				491
Centennial	2		523	391		391	301	200	5,500		14,169
Contact	8		207	6		6	1,012	29,700	100		3,990
Cope	8	3	134,788	96	17	113	39,690	28,129,700			2,956,385
Cornucopia	2		2,014	224		224	16,509				19,046
Delano	4		921	2		2	24,572	400	311,300		31,422
Ferguson Springs	1		3				7	800			88
Gold Circle	3		29,625	2,916		2,916	55,007				139,398
Island Mountain	2		134	56		56	32	200			2,003
Jarbidge	7		978	374		374	1,335				13,996
Lime Mountain	1		3,358	1,258		1,258	4,102	105,200			57,755
Loray	1		7				296	100			211
Mardis	3		79	194		194	620	1,000	4,400		7,522
Merrimac	6		2,487	12		12	39,073	1,400	225,700	192,000	47,680
Mud Springs	1		488	16		16	2,515		1,300		2,328
Railroad	1		195	2		2	1,463	23,800	1,800		3,623
Rock Creek	1		5	1		1	726				528

Spruce Mountain	7		472	3		3	6,484	9,500	105,300		10,443
Tecoma	1		31	1		1	427		24,600		1,481
Tuscarora	3	1	754	26	5	31	1,023				1,779
Esmeralda County:											
Desert	6		130	80		80	355				3,041
Divide	6		812	689		689	20,073		1,400		37,806
Goldfield	5		380,461	8,130		8,130	4,210	4,000			287,824
Klondyke	2	1	61	23	2	25	1,920		7,400		2,526
Lida	3	1	34	5	23	28	2,258		200		2,522
Lone Mountain	1		32,282	1,934		1,934	4,864				70,992
Palmetto	1		10	20		20	4				703
Silver Peak	10		210,451	39,353		39,353	851,776		9,500		1,955,977
Sylvania		5			31	31	8				1,090
Eureka County:											
Buckhorn	1		837	270		270	2,270				10,991
Cortez	3		13,896	6,354		6,354	64,683	2,700	27,000		267,846
Diamond	1		2,759	29		29	40,438				28,464
Eureka	21		9,178	3,232		3,232	40,538	500	103,700		145,563
Lynn	2	10	385	154	305	459	162	300			16,206
Safford	2		138				10,285	4,500	1,300		7,510
Humboldt County:											
Awakening	9		23,748	4,915		4,915	3,787		3,700		174,769
Barrett Springs	9	1	630	510	3	513	7,927	1,600	10,500		23,996
Central [6]	3	1	30	31	5	36	40				1,287
Disaster Peak	1		37	1		1	1,148	300	500		869
Donnelly	2		30	18		18	13				639
Dutch Flat		1			4	4					140
Gold Run	8	2	245	64	27	91	2,959	1,000	16,900	6,000	6,404
Jackson Creek	1		3	8		8	3				282
Leonard Creek	3	1	88	43	23	66	814		7,700		3,224
Paradise Valley	3		27	2		2	74	3,800			515
Potosi	1		278,975	49,288		49,288	2,559		1,800		1,726,902
Rebel Creek	4		1,674	143		143	27,530	500	2,700		23,871
Sawtooth [6]		1			332	332	41				11,648
Sulphur	2		192	2		2	899				680
Warm Springs	6		10,367	2,386		2,386	335	600			83,800
Lander County:											
Battle Mountain	23	4	14,397	5,365	1,420	6,785	36,916	801,900	40,300		347,825
Bullion	10	5	14,069	2,082	1,026	3,108	26,947	125,200	24,000		141,220
Gold Basin	5		689	326		326	1,502				12,430
Hilltop	4		271	194		194	2,968	700	1,700		8,957
Kingston	1		637	228		228	1,201				8,795
Lewis	4		379	136		136	11,641	6,200	1,900		13,396
McCoy	1	1	31	42	19	61	17				2,147
New Pass	3		412	181		181	43				6,364
Reese River	5		62	59		59	1,500		100		3,088
Lincoln County:											
Atlanta	1		26				740				502
Caliente	2		163	169		169	1,502	600	1,900		7,086
Comet	5		663	66		66	8,942	900	61,900		11,383
Eagle Valley	2		254	150		150	701				5,726

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1939, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore and old tailings	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
Lincoln County—Continued.			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Ferguson	2		170,049	5,294		5,294	19,643	100			$198,634
Jack Rabbit	2		13,874	162		162	121,587	673,900	443,100		179,113
Pahranagat	7		128	2		2	5,430	2,100	9,700		4,430
Pioche	12		46,851	1,406		1,406	354,432	4,400	5,928,700	11,474,000	1,165,549
Tempiute	1		52				1,201		700		848
Viola	1		17				167				113
Lyon County:											
Buckskin		2			38	38	17				1,342
Cambridge	2		357	67		67	24				2,361
Palmyra	9		1,035	300		300	3,833				13,102
Pine Grove	1		47	14		14	5				493
Ramsey	1		220	76		76	4				2,663
Silver City	39	2	44,793	7,702	831	8,533	31,994	300			320,403
Yerington	4	1	217	35	4	39	623	11,700			3,005
Mineral County:											
Aurora	11		3,960	656		656	4,199				25,810
Bell	1		411	353		353	326				12,576
Buena Vista	1		300	15		15	11				532
Candelaria	6		3,725	458		458	34,995	500	41,700		41,796
Eagleville [4]	1		437	49		49	1,060				2,435
East Walker	6	1	350	176	3	179	326		1,200		6,543
Fitting	3		28	80		80	27				2,818
Garfield	4		441	443		443	37,308	1,900	55,200		43,621
Hawthorne	12		2,497	669		669	16,397	1,500	26,000		35,923
Pilot Mountain	4		268	52		52	181				1,943
Pine Grove	1		27	27		27	16				956
Rand	4		134	113		113	371				4,207
Regent	11	1	846	252	71	323	3,504		3,900		13,867
Santa Fe	6		164	17		17	1,811		1,500		1,895
Silver Star	31		1,413	832		832	4,177	100	4,500		32,177
Nye County:											
Antelope Springs	1		4	1		1	139				129
Athens	1		1,127	642		642	518				22,822
Bellehelen	3		61	51		51	1,668				2,917
Bullfrog	18		1,322	684		684	2,453	600			25,667
Cloverdale	2	1	33	9	6	15	8				530
Currant	1		70	34		34	28				1,209
Eden	1		40	3		3	3				107

Ellendale	1		239	147		147	103				5,215
Fairplay	5		137	29		29	1,861				2,278
Golden Arrow	3		263	73		73	1,145				3,332
Hannapah	1		25	1		1	461				348
Jackson	7		174	108		108	242				3,944
Johnnie	5	2	1,725	386	21	407	60				14,286
Mammoth	5		250	183		183	366		700		6,686
Manhattan	21	18	20,032	7,222	20,748	27,970	9,530		6,100		985,706
Millett	8		125	136		136	1,544				5,808
Morey	2		442	27		27	8,202				6,512
Northumberland	1		4,029	540		540	539				19,266
Phonolite	1		18,069	6,347		6,347	13,883				231,569
Quartz Mountain	3		500	192		192	7,383	3,000	95,900		16,551
Reveille	1		1				41				28
Round Mountain	3	3	2,024	800	4,452	5,252	3,874				186,450
San Antone	3		55	7		7	2,966		1,500		2,329
Silverton	2		6				100				68
Tonopah	16		18,767	6,925		6,925	596,173				647,050
Tybo	6		6,231	456		456	79,272	400	27,700		71,112
Union	5	1	142	48	3	51	785		100		2,323
Ormsby County: Delaware	3		85	52		52	523				2,175
Pershing County:											
Antelope	6	4	983	292	163	455	7,544	10,400	83,700	11,600	26,664
Buena Vista	1		5				88		2,000		154
Central [6]	3		420	33		33	11,968	400	22,100		10,359
Farrell	1		1	1		1	1				36
Haystack	1		672	596		596	222				21,011
Imlay	4	9	20,038	481	230	711	823				25,444
Jersey	1		35	7		7	456		5,000		790
Kennedy	5		327	114		114	2,439	2,500	3,200		6,056
Loring	3		200	89		89	63				3,158
Muttleberry	1		14				331		200		234
Placerites		2			25	25	8				880
Rochester	16	2	965	366	32	398	23,330	700	10,600	4,400	30,566
Rosebud	(7)	5	(7)	(7)	1,710	[8] 1,710	[8] 226				[8] 60,003
Sawtooth [6]		1			5	5	2				176
Seven Troughs	10		1,297	2,221		2,221	2,165				79,205
Sierra	9	3	2,040	249	23	272	1,486		1,200		10,585
Spring Valley	2		1,001	154		154	3,410				7,705
Trinity	2	1	52	7	17	24	628				1,266
Velvet	2		36	26		26	10				917
Storey County: Comstock	46	1	310,763	33,629	12	33,641	415,584	2,000	2,000		1,459,830
Washoe County:											
Galena	1		35	17		17	25				612
Jumbo		1			19	19	30				685
Leadville	1		5	3		3	3				107
Peavine	2		18	10		10	314				563
White Horse	13	2	874	583	33	616	263				21,739

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1939, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore and old tailings	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pound*	*Pounds*	*Pounds*	
White Pine County:											
Aurum	7		296	10		10	2, 489	900	5, 300		$2, 382
Bald Mountain	1		2				1				1
Cherry Creek	9		16, 206	1, 918		1, 918	143, 356				164, 438
Duck Creek	2		65	2		2	2, 207				2, 282
Eagle	5		401	4		4	4, 287		15, 200		3, 674
Granite	7		210	171		171	431	1, 300	10, 400		6, 400
Newark	1		4				15		2, 600		10
Osceola	12	3	8, 310	5, 453	868	6, 321	2, 407				222, 869
Robinson	39		4, 825, 246	71, 031		71, 031	316, 224	103, 180, 700	72, 700	72, 000	13, 438, 688
Shoshone	1		8				201		7, 700		498
Taylor	2		1, 320	28		28	8, 365				6, 658
Ward	3		1, 390	26		26	15, 457	700	4, 300		11, 677
White Pine	8		2, 367	10		10	9, 067	400	69, 800		9, 827
Combined districts [9]	13		21, 307	7, 555		7, 555	68, 726	200	1, 700		311, 176
Total Nevada	891	104	6, 894, 999	328, 960	32, 558	361, 518	4, 316, 029	133, 194, 000	8, 472, 000	12, 456, 000	30, 480, 870

[1] Only those districts shown separately for which Bureau of Mines is at liberty to publish figures; other producing districts listed in footnote 9 and their output included under "Combined 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: 4,305,886 ounces from lode mines and 10,143 ounces from placers.
[4] Eagleville district lies in both Churchill and Mineral Counties.
[5] Output from property not classed as a "mine."
[6] Central and Sawtooth districts lie in both Humboldt and Pershing Counties.
[7] Included under "Combined districts."
[8] Exclusive of lode output, which is included under "Combined districts."
[9] Includes following districts: Desert in Churchill County; Silver Glance in Douglas County; Hornsilver in Esmeralda County; Florence and National in Humboldt County; Talapoosa in Lyon County; Rosebud (lode) in Pershing County; and Granite Range and Stateline Peak, in Washoe County.

CHURCHILL COUNTY [1]

Operation of a custom cyanide mill by the Westgate Mining & Milling Corporation was an important factor in reviving metal production in Churchill County. In 1939 this company handled over 5,000 tons of ore from more than 65 shippers.

Dixie Valley district.—The Comstock-Keystone Mining Co. cyanided old tailings at the Dixie mine during 1939.

Eastgate district.—Gold ore was shipped from the Gold Ledge mine to a custom cyanide plant in 1939.

Fairview district.—Lessees on the Blue Eagle mine in 1939 shipped to a custom cyanide plant 150 tons of gold-silver ore yielding 45 ounces of gold and 1,612 ounces of silver. Lessees shipped lead ore from the Chalk Mountain mine for smelting. Several groups of lessees worked the Nevada Hills mine and shipped ore to a custom cyanide plant and a smelter.

Holy Cross district.—Lessees working the Pyramid Group shipped 29 tons of lead smelting ore in 1939; the ore contained 36 ounces of gold, 9,898 ounces of silver, and 7,302 pounds of lead.

Sand Springs district.—The Summit King Mines Co. purchased the Dan Tucker mine March 1, 1939, and shipped 293 tons of smelting ore containing 198 ounces of gold, 10,291 ounces of silver, and 178 pounds of copper; a 70-ton cyanide plant was under construction at the end of the year.

Wonder district.—The Jack Pot mine was worked by a lessee from January 1 to April 30, 1939; 27 tons of silver ore shipped to a custom cyanide plant yielded 2 ounces of gold and 575 ounces of silver, and 42 tons shipped to a smelter yielded 5 ounces of gold and 1,749 ounces of silver. The Nevada Wonder mine, largest producer of gold and silver in Churchill County in 1939, was operated by lessees. E. S. Price worked the Queens and July No. 1 claims from April 1 to August 30; 52 tons of ore shipped to a custom cyanide plant contained 4 ounces of gold and 819 ounces of silver, and 57 tons shipped to a smelter contained 4 ounces of gold and 1,871 ounces of silver.

CLARK COUNTY [2]

Crescent district.—Lessees of the Paden mine in 1939 shipped to a smelter 129 tons of ore which contained 11 ounces of gold, 5,427 ounces of silver, and 4,636 pounds of lead.

Eldorado Canyon district.—The Diamond Gold Mining Co. worked the Jubilee and Techatticup mines throughout 1939; most of the ore was treated in the company 70-ton flotation mill, but small shipments were made to a custom cyanide mill and a smelter. The Oro Plata mine was active. The El Dorado Rover Mining Co. operated the Rand, Bell, and Rover groups and also treated some custom ore in its 100-ton cyanide plant; 27,375 tons of company ore yielded 4,560 ounces of gold and 93,492 ounces of silver. W. W. Hartman operated the Wall Street mine throughout the year; the ore was treated in a 50-ton amalgamation and flotation mill on the property.

Gold Butte district.—The Lakeshore Gold Mining Co. worked the Utah mine in 1939.

[1] *See also* Vanderburg, William O., Reconnaissance of Mining Districts in Churchill County, Nev.: Bureau of Mines Inf. Circ. 7093, 1940. 57 pp.

[2] *See also* Vanderburg, William O., Reconnaissance of Mining Districts in Clark County, Nev.: Bureau of Mines Inf. Circ. 6964, 1937. 81 pp.

Searchlight district.[3]—A lessee on the Duplex mine in 1939 shipped 29 tons of smelting ore which contained 147 ounces of gold, 92 ounces of silver, 1,098 pounds of copper, and 2,746 pounds of lead. The Calumet Gold Mines Co. worked the Quartette mine from January 1 to November 1; several small-scale lessees were also reported as active on the property.

Yellow Pine district.—The Chiquita Mining Co., Ltd., operated the Chiquita mine throughout 1939 and treated 31,604 tons of ore in the company 100-ton cyanide mill; slimes were cyanided, and concentrates removed by jigging were tabled and amalgamated; and recovery was as follows: By amalgamation, 1,050 ounces of gold and 83 ounces of silver; by cyanidation, 5,806 ounces of gold and 311 ounces of silver; and in concentrates, a content of 161 ounces of gold, 18 ounces of silver, and 539 pounds of copper. The Barefoot Lease operated the Keystone-Barefoot mine throughout the year; 7,908 tons of ore were treated in a 40-ton amalgamation-flotation mill and yielded 1,215 ounces of gold and 123 ounces of silver as bullion and 349 tons of concentrates containing 2,033 ounces of gold, 167 ounces of silver, 2,429 pounds of copper, and 174 pounds of lead; and a small quantity of crude ore was shipped to a smelter. Lead ore and zinc-lead ore were shipped from the Milford No. 2 mine. Lessees shipped zinc-lead ore from the Root Zinc mine. The Yellow Pine Lease worked the Yellow Pine mine from February 8 to December 31; shipments totaled 209 tons of lead-copper ore and 722 tons of zinc-lead ore with a metal content of 3 ounces of gold, 1,946 ounces of silver, 24,722 pounds of copper, 277,792 pounds of lead, and 494,785 pounds of zinc.

ELKO COUNTY

Centennial district.—The Bull Run mine was productive in 1939.

Cope district.—The Mountain City Copper Co., third-largest producer of copper in Nevada, was active throughout 1939. Part of the ore was treated in the company 450-ton flotation mill, and high-grade ore was shipped for direct smelting. The Protection mine was operated from April 1 to the end of the year; 530 tons of ore shipped to a smelter contained 49 ounces of gold and 7,801 ounces of silver, and 414 tons of old tailings cyanided yielded 11 ounces of gold and 1,329 ounces of silver.

Cornucopia district.—The Par Mining Co. shipped to a smelter 1,956 tons of old tailings containing 220 ounces of gold and 15,655 ounces of silver.

Delano district.—During 1939 a lessee and a sublessee shipped from the Cleveland mine to a smelter 134 tons of lead ore containing 4,915 ounces of silver, 474 pounds of copper, 49,375 pounds of lead, and 1,277 pounds of zinc. The Delno Mining & Milling Co. shipped lead ore from the Net Group.

Gold Circle district.—The Esmeralda Gold Mines, Ltd., operated the Esmeralda mine approximately 10 months of 1939 and treated the ore in a 30-ton cyanide mill on the property. The Gold & Silver Circle Mines, Inc., and lessees worked the Gold Circle Group during

[3] *See also* Callaghan, Eugene, Geology of the Searchlight District, Clark County, Nev.: U. S. Geol. Survey Bull. 906–D, 1939, pp. 135–188.

the year. Lessees on the Queen mine treated 425 tons of ore by amalgamation to recover 120 ounces of gold and 69 ounces of silver.

Jarbidge district.—The Kookaburra mine was worked between April 6 and November 1, 1939.

Lime Mountain district.—The Lime Mountain Consolidated worked the Lime Mountain mine throughout 1939 and shipped to a smelter 3,358 tons of ore containing 1,258 ounces of gold, 4,102 ounces of silver, and 107,427 pounds of copper.

Mardis district.—During 1939 a lessee shipped gold ore to a smelter from the Virginia mine.

Merrimac district.—The Rip Van Winkle Mining Co. made a number of shipments of silver ore containing lead and zinc during 1939.

Railroad district.—A lessee shipped copper ore from the Sweepstakes mine in 1939.

ESMERALDA COUNTY

Divide district.—The Tonopah Divide Mining Co. operated the Tonopah Divide mine in 1939 on the leasing system; smelter shipments totaled 685 tons of ore containing 560 ounces of gold and 19,292 ounces of silver.

Goldfield district.—Lessees worked the Combination Fraction throughout 1939 and shipped their output to smelters. The Goldfield Deep Mines Co. leased its Florence claims; smelter shipments totaled 512 tons of ore containing 3,001 ounces of gold, 230 ounces of silver, and 2,265 pounds of copper. The Goldfield Consolidated Mines Co. operated underground on the leasing system throughout the year. The company tailings pile was worked from March 1 to December 16 by the Bradshaw Syndicate, Inc.; 379,000 tons of old tailings hydraulicked and pumped to a 1,400-ton cyanide plant yielded 4,248 ounces of gold and 3,790 ounces of silver.

Hornsilver district.—The Gold Bug mine was operated under lease to McCarty and Wilson from January to June 1, 1939, when the lease was turned over to the Nevada Minnesota Mining Co.; 324 tons of ore treated in the neighboring Ohio Mines Corporation cyanide mill yielded 113 ounces of gold and 165 ounces of silver, and 98 tons of smelting ore contained 87 ounces of gold, 154 ounces of silver, and 2,163 pounds of lead. The Ohio Mines Corporation worked the Ohio mine throughout the year.

Lone Mountain district.—The Weepah Nevada Mining Co. suspended operations in 1939 after cyaniding 32,277 tons of old tailings, from which 1,773 ounces of gold and 4,560 ounces of silver were recovered as bullion.

Silver Peak district.—E. L. Cord (Prescott lease) and the Black Mammoth Consolidated Mining Co. worked the Mary mine throughout 1939. The lease operated a 350-ton flotation and cyanide sand-leaching plant, and the company operated a 150-ton all-slime cyanide plant. Desert Silver, Inc., operated a 200-ton cyanide plant at the Nivloc mine throughout the year; 70,403 tons of ore yielded 3,507 ounces of gold and 833,234 ounces of silver. This property was the largest silver producer in the State in both 1939 and 1938. The Oro Monte mine (Gold Wedge Divide Mining Co.) and the Sentinel mine were productive.

EUREKA COUNTY [4]

Buckhorn district.—In 1939 a lessee shipped gold ore to a smelter from the Buckhorn mine.

Cortez district.—The Cortez Metals Co. shipped silver ore to a smelter from the Cortez mine during 1939. Greenan & Co., Inc., operated the Emma E mine and mill in the Mill Canyon section of the Cortez district throughout the year and treated 12,220 tons of ore in a 35-ton cyanide plant to recover 5,957 ounces of gold and 1,618 ounces of silver as bullion. Gold ore was shipped to a smelter from the Ventura mine.

Diamond district.—The Silver Ledge Mines, Inc., shipped silver ore to a smelter from the Wynona mine in 1939.

Eureka district.—In 1939 the Eureka Corporation, Ltd., shipped gold-silver ore to a smelter from the Cyanide Group and gold ore from the Oswego and Richmond-Eureka mines. The Eureka Prospect Co. operated the Diamond Excelsior mine on the leasing system throughout the year and shipped gold-silver ore to a smelter. Cardinalli & Frank, lessees of the Eureka-Croesus mine, shipped lead ore to a smelter.

Lynn district.—Gold ore was shipped to a smelter from the Lynn Big Six mine in 1939. A number of productive small-scale placer operations were reported.

Safford district.—The Modarelli Mining Co. operated the Morning Glory mine in Safford Canyon 7 miles west of Palisade from January 15 to October 15, 1939, and shipped silver ore to a smelter.

HUMBOLDT COUNTY [5]

Awakening (Slumbering Hills) district.[6]—Wadley & Hunt, holders of a lease and option on the Jumbo mine in 1939, ceased operations August 30; the property reverted to the Austin Bros. Gold Mining Co., which resumed operations later in the year. The Morning mine was active during 1939.

Barrett Springs district.—The West Coast Mines Co. shipped gold-silver ore from the Pansy Lee mine to a smelter in 1939.

National district.—The P. H. O'Neil Corporation worked the National mine under the leasing system throughout 1939.

Potosi district.—Getchell Mine, Inc., operated the Getchell mine throughout 1939; this property, which has been in production only since March 1, 1938, attained first place in 1939 among Nevada gold producers. Oxidized ore was treated by agitation of slimes and leaching of sands in the company 700-ton cyanide plant; sulfide ore containing a large percentage of arsenic was roasted and treated in the cyanide slime plant. During the year the company paid $570,000 in dividends, bringing the total dividend disbursements during less than 2 years of production to $720,000.

Rebel Creek district.—The Ohio Eagle Mines Co. shipped silver ore in 1939 from the Ohio mine for smelting.

Warm Springs district.—The Curley Luck Gold Corporation operated the Ashdown mine throughout 1939; ore was treated in the com-

[4] *See also* Vanderburg, William O., Reconnaissance of Mining Districts in Eureka County, Nev.: Bureau of Mines Inf. Circ. 7022, 1938, 66 pp.

[5] *See also* Vanderburg, William O., Reconnaissance of Mining Districts in Humboldt County, Nev.: Bureau of Mines Inf. Circ. 6995, 1938, 54 pp.

[6] *See also* Calkins, Frank C., Gold Deposits of Slumbering Hills, Nev.: Univ. Nevada Bull., vol. 32, No. 3, 1938, 26 pp.

pany 30-ton amalgamation and concentration mill. The Homer Verne Mining Co. operated the Homer Verne mine in the Boyd Basin section of the Warm Springs district a few months; 1,075 tons of ore were treated in a 40-ton stamp mill, and 385 ounces of gold and 122 ounces of silver were recovered as bullion.

LANDER COUNTY [7]

Battle Mountain district.—In 1939, as in former years, lessees at the numerous small mines in the Battle Mountain district produced most of the ore shipped to smelters. The Copper Canyon Mining Co., which operated mines of the Copper Canyon group and Copper Basin group, was the leading producer in the district; part of its property was operated on company account and part through lessees; in all, 7,356 tons of copper ore containing 1,705 ounces of gold, 14,869 ounces of silver, and 805,199 pounds of copper were shipped to smelters. A lessee operated the Gold Cash mine from February to the end of the year and shipped to a smelter 1,046 tons of ore containing 300 ounces of gold and 431 ounces of silver. Reid & Reid operated the Honeycomb group under lease from the Buffalo Valley Mines Co. continuously in 1939, and the gold ore produced was shipped to a smelter. A group of lessees on the San Miguel (Iron Canyon claim) mine shipped 4,015 tons of ore containing 2,304 ounces of gold, 8,659 ounces of silver, 9,729 pounds of copper, and 36,055 pounds of lead. Between August 1 and December 3 a group of lessees on the Silver King mine shipped to a smelter 172 tons of ore containing 115 ounces of gold and 691 ounces of silver. Other active lode mines in the district included the Bailey Day, Big Bertha, Big Florence, Billie Day, Blue Eagle, Buena Vista, Buzzard, Cleveland, Good Chance, Independence, Jake, Plumas, and Ridge. F. C. Madsen worked the Box Canyon Placers property (Pay Day, Gold Eagle, and Duckey claims) with a dry concentrator; 3,545 cubic yards of gravel yielded 112 ounces of gold and 12 ounces of silver. J. O. Greenan recovered 386 ounces of gold and 51 ounces of silver while testing the Dahl placers. During the first 2 weeks of the year Chase & Caldwell produced 120 ounces of gold from 1,300 cubic yards of old tailings and 360 cubic yards of virgin gravel obtained in drift mining. On November 28 the property was leased to the Natomas Co., a leading connected-bucket dredge operator of California.

Bullion district.—The treatment of 10,500 tons of ore by cyanidation at the Goldacres property in 1939 resulted in the production of 1,717 ounces of gold and 151 ounces of silver; the ore was crushed to minus-2-inch size and given a cyanide leach in a 35-ton plant. The Gray Eagle Mining Co. operated the Gray Eagle mine; part of the ore was treated in the company concentrator, and part was shipped crude to a smelter. The Little Gem Mining Co. worked the Little Gem mine; ore was treated in the company flotation plant, and small lots of copper ore were shipped for direct smelting. The Mill Gulch Placer Mining Co. operated a dragline dredge on the Blue Sky No. 8 and Yellow Streak claims in the Camp Raleigh section of the Bullion district from January 1 to April 3; the dragline excavator used Diesel power and had a 1¾-cubic yard bucket. Before operations were sus-

[7] *See also* Vanderburg, William O., Reconnaissance of Mining Districts in Lander County, Nev.: Bureau of Mines Inf. Circ. 7043, 1939, 83 pp.

pended, 101,382 cubic yards of gravel had been treated to yield 800 ounces of gold and 93 ounces of silver.

Gold Basin district.—Gold ore was shipped to a custom cyanide plant from the Farnsworth, Gold Annie and Greenback Gold, Gold Park, and May-be-so properties during 1939.

Kingston district.—A lessee operated the Kingston mine from January 5 to December 5, 1939; 637 tons of smelting ore contained 228 ounces of gold and 1,201 ounces of silver.

New Pass district.—Smith and Snyder treated by amalgamation 276 tons of ore from the Thomas W. mine in 1939 and recovered 130 ounces of gold and 22 ounces of silver.

LINCOLN COUNTY

Caliente district.—Lessees working the Caliente Cobalt mine in 1939 shipped to a smelter 156 tons of ore containing 169 ounces of gold, 1,339 ounces of silver, 314 pounds of copper, and 3,748 pounds of lead.

Comet district.—The Prince Consolidated Mining Co. operated the Prince mine on the leasing system throughout 1939, and ore and old tailings were shipped to a smelter.

Eagle Valley district.—The Andesite Mining Co. shipped gold ore to a smelter during 1939.

Ferguson (Delamar) district.[8]—The Caliente Cyaniding Co. operated a 500-ton all-slime cyanide plant on Delamar old tailings during 1939 and treated 168,966 tons to recover 3,798 ounces of gold and 16,216 ounces of silver. Lessees shipped gold ore from the Delamar Exploration Co. property.

Jack Rabbit district.—The Bristol Silver Mines Co., leading operator in the Jack Rabbit district during 1939, shipped a large tonnage of silver ore to a smelter.

Pioche district.[9]—From the Apex mine in 1939 W. A. Free & Sons shipped to a smelter 1,707 tons of lead ore containing 178 ounces of gold, 95,390 ounces of silver, 1,650 pounds of copper, and 901,218 pounds of lead. The Hodges Cook Mercantile Co. shipped 853 tons of lead smelting ore from the Highland King mine; the ore contained 151 ounces of gold, 6,286 ounces of silver, 2,565 pounds of copper, and 143,982 pounds of lead. The Combined Metals Reduction Co., affiliate of the National Lead Co., worked the Pioche Nos. 1 and 2 mines throughout the year and was the largest producer of both lead and zinc in the State. Virtually all the ore was shipped to the company 600-ton selective-flotation mill at Bauer, Utah, where gold (iron) concentrate, lead concentrate, and zinc concentrate were made.

LYON COUNTY

Silver City district.[10]—Lessees operated the Buckeye mine in 1939 and shipped the ore to amalgamation and cyanidation custom mills. The Dayton Consolidated Mines Co. operated the Dayton mine throughout the year both on company account and through lessees;

[8] *See also* Callaghan, Eugene, Geology of the Delamar District. Lincoln County, Nev.: Univ. Nevada Bull., vol. 31, No. 5, 1937, 72 pp.
[9] *See also* Wheeler, Harry E., and Lemmon, Dwight M., Cambrian Formations of the Eureka and Pioche Districts, Nev.: Univ. Nevada Bull., vol. 33, No. 3, 1939, 60 pp.
[10] *See also* Gianella, Vincent P., Geology of the Silver City District and the Southern Portion of the Comstock Lode, Nev.: Univ. Nevada Bull., vol. 30, No. 9, 1936, 108 pp.

7,914 tons of ore yielded 2,392 ounces of gold and 8,801 ounces of silver by cyanidation. In addition to ore from the Dayton mine, the company treated ore obtained from mines it operated in the Comstock district of Storey County and custom ore from more than 200 shippers. The company mill was an important factor in production at small mines in the Silver City district and in other districts within trucking distance of the plant. Ore mined at the Haywood property was shipped to a custom cyanide mill. Several lessees on the Montezuma property shipped to a custom cyanide mill 390 tons of ore from which 121 ounces of gold and 680 ounces of silver were recovered. Various lessees operated the Oest mine and shipped ore to custom amalgamation and cyanidation mills in the district. Smith and Crow worked the Silver Queen mine and shipped ore to the Trimble custom amalgamation mill. A large number of lessees and sublessees worked the property of South Comstock Gold Mines, Inc.; their product was shipped to custom amalgamation and custom cyanidation mills. Lessees also worked the Sutro dump. A number of lessees shipped gold ore from the Vivian mine to custom amalgamation and custom cyanidation mills. The Dayton Douglas Cyanidation Co. operated its 100-ton cyanide leaching plant from April 1 to December 1 and treated 17,819 tons of old tailings yielding 736 ounces of gold and 9,449 ounces of silver. The Oro Neva Dredging Co. began work with a dragline dredge 1½ miles northwest of Dayton at the end of 1939, using a dragline excavator with a 2½-cubic yard bucket. Contractors Corporation operated a nonfloating washing plant at the Rose mine from September 1 to the end of the year; 49,000 cubic yards of gravel delivered by truck loaded by a 1½-cubic yard power shovel yielded 638 ounces of gold and 310 ounces of silver.

Talapoosa district.—The Talapoosa Tailings Treatment Co. operated a 40-ton cyanide leaching plant in 1939 on old tailings from the Talapoosa mine; a lessee on the property shipped ore to a custom cyanide plant. The Loranger & Myler Lease worked the Virginia Hills property.

MINERAL COUNTY [11]

Aurora district.—The Spring Valley Milling Co. began operating a flotation plant at Aurora May 16, 1939, and worked dump material on a royalty basis the rest of the year; concentrates were shipped to a smelter.

Bell district.—Lessees worked the Olympic (Omco) mine during 1939; 411 tons of ore shipped to a custom cyanide plant yielded 353 ounces of gold and 326 ounces of silver.

Candelaria district.—Shipments of ore from the Georgine, Lucky Hill, Hecla-Climax, Protection, Silver King, and Silver Surprise mines in the Candelaria district during 1939 were reported. Most of the ore went to smelters, but some was sent to custom cyanide plants.

Garfield district.—The New Eldorado Mines Co. shipped crude smelting ore from the Garfield mine in 1939. The West End Consolidated Mines Corporation shipped 188 tons of lead ore to a smelter from the Mabel mine; the ore contained 213 ounces of gold, 20,974 ounces of silver, 2,104 pounds of copper, and 20,968 pounds of lead.

[11] *See also* Vanderburg, William O., Reconnaissance of Mining Districts in Mineral County, Nev.: Bureau of Mines Inf. Circ. 6941, 1937, 79 pp.

Hawthorne district.—Silver ore was shipped to a smelter from the Lucky Boy mine by the Lucky Boy Consolidated Mines Co. in 1939. The Borealis Mines Trust Estate cyanided ore from the Silent Partner mine.

Regent district.—In 1939 lessees worked the Heckla mine and shipped ore to a custom cyanide mill.

Silver Star district.—Production by lessees on the Fortuna mine in 1939 was recorded. Five sets of lessees worked the Mary Ann mine, and most of the ore was shipped to custom cyanide mills.

NYE COUNTY

Athens district.—Ore from the Warrior mine was treated at the Dayton cyanide mill in 1939.

Bullfrog district.—Gold ore was shipped to a smelter from the Polaris mine during 1939. The Senator Stewart mine was operated by lessees from June 1 to the end of the year; 181 tons of ore yielded 198 ounces of gold and 175 ounces of silver when treated by cyanidation at a custom plant.

Ellendale district.—Gold ore from the Ellendale mine was shipped to a smelter during 1939.

Manhattan district.—In 1939 more than 3,000 tons of ore from the Indian Camp and Jumbo group were treated by amalgamation. A lessee worked the property of the Manhattan Consolidated Mines Development Co. from January to December; gold ore was treated by amalgamation and concentration, and the resulting concentrates were shipped to a smelter. Lessees worked the Union No. 2 mine owned by the Nevada Coalition Gold Mines Co. A lessee operated the Sunday mine throughout the year and treated in a 5-ton stamp mill 1,250 tons of ore which yielded 1,216 ounces of gold and 795 ounces of silver. The Reliance Mining Co. operated the Verden mine throughout 1939; in July the property was opened to leasers. The White Caps Gold Mining Co. and lessees mined 2,826 tons of ore at the White Caps mine; 726 tons of ore yielded 67 ounces of gold and 2 ounces of silver by amalgamation, and 2,100 tons of ore shipped to smelters contained 2,345 ounces of gold and 64 ounces of silver. Lessees operated the Arizona No. 3 drift mine from April 4 to the end of the year; 1,408 cubic yards of gravel yielded 159 ounces of gold and 60 ounces of silver. Lessees sluiced gravel from the Little Grey mine between May 1 and the end of the year. The Manhattan Gold Dredging Co., largest producer of placer gold in Nevada in 1939, operated a connected-bucket dredge the entire year.

Northumberland district.—The Northumberland Mining Co. began construction work at the Northumberland mine in April 1939 and production on November 16; ore was mined with a power shovel in an open pit and delivered to the new company 300-ton cyanide plant. A total of 4,029 tons of ore was treated and yielded 540 ounces of gold and 539 ounces of silver.

Phonolite district.—The Penelas Mining Co. worked the Penelas mine throughout 1939; 18,069 tons of ore, yielding 6,347 ounces of gold and 13,883 ounces of silver, were treated in the company 50-ton countercurrent cyanide plant.

Quartz Mountain district.—A lessee shipped lead ore from the San Rafael mine to a smelter during 1939.

Round Mountain district.—Lessees worked the Gold Hill mine from May 15 to November 30, 1939; 1,670 tons of ore treated in a cyanide plant on the property yielded 444 ounces of gold and 1,077 ounces of silver. The Monte Cristo mine was active during the year. Dodge Construction, Inc., operated a stationary washing plant at the Round Mountain mine of the Nevada Porphyry Mining Co. Sluicing was carried on at the Shoshone Fraction property from April 28 to November.

Tonopah district.—The Tonopah Belmont Development Co. operated the Tonopah Belmont mine on the leasing system from January to October 31, 1939, when a fire destroyed the timber in the working shaft and much of the surface equipment. Before the fire, 3,979 tons of ore containing 1,574 ounces of gold and 145,549 ounces of silver had been shipped for smelting. The Tonopah Mining Co. of Nevada worked its property on the leasing system throughout the year; all ore was shipped crude to smelters. The West End Consolidated Mines Corporation operated the West End mine through lessees; 3,072 tons of ore containing 688 ounces of gold and 58,075 ounces of silver were shipped to a smelter.

Tybo district.—R. R. Redenbaugh and E. Vassar shipped 660 tons of silver ore to a smelter from the Ramona mine; the ore contained 13 ounces of gold, 15,441 ounces of silver, 646 pounds of copper, and 9,064 pounds of lead. Lessees on the 2–G mine shipped 2,644 tons of smelting ore which contained 209 ounces of gold and 28,396 ounces of silver. The Dimmick lease working the Tybo mine shipped 2,793 tons of smelting ore containing 228 ounces of gold, 32,445 ounces of silver, and 19,263 pounds of lead.

PERSHING COUNTY [12]

Antelope district.—The Lambert lease worked the North Star claim in the Scossa section of the Antelope district in 1939 and treated 450 tons of ore in a 3-stamp mill equipped with amalgamation plates and table concentrators; 120 ounces of gold and 115 ounces of silver were recovered as bullion, and 11 ounces of gold and 10 ounces of silver were contained in 3 tons of concentrates sold to a smelter.

Central district.—In 1939 lessees at the Keystone mine shipped 370 tons of smelting ore containing 11 ounces of gold, 11,341 ounces of silver, 424 pounds of copper, and 31,638 pounds of lead.

Haystack district.—The Jungo Star Gold Mines Co. worked the Jungo Star mine throughout 1939 and shipped ore to a custom cyanide mill and smelter.

Imlay district.—The Standard Cyaniding Co. built a 500-ton cyanidation plant in 1939 to treat ore mined at the Gold Standard and Lally claims; production from the company open pit was begun November 7.

Rochester district.—The Looney mine was active during 1939.

Rosebud district.—Nelson, Mullen & Webster, Inc., installed a dry-bank plant on the Janke claims and operated from January 4 to November 24, 1939. The Rio Seco Mining Co. operated a dry-land placer plant on the Rio Seco mine from April to the end of the year; 84,603 cubic yards of gravel yielded 728 ounces of gold and 82 ounces of silver. Many small-scale placer miners were active in the Rosebud district.

[12] *See also* Vanderburg, William O., Reconnaissance of Mining Districts in Pershing County, Nev.: Bureau of Mines Inf. Circ. 6902, 1936, 57 pp.

Seven Troughs district.—Several lessees worked the Portland mine in 1939. A group of properties owned by the Nevada State Gold Mines Co. was operated on the leasing system.

Sierra district.—The White Bear Mining Co. worked the Black Hole mine throughout 1939. A lessee treated old tailings at the property in a 20-ton cyanide leaching plant.

STOREY COUNTY

Comstock district.—In 1939 the Adriatic mine was operated by the Adriatic Mining Co. from January 1 to May 18, when operation was turned over to Adriatic Mines, Inc., which continued work until December 16; 5,101 tons of ore were treated by flotation to produce 46 tons of concentrates containing 195 ounces of gold, 1,163 ounces of silver, 1,679 pounds of copper, and 317 pounds of lead. Several lessees on the Chollar-Potosi mine shipped gold-silver ore to a custom cyanidation plant. The Consolidated Virginia Mining Co. worked the Consolidated Virginia mine, both on company account and under lease; gold ore was shipped to a custom cyanidation plant. Sutro Tunnel Coalition, Inc., operated the Crown Point mine during the year; the output of gold-silver ore was treated in the company cyanidation plant. The Hartford mine was worked by the Hartford Mining Co. The Dayton Consolidated Mines Co. worked the Justice mine and shipped the output to the company cyanidation mill at the Dayton mine in Lyon County. The Keystone mine was operated by the Dayton Consolidated Mines Co. and several lessees; 22,278 tons of ore shipped to the Dayton cyanide mill in Lyon County yielded 7,005 ounces of gold and 30,375 ounces of silver. The Storey County Mines, Inc., worked the Overland mine during the first part of 1939; the company was reported in bankruptcy late in the year. The Consolidated Chollar Gould & Savage Mining Co. operated the Overman mine in the Gold Hill section of the Comstock Lode throughout 1939; 96,098 tons of ore treated in the 300-ton flotation-cyanidation plant (remodeled during the year as a 400-ton all-cyanide plant) yielded 5,250 ounces of gold and 129,367 ounces of silver. Sierra Nevada, Ltd., worked the Sierra Nevada mine near the north end of the Lode; ore was treated by amalgamation and flotation, and the resulting concentrates were shipped to a smelter. The Silver Hill mine was operated by the Silver Hill Mining Co.

WASHOE COUNTY

Granite Range district.—The Burm Ball Mining Co. began production from the Mountain View mine January 26, 1939, and continued operations until the end of the year.

White Horse district.—The Renegade mine was worked throughout 1939. Lessees operated the Texas No. 2 mine and treated 67 tons of ore which yielded amalgam containing 115 ounces of gold and 45 ounces of silver.

WHITE PINE COUNTY

Cherry Creek district.—During 1939 shipments of 1,007 tons of old tailings from the Cherry Creek district to the McGill smelter to be used as siliceous flux contained 75 ounces of gold and 4,936 ounces of silver. The Egan mine was operated on the leasing system; 3,037 tons of ore shipped to a smelter contained 545 ounces of gold and 22,554 ounces of silver. Silver ore was shipped to a smelter from the

Exchequer mine. The Nevada Standard Mining Corporation shipped gold-silver ore to a smelter. Gold-silver ore was shipped by lessees from the Mary Ann mine.

Granite district.—Lessees shipped gold ore to a smelter from the Stinson mine during 1939.

Osceola district.—The Gilded Age Mining Co. worked the Gilded Age mine in 1939. The Golden Eagle Leasing Co. and another lessee shipped gold ore from the Golden Eagle mine to a smelter. Venture Gold Syndicate carried on a development campaign at the Lassie Jean mine and built a 15-ton amalgamation-concentration mill during the year. Placers Recovery Co. hydraulicked gravel at the Ghost Walk and Transit mines.

Robinson district.—The Chainman Leasing Co. shipped 9,691 tons of smelting ore from the Chainman mine during 1939; contents were 1,009 ounces of gold and 19,629 ounces of silver. The Consolidated Coppermines Corporation, second-largest copper producer in Nevada in 1939, was active the entire year. Copper ore mined on company account was shipped to McGill for concentration and smelting; siliceous ore was produced and shipped by lessees. During the year the company developed plans for building its own concentrator, but after negotiations with the Kennecott Copper Corporation a contract was signed to continue shipping ore to the McGill concentrator. Terms of the new contract reduced the basic charges for freight and milling 8 cents a ton beginning October 1, 1940, and raised the maximum daily tonnage to be treated from 6,000 to 9,000 tons. The contract runs until December 31, 1975, but contains clauses to permit its earlier termination. According to the company printed annual report for the year ended December 31, 1939, 2,327,922 tons of ore were produced, which yielded on the basis of smelter settlements 47,690,894 pounds of copper, 26,374 ounces of gold, 89,264 ounces of silver, 26,786 pounds of lead, and 84,164 pounds of zinc. Copper ore was mined by the company and shipped to the McGill concentrator; siliceous ores were mined by lessees and sent to the McGill smelter; and small outputs of lead and zinc ores were shipped to other smelters. Gold-silver ore was shipped from the Hayes mine. Shipments of 2,312 tons of ore from the Jupiter mine to a smelter contained 373 ounces of gold and 1,233 ounces of silver. A lessee on the Matilda claim shipped 1,356 tons of smelting ore which contained 318 ounces of gold and 1,898 ounces of silver. Silver ore was shipped from the Midnight mine. Gold ore was shipped to a smelter from the Revenue property. The Nevada Consolidated Copper Corporation, operating subsidiary of the Kennecott Copper Corporation and largest industrial company in Nevada, worked the Ruth mine at Ruth and the open pit at Copper Flat throughout the year; it handled more ore and produced more copper than any other operation in the State. In addition to its mining activities, the company operated the McGill copper smelter (only smelter in the State) and the McGill flotation concentrator (18,000 tons daily capacity); both of these plants did some custom work. The smelter operated 263 days and the concentrator 293 days during the year. A lessee operated the Saxton claim from April through December and shipped gold ore to a smelter. Lessees shipped 1,016 tons of smelting ore from the Turkoy (Nevada Consolidated Copper Corporation property) mine 2 miles north of Ruth; contents were 219 ounces of gold and 910 ounces of silver.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEW MEXICO

(MINE REPORT)

By CHAS. W. HENDERSON AND A. J. MARTIN

SUMMARY OUTLINE

The mine output of recoverable gold, silver, copper, lead, and zinc in New Mexico in 1939 surpassed in total value that in each year since 1929; the increase over 1938 was $5,928,753, or 63 percent. Copper, the bulk of which came from the Chino open-pit mine at Santa Rita, Grant County, showed the largest relative gain in both quantity and value, and its value represented 62 percent of the total for the five metals. Gold was the only one of these metals to show a decrease from 1938. Zinc production in the Central district, Grant County, increased materially and more than offset the decrease in San Miguel County caused by the closing on May 31 of the Pecos mine, which during the preceding 12 years and 5 months was the largest producer of zinc, lead, gold, and silver in New Mexico and a substantial producer of copper. Mining operations in most of the other principal mining districts of the State continued at a rate of output equal to or higher than in 1938.

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, 1935–39

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1935	$35.00	$0.71875	$0.083	$0.040	$0.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4].646+	.098	.046	.048
1939	35.00	[5].678+	.104	.047	.052

[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] 1935–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–39: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464.
[5] $0.67878787.

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 1935 to 1939; also the total production from 1848 to 1939. 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, 1935–39, and total, 1848–1939, 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
1935	150	234	440,799	33,435	$1,170,225	1,061,902	$763,242
1936	136	169	514,966	33,037	1,156,295	1,163,255	900,941
1937	159	160	4,191,092	41,171	1,440,985	1,243,766	962,053
1938	166	164	2,414,857	43,050	1,506,750	1,229,860	795,061
1939	214	168	4,977,375	36,979	1,294,265	1,400,878	950,899
1848–1939	--------	--------	(1)	2,084,992	46,308,913	62,540,420	49,204,495

Year	Copper: Pounds	Copper: Value	Lead: Pounds	Lead: Value	Zinc: Pounds	Zinc: Value	Total value
1935	4,505,000	$373,915	14,578,000	$583,120	44,252,000	$1,947,088	$4,837,590
1936	6,332,000	582,544	13,252,000	609,592	41,336,000	2,066,800	5,316,172
1937	64,106,000	7,756,826	13,024,000	768,416	47,854,000	3,110,510	14,038,790
1938	40,878,000	4,006,044	9,898,000	455,308	56,472,000	2,710,656	9,473,819
1939	92,284,000	9,597,536	10,784,000	506,848	58,712,000	3,053,024	15,402,572
1848–1939	[2] 874,118	275,752,527	[2] 236,194	22,617,379	[2] 543,655	65,387,786	459,271,100

[1] Figures not available. [2] Short tons.

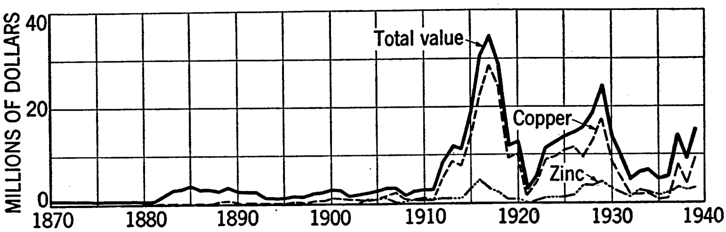

FIGURE 1.—Value of mine production of copper and zinc and total value of gold, silver, copper, lead, and zinc in New Mexico, 1870–1939. The value of gold, silver, and lead produced annually has been relatively small.

Gold and silver produced at placer mines in New Mexico, 1935–39, in terms of recovered metals

Year	Gold: Fine ounces	Gold: Value	Silver: Fine ounces	Silver: Value	Total value	Year	Gold: Fine ounces	Gold: Value	Silver: Fine ounces	Silver: Value	Total value
1935	3,554	$124,404	302	$217	$124,621	1938	2,626	$91,910	167	$108	$92,018
1936	3,378	118,230	235	182	118,412	1939	3,474	121,590	209	142	121,732
1937	3,027	105,945	203	157	106,102						

Gold.—The principal gold-producing districts in New Mexico in 1939 were: Mogollon, Catron County, which contributed 21 percent of the State total recoverable output of gold; Willow Creek (Pecos mine), San Miguel County, 15 percent; Central, Grant County, 13 percent; Steeple Rock, Grant County, 12 percent; Lordsburg, Hidalgo County, 11 percent; Las Animas, Sierra County (mostly from placers), 8 percent; and Mount Baldy, Colfax County, 8 percent. The most important gold-mining districts of the State are described in Information Circular 6987, issued by the Bureau of Mines.[1] Dry and siliceous ores yielded 48 percent of the State total gold in 1939; copper ore nearly 26 percent; zinc-lead ore 16 percent; and placers, together with a small quantity from lead, zinc, and lead-copper ores, slightly more than 10 percent.

Silver.—The mine production of recoverable silver in New Mexico in 1939 (the largest since 1916) was 14 percent above that in 1938. The Central district contributed 30 percent of the State total silver, Mogollon 27 percent, Steeple Rock 17 percent, Willow Creek 12 percent, and Lordsburg 9 percent. Dry and siliceous ores yielded 48 percent of the total silver; copper ore 27 percent; zinc-lead ore 22 percent; and zinc, lead-copper, and lead ores, together with a small quantity of silver from placers, 3 percent.

Copper.—Copper production in New Mexico in 1939 increased 126 percent in quantity and 140 percent in value over 1938. The opening of the new Chino copper smelter of the Nevada Consolidated Copper Corporation at Hurley on May 2 was an outstanding event, as the State had been without a smelting industry for many years. The smelter treated concentrates from the adjacent 17,500-ton Chino concentrator, operated on ore from the Nevada Consolidated open pits at Santa Rita which produced most of the State copper. The company smelter also treated siliceous mixed copper sulfide and oxide ores from its own ore bodies, as well as copper precipitates from mine waters. The only other important producers of copper in the State during the year were the Banner Mining Co., producing copper-gold-silver ore from the Bonney mine near Lordsburg, and the American Smelting & Refining Co., operating the Ground Hog group near Hanover and producing zinc-lead-silver ore and copper-lead-silver ore. Copper ore and mine-water precipitates yielded 98 percent of the total copper and zinc-lead ore nearly 2 percent.

Lead.—Although the Pecos mine (which produced 86 percent of the total lead output from New Mexico in 1938) was operated only 5 months in 1939, other lead-producing mines in the State, among which the largest was the Ground Hog near Hanover in Grant County, made an increased production, and the State total output of recoverable lead increased 9 percent in quantity over 1938. Zinc-lead ore yielded 74 percent of the total lead, copper ore 14 percent, lead ore 4 percent, and other types of ore 8 percent.

Zinc.—The output of recoverable zinc from mines in New Mexico increased 4 percent in quantity in 1939 over 1938. A substantial increase in production in the Central district, Grant County, which resulted in part from the resumption of mining at the Ground Hog group, more than offset the decrease in San Miguel County caused by the closing of the Pecos mine. The other principal producers of zinc

[1] Metzger, O. H., Gold Mining in New Mexico: Bureau of Mines Inf. Circ. 6987, 1938, 71 pp.

in the State were the Empire Zinc Co. Hanover group and the Pewabic group, both in the Central district. Zinc-lead sulfide ore was shipped from several mines in Grant and Socorro Counties to the Ozark pigment plant at Coffeyville, Kans.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1939, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Catron	12		7,708	$269,780	381,013	$258,627
Colfax	7	5	2,800	98,000	1,196	812
Dona Ana	8		70	2,450	392	266
Eddy	1				3	2
Grant	81	42	10,369	362,915	671,045	455,497
Hidalgo	35		4,406	154,210	135,982	92,303
Lincoln	2	55	263	9,205	84	57
Luna	5		455	15,925	17,397	11,809
Otero	6	1	9	315	87	59
Rio Arriba	1	4	55	1,925	467	317
Sandoval	2		66	2,310	2,130	1,446
San Miguel	1		5,694	199,290	166,619	113,099
Santa Fe	8	10	1,520	53,200	8,881	6,028
Sierra	26	50	3,384	118,440	12,702	8,622
Socorro	16		147	5,145	1,905	1,293
Taos	3	1	33	1,155	975	662
	214	168	36,979	1,294,265	1,400,878	950,899
Total, 1938	166	164	43,050	1,506,750	1,229,860	795,061

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Catron	900	$94					$528,501
Colfax	28,500	2,964					101,776
Dona Ana	2,800	291	4,600	$216			3,223
Eddy	700	73					75
Grant	84,728,000	8,811,712	6,566,000	308,602	48,221,000	$2,507,492	12,446,218
Hidalgo	6,376,000	663,104	52,600	2,472			912,089
Lincoln							9,262
Luna	9,500	988	332,800	15,642	9,000	468	44,832
Otero	6,600	686	100	5			1,065
Rio Arriba	300	31	5,000	235			2,508
Sandoval	100	10					3,766
San Miguel	418,000	43,472	3,599,000	169,153	9,849,000	512,148	1,037,162
Santa Fe	671,200	69,805	200	9			129,042
Sierra	32,400	3,370	23,700	1,114			131,546
Socorro	9,000	936	200,000	9,400	633,000	32,916	49,690
Taos							1,817
	92,284,000	9,597,536	10,784,000	506,848	58,712,000	3,053,024	15,402,572
Total, 1938	40,878,000	4,006,044	9,898,000	455,308	56,472,000	2,710,656	9,473,819

Gold and silver produced at lode mines in New Mexico in 1939, by counties, in terms of recovered metals

County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
Catron	61,411	7,708	381,013
Colfax	26,567	2,756	1,189
Dona Ana	159	70	392
Eddy	4		3
Grant	4,683,979	10,187	671,005
Hidalgo	117,040	4,406	135,982
Lincoln	101	60	71
Luna	3,599	455	17,397
Otero	67	6	87
Rio Arriba	975	52	467
Sandoval	514	66	2,130
San Miguel	75,620	5,694	166,619
Santa Fe	2,430	755	8,844
Sierra	2,209	1,113	12,590
Socorro	2,559	147	1,905
Taos	141	30	975
	4,977,375	33,505	1,400,669
Total, 1938	2,414,857	40,424	1,229,693

Gold and silver produced at placer mines in New Mexico in 1939, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Drift mining		Dry-land dredges [1]		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Colfax	44	7					44	7
Grant	46	10			136	30	182	40
Lincoln	203	13					203	13
Otero	3						3	
Rio Arriba	3						3	
Santa Fe	47	3			718	34	765	37
Sierra	185	11			2,086	101	2,271	112
Taos	3						3	
	534	44			2,940	165	3,474	209
Total, 1938	549	60	4		2,073	107	2,626	167

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

MINING INDUSTRY

The output of ore from mines in New Mexico producing gold, silver, copper, lead, and zinc totaled 4,977,375 tons in 1939, the largest in any year on record and 2,562,518 tons more than in 1938. Most of the ore in 1939, as in 1938, was copper ore mined with power shovels from the Chino open-pit mine of the Nevada Consolidated Copper Corporation at Santa Rita, Grant County. Underground mining was done at the other principal mines of the State, comprising, in order of output and by types of ore, the Empire Zinc Co. Hanover group and the Pewabic group in Grant County (Central district), producing zinc ore; the Bonney mine in Hidalgo County, copper-gold-silver ore; the Ground Hog group in Grant County (Central district), zinc-lead-copper-silver ore; the Pecos mine in San Miguel County, zinc-lead-copper-gold-silver ore; and the Black Hawk Consolidated Mines Co. (Mogollon Operations) in Catron County, the Aztec mine in Colfax County, and the East Camp group in Grant County (Steeple Rock district), siliceous gold-silver ores.

In yardage handled at placer mines the John I. Hallett Construction Co. in the Hillsboro district, Sierra County, ranked first and was followed by the Universal Placer Mining Corporation near Cerrillos, Santa Fe County; William Little in the Pittsburg district, Sierra County; and the Bear Creek Mining Co. (including yardage handled by the Ryan Mining Corporation, initial operator on the property) and the Texas Placer Co., both in the Pinos Altos district, Grant County. These operators handled 535,462 cubic yards of gravel with draglines and land washing plants and recovered 84 percent of the State total placer gold.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in New Mexico in 1939, with content in terms of recovered metals

Source	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	33,278	5,699	15,897	79,322	33,676	
Dry and siliceous gold-silver ore	77,455	12,176	643,670	22,657	254,407	
Dry and siliceous silver ore	469	10	8,012	4,601	8,881	
	111,202	17,885	667,579	106,580	296,964	
Copper ore	4,517,429	9,426	381,875	[1]90,272,599	1,465,208	
Lead ore	1,431	319	7,461	4,652	400,555	
Lead-copper ore	1,102	11	8,503	64,062	235,482	
Zinc ore	217,517	55	27,298	220,825	378,500	41,450,000
Zinc-lead ore	128,694	5,809	307,953	1,615,282	8,007,291	17,262,000
	4,866,173	15,620	733,090	[1]92,177,420	10,487,036	58,712,000
Total, lode mines	4,977,375	33,505	1,400,669	[1]92,284,000	10,784,000	58,712,000
Total, placers		3,474	209			
	4,977,375	36,979	1,400,878	[1]92,284,000	10,784,000	58,712,000
Total, 1938	2,414,857	43,050	1,229,860	40,878,000	9,898,000	56,472,000

[1] Includes 3,237,257 pounds of copper recovered from mine-water precipitates.

METALLURGIC INDUSTRY

The following six flotation mills treated 96 percent of the total New Mexico output of ore in 1939: Chino at Hurley, Empire Zinc at Hanover, Banner near Lordsburg, Peru near Deming, Pecos in San Miguel County, and Combination near Hanover. Two percent was treated by the Little Fanney cyanidation mill at Mogollon, the Aztec amalgamation-flotation mill in Colfax County, and scattered small concentration and amalgamation mills; and 2 percent was shipped crude to smelters outside the State. The Chino concentrates produced after March 22 were treated in the new Chino smelter at Hurley; the remainder of the concentrates produced in the State were shipped to smelters in other States, mentioned in the following review by counties and districts.

Mine production of metals in New Mexico in 1939, 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	24,703	658	179			
Ore cyanided [1]	63,750	7,647	377,816			
Concentrates smelted	215,947	16,614	519,616	[2] 88,074,425	7,798,121	57.178,000
Ore smelted	87,020	8,586	503,058	4,209,575	2,985,879	1,534,000
Placer		3,474	209			
		36,979	1,400,878	92,284,000	10,784,000	58,712,000
Total, 1938		43,050	1,229,860	40,878,000	9,898,000	56,472,000

[1] Cyanide used was approximately 192,800 pounds of Aero Brand calcium cyanide, approximately 48 to 49 percent NaCN.
[2] Includes 3,237,257 pounds of copper recovered from smelting of mine-water precipitates.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in New Mexico in 1939, by counties, in terms of recovered metals

County	Ore treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Catron	61,242	7,557	377,531					
Colfax	26,261	512	108	416	2,077	993	28,500	
Dona Ana	10	11	4					
Grant	40	44	18					
Santa Fe	128	52	11					
Sierra	650	94	68	6	23	1,127	391	52
Socorro	12	16	5	1	3	2		
Taos	110	19	250					
	88,453	8,305	377,995	423	2,103	2,122	28,891	52
Total, 1938	84,057	9,276	424,310	524	2,370	1,856	28,800	23,760

Mine production of metals from concentrating mills in New Mexico in 1939, by counties, in terms of recovered metals

County	Ore treated (short tons)	Concentrates smelted and recovered metal					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Colfax	50	1	4	1			
Grant	4,608,614	186,809	4,632	219,211	[1] 81,267,789	4,194,069	47,329,000
Hidalgo	116,153	13,040	4,077	130,297	6,359,345		
Rio Arriba	975	39	52	467	300	5,000	
San Miguel	75,620	15,622	5,694	166,619	418,000	3,599,000	9,849,000
Sierra	10	1	3	3	100		
Socorro	480	12	49	896			
	4,801,902	215,524	14,511	517,494	[1] 88,045,534	7,798,069	57,178,000
Total, 1938	2,302,992	145,537	18,829	483,805	40,539,050	9,121,500	55,850,000

[1] Includes 3,237,257 pounds of copper recovered from mine-water precipitates.

Gross metal content of concentrates produced from ores mined in New Mexico in 1939, by classes of concentrates smelted

Class of concentrates	Concentrates produced (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (wet assay) (pounds)	Lead (wet assay) (pounds)	Zinc (pounds)
Dry gold	2	7	3			
Dry gold-silver	32	57	1,069	645	703	
Copper	146,000	10,588	181,491	[1]88,765,844	94	
Lead	453	62	1,751	7,602	315,573	45,692
Lead-copper	11,498	5,601	290,784	1,650,930	8,173,759	2,569,158
Zinc	57,962	452	68,488	600,323	780,878	63,203,165
	215,947	16,767	543,586	[1]91,025,344	9,271,007	65,818,015
Total, 1938	146,061	21,605	522,080	42,292,557	10,799,010	68,555,111

[1] Includes 3,287,100 pounds of copper contained in mine-water precipitates.

Mine production of metals from New Mexico concentrates shipped to smelters in 1939, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Colfax	417	2,081	994	28,500		
Grant	186,809	4,632	219,211	[1]81,267,789	4,194,069	47,329,000
Hidalgo	13,040	4,077	130,297	6,359,345		
Rio Arriba	39	52	467	300	5,000	
San Miguel	15,622	5,694	166,619	418,000	3,599,000	9,849,000
Sierra	7	26	1,130	491	52	
Socorro	13	52	898			
	215,947	16,614	519,616	[1]88,074,425	7,798,121	57,178,000
Total, 1938	146,061	21,199	485,661	40,567,850	9,145,260	55,850,000

BY CLASSES OF CONCENTRATES SMELTED

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	2	7	3			
Dry gold-silver	32	57	1,069	607	382	
Copper	146,000	10,588	181,491	[1]86,235,593	52	
Lead	453	62	1,751	6,087	283,798	
Lead-copper	11,498	5,601	290,784	1,354,017	7,513,889	
Zinc	57,962	299	44,518	478,121		57,178,000
	215,947	16,614	519,616	[1]88,074,425	7,798,121	57,178,000

[1] Includes 3,237,257 pounds of copper recovered from mine-water precipitates.

Gross metal content of New Mexico crude ore shipped to smelters in 1939, by classes of ore

Class of ore	Ore		Gross metal content				
	Short tons	Percent of total	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	5,032	5.78	2,789	12,840	52,617	48,886	5,574
Dry and siliceous gold-silver	15,268	17.55	4,514	263,554	22,581	254,812	159,678
Dry and siliceous silver	469	.54	10	8,012	4,878	11,605	
Copper	59,144	67.97	941	202,507	4,224,931	2,664,107	809
Lead	1,431	1.64	319	7,461	5,979	446,281	25,153
Lead-copper	1,102	1.27	11	8,503	80,078	261,646	
Zinc	1,047	1.20	3	278	522	24,833	602,993
Zinc-lead	3,527	4.05				860,176	1,306,866
	87,020	100.00	8,587	503,155	4,391,586	4,572,346	2,101,073
Total, 1938	27,808	100.00	9,949	319,722	338,083	920,308	871,730

Mine production of metals from New Mexico crude ore shipped to smelters in 1939, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Catron	169	151	3,482	900		
Colfax	256	163	87			
Dona Ana	149	59	388	2,800	4,600	
Eddy	4		3	700		
Grant	75,325	5,511	451,776	3,460,211	2,371,931	892,000
Hidalgo	887	329	5,685	16,655	52,600	
Lincoln	101	60	71			
Luna	3,599	455	17,397	9,500	332,800	9,000
Otero	67	6	87	6,600	100	
Sandoval	514	66	2,130	100		
Santa Fe	2,302	703	8,833	671,200	200	
Sierra	1,549	993	11,392	31,909	23,648	
Socorro	2,067	79	1,002	9,000	200,000	633,000
Taos	31	11	725			
	87,020	8,586	503,058	4,209,575	2,985,879	1,534,000
Total, 1938	27,808	9,949	319,722	310,150	752,740	622,000

BY CLASSES OF ORE

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	5,032	2,789	12,840	50,031	28,624	
Dry and siliceous gold-silver	15,268	4,514	263,554	19,832	228,107	
Dry and siliceous silver	469	10	8,012	4,601	8,881	
Copper	59,144	941	202,507	4,065,997	1,465,208	
Lead	1,431	319	7,461	4,652	400,555	
Lead-copper	1,102	11	8,503	64,062	235,482	
Total to copper and lead plants	82,446	8,584	502,877	4,209,175	2,366,857	
Zinc	1,047	2	181	400	17,000	487,000
Zinc-lead	3,527				602,022	1,047,000
	87,020	8,586	503,058	4,209,575	2,985,879	1,534,000

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1939, 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				
Catron County: Mogollon	12		61,411	7,708		7,708	381,013		381,013	900			$528,501
Colfax County: Mount Baldy	7	5	26,567	2,756	44	2,800	1,189	7	1,196	28,500			101,776
Dona Ana County: Organ	8		159	70		70	392		392	2,800	4,600		3,223
Eddy County	1		4				3		3	700			75
Grant County:													
Burro Mountain	3		142	7		7	1,002		1,002	6,400			1,591
Central	15	1	4,665,556	4,828	1	4,829	420,769		420,769	84,687,500	5,881,300	47,354,000	12,000,957
Chloride Flat	1		2				28		28		400		38
Gold Hill [1]	5		29	44		44	140		140		2,600		1,757
Lone Mountain	1		1				19		19				13
Pinos Altos	45	36	2,465	807	167	974	11,067	40	11,107	15,700	119,700	147,000	56,532
Steeple Rock	7		12,772	4,487		4,487	237,030		237,030	13,000	19,000		320,183
Swartz	1		2,998	1		1	943		943	5,300	543,000	720,000	64,187
White Signal	3	5	14	13	14	27	7		7	100			960
Hidalgo County:													
Apache	4		164	37		37	3,636		3,636	5,600	5,000		4,580
Gold Hill [1]	5		30	24		24	103		103	200	4,600		1,147
Lordsburg	20		116,331	4,230		4,230	131,471		131,471	6,367,900	6,000		899,835
San Simon	2		75	2		2	566		566	300	36,900		2,219
Sylvanite	4		440	113		113	206		206	2,000	100		4,308
Lincoln County:													
Jicarilla		55			203	203		13	13				7,114
Nogal	1		1				52		52				35
White Oaks	1		100	60		60	19		19				2,113
Luna County:													
Cooks Peak	4		106	2		2	595		595	800	54,000	9,000	3,563
Victorio	1		3,493	453		453	16,802		16,802	8,700	278,800		41,269
Otero County:													
Orogrande	4	1	37	6	3	9	25		25	3,600			706
Sacramento	2		30				62		62	3,000	100		359
Rio Arriba County: Headstone	1	4	975	52	3	55	467		467	300	5,000		2,508
Sandoval County: Cochiti	2		514	66		66	2,130		2,130	100			3,766
San Miguel County: Willow Creek	1		75,620	5,694		5,694	166,619		166,619	418,000	3,599,000	9,849,000	1,037,162
Santa Fe County:													
Ortiz Mountains (Cerrillos)	1	8	19	9	736	745	13	34	47	200			26,128
San Pedro	7	2	2,411	746	29	775	8,831	3	8,834	671,000	200		102,914
Sierra County:													
Chloride	8		775	242		242	4,371		4,371	2,200	22,700		12,733
Kingston	2		150	1		1	3,254		3,254	200	600		2,293

Lake Valley	2		119				1,572		1,572	100	300		1,091
Las Animas (Hillsboro) and Pittsburg	13	50	1,160	868	2,271	3,139	3,315	112	3,427	29,900	100		115,306
Tierra Blanca	1		5	2		2	78		78				123
Socorro County:													
Good Fortune	1		22				7		7	4,400			463
Hansonberg	1		9				15		15		4,300		212
Magdalena	7		1,903	14		14	648		648	1,800	181,000	633,000	42,540
Mockingbird	2		18				18		18		10,100		487
San Mateo Mountains	2		495	68		68	928		928				3,010
Silver Mountain (or Water Canyon)	3		112	65		65	289		289	2,800	4,600		2,978
Taos County: Red River	3	1	141	30	3	33	975		975				1,817
Total New Mexico	214	168	4,977,375	33,505	3,474	36,979	1,400,669	209	1,400,878	92,284,000	10,784,000	58,712,000	15,402,572

[1] District lies in both Grant and Hidalgo Counties.

CATRON COUNTY

Mogollon district.—In 1939 the Black Hawk Consolidated Mines Co. operated continuously the Consolidated group (comprising the Andrew Jackson Consolidated, Lexington Contention, and Lexington Gunboat claims on the Queen vein) and the Little Fanney 200-ton cyanide mill, both under lease from the Lehigh Metals Co. This group was the largest single producer of gold and silver in the State during the year. The mill treated 55,137 tons of ore and 1,075 tons of old tailings on company account and 5,028 tons of custom ore, of which the bulk came from the Maud S, Last Chance, Little Fanney, and Pacific groups, all worked by lessees. The rest of the custom ore came from the Bearup, Champion, Hardscrabble, Joy, and Oakton properties. Some of the ore produced at the Last Chance and Maud S groups and a few lots of ore from the Homestake and Sheridan claims were shipped crude to the El Paso smelter and to ore buyers at Silver City and at Douglas, Ariz.

COLFAX COUNTY

Mount Baldy district (*Baldy, Elizabethtown, Eagle Nest*).—The Aztec mine group, owned and operated by the Maxwell Land Grant Co., continued in 1939 to be the principal producer in the Mount Baldy district. The ore was treated in the company 140-ton mill by jigging in the ball mill-classifier circuit, followed by flotation. The products were gold-silver-copper concentrates, shipped to the El Paso smelter, and gold-silver bullion, sold to the Denver Mint. Other mines owned by the Maxwell Land Grant Co. and worked by lessees on a small scale included the Montezuma and Gold Dollar. The Deep Tunnel Mining Co. built a 40-ton cyanide plant at the Moreno-Red Bandana group 2 miles northeast of Elizabethtown and operated it from July 8 to September 19 on company and custom ore. The custom ore came from the Ajax, Black Tail, and a claim owned by the Maxwell Land Grant Co., all in the Mount Baldy district, and the Memphis and Black Copper groups in the Red River district, Taos County. Placer miners continued to recover some gold by sluicing on streams in the Mount Baldy district.

DONA ANA COUNTY

Organ district.—The Donalco Mining Co. worked the Mormon mine 1½ months in November and December 1939 and the Rock of Ages 2 months beginning in September. The company shipped several lots of gold-silver-copper ore from each property to the El Paso smelter. A few small lots of smelting ore were shipped from other claims in the Organ district.

EDDY COUNTY

The Ammann Mining Co. shipped 4 tons of copper-silver ore to the El Paso smelter from its claim 11½ miles northwest of Carlsbad.

GRANT COUNTY

Burro Mountain district (*Tyrone*).—Strong & Harris worked the Virtue claim under lease 2 months in 1939 and shipped 88 tons of gold-silver ore to the El Paso smelter. Lessees at the Casino and Sunset claims each shipped some copper-silver ore.

Central district (*Bayard, Fierro, Georgetown, Hanover, Santa Rita*).—The Nevada Consolidated Copper Corporation, Chino Mines Division, continued producing throughout 1939 from its open-pit mine at Santa Rita. The ore is mined with electric shovels and transported 10 miles over the Atchison, Topeka & Santa Fe Ry. to Hurley, where it is concentrated in the company mill, the daily capacity of which has been increased during the past 2 years from 15,000 to 17,500 tons. The concentrates produced before March 22, 1939, were shipped to the El Paso smelter for treatment under contract; those produced after that date were smelted in the new company smelter adjacent to the concentrator, which was put in operation on May 2. The copper concentrates carry a low content of gold and silver to the ton. Molybdenite concentrates are recovered in the mill as a byproduct. The Twenty-fifth Annual Report of the Kennecott Copper Corporation, dated March 16, 1940, contains the following paragraphs regarding operations at the Chino property in 1939:

A total of 27,558,108 tons of ore having a calculated average of 1.02 percent copper was treated at the four domestic properties of the Corporation. Copper production amounted to 502,570,103 pounds, or about 50 percent more than the 1938 production of 334,816,884 pounds. In addition to the ore mined, approximately 36,573,000 tons of noncommercial overburden were removed at the power-shovel properties in Utah, Nevada, and New Mexico, this tonnage being equivalent to 1.40 tons overburden per ton of ore sent to the respective concentrating mills.

Copper production at the Chino property was continued at a comparatively low rate for the first half of the year but was stepped up to full capacity during the last 4 months. Orders for seven electric locomotives and other equipment necessary for the partial electrification of pit haulage were placed and preparatory track and line work commenced toward the close of the year. At Hurley a dust-collecting system was installed in the primary crushing plant. At the power plant a new 10,000-kilowatt turbogenerator and one high-pressure, high-superheat boiler were ordered and will be installed during the year 1940 to provide adequate generating capacity and permit more efficient utilization of reverberatory waste heat steam. The new smelter, which embodies in its design the latest developments in smelting practice, has proven satisfactory in every way since placed in service early in May and has effected a very material reduction in the cost of smelting.

Molybdenite production amounted to 12,055,554 pounds, including 111,561 pounds produced in an experimental way at the Braden plant in Chile. The molybdenite content of the ore treated at the Utah and New Mexico properties averaged 0.0354 percent and the recovery 71.31 percent. In contrast the 1938 recovery was 60.08 percent and in 1937, the first full year of operation, 43.41 percent. The demand for molybdenite was seriously curtailed upon the outbreak of war and largely as a result thereof the entire production was not sold. Since December the market has been narrowed even more, and there has been a further accumulation of unsold product.

The Empire Zinc Co. operated its Hanover mine group and 300-ton selective-flotation mill continuously in 1939. The products of the mill were zinc concentrates, shipped to the American Zinc Co. plant at East St. Louis, Ill., and the New Jersey Zinc Co. plants at Depue, Ill. (Mineral Point Zinc Division), and Palmerton, Pa.; and lead-copper concentrates, shipped to the El Paso smelter. The Pewabic zinc mine at Hanover and the Peru 500-ton mill near Deming were operated by the Callahan Zinc-Lead Co. under lease from January 1 to February 15 and were then inactive until June 5, when they were reopened by the same company and continued producing to the end of the year. Besides ore from the Pewabic mine, the mill treated some zinc ore produced by lessees from the Republic claim in the Union Hill group of the Hanover-Bessemer Iron & Copper Co. The concentrates produced in the mill in January and February were shipped to the Illinois Zinc Co. smelter at Dumas, Tex. This smelter was closed March 25 and did not reopen during the year; the concentrates produced from June to December went to the American Smelting & Refining Co. plant at Amarillo, Tex. The Callahan Zinc-Lead Co. returned the property to the Peru Mining Co., owner, as of January 1, 1940.

The American Smelting & Refining Co. operated the 200-ton Combination mill near Hanover under lease from March 1 to December 31, 1939, treating mostly company zinc-lead-copper-silver ore from the Ground Hog group but also custom ore of somewhat similar type from the Peerless, Grandview (Swartz district), Gold Frog group, September group, Silver Hill (Pinos Altos district), and two other properties in the Central district. The zinc concentrates produced in the mill were shipped to the Amarillo (Tex.) smelter and the lead-copper concentrates to the El Paso smelter. Part of the output from the Ground Hog was copper-lead-silver ore, shipped direct to the El Paso smelter; part of that from the Peerless and September groups was zinc-lead ore, shipped to the Ozark pigment plant at Coffeyville, Kans.; and 80 tons from the Gold Frog group was gold-silver-lead ore, shipped to the El Paso smelter.

A few cars of smelting ore were shipped from other mines in the Central district, including the Union Hill group and the Cash and Gold Spot claims. A placer miner in the Central district recovered a little gold.

Chloride Flat district.—A lessee on the Baltic claim shipped 2 tons of lead-silver ore in 1939.

Gold Hill district (see also Hidalgo County).—Small lots of gold-silver ore from the Ellandell, God's Tenth No. 1, Reservation, and Yellow Queen claims and 6 tons of lead-silver ore from the World's Fair claim were sold to the Ira L. Wright assay office at Silver City.

Lone Mountain district.—A little silver ore was shipped from the My Chance claim in 1939.

Pinos Altos district.—Lessees operated the Calumet 20-ton flotation- and table-concentration mill as a custom plant part of 1939. The ore treated came chiefly from the Ohio, Silver Hill, and Alaska mines and the Wild Horse dump. The products of the mill were lead-copper-gold-silver concentrates, sold to the El Paso smelter, and zinc-gold-silver-copper-lead concentrates, sold to the Amarillo (Tex.) smelter. Most of the ores produced from other mines and dumps in the Pinos Altos district were shipped to the El Paso smelter, the Ira L. Wright assay office at Silver City, and to Hawley & Hawley at Douglas, Ariz. Producers of 25 tons or more of ore included the Cleveland, Golden Rule-Campo Santo group, Hazard, Houston Thomas, Iron Clad, Lupita group, Mountain Key, Mina Grande, and Waggoner dump.

The Ryan Mining Corporation built a dam to collect water and installed a dragline, washer, and sluices on the Sunny Spot placer on Bear Creek 3 miles north of Pinos Altos in the summer of 1939; digging and washing continued about 2 months, when interrupted by heavy cloudbursts. The operation was later taken over by the Bear Creek Mining Co., which ran the equipment from November 1 to December 31. The Texas Placer Co. operated a dragline and portable screening plant, with a jig as a concentrator, on its claims on Bear

Creek from early summer to December 31. These two operations produced most of the placer gold from the Pinos Altos district in 1939. Individuals continued to recover some gold with sluices and pans.

Steeple Rock district.—The East Camp Exploration Syndicate operated the East Camp group continuously in 1939. It sank the vertical shaft an additional 550 feet to a total depth of 850 feet and drove 1,000 feet of drifts. Production totaled 10,248 tons of ore averaging 0.34 ounce of gold and 22.02 ounces of silver to the ton; the ore was shipped crude to the International Smelting & Refining Co., Miami, Ariz. The Carlisle group was operated by Veta Mines, Inc., from January 1 to February 15, when the company surrendered its lease; other lessees at the property shipped some ore and old tailings during the year. The other producing mines in the Steeple Rock district comprised the Homestake, Laura, Norman King, Frazier Brothers group, and Thanksgiving-Alberta property. The ore was shipped crude to smelters in Arizona and Texas. The Willmont Mining Co. erected a 30-ton cyanide plant at the Laura mine and began operating it in January 1940.

Swartz (or Carpenter or Camp Monarch) district.—The Black Range Development Co. operated the Grandview group throughout 1939 and produced 2,998 tons of ore, of which about half was zinc-lead ore sold to the Ozark pigment plant at Coffeyville, Kans.; the remainder was mostly zinc-lead-copper-silver ore and was shipped to the Combination mill near Hanover for treatment.

White Signal district.—Small lots of gold ore from the Apache Trail and Reward claims and a 4-ton lot of gold-silver-copper ore from the Combination claim were shipped to the Ira L. Wright assay office at Silver City in 1939. Testing operations on placer ground of Sunset Gold Fields, Inc., and sluicing by individuals in Gold Gulch recovered a little placer gold.

HIDALGO COUNTY

Apache district.—The output from the Apache district in 1939 comprised chiefly silver-copper-lead-gold ore shipped to the El Paso smelter from the Apache and Chappo groups.

Gold Hill district (see also Grant County).—A few truckloads of gold ore and lead-silver-gold ore from the Bob Cat, Martha Greer, Mary Florence, and Oro Grande prospects were sold to ore buyers at Silver City and at Douglas, Ariz., in 1939. Sweet & Wallace shipped 14 tons of lead-silver ore from another property to the El Paso smelter.

Lordsburg district.—The Banner Mining Co. operated the Bonney mine and 350-ton flotation mill 6 miles south of Lordsburg continuously in 1939. The vertical main shaft was sunk an additional 193 feet to a total depth of 1,213 feet, 3,138 feet of development drifts were driven, and 864 feet of diamond drilling were done. The product of the mill is copper-gold-silver-[iron] concentrates, which are sold to the El Paso smelter. Individuals working small mines, prospects, and dumps intermittently shipped newly mined and sorted dump ore to the El Paso smelter and to Hawley & Hawley at Douglas, Ariz. The producers included the Blas Noche property, Henry Clay, Homestake, Needmore, and Silver King. The Miser's Chest Mining & Milling Co., Inc., repaired 300 feet of the 400-foot 73° incline shaft at the Miser's Chest group and drove 400 feet of drifts.

San Simon district (Steins).—The Bob Montgomery group was worked on a small scale throughout 1939 by the owner, who shipped 64 tons of lead-silver ore to the El Paso smelter. A few lots of gold-silver ore were shipped from another property in the San Simon district.

Sylvanite district.—Lessees at the Buckhorn-Barney-Woods group 16 miles southwest of Hachita shipped four cars of gold-silver ore to the El Paso smelter in November and December 1939. A lessee at the Hardscrabble group shipped several cars of gold-silver-copper smelting ore. Some gold-silver ore was shipped from the Last Chance claim and another property in the Sylvanite district.

LINCOLN COUNTY

Jicarilla district.—Placer miners continued to recover gold in 1939 by rocking and sluicing in the Jicarilla Mountains southeast of Ancho.

Nogal district.—In 1939 the owner of the Silver Plume group shipped 1 ton of silver ore.

White Oaks district.—The Big Four Gold & Tungsten Mines drove a 100-foot incline shaft and 75 feet of drifts on its property 14 miles north of Carrizozo in 1939 and shipped 100 tons of gold-silver ore to the El Paso smelter.

LUNA COUNTY

Cooks Peak district.—Small-scale prospecting and mining at the Ethel-"85" group, the Big Lead & Silver property, and the Lookout claim yielded lead-silver ore, which was shipped to the Ira L. Wright assay office at Silver City. The Lookout claim also yielded 19 tons of zinc-lead ore, shipped to the Ozark pigment plant at Coffeyville, Kans. The owners of the Copper claim shipped 19 tons of copper-silver ore to the El Paso smelter.

Deming.—The Peru 500-ton selective-flotation mill at Wemple near Deming was operated most of 1939 under lease by the Callahan Zinc-Lead Co. and continued to treat ore from the Pewabic mine (see Central district, Grant County).

Victorio district.—Shanks Carpenter shipped oxidized gold-silver-lead-[zinc]-iron-lime ore to the El Paso smelter throughout 1939 from the Victorio group 4 miles south of Gage. The mine is developed by a 300-foot vertical shaft, a 700-foot adit, and over 4,000 feet of drifts.

OTERO COUNTY

Orogrande district.—The Garnet mine (opened by a 250-foot shaft and 200 feet of drifts) and three prospects in the Orogrande district each produced in 1939 a little copper ore containing gold and silver, all of which was sold to the El Paso smelter. The placer gold credited to Otero County for 1939 in this report was recovered from the Orogrande placer in 1938 but was not sold until 1939.

Sacramento district.—A sample lot of copper-silver ore from the La Luz No. 1 claim was trucked to the El Paso smelter in 1939, and 20 tons of copper-lead-silver ore were shipped from another property near High Rolls.

RIO ARRIBA COUNTY

Headstone district.—The Badger-Hidden Treasure group, operated for a period in 1938 under lease, reverted to the Amarillo Gold Mining

Co., owner, which operated the mine and mill part of 1939. The product of the mill was gold-silver-lead-copper concentrates, sold to the Leadville (Colo.) smelter. Small lots of placer gold were recovered from the Columbine and other placers in the Headstone district.

SANDOVAL COUNTY

Cochiti (Bland) district.—Lessees worked the Lone Star-Crown Point-Iron King group several months in 1939 and shipped gold-silver ore to the El Paso smelter. Some gold and silver were recovered from a clean-up of the old Cossak cyanidation mill.

SAN MIGUEL COUNTY

Willow Creek district (Tererro).—The American Metal Co. of New Mexico continued production from its Pecos mine on Willow Creek until May 31, 1939, when the mine was closed owing to exhaustion of ore. Part of the equipment, which includes a 12-mile aerial tram and the machinery in the 600-ton flotation mill in Alamitos Canyon, was sold in 1939 and 1940. The total output of the mine from its first production on January 20, 1927, to the date of closing in 1939 was 2,299,082 dry tons of ore containing 243,474 ounces of gold, 7,748,006 ounces of silver, 185,514,389 pounds of lead (wet assay), 35,835,807 pounds of copper (wet assay), and 595,355,840 pounds of zinc. The ore, treated by selective flotation, yielded 193,751 tons of lead-copper concentrates—containing 162,338 ounces of gold, 4,536,216 ounces of silver, 146,061,551 pounds of lead (wet assay), 16,491,992 pounds of copper (wet assay), and 46,342,538 pounds of zinc—and 473,606 tons of zinc concentrates—containing 25,922 ounces of gold, 1,642,360 ounces of silver, 13,497,879 pounds of lead (wet assay), 10,855,170 pounds of copper (wet assay), and 504,824,696 pounds of zinc. The aggregate smelter gross value of the combined concentrates before deductions for freight and treatment was $35,325,554, and the net value after deductions was $18,007,048.

SANTA FE COUNTY

Ortiz Mountains district (Cerrillos).—From March 27 to December 31, 1939, the Universal Placer Mining Corporation operated a 2½-cubic yard dragline and a land dredge, using a dry-separation method, on a part of the Ortiz grant known as the Old Placers about 6 miles south of Cerrillos and was the principal producer of placer gold in Santa Fe County during the year. Individuals continued to recover gold at small placers in the Ortiz Mountains, using sluices and dry washers. Some copper-gold-silver smelting ore was shipped from a lode claim.

San Pedro or New Placers district.—Lessees at the San Pedro (or Copper) mine, owned by John J. Raskob, continued to ship copper-gold-silver ore to the El Paso smelter in 1939. Raskob Interests, Inc., did considerable development work at the property and built a 150-ton flotation mill which was set going early in 1940. Gold was recovered in a Huntington mill at the Old Timer group and by hand methods at the Candelari, La Santa Fe, Live Oak, and Mascot claims. The Ortiz Gold Mining Co. shipped 6 tons of gold ore to the Leadville (Colo.) smelter. The Lazarus and another placer near Golden produced some gold.

SIERRA COUNTY

Chloride (Apache, Cuchillo Negro) district.—The Bald Eagle group was under development in 1939 by the Empire Mines & Metals Co., which shipped a test lot of lead-silver ore to the El Paso smelter and began installing equipment for a mill. Small lots of smelting ore were shipped from the Alta Vista No. 1, Fortuna, and other claims in the Chloride district. Andrew B. Stewart operated the Grand Republic group under lease from April to December and treated 650 tons of ore by jig and table concentration; the jig concentrates were amalgamated and the table concentrates shipped to the El Paso smelter.

Kingston district.—Silver ore containing a little lead, copper, and gold was shipped to smelters in 1939 from the Virginian and one other property in the Kingston district.

Lake Valley district.—Three cars of silver ore were shipped to the El Paso smelter from the Lake Valley district in 1939.

Las Animas district (Hillsboro).—The John I. Hallett Construction Co. continued operations throughout 1939 at the leased Gold Dust, Graf Von Luxemburg, Bunker Hill, and other placers in a group about 8 miles east of Hillsboro. The equipment consists of two gasoline-powered dragline excavators of 1 and 1¼ cubic yards capacity, a Coulter-Ainlay bowl recovery plant mounted on wheels, water-storage tanks, and pumps. Sluicing and panning at other placers in the Hillsboro district recovered some gold.

Lessees at the Wicks lode mine shipped copper-gold-silver ore to the El Paso smelter steadily throughout 1939. Small-scale operations at the Biglow, Bonanza, Duke, El Oro, M. K. T., Mocassin, Ready Pay-Apex, and other properties yielded ore aggregating 149 tons, of which part was sold to the El Paso smelter, part to Hawley & Hawley at Douglas, Ariz., and part to the Ira L. Wright assay office at Silver City.

Pittsburg district.—From February 1 to December 31, 1939, William Little operated a ¾-cubic yard dragline and centrifugal bowl washing plant on placer ground of the Pittsburg Placer Mining Co. Individuals continued sluicing and panning at placers in the Pittsburg district; they sold the gold recovered to the Myers Co. general store at Hatch.

Tierra Blanca district.—In 1939 L. E. Cleveland shipped 5 tons of gold-silver ore from his Silver Bell claim.

SOCORRO COUNTY

Good Fortune district (40 miles west of Tularosa).—A lessee worked the Belle Vista prospect 2 months in 1939 and shipped a car of copper-silver ore to the El Paso smelter.

Hansonberg district (17 miles southeast of Carthage).—The Globe Mining Co. shipped 9 tons of lead-silver ore from Bingham in 1939.

Magdalena district.—The Ozark Smelting & Mining Co. operated its Waldo group from September 18, 1939, to the end of the year, producing zinc-lead ore for shipment to the Ozark pigment plant at Coffeyville, Kans. A lessee operating the Kelly group also shipped zinc-lead ore to this plant and lead-copper-silver ore to the El Paso smelter. The Oro Alto Mining Co. shipped gold-silver-lead-copper ore from a property south of Kelly. Small tonnages of smelting ore were shipped from other properties in the Magdalena district.

Mockingbird district.—Small lots of lead-silver ore were shipped from two properties in the Mockingbird district in 1939.

San Mateo Mountains district.—A lessee operated the Panky group from January to April 1939 and mined about 480 tons of ore, which was treated in the flotation mill at the mine. The yield was 12 tons of high-grade gold-silver concentrates shipped to the El Paso smelter. Bishop & Warren worked the Victorio claim 1 month and shipped 15 tons of gold-silver ore.

Silver Mountain (or Water Canyon) district.—Test runs made in 1939 on ore from the Open Cut mine in the gravity-concentration mill on the property yielded some gold and silver. Other small producers in the Silver Mountain district were the Rose Quartz and La Plata claims.

TAOS COUNTY

Red River district.—The Black Copper and Memphis mines were operated on a small scale several months in 1939; each yielded some ore, which was sent to the small custom cyanide mill of the Deep Tunnel Mining Co. near Elizabethtown, Colfax County, for treatment. Scavarda Brothers worked their Neptune claim from June 17 through December and shipped 31 tons of gold-silver ore to the El Paso smelter. A little gold was recovered from a placer claim near Red River.

The Molybdenum Corporation of America continued to produce molybdenum ore from the Phyllis group on Sulphur Creek. The ore is treated in the company 40-ton (per 24 hours) flotation mill at the junction of Sulphur Creek and Red River above Questa.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN OREGON

(MINE REPORT)

By Charles White Merrill and H. M. Gaylord

SUMMARY OUTLINE

The total value (in terms of recovered metals) of the gold, silver, copper, and lead produced in Oregon in 1939—$3,350,950—exceeded that in each year since mining was begun in 1852 and represents a 14-percent increase over 1938. It was divided among the metals as follows: Gold, over 97 percent; silver, 2 percent; and copper and lead combined, less than 0.5 percent. No recovery of zinc was reported for the year. Baker County continued as the leading metal producer and contributed 48 percent of the State total value; Grant County yielded 34 percent, Jackson County 9 percent, Josephine County 7 percent, and the other 14 producing counties only 2 percent.

The principal shift in production between counties in 1939, compared with 1938, was an increase in importance of Grant County and a sharp decline in that of Josephine County; the increase in Grant County resulted mainly from activities of lessees working the Independence Cougar mine, and the decline in Josephine County was caused primarily by suspension of dredging on Grave Creek by the Rogue River Gold Co. late in 1938.

Cornucopia Gold Mines, which worked the Cornucopia mine in the Cornucopia district of Baker County, not only was the largest producer of lode gold in Oregon in 1939 but also led in output of total gold and of silver, copper, and lead.

Another feature in the mining industry of the State in 1939 was the record output of gold by dragline dredges, which exceeded that by connected-bucket dredges for the first time and more than counterbalanced losses by some of the other placer methods.

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 reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1935–39

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1935	$35.00	$0.71875	$0.083	$0.040	$0.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052

[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] 1935–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–39: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787.

Mine production of gold, silver, copper, lead, and zinc in Oregon, 1935–39, and total, 1852–1939, 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
1935	115	268	184,543	54,160.11	$1,895,604	110,385	$79,339
1936	93	166	136,338	60,753.00	2,126,355	85,061	65,880
1937	104	150	77,230	52,662.00	1,843,170	60,564	46,846
1938	84	157	74,936	81,729.00	2,860,515	100,507	64,974
1939	116	201	69,025	93,372.00	3,268,020	105,388	71,536
1852–1939			(2)	5,410,821.00	117,341,778	4,594,512	4,345,195

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1935	397,800	$33,017	59,575	$2,383			$2,010,343
1936	574,000	52,808	158,000	7,268	122,000	$6,100	2,258,411
1937	820,000	99,220	218,000	12,862	48,000	3,120	2,005,218
1938	76,000	7,448	46,000	2,116			2,935,053
1939	96,000	9,984	30,000	1,410			3,350,950
1852–1939	[3] 12,052	4,571,253	[3] 620	61,625	[3] 140	13,846	126,333,697

[1] Beginning with 1936, excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Figures not available.
[3] Short tons.

Gold produced at placer mines in Oregon, 1935–39, 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:					
Connected-bucket dredges:					
1935	5	3,440,000	12,720.13	$445,205	$0.129
1936	5	5,148,000	17,067.26	597,354	.116
1937	4	5,017,000	17,178.00	601,230	.120
1938	5	7,258,000	29,006.00	1,015,210	.140
1939	5	6,267,000	25,028.00	875,980	.140
Dragline dredges: [2]					
1935	3	1,237,000	4,008.23	140,288	.113
1936	4	2,066,000	12,989.42	454,630	.220
1937	4	2,085,000	9,126.00	319,410	.153
1938	11	2,891,000	15,939.00	557,865	.193
1939	10	5,964,000	26,257.00	918,995	.154
Nonfloating washing plants: [3]					
1935	11	327,000	5,040.89	176,431	.540
1936	6	136,000	1,479.21	51,772	.381
1937	9	186,000	2,017.00	70,595	.380
1938	5	136,000	1,768.00	61,880	.455
1939	13	346,000	2,169.00	75,915	.219
Gravel hydraulically handled:					
Hydraulic:					
1935	72	669,000	4,224.84	147,869	.221
1936	52	1,051,000	2,677.05	93,697	.089
1937	48	366,000	2,344.00	82,040	.224
1938	66	731,000	3,261.00	114,135	.156
1939	76	440,000	2,585.00	90,475	.206
Small-scale hand methods: [4]					
Wet:					
1935	151	615,663	6,293.52	220,273	.358
1936	79	455,580	4,785.85	167,505	.368
1937	71	173,892	3,197.00	111,895	.643
1938	57	332,800	3,874.00	135,590	.407
1939	83	299,200	4,398.00	153,930	.514
Dry: [5]					
1938	2	800	16.00	560	.700
1939	1	400	13.00	455	1.138
Underground placers:					
Drift:					
1935	26	7,337	416.42	14,575	1.987
1936	20	5,420	422.21	14,777	2.726
1937	15	3,108	357.00	12,495	4.020
1938	11	5,400	467.00	16,345	3.027
1939	13	5,400	329.00	11,515	2.132
Grand total placers:					
1935	268	6,290,000	32,704.03	1,144,641	.182
1936	166	8,862,000	39,421.00	1,379,735	.156
1937	[6] 150	7,831,000	34,219.00	1,197,665	.153
1938	157	11,355,000	54,331.00	1,901,585	.167
1939	201	13,322,000	60,779.00	2,127,265	.160

[1] Beginning with 1936, excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Includes all placer operations using dragline excavator for delivering gravel to floating washing plant.
[3] 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 operations in which hand labor is principal factor in delivering gravel to sluices, long toms, dip boxes, pans, etc.
[5] None reported for 1935–37, inclusive.
[6] A mine using more than 1 method of recovery is counted but once in arriving at total for all methods.

Gold.—Production of gold in Oregon in 1939 increased 14 percent over 1938; the output from placers increased 12 percent and that from lode mines 19 percent. Of the total placer gold, 43 percent was recovered by dragline dredges, 41 percent by connected-bucket dredges, 7 percent by small-scale hand methods, 4 percent each by hydraulicking and nonfloating washing plants with mechanical excavators, and 1 percent by drifting. All the lode gold was derived from dry ores and virtually all from gold ore. Although 317 properties produced in 1939, the bulk of the gold came from relatively few mines; the following 10 properties supplied 72 percent of the total.

The 10 leading gold producers in Oregon in 1939, in order of output, were: Cornucopia Gold Mines (gold ore), Sumpter Valley Dredging Co. (connected-bucket dredge), Ferris Mining Co. (formerly Ferris & Marchbank) (dragline dredge), Western Dredging Co. (connected-bucket dredge), Porter & Co. (connected-bucket dredge), Independence Cougar Lessees (gold ore), Oroplata Mining Co. (dragline dredge), H. F. England Co. (dragline dredge), Consuelo Oregon Mines (dragline dredge), and Little, Harris & Wolfinger (dragline dredge).

Silver.—Silver production in Oregon in 1939 increased 5 percent in quantity and 10 percent in value over 1938. Of the State total silver, Baker County contributed 85 percent (76 percent coming from the Cornucopia mine in the Cornucopia district) and Grant County 12 percent; dry gold ore yielded 88 percent and placer gravels 10 percent. Nearly 88 percent of the total lode silver was recovered by concentration followed by smelting of the resulting concentrates.

Copper, lead, and zinc.—More than 92 percent of the copper produced in Oregon in 1939 was a byproduct of gold production at the Cornucopia mine. Lead production in the State totaled only 30,000 pounds. No zinc was reported recovered.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, and lead in Oregon in 1939, by counties, in terms of recovered metals

County	Mines producing [1]		Gold						Silver (lode and placer) [2]	
			Lode		Placer		Total			
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Baker	30	39	21,994	$769,790	22,002	$770,070	43,996	$1,539,860	89,236	$60,572
Coos	------	5	--------	----------	117	4,095	117	4,095	16	11
Crook	2	-------	4	140	-------	----------	4	140	6	4
Curry	3	7	57	1,995	197	6,895	254	8,890	37	25
Douglas	2	11	40	1,400	300	10,500	340	11,900	49	33
Grant	17	32	6,008	210,280	26,648	932,680	32,656	1,142,960	13,045	8,855
Harney	------	1	--------	----------	3	105	3	105	--------	------
Jackson	33	39	1,119	39,165	7,651	267,785	8,770	306,950	1,805	1,225
Josephine	22	53	3,098	108,430	3,499	122,465	6,597	230,895	803	545
Lane	3	-------	259	9,065	-------	----------	259	9,065	337	229
Linn	3	2	12	420	8	280	20	700	4	3
Malheur	------	5	--------	----------	291	10,185	291	10,185	38	26
Marion	1	(3)	2	70	2	70	4	140	1	1
Morrow	------	1	--------	----------	1	35	1	35	--------	------
Umatilla	------	1	--------	----------	32	1,120	32	1,120	6	4
Union	------	4	--------	----------	22	770	22	770	3	2
Wallowa	------	(3)	--------	----------	4	140	4	140	2	1
Wheeler	------	1	--------	----------	2	70	2	70	--------	------
	116	201	32,593	1,140,755	60,779	2,127,265	93.372	3,268,020	105,388	71,536
Total, 1938	84	157	27,398	958,930	54,331	1,901,585	81,729	2,860,515	100,507	64,974

See footnotes at end of table.

Mine production of gold, silver, copper, and lead in Oregon in 1939, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Total value
	Pounds	Value	Pounds	Value	
Baker	92,000	$9,568	18,000	$846	$1,610,846
Coos					4,106
Crook					144
Curry					8,915
Douglas					11,933
Grant	2,000	208	4,000	188	1,152,211
Harney					105
Jackson			2,000	94	308,269
Josephine					231,440
Lane	2,000	208	6,000	282	9,784
Linn					703
Malheur					10,211
Marion					141
Morrow					35
Umatilla					1,124
Union					772
Wallowa					141
Wheeler					70
	96,000	9,984	30,000	1,410	3,350,950
Total, 1938	76,000	7,448	46,000	2,116	2,935,053

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Source of total silver as follows: 1939, 94,794 ounces from lode mines and 10,594 ounces from placers; 1938, 92,206 ounces from lode mines and 8,301 ounces from placers.
[3] Output from property not classed as a "mine."

MINING INDUSTRY

Of the 65,261 tons of ore sold or treated in Oregon in 1939, 65,174 tons were dry gold ore and 87 tons dry gold-silver ore; in addition, 3,764 tons of old tailings, of value principally in gold, were treated. The following figures give a measure of the large increase in output from Oregon mines during recent years: Tonnage of ore and old tailings sold or treated in 1939 was 13 times and quantity of lode gold produced was nearly 9 times that at the low point reached in 1932; and quantity of placer gold produced was 10 times and total value of gold, silver, copper, and lead produced was 11 times that at the low point recorded in 1928. Three-fourths of the lode gold produced in Oregon in 1939 came from the Cornucopia mine in the Cornucopia district of Baker County and the Independence Cougar mine in the Granite district of Grant County. Half of the placer gold output of the State was produced by the following four companies: The Sumpter Valley Dredging Co. (connected-bucket dredge), Sumpter district, Baker County; Ferris Mining Co. (dragline dredge), Canyon district, Grant County; Western Dredging Co. (connected-bucket dredge), Canyon district, Grant County; and Porter & Co. (connected-bucket dredge), Granite district, Grant County. These six operators supplied 58 percent of the total gold produced in Oregon in 1939.

Reports on the use of quicksilver at Oregon placer mines indicate that 1,400 pounds were consumed during 1939. All the connected-bucket dredges used quicksilver, and they averaged 53 ounces of gold recovered per pound consumed. The average consumption of quicksilver by all dragline dredges was 1 pound per 42 ounces of gold recovered, but several of the dredges did not amalgamate; those that did use quicksilver consumed 1 pound per 16 ounces of gold saved.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore and old tailings sold or treated in Oregon in 1939, with content in terms of recovered metals

Source	Material sold or treated		Gold	Silver	Copper	Lead
	Ore	Old tailings				
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry and siliceous gold ore	65, 174	3, 764	32, 518	93, 268	96, 000	30, 000
Dry and siliceous gold-silver ore	87		75	1, 526		
Total, lode mines	65, 261	3, 764	32, 593	94, 794	96, 000	30, 000
Total, placers			60, 779	10, 594		
	65, 261	3, 764	93, 372	105, 388	96, 000	30, 000
Total, 1938	61, 278	13, 658	81, 729	100, 507	76, 000	46, 000

METALLURGIC INDUSTRY

Of the 69,025 tons of ore (including 3,764 tons of old tailings) sold or treated in Oregon in 1939, Baker County produced 38,632 tons (including 1,275 tons of old tailings), or 56 percent; Josephine County, 15,889 tons (including 2,284 tons of old tailings), or 23 percent; and Grant County 11,222 tons (ore), or 16 percent. Of the State total ore and old tailings, 56 percent was treated in concentrating mills, most of which used flotation; 32 percent was treated in amalgamation and cyanidation mills, with or without concentration equipment; and 12 percent was shipped crude to smelters. Sixty-four percent of the total lode gold was recovered ultimately by the smelting of concentrates; 20 percent by direct smelting of ore; 10 percent as bullion by cyanidation of ore, concentrates, and old tailings; and 6 percent by amalgamation of ore and old tailings. All material requiring smelting was shipped out of the State, as Oregon has no smelters.

Data furnished by operators of gold and silver mills show that 2,389 pounds of 91-percent sodium cyanide were consumed in recovering 303 ounces of gold and 161 ounces of silver from 3,439 tons of old tailings, and 156 pounds of quicksilver were used in the recovery of 1,971 ounces of gold and 383 ounces of silver from 4,422 tons of ore.

Mine production of metals in Oregon in 1939, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Ore and old tailings amalgamated	4, 747	2, 048	516		
Ore, concentrates, and old tailings cyanided	17, 468	3, 087	400		
Concentrates smelted:					
Flotation	2, 030	20, 549	82, 398	88, 400	13, 700
Gravity	91	260	642		2, 700
Ore smelted	8, 060	6, 649	10, 838	7, 600	13, 600
Total, lode mines		32, 593	94, 794	96, 000	30, 000
Total, placers		60, 779	10, 594		
		93, 372	105, 388	96, 000	30, 000
Total, 1938		81, 729	100, 507	76, 000	46, 000

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Oregon in 1939, by types of mills and by counties, in terms of recovered metals

County	Material treated		Recovered in bullion		Concentrates smelted and recovered metal				
	Ore [1]	Old tailings	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
AMALGAMATION MILLS									
Baker	2,026		804	161	20	40	40		700
Curry	1		3						
Douglas	5		29	3					
Grant	387		133	33	4	6	11		
Jackson	1,333		774	246	17	87	69		
Josephine	587	300	283	66	3	17	5		
Lane		25	8	3					
Linn	43		12	3					
Marion	40		2	1					
	4,422	325	2,048	516	44	150	125		700
Total, 1938	6,101	360	2,952	608	43	217	258	716	
CYANIDATION MILLS									
Baker		1,275	157	10					
Curry		180	49	11					
Grant	819		117	23					
Jackson	212		27	18					
Josephine	12,998	1,984	2,737	338					
	14,029	3,439	3,087	400					
Total, 1938	9,243	11,950	2,611	592					
Grand total: 1939	18,451	3,764	5,135	916	44	150	125		700
1938	15,344	12,310	5,563	1,200	43	217	258	716	

[1] Figures under "Ore" for cyanidation mills include both raw ore and concentrates cyanided, but not raw ore concentrated before cyanidation of concentrates.

Mine production of metals from concentrating mills in Oregon in 1939, by counties, in terms of recovered metals

County	Material treated		Concentrates smelted and recovered metal				
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Baker	32,885		1,669	19,431	80,021	88,000	12,100
Grant	4,675		362	1,122	2,393	400	1,600
Jackson	1,200		46	106	501		2,000
	38,760		2,077	20,659	82,915	88,400	15,700
Total, 1938	44,660	1,348	1,991	19,555	85,057	72,604	44,595

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Gross metal content of concentrates produced from ores mined in Oregon in 1939, by classes of concentrates

Class of concentrates	Concentrates	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	452	1,378	3,019	1,397	5,525	1,664
Copper	1,666	19,415	79,978	89,502	19,549	--------
Lead-copper	3	16	43	277	534	--------
	2,121	20,809	83,040	91,176	25,608	1,664
Total, 1938	2,034	19,772	85,315	75,166	69,873	--------

Mine production of metals from Oregon concentrates shipped to smelters in 1939 in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Baker	1,689	19,471	80,061	88,000	12,800
Grant	366	1,128	2,404	400	1,600
Jackson	63	193	570	----------	2,000
Josephine	3	17	5	----------	----------
	2,121	20,809	83,040	88,400	16,400
Total, 1938	2,034	19,772	85,315	73,320	44,595

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead
Dry gold	452	1,378	3,019	400	4,300
Copper	1,666	19,415	79,978	87,800	11,800
Lead-copper	3	16	43	200	300
	2,121	20,809	83,040	88,400	16,400

Gross metal content of Oregon crude ore shipped to smelters in 1939, by classes of ore

Class of ore	Ore	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold	7,973	6,574	9,312	10,093	20,703	3,684
Dry and siliceous gold-silver	87	75	1,526			
	8,060	6,649	10,838	10,093	20,703	3,684
Total, 1938	1,420	2,063	5,691	3,464	1,997	

Mine production of metals from Oregon crude ore shipped to smelters in 1939, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Baker	2,446	1,562	3,811	4,000	5,200
Crook	12	4	6		
Curry	5	5	2		
Douglas	4	11	15		
Grant	5,341	4,630	6,630	1,600	2,400
Jackson	8	125	25		
Josephine	20	61	15		
Lane	224	251	334	2,000	6,000
	8,060	6,649	10,838	7,600	13,600
Total, 1938	1,420	2,063	5,691	2,680	1,405

BY CLASSES OF ORE

Dry and siliceous gold	7,973	6,574	9,312	7,600	13,600
Dry and siliceous gold-silver	87	75	1,526		
	8,060	6,649	10,838	7,600	13.600

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, and lead in Oregon in 1939, by counties and districts, in terms of recovered metals [1]

County and district [1]	Mines producing [2]		Ore and old tailings	Gold			Silver (lode and placer) [3]	Copper	Lead	Total value
	Lode	Placer		Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	
Baker County:										
Baker	3	6	37	38	173	211	42			$7,414
Bull Run	2	([4])	11	15	17	32	8	100		1,136
Connor Creek		2			267	267	41			9,373
Cornucopia	2	5	32,972	19,743	357	20,100	80,916	88,700	12,800	768,251
Cracker Creek	2	1	1,247	516	3,201	3,717	1,335			131,001
Eagle Creek	2	([4])	101	19	8	27	5			948
Greenhorn [5]	1	3	111	118	17	135	420	2,400	4,500	5,471
Hereford		5			131	131	34			4,608
Mormon Basin [6]	3	9	145	122	724	846	476			29,933
Rock Creek	2	([4])	331	203	30	233	1,801		700	9,410
Sparta	3	([4])	981	450	39	489	83			17,171
Sumpter		5			16,918	16,918	3,874			594,760
Virtue	4	([4])	721	414	14	428	109	800		15,137
Weatherby	6	1	1,975	356	95	451	90			15,846
Coos County:										
Coos Bay		([4])			16	16	1			561
Johnson Creek		4			84	84	10			2,947
Randolph		1			13	13	4			457
Rock Creek		([4])			4	4	1			141
Crook County: Maury Mountain	2		12	4		4	6			144
Curry County:										
Chetco		1			15	15	1			526
China Diggings	2		181	52		52	11			1,827
Gold Beach		([4])			135	135	17			4,737
Mule Creek		1			3	3				105
Port Orford		2			32	32	5			1,123
Sixes	1	3	5	5	12	17	3			597
Douglas County:										
Agness		([4])			1	1	1			36
Canyonville		1			3	3	1			106
Cow Creek	1	2	5	29	142	171	17			5,996
Elk Creek		([4])			3	3				105
Green Mountain		2			41	41	7			1,440
Mount Reuben [7]		1			32	32	2			1,121
Myrtle Creek	1	1	4	11	29	40	18			1,412
Ollala		2			15	15	1			526
Riddle		2			34	34	2			1,191
Grant County:										
Black Butte		1			2	2				70
Canyon	4	10	121	54	13,374	13,428	1,402			470,932
Desolation [8]		4			28	28	5			983
Granite	5	5	10,828	5,823	9,414	15,237	10,965	1,800	4,000	541,113

Greenhorn [5]	3	4	214	88	68	156	58	200	----------	5,520
North Fork John Day	----------	2	----------	----------	23	23	6	----------	----------	809
Quartzburg	4	3	57	36	3,309	3,345	538	----------	----------	117,440
Susanville	(9)	3	(9)	(9)	430	[10] 430	[10] 70	----------	----------	[10] 15,098
Harney County: Idol City	----------	1	----------	----------	3	3	----------	----------	----------	105
Jackson County:										
Ashland	3	1	587	352	8	360	157	----------	----------	12,707
Elk Creek	(9)	(4)	(9)	(9)	9	[10] 9	[10] 1	----------	(9)	[10] 316
Foots Creek	----------	8	----------	----------	447	447	61	----------	----------	15,686
Gold Hill	10	10	567	243	2,635	2,878	327	----------	----------	100,952
Greenback [11]	4	1	184	157	19	176	33	----------	----------	6,182
Jacksonville	1	4	20	8	365	373	56	----------	----------	13,093
Upper Applegate	14	15	173	246	4,168	4,414	657	----------	----------	154,936
Josephine County:										
Althouse	(9)	9	(9)	(9)	181	[10] 181	[10] 27	----------	----------	[10] 6,353
Galice	5	14	13,670	2,722	778	3,500	306	----------	----------	122,708
Grants Pass	2	6	103	26	290	316	40	----------	----------	11,087
Greenback [11]	5	8	1,814	149	963	1,112	263	----------	----------	39,099
Illinois River	(9)	8	(9)	(9)	366	[10] 366	[10] 43	----------	----------	[10] 12,839
Lower Applegate	5	(9)	239	168	(9)	[12] 168	[12] 43	----------	----------	[12] 5,909
Mount Reuben [7]	1	----------	8	8		8	3	----------	----------	282
Waldo	----------	6	----------	----------	856	856	59	----------	----------	30,000
Lane County: Bohemia	3	----------	249	259	----------	259	337	2,000	6,000	9,784
Linn County: Quartzville	3	2	43	12	8	20	4	----------	----------	703
Malheur County:										
Malheur	----------	2	----------	----------	221	221	24	----------	----------	7,752
Mormon Basin [6]	----------	2	----------	----------	63	63	12	----------	----------	2,213
Snake River	----------	1	----------	----------	7	7	2	----------	----------	246
Marion County:										
Gold Butte	1	----------	40	2	----------	2	1	----------	----------	71
North Santiam	----------	(4)	----------	----------	2	2	----------	----------	----------	70
Morrow County: Emberger	----------	1	----------	----------	1	1	----------	----------	----------	35
Umatilla County: Desolation [8]	----------	1	----------	----------	32	32	6	----------	----------	1,124
Union County:										
Camp Carson	----------	3	----------	----------	19	19	2	----------	----------	666
Grande Ronde	----------	1	----------	----------	3	3	1	----------	----------	106
Wallowa County: Wallowa	----------	(4)	----------	----------	4	4	2	----------	----------	141
Wheeler County: Spanish Gulch	----------	1	----------	----------	2	2	----------	----------	----------	70
Combined districts [13]	6	4	1,269	145	76	221	535	----------	2,000	8,193
Total Oregon	116	201	69,025	32,593	60,779	93,372	105,388	96,000	30,000	3,350,950

[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 included under "Combined 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: 94,794 ounces from lode mines and 10,594 ounces from placers.

[4] Output from property not classed as a "mine."

[5] Greenhorn district lies in both Baker and Grant Counties.

[6] Mormon Basin district lies in both Baker and Malheur Counties.

[7] Mount Reuben district lies in both Douglas and Josephine Counties.

[8] Desolation district lies in both Grant and Umatilla Counties.

[9] Included under "Combined districts."

[10] Exclusive of lode output, which is included under "Combined districts."

[11] Greenback district lies in both Jackson and Josephine Counties.

[12] Exclusive of placer output, which is included under "Combined districts."

[13] Includes following districts: Homestead (all placer) in Baker County; Susanville (lode) in Grant County; Elk Creek (lode) in Jackson County; Althouse (lode), Illinois River (lode), and Lower Applegate (placer) in Josephine County.

BAKER COUNTY [1]

Connor Creek district.—Lessees working the Connor Creek placer mine in 1939 produced 138 ounces of gold and 20 ounces of silver from 1,850 cubic yards of gravel.

Cornucopia district.[2]—The Cornucopia mine, operated by Cornucopia Gold Mines, was the outstanding producer in Oregon in 1939. The content of its output of concentrates and smelting ore was 19,579 ounces of gold, 80,613 ounces of silver, 90,080 pounds of copper, and 19,675 pounds of lead. The mine was the principal source of each of these four metals and, in terms of recovered metals, supplied 60 percent of the lode gold produced in the State, 21 percent of the total gold, 76 percent of the total silver, 92 percent of the copper, and 39 percent of the lead. The company sent 32,870 tons of gold ore to its 150-ton flotation mill and shipped 1,666 tons of copper concentrate and 20 tons of crude ore to a smelter. An extensive construction campaign resulted in the building, during the year, of workmen's houses, a substation, bunk houses, a recreation hall, and a change house. The company announced the acquisition of the Queen of the West group of 13 quartz claims and the Panter group of 3 claims in 1939. The Forest Queen mine was worked from July until the end of the year. Among the placers in operation along Pine Creek in the Cornucopia district were the Boulder Creek, Lillard (formerly Ingram), Pebble, and Cold Springs mines.

Cracker Creek district.—The dragline dredge of Consuelo Oregon Mines was the largest gold producer in the Cracker Creek district in 1939. A small quantity of gold ore derived from dumps and clean-up work in old mills at the E and E and North Pole mines was shipped for smelting. An examination and sampling campaign covering the North Pole, E and E, Tabor Fraction, and Columbia mines, undertaken by the Campbell Oregon Gold Mining Corporation in 1938, was terminated September 30, 1939, without production, and the lease surrendered in October.

Greenhorn district.—The Snow Creek lode mine was the principal producer in the Greenhorn district in 1939. Some changes were made in the mine flotation mill, but most of the output came from direct smelting ore.

Mormon Basin district.—The Oregon Mining Co. operated a dragline dredge on Burnt River 5 miles below Bridgeport during 1939 and produced 457 ounces of gold and 74 ounces of silver. Small shipments of smelting ore recovered from the clean-up of old mills and dumps were made from the Humboldt, Rainbow, and Sunday Hill mines.

Rock Creek district.—Lessees of the Elkhorn mine in 1939 treated 125 tons of gold ore by amalgamation and concentration and shipped 20 tons of concentrates for smelting; 43 ounces of gold were recovered by amalgamation and 40 ounces by smelting of concentrates. Mill cleanings were shipped from the Highland mine.

[1] *See also* State of Oregon Department of Geology and Mineral Industries, Oregon Metal Mines Handbook: Bull. 14-A, 1939, 125 pp.
Lorain, S. H., Gold Mining and Milling in Northeastern Oregon: Bureau of Mines Inf. Circ. 7015, 1938, 46 pp.

[2] *See also* Goodspeed, G. E., Geology of the Gold Quartz Veins of Cornucopia: Am. Inst. Min. and Met. Eng., Min. Technol., vol. 3, No. 2, March 1939, pp. 15–18.

Sparta district.—Lessees working the Macy mine in 1939 treated 969 tons of gold ore by amalgamation and recovered 446 ounces of gold and 72 ounces of silver.

Sumpter district.—The Sumpter Valley Dredging Co., the largest producer of placer gold in Oregon in 1939, treated 3,291,663 cubic yards of gravel and recovered 11,289 ounces of gold and 2,523 ounces of silver; the company dredge was of the connected-bucket electric-power type with seventy-two 9-cubic foot buckets. Little, Harris & Wolfinger worked a dragline dredge with a 1½-cubic yard bucket throughout the year and recovered 3,083 ounces of gold and 748 ounces of silver from 590,149 cubic yards of gravel. The Nutting Dredging Co., which began operations April 6, 1939, with a 1¾-cubic yard bucket dragline, handled 501,144 cubic yards of gravel during the remainder of the year to recover 2,472 ounces of gold and 584 ounces of silver.

Virtue district.—Work at the Columbian mine in 1939 yielded 623 tons of smelting ore containing 338 ounces of gold and 99 ounces of silver.

CURRY COUNTY

China Diggings district.—Operations begun August 15, 1939, at the Robert E mine continued during the rest of the year; cyanidation of 180 tons of old tailings yielded 49 ounces of gold and 11 ounces of silver.

GRANT COUNTY[3]

Canyon district.—Ferris & Marchbank became the Ferris Mining Co. November 1, 1939. The organizations operated a dragline dredge equipped with a 4-cubic yard Diesel-electric dragline excavator and handled 1,943,200 cubic yards of gravel during 1939 to recover 6,747 ounces of gold and 697 ounces of silver. This is one of the largest (if not the largest) dragline-dredge projects in the world. The hydraulicking of 10,000 cubic yards of gravel at the Quartz Gulch mine resulted in the production of 70 ounces of gold and 10 ounces of silver. The Western Dredging Co. operated its connected-bucket dredge on the John Day River near John Day throughout the year; the dredge was equipped with seventy-two 6-cubic foot buckets.

Granite district.—The Oroplata Mining Co. worked the Milwaukee Placers in the Ten Cent section of the Granite district throughout 1939; the site of Lawton, an abandoned mining town, formed part of the area dredged. The company used a Diesel-powered washing plant and a dragline excavator with a 2½-cubic yard bucket and washed 940,000 cubic yards of gravel to recover 3,661 ounces of gold and 901 ounces of silver. Porter & Co. operated an electric dredge with sixty-two 4½-cubic foot buckets; the company property lies on Bull Run, Clear, Granite, Olive, and Crane Creeks. Work was begun at the Bellevue mine October 1, and 87 tons of ore containing 75 ounces of gold and 1,526 ounces of silver were shipped before the end of the year. The Constitution mine was worked throughout 1939; part of the ore was treated at the company flotation mill, and the remainder was shipped direct to a smelter. The mill burned November 2. The Independence Cougar mine, which had only a small output

[3] *See also* works cited in footnote 1.

in 1938, made a production in 1939 that ranked it as the second-largest lode gold and third-largest silver producer in Oregon. Lessees on the property completely rebuilt the old metallurgical plant as a flotation mill with a daily capacity of 75 tons. Approximately 4,000 tons of ore were treated by flotation to produce 290 tons of concentrates; the concentrates, containing 789 ounces of gold and 773 ounces of silver, and 5,049 tons of crude ore, containing 3,820 ounces of gold and 2,812 ounces of silver, were shipped to a smelter.

Quartzburg district.—The H. F. England Co. operated throughout 1939 a dragline dredge, using a dragline excavator with a 1½-cubic yard bucket, on Dixie Creek, 2 miles from Prairie City.

Susanville district.—The Timms Gold Dredging Co., which had operated since November 1933 on the Middle Fork of John Day River near Galena, worked out its dredgeable ground in 1939 in about 2 months. The company spent much of the year testing beds of gravel and rebuilding the dredge.

JACKSON COUNTY

Ashland district.—Development work was continued at the Ashland mine throughout 1939; the resulting gold ore was treated by amalgamation and concentration. A small output of gold ore was reported from the Free Gold mine.

Elk Creek district.—Production was resumed at the Buzzard mine by Al Sarena Mines, Inc., November 15, 1939; the ore was treated by table concentration.

Foots Creek district.—William von der Hellen Mines abandoned operation of the Lance mine March 24, 1939, after washing 29,494 cubic yards of gravel to recover 335 ounces of gold and 44 ounces of silver in a stationary washing plant to which the gravel was delivered from an open-cut by power shovel and trucks.

Gold Hill district.—The Lucky Bart mine, following lessee operation during the early months of 1939, was taken over by the Lucky Eagle Mining Co. May 1; production for the year was 122 ounces of gold and 33 ounces of silver recovered by amalgamation. Gold Hill Placers operated a washing plant, mounted on caterpillar treads, on Sardine Creek from April 20 until the end of 1939. The Pleasant Creek Mining Corporation operated a sluice-type connected-bucket dredge and produced a substantial quantity of gold during the year.

Upper Applegate district.—The B-H Co. continued to operate its dragline dredge on West Fork of Forest Creek in 1939, except for a shut-down from September 3 until November 1. A dragline dredge was worked for 5 months by the Crescent Pacific Mining Co. on the Applegate River. From June 1 until September 1 M. C. Lininger & Son operated a stationary washing plant fed by a gasoline shovel and trucks and washed 25,360 cubic yards of gravel to recover 195 ounces of gold. The Glide Foundation operated a Diesel-powered dragline dredge with a 1¼-cubic yard bucket on Poorman's Creek from January 1 until May 1.

JOSEPHINE COUNTY

Galice district.—The Lewis Investment Co. operated the Benton mine throughout 1939 and was the third-largest producer of lode gold in the State. The ore was treated in a cyanide plant having a daily capacity of 50 tons. A new road, completed by the Civilian Conservation Corps from a point near Galice to the mine, makes year-round trucking possible.

Grants Pass district.—A lessee hydraulicked a substantial quantity of gravel at the Forest Queen mine and Boulder claim on Louse Creek during 1939.

Greenback district.—P. B. Wickham, lessee of the Greenback mine, reopened the property and rebuilt the mill during 1939; the only output from the property resulted from operations by other lessees who cyanided old tailings to recover 74 ounces of gold and 85 ounces of silver. From January 10 to April 15, while water was available, 20,000 cubic yards of gravel were hydraulicked at the Blue Channel mine. Gold was produced at the Columbia mine by hydraulicking when water was sufficient for operation.

Lower Applegate district.—The Powell Creek Mining Co. worked the Bonanza mine from May 1, 1939, until the end of the year. Including lessee output, 139 tons of gold ore were treated by amalgamation and concentration at the nearby Humdinger mill to recover 40 ounces of gold by amalgamation and 2 tons of concentrates. The concentrates, containing 14 ounces of gold, and 20 tons of crude ore, containing 61 ounces of gold, were shipped to a smelter. The Humdinger mine was operated intermittently during 1939; 53 tons of ore amalgamated yielded 30 ounces of gold and 6 ounces of silver.

Waldo district.—At the Esterly mine 75,000 cubic yards of gravel were hydraulicked to recover 421 ounces of gold and 25 ounces of silver during 1939. A substantial quantity of gold was produced by hydraulicking at the Platurica (Plataurica) mine.

LANE COUNTY

Bohemia district.—A small shipment of smelting gold ore was made from the Helena mine in 1939.

MALHEUR COUNTY[4]

Malheur district.—A dragline dredge was operated on Quartz Gulch three-fourths mile south of Malheur City during 1939.

OTHER COUNTIES

Small outputs in 1939 were reported also from Coos, Crook, Douglas, Harney, Linn, Marion, Morrow, Umatilla, Union, Wallowa, and Wheeler Counties.

Details of production by counties and districts are given in the preceding table.

[4] *See also* works cited in footnote 1.

GOLD, SILVER, COPPER, AND LEAD IN SOUTH DAKOTA

(MINE REPORT)

By Chas. W. Henderson and A. J. Martin

SUMMARY OUTLINE

Metal mining in South Dakota is confined to a small area comprising parts of Custer, Lawrence, and Pennington Counties in the group of mountains known as the Black Hills. Gold is the chief metal produced and gold mining the principal mineral industry of the State. Gold was first discovered in South Dakota on French Creek, Custer County, in 1875. In 1939 the recovered output of gold in the State was the highest for any one year during the period 1876–1939; it totaled 618,536 fine ounces valued at $21,648,760, an increase of 4 percent over 1938, the former record year. Besides gold, South Dakota in 1939 produced 167,584 fine ounces of byproduct silver valued at $113,754. No recoverable copper has been produced in the State since 1918 and no lead since 1935. As the record gold production of 1939 indicates, operations at the principal producing mines were maintained at close to capacity throughout the year. The Homestake mine at Lead, Lawrence County, the largest producer of gold in the United States, yielded 92 percent of the State output of gold; other mines in Lawrence County—chiefly the Bald Mountain Mining Co. group at Trojan, the Maitland in the Maitland district, and the Gilt Edge in the Bear Butte district—contributed most of the remainder. The only sizable producer outside of Lawrence County was the Golden Slipper mine in the Hill City district, Pennington County. The output of gold and silver from Custer County came from placer mines on French Creek.

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, 1935–39

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1935	$35.00	$0.71875	$0.083	$0.040	$0.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052

[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] 1935–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–39: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464.
[5] $0.67878787.

Except for a slight drop in 1937 from 1936, gold production in South Dakota has increased annually over the 5 years ended with 1939. The quantity of silver recovered varied somewhat in proportion to the gold produced in the individual years but also increased over the period.

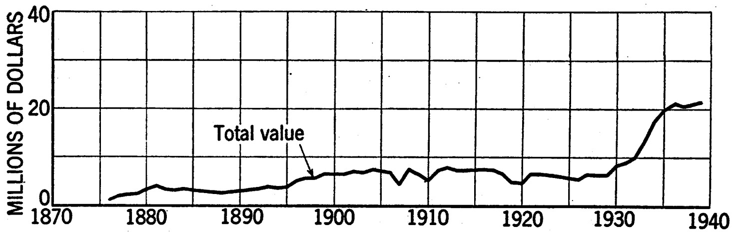

FIGURE 1.—Total value of mine production of gold and silver in South Dakota, 1876–1939.

Mine production of gold, silver, copper, and lead in South Dakota, 1935–39, and total, 1876–1939, 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
1935	15	199	1, 487, 235	567, 230. 20	$19, 853, 057	151, 047	$108, 565
1936	12	130	1, 549, 146	586, 353. 40	20, 522, 369	144, 448	111, 875
1937	14	73	1, 597, 178	581, 544. 00	20, 354, 040	139, 638	108, 010
1938	11	71	1, 586, 181	594, 847. 00	20, 819, 645	162, 295	104, 918
1939	18	80	1, 632, 778	618, 536. 00	21, 648, 760	167, 584	113, 754
1876–1939			(2)	18, 850, 644. 00	441, 369, 749	8, 999, 991	6, 402, 381

Year	Copper		Lead		Total value
	Pounds	Value	Pounds	Value	
1935			7, 000	$280	$19, 961, 902
1936					20, 634, 244
1937					20, 462, 050
1938					20, 924, 563
1939					21, 762, 514
1876–1939	195, 691	$34, 598	575, 313	34, 820	447, 841, 548

[1] For total production of gold and silver in South Dakota, by years, see Mineral Resources, 1913, pt. I, p. 42; Mineral Resources, 1922, pt. I, p. 194; and subsequent volumes of Mineral Resources and Minerals Yearbook.
[2] Figures not available.

Gold and silver produced at placer mines in South Dakota, 1935–39, in terms of recovered metals

Year	Gold		Silver		Total value
	Fine ounces	Value	Fine ounces	Value	
1935	936. 86	$32, 790	103	$74	$32, 864
1936	346. 80	12, 138	31	24	12, 162
1937	1, 010. 60	35, 371	75	58	35, 429
1938	1, 069. 00	37, 415	82	53	37, 468
1939	622. 00	21, 770	47	32	21, 802

MINE PRODUCTION BY COUNTIES

Mine production of gold and silver in South Dakota in 1939, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)		Total value
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	
Custer		16	268.00	$9,380	22	$15	$9,395
Lawrence	10	16	615,422.00	21,539,770	167,098	113,424	21,653,194
Pennington	8	48	2,846.00	99,610	464	315	99,925
	18	80	618,536.00	21,648,760	167,584	113,754	21,762,514

Gold and silver produced at placer mines in South Dakota in 1939, by counties and methods of recovery, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Drift mining		Dry-land dredges [1]		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Custer	26.00	4	9.00	1	233.00	17	268.00	22
Lawrence	123.00	14	15.00	3	36.00	2	174.00	19
Pennington	121.00	5			59.00	1	180.00	6
	270.00	23	24.00	4	328.00	20	622.00	47
Total, 1938	176.98	13	22.47	1	869.55	68	1,069.00	82

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

MINING AND METALLURGIC INDUSTRY

The total ore mined and treated by producers of lode gold and silver in South Dakota in 1939 was 1,632,778 tons yielding in recovered metals 617,914 fine ounces of gold and 167,537 fine ounces of silver compared with 1,586,181 tons yielding 593,778 ounces of gold and 162,213 ounces of silver in 1938. An analysis of methods of treatment shows that 1,400,015 tons were treated by amalgamation followed by cyanidation of sands and slimes; 170,270 tons by cyanidation only or by roasting followed by cyanidation; 47,860 tons by jigging, amalgamation of the jig concentrates, and all-slime cyanidation of the remaining pulp; 508 tons by amalgamation only; 12,900 tons by amalgamation and flotation concentration (101 tons of concentrates containing 348.40 ounces of gold and 67 ounces of silver were shipped to smelters); 1,143 tons by flotation followed by cyanidation of the concentrates; and 82 tons (containing 1,250.90 ounces of gold and 443 ounces of silver) were shipped crude to smelters. Operating details at both lode and placer mines are given in the following review by counties.

METALLURGIC RECOVERY

Gold and silver bullion produced at mills in South Dakota by amalgamation, 1935–39

Year	Ore treated	Gold in bullion	Silver in bullion	Quicksilver used
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*
1935	1,382,774	335,553.97	75,858	15,550
1936	1,393,450	330,052.08	66,585	15,093
1937	1,414,772	329,975.10	66,640	10,178
1938	1,430,391	328,044.50	32,602	7,744
1939	1,461,283	336,424.93	64,710	9,221

Gold and silver bullion produced at mills in South Dakota by cyanidation, 1935–39

Year	Material treated				Gold in bullion product	Silver in bullion product	Sodium cyanide used [1]
	Crude ore	Concentrates	Sands and slimes	Total			
	Short tons	*Short tons*	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*
1935	104,431		1,380,128	1,484,559	230,653.47	73,558	686,625
1936	155,652		1,382,676	1,538,328	255,849.83	77,811	749,923
1937	182,406		1,394,252	1,576,658	249,980.70	72,833	786,072
1938	155,667		1,416,899	1,572,566	262,913.21	98,777	860,762
1939	170,270	[2] 61	1,443,548	1,613,879	279,889.77	102,317	[3] 887,888

[1] In terms of 96- to 98-percent strength.
[2] From 1,143 tons of ore treated by flotation.
[3] Actually 1,675,500 pounds of calcium cyanide (48- to 49-percent strength) and 53,995 pounds of sodium cyanide (91-percent strength); all reduced to equivalent of 96- to 98-percent strength to conform with earlier use of figures for high-strength NaCN and KCN.

REVIEW BY COUNTIES

CUSTER COUNTY

The Sterling Mining Co. operated its 1½-cubic yard dragline and screening and sluicing plant on the Durst ranch on French Creek 1 mile west of Custer from April to June 1939. Harry E. Mosher worked the Rhodes placer ground on French Creek 1 mile east of Custer from May 1 to October 15, using a ¾-cubic yard dragline and sluices. Drift mining was done at the Plaza Bar on French Creek 2¼ miles above Custer, operated intermittently by Max Husaboe from April 13 to October 30. Other placer miners sluicing and panning along the creek recovered some gold. No production was made from lode mines in Custer County during the year.

LAWRENCE COUNTY

Homestake mine.—The Homestake mine has been producing almost continuously since 1876 and has been operated since 1877 by the Homestake Mining Co., which at first owned only the Homestake and Golden Star claims but has since acquired and consolidated into one group numerous other claims which, with the first two, now constitute the Homestake mine. Development of the mine from the 3,200- to the 5,000-foot level has been in progress since 1932, and two shafts equipped for an ultimate depth of 5,000 feet are being sunk to replace other shafts, one of which was still in use in 1939. One of the new shafts, the Ross, has been in operation since 1934 and had been completed to the 4,100-foot level at the end of 1938; the other, the Yates, was begun in 1938. The annual report of the general manager of the Homestake Mining Co. for the year ended December 31, 1939, says—

Operations during 1939 were normal in all departments. Ore production from the mine was 1.62 percent higher than in 1938 and the gross income for gold and silver produced was 3.31 percent higher. It is expected that production for 1940 will be slightly lower than in the past year.

Operating expenses exclusive of taxes were slightly higher than in 1938. This resulted largely from certain nonrecurring costs. Total taxes were $3,132,512.11, which is slightly higher than in 1938. This amounted to $2.24 per ton of ore mined.

There are 196,913 tons of broken ore remaining in shrinkage stopes.

The reserve of developed ore is 18,395,991 tons. Of this reserve 7,653,400 tons are in the new ledge which has been under development for the past 3 years. This ore is materially lower in grade than that in the main ledges. Production from this ledge began in 1939 and will be substantially increased in 1940. It is expected therefore that the grade of ore produced in 1940 will be slightly lower than that for 1939.

The mine, treatment plants, and other surface plants are in excellent condition. All changes resulting from reconstruction of Cyanide sand plant No. 1 are completed. Improvements in the metallurgical plants which began with the construction of Cyanide sand plant No. 3 in 1933 have resulted in material economies in treatment cost.

Yates shaft construction has made excellent progress. In the shaft, 3,426 feet of pilot raises are completed of which 1,714.5 feet have been stripped to full size and timbered. The hoist building, head frame, and crusher house are nearly completed and installation of equipment is under way. It is expected that the shaft will be ready for operation soon after the middle of the year.

The winze from the 4,100-foot level was sunk to the 4,550-foot level and 543 feet of level development completed on the 4,550-foot level.

Precipitation was again below normal and power output from the hydroelectric plants was the lowest on record.

A new sawmill was authorized and construction is under way. With recent improvements in log-hauling equipment it was deemed advisable to locate the sawmill out of the forest, and a site at Spearfish, about 20 miles from Lead, was selected. The new mill will probably be in operation in July 1940.

Ore milled, receipts, and dividends, Homestake mine, 1935–39 [1]

Year	Ore milled (short tons)	Receipts for bullion product		Dividends
		Total	Per ton	
1935	1,379,163	$19,191,013.19	$13.9150	$14,064,960
1936	1,383,929	19,506,534.78	14.0950	9,041,760
1937	1,394,773	19,304,076.45	13.8403	9,041,760
1938	1,377,314	19,284,459.67	14.0015	9,041,760
1939	1,400,015	19,922,964.60	14.2300	9,041,760

[1] From 1876 to 1939, inclusive, this mine yielded bullion and concentrates that brought a net return of $379,997,979 and paid $124,187,482 in dividends.

Interesting data regarding the extensive mining operations at the Homestake mine, published by the Homestake Mining Co. in 1938, include the following: In the mining of approximately 1,400,000 tons of ore annually approximately 600,000 tons of porphyry or waste rock must be handled to "back-fill" the stopes from which the ore is taken. To mine this ore, 1,554,117 pounds of 40-percent dynamite and approximately 773 miles of fuse are used; over 1,000,000 blasts were set off in 1937, and 11,000 feet of crosscut and 25,000 feet of main drift were run at a cost of $15 per foot through waste rock never brought to the surface. In addition, 2 miles of diamond drilling were done. There were 490 drilling machines in service in the mine, and approximately 500,000 pounds of drill steel were required. In hauling the ore from the stopes to the shafts 73 miles of narrow-gage railroad track and 36 compressed-air locomotives were used. In 1937 the amount paid for labor alone was $4,081,193.

In the course of mining and development in 1939 the company sank 1,714 feet of shaft, drove 33,592 feet of drifts and 11,744 feet of raises, and did 39,930 feet of diamond drilling. Surface treatment plants operated (besides the primary crushing plants at the hoists) comprised the South mill (the main secondary crushing, grinding, and amalgamating plant, with a capacity of 3,900 tons per 24 hours), cyanide sand plant No. 1, cyanide sand plant No. 3, and the refinery—all at Lead; and the slime plant at Deadwood. Silver is parted from the gold in the refinery, and virtually pure metals are shipped to the mint, the gold bars ordinarily ranging in fineness from 0.996 to 0.998 and the silver from 0.985 to 0.995. The mine produced more gold in 1939 than in any other year in its history.

Other mines.—The Bald Mountain Mining Co., the second-largest producer of gold and silver in South Dakota in 1939, operated its consolidated group of mines and cyanide mill at Trojan at an average rate of 336 tons of ore daily for 365 days. The 110-ton gas-fired rotary hearth furnace, installed in 1938 to treat the refractory sulfide ores not amenable to treatment by straight cyanidation, was reported to be working satisfactorily. The yield in recovered metals from 122,524 tons of ore treated in the mill and 74 tons of high-grade ore shipped to smelters was 29,279 fine ounces of gold and 37,132 fine ounces of silver, which together brought a net return of $1,040,982 after deductions for transportation and mint and smelter charges. The ore treated in 1939 came from the Portland, Clinton, Empire, Two Johns, and Dakota claims and was brought to the mill by rail tramway and trucks. The company did 9,911 feet of development work in the mine during the year.

At the Maitland group 5½ miles northwest of Deadwood the Canyon Corporation continued operations at capacity throughout 1939, producing an average of 101 tons daily of refractory sulfide ores (commonly known as blue ores) for treatment in its 100-ton roast-cyanide mill. Besides gold and silver, the ores contain pyrite, silica, dolomite, and some undetermined arsenic mineral. The recovery was 11,820 fine ounces of gold worth $413,700 and 2,012 fine ounces of silver worth $1,366. Mine development work done totaled 4,090 feet and prospecting 3,463 feet. The mine is opened by a vertical shaft 600 feet deep and by drifts and winzes.

The Gilt Edge-Dakota Maid group in the Bear Butte district was operated continuously in 1939 by Gilt Edge Mines, Inc. The mine is developed by two vertical shafts, 120 and 400 feet deep, and by 8,500 feet of drifts and tunnels. The ore is treated in the company 150-ton mill by jaw crushing, ball-mill grinding, classification, and jigging followed by continuous countercurrent decantation-cyanidation. The jig product, containing about 30 percent of the recoverable gold, is tabled and treated in an amalgam barrel, and the amalgam recovered is melted with the precipitate.

The Black Hills Tin Co. treated 1,143 tons of ore from its property near Tinton in a 100-ton flotation mill, equipped with a cyanide unit to treat the concentrates, built in 1939 and operated from September 13 to November 30. The Frerichs Mining Co., operating a group of claims in Whistler Gulch 1½ miles from Deadwood, recovered some gold during the year from ore treated in a 50-ton cyanide mill on the property. Gold, Inc., operated the Minnesota group 4 miles northeast of Rochford on Gimlet Creek part of 1939 and shipped to the Denver Mint several lots of gold recovered by amalgamation. The property was taken over during the year by the G. F. G. Corporation, which continued developing the mine and did construction work on a new mill. Other small lode-gold producers in Lawrence County comprised the Golden Bottle and Ragged Top properties. Individuals cleaning up the soil underlying the old melting furnace and assay office at the Monarch mine recovered 34 fine ounces of gold.

The Driskill Co. handled about 8,400 cubic yards of gravel on the Little Tom placers on Potato Creek 2 miles east of Tinton with a

⅜-cubic yard power shovel and land dredge and recovered 36 fine ounces of gold and 2 fine ounces of silver. Sluicing at small placers near Deadwood and Tinton yielded some gold.

PENNINGTON COUNTY

Empire Gold Mines, Inc., operated its Golden Slipper mine and amalgamation-flotation mill 5 miles east of Hill City about 10 months in 1939, treating 40 to 50 tons daily. The Yellow Bird Mining & Milling Association completed a 50-ton flotation mill at the Yellow Bird group 4½ miles southwest of Rochford in the spring of 1939 and operated it intermittently until July 19, when operations were suspended owing to lack of ore. Inca Gold Mines, Inc., produced some gold from test runs of ore in its flotation mill on the Bessie B claims a short distance northwest of Mystic. Other producing lode properties, equipped with small amalgamating mills, included the Burlington and Gold Lode, 7 and 5 miles, respectively, northwest of Hill City; the Western Bell and James, south of Hill City; and the Shellerud, in the Hornblende district.

The Anchor Gold Mining Co. worked the Matt placer on Gold Run Creek from April 15 to June 15, 1939, with a 1½-cubic yard dragline and a portable land dredge on skids and handled 6,000 cubic yards of gravel. Individuals sluicing, drift mining, and panning, principally on Battle, Castle, Rapid, and Spring Creeks, continued to recover small lots of gold dust, most of which was sold to dealers or traded for groceries at stores in the vicinity.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN TEXAS

(MINE REPORT)

By Chas. W. Henderson and A. J. Martin

SUMMARY OUTLINE

From 1885 through 1939 silver has been the principal metal produced in Texas, and most of the output has come from the Presidio mine at Shafter, Presidio County. Recovery of some gold and lead with the silver has made this mine the largest producer of these metals also in the State. The other producers of more than 1,000 ounces of silver in 1939 were the Hazel mine in Culberson County and the Sancho Panza and Plata Verde mines in Hudspeth County; silver-copper ores from these three mines yielded 98 percent of the copper produced in the State during the year. Silver production decreased 6 percent in quantity from 1938 but only 2 percent in value owing to an increase of 10 percent in the Government price of newly mined domestic silver by an act of Congress approved July 6, 1939. As the new price of $0.711+ per ounce was in effect for only the last 6 months of 1939, the increase in the average price (formerly $0.646+) for the year was only 5 percent. The output of gold and lead decreased in both quantity and value, but that of copper increased. No zinc has been recovered from ores mined in Texas since 1917.

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, 1935–39

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1935	$35.00	$0.71875	$0.083	$0.040	$0.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052

[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] 1935–37: Yearly average weighted Treasury buying price for newly mined silver: 1938–39: Treasury buying price for newly mined silver.

[3] Yearly average weighted price of all grades of primary metal sold by producers.

[4] $0.64646464. [5] $0.67878787.

MINE PRODUCTION

The following table shows the annual output of ore and the quantity and value of the metals recovered from Texas mines from 1935 to 1939, as well as the total metal production from 1885 to 1939.

Mine production of gold, silver, copper, lead, and zinc in Texas, 1935–39, and total, 1885–1939, in terms of recovered metals

Year	Ore (short tons)	Gold		Silver	
		Fine ounces	Value	Fine ounces	Value
1935	72,222	518	$18,130	1,000,960	$719,440
1936	104,990	613	21,455	1,361,459	1,054,450
1937	120,145	562	19,670	1,325,660	1,025,398
1938	131,002	439	15,365	1,433,008	926,389
1939	141,795	324	11,340	1,341,945	910,896
1885–1939	(1)	7,423	193,750	30,091,579	21,151,856

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1935	28,000	$2,324	1,043,000	$41,720			$781,614
1936	53,000	4,876	935,000	43,010			1,123,791
1937	320,000	38,720	790,000	46,610			1,130,398
1938	32,000	3,136	684,000	31,464			976,354
1939	68,000	7,072	454,000	21,338			950,646
1885–1939	[2] 920	269,957	[2] 4,203	421,541	[2] 744	$106,491	22,143,595

[1] Figures not available.
[2] Short tons.

Mine production of gold, silver, copper, and lead in Texas in 1939, by counties, in terms of recovered metals

County	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Culberson	1	1,742		32,690	24,000	
Hudspeth	5	1,119	1	5,507	44,000	1,400
Presidio	1	138,934	323	1,303,748		452,600
	7	141,795	324	1,341,945	68,000	454,000
Total, 1938	7	131,002	439	1,433,008	32,000	684,000

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Texas in 1939, with content in terms of recovered metals

Source	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Dry and siliceous silver ore	5	141,132	323.90	1,339,609	35,830	452,855
Copper ore	2	657		2,209	32,170	160
Lead ore	1	6	.10	127		985
	[1] 7	141,795	324.00	1,341,945	68,000	454,000
Total, 1938	7	131,002	439.00	1,433,008	32,000	684,000

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

SMELTING AND REFINING PLANTS IN TEXAS

In 1939 the American Smelting & Refining Co. continued to purchase gold, silver, copper, and lead ores and concentrates from operators in the Western States for reduction in its lead and copper smelters at El Paso. The copper and lead furnaces were in operation only part of the year owing to a sharp drop in receipts as a result of the termination on March 22, 1939, of the company contract under which it had treated the copper concentrates from the 15,000-ton Chino concentrator at Hurley, N. Mex., and of the closing on May 31, 1939, of the Pecos zinc-lead mine and 600-ton flotation mill in San Miguel County, N. Mex., formerly an important shipper of lead-copper-gold-silver concentrates to the plant. In addition to the lead and copper furnaces the plant contains a unit for the recovery of arsenic. The Nichols electrolytic copper refinery at El Paso, a unit of the Phelps Dodge Corporation, continued to treat copper anodes produced at the corporation Arizona smelters. The Illinois Zinc Co. smelter at Dumas treated concentrates from the Peru mill at Deming, N. Mex., from January 1 to March 25, 1939, when it was shut down; it remained idle the rest of the year. The American Smelting & Refining Co. zinc smelter at Amarillo was operated continuously on zinc ores and concentrates purchased from operators in Arizona, Colorado, Nevada, New Mexico, and Utah.

MINE REVIEW BY COUNTIES

Culberson County.—Ore from the Hazel mine northwest of Van Horn, worked under lease by A. P. Williams throughout 1939 except for 2 weeks in July, yielded all the metal output from Culberson County during the year. The ore contained principally silver, with a small content of copper, and was shipped crude to the El Paso smelter.

Hudspeth County.—A lessee began operating the Sancho Panza mine northeast of Allamoore on a small scale about September 1, 1939, and to the end of the year shipped silver-copper ore to the El Paso smelter. The Texas-Arizona Mining Co. shipped a few cars of silver ore containing a little copper from the Plata Verde mine southwest of Van Horn. Small quantities of copper and silver-copper ore from two prospects in the Allamoore district, one of which was called the Sancho Panza No. 2, and 6 tons of lead-silver ore from a property near Sierra Blanca were shipped to the El Paso smelter during the year.

Presidio County.—The American Metal Co. of Texas operated its Presidio silver mine and gravity concentration-cyanidation mill at Shafter continuously at capacity in 1939. The maximum quantity of ore the mill can handle in 24 hours is 400 tons and the average treated was 381 tons compared with 350 tons in 1938. However, the average grade of ore was lower in 1939 than in 1938, and the total quantity of silver recovered decreased slightly. The mine is developed by two vertical shafts, one 400 and one 700 feet deep; three underground subshafts, one 100, one 250, and one 450 feet deep; and nine levels with stopes, raises, and other openings totaling more than 50 miles of underground workings. Development work in 1939 totaled 7,884 feet of drifts and raises and 30,319 feet of diamond drilling. The minerals contained in the ore are argentite, cerargyrite, galena, anglesite, and cerussite. The ore is transported 1¼ miles by rail and aerial tramways from the shafts to the mill. It is crushed to one-quarter-inch size and then slimed to 65 percent minus 200-mesh in ball mills, grinding in cyanide solution. Minus-6-mesh material is screened out before grinding and tabled for lead-silver concentrates. Part of the ball-mill circulating load is also passed over tables. The pulp is agitated in Pachuca tanks and then passes through a series of thickeners for washing and decantation. The last thickener underflow is filtered before going to waste. The silver-bearing solutions are clarified and precipitated, using zinc dust. In 1939 the mill produced 636 tons of table concentrates averaging 0.04 ounce of gold and 321.29 ounces of silver to the ton and 35.18 percent lead (wet assay). The concentrates and precipitates were shipped to the Carteret (N. J.) smelter. Electric power for the mine and mill is obtained from a 1,200-horsepower Diesel plant.

Production of silver from the Presidio mine,[1] 1885–1939 [2]

Period	Mill heads treated (short tons)	Silver content of mill heads (ounces)		Recovery of silver	
		Per ton	Total	Percent	Ounces
1885–1912	450,000	25.84	11,628,000	81.68	9,497,750
1913–26	720,000	12.00	8,640,000	83.66	7,228,224
1927	48,190	22.87	1,102,105	91.41	1,007,434
1928	57,475	23.17	1,331,696	91.04	1,212,340
1929	54,644	19.74	1,078,673	90.30	974,049
Total, 1885–1929	1,330,309	17.88	23,780,474	83.77	19,919,797
1930	24,985	16.09	401,926	88.79	356,854
1934	46,653	19.70	919,064	91.39	839,936
1935	70,166	15.87	1,113,686	87.84	978,303
1936	98,499	14.41	1,419,371	87.48	1,241,605
1937	110,220	12.76	1,406,825	86.79	1,220,921
1938	127,574	12.76	1,627,844	84.72	1,379,187
1939	138,934	11.24	1,561,618	83.49	1,303,748
Total, 1885–1939	1,947,340	16.55	32,230,808	84.52	27,240,351

[1] Howbert, Van Dyne, and Gray, F. E., Milling Methods and Costs at Presidio Mine of the American Metal Co. of Texas: Am. Inst. Min. and Met. Eng. Tech. Pub. 368, 1930.
Howbert, Van Dyne, and Bosustow, Robert, Mining Methods and Costs at Presidio Mine of the American Metal Co. of Texas: Am. Inst. Min. and Met. Eng. Tech. Pub. 334, 1930.
[2] No production in 1931, 1932, and 1933.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN UTAH

(MINE REPORT)

By T. H. Miller and Paul Luff

SUMMARY OUTLINE

The total value of the output of gold, silver, copper, lead, and zinc from mines in Utah, in terms of recoverable metals, was $62,725,551 in 1939 compared with $43,745,902 in 1938, an increase of 43 percent. There was a gain in total value of each of the five metals, notably in copper which increased $14,560,424; the total value of gold rose $2,699,235, that of silver $1,043,302, that of lead $317,152, and that of zinc $359,536. Most of the gain in copper and gold was in the Bingham district and was due to a larger output of copper ore by the Utah Copper Co. There was a substantial increase in production of zinc-lead ore from the Park City region, but this gain was partly offset by decreased output of zinc-lead ore from other sections of the State.

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, 1935–39

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1935	$35.00	$0.71875	$0.083	$0.040	$0.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052

[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] 1935–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–39: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464.
[5] $0.67878787.

Mine production of gold, silver, copper, lead, and zinc in Utah, 1935–39, and total, 1864–1939, 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
1935	203	31	7,771,596	184,759.80	$6,466,593	9,206,329	$6,617,049
1936	171	28	14,997,892	223,444.00	7,820,540	9,997,645	7,743,176
1937	189	14	24,578,275	322,759.00	11,296,565	12,869,117	9,954,262
1938	183	22	13,248,660	200,630.00	7,022,050	9,682,732	6,259,544
1939	175	11	21,094,097	277,751.00	9,721,285	10,758,657	7,302,846
1864–1939			(1)	8,346,234.00	192,343,230	657,732,367	479,995,955

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1935	129,515,217	$10,749,763	127,019,175	$5,080,767	62,213,614	$2,737,399	$31,651,571
1936	252,434,000	23,223,928	139,772,000	6,429,512	72,384,000	3,619,200	48,836,356
1937	411,988,000	49,850,548	178,916,000	10,556,044	96,002,000	6,240,130	87,897,549
1938	216,252,000	21,192,696	131,314,000	6,040,444	67,316,000	3,231,168	43,745,902
1939	343,780,000	35,753,120	135,268,000	6,357,596	69,052,000	3,590,704	62,725,551
1864–1939	[2] 3,147,824	924,114,309	[2] 4,012,517	432,208,528	[2] 703,819	84,017,989	2,112,680,011

[1] 1864–1901: Figures not available; 1902–39: 361,473,820 tons produced. [2] Short tons.

Gold.—The output of gold in Utah increased 77,121 ounces in 1939—gold from copper ore increased 61,553 ounces and that from siliceous ores 15,228 ounces. Copper ore yielded 57 percent of the total gold, siliceous ores 31 percent, and zinc-lead ore 10 percent. Ore of all classes treated at concentration mills yielded 67 percent of the total gold, crude ore smelted 27 percent, and ore cyanided nearly 6 percent. There was a gain of 61,165 ounces in gold from the Bingham or West Mountain district, owing to increased output of copper ore from the Utah Copper property, and the district yielded nearly 69 percent of the State total gold. There were marked increases in gold from Tooele County and the Tintic district and a slight increase from Park City. The Utah Copper Co. was, as usual, the largest gold producer in Utah; it was followed by the Con Mercur, United States & Lark, Tintic Bullion, and Mammoth mines.

Silver.—The output of silver from Utah mines increased 11 percent in 1939. There was a gain of more than 600,000 ounces in Tooele County, owing to greater production from the Ophir Hill and Hidden Treasure properties; there were increases also at Bingham and Park City, but there was a decrease of nearly 282,000 ounces in the Tintic district. Zinc-lead and zinc-lead-copper ores yielded 44 percent of the total silver, siliceous ores 32 percent, copper ore 14 percent, and lead ore nearly 10 percent. Concentrates of all classes yielded 62 percent of the total silver and crude ore smelted nearly 38 percent. Silver from copper ore gained nearly 600,000 ounces, owing to increased output of copper ore at Bingham; silver from siliceous ores increased more than 320,000 ounces. The United States & Lark property again was the leading silver producer in Utah, followed by the Tintic Standard, Utah Copper, Silver King Coalition, Park City Consolidated, and Ophir Hill properties; these six properties produced 69 percent of the State total.

Copper.—The output of recoverable copper in Utah increased 127,528,000 pounds in 1939, owing to the increased rate of operations by the Utah Copper Co. The open-cut mine at Bingham and the mills at Magna and Arthur were operated at a record high in November and December, and the output of copper ore from the mine increased from 11,704,900 tons in 1938 to 19,310,200 tons in 1939 but was much less than the record of 23,119,800 tons established in 1937. Copper ore and mine-water precipitates yielded more than 96 percent of the State total copper in 1939, and most of the remainder came from siliceous ores shipped for smelting and from zinc-lead ore treated by flotation. Other important copper producers included the United

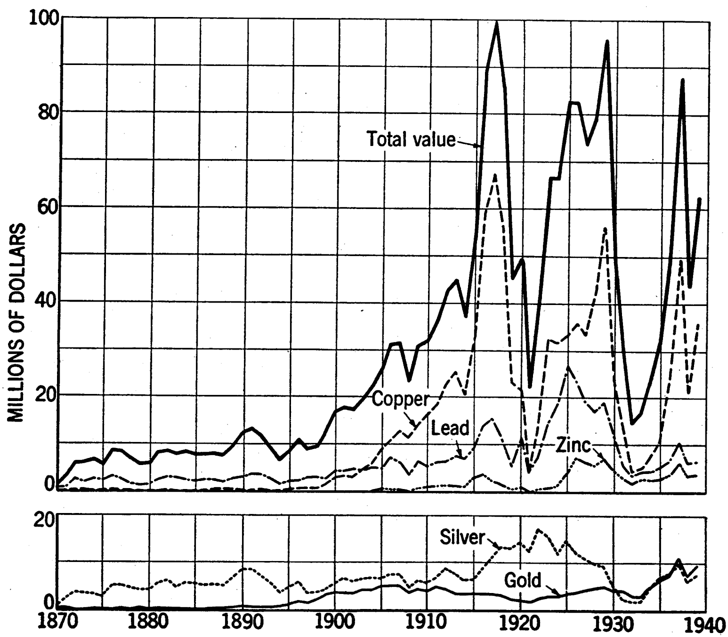

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value in Utah, 1870–1939.

States & Lark property at Bingham, the Ophir Hill and Hidden Treasure mines in Tooele County, and the Ohio Copper and Boston Consolidated mines at Bingham.

Lead.—There was a 3-percent gain in production of recoverable lead in Utah in 1939. The output from the Park City region and from Tooele County increased, but that from the Bingham and Tintic districts declined. Most of the gain was from siliceous ores, as lead from lead ore decreased and that from zinc-lead ore was about the same as in 1938. Zinc-lead and zinc-lead-copper ores yielded 70 percent of the total lead, lead ore 17 percent, and siliceous ores 11 percent. Reopening the Silver King Coalition and Park Utah Consolidated mines in May 1939 resulted in increased output of lead from Park City, but there were decreases from the United States & Lark mine at Bingham and from the Tintic Standard mine in the Tintic district; substantial increases were made by the Ophir Hill and Hidden Treasure mines in Tooele County. The United States & Lark mine again was the largest lead producer in Utah, followed by the Silver King Coalition, Tintic Standard, Ophir Hill, Park Utah Consolidated, and West Calumet properties; these six mines produced 74 percent of the State total.

Zinc.—The output of recoverable zinc in Utah increased slightly in 1939, owing to the increase in the Park City region; zinc from Bingham decreased nearly 4,500,000 pounds, and there were slight decreases in the Tintic district and in Tooele County. Nearly all the zinc recovered came from zinc-lead ore treated by flotation at four plants; zinc-lead ore shipped for smelting yielded 191,504 pounds of recoverable zinc. The United States & Lark mine at Bingham again was the chief zinc producer, followed by the Silver King Coalition and Park Utah Consolidated at Park City and the West Calumet and Hidden Treasure in Tooele County; these five mines produced 85 percent of the State total.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Utah in 1939, by counties, in terms of recovered metals

County	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
Beaver	12		11,958	1,546	$54,110	89,178	$60,533
Box Elder	3		166	31	1,085	8,667	5,883
Garfield	1	2	1	8	280		
Grand		3		70	2,450	19	13
Iron	7		1,884	1,189	41,615	8,275	5,617
Juab	32		159,953	21,825	763,875	1,029,435	698,768
Millard	1	2	239	55	1,925	9	6
Piute	8		2,608	1,824	63,840	19,464	13,212
Salt Lake	24		20,042,085	190,801	6,678,035	4,157,250	2,821,891
San Juan	1	2	1	21	735	6	4
Sevier	1		2	1	35	3	2
Summit	6		105,933	2,614	91,490	1,138,313	772,673
Tooele	48		557,061	34,251	1,198,785	1,006,469	683,179
Uintah	2	2	4	29	1,015	81	55
Utah	20		135,772	19,534	683,690	2,209,876	1,500,037
Wasatch	5		76,411	3,934	137,690	1,091,332	740,783
Washington	4		19	18	630	280	190
	175	11	21,094,097	[1] 277,751	9,721,285	10,758,657	7,302,846
Total, 1938	183	22	13,248,660	[2] 200,630	7,022,050	9,682,732	6,259,544

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaver	20,683	$2,151	1,398,213	$65,716	108,750	$5,655	$188,165
Box Elder	298	31	511	24			7,023
Garfield	154	16					296
Grand							2,463
Iron	461	48	702	33			47,313
Juab	1,119,577	116,436	5,532,489	260,027	426,904	22,199	1,861,305
Millard							1,931
Piute	5,269	548	12,766	600			78,200
SaltLake	335,782,000	34,921,328	74,051,298	3,480,411	41,808,692	2,174,052	50,075,717
San Juan	279	29					768
Sevier							37
Summit	509,596	52,998	19,478,276	915,479	15,018,596	780,967	2,613,607
Tooele	4,285,202	445,661	19,210,659	902,901	7,293,788	379,277	3,609,803
Uintah	596	62	830	39			1,171
Utah	1,737,856	180,737	11,798,405	554,525	1,306,000	67,912	2,986,901
Wasatch	315,077	32,768	3,783,851	177,841	3,089,270	160,642	1,249,724
Washington	2,952	307					1,127
	343,780,000	35,753,120	135,268,000	6,357,596	69,052,000	3,590,704	62,725,551
Total, 1938	216,252,000	21,192,696	131,314,000	6,040,444	67,316,000	3,231,168	43,745,902

[1] Includes 145 ounces of placer gold distributed as follows: Garfield County, 7 ounces; Grand County, 70 ounces; Millard County, 19 ounces; San Juan County, 21 ounces; and Uintah County, 28 ounces.
[2] Includes 148 ounces of placer gold.

MINING INDUSTRY

The output of copper ore from the Utah Copper mine at Bingham was increased markedly during the fall of 1939, and by the end of the year the property was producing recoverable copper at the rate of nearly 40,000,000 pounds a month, the highest rate in the history of the company; the resulting increase for the full year in tonnage of copper ore carrying also a low content of gold and silver accounted for nearly all the gain in copper output in Utah in 1939 and contributed much of the increase in both gold and silver. The output of zinc-lead ore from the Park City region was materially higher than in 1938 but was considerably below a normal average, as the properties of both the Silver King Coalition Mines Co. and the Park Utah Consolidated Mines Co. were operated only about 8 months in 1939 (these mines were reopened in May after a year's shut-down). The production of both lead and zinc from Bingham decreased in 1939, owing to the decrease in zinc-lead ore mined at the property of the United States Smelting, Refining & Mining Co. There was a marked increase in value of metal output in Tooele County in 1939; most of the gain in gold was due to increased activity at mines in the Camp Floyd (Mercur) district, and the increased output at the Ophir Hill and Hidden Treasure properties was responsible for the gain in output of silver, copper, and lead.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Utah in 1939, with content in terms of recovered metals

Source	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold ore	41	385,500	63,507	419,534	2,090,687	1,052,405	
Dry and siliceous gold-silver ore	24	133,029	17,582	894,471	1,322,736	3,357,471	
Dry and siliceous silver ore	30	320,368	4,405	2,081,651	3,169,613	10,354,617	
	95	838,897	85,494	3,395,656	6,583,036	14,764,493	
Copper ore	15	19,602,472	159,653	1,514,899	[1] 331,374,061	22,873	
Lead ore	77	77,072	5,043	1,048,887	649,545	23,380,971	
Lead-copper ore	1	4,951	41	81,490	385,239	1,915,212	
Zinc-lead ore; Zinc-lead-copper ore[2]	30	570,705	27,375	4,717,700	4,788,119	95,184,451	69,052,000
Total, lode mines	[3] 175	21,094,097	277,606	10,758,632	[1] 343,780,000	135,268,000	69,052,000
Total, placers	11		145	25			
	186	21,094,097	277,751	10,758,657	[1] 343,780,000	135,268,000	69,052,000
Total, 1938	205	13,248,660	200,630	9,682,732	[4] 216,252,000	131,314,000	67,316,000

[1] Includes 7,923,790 pounds recovered from mine-water precipitates.
[2] Zinc-lead-copper ore all from 1 mine; Bureau of Mines not at liberty to publish figures.
[3] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[4] Includes 10,220,878 pounds recovered from mine-water precipitates.

METALLURGIC INDUSTRY

The 21,094,097 tons of ore produced in Utah in 1939 comprised 230,224 tons treated by cyanidation (no ore amalgamated in Utah in 1939) compared with 190,312 tons cyanided and 7,624 tons amalgamated in 1938; 20,393,488 tons treated at concentration plants, a decided increase from 12,597,042 tons in 1938; and 470,385 tons shipped crude to smelters compared with 453,682 tons in 1938.

All the ore cyanided was treated at the plants of two companies at Mercur, each of which treated considerable custom as well as company ore. The 230,224 tons cyanided contained 21,805 ounces of gold and 3,800 ounces of silver; the cyanide bullion produced yielded 15,651 ounces of gold and 1,967 ounces of silver, indicating an average recovery of 72 percent of the gold and 52 percent of the silver.

Ten concentration plants were operated in Utah in 1939. Three plants (Arthur, Magna, and Ohio Copper) treated 19,601,000 tons of copper ore and old tailings; four mills (Bauer, Midvale, Silver King, and Tooele) treated 570,187 tons of zinc-lead ore and zinc-lead-copper ore; one mill (Ophir Hill) treated 222,178 tons of silver tailings; and two small gravity-concentration plants in Tooele County treated 123 tons of lead ore.

The following tables give details of treatment for all the ore produced in Utah in 1939.

Mine production of metals in Utah in 1939, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore cyanided	230, 224	15, 651	1, 967			
Concentrates smelted	774, 106	186, 796	6, 712, 712	330, 323, 150	101, 862, 708	68, 860, 496
Ore smelted	470, 385	75, 159	4, 043, 953	5, 533, 060	33, 405, 292	191, 504
Mine-water precipitates smelted [1]	5, 218			7, 923, 790		
Placer		145	25			
		277, 751	10, 758, 657	343, 780, 000	135, 268, 000	69, 052, 000
Total, 1938		200, 630	9, 682, 732	216, 252, 000	131, 314, 000	67, 316, 000

[1] All from Salt Lake County.

Mine production of metals from concentrating mills in Utah in 1939, by counties, in terms of recovered metals

County	Ore milled	Concentrates smelted and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	375	187	3	1, 679	3, 205	37, 569	108, 750
Juab	2, 276	840	32	10, 922	3, 543	229, 004	301, 100
Salt Lake	19, 940, 749	671, 929	178, 327	3, 737, 376	325, 626, 061	62, 306, 532	41, 742, 992
Summit	94, 454	36, 962	1, 687	976, 644	460, 852	18, 453, 678	15, 018, 596
Tooele	269, 801	48, 211	2, 065	863, 371	3, 854, 549	15, 193, 640	7, 293, 788
Utah	11, 460	6, 230	918	131, 436	65, 768	2, 124, 734	1, 306, 000
Wasatch	74, 373	9, 747	3, 764	991, 284	309, 172	3, 517, 551	3, 089, 270
	20, 393, 488	774, 106	186, 796	6, 712, 712	330, 323, 150	101, 862, 708	68, 860, 496
Total, 1938	12, 597, 042	545, 983	124, 882	5, 502, 246	200, 941, 529	95, 229, 226	67, 219, 921

Gross metal content of concentrates produced from ores mined in Utah in 1939, by classes of concentrates smelted

Class of concentrates	Concentrates produced	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Copper	514,994	159,167	1,497,195	333,310,495		
Lead	81,543	11,864	3,802,352	2,636,138	87,461,944	9,063,202
Lead-copper	26,857	320	640,490	4,038,615	9,838,534	841,478
Zinc	72,130	4,083	510,166	983,691	6,725,447	76,511,224
Iron (from zinc-lead ore) [1]	78,582	11,362	262,509	414,531	3,053,392	4,079,874
	774,106	186,796	6,712,712	341,383,470	107,079,317	90,495,778
Total, 1938	546,903	126,526	5,504,390	207,751,017	100,112,555	88,179,674

[1] Also belongs in "Dry" classification.

Mine production of metals from Utah concentrates shipped to smelters in 1939, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	187	3	1,679	3,205	37,569	108,750
Juab	840	32	10,922	3,543	229,004	301,100
Salt Lake	671,929	178,327	3,737,376	325,626,061	62,306,532	41,742,992
Summit	36,962	1,687	976,644	460,852	18,453,678	15,018,596
Tooele	48,211	2,065	863,371	3,854,549	15,193,640	7,293,788
Utah	6,230	918	131,436	65,768	2,124,734	1,306,000
Wasatch	9,747	3,764	991,284	309,172	3,517,551	3,089,270
	774,106	186,796	6,712,712	330,323,150	101,862,708	68,860,496
Total, 1938	546,903	126,526	5,504,390	200,941,529	95,229,226	67,219,921

BY CLASSES OF CONCENTRATES SMELTED

Copper	514,994	159,167	1,497,195	323,311,231		
Lead	81,543	11,864	3,802,352	2,145,795	83,962,936	
Lead-copper	26,857	320	640,490	3,536,137	9,283,497	
Zinc	72,130	4,083	510,166	934,504	6,389,174	68,860,496
Iron (from zinc-lead ore) [1]	78,582	11,362	262,509	395,483	2,227,101	
	774,106	186,796	6,712,712	330,323,150	101,862,708	68,860,496

[1] Also belongs in "Dry" classification.

Gross metal content of Utah crude ore shipped to smelters in 1939, by classes of ore

Class of ore	Ore	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold	155, 276	47, 856	417, 567	2, 155, 340	1, 763, 986	
Dry and siliceous gold-silver	133, 029	17, 582	894, 471	1, 363, 696	5, 593, 677	
Dry and siliceous silver	98, 190	4, 151	1, 583, 946	975, 318	5, 919, 824	
Copper	1, 472	486	17, 704	144, 262	38, 118	
Lead	76, 949	5, 043	1, 048, 775	785, 509	24, 434, 682	
Lead-copper	4, 951	41	81, 490	481, 549	1, 995, 012	
Zinc-lead	518				156, 085	212, 793
	470, 385	75, 159	4, 043, 953	5, 905, 674	39, 901, 384	212, 793
Total, 1938	453, 682	59, 184	4, 177, 452	5, 375, 896	40, 860, 920	106, 743

Mine production of metals from Utah crude ore shipped to smelters in 1939, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	11, 583	1, 543	87, 499	17, 478	1, 360, 644	
Box Elder	166	31	8, 667	298	511	
Garfield	1	1		154		
Iron	1, 884	1, 189	8, 275	461	702	
Juab	157, 677	21, 793	1, 018, 513	1, 116, 034	5, 303, 485	125, 804
Millard	239	36	9			
Piute	2, 608	1, 824	19, 464	5, 269	12, 766	
Salt Lake	101, 336	12, 474	419, 874	2, 232, 149	11, 744, 766	65, 700
San Juan	1		3	279		
Sevier	2	1	3			
Summit	11, 479	927	161, 669	48, 744	1, 024, 598	
Tooele	57, 036	16, 535	141, 131	430, 653	4, 017, 019	
Uintah	4	1	78	596	830	
Utah	124, 312	18, 616	2, 078, 440	1, 672, 088	9, 673, 671	
Wasatch	2, 038	170	100, 048	5, 905	266, 300	
Washington	19	18	280	2, 952		
	470, 385	75, 159	4, 043, 953	5, 533, 060	33, 405, 292	191, 504
Total, 1938	453, 682	59, 184	4, 177, 452	5, 089, 593	36, 084, 774	96, 079

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous gold	155, 276	47, 856	417, 567	2, 090, 687	1, 052, 405	
Dry and siliceous gold-silver	133, 029	17, 582	894, 471	1, 322, 736	3, 357, 471	
Dry and siliceous silver	98, 190	4, 151	1, 583, 946	945, 813	3, 555, 117	
Copper	1, 472	486	17, 704	139, 040	22, 873	
Lead	76, 949	5, 043	1, 048, 775	649, 545	23, 361, 738	
Lead-copper	4, 951	41	81, 490	385, 239	1, 915, 212	
Zinc-lead	518				140, 476	191, 504
	470, 385	75, 159	4, 043, 953	5, 533, 060	33, 405, 292	191, 504

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Utah in 1939, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Beaver County:													
Beaver Lake	1		38				171		171	125	22,957		$1,208
Bradshaw	2		91	3		3	2,263		2,263				1,641
Granite	1		5				19		19	48	2,043		114
Pine Grove	1		889	57		57	6,871		6,871	1,173	185,490		15,499
San Francisco	4		10,632	1,470		1,470	78,400		78,400	16,173	1,150,744	19,481	161,447
Star and North Star	3		303	16		16	1,454		1,454	3,164	36,979	89,269	8,256
Box Elder County:													
Ashbrook	1		160	26		26	8,661		8,661	134	362		6,820
Crater Island	1		3	1		1	3		3	164			54
Park Valley	1		3	4		4	3		3		149		149
Garfield County:													
Henry Mountains	1		1	1		1				154			51
Imperial (Crescent Creek)		2			7	7							245
Grand County: Colorado River		3			70	70		19	19				2,463
Iron County: Stateline	7		1,884	1,189		1,189	8,275		8,275	461	702		47,313
Juab County:													
Detroit [1]	1		349	90		90	850		850	11,731			4,947
Fish Springs	3		66	1		1	6,986		6,986	125	45,064		6,908
Mount Nebo	2		10				34		34		4,765		247
Tintic [2]	22		159,426	21,723		21,723	1,021,101		1,021,101	1,104,500	5,470,979	426,904	1,847,619
West Tintic	4		102	11		11	464		464	3,221	11,681		1,584
Millard County:													
Detroit [1]	1		239	36		36	9		9				1,266
Sawtooth Mountains		2			19	19							665
Piute County:													
Gold Mountain	2		687	675		675	6,189		6,189				27,826
Mount Baldy	1		1,749	1,079		1,079	12,316		12,316	3,625	11,170		47,027
Ohio	5		172	70		70	959		959	1,644	1,596		3,347
Salt Lake County:													
Big Cottonwood	4		905	55		55	23,349		23,349	48,115	214,659	86,789	37,380
Little Cottonwood	6		1,748	193		193	13,605		13,605	21,010	151,660		25,303
West Mountain	14		20,039,432	190,553		190,553	4,120,296		4,120,296	335,712,875	73,684,979	41,721,903	50,013,034
San Juan County:													
Colorado River		2			21	21		3	3				737
La Sal	1		1				3		3	279			31

[1] Detroit district lies in both Juab and Millard Counties.

[2] Tintic district lies in both Juab and Utah Counties.

Mine production of gold, silver, copper, lead, and zinc in Utah in 1939, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Sevier County: Henry	1	------	2	1	------	1	3	------	3	------	------	------	$37
Summit County: Uintah	6	------	105, 933	2, 614	------	2, 614	1, 138, 313	------	1, 138, 313	509, 596	19, 478, 276	15, 018, 596	2, 613, 607
Tooele County:													
Camp Floyd	9	------	274, 369	31, 282	------	31, 282	2, 394	------	2, 394	------	------	------	1, 096, 495
Clifton	4	------	186	128	------	128	2, 092	------	2 092	1, 029	17, 596	------	6, 834
Columbia	1	------	34	------	------	------	168	------	168	------	11, 553	------	657
Dugway	1	------	63	------	------	------	84	------	84	------	8, 489	16, 192	1, 298
Erickson	1	------	79	7	------	7	1, 009	------	1, 009	------	------	------	930
Free Coinage	2	------	57	1	------	1	364	------	364	------	28, 532	------	1, 623
Lakeside	3	------	390	------	------	------	461	------	461	423	120, 681	------	6, 029
North Tintic	1	------	30	------	------	------	28	------	28	------	13, 383	------	648
Ophir	14	------	243, 506	420	------	420	781, 471	------	781, 471	4, 139, 971	12, 099, 553	2, 536, 692	1, 676, 297
Rush Valley	8	------	38, 089	2, 114	------	2, 114	217, 358	------	217, 358	143, 404	6, 844, 681	4, 740, 904	804, 671
Silver Islet	1	------	1	------	------	------	50	------	50	29	149	------	44
Third Term	1	------	50	------	------	------	50	------	50	------	5, 893	------	311
Willow Springs	2	------	207	299	------	299	940	------	940	346	60, 149	------	13, 966
Uintah County:													
Carbonate	2	------	4	1	------	1	78	------	78	596	830	------	189
Green River	------	2	------	------	28	28	------	3	3	------	------	------	982
Utah County:													
American Fork	7	------	570	177	------	177	3, 169	------	3, 169	16, 923	32, 766	30, 000	13, 206
Tintic [2]	13	------	135, 202	19, 357	------	19, 357	2, 206, 707	------	2, 206, 707	1, 720, 933	11, 765, 639	1, 276, 000	2, 973, 695
Wasatch County:													
Blue Ledge	4	------	76, 337	3, 931	------	3, 931	1, 089, 109	------	1, 089, 109	313, 740	3, 773, 298	3, 079, 270	1, 246, 955
Snake Creek	1	------	74	3	------	3	2, 223	------	2, 223	1, 337	10, 553	10, 000	2, 769
Washington County:													
Bull Valley	1	------	1	18	------	18	3	------	3	------	------	------	632
Tutsagubet	3	------	18	------	------	------	277	------	277	2, 952	------	------	495
Total Utah	175	11	21, 094, 097	277, 606	145	277, 751	10, 758, 632	25	10, 758, 657	343, 780, 000	135, 268, 000	69, 052, 000	62, 725, 551

[2] Tintic district lies in both Juab and Utah Counties.

BEAVER COUNTY

Beaver Lake district.—A car of silver-lead smelting ore was shipped in 1939 from the Beaver Lake mine northwest of Milford.

Bradshaw district.—Two cars of silver smelting ore were shipped in 1939 from the Honey Boy mine 10 miles southeast of Milford. A test lot of gold ore was produced at the Cave property.

Granite district.—A test lot of lead ore was shipped in 1939 from the Beaver View property 5 miles north of Adamsville.

Pine Grove district.—All the output from the Pine Grove district in 1939 was silver-lead ore shipped to smelters from the Revenue property, 22 miles west of Frisco, operated by the Wah Wah Mining Co.

San Francisco district.—The value of metal output from the San Francisco district increased $105,149 in 1939, owing to the increase at the Horn Silver mine near Frisco; the mine was operated on a block-leasing system, and the output comprised 8,821 tons of gold-silver ore and 1,609 tons of lead ore shipped to smelters and 120 tons of zinc-lead ore sent to the flotation plant at Midvale—a total of 10,550 tons compared with 4,811 tons in 1938. The rest of the district output comprised small lots of smelting ore from the Cactus, Quadmetals, and Club properties.

Star and North Star district.—Lessees continued shipments of zinc-lead ore and lead ore from the Moscow Silver property in 1939; a car of zinc-lead ore was shipped also from the Harrington-Hickory mine by the New Majestic Mining Co.; and a test lot of gold ore was shipped from the Gold Bar property.

BOX ELDER COUNTY

Ashbrook district.—A lessee shipped 160 tons of silver ore from the Vipont mine in 1939, an increase from 30 tons in 1938.

Crater Island district.—A test lot of copper ore was shipped from the Copper Blossom property in 1939 by a lessee.

Park Valley district.—The Little May Mining Co. mined a little gold ore at the Raft River property in 1939.

GARFIELD COUNTY

A test lot of copper ore was shipped in 1939 from the Bromide & Mount Hillyer property in the Henry Mountains district. A little placer gold was recovered at two properties in the Imperial (Crescent Creek) district.

GRAND COUNTY

The entire output from Grand County in 1939 came from operations at three placers along the Colorado River; most of it originated at the Rio Grande group 2 miles north of Moab, where about 25,000 cubic yards of gravel were handled by a tractor-scraper unit.

IRON COUNTY

Stateline district.—The value of metal output from Iron County (all from the Stateline district) in 1939 was more than double that in 1938, owing to increased shipments of gold ore to smelters from the Gold Hill and Creole mines; the rest of the district output was crude ore shipped to smelters from several properties, including the Wonder, Buck & Winner, Helen, and Beaver Empire mines.

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JUAB COUNTY

Detroit district.—Lessees continued to ship gold ore from the Ibex mine 35 miles west of Delta, but the output in 1939 decreased sharply from that in 1938.

Fish Springs district.—Small lots of rich silver-lead ore were shipped in 1939 from the Carnation, Galena, and Utah mines (all east of Callao), but the value of the metal output of the Fish Springs district declined $11,844.

Mount Nebo district.—Small lots of lead ore were shipped in 1939 from the Liberty Lead and Earl properties near Santaquin.

Tintic district.—The Tintic district lies in both Juab and Utah Counties, and the mines in both sections are reviewed here. The table that follows gives the metal production in each section in 1939, a comparison of the total with that for 1938, and the total output of the district from 1869 to 1939. The table indicates increases in output of gold and copper but decreases in silver, lead, and zinc. The value of the output from the western section (Juab County) increased $212,293, but that from the eastern or Utah County section decreased $127,764.

Mine production of gold, silver, copper, lead, and zinc in Tintic district, Juab and Utah Counties, Utah, 1938–39, and total, 1869–1939, in terms of recovered metals

	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
1939		*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Juab County	22	159.426	21,723	1,021,101	1,104,500	5,470,979	426,904	$1,847,619
Utah County	13	135,202	19,357	2,206,707	1,720,933	11,765,639	1,276,000	2,973,695
	35	294,628	41,080	3,227,808	2,825,433	17,236,618	1,702,904	4,821,314
Total, 1938	25	293,428	36,148	3,509,632	2,353,970	19,209,239	1,842,458	4,736,785
Total, 1869–1939		(1)	2,435,607	247,760,072	232,247,447	1,766,091,359	38,702,024	367,955,105

1 Figures not available.

In 1939 the Chief Consolidated Mining Co. continued to operate at the Chief No. 1, Gemini, Eureka Hill, and Plutus mines in Juab County, but no work was reported at the Apex Standard property in Utah County. According to the company printed annual report the output in 1939 was considerably larger than that in 1938. It comprised 25,613 tons of siliceous ore, 1,250 tons of lead ore, and 2,155 tons of zinc-lead ore from the Chief No. 1 mine; 2,947 tons of siliceous ore and 456 tons of lead ore from the Gemini mine; 3,768 tons of siliceous ore and 35 tons of lead ore from the Eureka Hill mine; and 4,100 tons of siliceous ore and 13 tons of lead ore from the Plutus mine—a total of 40,337 tons of ore of all classes yielding 3,601 ounces of gold, 345,788 ounces of silver, 117,569 pounds of copper, 919,847 pounds of lead, and 367,460 pounds of zinc. In addition, lessees shipped old tailings from the Eureka Hill dumps and residue from the Chief Consolidated volatilization plant at Eureka, which has been idle for many years. The company reported a total of 2,132 feet of development and 485 feet of diamond drilling at the Juab County properties in 1939. The United States Smelting, Refining & Mining Co. in 1939 continued to operate at the Centennial-Beck, Victoria, and Eagle & Blue Bell properties; all the output was by lessees and comprised about 39,000 tons of siliceous ore and about 2,700 tons of lead ore, indicating slight decreases compared with 1938. The Mammoth Mining Co. operated regularly in 1939 at the property near Mammoth and produced 40,801 tons of smelting ores (chiefly siliceous gold ore), about the same as in 1938; no new development other than stoping was reported, and dividends paid totaled $59,298. Crude ore was shipped to smelters by lessees from the Dragon, Empire Star, Swansea, Treasure, and Victor groups, all owned or controlled by the International Smelting & Refining Co.; most of the output was siliceous gold-silver ore from the Dragon and Empire Star units. Leasing operations at the Godiva property were continued in 1939, and the output comprised 3,651 tons of ore (gold ore, lead ore, and zinc-lead ore) shipped to smelters. The output of siliceous ore from the Grand Central mine of the American Smelting & Refining Co. decreased from more than 28,000 tons in 1938 to about 1,700 tons in 1939; the entire output in 1939 was from lessees' operations, as no production was made on company account. The remainder of the output from the Juab County section of the Tintic district was crude ore shipped to smelters from several properties, including the Joe Daily, Showers, Sunbeam, and Undine (Windrige) mines.

The printed annual report of the Tintic Standard Mining Co. and subsidiary companies gives the following details of production in 1939 from properties in the Utah County section of the Tintic district, owned or controlled by the company: Tintic Standard mines (including the Iron Blossom mine), 65,317 tons of siliceous ore and 21,440 tons of lead ore; Eureka Standard mine, 3,357 tons of siliceous ore and 9,886 tons of zinc-lead ore; Eureka Lilly mine, 2,876 tons of siliceous ore; Colorado Consolidated mine, 10,491 tons of siliceous ore; and Sioux mine, 168 tons of siliceous ore. Ore of all classes from all mines totaled 113,535 tons containing 7,236 ounces of gold, 2,064,563 ounces of silver, 1,107,694 pounds of copper, 13,600,146 pounds of lead, and 1,747,563 pounds of zinc. The company reported 8,526 feet of development for 1939, chiefly in drifting and raising in the Tintic Standard mine. Producing mines in the Utah County section of the Tintic district, owned or controlled by the International Smelting & Refining Co. and its subsidiaries, included in 1939 the Eureka Bullion, May Day (Mountain View), North Lily, Tintic Bullion, and Yankee properties; the output from the North Lily mine declined, but there was a sharp increase in gold from the Tintic Bullion property as a result of the opening of a new body of rich gold ore in the mine during 1939. The remainder of the district output was crude lead ore shipped to smelters from the Zuma mine.

West Tintic district.—Crude ore was shipped to smelters in 1939 from four properties in the West Tintic district, including the Copper Prince, Orient, and Scotia mines.

MILLARD COUNTY

Detroit district.—The Detroit district lies in both Juab and Millard Counties; the output from the Millard County section in 1939 was gold ore shipped to smelters from the King Tut group.

Sawtooth Mountains district.—Placer gold was produced at the Amasa and New Klondike placers in 1939.

PIUTE COUNTY

Gold Mountain district.—The mill of the Annie Laurie property was not operated in 1939, but lessees shipped nearly 400 tons of gold ore from the mine for smelting. Gold ore was shipped also from the General Connor mine.

Mount Baldy district.—Lessees continued operations at the Deer Trail mine during 1939, and the output of gold ore shipped to smelters increased.

Ohio district.—Gold ore was shipped to smelters in 1939 from the Bully Boy, Gold Strike, Tusher, and Wedge properties. A test lot of lead ore was shipped from the Salt Gap prospect.

SALT LAKE COUNTY

Big and Little Cottonwood districts.—Lessees continued operations in 1939 at the Cardiff property in the Big Cottonwood district; the output was about the same as in 1938 and comprised copper ore, lead ore, and zinc-lead ore shipped for smelting and zinc-lead ore shipped to Midvale for milling. Other producers in the district included the Wasatch Gold Mines property and the Tar Baby mine.

All the output from the Little Cottonwood district in 1939 was crude smelting ore shipped; producing mines included the Alta United, Columbus, Columbus Rexall, Michigan-Utah, and Toledo properties.

Bingham (West Mountain) district.—The Bingham district is by far the most important mining area in Utah. In 1939 mines in the district produced recoverable gold, silver, copper, lead, and zinc valued in all at $50,013,034, or 80 percent of the State total. The value of the district output increased $16,305,116 (48 percent) and represented 86 percent of the State total gain. Most of the district gain was in copper, the output of which increased 123,614,375 pounds (58 percent); there were also substantial increases in gold and silver, but the quantity of lead and zinc declined. The following table gives the production from mines at Bingham in 1938 and 1939 and the total from 1865 to 1939.

Mine production of gold, silver, copper, lead, and zinc in Bingham or West Mountain district, Salt Lake County, Utah, 1938–39, and total, 1865–1939, in terms of recovered metals

Year	Mines producing	Ore	Gold (lode and placer)	Silver (lode and placer)	Copper	Lead	Zinc	Total value
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1938	14	12,507,863	129,388	3,671,794	212,098,500	82,668,239	46,192,937	$33,707,918
1939	14	20,039,432	190,553	4,120,296	335,712,875	73,684,979	41,721,903	50,013,034
Total, 1865–1939		(1)	3,939,250	112,378,401	(2) 2,932,709	(2) 1,347,994	(2) 349,937	1,214,636,982

(1) Figures not available. (2) Short tons.

All the increase in output of gold, silver, and copper from Bingham in 1939 was caused by the increased rate of operations by the Utah Copper Co. The open-cut mine at Bingham and the mills at Magna and Arthur were operated continuously in 1939, and the output of copper ore was 19,310,200 tons compared with 11,704,900 tons in

1938; the output, however, was much less than the record of 23,119,800 tons established in 1937. According to the printed annual report of the Kennecott Copper Corporation the output of recoverable copper from Utah operations ranged from an average of about 23,000,000 pounds a month from January through August to a high of nearly 40,000,000 pounds a month in November and December. In addition to copper concentrates and other products from the mills, the company also shipped several million pounds of cement copper from the mine-water precipitation plant at Copperton. The molybdenite units in the mills operated regularly in 1939, and the over-all recovery of molybdenite was increased markedly. The American Smelting & Refining Co. operated the full year at the Boston Consolidated property of the Utah Copper Co.; the output, comprising nearly 40,000 tons of gold ore and lead ore shipped to smelters and about 700 tons of zinc-lead ore sent to Midvale for milling, was slightly less than in 1938.

The United States Smelting, Refining & Mining Co. operated continuously at the United States & Lark property at Bingham in 1939, but the quantity of zinc-lead ore sent to the mill at Midvale was nearly 24,000 tons less than in 1938 and the output of crude ore shipped to smelters also declined, resulting in decreases in output of all five metals. Most of the decrease in lead and zinc output from the Bingham district was caused by smaller production at the United States & Lark mine. Other properties at Bingham operated in 1939 by the United States Smelting, Refining & Mining Co. were the Bingham Metals, Montana-Bingham Consolidated, Niagara, and Utah Metal & Tunnel.

The Apex-Delaware group of the National Tunnel & Mines Co. was operated continuously in 1939 by lessees and on company account; the output—about the same as in 1938—comprised gold ore and lead ore shipped to smelters and zinc-lead ore sent to the mill at Tooele. Work on the Elton tunnel was continued, and early in 1940 the bore was reported to have reached the midpoint of its projected length of 23,000 feet.

The Ohio Copper Co. treated 290,800 tons of old tailings in its 1,000-ton mill during 1939, a decrease from the quantity milled in 1938, but the output of copper increased considerably; copper precipitates and a little crude ore also were shipped from the property.

The production of all five metals from the Bingham (Lavagnino) property of the Combined Metals Reduction Co. rose in 1939, as the output of both crude ore shipped to smelters and zinc-lead ore shipped to the mill at Bauer increased; the yield of gold from the property was 70 percent greater than in 1938.

Other production from the Bingham district in 1939 included copper ore from the Bingham Congor mine and gold ore from the Ophir group.

SAN JUAN COUNTY

Colorado River district.—Placer bullion was recovered in 1939 by sluicing at the Dorothy and Red Canyon properties on the Colorado River.

La Sal district.—A test lot of copper ore was shipped in 1939 from the Lisbon Copper group south of Moab.

SEVIER COUNTY

Henry district.—The B. W. & H. property, chief producer in Sevier County in 1938, was idle in 1939. A test lot of gold ore was shipped from the Independence property.

SUMMIT AND WASATCH COUNTIES

PARK CITY REGION

The value of metal output from mines in the Park City region increased $1,131,072 (41 percent) in 1939, owing chiefly to reopening of the Silver King Coalition and Park Utah Consolidated properties. The following table gives the production from the Park City region in 1938 and 1939 and the total since 1870.

Mine production of gold, silver, copper, lead, and zinc in Park City region, Summit and Wasatch Counties, Utah, 1938–39, and total, 1870–1939, in terms of recovered metals

Year	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1938	12	149, 113	5, 678	1, 962, 576	530, 041	14, 515, 652	11, 356, 855	$2, 732, 259
1939	11	182, 344	6, 548	2, 229, 645	824, 673	23, 262, 127	18, 107, 866	3, 863, 331
Total, 1870–1939		(1)	436, 338	220, 063, 813	60, 524, 513	2, 210, 261, 434	517, 504, 911	321, 766, 897

1 Figures not available.

The mine and 800-ton flotation plant of the Silver King Coalition Mines Co. at Park City were reopened on May 8, 1939, ending a shut-down that began in April 1938. According to the company printed annual report the 1939 output comprised 66,876 tons of milling ore and 243 tons of crude lead ore shipped for smelting; the products sold contained 1,308 ounces of gold, 924,874 ounces of silver, 447,098 pounds of copper, 14,746,345 pounds of lead, and 10,180,823 pounds of zinc. Mine development in 1939 totaled 11,944 feet, including 373 feet of shaft sinking at the new Thaynes shaft which was completed to a depth of 1,752 feet. This shaft has improved ventilation in the entire mine and provides a new outlet for mine waste. Dividends declared in 1939 amounted to $305,117.

The Park Utah Consolidated Mines Co. resumed work on a part-time basis at the Judge (City unit) property in May after a shut-down of about a year. The rate of production was increased during the fall and was on a normal basis at the end of the year. The output comprised 29,303 tons of zinc-lead ore sent to the mill at Tooele and 5,888 tons of smelting ore (silver ore and lead ore). According to the company printed annual report the 35,191 tons of ore contained 722 ounces of gold, 244,901 ounces of silver, 25,759 pounds of copper, 7,097,906 pounds of lead, and 8,911,940 pounds of zinc. Operations were resumed also at the Liberty property near Keetley by the Park City Utah Mines Co. (affiliate of the Park Utah Consolidated Mines Co.) after a shut-down of several years owing to litigation; the output in 1939 comprised 2,551 tons of zinc-lead ore and 2,038 tons of lead ore. The Daly Mining Co. (subsidiary of the Park Utah Consolidated Mines Co.) shipped 331 tons of silver ore from the Daly dumps.

According to the printed annual report of the Park City Consolidated Mines Co. the output from the Roosevelt group comprised 55,631 tons of ore in 1939 compared with 74,650 tons in 1938. The 1939 output, shipped to the flotation plant at Midvale for treatment, contained 2,744 ounces of gold, 845,607 ounces of silver, 105,873 pounds of lead, and 2,728,974 pounds of zinc. The New Park Mining Co. operated the full year at the Park Galena property, producing 15,845 tons of zinc-lead ore—about the same as in 1938. The company extended the Mayflower tunnel about 3,000 feet, undercutting the Park Galena ore body in December; mining of this ore body will be greatly facilitated with completion of raises from the tunnel level. The United States Smelting, Refining & Mining Co. reported 2,884 feet of drifting and raising at the Park City unit (Star) during 1939; several cars of zinc-lead ore produced during development were shipped to Midvale for milling. Lessees operating property of the Park Flag Mines Co. shipped about 3,700 tons of siliceous smelting ore in 1939.

The rest of the output from the Park City region in 1939 included old tailings from Silver Creek shipped for smelting and a little zinc-lead ore from the New Quincy property sent to Tooele for milling.

TOOELE COUNTY

The total value of metal output from mines in Tooele County increased $1,355,829 (60 percent) in 1939, as substantial gains were recorded in the Ophir and Camp Floyd districts.

Camp Floyd district.—The output of gold from Mercur continued to increase in 1939, and the output was 31,282 ounces compared with 23,001 ounces in 1938 and 14,016 ounces in 1937. The Con Mercur property, operated by Snyder Mines, Inc., again was the largest producer in the district; the output comprised 43,493 tons of gold ore shipped to smelters and 21,240 tons of ore treated by straight cyanidation. The Snyder cyanidation mill also handled nearly 38,000 tons of ore from the West Dip property operated by the Ophir Development Co., and custom ore was received also from five other mines in the district. The Geyser Marion Gold Mining Co. continued operations at the Geyser Marion and Sacramento properties; more than 150,000 tons of gold ore were treated in the enlarged cyanidation units, a marked increase over 1938. Other producers at Mercur in 1939 were the Boston Sunshine, Herschel, Saratoga (McCornick), Rover, and Silver Lode properties.

Clifton (Gold Hill) district.—All the output from Gold Hill in 1939 was crude ore shipped for smelting; it comprised lead ore from the Rube and Spotted Fawn mines and silver ore from the Success and Rose properties.

Columbia district.—A car of lead smelting ore was shipped from the Benmore group near Vernon in 1939.

Dugway district.—Zinc-lead ore from the Four Metals mine was shipped in 1939 to Tooele for milling.

Erickson district.—A lessee shipped silver smelting ore from the property of the O. K. Silver Mining & Milling Co. in 1939.

Free Coinage district.—Lead smelting ore was shipped from the Humdinger and Utah-Bunker Hill properties in 1939.

Lakeside district.—The Georgia Lyn Mining Co. treated a little lead ore in a small gravity-concentration plant and shipped lead concentrates, together with crude lead ore, to the Murray smelter in 1939. Lessees shipped crude lead ore from the Monarch mine of the Lakeside Monarch Mining Co., but the flotation mill on the property was idle.

North Tintic district.—Lessees shipped small lots of lead smelting ore from the Scranton property in 1939.

Ophir district.—The total value of metal output from mines in the Ophir district increased from $551,189 in 1938 to $1,676,297 in 1939, owing to increased output from both the Hidden Treasure and Ophir Hill mines. The United States Smelting, Refining & Mining Co. operated the entire year at the Hidden Treasure mine, and the output comprised lead-copper ore shipped to smelters and zinc-lead-copper ore sent to the mill at Midvale. The complex milling ore was treated in a separate circuit of the Midvale concentrator, making copper concentrates, lead concentrates, zinc concentrates, and iron concentrates; the increase in output of copper was noteworthy. The new 700-ton flotation plant of the International Smelting & Refining Co., which was put in operation in November 1938, was operated throughout 1939, treating 222,178 tons of old tailings from the Ophir Hill dumps; lead-copper concentrates were trucked to the smelter at Tooele for treatment. Underground mining at the Ophir Hill property was continued by the Ophir Development Co., and the output comprised nearly 2,300 tons of zinc-lead ore sent to Tooele for milling; the Ophir Development Co. also operated property of the Ophir Coalition Mines Co. and shipped crude lead smelting ore. The remainder of the district output in 1939 was lead ore and silver ore shipped to smelters from the Kearsarge, Ophir, Queen of the Hills, Tintic Ophir, Wandering Jew, Madison, Hullinger, Cowan, Silver Eagle, and Silver Prince properties.

Rush Valley district.—The Combined Metals Reduction Co. continued operations in 1939 at the Cyclone (Bluestone), Honerine (Bullion Coalition), and West Calumet properties. Most of the production came from company and lessee operations at the West Calumet mine, which produced 32,738 tons of zinc-lead ore sent to the mill at Bauer and 461 tons of lead ore shipped for smelting. The output from the Honerine group comprised 709 tons of crude lead ore and 48 tons of zinc-lead ore, and that from the Cyclone property 3,919 tons of lead ore. The rest of the district output was crude lead ore shipped for smelting, chiefly from the Commodore, Muirbrook, and Salvation-Hercules mines.

Silver Islet district.—A test lot of silver ore was shipped from the Silver Island mine in 1939.

Third Term district.—A little lead ore was treated in a small table-concentration plant in 1939 by the Metal Queen Mining Co.

Willow Springs district.—Most of the output from the Willow Springs district in 1939 was lead ore shipped by lessees from the Oro Del Rey mine. A little gold ore was shipped from the Depression property.

UINTAH COUNTY

The output from Uintah County in 1939 comprised placer gold and silver from sluicing operations at the Big Ben and Big Lizard placers on Green River, a test lot of copper ore from the Dyer mine in the Carbonate district, and a little lead ore from a prospect near Vernal.

UTAH COUNTY

American Fork district.—Lessees continued operations at the Yankee property of the American Smelting & Refining Co., but the output in 1939 declined to 431 tons of gold ore shipped for smelting and 65 tons of zinc-lead ore sent to Midvale for milling. A car of zinc-lead milling ore was shipped also from the Dutchman mine. The remainder of the output comprised small lots of crude lead ore from the Blue Rock, Miller, Silver Dipper, and Silver Dollar properties.

Tintic district.—Mines in the Utah County section of the Tintic district are reviewed under Juab County.

WASHINGTON COUNTY

A small lot of copper ore was shipped by a lessee in 1939 from the Dixie property of the Utah Southern Mining Co., and small lots of crude ore were shipped from the Hidden Canyon and Silver Peak properties, all in the Tutsagubet district. A little gold ore was produced at a prospect in the Bull Valley district.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN WASHINGTON

(MINE REPORT)

By T. H. Miller and Paul Luff

SUMMARY OUTLINE

The total value of the gold, silver, copper, lead, and zinc recovered from Washington ores and gravels was $6,739,467 in 1939 compared with $5,510,440 in 1938, an increase of 22 percent. Substantial gains were recorded in output of gold, silver, and copper but losses in lead and zinc. The total value of the copper produced increased 59 percent and that of the gold and silver each 22 percent; the total value of lead declined 11 percent and that of zinc 4 percent. Except for a brief shut-down during the summer, the Holden mine and mill of the Howe Sound Co. in Chelan County were operated regularly in 1939, and gains at this property accounted for the increases in total output of gold, silver, and copper in the State. The closing of the Azurite plant in February caused a decrease in gold from Whatcom County, but there was a gain in gold from Okanogan County owing to operation of the Alder group near Twisp by the Methow Gold Corporation. Production of gold from the Republic district, Ferry County, increased slightly in 1939, but that from Stevens County decreased as the First Thought cyanide mill was idle. The output of lead and zinc from Pend Oreille County declined slightly as the mine and mill of the Metaline Mining & Leasing Co. were closed in March.

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, 1935–39

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1935	$35.00	$0.71875	$0.083	$0.040	$0.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052

[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] 1935–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–39: Treasury buying price for newly mined silver.

[3] Yearly average weighted price of all grades of primary metal sold by producers.

[4] $0.64646464. [5] $0.67878787.

Mine production of gold, silver, copper, lead, and zinc in Washington, 1935–39, and total, 1860–1939, 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
1935	63	172	32,187	9,739.60	$340,886	52,338	$37,618
1936	44	106	133,435	12,217.40	427,609	66,900	51,814
1937	65	90	294,826	36,310.00	1,270,850	126,304	97,696
1938	77	80	901,689	74,175.00	2,596,125	380,938	246,263
1939	88	84	1,124,564	90,420.00	3,164,700	442,063	300,067
1860-1939			(1)	1,715,413.00	38,794,778	10,455,685	7,395,579

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1935	86,699	$7,196	206,150	$8,246	2,159	$95	$394,041
1936	204,000	18,768	1,680,000	77,280	8,806,000	440,300	1,015,771
1937	128,000	15,488	5,660,000	333,940	8,232,000	535,080	2,253,054
1938	12,034,000	1,179,332	8,568,000	394,128	22,804,000	1,094,592	5,510,440
1939	17,996,000	1,871,584	7,436,000	349,492	20,262,000	1,053,624	6,739,467
1860-1939	[2] 28,766	7,929,093	[2] 46,818	5,806,138	[2] 50,408	5,292,434	65,218,022

[1] 1860-1903: Figures not available; 1904-39: 4,758,966 tons produced. [2] Short tons.

Gold and silver produced at placer mines in Washington, 1935–39, in terms of recovered metals

Year	Gold		Silver		Total value
	Fine ounces	Value	Fine ounces	Value	
1935	1,547.60	$54,166	263	$189	$54,355
1936	657.20	23,002	133	103	23,105
1937	371.00	12,985	48	37	13,022
1938	1,575.00	55,125	218	141	55,266
1939	2,261.00	79,135	358	243	79,378

Gold.—The output of recoverable gold in Washington in 1939 increased 22 percent over 1938, owing chiefly to the larger output of copper ore in Chelan County. Gold from copper ore increased 17,414 ounces, but that from gold ore decreased 1,890 ounces. Gold ore treated at cyanidation plants declined in Ferry, Stevens, and Whatcom Counties, but that shipped to smelters increased markedly in Ferry and Okanogan Counties. The output of gold from Ferry County increased slightly, as the gain in gold from crude smelting ore more than offset the decrease from gold ore cyanided. Production of gold in Okanogan County increased sharply as a result of operations at the Alder group near Twisp. Idleness of the cyanidation mill at the Orient property in 1939 was the cause of decreased output of gold from Stevens County, and closing of the Azurite mill in February resulted in a marked decline in the output of gold from Whatcom County. The Holden property in Chelan County was again by far the largest gold producer in Washington, contributing in 1939 more than half of the State total. Other important producers included the Aurum, Knob Hill, Mountain Lion, Quilp, and Republic properties in Ferry County; the Alder property in Okanogan County;

and the Azurite mine in Whatcom County. The State total output of gold ore was 261,651 tons in 1939 compared with 271,557 tons in 1938; it comprised 6,421 tons amalgamated, 161,551 tons cyanided, 2,600 tons concentrated, and 91,079 tons shipped direct to smelters. Production of gold from placer mines increased from 1,575 ounces in 1938 to 2,261 ounces in 1939; as usual, most of it came from operations on bars along the Columbia River in Ferry and Stevens Counties. Mechanical placer equipment (draglines, power shovels, tractor scrapers, etc.) was used at 15 properties and treated 276,325 cubic yards of gravel which yielded 1,876 ounces of gold and 316 ounces of silver, a total recovery of 24 cents per cubic yard.

Silver.—The output of recoverable silver in Washington in 1939 increased 16 percent in quantity over 1938. Silver from copper ore and gold ore increased, but that from silver ore and zinc-lead ore decreased. Copper ore yielded 43 percent of the total silver, gold ore nearly 38 percent, silver ore nearly 15 percent, and lead ore and zinc lead ore 3 percent. Production of silver increased sharply in Chelan and Ferry Counties but decreased markedly in Okanogan County. The Holden mine in Chelan County was again the chief silver producer in Washington, followed by the Aurum and Knob Hill mines at Republic and the Arlington mine in Okanogan County.

Copper.—The output of recoverable copper in Washington increased 50 percent in quantity in 1939 to a new record and, as in 1938, nearly 98 percent of it came from the Holden property of the Howe Sound Co. in Chelan County; the company treated 596,967 tons of gold-copper-silver ore in its 2,000-ton flotation plant and was again by far the largest producer of gold, silver, and copper in the State. Other copper producers included the Sunset and Florence Rae mines in Snohomish County, the Alder and Arlington mines in Okanogan County, the Royal property in Chelan County, and the Chinto mine in Stevens County.

Lead and zinc.—The output of recoverable lead in Washington decreased 13 percent in quantity in 1939 and that of zinc 11 percent. Production of zinc-lead ore, chiefly from two mines in Pend Oreille County, rose slightly, but the grade was lower and less lead and zinc were recovered than in 1938. The 700-ton mill of the Pend Oreille Mines & Metals Co. was operated the entire year, but the 400-ton plant of the Metaline Mining & Leasing Co. was operated only 3 months. A little zinc-lead ore was treated at a test mill in Stevens County. Most of the remainder of the lead output came from the Electric Point mine and other properties in Stevens County.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Washington in 1939, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Asotin		11	171	$5,985	28	$19
Benton		4	31	1,085	3	2
Chelan	6	7	48,500	1,697,500	184,059	124,937
Clallam		3	13	455		
Columbia		1	1	35		
Douglas		4	103	3,605	22	15
Ferry	19	8	29,287	1,025,045	159,670	108,382
Grant		4	85	2,975	22	15
King	2		195	6,825	598	406
Kittitas	3	5	69	2,415	152	103
Lincoln		2	26	910	3	2
Okanogan	26	12	7,718	270,130	44,522	30,221
Pend Oreille	2	2	8	280	11,603	7,876
Skamania	1		8	280		
Snohomish	3	3	54	1,890	4,835	3,282
Stevens	19	12	967	33,845	35,917	24,380
Whatcom	7	5	3,179	111,265	629	427
Whitman		1	5	175		
	88	84	90,420	3,164,700	442,063	300,067
Total, 1938	77	80	74,175	2,596,125	380,938	246,263

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Asotin							$6,004
Benton							1,087
Chelan	17,581,327	$1,828,458					3,650,895
Clallam							455
Columbia							35
Douglas							3,620
Ferry	8,423	876	2,936	$138			1,134,441
Grant							2,990
King	875	91	2,085	98			7,420
Kittitas	67	7	447	21			2,546
Lincoln							912
Okanogan	149,500	15,548	47,723	2,243			318,142
Pend Oreille			7,018,404	329,865	20,260,558	$1,053,549	1,391,570
Skamania							280
Snohomish	237,462	24,696					29,868
Stevens	18,279	1,901	364,192	17,117	1,442	75	77,318
Whatcom	67	7	213	10			111,709
Whitman							175
	17,996,000	1,871,584	7,436,000	349,492	20,262,000	1,053,624	6,739,467
Total, 1938	12,034,000	1,179,332	8,568,000	394,128	22,804,000	1,094,592	5,510,440

Gold and silver produced at lode mines in Washington in 1939, by counties, in terms of recovered metals

County	Ore sold or treated	Gold	Silver
	Short tons	*Fine ounces*	*Fine ounces*
Chelan	606,143	48,485	184,059
Ferry	224,455	28,544	159,552
King	909	195	598
Kittitas	18	23	146
Okanogan	23,386	7,574	44,497
Pend Oreille	259,320		11,603
Skamania	10	8	
Snohomish	644	41	4,835
Stevens	3,190	132	35,786
Whatcom	6,489	3,157	629
	1,124,564	88,159	441,705
Total, 1938	901,689	72,600	380,720

Gold and silver produced at placer mines in Washington in 1939, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Dry-land dredges [1]		Total	
	Gold	Silver	Gold	Silver	Gold	Silver
Asotin	60	10	111	18	171	28
Benton	25	3	6		31	3
Chelan	15				15	
Clallam	13				13	
Columbia	1				1	
Douglas	2		101	22	103	22
Ferry	10		733	118	743	118
Grant	9	1	76	21	85	22
Kittitas	46	6			46	6
Lincoln	26	3			26	3
Okanogan	34	6	110	19	144	25
Pend Oreille	8				8	
Snohomish	13				13	
Stevens	96	13	739	118	835	131
Whatcom	22				22	
Whitman	5				5	
	385	42	1,876	316	2,261	358
Total, 1938	509	68	1,066	150	1,575	218

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

MINING INDUSTRY

The increased output of gold, silver, and copper in Washington in 1939 was due chiefly to normal operations at the Holden property of the Howe Sound Co. The 2,000-ton flotation mill treated 596,967 tons of ore, compared with 371,800 tons in 1938. As a result, the output of both gold and copper established new records for the State. There was a decrease in gold from ore cyanided, but this loss was more than offset by gains in gold from ore smelted and ore concentrated. The Azurite mill in Whatcom County was closed in February 1939 and the First Thought mill in Stevens County was idle all of 1939, but the Knob Hill plant at Republic operated at capacity the entire year. The output of lead and zinc declined slightly owing to the closing of one of the plants at Metaline Falls in March.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Washington in 1939, with content in terms of recovered metals

Source	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold ore	55	261,651	39,979	167,388	134,417	4,165	
Dry and siliceous gold-silver ore	1	68	30	1,672	595	2,991	
Dry and siliceous silver ore	11	5,138	67	65,449	19,615	66,484	
	67	266,857	40,076	234,509	154,627	73,640	
Copper ore	8	597,957	48,064	192,237	17,841,078		
Lead ore	10	400	18	3,279	275	343,051	
Zinc-lead ore	3	259,350	1	11,680	20	7,019,309	20,262,000
Total, lode mines	88	1,124,564	88,159	441,705	17,996,000	7,436,000	20,262,000
Total, placers	84		2,261	358			
	172	1,124,564	90,420	442,063	17,996,000	7,436,000	20,262,000
Total, 1938	157	901,689	74,175	380,938	12,034,000	8,568,000	22,804,000

METALLURGIC INDUSTRY

The total output of ore from mines in Washington in 1939 was 1,124,564 tons and comprised 6,421 tons treated at amalgamation mills, 161,551 tons treated at cyanidation mills, 864,151 tons treated at concentration plants, and 92,441 tons shipped crude to smelters.

Amalgamation plants.—Five straight amalgamation plants and four combined amalgamation and concentration plants were operated in Washington in 1939 and treated 6,421 tons of gold ore; the chief producers were the Bodie mine in Okanogan County and the Boundary Red Mountain property in Whatcom County.

Cyanidation plants.—The 400-ton straight cyanidation plant of Knob Hill Mines, Inc., at Republic, Ferry County, operated throughout 1939 on ore from the Knob Hill, Mountain Lion, and Quilp mines; and the 100-ton cyanidation and blanket-concentration mill at the Azurite mine in Whatcom County operated 30 days on Azurite ore. The two plants treated 161,551 tons of ore and reported the consumption of 20,043 pounds of sodium cyanide (91-percent grade), 220,800 pounds of calcium cyanide, 34,997 pounds of zinc dust, and 876,093 pounds of lime.

Concentration plants.—The 864,151 tons of ore treated at 14 straight flotation plants comprised 597,127 tons of copper ore treated at 2 plants, 259,350 tons of zinc-lead ore treated at 3 plants, 5,074 tons of silver ore treated at 7 plants, and 2,600 tons of gold ore treated at 2 plants.

Details of the treatment of all ore produced in Washington in 1939 are given in the following tables.

Mine production of metals in Washington in 1939, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore amalgamated	6,421	961	344			
Ore cyanided	161,551	15,481	56,078			
Concentrates smelted	64,105	49,442	257,345	17,618,979	7,086,370	20,262,000
Ore smelted	92,441	22,275	127,938	377,021	349,630	
Placer		2,261	358			
		90,420	442,063	17,996,000	7,436,000	20,262,000
Total, 1938		74,175	380,938	12,034,000	8,568,000	22,804,000

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Washington in 1939, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Ore treated	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Okanogan	5,321	541	299	133	222	374	282	1,018
Skamania	10	8						
Whatcom	1,090	412	45	40	64	88		
	6,421	961	344	173	286	462	282	1,018
Total, 1938	2,071	439	230	58	111	190		

CYANIDATION MILLS

County	Ore treated	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
Ferry	156,176	13,523	55,876					
Whatcom	5,375	1,958	202	7	694	80		
	161,551	15,481	56,078	7	694	80		
Total, 1938	210,090	27,061	57,663	24	2,344	213		
Grand total: 1939	167,972	16,442	56,422	180	980	542	282	1,018
1938	212,161	27,500	57,893	82	2,455	403		

Mine production of metals from concentrating mills in Washington in 1939, by counties, in terms of recovered metals

County	Ore treated	Concentrates smelted and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Chelan	597,127	40,509	48,012	182,350	17,581,327		
King	900	127	188	415	777	1,462	
Okanogan	4,374	416	250	36,683	33,395	42,735	
Pend Oreille	259,320	22,665		11,603		7,018,404	20,260,558
Stevens	2,430	208	12	25,752	3,198	22,751	1,442
	864,151	63,925	48,462	256,803	17,618,697	7,085,352	20,262,000
Total, 1938	631,864	52,253	31,094	248,011	11,991,876	8,080,690	22,804,000

Gross metal content of concentrates produced from ores mined in Washington in 1939, by classes of concentrates smelted

Class of concentrates	Concentrates produced	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	307	1, 168	957	1, 100	4, 952	
Dry silver	193	10	23, 209	2, 470	19, 709	
Copper	40, 819	48, 234	210, 099	18, 154, 132	24, 120	
Lead	4, 500	29	20, 845	5, 192	6, 946, 691	108, 421
Lead-copper	11	1	2, 221	1, 233	2, 082	
Zinc	18, 275		14		422, 348	22, 514, 166
	64, 105	49, 442	257, 345	18, 164, 127	7, 419, 902	22, 622, 587
Total, 1938	52. 335	33, 549	248, 414	12, 364, 069	8, 538, 054	25, 562, 321

Mine production of metals from Washington concentrates shipped to smelters in 1939, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Chelan	40, 509	48, 012	182, 350	17, 581, 327		
King	127	188	415	777	1, 462	
Okanogan	549	472	37, 057	33, 677	43, 753	
Pend Oreille	22, 665		11, 603		7, 018, 404	20, 260, 558
Stevens	208	12	25, 752	3, 198	22, 751	1, 442
Whatcom	47	758	168			
	64, 105	49, 442	257, 345	17, 618, 979	7, 086, 370	20, 262, 000
Total, 1938	52, 335	33, 549	248, 414	11, 991, 876	8, 080, 690	22, 804, 000

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
Dry gold	307	1, 168	957	1, 059	2, 480	
Dry silver	193	10	23, 209	2, 100	18, 921	
Copper	40, 819	48, 234	210, 099	17, 610, 252	12, 060	
Lead	4, 500	29	20, 845	4, 520	6, 670, 769	
Lead-copper	11	1	2, 221	1, 048	1, 990	
Zinc	18, 275		14		380, 150	20, 262, 000
	64, 105	49, 442	257, 345	17, 618, 979	7, 086, 370	20, 262, 000

Gross metal content of Washington crude ore shipped to smelters in 1939, by classes of ore

Class of ore	Ore	Gross metal content			
		Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry and siliceous gold	91,079	22,172	109,857	119,638	3,389
Dry and siliceous gold-silver	68	30	1,672	614	5,966
Dry and siliceous silver	64	3	3,246	411	2,167
Copper	830	52	9,884	267,814	
Lead	400	18	3,279	340	357,302
	92,441	22,275	127,938	388,817	368,824
Total, 1938	57,664	11,551	74,413	43,748	509,612

Mine production of metals from Washington crude ore shipped to smelters in 1939, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Chelan	9,016	473	1,709		
Ferry	68,279	15,021	103,676	8,423	2,936
King	9	7	183	98	623
Kittitas	18	23	146	67	447
Okanogan	13,691	6,561	7,141	115,823	3,970
Snohomish	644	41	4,835	237,462	
Stevens	760	120	10,034	15,081	341,441
Whatcom	24	29	214	67	213
	92,441	22,275	127,938	377,021	349,630
Total, 1938	57,664	11,551	74,413	42,124	487,310

BY CLASSES OF ORE

Dry and siliceous gold	91,079	22,172	109,857	116,035	1,685
Dry and siliceous gold-silver	68	30	1,672	595	2,991
Dry and siliceous silver	64	3	3,246	365	1,903
Copper	830	52	9,884	259,751	
Lead	400	18	3,279	275	343,051
	92,441	22,275	127,938	377,021	349,630

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Washington in 1939, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Asotin County: Snake River		11			171	171		28	28				$6,004
Benton County: Columbia River		4			31	31		3	3				1,087
Chelan County:													
Chelan Lake	1		596,967	48,011		48,011	181,777		181,777	17,572,981			3,631,363
Columbia River		2			2	2							70
Leavenworth	1		160	1		1	573		573	8,346			1,292
Peshastin Creek	3	2	20	5	5	10	3		3				352
Wenatchee River	1	3	8,996	468	8	476	1,706		1,706				17,818
Clallam County: Ozette		3			13	13							455
Columbia County: Snake River		1			1	1							35
Douglas County: Columbia River		4			103	103		22	22				3,620
Ferry County:													
Columbia River		7			742	742		118	118				26,050
Danville	3		91	11		11	78		78	8,000			1,270
Enterprise	3		12				383		383	29	2,894		399
Republic	13	1	224,352	28,533	1	28,534	159,091		159,091	394	42		1,106,722
Grant County: Columbia River		4			85	85		22	22				2,990
King County: Miller River	2		909	195		195	598		598	875	2,085		7,420
Kittitas County:													
Fish Lake	1		13	16		16	146		146	67	447		687
Swauk	2	5	5	7	46	53		6	6				1,859
Lincoln County: Columbia River		2			26	26		3	3				912
Okanogan County:													
Cascade	1		5,000	708		708	638		638				25,213
Columbia River		5			119	119		19	19				4,178
Conconully	3		454	9		9	5,364		5,364	2,596	12,489		4,813
Methow	10		14,989	6,557		6,557	5,383		5,383	133,192	4,149		247,196
Myers Creek and Mary Ann Creek	4	2	484	217	9	226	386	3	389	10	21		8,176
Palmer Mountain	8		2,459	83		83	32,726		32,726	13,702	31,064		28,004
Similkameen River		5			16	16		3	3				562
Pend Oreille County: Metaline	2	2	259,320		8	8	11,603		11,603		7,018,404	20,260,558	1,391,570
Skamania County: Niggerhead	1		10	8		8							280
Snohomish County:													
Index	1		514	38		38	4,505		4,505	196,154			24,788
Sultan	2	3	130	3	13	16	330		330	41,308			5,080
Stevens County:													
Bossburg	1		6				134		134	19	639		123

Chewelah	2	-----	136	9	-----	9	5, 149	-----	5, 149	13, 375	1, 851	-----	5, 288
Columbia River	-----	12	-----	-----	835	835	-----	131	131	-----	-----	-----	29, 314
Colville	2	-----	43	16	-----	16	1, 186	-----	1, 186	96	4, 447	1, 442	1, 659
Kettle Falls	3	-----	448	79	-----	79	2, 634	-----	2, 634	1, 327	2, 064	-----	4, 788
Northport	5	-----	391	-----	-----	-----	775	-----	775	77	317, 914	-----	15, 476
Orient	2	-----	3	17	-----	17	3	-----	3	29	21	-----	601
Springdale	4	-----	2, 163	11	-----	11	25, 905	-----	25, 905	3, 356	37, 256	-----	20, 069
Whatcom County:													
Mount Baker	3	5	795	409	22	431	109	-----	109	19	-----	-----	15, 161
Slate Creek	4	-----	5, 694	2, 748	-----	2, 748	520	-----	520	48	213	-----	96, 548
Whitman County: Snake River	-----	1	-----	-----	5	5	-----	-----	-----	-----	-----	-----	175
Total Washington	88	84	1, 124, 564	88, 159	2, 261	90, 420	441, 705	358	442, 063	17, 996, 000	7, 436, 000	20, 262, 000	6, 739, 467

ASOTIN COUNTY

The output of placer gold from Asotin County increased in 1939 owing to the operation of four small dragline and washer plants on bars along the Snake River; the rest of the county output was obtained by small-scale sluicing operations.

BENTON COUNTY

The placer output from bars along the Columbia River near Richland and Paterson decreased slightly in 1939, as the output from the Gone Busted property was less than in 1938.

CHELAN COUNTY

Chelan Lake district.—The Chelan Division of the Howe Sound Co. continued regular activity at the Holden property during 1939, except from July 6 to August 17 when the property was strike-bound. The company mined and milled 596,967 tons of gold-copper-silver ore and was again the leading producer of gold, silver, and copper in Washington. The ore was treated in the 2,000-ton flotation plant, and copper concentrates rich in gold and carrying considerable silver were shipped to Tacoma for smelting. The company reported that mine development in 1939 comprised 13,440 feet of drifts, 5,176 feet of raises, and 21,991 feet of diamond drilling. The 57-percent increase ($1,317,806) in total value of metal output in the Chelan Lake district was greater than the net gain ($1,229,027) in the State total value in 1939.

Columbia River district.—A little placer gold was produced in 1939 at two properties on the Columbia River near Malaga.

Leavenworth district.—A car of copper concentrates was shipped to Tacoma in 1939 from the property of the Royal Development Co., 48 miles northwest of Leavenworth and only 8 miles in a direct line over the mountain from the Holden mine; the Royal property is equipped with a 350-ton flotation mill. It was an important producer of copper from 1935 to 1937 but has been idle since March 1, 1937.

Peshastin Creek district.—Small lots of gold ore were shipped to smelters in 1939 from the Black & White, Blewett, and Apex lodes; a little placer gold was reported recovered from two properties.

Wenatchee River district.—Shipments of ore from the Gold King & Macbeth (Keegan Mining & Development Co.) property near Wenatchee ceased early in 1939, after the contract with the Tacoma smelter terminated. From August 16, 1938, to April 17, 1939, the property produced 19,842 tons of highly siliceous low-grade gold ore which was used as flux at Tacoma; the ore was mined from an opencut and contained 1,358 ounces of gold and 4,164 ounces of silver. Placer gold was reported recovered from three properties on the Wenatchee River near Cashmere and Dryden.

CLALLAM COUNTY

Small-scale sluicing operations on beach sands near Ozette were continued in 1939; most of the gold came from the Yellow Bank property.

COLUMBIA COUNTY

A little placer gold was recovered by sluicing at a bar on the Snake River north of Dayton in 1939.

DOUGLAS COUNTY

The output of gold from placer operations on Columbia River bars in Douglas County increased considerably in 1939 owing to the operation of a bulldozer and sluicing plant on the Hopkins property near Alameda.

FERRY COUNTY

Columbia River district.—Gold production from placer properties along the Columbia River in Ferry County increased markedly in 1939 as the result of work by the Newton Construction Co.; the company used two tractor-scraper units in hauling 90,000 cubic yards of gravel to a washing plant and was the largest placer producer in Washington. Others in the district included small dragline operations at the Fish and Plumb Bar properties and several small-scale sluicing operations.

Danville district.—Shipments of gold ore from the Morning Star mine decreased in 1939. Small lots of copper ore were shipped from the Grand Forks and Gold Cup mines.

Enterprise district.—Small lots of crude ore from the Lucky Boy, Stemwinder, and Tyler properties near Inchelium were shipped in 1939 for smelting.

Republic district.—Mines in the Republic district produced metals valued at $1,106,722 in 1939, an increase of $133,818 over 1938. The entire output from lode mines was siliceous gold ore and comprised 156,176 tons treated by cyanidation and 68,176 tons shipped direct to smelters. The ore cyanided came from the Knob Hill and Mountain Lion properties operated by Knob Hill Mines, Inc., and from the Quilp property of the Eureka Mining & Milling Co.; it was treated in the 400-ton cyanide plant at the Knob Hill mine. Most of the crude smelting ore came from leasing operations on property of the Aurum Mining Co.; other producers of smelting ore included the California, El Caliph, Flag Hill, Knob Hill, Morning Glory, Quilp, Republic, Seattle, Valley, Klepinger, and Anecia properties. The Aurum property was the largest gold producer in the district in 1939, followed by the Knob Hill, Mountain Lion, Quilp, and Republic. A little placer gold was recovered by sluicing at the Marcella property on Granite Creek.

GRANT COUNTY

Most of the output of Grant County in 1939 came from the small power-shovel operation of Miller Bros. at Chinaman Bar on the Columbia River; gold was also recovered at three small sluicing operations along the river.

KING COUNTY

Miller River district.—Gold ore from the Apex mine was treated in 1939 in the 75-ton flotation plant of Apex Gold Mines, Inc. A small quantity of gold ore was shipped from the Coney Basin mine for smelting.

KITTITAS COUNTY

Fish Lake district.—A little gold ore was mined at the Silver Creek property north of Cle Elum in 1939.

Swauk district.—Producing placers near Liberty in 1939 included the Black Bar, Deer Gulch, Gold Bar, and Sunny Bar properties. Small lots of gold ore were produced at the North Star and Sonny Brown mines.

LINCOLN COUNTY

Small-scale sluicing operations in 1939 were reported at two properties on the Columbia River north of Wilbur.

OKANOGAN COUNTY

Cascade district.—The entire output of the Cascade district in 1939 was gold ore from the Bodie mine north of Wauconda and was treated by amalgamation and concentration; the property was operated part of the year by the Northern Gold Corporation and later by the Toroda Gold Mines Corporation.

Columbia River district.—The Gold Bar Mining Co. operated a bulldozer and washing plant in 1939 at the Gold Bar on the Columbia River near Kartar, treating 10,045 cubic yards of gravel from April 11 to November 6. Sluicing was reported at the Funk, Gove, Hill, and Lucky Strike properties.

Conconully district.—Silver ore was treated by flotation at two properties near Conconully in 1939—the Sonny Boy mine operated by the Ruby Mountain Mining Co. and the Mineral Hill group operated by Central Mines, Inc.; lead concentrates were produced at both plants.

Methow district.—The value of the metal output of the Methow district increased from $8,443 in 1938 to $247,196 in 1939 and accounted for most of the gain in Okanogan County. Operations at the Alder group near Twisp were begun April 22 by the Methow Gold Corporation; the output comprised nearly 13,000 tons of gold ore, containing considerable silver and copper, and copper concentrates from several hundred tons of ore treated in the Red Shirt mill and shipped to Tacoma for smelting. Other producers in the district included the Highland Light, Mazama Pride, Mazama Queen, Mid Range, Gold Crown, and Hyde properties.

Myers Creek and Mary Ann Creek district.—Gold ore was shipped in 1939 for smelting from the Gray Eagle, Mother Lode, Poland China (Overtop), and Harris lode mines. Small-scale sluicing operations were reported at the Ottia May and Davey placers.

Palmer Mountain district.—The value of the metal output of the Palmer Mountain district decreased $38,271 in 1939, owing chiefly to the closing of the Arlington mine and mill on April 30; the quantity of silver ore treated at the 75-ton flotation plant was only one-third of that in 1938. Other producers in the district included the Four Metals, Grand Summit, John Judge, Golden Zone, Monto Oro, Owasco, and Ruby mines.

Similkameen River district.—Small-scale sluicing operations in 1939 were reported at five placers along the Similkameen River.

PEND OREILLE COUNTY

Metaline district.—The value of the metal output from Pend Oreille County decreased from $1,473,116 in 1938 to $1,391,570 in 1939 as the output of both lead and zinc declined. The Pend Oreille Mines & Metals Co. operated the mine and 700-ton flotation plant the entire year and treated 241,624 tons of zinc-lead ore compared with 214,120 tons in 1938, but the output of lead and zinc decreased slightly; the company reported mine development in 1939 comprising 50 feet of shaft, 1,500 feet of drifts, 1,000 feet of tunnel, and 10,000 feet of diamond drilling. The Metaline Mining & Leasing Co. suspended production March 15, 1939, after 17,696 tons of zinc-lead ore had been treated in the 400-ton flotation mill (in 1938 the mill treated 35,064 tons of ore); the company reported 9,174 feet of diamond drilling during the year. A little placer gold was recovered by sluicing at two properties on the Pend Oreille River.

SKAMANIA COUNTY

A little gold ore was amalgamated in 1939 at the Camp Creek property in the Niggerhead district.

SNOHOMISH COUNTY

Index district.—The Sunset Copper Co. was idle in 1939, but lessees shipped 514 tons of crude copper ore from the Sunset mine to Tacoma for smelting.

Sultan district.—Four lots of copper ore were shipped to Tacoma in 1939 by the Florence Rae Mining Co., and a small lot of gold ore was shipped from a prospect. Sluicing operations were reported at three placers on the Sultan River.

STEVENS COUNTY

Bossburg district.—Lessees shipped a test lot of silver-lead ore from the Silver Trail mine north of Colville in 1939 for smelting.

Chewelah district.—The Chinto Mining Co. shipped 130 tons of silver-copper ore in 1939 to Tacoma from the Chinto mine on Eagle Mountain; the company reported 700 feet of drifts and tunnels and 1,500 feet of diamond drilling done during the year. A test lot of silver-lead ore was shipped from the Jay Gould mine.

Columbia River district.—The placer output from bars along the Columbia River in Stevens County in 1939 was about the same as in 1938; most of the 1939 output came from power-shovel or tractor-scraper operations at the Gibson Bar, B & W, Grover, and Valbush placers. Sluicing was reported at eight placers.

Colville district.—A car of silver-lead ore was shipped to the Bunker Hill smelter from the Old Dominion mine in 1939, and a little zinc-lead ore was treated by flotation in a small test mill at the Middleport mine.

Kettle Falls district.—The Silver Queen property of the Ark Mines Co. was operated by lessees about 5 months in 1939, and the quantity of silver ore treated in the 40-ton flotation plant decreased from about 1,700 tons in 1938 to 250 tons in 1939; silver-lead-copper concentrates were shipped to the Bunker Hill smelter. The remainder of the output of the Kettle Falls district in 1939 was gold ore shipped from two properties.

Northport district.—The output of lead from the Northport district decreased in 1939 as shipments of crude lead ore from the Electric Point mine declined. Crude lead ore was also shipped from the Gladstone Mountain, Lead Trust, and W. J. Bryan mines to the Bunker Hill smelter, and a little silver ore from the Burrus mine was treated in a small flotation mill.

Orient district.—The metal output of the Orient district decreased sharply in 1939 owing to the closing of the 50-ton cyanidation mill of the First Thought Mine Corporation; no ore was milled in 1939 (in 1938 the mill treated 11,668 tons), but considerable development at the mine was reported. The district output in 1939 comprised small lots of gold ore shipped to Tacoma from the Gem and Gold Stake mines.

Springdale district.—The metal output of the Springdale district increased in 1939 as the Deer Trail mine near Fruitland was reopened; the mine and 100-ton flotation plant were operated several months by the Metals Development Co., and silver concentrates and crude silver ore were sent to the Bunker Hill smelter. The remainder of the district output was crude ore shipped from the Cleveland, Double Eagle, and Lucky Boy mines for smelting.

WHATCOM COUNTY

Mount Baker district.—The Boundary Red Mountain mine was idle in 1939, but material cleaned up from former operations was treated by amalgamation and gold valued at more than $12,000 was recovered. The placer output came from sluicing operations on Ruby Creek.

Slate Creek district.—The value of the metal output of the Slate Creek district dropped from $429,823 in 1938 to $96,548 in 1939, owing to the closing of the Azurite mine and mill in February 1939; the mill treated only 5,375 tons of ore in 1939 compared with 36,515 tons in 1938. The mine has been operated under lease by the American Smelting & Refining Co. since 1936. A 100-ton cyanidation and corduroy-table concentration plant was built and placed in operation in November 1936 and since that time it has treated 72,998 tons of gold ore. The remainder of the district output in 1939 comprised gold ore from the Allen Basin group, shipped to Tacoma, and from the Newlight mine, treated by amalgamation and concentration.

WHITMAN COUNTY

A little placer gold was recovered in 1939 by sluicing at a bar on the Snake River near Almota.

GOLD, SILVER, COPPER, AND LEAD IN WYOMING

(MINE REPORT)

By Chas. W. Henderson and A. J. Martin

SUMMARY OUTLINE

The bulk of the 583 fine ounces of gold and 75 fine ounces of silver recovered from Wyoming ores and gravels in 1939 came from placer mines in the Atlantic City district, Fremont County. No recoverable copper or lead was produced in the State during the year, and only 57 tons of gold and gold-silver ores were shipped from lode mines and prospects. Other activities reported at mines in the State include about 1,000 feet of development work at 14 properties in Albany, Carbon, Fremont, and Johnson Counties; construction of a new mill building at the property of the Powder River Corporation in Johnson County; and reconditioning of the old stamp mill at the Keystone mine in Albany 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, 1935–39

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1935	$35.00	$0.71875	$0.083	$0.040	$0.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048
1939	35.00	[5] .678+	.104	.047	.052

[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] 1935–37: Yearly average weighted Treasury buying price for newly mined silver; 1938–39: Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464. [5] $0.67878787.

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 1935 to 1939; it also gives the total metal production from 1867 to 1939. About three-fourths of the total recorded value of the four metals is in copper, most of which was mined before 1924 in the Encampment district in Carbon County and the Hartville district in Laramie County.

Mine production of gold, silver, copper, and lead in Wyoming, 1935–39, and total, 1867–1939, in terms of recovered metals

Year	Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)		Copper		Lead		Total value
		Fine ounces	Value	Fine ounces	Value	Pounds	Value	Pounds	Value	
1935	4,190	3,715.00	$130,025	1,152	$828	1,000	$83	5,000	$200	$131,136
1936	344	1,964.40	68,754	1,113	862	--------	--------	--------	--------	69,616
1937	17	1,776.00	62,160	203	157	--------	--------	--------	--------	62,317
1938	581	798.00	27,930	328	212	--------	--------	--------	--------	28,142
1939	57	583.00	20,405	75	51	--------	--------	--------	--------	20,456
1867–1939	(1)	76,673.00	1,791,883	74,372	51,567	[2] 16,319	5,682,652	[2] 8	568	7,526,670

[1] Figures not available. [2] Short tons.

MINE PRODUCTION BY COUNTIES

Mine production of gold and silver in Wyoming in 1939, by counties, in terms of recovered metals

County	Mines producing		Ore sold or treated	Gold			Silver			Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total	
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	
Albany	2	3	12	5.80	2.60	8.40	1	--------	1	$295
Big Horn	--------	1	--------	--------	5.40	5.40	--------	--------	--------	189
Carbon	1	2	29	16.20	17.00	33.20	6	3	9	1,168
Crook	--------	1	--------	--------	2.60	2.60	--------	--------	--------	91
Fremont	5	17	12	7.40	518.40	525.80	6	59	65	18,447
Johnson	1	--------	4	1.60	--------	1.60	--------	--------	--------	56
Park	--------	2	--------	--------	3.20	3.20	--------	--------	--------	112
Teton	--------	2	--------	--------	2.80	2.80	--------	--------	--------	98
	9	28	57	31.00	552.00	583.00	13	62	75	20,456
Total, 1938	8	26	581	193.60	604.40	798.00	249	79	328	28,142

REVIEW BY COUNTIES AND DISTRICTS

ALBANY COUNTY

Douglas Creek district (*Holmes, Keystone*).—The Landrith Co. repaired the old stamp mill at the Keystone mine in 1939 and shipped 5 tons of clean-up material containing gold to the Leadville (Colo.) smelter. A 7-ton lot of gold-silver ore was shipped to the Garfield (Utah) smelter from an unidentified claim, presumably in the Douglas Creek district. Some development work was done at the Gold Crater group. Individuals sluicing on Douglas and Little Beaver Creeks recovered small lots of placer gold.

BIG HORN COUNTY

George E. Frame worked his placer ground along Big Horn River approximately 7 miles north of Kane from July 10 to October 10, 1939, using equipment consisting of steel wash boxes, a 4- by 3-inch pump driven by an automobile engine, hose with a 2-inch nozzle, ¼-inch grizzly screen, and sluices. The gravel was shoveled by hand into the wash boxes, from which it was carried by water over the screen and sluices. The gold recovered totaled 5.40 fine ounces.

CARBON COUNTY

Encampment or Upper Platte district.—Development work was continued at the Golden Clover property, from which a car of gold ore containing a little silver was shipped to the Garfield (Utah) smelter in 1939.

Spring Creek district.—The Saratoga Mining Co. operated its 1-cubic yard dragline and screening and sluicing plant on North Spring Creek about 11 weeks in April, May, and June 1939. Sluicing was done from April 20 to September 10 at the Betty No. 1 placer on Savery Creek west of the Spring Creek district.

CROOK COUNTY

Hurricane district.—Small lots of placer gold, one of which ran 0.882 fine in gold and 0.088½ fine in silver, were recovered in 1939 from the Baker placer on Sand Creek.

FREMONT COUNTY

Atlantic City district.—In 1939 the E. T. Fisher Co. operated its 1¼-cubic yard dragline and portable traction screening and sluicing plant for the seventh consecutive season on placer ground in the vicinity of Atlantic City. The company production of gold was a little higher than in 1938 but was much less than the peak of approximately 2,700 ounces recovered in 1934. None of the other individual operations in the Atlantic City district produced more than 10 fine ounces of gold in 1939. The Wyoming Mining Co. operated a ½-cubic yard dragline and a washing plant consisting of two 5-foot concentrating tables and sluices from June 15 to August 10 on placer ground in Poorman Gulch; the recovery amounted to 10.75 crude ounces of dust and buttons averaging 0.906½ fine in gold. Individuals sluicing at the Badger-Fox-Coyote, Blue Bird, Hester, and other placers near Atlantic City and South Pass City recovered small lots of placer gold, part of which was sold to the Smith-Sherlock Co. at South Pass City and part to the Denver Mint.

The B & H Gold Mining Co. shipped 8¼ tons of gold-silver ore to the Garfield (Utah) smelter from the Ellen Mc lode mine group, operated only during the period required for assessment work. Other lode claims from which a little gold was recovered by hand methods in 1939 included the Bouncing Dollar, Jack Rabbit, and Snowbird. The Iron Duke Mining Co. sank 50 feet of shaft and drove 25 feet of drift and 40 feet of crosscut at the Iron Duke mine but shipped no ore during the year. The Diana Mining Co. drove 200 feet of development drifts and tunnel at the McGrath or "1914"-Sullivan property. Some development work was done at the Independent, Lone Star, and R. J. Reynolds groups.

JOHNSON COUNTY

In 1939 the Powder River Corporation shipped a test lot of ore from its property in sec. 20, T. 47 N., R. 85 W., sixth principal meridian. A mill building was constructed on this property during the year.

PARK COUNTY

A little placer gold was recovered in 1939 on Clark Fork in Tps. 57 and 58, R. 101 W., sixth principal meridian.

TETON COUNTY

Two individuals working placers in the Snake River area, one using a shaking machine and the other a sluice, recovered small quantities of placer gold in 1939.

SECONDARY METALS—NONFERROUS

By James S. Earle

SUMMARY OUTLINE

In recognition of the need for additional facts on consumption of the more common nonferrous secondary metals and in order to present information of interest to both suppliers and consumers, the Bureau of Mines revised and enlarged the scope of its nonferrous secondary metal survey in 1939. To satisfy the growing demand for quantitative data on items of nonferrous scrap consumed and to make a separation between "new" and "old" scrap, schedules used in the 1939 canvass were designed to include stocks (by items) on hand at the beginning and end of the year, as well as receipts of purchased scrap and quantities used or resold.

Companies reported the weight of each metal recovered in pure or elemental form apart from the items of scrap used. In compiling the data recoverable metal contents were calculated from assay values assigned to each item of scrap used; in this manner, each metal recovered in alloyed form was determined after allowance had been made for that recovered in pure or unalloyed form.

To avoid duplication of figures, data were assembled only from consumers of purchased secondary metals that are equipped to produce finished products. Returns from remelters, smelters, and refiners were tabulated apart from those from manufacturers and foundries. Thus, two large groups that use scrap as a source of metal supply were included in the survey, whereas metal dealers and those producing "percentage metals" and similar products requiring further metallurgical treatment were excluded.

The canvass of remelters, smelters, and refiners included all metal companies in the United States that produce refined and alloyed products for sale to consumers, whereas the canvass of manufacturers and foundries included all companies that consumed purchased scrap for use in the manufacture of finished products.

Schedules mailed to remelters, smelters, and refiners differed from those mailed to manufacturers and foundries in that no information on plant scrap was requested; manufacturers and foundries were requested to report inventories of plant scrap on hand at the beginning and end of 1939.

The tables for 1939, except for the table showing tin recovered at detinning plants and the tables on imports and exports, do not include comparisons with 1938 because details reported for 1939 are not on a basis comparable with those reported in previous years. It should be stated, however, that the total tonnages recovered in 1939 appear to be approximately comparable to the recoveries revealed by past surveys. A historical table showing nonferrous secondary metals recovered during the 10-year period 1929–38 is included in this report.

Secondary metals of certain classes recovered in the United States, 1929–38, in short tons

	1929	1930	1931	1932	1933
Copper, including that in alloys other than brass	417,600	332,800	261,000	187,700	247,100
Brass scrap re-treated	298,500	192,000	122,800	86,400	130,000
Lead as metal	138,500	129,000	128,800	128,000	131,800
Lead in alloys	172,500	126,800	105,900	70,300	92,700
Zinc as metal	65,400	49,300	34,800	20,000	48,100
Zinc in alloys other than brass	11,600	7,700	7,400	6,300	7,600
Tin as metal	7,400	5,600	5,500	4,650	7,250
Tin in alloys and chemical compounds	26,900	20,600	14,300	10,100	14,850
Aluminum as metal	25,850	19,700	15,200	12,200	14,500
Aluminum in alloys	22,550	18,900	15,100	11,800	19,000
Antimony as metal and in alloys	11,131	8,082	7,900	6,450	7,400
Nickel as metal	850	500	270	200	300
Nickel in nonferrous alloys and salts	3,500	2,400	1,800	1,250	1,350
Total quantity	1,202,281	913,382	720,770	545,350	721,950
Total value	$331,028,900	$193,255,100	$110,674,600	$65,022,800	$101,268,800

	1934	1935	1936	1937	1938
Copper, including that in alloys other than brass	292,500	364,300	365,300	387,600	252,700
Brass scrap re-treated	121,300	120,800	170,400	206,400	153,100
Lead as metal	124,500	156,800	137,500	154,500	119,400
Lead in alloys	83,900	113,600	125,400	120,600	105,500
Zinc as metal	29,300	55,400	68,000	64,540	42,270
Zinc in alloys other than brass	8,200	8,950	11,500	11,150	6,400
Tin as metal	8,250	9,600	7,250	8,270	4,900
Tin in alloys and chemical compounds	16,650	18,300	20,770	22,030	18,710
Aluminum as metal	21,000	23,500	20,900	29,360	16,700
Aluminum in alloys	25,400	27,900	30,600	33,200	22,100
Antimony as metal and in alloys	7,550	9,600	9,900	12,340	8,500
Nickel as metal	550	700	855	917	850
Nickel in nonferrous alloys and salts	1,300	1,250	1,110	1,483	1,450
Total quantity	740,400	910,700	969,485	1,052,390	752,580
Total value	$127,286,100	$155,036,800	$174,183,300	$239,130,800	$137,915,800

Although reports were not received from all consumers, the final tables include data covering 154 plants of remelters, smelters, and refiners, and 1,367 plants of manufacturers and foundries that consumed purchased scrap in 1939. In previous years returns were received from approximately 400 companies. The term "purchased scrap" includes all crude scrap metal received from metal dealers or other sources of supply, as well as all scrap items returned from customers for reworking on a toll basis or conversion agreement.

Stocks of "plant scrap" shown at plants of manufacturers and foundries include all scrap on hand at the beginning and end of the year that was produced within the plant reporting. Typical examples of plant scrap are sprues, gates, risers, butts, croppings, clippings, borings, turnings, and defective products produced as a result of manufacturing operations.

"New scrap" is defined as the refuse produced during the manufacture of articles for ultimate consumption, including all finished and semifinished articles that are to be reworked. Typical examples of new scrap are defective castings, clippings, punchings, turnings, borings, skimmings, drosses, and slags. Finished and semifinished articles frequently are received as scrap because of excess inventory, faulty manufacture, or change in design or other causes of obsolescence, and the metal content of all such articles is included as new scrap.

"Old scrap" is defined as scrap derived from metal articles that have been discarded after serving a useful purpose. Typical examples of old scrap are discarded trolley wire, battery plates, railroad-car boxes, automobile crankcases, cocks and faucets, and lithographers plates.

In presenting these new data the Bureau of Mines believes that a decided advance has been made that will help to clarify the recovery of metals from secondary sources. It has long been recognized that the return of metals from use exerts a profound effect upon the mining industry, and the revised canvass has been designed to demonstrate the real significance of secondary metals and to assemble basic data of value to the expanding secondary-metals industry. Because of difficulties occasioned by revision of the canvass and the complex nature of secondary scrap metals, results of the first year's canvass on the new basis are not exact. The Bureau of Mines will welcome suggestions for improving the accuracy of the data and is aware that time will be required to present all details satisfactorily.

The figures on recoveries of metals from secondary sources in 1939 were derived from consumption data on the following items of scrap:

Aluminum:
- Pure clippings
- Pure wire and cable
- Castings
- Clean sheet
- Painted sheet
- Dural sheet and clippings
- Borings and turnings
- Foil
- Drosses and skimmings

Antimony:
- Battery lead plates
- Hard lead
- Common babbitt
- Genuine babbitt
- No. 1 babbitt
- No. 1 pewter
- Cable lead
- Type metals
- Battery mud

Copper:
- No. 1 wire
- No. 2 wire
- No. 1 heavy
- Mixed heavy
- Light
- Composition or red brass
- Railroad car boxes
- Cocks and faucets

Copper—Continued.
- Heavy yellow brass
- Yellow brass castings
- Light brass
- Old rolled brass
- Brass clippings
- Brass pipe
- No. 1 Red composition turnings
- No. 1 Yellow rod-brass turnings
- No. 1 Yellow brass turnings
- Auto radiators (unsweated)
- Electrotype shells
- Aluminum-base alloys
- Bronze
- Manganese-bronze
- Aluminum-bronze
- Nickel-silver
- Bell metal
- Secondary blister
- Copper oxide
- Buffings
- Grindings
- Washings
- Brass ashes
- Brass skimmings
- Slags
- Residues
- Miscellaneous copper-bearing materials

Lead:
- Soft lead
- Hard lead
- Cable lead
- Battery lead plates
- Common babbitt
- Solder
- Type metals
- Dross
- Battery mud
- Copper-base alloys
- Type-metal dross
- Solder dross
- Solder joints
- Lead oxide
- Slag

Nickel:
- Nickel clippings, anodes, hangers, etc.
- Monel metal
- Stainless steel
- Nickel-silver
- Secondary blister copper
- Nichrome wire
- Nickel-steel
- Nickel-iron

Tin:
- New tin-plate clippings
- Old tin-coated containers
- Block tin pipe
- Tinfoil
- Tin scruff and dross
- No. 1 pewter
- Genuine babbitt
- No. 1 babbitt
- Residues
- Copper-base alloys
- Lead-base alloys

Zinc:
- Clippings
- Sheet
- Skimmings
- Dross
- Die castings
- Flue dust
- Residues
- Zinc ashes
- Remelt zinc
- Die-cast slabs
- Castings
- Copper-base alloys

GENERAL SUMMARY

The value of the more common nonferrous metals recovered from secondary sources as metal and in alloys and chemical products totaled $199,856,800 in 1939. Metals recovered from market scrap produced as a result of manufacturing operations (new scrap) accounted for $81,868,200 of the total value, whereas metals returning from use (old scrap) accounted for $117,988,600.

Salient statistics of nonferrous secondary metals recovered in the United States in 1939

Metal	New scrap		Old scrap		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Aluminum	15,100	$5,964,500	34,900	$13,785,500	50,000	$19,750,000
Antimony	150	37,100	9,660	2,387,900	9,810	2,425,000
Copper	212,800	44,262,400	286,900	59,675,200	499,700	103,937,600
Lead	30,700	2,885,800	210,800	19,815,200	241,500	22,701,000
Nickel	1,910	1,337,000	1,010	707,000	2,920	2,044,000
Tin	12,300	12,349,200	16,860	16,927,400	29,160	29,276,600
Zinc	144,540	15,032,200	45,100	4,690,400	189,640	19,722,600
		81,868,200		117,988,600		199,856,800

The general improvement in nonferrous-metal markets in 1939 created widespread activity in the secondary-metals industry. The gain over 1938 followed increases in consumption, production, and prices and the downward trend of primary stocks of nonferrous metals. The secondary-metals industry was slightly more active in the first half of 1939 than in the latter half of 1938; however, substantial advances did not get under way until July, when demand increased in sympathy with the improved rate of industrial operations. The outbreak of war in Europe on September 1 precipitated a rush by domestic consumers to increase metal inventories in anticipation of war orders. As a result of the sudden gain in demand, scrap supplies became momentarily frozen because many dealers hesitated to dispose of their scrap stocks on a bullish market. The situation eased as soon as primary metals attained some stability at moderately higher levels. By October many dealers in secondary metals realized that early hopes of tremendous orders for materials from belligerent countries were not materializing, and as domestic consumers had covered their needs fairly well early in September, domestic demand also subsided. Activity relaxed toward the end of the year.

SECONDARY ALUMINUM

The quantity of secondary aluminum recovered in 1939 totaled 50,000 short tons valued at $19,750,000. The value was computed at 19.75 cents a pound of weight recovered.

Aluminum recovered from secondary sources in 1939 included 2,900 short tons of pure metal (98+ percent) and 47,100 tons of aluminum alloys. The aluminum content of the recovered alloys was approximately 43,900 tons (93 percent).

Secondary aluminum recovered in the United States in 1939, in short tons

	1939
Aluminum as metal	2, 900
Aluminum alloys produced and recovered from aluminum scrap	47, 100
	50, 000
From new scrap	15, 100
From old scrap	34, 900

Of the 50,000 tons of aluminum recovered in 1939, remelters supplied 39,700 tons (79 percent) and manufacturers and foundries 10,300 tons (21 percent). The 39,700 tons recovered by remelters included 11,600 tons (29 percent) derived from new scrap and 28,100 tons (71 percent) from old scrap. The 10,300 tons reported by manufacturers and foundries included 3,500 tons (34 percent) obtained from new scrap and 6,800 tons (66 percent) from old scrap. Thus, the 50,000 tons of secondary aluminum produced included 15,100 tons (30 percent) recovered from new scrap and 34,900 tons (70 percent) from old scrap.

The principal sources of aluminum recovered from scrap in 1939 were alloy castings and various items of soft and hard sheet. Of the total aluminum recovered, 50 percent came from castings, 27 from sheet, 7 from borings and turnings, 6 from new aluminum clippings, 2 from aluminum wire and cable, and 8 from miscellaneous materials comprising mainly drosses and skimmings. Of the aluminum recovered at plants of remelters, 40 percent was obtained from alloy castings, 34 from various classes of sheet scrap, 8 from borings and turnings, 4 from new aluminum clippings, 2 from wire and cable, and 12 from miscellaneous materials. Of the aluminum recovered at plants of manufacturers and foundries, 79 percent came from alloy castings, 11 from new aluminum clippings, 7 from various classes of sheet scrap, and 1 each from wire and cable, borings and turnings, and miscellaneous materials.

Stocks of unmelted aluminum scrap at remelting plants increased 15 percent from 3,900 tons at the beginning of 1939 to 4,500 at the end of the year. Stocks of purchased aluminum scrap at manufacturing and foundry plants decreased 17 percent from 2,300 tons to 1,900. Total stocks of purchased scrap on hand at all plants advanced from 6,200 tons to 6,400, a net gain of 3 percent. In addition, stocks of plant scrap at manufacturing and foundry plants increased from 2,800 tons at the beginning of the year to 3,000 at the end of the year, a 7-percent rise.

Dealers' buying prices for scrap cast aluminum in New York averaged 7.47 cents a pound in 1939 compared with 7.58 cents in 1938. Average monthly quotations in 1939 ranged from 6.87 cents for May, June, and July to 9.50 cents for November and December.

The average price of new aluminum clippings in New York was 13.90 cents a pound in 1939 compared with 13.18 cents in 1938. Prices had a spread of 2.38 cents a pound in 1939, ranging from 13.12 cents in January to 15.50 cents in December.

SECONDARY ANTIMONY

A total of 9,810 short tons of secondary antimony valued at $2,425,000 was recovered in 1939. The value in 1939 was computed at 12.36 cents a pound, the average price for ordinary brands of American-grade antimony.

Antimony recovered in lead-base alloys (in oxide and as metal) totaled 9,520 tons in 1939 and that recovered in tin-base alloys 290 tons.

Secondary antimony recovered in the United States in 1939, in short tons

	1939
In lead-base alloys [1]	9,520
In tin-base alloys	290
	9,810
From new scrap	150
From old scrap	9,660

[1] Includes antimony recovered as metal and in oxide and other compounds; 923 tons of antimony were recovered in antimonial lead produced at primary lead refineries.

Remelters, smelters, and refiners furnished 7,430 tons (76 percent) of the 9,810 tons of antimony recovered in 1939 and manufacturers and foundries 2,380 tons (24 percent). Of the 7,430 tons recovered by remelters, smelters, and refiners, 120 tons (1.6 percent) came from new scrap and 7,310 tons (98.4 percent) from old scrap. Of the 2,380 tons recovered by manufacturers and foundries, 30 tons (1.3 percent) were obtained from new scrap and 2,350 tons (98.7 percent) from old scrap. Thus, it may be seen that by far the greater part of the secondary antimony was recovered from old scrap metals. Only 150 tons (1.5 percent) of the 9,810 tons came from new scrap, whereas 9,660 tons (98.5 percent) came from old scrap.

Discarded lead storage batteries, the principal source of secondary antimony, were the source of 58 percent of the antimony recovered in 1939. Other scrap lead alloys, including hard or antimonial lead, common babbitt, type metals, and drosses, supplied 39 percent and scrap tin alloys 3 percent.

As all the recovered antimony comes from lead- and tin-base alloys, stocks of scrap containing antimony are shown under the headings "Secondary lead" and "Secondary tin."

SECONDARY COPPER AND BRASS

Copper recovered from scrap metals, including that in alloys, totaled 499,700 short tons valued at $103,937,600 in 1939. The value in 1939 was computed at 10.4 cents a pound, the average price of all merchantable grades of new metal.

A total of 151,370 tons of copper was recovered in 1939 as essentially pure metal, of which the larger part was refined electrolytically. Alloys other than brass yielded 182,730 tons and brass alloys 162,400 tons. In addition to the copper recovered as metal and in alloys, 3,200 tons of copper were recovered from scrap metals in the form of chemicals.

Secondary copper recovered in the United States in 1939, in short tons

	1939		1939
As metal:		Brass scrap remelted (gross weight):	
At primary plants	116,613	New scrap	[1] 170,900
At other plants	34,757	Old scrap	80,200
	151,370		251,100
In brass	[1] 162,400	In brass scrap:	
In alloys other than brass	[1] 182,730	New scrap	[1] 111,600
In chemicals	3,200	Old scrap	50,800
	499,700		162,400
In new scrap (not including brass)	[1] 101,200	Total secondary copper (including copper in brass scrap):	
In old scrap (not including brass)	236,100	From new scrap	[1] 212,800
	337,300	From old scrap	286,900
			499,700

[1] Includes some plant scrap at brass mills.

Brass and copper scrap imported into and exported from the United States, 1938–39, in short tons

	1938	1939
Brass scrap imported	------	------
Scrap copper imported	(1)	132
Brass scrap exported	15,988	5,338
Scrap copper exported	21,811	17,643

[1] 190 pounds, gross weight.

Of the 499,700 tons of copper recovered in 1939, remelters, smelters, and refiners accounted for 237,700 tons (48 percent), and manufacturers and foundries 262,000 tons (52 percent). The 237,700 tons recovered by remelters, smelters, and refiners included 43,000 tons (18 percent) derived from new scrap and 194,700 tons (82 percent) from old scrap. The 262,000 tons reported by manufacturers and foundries included 169,800 tons (65 percent) obtained from new scrap and 92,200 tons (35 percent) from old scrap. Thus, the 499,700 tons of copper included 212,800 tons (43 percent) recovered from new scrap and 286,900 tons (57 percent) from old scrap.

Various items of brass scrap were the principal source of the copper reclaimed from scrap in 1939, although the amounts recovered from items of scrap copper and composition and bronze alloys also comprised a large part of the total. The copper recovered in brass scrap and alloys other than brass, reported by certain brass mills that were unable to report purchased and plant scrap separately, is included in new scrap. The quantity of copper in new scrap is therefore somewhat higher by an indeterminable amount than that actually recovered. Of the total copper recovered, 43 percent came from brass-scrap items, consisting mainly of light and heavy yellow brass; 28 percent from items of copper scrap, including No. 1 wire, No. 2 wire, No. 1 heavy, and mixed heavy and light copper; 23 percent from composition and bronze alloys, including automobile radiators; and 6 percent from miscellaneous items. Of the copper recovered at plants of remelters, smelters, and refiners, 42 percent was obtained from items of copper scrap, 29 percent from brass, 24 percent from composition and bronze (including automobile radiators), and 5 percent from miscellaneous items. Of the copper recovered at plants of manufacturers and foundries, 18 percent came from items of copper scrap, 53 percent from brass scrap, 22 percent from composition and bronze (including automobile radiators), and 7 percent from miscellaneous items.

Stocks of purchased copper scrap at remelting, smelting, and refining plants rose from 38,100 tons at the beginning of 1939 to 41,000 at the end of the year, a gain of 8 percent. Stocks of purchased copper scrap at manufacturing and foundry plants decreased 9 percent from 56,000 tons to 50,800. Total stocks of purchased scrap on hand at all plants declined from 94,100 tons to 91,800, a net loss of 2 percent. Stocks of plant scrap at manufacturing and foundry plants decreased 2 percent from 17,300 tons at the beginning of the year to 17,000 at the end of the year.

Dealers' buying prices for heavy copper scrap in New York averaged 7.80 cents a pound in 1939 compared with 6.81 cents in 1938. Average monthly prices in 1939 ranged from 6.86 cents a pound for May to 9.31 cents for November.

No. 1 composition averaged 7.04 cents a pound in 1939 compared with 6.36 cents in 1938. Prices in 1939 ranged from a low of 6.11 cents, the average for May, to a high of 8.25 cents in November.

SECONDARY GOLD AND SILVER

Mints and refineries reported the recovery of 895,096 fine ounces of gold and 24,972,260 fine ounces of silver from waste or discarded material in 1939 compared with 870,881 ounces of gold and 18,438,847 ounces of silver in 1938.

SECONDARY LEAD

Secondary lead recovered in 1939 totaled 241,500 short tons, or 50 percent of the total production of refined lead from domestic and foreign sources in the United States. The value of lead recovered as metal and in alloys was $22,701,000 in 1939, computed at 4.7 cents a pound.

Lead recovered as metal from secondary sources in 1939 amounted to 86,900 short tons. Antimonial lead accounted for 113,050 tons, other lead alloys 22,100 tons, alloys other than lead alloys (principally copper alloys) 13,650 tons, and chemical products 5,800 tons.

Secondary lead recovered in the United States in 1939, in short tons

	1939
As metal:	
At primary plants	29,011
At other plants	57,889
	86,900
In antimonial lead	[1] 113,050
In other lead alloys	22,100
In alloys other than lead alloys	13,650
In chemical products	5,800
	241,500
From new scrap	30,700
From old scrap	210,800

[1] Includes 12,658 tons of lead recovered from secondary sources at primary plants.

By far the greater part of the lead reclaimed in 1939 was recovered by remelters, smelters, and refiners, who accounted for 206,900 tons (86 percent); scrap lead and lead in alloys recovered by manufacturers and foundries totaled 34,600 tons (14 percent). Of the 206,900 tons recovered by remelting, smelting, and refining processes 24,800 tons (12 percent) came from new scrap and 182,100 tons (88 percent) from old scrap. Of the 34,600 tons recovered at plants of manufacturers and foundries, 5,900 tons (17 percent) was obtained from new scrap and 28,700 tons (83 percent) from old scrap. Thus, the 241,500 tons of secondary lead comprised 30,700 tons (13 percent) from new scrap and 210,800 tons (87 percent) from old scrap.

Worn-out automobile batteries, the principal source of secondary lead, supplied 51 percent of the total lead recovered in 1939. Recoveries of lead from other secondary sources were as follows: 13 percent from soft lead, 9 percent from cable lead, 8 percent from drosses and residues, 6 percent from alloys other than lead, 4 percent from common babbitt, 3 percent each from solder, hard lead, and type metals.

Stocks of purchased lead scrap at remelting, smelting, and refining plants decreased 11 percent from 24,700 tons at the beginning of 1939 to 21,900 at the end of the year. Stocks of purchased lead scrap at manufacturing and foundry plants increased 7 percent from 6,100 tons to 6,500. Total stocks of purchased scrap on hand at all plants dropped 8 percent from 30,800 tons to 28,400. Plant scrap at manufacturing and foundry plants rose 10 percent from 2,000 tons at the beginning of the year to 2,200 at the end of the year.

Dealers' buying prices for heavy scrap lead in New York averaged 4.19 cents a pound in 1939 compared with 3.86 cents in 1938. Buying prices for battery plates ranged from 2 to 2.38 cents a pound during the first 7 months of 1939; in August prices advanced steadily and in September reached 2.75 to 3 cents, remaining at this level for the balance of the year. Battery-plate smelting charges were quoted at $16 to $17 per ton throughout the year.

SECONDARY NICKEL

The secondary nickel recovered in 1939 totaled 2,920 short tons valued at $2,044,000. The value was computed at 35 cents a pound, the spot delivery price of electrolytic nickel, including duty.

Nickel recovered as metal from secondary sources amounted to 45 tons in 1939. The quantity recovered in 1939 also included 2,180 tons of nickel in nickel-copper alloys, 330 tons in nickel-iron alloys, 315 tons in Monel metal, and 50 tons in stainless steel.

Secondary nickel recovered in the United States in 1939, in short tons [1]

	1939
As metal	45
In Monel metal	315
In copper alloys	2,180
In stainless steel	50
In iron alloys	330
	2,920
From new scrap	1,910
From old scrap	1,010

[1] Exclusive of nickel recovered from secondary copper treated at electrolytic refineries.

Of the 2,920 tons of nickel recovered in 1939, remelters, smelters, and refiners produced 525 tons (18 percent), and manufacturers and foundries 2,395 tons (82 percent). The 525 tons recovered by remelters, smelters, and refiners included only 25 tons (5 percent) derived from new scrap and 500 tons (95 percent) from old scrap. Of the 2,395 tons recovered by manufacturers and foundries, 1,885 tons (79 percent) came from new scrap, whereas only 510 tons (21 percent) came from old scrap. Thus, of the total 2,920 tons of secondary nickel recovered, 1,910 tons (65 percent) was derived from new scrap and 1,010 tons (35 percent) from old scrap.

Nickel-silver scrap is by far the largest source of secondary nickel, having contributed 60 percent of the nickel recovered in 1939. Nickel was recovered from other secondary sources as follows: 15 percent from clippings, nickel anodes, hangers, baskets, etc., 12 percent from iron alloys, 11 percent from Monel metal, and 2 percent from stainless steel.

Stocks of purchased nickel scrap at remelting, smelting, and refining plants decreased 38 percent from 470 tons at the beginning of 1939 to 290 at the end of the year. Stocks of purchased nickel scrap at plants of manufacturers and foundries dropped 28 percent from 920 tons to 660. Total stocks of purchased scrap on hand at all plants declined from 1,390 tons to 950, a net loss of 32 percent. Stocks of plant scrap in the hands of manufacturers and foundries increased 7 percent from 1,390 tons at the beginning of the year to 1,490 at the end of the year.

Dealers' buying prices (nominal) in New York for new nickel clippings stood at 27 cents a pound throughout the first 11 months of 1939 but advanced to 31 to 31.5 cents in December. The quotation for Monel clippings (14.5 to 15 cents a pound early in January) dropped to 12 to 13 cents before the end of that month and did not change until August, when it increased slightly to 13 cents; this level was held until early in December, when prices advanced to 15 to 15.5 cents for the remaining weeks of the year.

SECONDARY TIN

Secondary tin recovered in 1939 totaled 29,160 short tons valued at $29,276,600. The value was computed at 50.20 cents a pound, the average price of Straits tin in New York for the year.

Metallic tin recovered from secondary sources amounted to 4,460 short tons in 1939. The greater portion of the metallic tin recovered in 1939 (4,089 tons) came from tin-plate scrap, whereas other sources contributed only small amounts (371 tons). Tin recovered in alloys and chemical compounds accounted for 24,700 tons in 1939. The quantity recovered in 1939 also included 12,420 tons of tin in copper alloys, 6,925 tons in lead alloys, 4,675 tons in tin alloys, and 680 tons in chemical compounds.

Secondary tin recovered in the United States in 1939, in short tons

	1939
As metal:	
At detinning plants	4,089
At other plants	371
	4,460
In copper alloys	12,420
In lead alloys	6,925
In tin alloys	4,675
In chemical compounds	680
	29,160
From new scrap	12,300
From old scrap	16,860

Remelters, smelters, and refiners produced 13,410 tons (46 percent) and manufacturers and foundries (including detinning plants) 15,750 tons (54 percent) of the 29,160 tons of tin recovered in 1939. The 13,410 tons recovered by remelters, smelters, and refiners included 4,910 tons (37 percent) derived from new scrap and 8,500 tons (63 percent) from old scrap. Of the 15,750 tons recovered by manufacturers and foundries, 7,390 tons (47 percent) were obtained from new scrap and 8,360 tons (53 percent) from old scrap. Thus, the 29,160 tons of tin recovered included 12,300 tons (42 percent) derived from new scrap and 16,860 tons (58 percent) from old scrap.

The largest recovery of tin in 1939 was made in scrap-copper alloys, the source of 43 percent of the total. Other sources contributed the following recoveries: 16 percent from new tin-plate clippings (including 0.3 percent from old containers), 16 percent from solder, 9 percent from tin scruff and drosses, 5 percent from common babbitt, 3 percent from No. 1 babbitt, 2 percent each from block-tin pipe, genuine babbitt and No. 1 pewter, type metals, and miscellaneous items.

Stocks of purchased tin-base scrap at remelting, smelting, and refining plants rose from 375 tons at the beginning of 1939 to 550 tons at the end of the year, a 47-percent increase. Stocks of purchased tin-base scrap at manufacturing and foundry plants (not including detinning plants) increased 150 percent from 50 tons to 125. Total stocks of purchased tin-base scrap on hand at all plants advanced 59 percent from 425 tons to 675. Stocks of plant scrap in the hands of manufacturers and foundries declined 24 percent from 340 tons at the beginning of the year to 260 at the end of the year.

Dealers' buying prices for block-tin pipe in New York in 1939 remained at 35 to 36 cents a pound until late in April, when they rose to 41 to 42 cents. In August prices eased to 39 to 40 cents but advanced sharply following the outbreak of war in Europe on September 1. Prices became nominal, but by the last week of September were holding at 44 to 45 cents and remained at this level until the middle of December, when quotations dropped to 42 to 43 cents for the remainder of the year.

The price of automobile babbitt in 1939 followed the pattern of changes in the price of block-tin pipe. For the first 3 months quotations were 21 to 22 cents a pound, rising to 24 to 25 cents the latter part of April. In September prices became nominal, and quotations were not resumed until early in December, when they were 27 to 28 cents.

Detinning plants.—The quantity of new tin-plate clippings treated at detinning plants established a record of 248,676 long tons in 1939, exceeding the 209,474 tons treated in 1938 by 39,202 tons (19 percent). Old tin-coated containers treated in 1939 totaled 6,429 long tons compared with 3,059 tons in 1938. Tin recovered as metal and in chemical products, 4,769 short tons, also established a new high, exceeding the 3,923 tons recovered in 1938 by 846 tons (22 percent). Tin reclaimed was equivalent to 37.70 pounds per long ton of new tin-plate clippings treated in 1939 compared with 37.05 pounds in 1938.

Secondary tin recovered at detinning plants in the United States, 1938–39

	1938	1939
Scrap treated:		
Clean tin plate .... long tons	209,474	248,676
Old tin-coated containers .... do	3,059	6,429
	212,533	255,105
Tin recovered as metal:		
New tin-plate clippings .... short tons	2,492	4,007
Old tin-coated containers .... do	42	82
Tin content of tin tetrachloride, tin bichloride, tin crystals, tin oxide, and sodium stannate produced .... short tons	1,389	680
	3,923	4,769
Weight of tin tetrachloride, tin bichloride, tin crystals, tin oxide, and sodium stannate produced .... short tons	2,757	1,195
Average quantity of tin recovered per long ton of clean tin-plate scrap used .... pounds	37.05	37.70
Average delivered cost of clean tin-plate scrap .... per long ton	$11.42	$15.06

For the past few years, almost wholly because of the disappearing demand for tin tetrachloride in the silk industry, the quantity of pig tin produced from tin-plate clippings has increased while that recovered in chemicals has decreased. The ratio of tin reclaimed as pig tin to that reclaimed in chemical products increased sharply in 1939. This ratio, which stood at 0.5:1 in 1935, had increased to 1.8:1 by 1938 and reached 5.9:1 in 1939.

The average cost of new tin-plate clippings delivered at detinning plants, which follows roughly the changes in price of No. 1 heavy-melting steel, advanced to $15.06 per long ton in 1939, a gain of 32 percent over the average of $11.42 in 1938.

Imports of tin-plate scrap into the United States, largely from Canada, totaled 12,633 long tons valued at $126,518 in 1939 compared with 10,444 tons valued at $81,685 in 1938.

Exports of tin-plate scrap, waste—waste, circles, strips, cobbles, etc., from the United States amounted to 25,888 long tons valued at $1,121,153 in 1939 compared with 24,216 tons valued at $902,607 in 1938. Exports of tin-plate scrap or that portion which is subject to export licensing (Public, No. 448, 74th Cong.) amounted to 10,204 long tons valued at $186,393 in 1939 compared with 12,495 tons valued at $227,874 in 1938.

Export allotments of tin-plate scrap.—Export allotments totaling 13,636 long tons of tin-plate scrap, subject to license, were assigned during the calendar year 1939. The Department of State issued 172 licenses in 1939 authorizing the exportation of 10,699 tons of tin-plate scrap valued at $200,497.52. All licenses issued in 1939 named Japan as the country of destination.

The rules of procedure governing issuance of licenses during 1940 were released by the Department of State on December 5, 1939. The allotments in 1940 will be based upon the individual producer's request therefor, with the provision that no allotment of more than 25 long tons shall exceed 20 percent of the producer's output of tin-plate scrap during the calendar year 1938. No allotment to any producer shall exceed 2,000 tons. Export quotas for 1939 were based upon 20 percent of the 1937 production.

SECONDARY ZINC

Zinc recovered from secondary sources totaled 189,640 short tons valued at $19,722,600 in 1939. The value was computed at 5.2 cents a pound, the average selling price of all grades.

Zinc recovered as metal in 1939 from distillation and remelting of purchased secondary materials totaled 35,970 short tons; moreover 98,879 tons of zinc were recovered in copper alloys, 16,429 tons in zinc oxide, 1,674 tons in zinc sulfate, 6,686 tons in zinc chloride, 16,293 tons in zinc dust, and 13,709 tons in lithopone.

Secondary zinc recovered in the United States in 1939, in short tons

	1939
As metal:	
By distillation	[1] 33,135
By remelting	2,835
	35,970
In copper alloys	[2] 98,879
In chemical products:	
Zinc oxide	16,429
Zinc sulfate	1,674
Zinc chloride	6,686
Zinc dust	16,293
Lithopone	13,709
	189,640
From new scrap	144,540
From old scrap	45,100

[1] In addition, 17,293 tons of zinc were recovered by redistillation of plant scrap. Total output of redistilled secondary zinc was 50,428 tons.
[2] Includes some plant scrap at brass mills.

Of the 189,640 tons of zinc recovered in 1939, remelters, smelters, and refiners supplied 91,800 tons (48 percent) and manufacturers and foundries 97,840 tons (52 percent). The 91,800 tons recovered by remelters, smelters, and refiners included 58,500 tons (64 percent) derived from new scrap and 33,300 tons (36 percent) from old scrap. The 97,840 tons reported by manufacturers and foundries included 86,040 tons (88 percent) obtained from new scrap and 11,800 tons (12 percent) from old scrap. Thus, the 189,600 tons of zinc recovered included 144,540 tons (76 percent) derived from new scrap and 45,100 tons (24 percent) from old scrap.

The principal source of zinc recovered in 1939, secondary copper alloys contributed 45 percent of the total, and zinc drosses and skimmings 42 percent. Recoveries from other secondary sources were as follows: 5 percent from die castings, 2 percent from clippings and sheet, 2 percent from flue dusts, and 4 percent from miscellaneous sources.

Stocks of purchased zinc scrap on hand at remelting, smelting, and refining plants decreased 12 percent from 18,200 tons at the beginning of 1939 to 16,100 at the end of the year. Stocks of purchased zinc scrap on hand at manufacturing and foundry plants increased 20 percent from 540 tons to 650. Total stocks of purchased scrap on hand at all plants declined 11 percent from 18,740 tons to 16,750. Stocks of plant scrap at manufacturing and foundry plants advanced from 600 tons at the beginning of the year to 765 at the end of the year, a rise of 28 percent.

Dealers' buying prices for new zinc clippings in New York in 1939 remained at 2.75 to 3 cents a pound until late in April, when they rose to 3 to 3.25 cents. This level was held until the first week of September when quotations increased sharply to 4.5 cents, and by the end of September they stood at 4.875 to 5 cents. The first week in December prices dropped to 4.50 to 4.75 cents and again the middle of December to 4.375 to 4.50 cents, closing the year at this level.

Old-zinc quotations ranged from 2.25 to 2.50 cents a pound during the first 8 months of 1939 but increased to 3.25 cents in the first week of September; this level was held until the first week of December, when prices weakened slightly to 3.125 to 3.25 cents.

CLASSIFICATION OF OLD METALS

The standard classification of old metals (Circ. M), effective since March 16, 1932, was revised by the Secondary Metal Institute, a division of the National Association of Waste Material Dealers, Inc., at the association's convention in March 1940. The revised classifications (Circ. O) provided that changes become effective June 1, 1940.

The revisions apply principally to various items of secondary aluminum. The item of "scrap-aluminum castings" (Circ. M, item 33) is now divided into five separate groups, four of which cover automotive castings. Other changes include substitution of "scrap sheet and sheet utensil aluminum" (Circ. O, item 31), for "painted sheet aluminum" and "old scrap sheet aluminum" (Circ. M, items 31 and 32), and substitution of "aluminum borings and turnings" for "aluminum borings" (Circs. O and M, item 34).

Complete specifications for various grades of nickel scrap have been added to the classification.

The revised classification, as shown in Circular O, follows:

STANDARD CLASSIFICATION FOR OLD METALS, EFFECTIVE FROM JUNE 1, 1940

1. *Delivery.*—(*a*) Delivery of more or less on the specified quantity up to 1¼ percent is permissible.

(*b*) If the term "about" is used, it is understood that 5 percent more or less of the quantity may be delivered.

(*c*) Should the seller fail to make deliveries as specified in the contract the purchaser has the option of canceling all of the uncompleted deliveries or holding the seller for whatever damages the purchaser may sustain through failure to deliver and if unable to agree on the amount of damages, an Arbitration Committee of the National Association of Waste Material Dealers, Inc., appointed for this purpose, to determine the amount of such damages.

(*d*) In the event that buyer should claim the goods, delivered on a contract are not up to the proper standard and the seller claims that they are a proper delivery, the dispute shall be referred to an Arbitration Committee of the National Association of Waste Material Dealers, Inc., to be appointed for that purpose.

(*e*) A carload, unless otherwise designated, shall consist of the weight governing the minimum carload weight at the lowest carload rate of freight in the territory in which the seller is located. If destination of material requires a greater carload minimum weight, buyer must so specify.

(*f*) A ton shall be understood to be 2,000 pounds unless otherwise specified. On material purchased for direct foreign shipment a ton shall be understood to be a gross ton of 2,240 pounds unless otherwise specified.

(*g*) If, through embargo, a delivery cannot be made at the time specified, the contract shall remain valid, and shall be completed immediately on the lifting of the embargo, and terms of said contract shall not be changed.

(*g*–1) When shipments for export for which space has been engaged have been delivered or tendered to a steamship for forwarding and through inadequacy of cargo space the steamship cannot accept the shipment, or where steamer is delayed in sailing beyond its scheduled time, shipment on the next steamer from the port of shipment shall be deemed a compliance with the contract as to time of shipment.

(*h*) In case of a difference in weight and the seller is not willing to accept buyer's weights, a sworn public weigher shall be employed and the party most in error must pay the costs of handling and reweighing.

(*i*) When material is such that it can be sorted by hand, consignees cannot reject the entire shipment if the percentage of rejection does not exceed 10 percent. The disposition of the rejected material should then be arranged by negotiations; no replacement of the rejected material to be made.

Upon request of the shipper, rejections shall be returnable to the seller on domestic shipments within 1 week and on foreign shipments within 30 days from the time notice of rejection is received by them, and upon payment by them of 1 cent a pound on material rejected to cover cost of sorting and packing; the seller to be responsible for freight both ways.

2. *No. 1 copper wire.*—To consist of clean untinned copper wire not smaller than No. 16 B. & S. wire gage. To be free from burnt copper wire which is brittle and all foreign substances.

3. *No. 2 copper wire.*—To consist of miscellaneous clean copper wire which may contain a percentage of tinned wire and soldered ends but to be free of hair wire and burnt wire which is brittle; the tinned wire not to be over 15 percent of the total weight.

4. *No. 1 heavy copper.*—This shall consist of untinned copper not less than one-sixteenth inch thick, and may include trolley wire, heavy field wire, heavy armature wire, that is not tangled, and also new untinned and clean copper clippings and punchings, and copper segments that are clean.

5. *Mixed heavy copper.*—May consist of tinned and untinned copper, consisting of copper clippings, clean copper pipe and tubing, copper wire free of hair wire, and burnt and brittle wire, free from nickel-plated material.

6. *Light copper.*—May consist of the bottoms of kettles and boilers, bathtub linings, hair wire, burnt copper wire which is brittle, roofing copper and similar copper, free from radiators, brass, lead and solder connections, readily removable iron, old electrotype shells and free of excessive paint, tar, and scale.

7. *Composition or red brass.*—May consist of red scrap brass, valves, machinery bearings and other parts of machinery, including miscellaneous castings made of copper, tin, zinc, and/or lead, no piece to measure more than 12 inches over any one part or to weigh over 60 pounds, to be free of railroad boxes, and other similarly excessively leaded material, cocks and faucets, gates, pot pieces, ingots and burned brass, aluminum composition, manganese, and iron.

8. *Railroad bearing.*—Shall consist of railroad boxes or car journal bearings; must be old standard used scrap, free of yellow boxes, also iron-backed boxes, and must be free of babbitt, also free of excessive grease and dirt.

9. *Cocks and faucets.*—To be mixed clean red and yellow brass, free of gas cocks and beer faucets, and to contain a minimum of 35 percent red.

10. *Heavy yellow brass.*—May consist of heavy brass castings, rolled brass, rod brass ends, chandelier brass, tubing, not to contain over 15 percent of tinned and/or nickle-plated material; no piece to measure more than 12 inches over any one part and must be in pieces not too large for crucibles. Must be free of manganese mixture, condenser tubes, iron, dirt, and excessive corroded tubing. Must be free of aluminum brass containing over 0.20 percent aluminum.

11. *Yellow brass castings.*—Shall consist of brass castings in crucible shape, that is, no piece to measure more than 12 inches over any one part; must be free of manganese mixtures, tinned and nickel-plated material, and must be free of visible aluminum brass.

12. *Light brass.*—May consist of miscellaneous brass, tinned or nickel-plated, that is too light for heavy brass; to be free of gun shells containing paper, ashes or iron, loaded lamp bases, clockworks, and automobile gaskets. Free of visible iron unless otherwise specified.

13. *Old rolled brass.*—May consist exclusively of old pieces of sheet brass and pipe free from solder, tinned and nickel-plated material, iron, paint and corrosion, ship sheathing, rod brass, condenser tubes, and Muntz metal material.

14. *New brass clippings.*—Shall consist of the cuttings of new sheet brass to be absolutely clean and free from any foreign substances and not to contain more than 10 percent of clean brass punchings to be not smaller than one-quarter inch in diameter.

15. *Brass pipe.*—Shall consist of brass pipe, free of nickel-plated, tinned, soldered, or pipes with cast-brass connections. To be sound, clean pipes free of sediment and condenser tubes.

16. *No. 1 Red composition turnings.*—To be free of railroad-car box turnings and similarly excessively leaded material, aluminum, manganese, and yellow brass turnings; not to contain over 2 percent free iron; to be free of grindings and foreign material especially babbitt. Turnings not according to this specification, to be sold subject to sample.

17. *No. 1 Yellow rod brass turnings.*—Shall consist of strictly rod turnings, free of aluminum, manganese, composition, Tobin, and Muntz metal turnings; not to contain over 3 percent free iron, oil, or other moisture; to be free of grindings and babbitts; to contain not more than 0.30 percent tin and not more than 0.15 percent combined iron.

18. *No. 1 Yellow brass turnings.*—Shall consist of yellow brass turnings, free of aluminum, manganese and composition turnings; not to contain over 3 percent of free iron, oil, or other moisture; to be free of grindings and babbitts. To avoid dispute, to be sold subject to sample.

19. *Auto radiators (unsweated).*—All radiators to be subject to deduction of actual iron. The tonnage specification should cover the gross weight of the radiators, unless otherwise specified.

20. *No. 1 pewter.*—Shall consist of tableware and soda fountain boxes, but in any case must test 84 percent tin. Siphon tops to be treated for separately.

21. *Zinc.*—Must consist of clean sheet and cast zinc, also cast batteries to be free of loose oxide and dross, sal ammoniac cans, and other foreign materials.

22. *Zinc dross.*—Must be unsweated in slabs and must contain a minimum of 92 percent of zinc.

23. *Tin foil.*—Shall consist of pure foil free of lead compositions and other foreign ingredients and matters.

24. *Electrotype shells.*—Must be hand-picked and free of loose dross and chunks of dross.

25. *Scrap lead.*—Should be clean, soft scrap lead.

26. *Battery lead plates.*—(*a*) Shall consist of dry battery lead plates, moisture not to exceed 1 percent, allowance to be made for wood, rubber, and paper and excess moisture, or

(*b*) Lead plus antimony content, dry basis, less a treatment charge.

Note: Contracts covering this item should specify which method is to be used as a basis of settlement.

27. *New pure aluminum clippings.*—Shall consist of new, clean, unalloyed sheet clippings and/or aluminum sheet cuttings. Must be free from oil, grease, and any other foreign substance. Also to be free from punchings less than one-half inch square.

28. *New pure aluminum wire and cable.*—Shall consist of new, clean, dry, unalloyed aluminum wire or cable, free from iron, insulation, and any other foreign substance.

29. *Old pure aluminum wire and cable.*—Shall consist of old, unalloyed aluminum wire or cable containing not over 1 percent free oxide or dirt and free from iron, insulation, and any other foreign substance.

30. *Alloy sheet aluminum.*—To be sold on specification and sample.

31. *Scrap sheet and sheet utensil aluminum.*—Shall consist of clean, old, unalloyed sheet and utensils and unalloyed manufactured sheet aluminum, free from alloy, iron, dirt, or any other foreign substance and to be free of hub caps, radiator shells, airplane sheet, foil, and bottle caps.

32. *Aluminum crank cases.*—Shall consist of automobile and/or airplane crank cases, transmission cases and oil pans, free of iron, brass, babbitt bushings, brass bushings, and any other foreign materials. Oil and grease shall not exceed 2 percent.

33. *Aluminum cylinder heads.*—Shall consist of all types of aluminum automobile cylinder heads, free of iron, brass, and any other foreign materials. Oil and grease shall not exceed 2 percent.

34. *Aluminum borings and turnings.*—To avoid dispute, should be sold subject to sample.

35. *Aluminum foil.*—Shall consist of pure aluminum foil, free from paper and any foreign ingredients.

36. *Aluminum die castings.*—Shall consist of auto steering wheels, brake shoes, and all castings made by the die-casting or pressure-casting process, free of iron, brass, and any other foreign materials. Oil and grease shall not exceed 2 percent.

37. *Aluminum pistons.*—(*a*) Clean aluminum pistons—shall be free from struts, bushings, shafts, iron rings, and any other foreign materials. Oil and grease shall not exceed 2 percent.

(*b*) Aluminum pistons with struts—shall consist of clean, whole aluminum pistons with struts, free from bushings, shafts, iron rings, and any other foreign materials. Oil and grease shall not exceed 2 percent.

38. *Aluminum industrial castings.*—Shall consist of all other aluminum castings except cylinder heads, die-cast aluminum, pattern metal, and hat blocks, and free of iron, babbitt, brass, and all other foreign materials. Castings shall not have over 4 percent zinc content. Oil and grease shall not exceed 2 percent.

39. *Mixed common babbitt.*—Shall consist of lead-base bearing metal containing not less than 8 percent tin, free from Allens metal, ornamental, antimonial, and type metal.

40. *High tin-base babbitt.*—To have a minimum of 78 percent tin.

41. *Block tin.*—Shall consist of tin pipe and soda-tank lining, free from solder and brass connections, pewter, pump strips, and pot pieces.

DOMESTIC CLASSIFICATION OF NICKEL—NICKEL ALLOYS AND NICKEL BEARING MATERIALS

42. *Nickel clippings.*—Shall consist of new nickel clips—plate and skeleton material. Minimum nickel contents 98½ percent, maximum copper contents 0.50 percent.

43. *New nickel.*—Shall consist of forgings, flashings, punchings, new pipe, tubes, new bright wire, or screen, bar, rod, angles, or other structural rolled stock. Each grade to be packed and sold separately. Minimum nickel contents 98½ percent, maximum copper contents 0.50 percent.

44. *Carbonized nickel.*—Packed and sold separately. Minimum nickel contents 95 percent, maximum copper contents 0.50 percent.

45. *Old nickel scrap.*—Shall be of 98–99 percent purity, maximum 0.50 percent copper. All rolled stock should come under this classification such as sheet, pipe, tubes, bars, rods. Same to be free of soldered, brazed, or welded alloyed material. It shall also be free of trimmed seams that have been sweated. Soldered, brazed, welded, and sweated material shall be packed and sold separately. All painted materials shall be packed and sold separately.

46. *Old nickel wire-screen cloth.*—To be packed and sold separately. Samples should be submitted for quotations.

47. *Nickel castings.*—To be packed and sold separately and sold on analysis or sample.

48. *Manganese nickel.*—To be sold separately and/or by sample.

49. *Cupro nickel.*—Describe the physical characteristics and send representative samples for quotations.

50. *Nickel turnings.*—To be sold separately by analysis or according to sample. When submitting a sample of turnings containing oil, same shall be submitted in oilproof containers.

51. *Nickel anodes.*—Cast and rolled, each to be hard anodes free of soft, carbonized, and crusty material. Hooks to be cut off as close as possible to the anode. Substitutions not permitted.

52. *Clean nickel peelings and strippings.*—Sold on sample or analysis.

53. *Copper-nickel peelings or strippings.*—Sold on sample submitted or analysis.

54. *Nickel baskets.*—Hooks, racks, and hangers. Since this material varies to a great extent in alloys and deposits of various metals, representative samples should be submitted for quotation.

55. *New Monel metal clips.*—Should consist of new Monel clippings, skeleton, plate, of the standard grade of Monel. Alloyed Monel to be packed and sold separately. No used or cut old bright sheet Monel will be acceptable. Monel punchings to be sold separately.

56. *Clean old Monel sheet.*—Shall be of the standard grade of Monel, free of alloyed Monel. No sweated material of any kind acceptable. Free of welded, brazed, or soldered material, other metals, and alloy attachments.

57. *Soldered Monel sheet.*—To be the whole or part of a sheet. Free of trimmed seams or sweated trimmed seams. May include Monel welded sheet where a good portion of the piece is attached to the weld.

58. *Soldered Monel wire, screen, and cloth.*—To be sold separately. Must be free of filled filter cloth and asbestos-containing material.

59. *Clean Monel wire, screen, and cloth.*—Must be free of solder. Sweated material packed and sold separately.

60. *Monel turnings.*—Should contain a minimum of 60 percent nickel. To be free of other metals. Should the material contain oil, sample should be submitted in oilproof containers for a quotation.

61. *Monel castings.*—To be guaranteed minimum 60 percent nickel. All other alloys of Monel castings are to be packed and sold separately.

62. *Nickel-silver clips.*—Sold on nickel content specifications such as 10 percent, 12 percent, 15 percent, 18 percent, 20 percent. Leaded nickel-silver clips should be packed and sold separately. A description as to its physical characteristics should be made in offering all nickel-silver material. It should also be free of chrome-plated material and any other metal or alloy content material.

63. *Old nickel-silver.*—Shall consist of old nickel-silver sheet, pipe, rod, tubes, wire, screen, soldered or unsoldered. Must not be trimmed seams alone, and it is also to be free of foreign substances, iron-rimmed material, or other metals.

64. *Nickel-silver castings.*—To be packed and sold separately.

65. *Nickel-silver turnings.*—To avoid misunderstanding, to be sold by sample or analysis. Samples should be submitted in oilproof containers when the sample contains oil.

66. *Ferronickel chrome iron.*—Ferronickel chrome-iron materials whether castings, forgings, pipe, rod, tubes, wire screen, ribbon or in any other form, should be sold on analysis basis. Physical description should accompany each inquiry. Approximate weight of pieces should accompany the inquiry. Copper content up to one-half percent to be acceptable.

67. *Ferronickel iron alloy.*—Shall consist of alloys containing nickel and iron only. Physical description should accompany each inquiry and, in the case of larger pieces, approximate weight should be mentioned. Copper content in the alloy up to one-half percent to be acceptable. Material containing chrome should always be packed separately.

68. *New stainless steel.*—18–8 type graded as new clippings, 0.10 and under in carbon.

69. *Stainless steel.*—18–8 type. Shall consist of new and old sheet, pipe, rod, tubes, forgings, and flashings. Sold with no carbon guarantee, but to be free of all other metals and alloys.

70. *Stainless-steel castings.*—Submit analysis, size of pieces, and physical description.

71. *Stainless-steel turnings.*—Submit sample.

72. *Edison A and Edison B batteries.*—To be sold by type and to be free of crates and liquid.

73. *Packages.*—Shall be good strong packages suitable for shipment, and each package shall be plainly marked with separate shipping marks and numbers and with the gross and tare weights so that the packages may reach their destination and their weights can be easily checked.

IRON AND STEEL SCRAP[1]

By James S. Earle and Harold E. Carmony

SUMMARY OUTLINE

The iron and steel scrap industry in 1939 was characterized by sharp increases in consumption, exports, and prices and a slight rise in consumers' stocks of scrap. There was a sharp decrease in stocks of pig iron. Reflecting the 66-percent rise in steel ingot production in 1939, the use of ferrous scrap increased 52 percent over that in 1938 but was 15 percent below the tonnage consumed in 1937. During the first half of 1939 the rate of consumption was fairly stable and approximated the levels established in the last quarter of 1938, but with the outbreak of war in Europe demand improved as steel production soared to record proportions in the closing months of the year. The consumption of scrap probably reached an all-time peak in November 1939.

The proportion of purchased scrap used in open-hearth furnaces—the largest consumers of purchased scrap—has, in general, trended downward for a number of years. Again in 1939 the ratio of scrap to pig iron decreased and the proportions of both home and purchased scrap dropped slightly. The decline in the proportion of purchased scrap used in 1939 was accentuated by the quickened demand for steel and resulted in an increased amount of steel produced from duplexing operations following the outbreak of war in September. The sharp increase in steel production to record heights created an abnormal demand for scrap, and for a short period the price of scrap exceeded that of pig iron. During October and November many consumers were obliged to increase the amount of pig iron used because of the high cost of scrap. The higher prices offered for scrap developed an abundant supply, and the high levels were soon reduced; in consequence, the price structure and furnace proportions assumed a more normal aspect before the end of the year.

[1] Minerals Yearbook, 1939, p. 513, gives definitions of the various scrap terms used in this report.

The total consumption of ferrous scrap and pig iron in 1939 increased 60 percent over that in 1938. Of the 63,892,174 gross tons used, 51,681,886 tons were charged to steel-making furnaces and 12,210,288 to iron furnaces. In making the average ton of steel in 1939 less scrap and more pig iron were used than in 1938; the relative consumption of both home and purchased scrap declined in 1939 from 1938. In iron furnaces, moreover, the relative use of both home and purchased scrap decreased while that of pig iron increased.

Exports of ferrous scrap from the United States in 1939 increased 20 percent over 1938 and were second only to the record shipments of 1937, in both tonnage and value. Consignments to Japan comprised 56 percent of the total and exceeded those of any previous year, while those to the United Kingdom, Canada, and Poland were greater than in 1938. Shipments to Italy in 1939 were slightly lower than in 1938, while those to the Netherlands and Germany were reduced drastically early in the year and disappeared when the Allied blockade of Germany was established. Several bills and resolutions that would directly or indirectly impose restrictions on scrap exports from the United States were introduced during the first session of the Seventy-sixth Congress, but the session adjourned without passing any of the proposed legislation.

Immediately after the declarations of war in September the International Scrap Convention—a centralized buying agency for European consumers—suspended operations. Italy and certain Balkan countries continued to buy independently, but the United Kingdom and Germany withdrew from the domestic market. Coincident with the increased production of iron and steel and the abrupt rise in the price of scrap, agitation for legislation to restrict exports of iron and steel scrap from the United States was resumed in the last 4 months of 1939, and additional measures to accomplish this were introduced in the third session of the Seventy-sixth Congress, which opened in January 1940.

Prices for scrap fluctuated widely in 1939. The quotation for No. 1 Heavy-melting steel scrap at Pittsburgh, according to Iron Age, ranged from a low of $14.25 per gross ton the second week in May to a high of $24.25 the first week in October. The average for 1939 was $17.17 compared with $14.02 in 1938 and $18.86 in 1937. Scrap prices received little support in the first quarter of 1939 from either domestic or foreign markets; however, a strong foreign demand early in the second quarter stabilized prices at a time when domestic markets were depressed because of labor difficulties in the coal-mining industry. Following the settlement of the labor disputes prices trended upward in sympathy with the quickened rate of steel production. The price of basic pig iron remained stationary in 1939 until the last week of September, when the price at Valley furnaces increased 10 percent and held at the higher level for the remaining months of the year.

The unprecedented rise in steel production during the latter half of 1939 precipitated an abnormal and unexpected demand for scrap that dealers and brokers found difficult to meet. This occasioned considerable alarm as to the depleted condition of domestic stocks of iron and steel scrap. At the request of trade organizations representing both dealers and consumers of scrap the Bureau of Mines undertook to survey the stock situation as of September 30, 1939.[2] The results of the canvass of suppliers and consumers indicated inventories exceeding 7,111,701 gross tons, which was equivalent to a 10-week supply at the September rate of consumption. Some authorities interpreted this as representing an adequate supply. Another survey as of December 31, 1939,[3] revealed stocks exceeding 7,400,000 tons. Consumers' stocks of scrap increased from 4,596,094 tons at the beginning of 1939 to 4,741,159 at the close of the year.

Salient statistics of ferrous scrap and pig iron in the United States, 1938–39

	1938	1939	Percent of change in 1939
Stocks, Dec. 31:			
Ferrous scrap and pig iron at consumers' plants:	*Gross tons*	*Gross tons*	
Home scrap	1, 687, 609	1, 729, 228	+2
Purchased scrap	2, 908, 485	3, 11, 931	+4
Pig iron	4, 359, 484	3, 369, 136	−23
	8, 955, 578	8, 110, 295	−9
Ferrous scrap at suppliers' yards and in transit:			
Prepared scrap	(1)	1, 792, 312	(1)
Unprepared scrap	(1)	662, 421	(1)
Scrap in transit to yards or for export and at docks	(1)	105, 955	(1)
	(1)	2, 560, 688	(1)
Consumption:			
Ferrous scrap and pig iron charged to—			
Steel furnaces: [2]			
Home scrap	8, 521, 258	13, 650, 649	+60
Purchased scrap	7, 137, 455	10, 834, 885	+52
Pig iron	15, 691, 312	27, 196, 352	+73
	31, 350, 025	51, 681, 886	+65
Iron furnaces: [3]			
Home scrap	2, 800, 083	3. 868, 901	+38
Purchased scrap	2, 886, 138	4, 079, 972	+41
Pig iron	2, 813, 037	4, 261, 415	+51
	8, 499, 258	12, 210, 288	+44
All furnaces:			
Home scrap	11, 321, 341	17, 519, 550	+55
Purchased scrap	10, 023, 593	14, 914, 857	+49
Pig iron	18, 504, 349	31, 457, 767	+70
	39, 849, 283	63, 892, 174	+60
Ferrous scrap (total)	21, 344, 934	32, 434, 407	+52
Exports:			
Iron and steel	2, 974, 375	3, 558, 551	+20
Tin plate, waste—waste, circles, strips, cobbles, etc	24, 216	25, 888	+7
Average prices per gross ton:			
Scrap:			
No. 1 Heavy Melting, Pittsburgh [4]	$14. 02	$17. 17	+22
No. 1 Cast cupola [4]	15. 13	17. 21	+14
For export	15. 11	15. 40	+2
Pig iron, f. o. b. Valley furnaces: [4]			
Basic	21. 70	21. 09	−3
No. 2 Foundry	22. 20	21. 59	−3

[1] Data not available. [2] Includes open-hearth, bessemer, and electric furnaces.
[3] Includes cupola, air, Brackelsberg, puddling, crucible, and blast furnaces; also direct castings.
[4] Iron Age, vol. 145, Jan. 4, 1940.

[2] Bureau of Mines, Mineral Market Reports: M. M. S. 770, Dec. 4, 1939, 5 pp.; M. M. S. 797, Jan. 19, 1940, 6 pp.
[3] Bureau of Mines, Quarterly Iron and Steel Scrap Stock Reports: No. 3, April 18, 1940, 2 pp.; No. 4, May 21, 1940, 7 pp.

Figure 1 shows the consumption of purchased scrap and output of pig iron and steel ingots and castings from 1905 to 1939, inclusive.

PRICES [4]

The undertone of scrap prices in 1939 was generally firm, except for the period of coal-mine labor difficulties during the second quarter. Quotations for No. 1 Heavy-melting steel and No. 1 Cast cupola scrap, which had averaged $15.75 and $15.50 per gross ton (Pittsburgh), respectively, in December 1938, eased off, with No. 1 Heavy-melting steel dropping to $14.25 in the second week of May and No. 1 Cast cupola scrap dropping to $15.25, the low point of the year, in the second week of April. However, this weakness was short-lived, and there was a gradual uptrend in prices until September, when the advent of war in Europe disrupted the price structure. Quotations for scrap reached the high point of the year during the first week of October, when No. 1 Heavy-melting steel and No. 1 Cast cupola scrap reached $24.25 per ton. The increase in the average price of No. 1

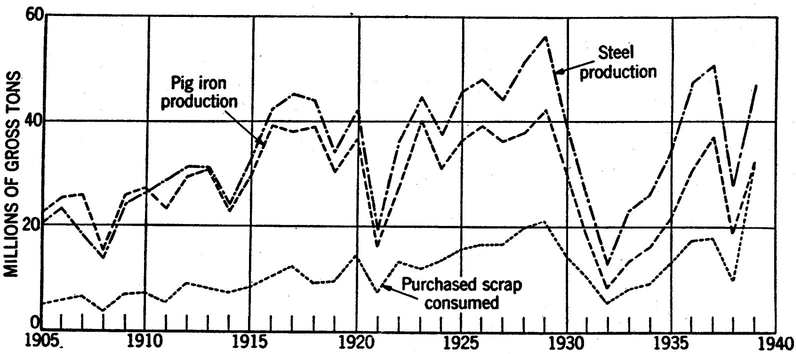

FIGURE 1.—Consumption of purchased scrap and output of pig iron and steel in the United States, 1905–39. Figures on consumption or purchased scrap for 1905–32 are from *State of Minnesota* vs. *Oliver Iron Mining Co. et al.*, Exhibits, vol. 5, 1935, p. 328; those for 1933–34 are estimates by authors; and those for 1935–39 are based upon Bureau of Mines reports. Figures on output of pig iron and steel are as given by the American Iron and Steel Institute.

Heavy-melting steel during the first month of the renewed Allied and German hostilities was the most rapid rise since June 1917. The average price in October of $23.05 for No. 1 Heavy-melting steel was exceeded in recent years only by that of $23.15 in March 1937; while the October average of $22.95 for No. 1 Cast cupola scrap was the highest on record since June 1923. In the closing weeks of 1939 prices gradually eased off to an average of $18.50 per ton for No. 1 Heavy-melting steel and $19.38 for No. 1 Cast cupola scrap. The high rate of ingot production in the last quarter of 1939 reduced suppliers' stocks but did not create an acute shortage of scrap as many expected. Higher prices widened the area from which supplies were drawn and stimulated collections of old scrap, while increased industrial activity produced greater amounts of home scrap.

In contrast to the rather wide fluctuations in scrap prices in 1939 the price of basic pig iron, established at $20.50 per gross ton at Valley furnaces late in September 1938, remained unchanged until

[4] Pittsburgh price quotations from The Iron Age.

the third week of September 1939, when it rose to $22.50 and held at this level during the rest of the year.

Export scrap prices in 1939, as indicated by the declared value of exports, averaged $15.40 a gross ton for the year and were only slightly above the 1938 average of $15.11. In the first 3 months of 1939 prices were supported by the fair volume of loading against old contracts, but in the second quarter they declined as a result of the general market weakness. The average value of exports in June—$14.11—represented the low monthly average for the year. Even lower averages probably would have prevailed had it not been for the steadying effect of new orders and increased loading for export at this time. Exports continued at an accelerated rate in the second half of the year and, together with increased domestic demand, caused a rise in the export price. After the outbreak of war in Europe the rapidly increased demand for scrap in the inland steel districts was the dominant factor in the domestic market and was reflected in the upward trend of export prices. Average export values advanced steadily through the latter part of 1939 and reached $19.45 a ton in December.

LEGISLATION

Several new bills [5] and resolutions [6] calling for the licensing or restricted embargoing of iron and steel scrap were introduced during the first session of the Seventy-sixth Congress. Moreover, Senator Schwellenbach's bill (S. 2025, 75th Cong.) to restrict foreign shipments of ferrous scrap was reintroduced (S. 651, 76th Cong.) without change. Some of the more recent proposals provide for the embargoing of pig iron as well as of iron and steel scrap. Resolutions by Senator Pittman (S. J. Res. 123, 76th Cong.) and Senator Schwellenbach (S. J. Res. 143, 76th Cong.) designed to prohibit exports of certain commodities, articles, and materials (including iron and steel scrap) to countries that are parties to the Nine-power Treaty and violate the rights of American citizens in China were of outstanding interest. Senator Pittman's resolution makes provision for the embargo to go into effect 30 days after proclamation by the President without any action by Congress, and Senator Schwellenbach's resolution would have such an embargo go into effect 60 days after proclamation by the President if not disapproved by concurrent resolution of Congress. Congress adjourned, however, without acting on any of the bills or resolutions, deferring further consideration to the 1940 session of the Seventy-sixth Congress.

STOCKS

Beginning in 1939 the regular annual canvass of consumers of iron and steel scrap and pig iron was expanded to include stocks of home scrap, purchased scrap, and pig iron on hand at the beginning and end of the year. In addition, to complete the data on total visible supplies of iron and steel scrap in the United States, a separate canvass

[5] H. R. 979. A bill to prohibit the exportation of pig iron, scrap iron, and scrap steel except under license from the Secretary of Commerce.
H. R. 3419. A bill to prohibit the exportation of pig iron, scrap iron, and scrap steel to China and Japan.
H. R. 7159. A bill to prohibit the exportation of articles in violation of existing treaties to which the United States is signatory.

[6] H. J. Res. 42. A joint resolution providing for an embargo on scrap iron and pig iron under Public Resolution No. 27 of the Seventy-fifth Congress.

of suppliers (including scrap-iron dealers, automobile wreckers, and selected lists of railroads and manufacturers) was begun on a quarterly basis in September 1939. The final results of the annual survey indicate that total consumers' and suppliers' stocks of iron and steel scrap totaled 7,301,847 gross tons on December 31, 1939, or 98,153 tons less than the 7,400,000 tons previously published as a result of the quarterly survey. Comparable figures for December 31, 1938, are not available as far as suppliers' stocks are concerned, inasmuch as the quarterly surveys did not begin until September 1939.

Consumers' stocks.—Consumers' stocks of home and purchased scrap were slightly greater at the end of 1939 than at the beginning of the year. Supplies of 1,729,228 gross tons of home scrap and 3,011,931 tons of purchased scrap on hand December 31, 1939, represented increases of 2 and 4 percent, respectively, above the 1,687,609 tons of home scrap and 2,908,485 tons of purchased scrap on hand at the beginning of the year. Thus, stocks of scrap totaling 4,741,159 tons at the year end were 3 percent greater than the 4,596,094 tons on hand at the beginning of the year.

In contrast to consumers' stocks of scrap, stocks of pig iron totaling 3,369,136 tons at the end of the year had decreased 23 percent from the 4,359,484 tons on hand at the beginning of the year.

Consumers' stocks of ferrous scrap and pig iron on hand in the United States on December 31, 1938–39, by States and districts, in gross tons

State and district	December 31, 1938				December 31, 1939			
	Scrap			Pig iron	Scrap			Pig iron
	Home	Purchased	Total		Home	Purchased	Total	
Connecticut	10,170	27,873	38,043	20,682	11,886	29,277	41,163	29,109
Maine	553	3,644	4,197	1,114	462	2,570	3,032	4,309
Massachusetts	14,015	46,874	60,889	112,893	14,911	46,796	61,707	130,983
New Hampshire	769	959	1,728	479	459	1,142	1,601	766
Rhode Island	4,315	4,403	8,718	7,642	3,484	6,019	9,503	10,642
Vermont	83	2,988	3,071	315	90	2,657	2,747	1,183
Total New England	29,905	86,741	116,646	143,125	31,292	88,461	119,753	176,992
Delaware, New Jersey	16,538	74,073	90,611	95,152	24,622	78,788	103,410	86,126
New York	86,579	223,734	310,313	487,908	120,028	204,203	324,231	358,890
Pennsylvania	511,693	456,489	968,182	968,423	503,987	559,312	1,063,299	720,150
Total Middle Atlantic	614,810	754,296	1,369,106	1,551,483	648,637	842,303	1,490,940	1,165,166
Alabama	35,552	55,136	90,688	455,977	57,296	63,506	120,802	183,903
District of Columbia, Kentucky, Maryland	170,778	98,060	268,838	126,935	131,578	82,501	214,079	119,911
Florida, Georgia	1,827	33,348	35,175	11,587	1,821	26,115	27,936	18,208
Mississippi	2	284	286	141	1	443	444	148
North Carolina	1,150	2,931	4,081	1,014	1,280	2,374	3,654	1,013
South Carolina	67	2,314	2,381	1,471	71	2,473	2,544	1,524
Tennessee, Virginia	12,637	44,914	57,551	26,674	11,032	50,847	61,879	41,904
West Virginia	1,076	99,879	100,955	57,354	1,921	108,969	110,890	48,176
Total Southeastern	223,089	336,866	559,955	681,153	205,000	337,228	542,228	414,787

Consumers' stocks of ferrous scrap and pig iron on hand in the United States on December 31, 1938–39, by States and districts, in gross tons—Continued

State and district	December 31, 1938				December 31, 1939			
	Scrap			Pig iron	Scrap			Pig iron
	Home	Purchased	Total		Home	Purchased	Total	
Arkansas, Louisiana, Oklahoma	258	12,114	12,372	609	617	14,959	15,576	1,031
Texas	2,221	9,860	12,081	504	1,840	14,028	15,868	492
Total Southwestern	2,479	21,974	24,453	1,113	2,457	28,987	31,444	1,523
Illinois	117,679	339,201	456,880	544,000	121,079	351,179	472,258	349,835
Indiana	219,719	278,777	498,496	175,244	241,084	201,498	442,582	131,686
Iowa	2,009	24,274	26,283	10,621	963	18,549	19,512	19,312
Kansas, Nebraska	1,865	16,412	18,277	472	1,126	10,455	11,581	1,016
Michigan, Wisconsin	148,186	193,387	341,573	429,660	79,484	213,555	293,039	319,599
Minnesota	7,763	53,385	61,148	15,142	3,730	32,330	36,060	18,735
Missouri	8,315	98,489	106,804	6,857	11,650	97,113	108,763	12,822
North Dakota, South Dakota	2,100	157	2,257	75	2,100	237	2,337	38
Ohio	249,556	474,952	724,508	723,433	329,042	529,267	858,309	705,657
Total North Central	757,192	1,479,034	2,236,226	1,905,504	790,258	1,454,183	2,244,441	1,558,700
Arizona, Nevada, New Mexico	10,835	4,287	15,122	46	4,306	10,518	14,824	5
Colorado, Utah	12,748	70,000	82,748	57,466	11,811	101,156	112,967	30,530
Idaho	200	1,645	1,845	40	150	1,700	1,850	30
Wyoming	------	------	------	------	5	------	5	1
Montana	27	5,229	5,256	283	49	5,585	5,634	322
Total Rocky Mountain	23,810	81,161	104,971	57,835	16,321	118,959	135,280	30,888
Alaska, Oregon, Washington	3,524	41,828	45,352	1,903	3,994	43,371	47,365	2,688
California	32,800	106,585	139,385	17,368	31,269	98,439	129,708	18,392
Total Pacific Coast	36,324	148,413	184,737	19,271	35,263	141,810	177,073	21,080
Total United States	1,687,609	2,908,485	4,596,094	4,359,484	1,729,228	3,011,931	4,741,159	3,369,136

Suppliers' stocks.—In appraising stocks, insofar as suppliers are concerned, it should be noted that the coverage of the canvass is unknown. However, the data assembled include virtually complete returns from the larger suppliers, as well as a representative number of returns from others, and the figures shown probably reveal a substantial part of the total visible supplies of iron and steel scrap in suppliers' hands.

Stocks held by dealers, automobile wreckers, railroads, and manufacturers rose from 2,463,701 gross tons (reported by 3,018 concerns) on September 30, 1939, to 2,560,688 tons (reported by 4,680 concerns) on December 31, 1939. This increase was due to inclusion in the survey of a representative number of the larger industrial plants that produce scrap for sale and to the larger number of reports received in December from small dealers who did not reply in the September survey. Stocks in the hands of the larger suppliers were 22 percent lower at the end of the year than at the end of September, and railroad inventories declined 14 percent for the period. Although the number of concerns canvassed in December was increased only 5 percent over the number canvassed in September, the average of replies received increased from 44 percent in September to 65 in December. This increase in replies resulted in only a 4-percent rise of stocks in suppliers' hands. Nineteen States, which embraced approximately 47 percent of the total 4,680 replies received in the December canvass, showed actual declines in stocks reported, notably Pennsylvania, Ohio, Illinois, and Michigan, all of which contain large scrap-consuming areas.

Suppliers' stocks of iron and steel scrap on hand and in transit, September 30 and December 31, 1939, by States and districts, in gross tons

State and district	September 30, 1939				December 31, 1939			
	Yards reporting	Scrap			Yards reporting	Scrap		
		Prepared	Unprepared	Total		Prepared	Unprepared	Total
Connecticut	62	24,658	5,516	30,174	92	22,734	7,393	30,127
Maine	25	6,174	1,311	7,485	38	13,714	1,717	15,431
Massachusetts	118	28,497	12,767	41,264	195	56,362	27,562	83,924
New Hampshire	15	750	948	1,698	22	2,472	3,532	6,004
Rhode Island	14	11,413	7,641	19,054	22	9,064	5,959	15,023
Vermont	22	1,506	1,500	3,006	32	1,838	1,492	3,330
Total New England	256	72,998	29,683	102,681	401	106,184	47,655	153,839
Delaware	9	608	510	1,118	14	2,196	684	2,880
New Jersey	125	32,480	32,344	64,824	181	59,333	42,904	102,237
New York	334	147,765	57,611	205,376	515	162,627	59,591	222,218
Pennsylvania	288	203,784	87,794	291,578	444	165,224	95,003	260,227
Total Middle Atlantic	756	384,637	178,259	562,896	1,154	389,380	198,182	587,562
Alabama	27	10,931	15,231	26,162	47	20,608	9,548	30,156
District of Columbia	7	9,500	1,325	10,825	27	16,255	2,182	18,437
Florida	30	5,167	1,365	6,532	42	11,643	3,617	15,260
Georgia	44	13,521	2,877	16,398	59	12,438	2,679	15,117
Kentucky	30	21,784	5,894	27,678	52	25,848	9,301	35,149
Maryland	20	43,628	6,803	50,431	48	48,366	8,306	56,672
Mississippi	14	2,818	1,080	3,898	25	5,855	1,227	7,082
North Carolina	33	15,471	2,556	18,027	46	18,377	6,410	24,787
South Carolina	17	4,206	1,947	6,153	24	11,260	4,494	15,754
Tennessee	27	16,242	8,025	24,267	49	14,853	8,896	23,749
Virginia	42	29,932	10,644	40,576	62	37,114	10,268	47,382
West Virginia	29	11,324	2,230	13,554	43	9,942	2,569	12,511
Total Southeastern	320	184,524	59,977	244,501	524	232,559	69,497	302,056
Arkansas	17	9,275	2,580	11,855	21	7,510	4,145	11,655
Louisiana	29	22,542	6,481	29,023	34	22,167	8,716	30,883
Oklahoma	37	7,849	2,519	10,368	65	17,531	4,465	21,996
Texas	134	74,483	25,416	99,899	163	160,330	39,175	199,505
Total Southwestern	217	114,149	36,996	151,145	283	207,538	56,501	264,039
Illinois	186	248,894	141,060	389,954	294	189,495	112,446	301,941
Indiana	92	35,631	5,258	40,889	161	48,292	8,812	57,104
Iowa	77	27,585	16,134	43,719	109	36,062	13,937	49,999
Kansas	67	21,027	2,196	23,223	95	9,909	6,473	16,382
Michigan	134	110,818	13,670	124,488	199	71,929	23,689	95,618
Minnesota	51	145,192	25,276	170,468	85	109,723	40,487	150,210
Missouri	85	34,238	21,179	55,417	111	29,480	18,939	48,419

Suppliers' stocks of iron and steel scrap on hand and in transit, September 30 and December 31, 1939, by States and districts, in gross tons—Continued

State and district	September 30, 1939				December 31, 1939			
	Yards reporting	Scrap			Yards reporting	Scrap		
		Prepared	Unprepared	Total		Prepared	Unprepared	Total
Nebraska	28	12,232	6,376	18,608	47	10,737	5,391	16,128
North Dakota	11	3,579	1,944	5,523	17	2,650	1,562	4,212
Ohio	212	191,706	45,345	237,051	383	120,139	58,726	178,865
South Dakota	15	1,290	3,170	4,460	16	1,175	2,300	3,475
Wisconsin	73	35,696	15,962	51,658	126	30,476	16,556	47,032
Total North Central	1,031	867,888	297,570	1,165,458	1,643	660,067	309,318	969,385
Arizona	7	3,290	419	3,709	17	1,563	268	1,831
Colorado	46	30,039	10,165	40,204	70	20,825	5,139	25,964
Idaho	14	121	571	692	21	369	2,263	2,632
Montana	11	4,945	1,067	6,012	16	5,425	1,763	7,188
Nevada	5	152	145	297	10	640	490	1,130
New Mexico	5	292	181	473	6	1,145	200	1,345
Utah	9	1,798	6,295	8,093	11	3,659	2,746	6,405
Wyoming	9	1,805	5,390	7,195	14	1,440	6,453	7,893
Total Rocky Mountain	106	42,442	24,233	66,675	165	35,066	19,322	54,388
California	219	71,807	29,343	101,150	364	93,133	32,757	125,890
Oregon	50	17,590	8,149	25,739	69	40,409	8,835	49,244
Washington	63	19,405	24,051	43,456	77	27,976	26,309	54,285
Total Pacific Coast	332	108,802	61,543	170,345	510	161,518	67,901	229,419
Total United States	[1] 3,018	1,775,440	[2] 688,261	2,463,701	[1] 4,680	1,792,312	[2] 768,376	2,560,688

[1] Includes 1,724 dealers, 1,227 automobile wreckers, and 67 railroads in September; and 2,580 dealers, 1,832 automobile wreckers, 66 railroads, and 202 manufacturers in December.
[2] Includes 107,562 tons in transit to yards or to shipping point for export and at docks awaiting export in September; and 105,955 tons in December.

CONSUMPTION

In the canvass of consumers of ferrous scrap and pig iron, data are obtained only on that portion of scrap used in remelting processes. To simplify the annual canvass, no details are sought regarding the ordinary trade classifications of scrap consumed, and no attempt is made to obtain data on its value or cost at consumers' plants. Statistics are compiled to show the consumption of scrap and pig iron by districts and States and by types of furnace. To avoid disclosing details concerning individual plants reporting it is necessary in some instances to combine figures for some States. All such combinations are made with a view to revealing details of consumption by types of furnace rather than by geographic subdivisions.

The importance of scrap from the standpoint of conservation is illustrated by the relative quantities of scrap and ore used in the domestic iron and steel industry. The total scrap consumed in 1939 was equivalent to 121 percent of the iron content of all domestic and foreign iron and manganiferous ores used in blast furnaces, and purchased scrap alone equaled 56 percent of the iron content of the ores; in 1938 the comparable percentages were 132 and 62.

Scrap constitutes by far the greater part of the ferrous raw materials used in iron and steel plants in the Southwestern, Pacific Coast, and New England districts. These regions, however, used only slightly more than 5 percent of the total scrap consumed in 1939. Except for the Southwestern district, proportionately less scrap was used in all areas in 1939 than in 1938, although most of the decreases were relatively small.

Ferrous scrap and pig iron consumed in the United States and percentage of total derived from home scrap, purchased scrap, and pig iron, 1938–39, by districts

District	1938					1939				
	Total used (gross tons)	Percent of total used				Total used (gross tons)	Percent of total used			
		Scrap			Pig iron		Scrap			Pig iron
		Home	Purchased	Total			Home	Purchased	Total	
New England	479,464	26.1	46.7	72.8	27.2	773,651	27.8	44.5	72.3	27.7
Middle Atlantic	12,025,365	28.8	22.1	50.9	49.1	20,314,650	25.7	20.5	46.2	53.8
Southeastern	6,238,315	25.3	19.9	45.2	54.8	9,344,743	24.8	19.3	44.1	55.9
Southwestern	138,187	25.5	71.3	96.8	3.2	152,150	23.4	73.9	97.3	2.7
North Central	19,783,190	29.4	26.0	55.4	44.6	31,361,491	29.5	24.1	53.6	46.4
Rocky Mountain	372,256	24.4	38.9	63.3	36.7	819,249	24.4	30.6	55.0	45.0
Pacific Coast	812,506	24.5	64.0	88.5	11.5	1,126,240	25.2	60.5	85.7	14.3
	39,849,283	28.4	25.2	53.6	46.4	63,892,174	27.4	23.4	50.8	49.2

Proportion of home and purchased scrap and pig iron used in furnace charges in the United States, 1938–39, in percent

Type of furnace	1938				1939			
	Scrap			Pig iron	Scrap			Pig iron
	Home	Purchased	Total		Home	Purchased	Total	
Open hearth	28.1	23.4	51.5	48.5	27.3	21.5	48.8	51.2
Bessemer	5.4	.2	5.6	94.4	5.6	.2	5.8	94.2
Electric	47.6	50.7	98.3	1.7	47.2	51.0	98.2	1.8
Cupola	26.4	37.1	63.5	36.5	29.3	36.4	65.7	34.3
Air [1]	48.2	21.4	69.6	30.4	39.8	22.6	62.4	37.6
Crucible	41.4	43.4	84.8	15.2	43.2	52.1	95.3	4.7
Puddling	6.3	33.2	39.5	60.5	6.0	14.2	20.2	79.8
Blast	71.8	28.2	100.0	--------	58.2	41.8	100.0	--------

[1] Includes data for 2 Brackelsberg furnaces.

Open-hearth steel furnaces use by far the largest quantities of ferrous scrap and pig iron. They consumed 70 percent of the total scrap in 1939 (68 percent in 1938), 73 percent of the home scrap (70 percent in 1938), 67 percent of the purchased scrap (66 percent in 1938), and 76 percent of the pig iron (74 percent in 1938).

Cupolas, the second largest consumers of scrap, took 21 percent of the purchased scrap in 1939 compared with 24 percent in 1938. Their relative consumption of home scrap did not change from 1938, when the percentage was 15; however, their consumption of pig iron decreased to 10 percent in 1939 from 13 percent in 1938.

Open-hearth and cupola furnaces together consumed 88 percent of both home and purchased scrap and 86 percent of the pig iron in 1939. Bessemer converters used 10 percent of the pig iron consumed in 1939 but only relatively small quantities of scrap (0.61 percent of the total). Although electric furnaces consumed only 5 percent of the total scrap in 1939, 98 percent of the total charge to this type of equipment was home and purchased scrap.

Consumption of ferrous scrap and pig iron in the United States, 1938–39, by type of furnace, in gross tons

Type of furnace or equipment	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
1938					
Open hearth	135	7,956,151	6,651,479	14,607,630	13,729,371
Bessemer	26	111,751	3,695	115,446	1,946,048
Electric	257	453,356	482,281	935,637	15,893
Cupola	2,611	1,740,688	2,451,214	4,191,902	[1] 2,404,637
Air	120	} 294,414	130,798	425,212	185,514
Brackelsberg	2				
Crucible	22	592	622	1,214	218
Puddling	7	557	2,926	3,483	5,343
Blast	71	763,832	300,578	1,064,410	----------
Direct castings	15	----------	----------	----------	[1] 217,325
	[2] 3,266	11,321,341	10,023,593	21,344,934	18,504,349
1939					
Open hearth	136	12,743,166	10,052,268	22,795,434	23,951,940
Bessemer	26	190,319	6,225	196,544	3,217,142
Electric	267	717,164	776,392	1,493,556	27,270
Cupola	2,716	2,550,853	3,176,552	5,727,405	[1] 2,990,355
Air	122	} 310,862	176,786	487,648	294,033
Brackelsberg	2				
Crucible	22	754	909	1,663	82
Puddling	7	1,867	4,439	6,306	24,963
Blast	77	1,004,565	721,286	1,725,851	----------
Direct castings	18	----------	----------	----------	[1] 951,982
	[2] 3,393	17,519,550	14,914,857	32,434,407	31,457,767

[1] Includes some pig iron used in making direct castings.
[2] Where 2 or more separate departments, such as blast-furnace, open-hearth, foundry, etc., are situated at the same place and are operated by 1 establishment, each appears as 1 plant in the total.

CONSUMPTION BY DISTRICTS AND STATES

All 48 States, the District of Columbia, and Alaska contain plants consuming ferrous scrap or pig iron. The greatest consumption, however, is concentrated in the steel-making centers of the North Central, Middle Atlantic, and Southeastern States. These areas include the 8 largest consuming States, which used 82 percent of the total scrap, 92 percent of the pig iron, and 88 percent of the total scrap and pig iron charged into furnaces in 1939. These States, the relative position of which did not change from 1938, and the percentage of the total ferrous scrap and pig iron each consumed in 1939 were as follows: Pennsylvania 26, Ohio 21, Indiana 11, Illinois 8, Michigan 7, Alabama 5, New York 5, and Maryland 5.

Consumption of ferrous scrap and pig iron in the United States, 1935–39, by districts

District and year	Active plants reporting	Scrap						Pig iron	
		Home		Purchased		Total			
		Gross tons	Change from previous year, percent	Gross tons	Change from previous year, percent	Gross tons	Change from previous year, percent	Gross tons	Change from previous year, percent
New England:									
1935	232	144,408	(1)	305,221	(1)	449,629	(1)	146,656	(1)
1936	238	177,305	+22.8	389,315	+27.6	566,620	+26.0	193,703	+32.1
1937	257	233,938	+31.9	401,698	+3.2	635,636	+12.2	239,549	+23.7
1938	257	125,307	−46.4	223,956	−44.2	349,263	−45.1	130,201	−45.6
1939	263	215,117	+71.7	344,469	+53.8	559,586	+60.2	214,065	+64.4
Middle Atlantic:									
1935	770	3,803,287	(1)	3,201,118	(1)	7,004,405	(1)	6,445,123	(1)
1936	804	5,765,704	+51.6	5,099,929	+59.3	10,865,633	+55.1	10,661,526	+65.4
1937	825	6,516,129	+13.0	5,487,702	+7.6	12,003,831	+10.5	12,681,040	+18.9
1938	817	3,466,651	−46.8	2,649,938	−51.7	6,116,589	−49.0	5,908,776	−53.4
1939	835	5,214,809	+50.4	4,161,527	+57.0	9,376,336	+53.3	10,938,314	+85.1
Southeastern:									
1935	370	1,567,671	(1)	1,748,596	(1)	3,316,267	(1)	2,865,364	(1)
1936	408	2,056,519	+31.2	2,026,502	+15.9	4,083,021	+23.1	3,789,654	+32.3
1937	448	2,156,393	+4.9	1,949,704	−3.8	4,106,097	+.6	4,494,498	+18.6
1938	445	1,576,624	−26.9	1,244,608	−36.2	2,821,232	−31.3	3,417,083	−24.0
1939	470	2,315,569	+46.9	1,803,232	+44.9	4,118,801	+46.0	5,225,942	+52.9
Southwestern:									
1935	98	20,922	(1)	75,348	(1)	96,270	(1)	5,010	(1)
1936	104	35,326	+68.8	115,289	+53.0	150,615	+56.5	6,972	+39.2
1937	111	51,855	+46.8	147,710	+28.1	199,565	+32.5	23,903	+242.8
1938	114	35,158	−32.2	98,541	−33.3	133,699	−33.0	4,488	−81.2
1939	131	35,594	+1.2	112,471	+14.1	148,065	+10.7	4,085	−9.0
North Central:									
1935	1,144	7,490,057	(1)	7,161,041	(1)	14,651,098	(1)	10,875,718	(1)
1936	1,230	10,444,433	+39.4	8,874,119	+23.9	19,318,552	+31.9	14,977,899	+37.7
1937	1,350	10,462,393	+.2	9,184,317	+3.5	19,646,710	+1.7	16,086,555	+7.4
1938	1,333	5,827,181	−44.3	5,142,183	−44.0	10,969,364	−44.2	8,813,826	−45.2
1939	1,374	9,254,712	+58.8	7,561,185	+47.0	16,815,897	+53.3	14,545,594	+65.0
Rocky Mountain:									
1935	58	109,796	(1)	125,259	(1)	235,055	(1)	174,507	(1)
1936	62	166,862	+52.0	257,316	+105.4	424,178	+80.5	323,391	+85.3
1937	66	199,056	+19.3	284,825	+10.7	483,881	+14.1	372,213	+15.1
1938	66	91,030	−54.3	144,642	−49.2	235,672	−51.3	136,584	−63.3
1939	68	200,006	+119.7	250,882	+73.5	450,888	+91.3	368,361	+169.7
Pacific Coast:									
1935	193	210,611	(1)	451,995	(1)	662,606	(1)	108,085	(1)
1936	217	255,240	+21.2	694,274	+53.6	949,514	+43.3	145,489	+34.6
1937	231	251,269	−1.6	679,283	−2.2	930,552	−2.0	158,769	+9.1
1938	234	199,390	−20.6	519,725	−23.5	719,115	−22.7	93,391	−41.2
1939	252	283,743	+42.3	681,091	+31.0	964,834	+34.2	161,406	+72.8
United States:									
1935	[2] 2,865	13,346,752	(1)	13,068,578	(1)	26,415,330	(1)	20,620,463	(1)
1936	[2] 3,063	18,901,389	+41.6	17,456,744	−33.6	36,358,133	+37.6	30,098,634	+46.0
1937	[2] 3,288	19,871,033	+5.1	18,135,239	+3.9	38,006,272	+4.5	34,056,527	+13.1
1938	[2] 3,266	11,321,341	−43.0	10,023,593	−44.7	21,344,934	−43.8	18,504,349	−45.7
1939	[2] 3,393	17,519,550	+54.7	14,914,857	+48.8	32,434,407	+52.0	31,457,767	+70.0

[1] Canvass begun in 1935.
[2] Where 2 or more separate departments, such as blast furnace, open hearth, foundry, etc., are situated at the same place and are operated by 1 establishment, each appears as 1 plant in the total.

Consumption of ferrous scrap and pig iron in the United States in 1939, by States and districts

State and district	Active plants reporting	Scrap						Pig iron	
		Home		Purchased		Total			
		Gross tons	Percent of total	Gross tons	Percent of total	Gross tons	Percent of total	Gross tons	Percent of total
Connecticut	73	79,023	0.5	125,986	0.9	205,009	0.6	74,005	0.2
Maine	21	6,284	(1)	5,163	(1)	11,447	(1)	6,000	(1)
Massachusetts	121	101,158	.6	167,700	1.1	268,858	.9	103,156	.3
New Hampshire	20	3,132	(1)	2,121	(1)	5,253	(1)	1,630	(1)
Rhode Island	14	21,106	.1	35,966	.2	57,072	.2	23,444	.1
Vermont	14	4,414	(1)	7,533	.1	11,947	(1)	5,830	(1)
Total New England	263	215,117	1.2	344,469	2.3	559,586	1.7	214,065	.7
Delaware	10	193,396	1.1	319,717	2.1	513,113	1.6	250,893	.8
New Jersey	93								
New York	241	832,967	4.8	790,197	5.3	1,623,164	5.0	1,622,545	5.1
Pennsylvania	491	4,188,446	23.9	3,051,613	20.5	7,240,059	22.3	9,064,876	28.8
Total Middle Atlantic	835	5,214,809	29.8	4,161,527	27.9	9,376,336	28.9	10,938,314	34.8
Alabama	89	672,303	3.8	522,095	3.5	1,194,398	3.7	2,123,905	6.8
District of Columbia	4								
Kentucky	28	1,166,852	6.7	488,108	3.3	1,654,960	5.1	2,112,084	6.7
Maryland	35								
Florida	22	37,906	.2	85,881	.6	123,787	.4	55,049	.2
Georgia	52								
Mississippi	12	716	(1)	1,878	(1)	2,594	(1)	323	(1)
North Carolina	49	12,246	.1	23,753	.2	35,999	.1	12,369	(1)
South Carolina	17	2,042	(1)	3,650	(1)	5,692	(1)	2,010	(1)
Tennessee	59	98,653	.6	168,875	1.1	267,528	.8	134,432	.4
Virginia	67								
West Virginia	36	324,851	1.9	508,992	3.4	833,843	2.6	785,770	2.5
Total Southeastern	470	2,315,569	13.3	1,803,232	12.1	4,118,801	12.7	5,225,942	16.6
Arkansas	17								
Louisiana	24	11,764	.1	48,012	.3	59,776	.2	1,788	(1)
Oklahoma	22								
Texas	68	23,830	.1	64,459	.4	88,289	.3	2,297	(1)
Total Southwestern	131	35,594	.2	112,471	.7	148,065	.5	4,085	(1)
Illinois	232	1,417,775	8.1	1,286,180	8.6	2,703,955	8.3	2,473,833	7.9
Indiana	156	2,098,696	12.0	1,585,293	10.6	3,683,989	11.3	3,419,691	10.9
Iowa	63	63,569	.3	76,088	.5	139,657	.4	48,959	.2
Kansas	42	15,192	.1	44,273	.3	59,465	.2	3,137	(1)
Nebraska	15								
Michigan	208	1,755,577	10.0	1,214,421	8.2	2,969,998	9.2	1,651,448	5.2
Wisconsin	138								
Minnesota	72	84,526	.5	131,805	.9	216,331	.7	166,050	.5
Missouri	74	92,116	.5	326,926	2.2	419,042	1.3	33,714	.1
North Dakota	3	1,446	(1)	651	(1)	2,097	(1)	132	(1)
South Dakota	3								
Ohio	368	3,725,815	21.3	2,895,548	19.4	6,621,363	20.4	6,748,630	21.4
Total North Central	1,374	9,254,712	52.8	7,561,185	50.7	16,815,897	51.8	14,545,594	46.2
Arizona	8								
Nevada	4	6,815	(1)	16,244	.1	23,059	.1	32	(1)
New Mexico	1								
Colorado	28	189,954	1.1	229,837	1.6	419,791	1.3	368,054	1.2
Utah	15								
Idaho	4	192	(1)	2,103	(1)	2,295	(1)	20	(1)
Wyoming	1	2	(1)			2	(1)	1	(1)
Montana	7	3,043	(1)	2,698	(1)	5,741	(1)	254	(1)
Total Rocky Mountain	68	200,006	1.1	250,882	1.7	450,888	1.4	368,361	1.2
Alaska	1								
Oregon	38	36,201	.2	140,915	1.0	177,116	.6	5,636	(1)
Washington	70								
California	143	247,542	1.4	540,176	3.6	787,718	2.4	155,770	.5
Total Pacific Coast	252	283,743	1.6	681,091	4.6	964,834	3.0	161,406	.5
Total United States: 1939	[2] 3,393	17,519,550	100.0	14,914,857	100.0	32,434,407	100.0	31,457,767	100.0
1938	[2] 3,266	11,321,341	100.0	10,023,593	100.0	21,344,934	100.0	18,504,349	100.0

[1] Less than 0.05 percent.
[2] Where 2 or more separate departments, such as blast furnace, open hearth, foundry, etc., are situated at the same place and are operated by 1 establishment, each appears as 1 plant in the total.

CONSUMPTION BY TYPE OF FURNACE

Open-hearth furnaces.—The total ferrous scrap and pig iron consumed in open hearths in 1939 was 46,747,374 gross tons, a 65-percent increase over 1938. Of the 1939 total home scrap comprised 27 percent, purchased scrap 22 percent, and pig iron 51 percent; in 1938 the percentages were 28, 24, and 48, respectively. The use of home scrap increased 60 percent, purchased scrap 51 percent, and pig iron 74 percent.

Charges to open-hearth furnaces in 1939 consisted of 49 percent total scrap and 51 percent pig iron compared with percentages in 1938 of 52 and 48, respectively. Of the total scrap consumed in open hearths in 1939, 44 percent was purchased scrap compared with 46 percent in 1938 and 47 percent in 1937. Higher proportions of purchased scrap are used in areas remote from pig-iron-producing centers, but the practice of using scrap exclusively is relatively rare. In 1939 only 5 plants out of a total of 136 operated on a 100-percent scrap basis; they consumed only 303,651 tons, less than 1 percent of the total consumption of ferrous raw materials in open hearths.

Pennsylvania, the leading steel producer, outranked all other States in 1939 in the consumption of ferrous scrap and pig iron in open hearths followed by Ohio, Indiana, and Illinois.

Consumption of ferrous scrap and pig iron in open-hearth furnaces in the United States in 1939, by districts and States, in gross tons

District and State	Active plants reporting	Scrap: Home	Scrap: Purchased	Scrap: Total	Pig iron
New England:					
Connecticut	1				
Massachusetts	2	48,796	175,960	224,756	58,789
Rhode Island	1				
Total: 1939	4	48,796	175,960	224,756	58,789
1938	3	28,633	120,324	148,957	28,198
Middle Atlantic:					
Delaware	1				
New Jersey	1	690,552	493,637	1,184,189	1,507,237
New York	7				
Pennsylvania	50	3,459,902	2,408,795	5,868,697	7,212,480
Total: 1939	59	4,150,454	2,902,432	7,052,886	8,719,717
1938	58	2,759,738	1,814,415	4,574,153	4,859,292
Southeastern and Southwestern:					
Alabama	3				
Georgia	1				
Tennessee	1	376,158	424,907	801,065	1,607,861
Oklahoma	1				
District of Columbia	1				
Kentucky	2				
Maryland	1	1,331,346	873,013	2,204,359	2,475,557
West Virginia	2				
Total: 1939	12	1,707,504	1,297,920	3,005,424	4,083,418
1938	11	1,104,661	866,852	1,971,513	2,638,878
North Central:					
Illinois	11	990,704	808,461	1,799,165	1,680,735
Indiana	7	1,860,413	1,367,304	3,227,717	3,076,669
Michigan	4	699,944	490,477	1,190,421	957,708
Iowa	1				
Missouri	3	52,728	219,396	272,124	5,801
Minnesota	1				
Wisconsin	2	75,807	66,296	142,103	156,558
Ohio	25	2,850,724	2,072,119	4,922,843	4,756,948
Total: 1939	54	6,530,320	5,024,053	11,554,373	10,634,419
1938	56	3,888,171	3,423,935	7,312,106	6,028,762

Consumption of ferrous scrap and pig iron in open-hearth furnaces in the United States in 1939, by districts and States, in gross tons—Continued

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
Rocky Mountain and Pacific Coast:					
Colorado	1	306,092	651,903	957,995	455,597
California	5				
Washington	1				
Total: 1939	7	306,092	651,903	957,995	455,597
1938	7	174,948	425,953	600,901	174,241
Total United States: 1939	136	12,743,166	10,052,268	22,795,434	23,951,940
1938	135	7,956,151	6,651,479	14,607,630	13,729,371

Bessemer converters.—The consumption of ferrous scrap and pig iron in bessemer converters in 1939 totaled 3,413,686 gross tons, a 66-percent increase over 1938. The proportion of scrap consumed in converter practice is low (amounting to only 5.8 percent in 1939), and virtually the entire quantity was home or plant scrap. Almost all of the small tonnage of purchased scrap consumed in converters was used in small steel-foundry plants.

Ohio was the principal consumer of scrap in bessemer converters in 1939.

Consumption of ferrous scrap and pig iron in bessemer converters in the United States in 1939, by districts and States, in gross tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England and Middle Atlantic:					
Delaware	1	860	714	1,574	760
Massachusetts	1				
New Jersey	1				
Pennsylvania	9	52,010	1,183	53,193	1,080,807
Total: 1939	12	52,870	1,897	54,767	1,081,567
1938	11	25,959	1,305	27,264	366,415
Southeastern and Southwestern:					
Alabama	1	24,185	1,054	25,239	226,923
Maryland	1				
West Virginia	1				
Louisiana	1				
Total: 1939	4	24,185	1,054	25,239	226,923
1938	4	16,371	766	17,137	129,728
North Central:					
Illinois	2	16,048	3,057	19,105	465,865
Indiana	1				
Michigan	1				
Missouri	1				
Ohio	5	97,216	217	97,433	1,442,787
Total: 1939	10	113,264	3,274	116,538	1,908,652
1938	11	69,421	1,624	71,045	1,449,905
Total United States: 1939	26	190,319	6,225	196,544	3,217,142
1938	26	111,751	3,695	115,446	1,946,048

Electric steel furnaces.—Ferrous scrap and pig iron consumed in electric furnaces in 1939 totaled 1,520,826 gross tons, a 60-percent increase over 1938. Pig iron comprised less than 2 percent of the total ferrous raw materials used in electric furnaces in 1939. Of the 267 active plants reporting in 1939, 99 operated exclusively on scrap and consumed 447,810 tons—about 29 percent of the total scrap and pig iron used.

Ohio led all States in 1939 in the consumption of scrap in electric furnaces, followed by Pennsylvania, Illinois, Michigan, and New York.

Consumption of ferrous scrap and pig iron in electric steel furnaces in the United States in 1939, by districts and States, in gross tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut	4				
New Hampshire	1	5,697	5,681	11,378	479
Rhode Island	1				
Massachusetts	6	7,603	3,375	10,978	68
Total: 1939	12	13,300	9,056	22,356	547
1938	13	7,293	8,033	15,326	378
Middle Atlantic:					
Delaware	1	15,969	21,370	37,339	608
New Jersey	5				
New York	19	32,539	53,310	85,849	2,648
Pennsylvania	52	150,297	149,649	299,946	5,393
Total: 1939	77	198,805	224,329	423,134	8,649
1938	73	125,930	131,572	257,502	4,284
Southeastern:					
District of Columbia	1				
Maryland	1	6,482	8,471	14,953	93
West Virginia	1				
Alabama	2				
Florida	1	1,880	4,372	6,252	12
Georgia	1				
Tennessee	2	12,544	6,531	19,075	238
Virginia	3				
Total: 1939	12	20,906	19,374	40,280	343
1938	12	14,362	15,963	30,325	342
Southwestern:					
Arkansas	1				
Oklahoma	1				
Louisiana	3	13,552	12,177	25,729	241
Texas	7				
Total: 1939	12	13,552	12,177	25,729	241
1938	10	15,069	11,932	27,001	192
North Central:					
Illinois	18	80,789	128,286	209,075	1,808
Indiana	11	15,886	29,301	45,187	321
Iowa	2				
Kansas	1	4,021	6,655	10,676	175
Nebraska	1				
Michigan	23	109,198	67,671	176,869	9,056
Minnesota	3	1,682	3,534	5,216	89
Missouri	10	4,931	5,610	10,541	632
Ohio	24	197,290	179,048	376,338	3,174
Wisconsin	14	22,603	36,580	59,183	1,428
Total: 1939	107	436,400	456,685	893,085	16,683
1938	104	256,344	265,178	521,522	9,942

Consumption of ferrous scrap and pig iron in electric steel furnaces in the United States in 1939, by districts and States, in gross tons—Continued

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
Rocky Mountain:					
Arizona	2	4,813	6,301	11,114	51
Colorado	2				
Nevada	1				
Utah	1				
Total: 1939	6	4,813	6,301	11,114	51
1938	6	4,735	6,068	10,803	----------
Pacific Coast:					
Alaska	1	3,544	6,381	9,925	8
Oregon	4				
California	23	20,455	22,985	43,440	713
Washington	13	5,389	19,104	24,493	35
Total: 1939	41	29,388	48,470	77,858	756
1938	39	29,623	43,535	73,158	755
Total United States: 1939	267	717,164	776,392	1,493,556	27,270
1938	257	453,356	482,281	935,637	15,893

Cupola furnaces.—Consumption of ferrous scrap and pig iron in cupola furnaces in 1939 totaled 8,717,760 gross tons, a 32-percent increase over 1938. Use of home scrap increased 47 percent, purchased scrap 30 percent, total scrap 37 percent, and pig iron 24 percent. Thus, the proportion of purchased scrap more than held its own, although the relatively low prices of scrap during the first 9 months of the year were an important factor.

Charges to cupola furnaces in 1939 consisted of 29 percent home scrap, 37 percent purchased scrap, and 34 percent pig iron; in 1938 the percentages were 26, 37, and 37, respectively. Many cupola plants operate on 100-percent scrap charge; a total of 472 plants reported the use of 700,566 tons of ferrous scrap without the use of pig iron in 1939 compared with 421 plants that reported the use of 595,090 tons in 1938.

The relative position of States that are large consumers of scrap in cupola furnaces was not changed in 1939. Michigan continued as the principal consumer, followed in order by Ohio, Pennsylvania, Illinois, and New York.

Consumption of ferrous scrap and pig iron in cupola furnaces in the United States in 1939, by districts and States, in gross tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut	60	55,402	37,101	92,503	50,304
Maine	21	6,284	5,163	11,447	6,000
Massachusetts	105	45,922	76,440	122,362	59,903
New Hampshire	17	1,447	1,686	3,133	1,323
Rhode Island	11	13,524	16,121	29,645	13,022
Vermont	14	4,414	7,533	11,947	5,830
Total: 1939	228	126,993	144,044	271,037	136,382
1938	222	76,187	90,576	166,763	88,694

Consumption of ferrous scrap and pig iron in cupola furnaces in the United States in 1939, by districts and States, in gross tons—Continued

District and State	Active plants reporting	Scrap: Home	Scrap: Purchased	Scrap: Total	Pig iron
Middle Atlantic:					
Delaware	6	1,563	3,800	5,363	2,037
New Jersey	81	80,274	201,086	281,360	139,631
New York	194	136,145	234,202	370,347	137,521
Pennsylvania	322	217,076	342,720	559,796	294,418
Total: 1939	603	435,058	781,808	1,216,866	573,607
1938	597	306,532	600,727	907,259	533,814
Southeastern:					
Alabama	76	141,192	126,327	267,519	533,286
District of Columbia	2	27,193	35,591	62,784	26,820
Maryland	30				
Florida	21	1,469	3,769	5,238	572
Georgia	50	16,252	22,235	38,487	21,047
Kentucky	24	20,279	20,069	40,348	52,562
Mississippi	12	716	1,878	2,594	323
North Carolina	49	12,246	23,753	35,999	12,369
South Carolina	17	2,042	3,650	5,692	2,010
Tennessee	55	67,642	73,573	141,215	111,291
Virginia	62	17,144	77,965	95,109	22,605
West Virginia	28	18,523	19,897	38,420	107,632
Total: 1939	426	324,698	408,707	733,405	890,517
1938	402	239,416	328,536	567,952	644,268
Southwestern:					
Arkansas	16	810	3,586	4,396	167
Louisiana	20	4,600	14,752	19,352	682
Oklahoma	20	1,141	6,536	7,677	686
Texas	60	10,817	55,726	66,543	1,398
Total: 1939	116	17,368	80,600	97,968	2,933
1938	102	19,551	69,194	88,745	4,086
North Central:					
Illinois	179	221,164	287,922	509,086	203,503
Indiana	122	129,552	153,466	283,018	114,692
Iowa	57	54,908	60,958	115,866	40,438
Kansas	40	10,884	33,426	44,310	1,742
Michigan	169	628,102	387,477	1,015,579	493,553
Minnesota	65	15,742	63,442	79,184	14,189
Missouri	59	32,884	109,088	141,972	26,842
Nebraska	14	2,338	7,107	9,445	1,260
North Dakota	3	1,446	651	2,097	132
South Dakota	3				
Ohio	262	239,788	328,580	568,368	296,994
Wisconsin	111	175,854	104,701	280,555	121,882
Total: 1939	1,084	1,512,662	1,536,818	3,049,480	1,315,227
1938	1,045	1,027,637	1,173,555	2,201,192	1,079,551
Rocky Mountain:					
Arizona	6	3,850	13,698	17,548	----------
Colorado	23	10,021	27,246	37,267	20,276
Idaho	4	192	2,103	2,295	20
Montana	7	3,043	2,698	5,741	254
Nevada	3	490	555	1,045	32
New Mexico	1				
Wyoming	1	2	----------	2	1
Utah	13	11,139	20,771	31,910	16,362
Total: 1939	58	28,737	67,071	95,808	36,945
1938	56	19,861	51,360	71,221	22,186
Pacific Coast:					
California	112	95,437	129,054	224,491	31,079
Oregon	34	2,931	8,153	11,084	1,938
Washington	55	6,969	20,297	27,266	1,727
Total: 1939	201	105,337	157,504	262,841	34,744
1938	187	51,504	137,266	188,770	32,038
Total United States: 1939	2,716	2,550,853	3,176,552	5,727,405	[1] 2,990,355
1938	2,611	1,740,688	2,451,214	4,191,902	[1] 2,404,637

[1] Includes some pig iron used in making direct castings.

Air furnaces.—Ferrous scrap and pig iron consumed in air furnaces in 1939 amounted to 781,681 gross tons, a 28-percent increase over 1938. The use of home scrap increased only 6 percent, while the use of purchased scrap rose 35 percent and that of pig iron 58 percent. Thus, equipment of this type used relatively more pig iron than total scrap in 1939, although there was an increase of 1 point in the proportion of purchased scrap used. Only nine operators of air furnaces reported exclusive use of scrap in 1939, the quantity consumed amounting to 33,812 tons.

Ohio led all States in 1939 in the consumption of scrap in air furnaces, followed by Pennsylvania, Indiana, Illinois, Michigan, and Wisconsin.

Consumption of ferrous scrap and pig iron in air furnaces[1] *in the United States in 1939, by districts and States, in gross tons*

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut	7	9,125	2,856	11,981	8,586
Massachusetts	3				
New Hampshire	1	10,033	6,007	16,040	9,474
Rhode Island	1				
Total: 1939	12	19,158	8,863	28,021	18,060
1938	12	12,676	4,381	17,057	12,554
Middle Atlantic:					
Delaware	1	4,496	2,152	6,648	6,314
New Jersey	3				
New York	9	19,411	9,796	29,207	13,710
Pennsylvania	24	50,061	28,609	78,670	47,437
Total: 1939	37	73,968	40,557	114,525	67,461
1938	36	42,039	21,798	63,837	42,108
Southeastern and Southwestern:					
Virginia	1				
West Virginia	2	6,498	12,351	18,849	4,324
Texas	1				
Total 1939	4	6,498	12,351	18,849	4,324
1938	3	2,109	5,251	7,360	2,077
North Central:					
Illinois	14	93,635	40,553	134,188	71,305
Indiana	11				
Michigan	7	32,367	22,359	54,726	33,684
Iowa	2				
Minnesota	1	8,228	5,165	13,393	10,544
Missouri	1				
Ohio	21	47,841	36,878	84,719	59,412
Wisconsin	11	27,393	9,381	36,774	27,571
Total: 1939	68	209,464	114,336	323,800	202,516
1938	68	236,765	99,183	335,948	128,020
Rocky Mountain and Pacific Coast:					
Colorado	1	1,774	679	2,453	1,672
California	2				
Total: 1939	3	1,774	679	2,453	1,672
1938	3	825	185	1,010	755
Total United States: 1939	124	310,862	176,786	487,648	294,033
1938	122	294,414	130,798	425,212	185,514

[1] Includes 2 Brackelsberg furnaces, 1 each in Indiana and Ohio.

Crucible and puddling furnaces.—Crucible and puddling furnaces, whose combined output of iron and steel is very small, consume only minor quantities of ferrous raw materials.

Consumption of ferrous scrap and pig iron in crucible and puddling furnaces in the United States in 1939, by districts and States, in gross tons

District and State	Active plants reporting	Scrap: Home	Scrap: Purchased	Scrap: Total	Pig iron
New England:					
Connecticut	1				
Massachusetts	3	119	531	650	1
New Hampshire	1				
Total: 1939	5	119	531	650	1
1938	6	219	416	635	142
Middle Atlantic:					
New Jersey	2	802	382	1,184	4,915
New York	3				
Pennsylvania	7	1,424	2,494	3,918	15,227
Total: 1939	12	2,226	2,876	5,102	20,142
1938	13	783	2,122	2,905	3,369
Southeastern and North Central:					
Kentucky	1				
Maryland	1				
Virginia	1	235	1,914	2,149	4,856
Indiana	1				
Kansas	1				
Ohio	5	30	18	48	44
Total: 1939	10	265	1,932	2,197	4,900
1938	10	147	1,010	1,157	2,050
Pacific Coast:					
California	1	11	9	20	2
Washington	1				
Total: 1939	2	11	9	20	2
1938					
Total United States: 1939	29	2,621	5,348	7,969	25,045
1938	29	1,149	3,548	4,697	5,561

Blast furnaces.—Ferrous scrap constitutes only a small proportion of the metal-bearing materials consumed in blast furnaces. The other materials used in 1939 were 53,422,383 gross tons of iron and manganiferous iron ores, 3,735,132 of cinder and scale, and 1,737,000 of flue dust. Total consumption of scrap in 1939, as reported by 77 plants operating blast furnaces, was 1,725,851 tons, a 62-percent increase over 1938. Of the 1939 total, 58 percent was home scrap and 42 percent purchased scrap.

The proportion of scrap used in blast furnaces again declined in 1939, amounting to 5.6 percent of the pig iron produced in 1939 compared with 5.7 percent in 1938 and 6.6 in 1937. Purchased scrap was equivalent to 2.3 percent of the pig iron produced in 1939 compared with 1.6 percent in 1938 and 2.5 in 1937.

Blast furnaces in Ohio continued to consume more scrap in 1939 than those in any other State, using 52 percent more than Pennsylvania, the second ranking State; in 1938 Ohio furnaces consumed 30 percent more than Pennsylvania furnaces.

Consumption of ferrous scrap in blast furnaces in the United States in 1939, by districts and States, in gross tons

District and State	Active plants reporting	Scrap: Home	Scrap: Purchased	Scrap: Total
New England and Middle Atlantic:				
Massachusetts	1	50,503	95,480	145,983
New York	7			
Pennsylvania	21	257,676	118,163	375,839
Total: 1939	29	308,179	213,643	521,822
1938	24	205,969	78,225	284,194
Southeastern:				
Alabama	6	175,918	45,101	221,019
Kentucky	1		26,903	26,903
Maryland	1	45,421	8,913	54,334
Tennessee	1	194	691	885
West Virginia	2	14,687		14,687
Total: 1939	11	236,220	81,608	317,828
1938	12	200,141	43,653	243,794
North Central:				
Illinois	4	81,022	40,555	121,577
Indiana	3	27,773	13,906	41,679
Iowa	1		1,000	1,000
Michigan	4	45,582	84,454	130,036
Minnesota	2	5,266	7,396	12,662
Ohio	21	292,926	278,688	571,614
Total: 1939	35	452,569	425,999	878,568
1938	33	348,798	178,700	527,498
Rocky Mountain:				
Colorado	1	7,597	36	7,633
Utah	1			
Total: 1939	2	7,597	36	7,633
1938	2	8,924		8,924
Total United States: 1939	77	1,004,565	721,286	1,725,851
1938	71	763,832	300,578	1,064,410

FOREIGN TRADE [7]

Imports.—Imports of iron and steel scrap into the United States, which are unimportant, totaled 29,492 gross tons valued at $301,513 in 1939 compared with 24,451 tons valued at $281,240 in 1938. Of the 1939 total, 27,208 tons came from Canada, 1,219 tons from Mexico, 937 tons from Europe, and only 128 tons from other countries. In addition, 12,633 tons of tin-plate scrap were imported in 1939, largely from Canada, compared with 10,444 tons in 1938 and 12,916 tons in 1937.

Exports.—Ferrous scrap exports (all types) from the United States in 1939 exceeded those of 1938 by 20 percent in tonnage and 22 percent in value, being outdistanced in tonnage and value only by the record shipments of 1937. A total of 3,584,439 gross tons valued at $55,911,516 was exported in 1939 compared with 2,998,591 tons valued at $45,829,533 in 1938. The shipments included 25,888 tons of tin-plate scrap, waste—waste tin plate, tin plate strips, cobbles, etc., valued at $1,121,153 in 1939 compared with 24,216 tons valued at $902,607 in 1938. The following table shows the principal countries to which shipments of scrap were consigned during the 5-year period 1935–39.

[7] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Ferrous scrap exported from the United States, 1935–39, by countries, in gross tons

Country	1935	1936	1937	1938	1939
Canada	96,128	63,712	185,571	92,217	175,496
Germany	4,113	6,799	88,153	230,903	16,584
Italy	382,775	285,126	381,394	434,717	425,896
Japan	1,117,973	1,057,621	1,911,508	1,381,801	2,024,264
Netherlands	9,055	4,777	143,401	206,554	52,864
Poland and Danzig	36,627	31,104	275,607	151,451	154,608
United Kingdom	277,366	364,874	847,177	387,347	508,293
Other countries	179,922	122,119	268,738	113,601	226,434
	2,103,959	1,936,132	4,101,549	2,998,591	3,584,439
Total value	$22,949,070	$24,684,084	$79,387,459	$45,829,533	$55,911,516

Of the total exports of ferrous scrap from the United States in 1939, 2,000,940 gross tons cleared through customs districts on the Atlantic coast (1,769,611 tons in 1938), 876,976 tons from districts bordering the Gulf of Mexico (779,613 tons in 1938), 544,554 tons from districts along the Pacific coast (368,842 tons in 1938), and 161,969 tons from other customs districts (80,525 tons in 1938).

Exports were drawn largely from seaboard areas where the cost of transportation from the point of origin to the port of exportation is relatively low and where the cost of transportation to domestic iron and steel plants not within the area is often prohibitive.

WORLD ASPECTS

The increase in world steel production in 1939, owing in a large measure to the turbulent state of affairs among the powerful foreign nations, resulted in expansion of the use and demand for iron and steel scrap compared with 1938. According to Metal Statistics 1940, world production of steel in 1939 totaled 131,800,000 gross tons, a 24-percent increase over the 1938 production of 106,000,000 tons and only 500,000 tons below the 1937 record (132,300,000 tons). The United States supplied 71 percent of the world increase, and all other countries contributed 29 percent. However, world production of steel in 1939, excluding the United States, established an all-time record of 85,050,000 tons, a 10-percent increase over the 1938 figure (77,650,000 tons) and a 4-percent increase over the 1937 record (81,731,000 tons). Steel production in the United States increased 66 percent over 1938.

World production of pig iron (including ferro-alloys) in 1939 totaled 100,389,000 gross tons, an increase of 18,803,000 tons over the 1938 production of 81,586,000 tons but a loss of 2,166,000 tons from the previous 1937 record of 102,555,000 tons. The United States supplied the greater part of the increase in world pig-iron production in 1939, as indicated by the fact that production of the rest of the world totaled 68,578,000 tons, an increase of 6,169,000 tons over the 1938 production of 62,409,000 tons.

The increased spread between the production of pig iron and steel in 1939 compared with 1938 indicates a pronounced rise in the world use of iron and steel scrap during 1939.

Cartel activities.—In the first 8 months of 1939 the British Iron and Steel Federation, acting for the International Scrap Convention, made two purchases of iron and steel scrap in the United States that totaled about 850,000 gross tons. Immediately after the outbreak of war in September the International Scrap Convention suspended operations, although no formal liquidation took place.[8] In the remainder of 1939 each European nation bought independently. Italy and the Balkan States made additional purchases totaling about 100,000 tons, but the United Kingdom, which had a large share in the earlier purchases made for the cartel, ceased buying. As in former years, the extensive purchases of scrap made by Japan in the United States during 1939 were negotiated by the several large mercantile houses of that nation.

REVIEW BY COUNTRIES

Germany.—Steel production in Germany proceeded at a feverish rate to meet the 1939 military requirements. New records were established, and the German output of steel ingots and castings continued to exceed the combined production of the United Kingdom and France. The productive capacity of Germany was augmented by conquests of Czechoslovakia and Poland, although these acquisitions furnished little additional raw-material supplies and the rate of steel production remained very largely dependent on imports of iron ores from the Scandanavian Peninsula. Germany adopted stringent measures to conserve its domestic supplies of iron and steel scrap. The use of pig iron produced from low-grade domestic ores and high-grade imported ores was continued. German imports of scrap from the United States were reduced drastically in 1939 and, 2 months before the outbreak of war, shipments from the United States to Germany had ceased. Figures showing the consumption of scrap in Germany in 1939 are not available, but it is estimated that the consumption in 1938 totaled 11,000,000 metric tons compared with 10,000,000 in 1937 and 9,700,000 in 1936.[9]

Italy.—Steel production in Italy reached new high levels in 1939, although the increase over previous years was relatively small. Italian production of pig iron also set a new record in 1939, but the iron and steel industry remains dependent by a wide margin on foreign raw materials. Italian imports of pig iron are surpassed by those of iron and steel scrap; and, although imports of scrap from the United States, whence Italy has received more than half its imports of this commodity in recent years, were slightly lower in 1939 than in 1938, the decrease may be attributed to a lack of shipping facilities occasioned by the outbreak of Allied and German hostilities. Italy is keenly aware of the vulnerability of her steel industry and, to minimize demand for raw materials from foreign sources, has by Royal Decree Laws issued stringent regulations regarding the use of scrap.[10] Restrictive measures also have been taken to curtail certain uses of iron and steel, and these materials may no longer be employed for enclosures, divisions of land, gardens, villas, etc., including barbed wire and fencing of any metal.[11]

Japan.—The Japanese steel industry, which has maintained a spectacular growth during the past decade, established new production records in 1939. The problem of raw materials is still difficult, as evidenced by the fact that steel production, which has almost tripled

[8] Daily Metal Reporter, vol. 39, No. 197, October 14, 1939, p. 10.
[9] Daily Metal Reporter, vol. 39, No. 87, May 9, 1939, p. 10.
[10] Bureau of Mines, Mineral Trade Notes: Vol. 10, No. 2, February 20, 1940, p. 9.
[11] Iron and Steel Fortnightly, vol. 1, No. 14 (N. S.), July 20, 1939, p. 94.

since 1930, has not been accompanied by proportionate increases in the output of pig iron. Consequently the maintenance of present production rates depends entirely on imports of pig iron and iron and steel scrap. Although sources of scrap within the empire are not large, strict Government control is exercised over all available supplies. A new iron and steel industrial policy provides for the unification, purchase, and distribution of scrap iron and the establishment of prices for materials based on the efficiency of various plants.[12]

The announced abrogation of the Treaty of Commerce and Navigation between the United States and Japan and the outbreak of war in Europe caused no little disturbance within Japanese iron and steel circles during the last 5 months of 1939. Apprehension regarding these matters was based on Japanese dependence on iron and steel scrap imports from the United States, on iron ore brought in from colonial possessions of belligerent countries, on securing plant equipment from Germany, and on the importation of special and alloy steels required for the aircraft, automobile, and machine-tool industries.[13]

Poland.—At the outset of 1939 it appeared that Poland, because of the seizure of the Trans-Olzan area from Czechoslovakia, had accomplished self-sufficiency in steel-making and was capable of meeting the needs of national defense. However, in the spring of 1939 the demand for armament became very great, and Poland entered world scrap markets, placing large orders in France and the United States. Consignments of scrap from the United States to Poland, which totaled approximately 15,000 gross tons for the first 4 months of 1939, increased to over 26,000 tons in May and continued at higher rates in June, July, and August. However, they dropped to less than 9,000 tons in September and disappeared after the German military conquest of Poland.

United Kingdom.—Scrap was an extremely significant factor in the all-time records of steel production established in the United Kingdom during 1939. Excess supplies of iron and steel scrap that depressed markets during 1938 disappeared rapidly following the increased production rate of the first quarter of 1939. Imports of scrap from the United States were resumed in March and established new highs during the third quarter; however, the trend was sharply downward throughout the remaining months of the year. House-to-house collection campaigns for scrap were inaugurated as early as March 1939, and some 150,000 firms were requested to assist by contributing whatever scrap was in their possession.[14] Later, following the outbreak of war, collection campaigns were intensified and extended to include dumps to assemble as much scrap as possible at home with a view toward reducing the number of ships involved in the scrap trade. The steel industry undertook to use higher ratios of pig iron in furnace charges, hoping to abate the demand for scrap.[15] Nevertheless, figures for 1939 indicate that a larger proportion of scrap was used than during any of the years immediately preceding.

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[12] Iron and Steel Fortnightly, vol. 1, No. 24, December 20, 1939, p. 152.
[13] Iron and Steel Fortnightly, vol. 1, Nos. 19 and 20 (N. S.), October 1939, p. 113.
[14] Bureau of Mines, Mineral Trade Notes: Vol. 10, No. 3, March 20, 1940, pp. 6, 7, 8.
[15] Iron Age, vol. 143, No. 25, June 22, 1939, p. 75.

IRON ORE, PIG IRON, FERRO-ALLOYS, AND STEEL

By Robert H. Ridgway and H. W. Davis [1]

SUMMARY OUTLINE

War-geared international economy drove world production of iron and steel to record or virtually record levels in 1939. Although other nations expanded their near-capacity activities of 1938, the major part of the world increase in 1939 was due to the gain in American output, which rose precipitously during the latter half of the year. Relatively small quantitative increases established new production peaks in Germany, Italy, Japan, the U. S. S. R., and the United Kingdom. Some of the gain in Germany, the second largest world producer and the largest producer in Europe, was due to territorial accession during 1939; but production in that country, even as formerly constituted, advanced despite some slowing down in certain Saar works during the first stages of the war. As a result of hostilities, output of iron and steel in several of the principal countries is under strict control and is oriented to armament and munitions, with little attention to civilian requirements. World production of pig iron (including ferro-alloys) and steel increased 23 percent and 24 percent, respectively, compared with 1938; domestic production of each increased 66 percent, and output of each in the rest of the world rose 10 percent. Of the total world output of pig iron and steel in 1939 the United States furnished about 32 and 35 percent, respectively, compared with the 23 and 27 percent in 1938. Since the depression the United States has been supplying a smaller proportion of the total world iron and steel production than formerly.

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

Salient statistics of iron ore, pig iron, ferro-alloys, and steel in the United States, 1938–39

	1938		1939	
	Gross tons	Value	Gross tons	Value
Iron ore:				
Production by—				
Districts:				
Lake Superior	21,308,410		41,679,608	
Southeastern	4,325,729	(1)	6,011,420	(1)
Northeastern	2,306,910		3,112,893	
Western	506,233		917,448	
	28,447,282	(1)	51,721,369	(1)
Mining methods:				
Open pit	[2][3] 14,705,349	(1)	[2] 32,741,636	(1)
Underground	[2][3] 13,741,933		[2] 18,979,733	
	28,447,282	(1)	51,721,369	(1)
Varieties:				
Hematite	[4][5] 25,607,467		[4][5] 47,756,770	
Brown ore	363,146	(1)	586,372	(1)
Magnetite	[4][5] 2,476,221		[4][5] 3,377,764	
Carbonate	448		463	
	28,447,282	(1)	51,721,369	(1)
Shipments (exclusive of ore for paint)	26,430,910	$74,322,405	54,820,589	$158,511,338
Average value per ton at mine		2.81		2.89
Stocks at mines Dec. 31	7,611,048	(1)	4,746,507	(1)
Imports	2,122,455	5,288,195	2,412,515	5,865,510
Exports	591,524	1,954,287	1,057,304	3,578,086
Pig iron:				
Production	18,582,322	(1)	31,075,914	(1)
Shipments	18,202,354	356,875,369	32,091,485	626,824,690
Average value per ton at furnaces		19.61		19.53
Imports	30,400	598,461	38,592	663,091
Exports	432,851	7,135,129	177,024	3,435,739
Ferro-alloys:				
Production	584,724	(1)	735,171	(1)
Shipments:				
Ferromanganese	223,720	19,144,884	296,631	24,137,211
Spiegeleisen	24,939	[3] 728,830	84,739	2,484,042
Ferrosilicon	163,775	7,999,661	343,822	16,850,356
Other varieties	51,678	14,586,138	115,970	32,684,979
	464,112	[3] 42,459,513	841,162	76,156,588
Imports:				
Ferromanganese	26,258	1,770,948	41,227	2,935,214
Spiegeleisen	17,248	625,480	38,264	1,329,814
Ferrosilicon	5,325	134,067	8,203	237,543
Steel production:				
Open hearth:				
Basic	25,691,963		42,704,197	
Acid	272,337		518,839	
Bessemer	1,880,661	(1)	2,999,032	(1)
Crucible	6		831	
Electric	505,024		918,810	
	28,349,991	(1)	47,141,709	(1)

[1] Figures not available. [2] Some underground included with open pit. [3] Revised figures.
[4] Small quantity of hematite included with magnetite.
[5] Small quantity of magnetite included with hematite.

As iron and steel manufacture the major implements of war, unsettled conditions in Europe and Asia dominated the iron-ore industry in 1939 and disturbed the usual routes of flow. Faced with problems of restricted imports and national self-sufficiency, certain European powers in recent years have focused their attention on development and treatment of low-grade ore bodies within their national boundaries. These activities were accelerated in 1939, particularly in Germany and the United Kingdom; even so, both countries still depend heavily on foreign ore supplies. The supply of raw materials, especially iron ore in Germany and England and to a smaller extent coal in France and Italy, is of utmost importance in maintaining the steel-production rate. The present international situation is furnishing further impetus to the nationalistic spirit of self-sufficiency, particularly as to iron and steel, in other nations.

In the first half of 1939 the domestic iron and steel industry maintained the gain of the last half of 1938, and steel operations were about 53 percent of capacity or slightly below those during the last quarter of 1938. During the latter half of 1939, however, production increased rapidly, amounting to nearly 5,500,000 tons in November or more than 93 percent of capacity compared with 62 percent in November, the peak month for 1938. Slightly more than one-third of the 1939 output was made in the final 3 months, when the production rate for steel ingots rose to new heights. At the close of 1939, activities were off a little but were still at a high rate (86 per-

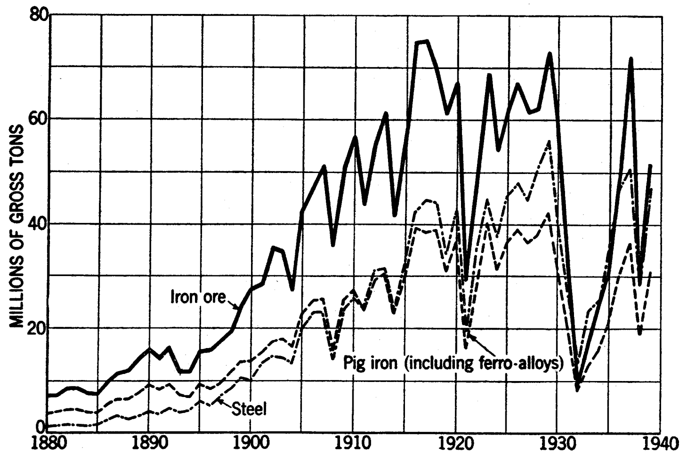

FIGURE 1.—Trends in production of iron ore, pig iron, and steel in the United States, 1880–1939.

cent of capacity for December); the average rate of production in the last quarter of 1939 was 89 percent compared with 51 percent in the second quarter. The average operating rate during 1939 was 64 percent compared with 40 percent in 1938. The producers of such mineral products as iron ore, manganiferous iron ore, fluorspar, fluxing stone, and coke, which depend on iron and steel furnaces for their chief market, felt the increased demand during the last half of 1939. Domestic production of iron ore, the principal raw material, increased 82 percent over 1938 but still was 21 percent under the 1925–29 average. Figure 1 shows the trends in domestic production of iron ore, pig iron, and steel for more than half a century.

A factor in the rise of domestic steel output in 1939 was the decision of consumers to change their inventory position. The advent of war in Europe created uncertainties that caused consumers of steel to rush to build up stocks of raw material. The automobile industry, with a strong fourth-quarter demand, was the largest consuming outlet for steel, taking about one-sixth of the total. Production of automobiles in 1939 increased 44 percent over 1938 and amounted to

3,577,058 units—still somewhat below the 5-million car year 1929. Although the farmer's cash income rose about 5 percent in 1939, the quantity of steel moving into this outlet was lower than in 1938. Exports of steel in 1939 increased over 1938 and were more than treble the quantity moving into agriculture. The relative quantity of steel used in containers, the third largest consuming outlet, was about the same in 1939 as in 1938.

The capital-goods industries expanded in 1939, and more steel was consumed in this outlet. Buying of equipment by the railroads rose sharply in September, and they participated in the business expansion of the fall when full utilization of capacity was approached. The problem of insufficient capacity of railroad equipment owing to the small outlays for new rolling stock during the last decade was brought into focus by the 1939 peak carloadings and heavy railway traffic. Recent replacements of rolling stock are designed for increased speed and efficiency, both for passenger and freight service. New freight cars made of low-alloy, high-strength steels increase capacity and lighten dead weight. Thus less steel may be used as a new unit replaces an old one. Large expenditures, however, will be necessary to correct the accumulated obsolescence.

The shipbuilding industry revived in 1939, and at the end of the year the total tonnage under construction in American shipyards was the highest since 1920. Activity increased in both private and Government yards on merchant and naval ships. The shipbuilding industry was bolstered by the acceleration of the building program of the Maritime Commission in September.

The construction industry had a better year in 1939 than in 1938, as activities continued to advance for the sixth consecutive year. Both public and private work contributed to the increase, with residential building especially active. Industrial and commercial building were only moderately higher in 1939 than in 1938, but increases were more pronounced after conditions changed in September. Despite the increase, total expenditures for construction in 1939 were less than three-quarters of those in the peak years 1926 to 1929; however, the physical volume and consumption of raw material, including steel, undoubtedly were greater as construction costs have changed during the last decade.

Continuing the movement of 1938, the price of steel products dropped during the first half of 1939 as demand weakened and the upturn of production late in 1938 flattened and receded. Price reduction during the first half of 1939 on nearly all steel products brought down the composite price of finished steel, as compiled by Iron Age, to 2.236 cents per pound in June from 2.286 cents at the beginning of the year. Recovery followed, and before the year ended there was frenzied buying of many products as consumers sought to fill their needs in advance because of fears that war would cause higher prices and delayed deliveries. At the beginning of the last quarter of 1939 the mills were generally sold out for the rest of the year, and prices advanced, the Iron Age average rising to 2.242 cents for November and 2.261 cents for December. The average for the year was 2.257 cents a pound. Pig-iron prices followed somewhat the same pattern, but buying during the earlier months was restricted by hold-over contracts. September saw a big "pick-up" in demand as prices advanced $1 to $2 a ton on most grades. The Iron Age composite pig-iron price, which was $20.61 a long ton until the end of August, advanced $1 a ton in September and $1 more in October; it held the October level the rest of the year. Scrap prices, which had been fairly steady until September, rose 44 percent by early October but were off several dollars per ton during the rest of the quarter. The price of ferromanganese at seaboard was reduced $12.50 a ton, in January, but in September it was raised to $100 a ton. Spiegeleisen, which had been quoted at $28 during the year, also increased in price in September, that of the 19–21 percent manganese grade advancing to $32. The quotations on Lake ores for the 1939 season were unchanged from 1938.

Figure 2 gives trends in prices of iron ore, pig iron, steel, and steel scrap since 1890.

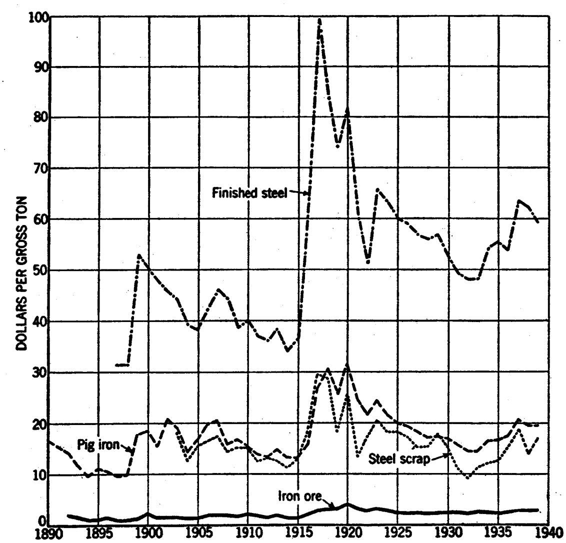

FIGURE 2.—Trends in prices of iron ore, pig iron, finished steel, and steel scrap, 1890–1939. The prices of iron ore and pig iron are the averages f. o. b. mines and furnaces, respectively, as reported to the Bureau of Mines; the price of finished steel is an average composite computed by American Metal Market; that of steel scrap is an average at Pittsburgh of No. 1 Heavy Melting, computed by Iron Age.

Employer-employee relationships, which have been receiving increased attention in recent years, were better in 1939 than in 1938 as employment rose to a higher level. As operations at plants increased there were steady gains in employment and earnings of wage earners during the year. According to the American Iron and Steel Institute average hourly earnings were 84 cents, the highest for any year in the history of the industry. Total pay rolls in the industry in 1939, according to the same source, were $810,000,000 compared with $600,000,000 in 1938. The contract entered into in March 1937 between the steel-manufacturing subsidiaries of the United States Steel Corporation and representatives of the Steel Workers Organizing Committee, one of the affiliates of the Congress of Industrial Organizations, as the collective bargaining agency for employees who were members of the Amalgamated Association of Iron, Steel, and Tinworkers of America, expired in February 1938. The agreement was renewed subject to change upon 10 days' notice from either party and to termination if changes are not agreed to within 20 days of the notice. This affords an opportunity for adjustment of operations to varying economic conditions. Apparently, the agreement is working out satisfactorily to the parties concerned, as there have been no changes since the signing. There were no major strikes in the iron and steel industries in 1939, although the Bureau of Labor Statistics, United States Department of Labor, lists 57 strikes that began in 1939, which involved 14,466 workers and resulted in 212,760 man-days idle during the year; however, all of the strikes were minor in extent. The wages-and-hours law, which provided for a change from 25 to 30 cents in the hourly rate and a reduction of the workweek from 44 to 42 hours effective October 24, 1939, had little or no effect on the iron and steel industry.

The record rate of activity in the steel industry during the closing months of 1939 brought production to near capacity. As the rise was abrupt, little time was available for expansion, and problems of immediate production were paramount. Present steel making and finishing capacity can take care of any reasonable demands, and little new capacity was added in 1939. War orders might serve as an incentive to increase capacity; but industry, recalling events of the last war, is chary of making investments on this basis. Three blast-furnace stacks were remodeled during the year, and four stacks were dismantled, resulting in a decrease in blast-furnace capacity. Only one open-hearth furnace (Alton, Ill.) was added to capacity in 1939. Considerable capacity was added to finishing operations of the steel processes, thereby rounding out activities of various producers.

Imports of iron ore into the United States in 1939 increased 14 percent over 1938 and were equivalent to 5 percent of the domestic production. Imports of pig iron rose 27 percent but were equivalent to only 0.1 percent of the domestic output. Imports of ferro-alloys also increased owing to much larger receipts of ferromanganese and spiegeleisen, the latter having more than doubled the 1938 figure. Imports of iron and steel manufactures, although relatively small, gained 19 percent over the low total for 1938. Exports of iron and steel products, which are much higher than imports, likewise advanced, topping those of 1938 by 16 percent. Exports of pig iron amounted to 177,024 long tons and were much lower than in 1938, whereas exports of iron ore, largely to Canada, increased 79 percent. Exports of ferro-alloys were higher than in 1938 but still did not represent much tonnage. Although exports of scrap increased 20 percent over 1938, they were 13 percent below the 1937 total.

Import duties on a few minor iron and steel products were lowered in 1939 under the Trade Agreements Act of June 12, 1934. These changes, which were provided for in the new trade agreement with Canada signed November 17, 1938, became effective January 1, 1939, and superseded the agreement signed November 15, 1935. There were also some changes, including a reduction in the duty on low-phosphorus (0.04 percent and under) pig iron from $1.125 to $0.75 per long ton, in the trade agreement with the United Kingdom, which likewise was signed November 17, 1938, to become effective January 1, 1939. Chromite was bound on the free list in the Turkish Agreement signed April 1, 1939, to become effective May 5, 1939.

In connection with its studies on the concentration of economic power, the Temporary National Economic Committee held hearings on various phases of the iron and steel industry late in the year. Testimony was taken from men in the industry with a view to developing information on the competitive position of different factors of the industry.

CONSUMPTION OF FERROUS SCRAP AND PIG IRON

Data on the consumption of ferrous scrap and pig iron, formerly included in this chapter, will be found in the chapter on Iron and Steel Scrap. Data on the consumption of pig iron will be found in the pig-iron section of this chapter.

IRON ORE

Production and shipments.—Mining of iron ore in the United States experienced the second best year since 1930. Production amounted to 51,721,369 gross tons, a gain of 82 percent over 1938 but 21 percent under the 1925–29 average. Output in 1939 came from 208 mines (this figure does not include an undetermined number of small operations whose aggregate output is only a fraction of 1 percent of the total), of which 11 produced more than 1 million tons each compared with 172 mines having only 4 in the million-ton class in 1938. Sixteen States were active producers in 1939 as well as in 1938. Minnesota, with 31,547,701 tons, supplied 61 percent of the domestic total, and Michigan, with 9,159,222 tons or 18 percent, was the second largest producer. These two States and Wisconsin (972,685 tons or 2 percent) constitute the Lake Superior region, which furnished 81 percent of the domestic total. Of the 1939 total, about three-fifths came from open-pit operations compared with about one-half in 1938. Shipments of iron ore likewise were much larger in 1939, amounting to 54,820,589 gross tons, an increase of 107 percent over 1938 but 18 percent less than the 1925–29 average. The greater part of the iron ore mined in the United States is used in the manufacture of iron and steel, but 56,763 tons of domestic ore were shipped in 1939 for other uses as follows: Cement, 33,140 tons; paint, 12,235 tons; ferromagnesite, 3,000 tons; flux at nonferrous smelters, 6,640 tons; and other industries, 1,748 tons.

The quantities of iron ore shown in the following tables include ore that was beneficiated—that is, treated in any way—as well as ore that did not require treatment. Although included in the figures on production, the iron ore sold for the manufacture of paint—12,235 tons in 1939 valued at $66,817 ($5.46 a ton) compared with 9,694 tons in 1938 valued at $44,249 ($4.56 a ton)—is not included in shipments from mines. The output of manganiferous ore that contained 5 to 35 percent manganese also is not included; 709,247 tons, valued at $2,148,321, were shipped in 1939 compared with 308,860 tons, valued at $858,356, in 1938. Moreover, the statistics do not include iron sinter recovered from the roasting of domestic pyrites concentrates in Tennessee.

Iron ore mined in the United States in 1939, by States and varieties, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	Number of active mines	Hematite	Brown ore	Magnetite	Carbonate	Total
Alabama	58	5,445,868	514,639			5,960,507
California	4	[1] 17,173		(1)		17,173
Georgia	10	7,867	18,219	247		26,333
Michigan	36	9,159,222				9,159,222
Minnesota	65	31,547,701				31,547,701
Missouri	[2] 12	9,824	29,415			39,239
New Jersey	4			399,289		399,289
New York	4	(3)		[3] 2,713,141	463	2,713,604
Pennsylvania	2					
South Dakota	1		300			300
Tennessee	[2] 2	781	23,799			24,580
Virginia	2					
Utah	2			262,087		262,087
Washington	3	7,757		3,000		10,757
Wisconsin	2	972,685				972,685
Wyoming	1	587,892				587,892
Total: 1939	[2] 208	[1 3] 47,756,770	586,372	[1 3] 3,377,764	463	51,721,369
1938	[2] 172	[1 3] 25,607,467	363,146	[1 3] 2,476,221	448	28,447,282

[1] Small quantity of magnetite included with hematite.
[2] Excludes an undetermined number of small pits. The output of these pits is included in the tonnage given.
[3] Small quantity of hematite included with magnetite.

Quantity and tenor of iron ore mined in the United States, 1938–39, by States and mining methods

State	1938				1939			
	Open pit (gross tons)	Underground (gross tons)	Total		Open pit (gross tons)	Underground (gross tons)	Total	
			Gross tons	Iron content, natural (percent)			Gross tons	Iron content, natural (percent)
Alabama	332,717	3,970,612	4,303,329	36.36	533,665	5,426,842	5,960,507	36.42
California	28,380		28,380	55.07	17,173		17,173	56.40
Georgia	8,944	277	9,221	39.33	26,333		26,333	47.91
Michigan	686,981	5,317,330	6,004,311	52.23	1,246,550	7,912,672	9,159,222	51.68
Minnesota	[1] 11,195,117	[1] 3,254,187	14,449,304	52.31	27,639,063	3,908,638	31,547,701	52.43
Missouri	27,409	1,135	28,544	51.33	37,989	1,250	39,239	52.51
New Jersey		185,639	185,639	63.24		399,289	399,289	63.32
New Mexico	1,826		1,826	61.11				
New York	[2] 2,121,271	(2)	2,121,271	67.10	[2] 2,713,604	(2)	2,713,604	66.85
Pennsylvania				42.76				40.15
Tennessee	13,179		13,179	47.15	24,580		24,580	46.41
Virginia				52.53				53.28
Utah	167,933		167,933	54.11	262,087		262,087	53.18
Washington	1,825	1,730	3,555	39.41	8,326	2,431	10,757	44.48
Wisconsin		854,795	854,795	53.26		972,685	972,685	53.10
South Dakota					300		300	53.22
Wyoming	119,767	156,228	275,995	52.80	231,966	355,926	587,892	
	[1 2] 14,705,349	[1 2] 13,741,933	28,447,282	49.55	[2] 32,741,636	[2] 18,979,733	51,721,369	50.28

[1] Revised figures. [2] Some underground included with open pit.

Iron ore mined in the United States, by mining districts and varieties in 1939, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

District	Hematite	Brown ore	Magnetite	Carbonate	Total
Lake Superior	41,679,608				41,679,608
Birmingham	5,443,372	291,316			5,734,688
Chattanooga	11,144	97,467	247		108,858
Adirondack and Cornwall			[1] 2,713,141		[1] 2,713,141
Northern New Jersey			399,289		399,289
Other districts	[1 2] 622,646	197,589	[2] 265,087	463	[1] 1,085,785
	[1 2] 47,756,770	586,372	[1 2] 3,377,764	463	51,721,369

[1] Small quantity of hematite from "Other districts" included with magnetite from Adirondack and Cornwall districts.
[2] Small quantity of magnetite included with hematite.

Iron ore shipped from mines in the United States, 1938–39, by States

[Exclusive of ore containing 5 percent or more manganese and ore sold for paint]

State	1938		1939	
	Gross tons	Value	Gross tons	Value
Alabama	4,281,332	$7,341,620	5,985,208	$9,971,024
California	28,378	(1)	17,173	(1)
Georgia	9,221	11,375	25,846	51,078
Michigan	4,092,902	13,139,823	11,238,605	37,026,665
Minnesota	14,535,744	44,361,534	32,370,241	97,113,591
Missouri	20,671	31,514	36,638	53,839
New Jersey	139,890	760,929	394,709	1,865,037
New Mexico	1,826	(1)		
New York, Pennsylvania	2,232,837	5,867,320	2,693,856	7,403,750
Tennessee, Virginia	13,456	(1)	23,759	(1)
Utah	169,947	(1)	262,087	(1)
Washington	3,333	(1)	10,747	44,188
Wisconsin	625,378	1,886,477	1,173,828	3,526,980
Wyoming	275,995	(1)	587,892	(1)
Undistributed		[2] 921,813		[2] 1,455,186
	26,430,910	74,322,405	54,820,589	158,511,338

[1] Included under "Undistributed." [2] Includes value for States entered as "(1)."

Principal mines.—The importance of large mining units in the iron-mining industry is shown by the fact that 11 yielding more than 1,000,000 tons each produced about half the entire output in 1939. In years of heavy demand this situation is more pronounced, thus concentration of production was greater in 1939 than in 1938, when 13 mines yielding more than 500,000 tons each furnished about half the output. Of the eleven 1-million-ton producers in 1939, 9 were in Minnesota (all on the Mesabi range), with 1 each in Alabama and Pennsylvania. Only 4 contributed a million tons or more in 1938. Of the 11 principal producers in 1939, 7 were open pits; 1 was operated by underground methods, and 3 were combinations. Except for 1 mine that produced magnetite, all principal mines produced hematite.

Iron-ore mines of the United States in 1939, by size of output

Name of mine	State	Nearest town	Range or district	Mining method	Gross tons
Hull-Rust-Burt-Sellers group.	Minnesota	Hibbing	Mesabi	Open pit	5,389,179
Red Mountain group	Alabama	Bessemer	Birmingham	Underground	3,350,184
Missabe Mountain	Minnesota	Virginia	Mesabi	Open pit	2,739,250
Mahoning	do	Hibbing	do	do	2,525,921
Hill Annex	do	Calumet	do	do	2,166,603
Adams-Spruce group	do	Eveleth	do	Combination	1,606,295
Minnewas	do	Virginia	do	Open pit	1,393,281
Morris	do	Hibbing	do	Combination	1,183,718
Hill-Trumbull	do	Marble	do	Open pit	1,019,673
Frazer	do	Chisholm	do	do	1,000,317
Woodward No. 3	Alabama	Bessemer	Birmingham	Underground	885,223
Mesabi Chief	Minnesota	Nashwauk	Mesabi	Open pit	839,325
Hartley-Burt	do	Chisholm	do	do	809,505
Montreal	Wisconsin	Montreal	Gogebic	Underground	808,973
Raimund Nos. 1 and 2	Alabama	Bessemer	Birmingham	do	662,473
Susquehanna	Minnesota	Hibbing	Mesabi	Open pit	618,639
Grant	do	Buhl	do	do	601,118
Sunrise	Wyoming	Sunrise	Hartville	Combination	587,892
Biwabik	Minnesota	Biwabik	Mesabi	Open pit	575,740
Morrison	do	Coleraine	do	do	569,378
Webb	do	Hibbing	do	Combination	564,781
Pioneer	do	Ely	Vermilion	Underground	555,127
Godfrey	do	Chisholm	Mesabi	do	554,454
Negaunee	Michigan	Negaunee	Marquette	do	551,362
Anvil-Palms-Keweenaw.	do	Bessemer	Gogebic	do	533,027
Sloss Nos. 1 and 2	Alabama	do	Birmingham	do	528,962
Maas	Michigan	Negaunee	Marquette	do	520,944
Leonidas	Minnesota	Eveleth	Mesabi	do	508,360
Output of 28 [1] mines producing more than 500,000 tons each					[1] 33,649,704
Output of 10 [1] mines producing between 400,000 and 500,000 tons each					[1] 5,945,198
Output of 10 mines producing between 300,000 and 400,000 tons each					3,340,130
Output of 11 mines producing between 200,000 and 300,000 tons each					2,762,501
Output of 28 mines producing between 100,000 and 200,000 tons each					4,181,991
Output of 17 mines producing between 50,000 and 100,000 tons each					1,216,178
Output of 104 [2] mines producing less than 50,000 tons each					625,667
Grand total of United States (208 [2] mines)					51,721,369

[1] Output of 1 mine producing more than 500,000 tons included with mines producing between 400,000 and 500,000 tons each.
[2] Excludes an undetermined number of small pits. The output of these pits is included in the tonnage given.

Beneficiation.—Beneficiation of iron ore was reported at 51 mines in 8 States compared with 43 mines in 7 States in 1938. At many mines the ore is crushed and screened to improve its structure, but ore so improved is not included in the statistics on beneficiated ore. Some iron ore is recovered in the form of dust from blast furnaces; data on ore so recovered, however, have been accounted for previously in shipments from mines.

Beneficiated ore shipped from domestic mines in 1939 increased 95 percent over 1938 and comprised 17 percent of the total shipments in 1939 compared with 18 percent in 1938.

Beneficiated iron ore shipped from mines in the United States, 1938–39

[Exclusive of ore containing 5 percent or more manganese and of ore sold for paint]

State	Variety	1938		1939	
		Gross tons	Value	Gross tons	Value
Alabama	Brown ore	263,766	$605,226	471,054	$995,860
Georgia	do			11,840	21,312
Minnesota	Hematite	2,805,996	8,150,937	6,658,596	18,082,918
New Jersey	Magnetite	139,890	760,929	321,037	1,438,902
New York Pennsylvania	do do	1,613,602	4,443,421	1,933,404	5,869,653
Tennessee California	Brown ore Magnetite	13,181	34,542	23,367	52,848
		4,836,435	13,995,055	9,419,298	26,461,493

The quantity of crude ore beneficiated in the Lake Superior district (all in Minnesota) in 1939 totaled 10,194,506 gross tons and the beneficiated ore recovered 6,170,779 tons—a ratio of 1.652 to 1. In 1938 the crude ore treated totaled 5,112,485 tons and the beneficiated ore recovered therefrom 2,999,464 tons—a ratio of 1.704 to 1. Most of the concentration in this district is done by washing, but a few plants are equipped with jigs. Processes have been described by Zappfe and Hunner.[2] Most of the concentrated ore shipped from Minnesota is obtained in the treatment of wash ores from the western end of the Mesabi range which yield 65 percent concentrates and 35 percent tailings containing about 22 percent iron. Preliminary tests of a limited number of samples indicate that wash ore tailings are amenable to concentration by flotation[3] and that a merchantable commodity can be produced.[4] Improved concentration of low-grade ores is being given increased attention.

In recent years a process has been developed on the Mesabi range for roasting ore to the magnetic state and concentrating it on magnetic separators.[5] More recently heavy-density separation has been developed by Butler Bros. at the Harrison plant on the Mesabi range. The aim is to make a high-grade concentrate rather than a clean tailing. Finely ground ferrosilicon is used as a suspension medium in two 7½-foot-diameter cone separators that have a surprisingly large capacity. The material treated passes 1¼-inch but is retained on 4-mesh.[6] The ferrosilicon adhering to the concentrate and tailing is washed off on screens, thickened, passed through a magnetizing coil, and recovered by Crockett magnetic separators; it is then demagnetized and reused. The rated capacity of the plant is 160 tons of feed per hour to each cone, or a total of 320 tons per hour.[7] Experiments are being conducted on heavy-medium concentration of materials finer than 4-mesh.

[2] Zappfe, Carl, and Hunner, E. E., Preparation for Market Requirements, Shipment and Reduction: Lake Superior Iron Ores, chap. 6, Lake Superior Iron Ore Assoc., Cleveland, 1938, pp. 77–84.
[3] Searles, John N., Some Tests with Flotation on Mesabi Wash-ore Tailings: Eng. and Min. Jour., vol. 139, No. 6, June 1938, pp. 42–44.
[4] Counselman, T. B., Dollars in Current Tailings of Mesabi Washing Plants: Eng. and Min. Jour., vol. 140, No. 4, April 1939, pp. 34–36.
[5] Craig, J. J., Magnetic Concentration on the Mesabi Makes Progress: Eng. and Min. Jour., vol. 139, No. 1, January 1938, pp. 48–52.
[6] Engelmann, E. W., Concentration and Milling: Min. and Met., vol. 21, No. 397, January 1940, p. 37.
[7] Rudolph, J., Iron-ore Beneficiation: Eng. and Min. Jour., vol. 141, No. 2, February 1940, pp. 83–84.

The first concentration plant to be erected on the Vermilion range is under construction. The plant will treat ore left in underground workings by earlier operators.

Wet magnetic methods will replace dry magnetic machines in the new mill in the Mineville-Port Henry district of New York. In the Birmingham (Ala.) district the Tennessee Coal, Iron & Railroad Co. has under way a central ore conditioning and sintering plant. The Bureau of Mines continued its work on milling of the red iron ores and ferruginous sandstones of the Birmingham area by scuffing. Results indicate possible commercial application, and plans were materializing rapidly for installation of a plant incorporating this innovation.[8] Application of this principle to ferruginous sandstones that are low in phosphorus may result in production of a commodity useful in acid steel processes.

Beneficiated ore comprised a slightly smaller part of the total shipments in 1939. As pressure for production increases, a relatively larger proportion of the total comes from direct shipping ores. Thus in 1939 the percentage of beneficiated ore was about the same as in 1937, a year of very high production. Furthermore, in 1939, the immediate need for a high tonnage late in the year also favored production of the more easily obtainable direct shipping ores. Data for recent years are shown in the following table, and corresponding statistics for 1914 (the first year for which they were gathered) to 1929 are given in Mineral Resources, 1930. Data for 1930 to 1934, inclusive, are given in Minerals Yearbook, 1935.

Iron ore shipped from mines in the United States, 1925–29 (average) and 1935–39, in gross tons, and percentage of beneficiated ore compared to the total shipped

[Exclusive of ore containing 5 percent or more manganese and of ore sold for paint]

Year	Beneficiated	Total	Percentage of beneficiated to total	Year	Beneficiated	Total	Percentage of beneficiated to total
1925–29 (ave.)	8,653,590	66,697,126	13.0	1937	12,350,136	72,347,785	17.1
1935	6,066,601	33,426,486	18.1	1938	4,836,435	26,430,910	18.3
1936	9,658,699	51,465,648	18.8	1939	9,419,298	54,820,589	17.2

Average value.—The average value per gross ton of iron ore at the mines was $2.89 in 1939 compared with $2.81 in 1938.

The table that follows gives the average value at the mines of the different classes of iron ore in 1938–39 for each of the producing States or groups of States, except where there are fewer than three shippers of a certain variety of ore in a State and permission was not given to publish the value. These data are taken directly from statements of producers and probably represent the commercial selling prices only approximately, as not all reports are comparable. Some evidently include mining costs only; others contain, in addition, the cost of selling and insuring the ore; others include an allowance for a sinking

[8] Dean, R. S., Annual Report of the Metallurgical Division. Progress Report 34: Bureau of Mines Rept. of Investigations 3480, January 1940, pp. 67–69.

fund; and still others comprise only costs charged against blast furnaces. None of the reports, however, is supposed to include freight charges.

Average value per gross ton of iron ore at mines in the United States, 1938–39

[Exclusive of ore containing 5 percent or more manganese and of ore sold for paint]

State	Hematite		Brown ore		Magnetite	
	1938	1939	1938	1939	1938	1939
Alabama	$1.67	$1.62	$2.34	$2.16		
Georgia		2.53	1.23	1.74		(1)
Michigan	3.21	3.29				
Minnesota	3.05	3.00				
Missouri	1.51	2.14	(1)	(1)		
New Jersey					$5.44	$4.73
New York					2.63	2.75
Pennsylvania						
Wisconsin	3.02	3.00				
Other States [2]	1.35	1.13	2.49	2.42	2.76	2.83
	2.82	2.89	2.31	2.12	2.79	2.99

[1] Less than 3 producers; permission to publish not given, therefore value may not be shown.
[2] 1938: California, New Mexico, Tennessee, Utah, Virginia, Washington, and Wyoming; 1939: California, Tennessee, Utah, Virginia, Washington, and Wyoming.

Consumption.—The production of 31,075,914 gross tons of pig iron in 1939 required 53,422,383 tons of iron and manganiferous iron ores, 3,735,132 tons of mill cinder and roll scale, and 721,286 tons of purchased scrap, an average of 1.862 tons of metalliferous materials (exclusive of home scrap and flue dust) per ton of iron made.

The greater part of the iron ore used in Alabama furnaces in 1939 was hematite, chiefly from mines in Jefferson County, but some came from Etowah and St. Clair Counties. Considerable brown ore, iron sinter, pyrite ash, and imported iron ore and manganese ore and small quantities of domestic manganese-bearing ores were used. The brown ore originated chiefly in mines of the Birmingham and Russellville districts, Alabama. In addition to the iron sinter (sintered pyrite ash) from Tennessee, considerable pyrite ash was shipped to Birmingham in 1939 from acid plants in other Southern States. The pyrite from which the ash was made was of both domestic and foreign origin. The domestic manganese-bearing ores came chiefly from Alabama, Arkansas, Georgia, and Tennessee. Imported manganese-bearing ores came from Cuba. In 1939 Alabama furnaces consumed an average of 2.440 tons of ore in making 1 ton of pig iron, the highest average for any State.

Maryland furnaces consumed considerable domestic ore in 1939, in addition to ores from Africa, Australia, Brazil, Chile, Cuba, and Sweden. These furnaces used an average of 1.544 tons of ore per ton of pig iron; however, they used proportionately more cinder, scale, and scrap than furnaces in any other State except Minnesota.

Illinois, Indiana, Kentucky, Michigan, Minnesota, and West Virginia blast furnaces handled Lake Superior iron ore and manganiferous iron ore exclusively. Kentucky furnaces had the lowest consumption of metal-bearing material per ton of iron.

In New York the furnaces in the Buffalo district used ore chiefly from the Lake Superior district, as well as considerable magnetite from New York, and the furnace at Standish consumed magnetite from the Chateaugay mine at Lyon Mountain, N. Y.

Blast furnaces in Ohio consumed considerable magnetite from New York, hematite and brown ore from Missouri, and some ore from Africa, in addition to ore from the Lake Superior district.

Virtually all the ore consumed in western Pennsylvania furnaces came from the Lake Superior district. Those in the eastern part of the State used some Lake ores; magnetite ores from Pennsylvania, New Jersey, and New York; and considerable ore from Africa, Australia, Chile, Cuba, Sweden, and the U. S. S. R.

The Pueblo (Colo.) blast furnaces handled hematite from the Sunrise mine in Wyoming and manganese-bearing ores, chiefly from Colorado and New Mexico.

The Provo (Utah) furnace treated chiefly semialtered magnetite from the Iron Mountain mine near Cedar City, Utah, and manganese-bearing ores from Idaho and Utah.

The Tennessee furnace used Tennessee brown ore and iron sinter.

Iron ore and other metallic materials consumed and pig iron produced in 1939, by States, in gross tons

State	Metalliferous materials consumed				Pig iron produced, exclusive of ferro-alloys	Materials consumed per ton of iron made		
	Iron and manganiferous iron ores		Cinder, scale, and purchased scrap	Total		Ores	Cinder, scale, and purchased scrap	Total
	Domestic	Foreign						
Alabama	6,381,465	14,551	97,621	6,493,637	2,621,268	2.440	0.037	2.477
Illinois	4,577,855		300,040	4,877,895	2,650,541	1.727	.113	1.840
Indiana	5,680,528		479,053	6,159,581	3,309,903	1.716	.145	1.861
Kentucky	332,172		45,279	377,451	231,494	1.435	.196	1.631
Maryland	641,020	2,114,937	360,579	3,116,536	1,784,959	1.544	.202	1.746
Michigan	1,546,733		157,896	1,704,629	963,946	1.604	.164	1.768
Minnesota	314,621		38,012	352,633	176,699	1.781	.215	1.996
New York	3,515,369	582	142,452	3,658,403	2,046,447	1.718	.070	1.788
Ohio	11,739,847	7,395	1,089,897	12,837,139	7,216,278	1.628	.151	1.779
Pennsylvania	14,129,449	100,291	1,654,169	15,883,909	8,730,118	1.630	.189	1.819
West Virginia	1,272,943		54,549	1,327,492	750,016	1.697	.073	1.770
Undistributed [1]	1,028,338	24,287	36,871	1,089,496	594,245	1.771	.062	1.833
	51,160,340	2,262,043	4,456,418	57,878,801	31,075,914	1.719	.143	1.862

[1] Includes Colorado, Iowa, Massachusetts, Tennessee, and Utah.

Foreign iron and manganiferous iron ore consumed in the manufacture of pig iron in the United States, 1938–39, by sources of ore, in gross tons

Source of ore	1938	1939	Source of ore	1938	1939
Africa	8,711	47,084	Newfoundland		19,479
Asia	108	1,133	Norway		271
Australia	61,473	54,941	Sweden	4,215	7,718
Brazil	9,597	12,917	U. S. S. R.	77	54
Chile	1,232,156	1,841,797	Undistributed	16,203	4,317
Cuba	175,044	272,332			
				1,507,584	2,262,043

Stocks at mines.—During 1939 stocks at the mines declined 38 percent from 1938 and at the end of the year were the lowest since 1907.

Stocks of iron ore at mines, Dec. 31, 1938–39, by States, in gross tons

State	1938	1939	State	1938	1939
Alabama	27,506	2,805	North Carolina	200	200
Michigan	5,299,847	3,384,077	Pennsylvania	79,125	95,492
Minnesota	1,728,263	986,467	Virginia	3,086	3,126
Missouri	4,523	2,207	Washington	255	265
New Jersey	95,093	99,674	Wisconsin	356,579	158,939
New York	16,571	13,255		7,611,048	4,746,507

Foreign trade.—Imports of iron ore in 1939 increased 14 percent over 1938. Chile continued to be the chief source of imports into this country, furnishing 66 percent of the 1939 total, while Cuba and Sweden supplied 11 percent each. In addition to the figures in the following table, 266 tons of dross or pyrites ash were imported from Canada in 1939.

Iron ore imported for consumption in the United States, 1937–39, by countries, in gross tons

Country	1937		1938		1939	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Algeria	3,700	$17,424	7,480	$32,170	7,000	$25,167
Australia	79,588	137,444	82,827	138,614	16,520	30,184
Brazil	11,000	26,620	9,650	44,170	16,700	68,267
British West Africa (other)					11,540	55,677
Canada	5,046	44,156	875	26,441	23,275	129,251
Chile	1,438,886	2,608,696	1,577,750	2,853,060	1,586,625	2,824,252
China					10	22
Cuba	441,500	1,065,929	148,701	357,730	269,866	596,318
India, British	845	10,567				
Iran (Persia)	3,385	55,713	5,648	90,969	110	5,207
Mexico	4,183	9,613			1,722	3,319
Newfoundland and Labrador	45,080	115,804			14,450	41,183
Norway	252,657	919,936	75,625	394,705	199,966	845,355
Philippine Islands	350	4,200			22	230
Sweden	150,233	796,953	213,616	1,339,393	264,353	1,227,864
U. S. S. R.	5,100	8,466				
United Kingdom	516	20,116	228	10,131	356	13,214
Yugoslavia			55	812		
	2,442,069	5,841,637	2,122,455	5,288,195	2,412,515	5,865,510

Exports of iron ore from the United States totaled 1,057,304 gross tons valued at $3,578,086 ($3.38 a ton) in 1939 compared with 591,524 tons valued at $1,954,287 ($3.30 a ton) in 1938. Of the 1939 total. 1,032,635 tons went to Canada.

Mining in Cuba.—Shipments of iron ore from Cuba to the United States increased 84 percent in 1939 over 1938. The 1939 total of 279,133 gross tons included 164,210 tons of hematite carrying (dried) 54.90 percent iron and 72,204 tons of siliceous ore carrying (dried) 31.05 percent iron from the Daiquiri-Juragua mines on the southern coast and 42,719 tons of nodulized brown ore carrying (dried) 54.52 percent iron from the Mayari mines near the northern coast. The Mayari mine was nonproductive in 1939.

The total stock of ore reported on hand was 164,059 gross tons at the end of the year compared with 170,044 at the end of 1938.

The following table shows shipments of iron ore from Cuba since the mines were opened in 1884. The statistics on shipments of Cuban iron ore are collected by the Bureau of Mines.

Iron ore shipped from mines in the Province of Oriente, Cuba, 1884–1939, in gross tons

Year	Juragua (hematite and magnetite), Daiquiri (hematite and a little magnetite)	Sigua (hematite)	Mayari (brown ore)	Guamá (hematite)	El Cuero (hematite)	Total
1884–1937	[1] 21,784,498	20,438	3,847,577	41,241	903,103	26,596,857
1938	141,212		10,887			152,099
1939	236,414		42,719			279,133
	22,162,124	20,438	3,901,183	41,241	903,103	27,028,089

[1] Of this quantity, 5,932 tons were sent to Pictou, Nova Scotia, and 64,228 tons to other ports outside of the United States.

REVIEW OF LAKE SUPERIOR DISTRICT

Production and shipments.—Activities in the Lake Superior district (the principal producing district) were at a much higher rate, particularly during the closing months of 1939. The season began at about the level of 1938, but the quick rise in iron and steel output during the latter half of the year caused much greater demand for iron ore. Over three-fourths (81 percent in 1939) of the domestic output comes from the Lake Superior region, where in the third quarter of 1939 mine schedules were revised upward on short notice and immediately available lake transportation capacity was pressed into service. Monthly shipments down the Lakes, the main artery of iron-ore movement, reached high levels. As much of the lake ore comes from the Mesabi range (71 percent in 1939) where open-pit operations predominate, great flexibility in output is attained and increases of considerable magnitude are possible on short notice. The mild fall weather and the late closing of navigation permitted revised requirements to be filled from a lake movement of 45,000,657 tons of iron ore and manganiferous iron ore compared with 19,263,886 tons in 1938. More ore could have moved if the season had been longer, but the tonnage shipped was sufficient to raise combined stocks at furnaces and lower Lake ports at the end of the season above those on hand at the end of the 1938 season, notwithstanding the fact that consumption was at a much higher rate. Shipments of ore from the Lake Superior district totaled 44,849,573 gross tons (44,197,610 gross tons of iron ore and 651,963 tons of manganese-bearing ores containing 5 percent or more manganese) compared with 19,546,835 tons (19,254,171 tons of iron ore and 292,664 tons of manganese-bearing ore containing 5 percent or more manganese) in 1938. The iron-ore-shipment figures given above include 872 tons of paint ore in 1939 and 147 tons in 1938.

Production in the Lake Superior region in 1939 increased 96 percent over 1938 but was considerably below the record. The district furnished 81 percent of the United States total compared with 75 percent in 1938, thereby regaining part of the ground lost to other districts, particularly the Birmingham district, in 1938. Several ranges contributed to the district total. The Mesabi was the largest producer, furnishing 71 percent of the district output and 57 percent of the United States total. The output by ranges is shown in the following table. After 1905 the figures do not include manganiferous iron ore containing 5 percent or more manganese.

Iron ore mined in the Lake Superior district, 1854–1939, by ranges, in gross tons

[Exclusive after 1905 of ore containing 5 percent or more manganese]

Year	Marquette	Menominee	Gogebic	Vermilion	Mesabi	Cuyuna	Total
1854–1937	194,940,914	181,565,297	206,589,891	64,802,561	1,030,463,863	25,170,759	1,703,533,285
1938	2,686,713	1,283,563	2,888,830	932,505	13,256,605	260,194	21,308,410
1939	3,906,195	1,921,704	4,304,008	1,400,341	29,522,227	625,133	41,679,608
	201,533,822	184,770,564	213,782,729	67,135,407	1,073,242,695	26,056,086	1,766,521,303

In 1939, 69 percent of the ore produced on the iron ranges of the Lake Superior district came from open-pit mines. A large part of the open-pit production originates in operations on the Mesabi range, which in 1939 supplied 65 percent of the open-pit ore mined in the district. There is no open-pit mining in Wisconsin and relatively little in Michigan. In addition to the output on the Mesabi range, there is some open-pit production in Minnesota on the Cuyuna range.

Recent years have witnessed significant changes in open-pit mining practice in the iron country.[9] The use of small tractor shovels, tractors, wagons, scrapers, scraper hoists, heavy trucks, and conveyors continued to expand in 1939. In May 1939, six trucks were received at the Mahnomen mine on the Cuyuna range to replace railroad haulage. These trucks [10] are four-wheeled, with 13.50-inch by 24-inch dual tires on the rear and 12-inch by 24-inch tires on the front. The gross load capacity is 62,000 pounds and the payload capacity 36,000 pounds. The average load per truck was 12.9 long tons in 1939. The 9-cubic yard water-level-capacity body is carried over the rear axles, is rear dump and scoop-ended, and is raised and lowered by a horizontal double-acting hydraulic cylinder through rocker arms. The oil-burning engine delivers 185 horsepower, and the trucks move 8 to 10 miles per hour up an 8-percent grade when loaded. The average haul at the Mahnomen mine was 0.73 mile loaded and 0.70 mile empty; the ore was elevated an average of 206 feet. For the 304,168 tons hauled during 1939 the total ton-mile cost was \$0.0644.[11]

Of interest in 1939 was the shipments from the Michipicoten range in Ontario, Canada. Although this output is not included in Bureau production figures, it enters the same commercial channels. The ore came from the old Helen mine of the Algoma Steel Corporation,

[9] Ridgway, Robert H., and Davis, H. W., Iron Ore, Pig Iron, Ferro-alloys and Steel: Bureau of Mines Minerals Yearbook, 1939, pp. 547–548.

[10] Gallagher, W. H., Truck Haulage at the Mahnomen Mine: Min. Cong. Jour., vol. 25, No. 11, November 1939, pp. 28–30.

[11] Data from unpublished manuscript by F. A. Kelley, general supt., Pickands, Mather & Co., Crosby, Minn.

which in August 1939 began production from new open-pit operations and shipments for the first time since 1922. A total of 111,307 tons of sinter, made from the carbonate ores, was shipped during the season. Other Canadian production in the lake region of Ontario will come from the Steep Rock Lake some 150 miles west of Port Arthur, where large reserves of high-grade hematite are reported to have been developed. The Ontario Government is encouraging production of iron ore by a bonus of 2 cents per unit of iron.

Analyses.—The following table, compiled by the Lake Superior Iron Ore Association, summarizes the average analyses of the total tonnages of all grades of ore shipped and shows the remarkable uniformity maintained during the past 5 years. This uniformity does not mean, of course, that the average grade of available Lake Superior ore is not declining. The grade of shipments has been maintained partly by beneficiation and partly by mixing ores from different deposits. The method of sampling and grading Lake Superior iron ores has been described by Bayer [12] and the method of classification and sampling by Murray.[13]

Average analyses of total tonnages (bill-of-lading weights) of all grades of iron ore from all ranges of Lake Superior district, 1935–39

Year	Gross tons	Iron (natural)	Phosphorus	Silica	Manganese	Moisture
		Percent	*Percent*	*Percent*	*Percent*	*Percent*
1935	28,214,056	51.44	0.093	8.93	0.79	10.75
1936	44,745,754	51.45	.091	8.62	.81	10.92
1937	61,972,823	51.53	.091	8.27	.82	11.31
1938	19,353,497	51.90	.089	8.25	.81	10.13
1939	44,983,754	51.75	.085	8.27	.76	10.73

Stocks at Lake Erie ports.—At the close of navigation in 1939, according to the Lake Superior Iron Ore Association, 5,216,496 gross tons were in stock at Lake Erie ports compared with 5,290,294 tons on the corresponding date in 1938. At the opening of navigation in May 1940, 2,950,752 tons were in stock at these ports, a decrease of 1,534,215 tons from the figure on May 1, 1939. Withdrawals from docks were therefore 2,265,744 tons during the winter of 1939–40.

Prices of Lake Superior ore.—The prices established May 4, 1939, for the four standard grades of Lake Superior ore were the same as in 1937 and 1938 but were 45 cents a ton more than the price that had been maintained from 1929 to 1936. The unit prices for 1937, 1938, and 1939 for base ore of the various grades quoted at Lake Erie ports were as follows: Old-range bessemer, 10.194 cents; Mesabi bessemer, 9.903 cents; old-range nonbessemer, 9.903 cents; and Mesabi nonbessemer, 9.612 cents. The prices that correspond to these unit prices are, respectively, $5.25, $5.10, $5.10, and $4.95 a gross ton. The base of the four standard grades for 1925–39 is an iron content of 51.5 percent natural. For the bessemer grades the phosphorus con-

[12] Bayer, E. P., Sampling and Grading Mesabi Iron Ore: Min. and Met., vol. 18, No. 372, December 1937, pp. 547–548.
Bayer, E. P., Grading Lake Superior Iron Ores: Eng. and Min. Jour., vol. 139, No. 3, March 1938, pp. 50–51.

[13] Murray, C. B., Classification and Sampling: Lake Superior Iron Ores, chap. 4, Lake Superior Iron Ore Assoc., Cleveland, 1938, pp. 69–72.

tent is 0.045 percent (dry), and for the nonbessemer grades the phosphorus content ranges from 0.045 to 0.18 percent. Ores containing more than 0.18 percent phosphorus are classed as high-phosphorus ores, whereas those containing 18 percent or more silica are classed as siliceous ores.

Reserves.—Estimates of ore reserves for Minnesota, furnished by the Minnesota Tax Commission, and for Michigan, furnished by the Michigan Board of Tax Commissioners, are shown in the following tables. These estimates reveal decreases from 1938 of 9,581,775 gross tons in Minnesota and 6,097,470 tons in Michigan. Reserves in Wisconsin have been estimated recently at 5,500,000 tons.

Unmined iron-ore reserves in Minnesota, May 1, 1935–39, in gross tons

Range	1935	1936	1937	1938	1939
Mesabi	1,163,087,457	1,164,802,947	[1] 1,172,908,376	[2] 1,143,339,871	1,132,513,348
Vermilion	13,307,031	13,074,509	13,943,325	13,599,025	13,631,484
Cuyuna	46,709,113	63,066,428	61,922,739	60,690,596	61,902,885
	1,223,103,601	1,240,943,884	1,248,774,440	1,217,629,492	1,208,047,717

[1] 200,000 tons removed from tax roll by applications granted.
[2] 8,152,896 tons removed from tax roll—land has reverted to State.

Iron-ore reserves in Michigan, Jan. 1, 1936–40, in gross tons

Range	1936	1937	1938	1939	1940
Gogebic	45,615,323	42,757,025	40,706,291	40,456,002	37,160,900
Marquette	52,461,173	51,339,347	49,869,363	52,130,385	49,573,794
Menominee	60,347,752	59,936,572	58,031,692	57,168,510	56,922,733
	158,424,248	154,032,944	148,607,346	149,754,897	143,657,427

MINING BY STATES

Alabama.—Production of iron ore in Alabama during 1939 increased 39 percent over 1938. About 91 percent of the 1939 production came from underground mines and the remainder from open-cuts. Hematite represented 91 percent of the 1939 total, and much of this red ore contained enough or nearly enough lime to be self-fluxing. The hematite is derived chiefly from underground mines on Red Mountain near Birmingham in Jefferson County, where in 1939 Raimund Nos. 1 and 2, Red Mountain group (comprising the Muscoda, Wenonah, and Ishkooda groups), Sloss Nos. 1 and 2, and Woodward No. 3 mines were producers. Several smaller mines (open-pit and underground) in Etowah, Jefferson, and St. Clair Counties contributed to the total output of hematite ore. The iron content of the hematite produced in 1939 averaged (natural) 35.40 percent, manganese 0.15 percent, phosphorus 0.31 percent, and lime 16.12 percent. The Red Mountain group, with 3,350,184 tons, was the second largest producer in the United States in 1939.

Limonite (brown ore) is mined from a number of widely scattered deposits in Alabama, but production is not nearly so large as that of red ore. In 1939 the output of brown ore comprised 9 percent of the

Alabama total. Brown ores, however, are of higher grade and usually have been subjected to beneficiation, although some operations are rather crude. The brown ore mined in 1939 averaged (natural) 47 percent iron and 0.67 percent manganese. Brown ore is mined from open-cuts and was produced chiefly from the Russellville mines in Franklin County, the Champion mine in Blount County, and the Martaban, Reno, and Woodstock mines in Tuscaloosa County.

California.—Production in California in 1939 was small and came from four mines, two producing magnetite (one in Santa Cruz County and one in Inyo County) and two producing hematite (one in San Bernardino County and one in Inyo County). The magnetite averaged 64 percent iron; the hematite, which averaged 56 percent iron, was absorbed chiefly by the cement industry.

Georgia.—Production of iron ore in Georgia increased to 26,333 gross tons in 1939 from 9,221 tons in 1938. Ten mines—three in Bartow County, one each in Dade, Haralson, and Polk Counties, and four in Walker County—furnished the output in 1939. The output from Georgia in 1939 comprised 18,219 tons of brown ore containing (natural) 41 to 47 percent iron and 0.13 to 3 percent manganese; 7,867 tons of hematite containing (natural) 45 to 60 percent iron and 0.15 to 1 percent manganese; and 247 tons of magnetite averaging (natural) 64.76 percent iron, 0.1 percent manganese, and 0.03 percent phosphorus. Shipments of iron ore comprised 19,643 tons to blast furnaces, 6,203 tons to cement plants, and 487 tons to paint manufacturers.

Michigan.—Output from Michigan comes from three ranges—the Marquette, the Menominee, and the Gogebic. All ranges increased their production in 1939, the Gogebic showing the largest tonnage gain. Production in Michigan rose 53 percent in 1939 over 1938 and totaled 9,159,222 gross tons. Of the 1939 total, 86 percent came from underground mines; the Negaunee mine, an underground producer on the Marquette range, was the largest producer. The iron content (natural) of the ore mined in Michigan in 1939 averaged 51.68 percent compared with 52.23 percent in 1938.

Iron-ore reserves in Michigan at the end of 1939 totaled 143,657,427 gross tons, a decrease of 6,097,470 tons during the year.

A report of the iron-ore mines of Michigan for 1939, published by the Geological Survey Division of the Michigan Department of Conservation,[14] shows that the average number of men employed was 5,818 (5,633 in 1938), the average number of days worked 206 (157 in 1938), the average daily wage $7.07 ($7.59 in 1938), the average yearly earning $1,457.12 ($1,192.29 in 1938), and the average tons of ore mined per man per day 6.63 (5.32 in 1938).

The data in the following table on average per-ton costs of mining ore at underground mines and at siliceous open pits have been abstracted from statistics published in much greater detail by the Geological Survey Division of Michigan.

[14] Pardee, F. G., and Eddy, G. E., General Statistics Covering Costs and Production of Michigan Iron Mines: Michigan Dept. of Conservation, Geol. Survey Div., Lansing, 1940.

Average per-ton costs of mining iron ore at underground mines and at siliceous open pits in Michigan in 1939

Item	Underground				Siliceous open pits
	Gogebic	Marquette	Dickinson and Iron	Total	
Cost of mining	$1.5481	$1.6936	$1.6611	$1.6359	$0.4447
Deferred mining cost	.2032	.0731	.1230	.1296	.0394
Taxes	.3042	.2824	.2016	.2750	.0470
General overhead	.2299	.2533	.1750	.2294	.1005
Transportation	1.8208	1.4959	1.6324	1.6480	1.5211
Marketing	.0550	.0904	.0775	.0756	.0798
Royalty	.4008	.2960	.2497	.3228	.0967
Interest on borrowed money	.0001	.0133	.0125	.0086	.0014
Total ore cost	4.5621	4.1980	4.1328	4.3249	2.3306
Lake Erie value per ton	5.3086	5.2377	5.0370	5.2218	2.4791
Gross ore profit [1]	.7465	1.0397	.9042	.8969	.1485

[1] This figure does not represent true profit, as much ore is sold below the Lake Erie price.

Minnesota.—More than 1 billion gross tons (1,166,434,188) of iron ore have been produced in Minnesota. In 1939 output increased 118 percent over that in 1938. Three ranges contribute to Minnesota's production—the Cuyuna, the Mesabi, and the Vermilion. The Mesabi range supplies a large part of the Minnesota total and in 1939 produced 29,522,227 tons. Output from open-pit mines in 1939 furnished 88 percent of the total compared with 77 percent in 1938 and 88 percent in 1937. Of the 11 domestic mines producing more than 1 million tons each in 1939, 9 were in Minnesota; of these 7 were open pits, and 2 used combination open-pit and underground methods. Of the 65 mines in Minnesota active in 1939 (55 in 1938), 45 (29 in 1938) yielded more than 100,000 tons each. The iron content (natural) of the ore mined in 1939 averaged 52.43 percent compared with 52.31 percent in 1938.

According to the annual report of the mine inspector of St. Louis County, the average number of men employed in iron mines in St. Louis County was 4,589 in 1939 (3,773 in 1938), and the average daily wage was $6.61 ($6.60 in 1938) for 8 hours. In 1939, 3,098,991 cubic yards of overburden were removed compared with 3,762,318 yards in 1938.

According to the annual report of the mine inspector of Itasca County, the average number of men employed in iron mines was 2,567 in 1939 (2,132 in 1938), and the average daily wage was $6.08 ($5.82 in 1938) for 8 hours. In 1939, 4,555,471 cubic yards of overburden were removed compared with 3,807,920 yards in 1938.

Unmined iron-ore reserves in Minnesota on May 1, 1939, totaled 1,208,047,717 gross tons, a decrease of 9,581,775 tons from 1938.

Missouri.—An undetermined number of small mines in Butler, Carter, Crawford, Dent, Franklin, Howell, Iron, Madison, Phelps, Pulaski, Ripley, St. Francois, Shannon, and Wayne Counties supplied the iron-ore output of Missouri in 1939. The ore, which averaged 52.51 percent iron, comprised both hematite and brown ore, was mined by open-pit and underground methods, and was shipped to paint and steel plants as well as nonferrous smelters.

New Jersey.—Output of iron ore in New Jersey increased in 1939 over 1938 and totaled 399,289 tons. The ore, all magnetite and all produced from underground operations, came from three mines in Morris County and one mine in Warren County in the northern part of the State. New Jersey ores are crushed and concentrated before shipment. Most of the concentration is done magnetically, although some nonmagnetic martite is recovered by gravity methods and some hand sorting is practiced, principally to recover high-grade lump used in open-hearth steel furnaces. The concentrates produced in 1939 averaged (natural) 63.32 percent iron. The largest output came from the Scrub Oaks mine. Other producers were the Mt. Hope, Richard, and Washington mines.

New York.—The iron ore produced in New York during 1939 was chiefly magnetite from underground operations at the Harmony and Old Bed shafts in Essex County and the Chateaugay mine in Clinton County. Some hematite was mined for paint in Oneida and Wayne Counties. Shipments from New York in 1939 included sinter averaging 68 percent iron, lump averaging 61 percent iron, and concentrates averaging 68 percent iron.

The largest producer was the Republic Steel Corporation, which operates properties at Mineville near Port Henry and at Lyon Mountain. The Chateaugay mine at Lyon Mountain was acquired by the corporation on August 1, 1939.

Pennsylvania.—Pennsylvania is the most important source of magnetite in the United States. The output comes from the Cornwall mine in Lebanon County, where the ore is extracted by both open-pit and underground methods. In addition, some carbonate ore for use in paint was mined in Carbon County in 1939. Hickok [15] has summarized the history of iron-ore production in Pennsylvania and the changing economic conditions that affect the industry and control its history; he also discusses the geological environment, mode of origin, and future reserves of the various types of iron ore.

South Dakota.—A small quantity (300 gross tons) of brown iron ore was mined at a property in Pennington County and shipped to paint plants in 1939.

Tennessee.—The output of iron ore (brown ore and hematite) in Tennessee in 1939 came from two mines (one in Hickman County and one in Lewis County) and an undetermined number of small surface workings in Hamilton County; it contained 46.41 percent iron and was shipped to blast-furnace and paint plants.

In addition, considerable sintered pyrite ash was made at the plants of the Tennessee Copper Co. in Ducktown Basin. This sinter, which contained 67.4 percent iron and 0.005 percent phosphorus in 1939, moved largely to the blast furnaces in the Birmingham district, where it was added to the blast-furnace burden. Such sinter is not included in iron-ore production or shipment figures for the United States.

Utah.—Two operators in Iron County supplied the Utah total in 1939. By far the larger output came from the Iron Mountain mine, while a relatively small quantity came from the Great Western mine. The ore, principally semialtered magnetite, contained (natural) 53.14

[15] Hickok, W. O., IV, Iron Ores of Pennsylvania: Pennsylvania Geol. Survey Bull. M 18-B, 4th ser., 1939, 21 pp.

percent iron and moved largely to the blast furnace at Provo, Utah, although small quantities went to steel and cement plants.

Virginia.—The output of iron ore in Virginia is small. The entire 1939 production was brown ore from Botetourt County and averaged (natural) about 53 percent iron. The ore was used in the manufacture of hydrogen gas.

Washington.—Two open-pit mines and one underground mine produced the total output of Washington in 1939. Two mines—the Napoleon in Stevens County and the Keystone in Pend Oreille County—yielded hematite averaging (natural) 35.10 percent iron, which was used for cement manufacture, and the Neutral mine in Okanogan County yielded magnetite averaging (natural) 68.73 percent iron, which was used in making ferromagnesite.

Wisconsin.—The Montreal underground mine in Iron County was the larger producer of iron ore in Wisconsin, contributing 808,973 gross tons of the 972,685 produced in 1939. The ore—hematite—averaged (natural) 52.88 percent iron, 1.17 percent manganese, and 0.057 percent phosphorus. The Cary underground mine, also in Iron County, was the other producer in 1939 and furnished 163,712 tons of hematite containing (natural) 53.98 percent iron, 0.62 percent manganese, and 0.048 percent phosphorus. Shipments from Wisconsin mines totaled 1,173,828 tons in 1939.

Wyoming.—The output of iron ore from Wyoming in 1939 came from the Sunrise mine and comprised 587,892 gross tons of hematite containing (natural) 53.22 percent iron, 0.07 percent manganese, and 0.066 percent phosphorus. Much of the ore is a red, earthy hematite similar to Mesabi ore. Production came from both open-pit and underground operations.

Iron ore mined in the United States, 1938–39, by States and counties

[Exclusive of ore containing 5 percent or more manganese]

State and county	1938		1939	
	Active mines	Gross tons	Active mines	Gross tons
Alabama:				
Bibb and Tuscaloosa	3	143,736	3	238,708
Blount	2	31,764	2	40,374
Butler, Conecuh, and Crenshaw	2	1,509	2	20,082
Calhoun	5	21,378	9	34,107
Cherokee	5	12,826	12	27,186
Chilton	2	5,559	2	4,651
Cleburne	2	2,138		
Coosa	1	47	1	1,631
Etowah	1	77	1	509
Franklin	2	101,790	2	120,183
Jefferson	6	3,970,604	8	5,443,372
Lamar			2	494
Marshall			1	83
Pike			1	3,316
St. Clair	3	233	6	1,987
Shelby	2	4,417	1	7,583
Talladega	1	7,251	5	16,241
	37	4,303,329	58	5,960,507
California:				
San Bernardino	1	28,380	1	17,173
Inyo	1		2	
Santa Cruz	1		1	
	3	28,380	4	17,173
Georgia:				
Bartow	3	9,176	3	18,129
Dade			1	42
Haralson			1	247
Polk	1	45	1	90
Walker			4	7,825
	4	9,221	10	26,333
Michigan:				
Dickinson	3	270,777	3	428,454
Gogebic	10	2,034,035	9	3,331,323
Iron	12	1,012,786	10	1,493,250
Marquette	14	2,686,713	14	3,906,195
	39	6,004,311	36	9,159,222

Iron ore mined in the United States, 1938–39, by States and counties—Continued

[Exclusive of ore containing 5 percent or more manganese]

State and county	1938 Active mines	1938 Gross tons	1939 Active mines	1939 Gross tons
Minnesota:				
Crow Wing	4	260,194	5	625,133
Itasca	17	3,603,483	24	7,415,016
St. Louis	34	10,585,627	36	23,507,552
	55	14,449,304	65	31,547,701
Missouri:				
Butler, Carter, Crawford, Howell, Phelps, Pulaski, Ripley, Shannon, and Wayne	[1] 10	25,995	[1] 7	33,314
Dent	1	1,135	1	1,250
Franklin	1	1,200	1	1,646
Iron	------	----------	1	1,360
Madison	------	----------	1	985
St. Francois	1	214	1	684
	[1] 13	28,544	[1] 12	39,239
New Jersey:				
Morris	3	185,639	3	399,289 (Morris and Warren)
Warren	------	----------	1	
	3	185,639	4	399,289
New Mexico: Grant	1	1,826	------	----------
New York:				
Essex	1		1	
Clinton	1		1	
Oneida	1		1	
Wayne	1	2,120,823 (Essex to Lebanon)	1	2,713,141 (Essex to Lebanon)
Pennsylvania:				
Lebanon	1		1	
Carbon	1	448	1	463
	6	2,121,271	6	2,713,604
South Dakota: Pennington	------	----------	1	300
Tennessee:				
Hamilton	------	----------	(2)	
Hickman	1		1	
Lewis	1	13,179 (Hickman to Botetourt)	1	24,580 (Hamilton to Botetourt)
Virginia: Botetourt	2		2	
	4	13,179	[1] 4	24,580
Utah: Iron	2	167,933	2	262,087
Washington:				
Okanogan	------	----------	1	3,000
Pend Oreille	1	1,730	1	2,431
Stevens	1	1,825	1	5,326
	2	3,555	3	10,757
Wisconsin: Iron	2	854,795	2	972,685
Wyoming: Platte	1	275,995	1	587,892
	[1] 172	28,447,282	[1] 208	51,721,369

[1] In addition there is an undetermined number of small pits. The output of these pits is included in the tonnage given.
[2] Undetermined number of small pits. The output of these pits is included in the tonnage given.

MEN EMPLOYED AND OUTPUT PER MAN AT MINES

Although complete information on employment at iron-ore mines in 1939 is not yet available, incomplete figures indicate that about 22,000 men working about 39,000,000 man-hours were required to produce 51,721,369 tons of merchantable ore, an average of 1.326 tons per man-hour. Thus, the total man-hours worked in 1939 advanced 27 percent over 1938, whereas the output of merchantable ore increased 82 percent; in consequence, output per man-hour increased 43 percent. The gain in output per man-hour in 1939 compared with 1938 was due mainly to a shift in the production of ore from underground to open-pit mines and to nearer-capacity operation of large units. Specifically, about three-fifths of the output came from open-pit mines in 1939 compared with about one-half in 1938, and 11 mines produced more than 1 million tons each in 1939 compared with 4 in 1938.

Figure 3 shows trends in employment and output at iron-ore mines in the United States from 1923 to 1938.

During 1938, the last year for which complete statistics are available, the low level of iron-ore output resulted in a decrease in labor at the mines. The average number of men decreased, as did the average number of days and total man-hours worked. In 1938, 19,788 men working 30,625,760 man-hours produced 28,447,282 tons of merchantable ore, an average output of 0.929 ton per man-hour, whereas in 1937, 25,945 men working 51,416,193 man-hours produced

72,093,548 tons of merchantable ore, or 1.402 tons per man-hour. Thus, although the output of merchantable ore declined 61 percent from 1937 to 1938, the number of men, total man-hours worked, and output per man-hour decreased only 24, 40, and 34 percent, respectively. The output per man-hour in 1937 exceeded that for any year since records have been compiled and undoubtedly was greater than in any other year. The relatively larger labor requirements in 1938 than in 1937 resulted from several factors—the proportionately smaller output of open-pit mines and of direct shipping ore, the partial-capacity production of operating units, and the stripping of proportionately more overburden in preparation for future mining.

The number of man-hours of labor decreased in all districts in 1938 from 1937, but the decrease was relatively more in the Lake Superior and Northeastern districts than in the Southeastern and Western districts. In the Lake Superior district, the principal producing

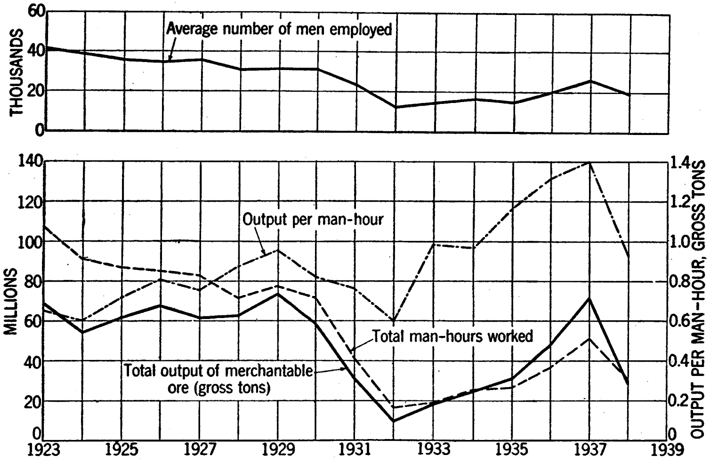

FIGURE 3.—Trends in number of men employed at iron-ore mines, output of merchantable ore, man-hours worked, and output per man-hour in the United States, 1923–38

region, output of merchantable ore decreased 65 percent in 1938 from 1937, but this decrease was more pronounced than the decline in labor requirements, as the total man-hours worked dropped only 42 percent. Much of the Lake Superior output comes from Minnesota, where open pits furnished 77 percent of the State total in 1938. Because of this preponderant production from open pits, output per man-hour in Minnesota is greater than in any other State or district and in 1938 amounted to 1.390 tons. Output per man-hour in 1938, however, was substantially less than in 1937 (2.479 tons) owing to the smaller proportion of ore from open-pit mines and to partial-capacity operations. Although, as was pointed out in Minerals Yearbook, 1934 (p. 322), the improved performance in mining iron ore has been closely related to advances in mechanization, better mining methods, operation of larger units, and more efficient management of mines, the gain in the 6-year period 1933–38 compared with the 10-year period 1923–32 was due chiefly to expansion of open-pit operations in Minnesota. For example, whereas about 75 percent of the merchantable ore produced in Minnesota from 1923 to 1932 came from open-pit mines, 85 percent was so produced in 1933–38. The significance of this shift can be appreciated when it is recalled that Minnesota contributed 61 percent of the total merchantable ore produced in 1923–38 and that during this period the output of men at open-pit mines averaged 2.019 tons per man-hour compared with only 0.699 ton per man-hour for workers at underground mines.

The greater output per man-hour in recent years also was due partly to the stripping of proportionately less overburden in Minnesota in 1933–38 than in 1923–32, in preparation for future mining. In 1933–38 about one-fourth cubic yard of overburden was removed for each ton of merchantable ore mined in Itasca and St. Louis Counties, Minn., whereas in 1923–32 about one-half cubic yard of overburden was re-

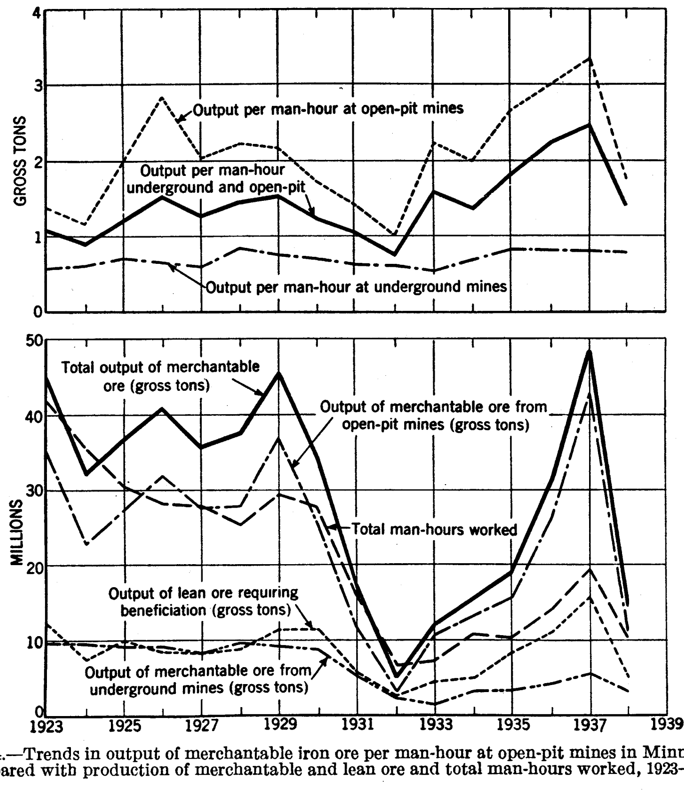

FIGURE 4.—Trends in output of merchantable iron ore per man-hour at open-pit mines in Minnesota compared with production of merchantable and lean ore and total man-hours worked, 1923–38.

moved for each ton of merchantable ore mined. Any material shift in the labor force used for direct mining of the ore at the expense of that used in stripping will result in a much higher output per man-hour for any year. This is illustrated strikingly in figure 4, which shows that in 1926, 1933, 1935, 1936, and 1937, when only about one-fourth cubic yard of overburden was removed for each ton of merchantable ore mined at both open-pit and underground mines, the output per worker increased substantially, whereas in the other years, when one-third to four-fifths cubic yard of overburden was removed for each ton of ore mined, the output per worker decreased.

Another factor that affects the output per man-hour is the tendency to mine leaner ore. Proportionately more lean ore requiring beneficiation has been mined in Minnesota in recent years than during the period 1923–32. In 1933–38, for instance, beneficiated ore represented 21 percent of the total merchantable ore compared with an average of only 16 percent in 1923–32.

Most of the ore mined in the Southeastern district—the second largest producing region—is obtained from underground operations. Output of merchantable ore per man-hour in this area increased slightly to 0.631 ton in 1938 from 0.624 ton in 1937. The largest and most consistent producing mines in the Southeastern district are in Jefferson County, Ala., where 3,803 men working 6,058,805 man-hours in 1938 produced 3,970,604 tons of merchantable ore, equivalent to an average output of 0.655 ton per man-hour. Virtually all ore produced in Jefferson County comes from underground mines. In comparing the man-hour cost of mining ore in Jefferson County, Ala., with that at underground mines in the Lake Superior district one should remember that whereas the ore in the Lake Superior district is considerably richer in iron the ore from the Jefferson County mines contains enough

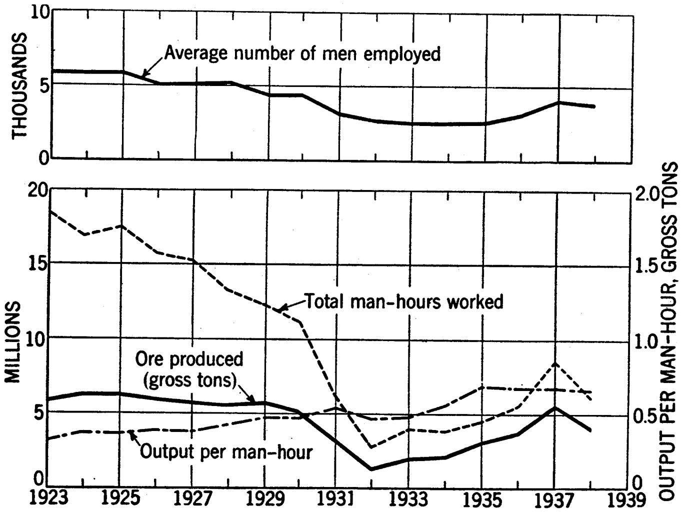

FIGURE 5.—Trends in production, man-hours worked, output per man-hour, and number of men employed at iron-ore mines in Jefferson County, Ala., 1923–38.

or almost enough lime to make it self-fluxing. Thus, the lower iron content is partly offset by the self-fluxing nature of the ore, although it is impossible to show this important characteristic in the productivity figures.

Figure 5 shows trends in production and employment at iron-ore mines in Jefferson County, Ala., 1923–38.

In the Northeastern district the average output of merchantable ore per man-hour increased to 0.735 ton in 1938 from 0.523 ton in 1937. The gain in productivity was due partly to the fact that proportionately more ore was produced in 1938 than in 1937 from the Cornwall open pit, where a relatively high output per man-hour is attainable.

The following table shows employment at iron mines and beneficiating plants, quantity and tenor of ore produced, and average output per man by districts and States in 1938. Corresponding statistics and supplementary data are given in Minerals Yearbook, 1934 to 1939, inclusive.

Employment at iron-ore mines and beneficiating plants, quantity and tenor of ore produced, and average output per man in 1938, by districts and States

[Exclusive of ore containing 5 percent or more manganese]

District and State	Employment					Production									
	Average number of men employed	Time employed				Crude ore (partly estimated), gross tons	Merchantable ore			Average per man (gross tons)					
		Average number of days	Total man-shifts	Man-hours			Gross tons	Iron contained		Crude ore (partly estimated)		Merchantable ore			
				Average per shift	Total			Gross tons	Per cent natural	Per shift	Per hour	Per shift	Per hour	Iron contained	
														Per shift	Per hour
Lake Superior:															
Michigan	5,712	190	1,085,278	8.0	8,684,421	6,004,311	6,004,311	3,135,807	52.23	5.533	0.691	5.533	0.691	2.889	0.361
Minnesota	7,113	183	1,298,860	8.0	10,396,059	16,560,932	14,449,304	7,558,445	52.31	12.750	1.593	11.125	1.390	5.819	.727
Wisconsin	546	253	138,126	8.0	1,105,018	854,795	854,795	455,306	53.26	6.189	.774	6.189	.774	3.296	.412
	13,371	189	2,522,264	8.0	20,185.498	23,420,038	21,308,410	11,149,558	52.32	9.285	1.160	8.448	1.056	4.420	.552
Southeastern:															
Alabama	4,262	197	838,572	8.1	6,785,808	4,903,761	4,303,329	1,564,626	36.36	5.848	.723	5.132	.634	1.866	.231
Georgia						9,221	9,221	3,627	39.33						
Tennessee	94	82	7,694	9.3	71,830	45,412	13,179	6,233	47.15	7.100	.761	2.911	.312	1.281	.137
Virginia									52.53						
	4,356	194	846,266	8.1	6,857,638	4,958,394	4,325,729	1,574,486	36.40	5.859	.723	5.112	.631	1.861	.230
Northeastern:															
New Jersey	483	216	104,195	8.0	833,338	311,320	185,639	117,405	63.24	2.988	.374	1.782	.223	1.127	.141
New York	1,180	245	289,262	8.0	2,303,830	2,521,514	2,121,271	983,442	67.10	8.717	1.094	7.333	.921	3.400	.427
Pennsylvania									42.76						
	1,663	237	393,457	8.0	3,137,168	2,832,834	2,306,910	1,100,847	47.72	7.200	.903	5.863	.735	2.798	.351
Western:															
California						28,917	28,380	15,629	55.07						
Missouri						28,544	28,544	14,652	51.33						
New Mexico	192	139	26,646	8.8	235,760	1,826	1,826	1,116	61.11	8.661	.979	8.641	.977	4.641	.525
Utah						167,933	167,933	90,874	54.11						
Washington						3,555	3,555	1,401	39.41						
Wyoming	206	127	26,212	8.0	209,696	275,995	275,995	145,725	52.80	10.529	1.316	10.529	1.316	5.559	.695
	398	133	52,858	8.4	445,456	506,770	506,233	269,397	53.22	9.587	1.138	9.577	1.136	5.097	.605
	19,788	193	3,814,845	8.0	30,625,760	31,718,036	28,447,282	14,094,288	49.55	8.314	1.036	7.457	.929	3.695	.460

WORLD PRODUCTION

The following table shows the production of iron ore by countries from 1935 to 1939, insofar as statistics are available. Although complete returns for 1939 are not yet available it is evident that world production was considerably greater than in 1938. Output in the latter year amounted to 162,000,000 metric tons, of which the United States supplied only 18 percent, compared with 211,000,000 tons in 1937, of which the United States supplied 35 percent.

World production of iron ore, 1935–39, by countries, in metric tons

[Compiled by M. T. Latus]

Country [1]	1935	1936	1937	1938	1939
North America:					
Cuba (shipments)	228, 408	456, 827	496, 258	154, 540	283, 613
Guatemala	----	----	101	----	(2)
Mexico	95, 590	123, 121	136, 018	118, 251	(2)
Newfoundland	677, 137	907, 646	1, 635, 554	1, 707, 180	1, 679, 625
United States	31, 030, 423	49, 571, 804	73, 250, 649	28, 903, 861	52, 551, 497
South America:					
Brazil (exports)	47, 184	110, 997	209, 715	359, 115	396, 938
Chile [3]	841, 300	1, 347, 831	1, 489, 637	1, 608, 399	1, 626, 490
Europe:					
Belgium	164, 520	190, 660	265, 540	180, 920	(2)
Bulgaria	2, 370	6, 498	11, 920	16, 771	(2)
Czechoslovakia	731, 058	1, 089, 623	1, 836, 495	(4)	(2)
France	32, 045, 900	33, 301, 620	37, 839, 000	33, 137, 000	(2)
Germany [5]	5, 851, 634	7, 339, 836	9, 575, 234	10, 938, 650	(2)
Austria	775, 421	1, 024, 288	1, 884, 694	2, 600, 063	(2)
Greece	204, 146	280, 271	300, 498	348, 613	(2)
Hungary	192, 396	279, 673	290, 044	369, 935	(2)
Italy	551, 454	838, 833	997, 805	990, 043	(2)
Luxemburg	4, 133, 808	4, 895, 992	7, 766, 254	5, 140, 632	(2)
Norway	765, 152	846, 809	1, 008, 225	1, 425, 297	(2)
Poland	332, 536	466, 659	780, 152	872, 591	(2)
Portugal	880	6, 539	7, 700	2, 519	418
Rumania	93, 813	108, 549	129, 060	138, 942	131, 992
Spain	2, 633, 165	2, 045, 890	990, 783	2, 513, 827	(2)
Sweden	7, 932, 854	11, 249, 605	14, 952, 549	13, 928, 023	(2)
Switzerland (exports)	5, 894	31, 833	148, 578	133, 998	171, 279
U. S. S. R. [6]	26, 845, 000	27, 918, 000	26, 000, 000	26, 529, 700	(2)
United Kingdom: Great Britain [7]	11, 070, 256	12, 905, 243	14, 443, 146	12, 049, 531	(2)
Yugoslavia	234, 729	450, 859	629, 172	607, 111	666, 863
Asia:					
Burma	23, 456	26, 738	25, 834	18, 340	(2)
Chosen	228, 220	234, 400	207, 500	(4)	(2)
India, British	2, 378, 788	2, 567, 488	2, 883, 548	2, 787, 711	(2)
Indochina	635	10, 017	33, 285	130, 298	(2)
Japan	515, 529	754, 400	(4)	(4)	(2)
Malay States:					
Federated Malay States	----	457	1, 165	938	(2)
Unfederated Malay States	1, 434, 293	1, 681, 102	1, 686, 990	1, 606, 289	(2)
Philippine Islands (exports)	283, 311	654, 458	601, 190	910, 952	(2)
Turkey	----	----	----	71, 375	239, 035
U. S. S. R.	(6)	(6)	(6)	(6)	(2)
Africa:					
Algeria	1, 674, 628	1, 884, 281	2, 427, 230	3, 105, 037	[8] 2, 750, 000
Belgian Congo	----	----	----	2, 650	(2)
Egypt	15	----	----	----	(2)
Morocco:					
French	----	----	66, 864	266, 100	(2)
Spanish	1, 167, 606	1, 047, 041	1, 424, 737	1, 341, 658	(2)
Northern Rhodesia	----	2	528	208	138
Sierra Leone	440, 498	575, 689	644, 160	875, 789	(2)
South-West Africa	----	----	14, 280	23, 861	19, 500
Tunisia	503, 000	750, 000	943, 763	822, 053	(2)
Union of South Africa	304, 048	364, 981	461, 796	505, 314	490, 136
Oceania:					
Australia:					
New South Wales	7, 785	----	----	----	(2)
Queensland	1, 137	2, 338	4, 551	5, 207	3, 526
South Australia	1, 898, 712	1, 917, 589	1, 896, 370	2, 281, 404	2, 613, 036
Tasmania	----	----	62	----	(2)
New Caledonia	----	----	----	36, 279	83, 567
New Zealand	10, 817	----	580	1, 238	(2)
	138, 000, 000	170, 000, 000	211, 000, 000	162, 000, 000	(2)

[1] In addition to the countries listed, China, Finland and Madagascar report production of iron ore, but complete data are not available.
[2] Data not available.
[3] Production of Tofo Mines.
[4] Estimate included in total.
[5] Exclusive of manganiferous iron ore carrying 12 to 30 percent manganese.
[6] Russia in Asia included with Russia in Europe.
[7] Exclusive of bog ore, which is used mainly for the purification of gas.
[8] Estimated.

PIG IRON

Production and shipments.—Domestic production of pig iron, exclusive of ferro-alloys, increased 67 percent in 1939 over 1938 and was the second best year since 1929. The output in 1939 comprised 31,031,973 gross tons using coke and 43,941 tons using charcoal as fuel. Pennsylvania was the largest producer of pig iron in 1939, with 28 percent of the total; Ohio ranked second, with 23 percent. Of the pig iron manufactured in 1939, it is calculated that 1,360,174 tons valued at $23,141,343 were made from 2,262,043 tons of foreign ores, including ore from Africa, Australia, Brazil, Chile, Cuba, Newfoundland, Palestine, Sweden, and the U. S. S. R., indicating an average yield of 60.13 percent from imported ore. Domestic ore (51,160,340 tons) and cinder, scale, and purchased scrap (4,456,418 tons) totaling 55,616,758 tons were reported as used in the manufacture of 29,715,740 tons of pig iron, indicating an average pig-iron yield of 53.43 percent from domestic materials. In addition, 1,004,565 tons of home scrap and 1,737,000 tons of flue dust were consumed in making pig iron in 1939.

Shipments of pig iron, exclusive of ferro-alloys, were 76 percent above 1938 in both quantity and value in 1939. The values given represent the approximate amounts received for the iron f. o. b. furnaces and do not include freight costs, selling commissions, and other items that are figured in some of the market prices for pig iron published by trade journals.

Pig iron produced and shipped in the United States, 1938–39, by States

State	Produced		Shipped from furnaces			
	1938	1939	1938		1939	
	Gross tons	Gross tons	Gross tons	Value	Gross tons	Value
Alabama	2,023,269	2,621,268	1,990,342	$29,190,091	2,717,502	$43,902,681
Colorado	(1)	(1)	(1)	(1)	(1)	(1)
Illinois	1,656,591	2,650,541	1,519,572	30,899,012	2,860,577	57,718,814
Indiana	1,791,085	3,309,903	1,807,808	37,025,980	3,375,325	68,164,618
Iowa	(1)	(1)	(1)	(1)	(1)	(1)
Kentucky	126,102	231,494	126,102	(1)	231,494	(1)
Maryland	1,201,374	1,784,959	1,219,611	(1)	1,805,080	(1)
Massachusetts	-------	(1)	(1)	(1)	(1)	(1)
Michigan	556,230	963,946	558,782	9,806,994	1,138,964	18,872,150
Minnesota	(1)	(1)	135,931	(1)	167,869	(1)
New York	1,338,907	2,046,447	1,222,832	25,450,764	2,210,223	45,275,716
Ohio	4,210,514	7,216,278	4,186,217	85,186,824	7,249,172	147,154,864
Pennsylvania	4,836,093	8,730,118	4,684,017	101,266,844	8,979,649	186,302,533
Tennessee	(1)	(1)	(1)	(1)	(1)	(1)
Utah	(1)	(1)	(1)	(1)	(1)	(1)
Virginia	(1)	-------	(1)	(1)	(1)	(1)
West Virginia	472,738	750,016	496,905	(1)	761,812	(1)
Undistributed	[2] 369,419	[2] 770,944	[2] 254,235	[2] 38,048,860	[2] 593,818	[2] 59,433,314
	18,582,322	31,075,914	18,202,354	356,875,369	32,091,485	626,824,690

(1) Included under "Undistributed."

[2] Includes statistics for States entered as "(1)."

Pig iron shipped from blast furnaces in the United States, 1938–39, by grades

Grade	1938			1939		
	Gross tons	Value		Gross tons	Value	
		Total	Average		Total	Average
Charcoal	26,558	$657,885	$24.77	57,778	$1,404,719	$24.31
Foundry	1,538,349	28,308,696	18.40	2,155,874	40,820,296	18.93
Basic	13,058,455	250,310,020	19.17	23,559,239	448,263,976	19.03
Bessemer	2,611,015	56,680,050	21.71	4,618,440	98,823,031	21.40
Low-phosphorus	120,195	2,830,256	23.55	294,276	6,838,917	23.24
Malleable	765,780	16,489,173	21.53	1,284,449	27,775,986	21.62
Forge	1,347	27,653	20.53	5,750	110,009	19.13
All other (not ferro-alloys)	80,655	1,571,636	19.49	115,679	2,787,756	24.10
	18,202,354	356,875,369	19.61	32,091,485	626,824,690	19.53

The number of furnaces in blast on June 30 and December 31 and the total number of stacks recorded for 1938 and 1939, exclusive of electric reduction furnaces, were as follows:

Blast furnaces (including ferro-alloy blast furnaces) in the United States, 1938–39 [1]

State	In blast June 30, 1938	Dec. 31, 1938			In blast June 30, 1939	Dec. 31, 1939		
		In	Out	Total		In	Out	Total
Alabama	6	16	4	20	14	18	1	19
Colorado	2	1	2	3	1	3	-------	3
Illinois	4	9	14	23	8	14	9	23
Indiana	5	8	11	19	9	17	2	19
Kentucky	1	1	1	2	2	2	-------	2
Maryland	4	5	1	6	6	6	-------	6
Massachusetts	-------	-------	1	1	1	1	-------	1
Michigan	4	5	3	8	5	7	1	8
Minnesota	1	1	1	2	1	2	-------	2
Missouri	-------	-------	1	1	-------	-------	-------	-------
New York	5	9	8	17	8	11	4	15
Ohio	17	29	19	48	28	43	5	48
Pennsylvania	20	29	49	78	32	65	13	78
Tennessee	1	-------	3	3	1	1	2	3
Utah	1	1	-------	1	1	1	-------	1
Virginia	1	1	-------	1	1	1	-------	1
West Virginia	1	1	2	3	3	3	-------	3
	73	116	120	236	121	195	37	232

[1] American Iron and Steel Institute.

Value at blast furnaces.—The average value of all kinds of pig iron given in the accompanying table is based upon reports of manufacturers to the Bureau of Mines. The figures represent the approximate values f. o. b. blast furnaces and do not include the values of ferro-alloys. The general average value for all grades of pig iron at the furnaces was $19.53 a gross ton in 1939—only 8 cents less than in 1938.

Average value per gross ton of pig iron at blast furnaces in the United States, 1935–39, by States

State	1935	1936	1937	1938	1939
Alabama	$14.67	$15.01	$16.68	$14.67	$16.16
Illinois	17.58	18.24	21.11	20.33	20.18
Indiana	17.78	18.14	21.11	20.48	20.19
Michigan	15.64	15.56	16.99	17.55	16.57
New York	15.95	15.87	20.65	20.81	20.48
Ohio	16.70	17.02	21.63	20.35	20.30
Pennsylvania	18.38	18.82	21.73	21.62	20.75
Other States[1]	14.46	17.50	18.92	17.04	16.69
Average for United States	16.91	17.59	20.76	19.61	19.53

[1] Colorado, Iowa, Kentucky, Maryland, Massachusetts, Minnesota, Tennessee, Utah, Virginia, and West Virginia.

Commercial quotations.—The average monthly prices of foundry, basic, and bessemer pig iron at Valley furnaces and of foundry pig iron at Birmingham furnaces, according to published market quotations, are summarized in the following table:

Average monthly prices per ton of chief grades of pig iron, 1938–39 [1]

Month	Foundry pig iron at Valley furnaces		Foundry pig iron at Birmingham furnaces		Bessemer pig iron at Valley furnaces		Basic pig iron at Valley furnaces	
	1938	1939	1938	1939	1938	1939	1938	1939
January	$24.00	$21.00	$20.38	$17.38	$24.50	$21.50	$23.50	$20.50
February	24.00	21.00	20.38	17.38	24.50	21.50	23.50	20.50
March	24.00	21.00	20.38	17.38	24.50	21.50	23.50	20.50
April	24.00	21.00	20.38	17.38	24.50	21.50	23.50	20.50
May	24.00	21.00	20.38	17.38	24.50	21.50	23.50	20.50
June	23.35	21.00	19.61	17.38	23.85	21.50	22.85	20.50
July	20.00	21.00	16.38	17.38	20.50	21.50	19.50	20.50
August	20.00	21.00	16.38	17.38	20.50	21.50	19.50	20.50
September	20.16	22.20	16.54	18.50	20.66	22.70	19.66	21.70
October	21.00	23.00	17.38	19.38	21.50	23.50	20.50	22.50
November	21.00	23.00	17.38	19.38	21.50	23.50	20.50	22.50
December	21.00	23.00	17.38	19.38	21.50	23.50	20.50	22.50
Average	22.21	21.60	18.58	17.97	22.71	22.10	21.71	21.10

[1] Metal Statistics, 1940.

Foreign trade.—Imports of pig iron for consumption in 1939 increased 27 percent over 1938 owing to larger receipts from Canada and British India. British India supplied 64 percent of the 1939 total.

Pig iron imported for consumption in the United States, 1935–39, by countries, in gross tons

Country	1935	1936	1937	1938	1939
North America: Canada	13,771	11,603	6,638	2,656	6,862
South America: Brazil					155
Europe:					
Belgium	100	973			
Czechoslovakia		37			
Denmark					1
France	50				
Germany	4,877	4,749	510		
Netherlands	48,122	60,363	28,772	14,236	6,473
Norway	2,420	2,649	875	850	
Sweden	907	689	600	205	261
U. S. S. R.	9,124	24,556	4,581		
United Kingdom	14,500	4,354	100	42	
Asia:					
Hong Kong		200			
India, British	37,016	55,426	69,621	12,411	24,840
Japan	50				
Kwantung		209			
	130,937	165,808	111,697	30,400	38,592
Value	$1,979,324	$2,336,236	$1,701,304	$598,461	$663,091

Exports of pig iron from the United States in 1939 decreased to 177,024 gross tons from 432,851 in 1938 but were still much higher than normal. Sweden (64,767 tons) and the United Kingdom (64,769 tons) together took 73 percent of the total.

Pig iron exported from the United States, 1938–39, by countries, in gross tons

Country	1938	1939	Country	1938	1939
North America:			Asia:		
Canada	4,759	3,423	China	6,553	9,149
Other North America	506	1,069	Hong Kong	1,970	1,281
South America:			Japan	316,280	9,812
Argentina		1,385	Philippine Islands	734	488
Chile	1,426	1,262	Other Asia	665	869
Colombia	233	614	Africa:		
Peru	215	797	Algeria	6,236	
Other South America	76	140	Union of South Africa	1,462	
Europe:			Oceania: New Zealand	15	
Belgium	3,349	1,041			
France	12,241	200		432,851	177,024
Germany	10,075	60	Value	$7,135,129	$3,435,739
Greece		1,705			
Hungary	13,825	650			
Italy	6,672	5,240			
Netherlands	610	175			
Norway	96	6,601			
Sweden	3,603	64,767			
United Kingdom	40,615	64,769			
Other Europe	635	1,527			

Consumption.—Consumption of pig iron rose 70 percent in 1939 over 1938. Pig iron, a product of the blast furnace, is a semiraw material and, except for the small quantity used in direct castings, moves to other type furnaces for further refining or mixture with other required ingredients. In general, it goes to steel-making or iron-making furnaces. By far the larger part is taken to steel-making furnaces (open-hearth, bessemer, and electric) for refining and processing into steel. In 1939, 86.5 percent of the pig iron was consumed in steel making. Direct castings took 3 percent of the 1939 total, and the remaining 10.5 percent was consumed in iron-making furnaces, of which the cupola is by far the most important. The consumption of pig iron by types of furnace for 1936 to 1939 is shown in the following table. Typically, the quantities of pig iron used in these furnaces are supplemented by the addition of ferrous scrap. The proportion of pig iron to scrap used in steel furnaces increased in 1939 compared with 1938, whereas the proportion of pig iron in cupola furnaces decreased.

Consumption of pig iron in the United States, 1936–39, by type of furnace

Type of furnace or equipment	1936		1937		1938		1939	
	Gross tons	Percent of total	Gross tons	Percent of total	Gross tons	Percent of total	Gross tons	Percent of total
Open hearth	21,960,842	73.0	25,118,216	73.8	13,729,371	74.2	23,951,940	76.2
Bessemer	3,635,562	12.1	3,688,335	10.8	1,946,048	10.5	3,217,142	10.2
Electric	22,866	.1	44,715	.1	15,893	.1	27,270	.1
Cupola [1]	3,633,720	12.1	4,195,234	12.3	2,404,637	13.0	2,990,355	9.5
Air	407,038	1.3	444,988	1.3	185,514	1.0	294,033	.9
Brackelsberg								
Crucible	34	(2)	43	(2)	218	(2)	82	(2)
Puddling	30,498	.1	31,489	.1	5,343	(2)	24,963	.1
Direct castings [1]	408,074	1.3	533,507	1.6	217,325	1.2	951,982	3.0
	30,098,634	100.0	34,056,527	100.0	18,504,349	100.0	31,457,767	100.0

[1] Some pig iron used in making direct castings included in cupola. [2] Less than 0.05 percent.

The consumption of pig iron in this country is widespread, and plants using pig iron are situated in all 48 States, the District of Columbia, and Alaska. As expected from the nature of its use, consumption is concentrated largely in the iron- and steel-making centers of the North Central, Middle Atlantic, and Southeastern States. These areas in 1939 used 98 percent of the pig iron, Pennsylvania (the leading consumer) taking nearly 29 percent of the total and Ohio (the second largest consumer) 21 percent. Of the chief consuming areas in 1939 the Middle Atlantic district made the largest gain over 1938—85 percent compared with 65 percent in the North Central district and 53 percent in the Southeastern district, including the Birmingham district of Alabama. The following table shows the distribution of pig-iron consumption by States from 1936 to 1939.

Consumption of pig iron in the United States, 1936–39, by States and districts

State and district	1936 Consumers	1936 Gross tons	1937 Consumers	1937 Gross tons	1938 Consumers	1938 Gross tons	1939 Consumers	1939 Gross tons
Connecticut	53	79,208	58	87,912	57	47,746	59	74,005
Maine	16	9,257	16	8,824	16	4,052	15	6,000
New Hampshire	13		13	2,180	14	1,248	15	1,630
Massachusetts	87	75,389	103	98,407	98	59,774	97	103,156
Rhode Island	13	25,983	14	35,140	13	14,362	12	23,444
Vermont	14	3,866	14	7,086	13	3,019	12	5,830
Total New England	196	193,703	218	239,549	211	130,201	210	214,065
Delaware	6	215,460	7	309,065	7	199,944	7	250,893
New Jersey	79		81		80		79	
New York	191	1,371,661	192	1,793,421	194	927,350	193	1,622,545
Pennsylvania	341	9,074,405	348	10,578,554	345	4,781,482	365	9,064,876
Total Middle Atlantic	617	10,661,526	628	12,681,040	626	5,908,776	644	10,938,314
Alabama	50	1,453,524	59	1,802,027	59	1,395,369	57	2,123,905
District of Columbia	1	501	1	444	1	1,353,414	2	2,112,084
Kentucky	18	1,489,375	22	1,724,693	21		24	
Maryland	24		25		26		26	
West Virginia	21	648,882	22	746,015	22	501,920	23	785,770
Florida	9	41,051	11	64,357	10	33,965	12	55,049
Georgia	34		40		40		40	
Mississippi	7	351	7	301	6	327	7	323
North Carolina	26	11,064	27	11,033	30	10,929	32	12,369
South Carolina	14	1,912	12	2,086	13	1,533	13	2,010
Tennessee	46	142,994	53	143,542	53	119,626	52	134,432
Virginia	44		45		44		46	
Total Southeastern	294	3,789,654	324	4,494,498	325	3,417,083	334	5,225,942
Arkansas	3	2,273	6	4,732	5	1,797	6	1,788
Oklahoma	8		9		7		6	
Louisiana	8		8		8		8	
Texas	20	4,699	22	19,171	23	2,691	24	2,297
Total Southwestern	39	6,972	45	23,903	43	4,488	44	4,085
Illinois	176	2,770,746	193	3,077,837	182	1,468,762	179	2,473,833
Indiana	109	3,473,415	116	3,661,133	120	1,891,230	124	3,419,691
Iowa	41	62,576	51	80,893	51	39,214	49	48,959
Minnesota	48	46,024	49	206,903	52	131,618	53	166,050
Missouri	48	40,367	54	51,885	50	25,319	53	33,714
Kansas	13	3,726	17	5,108	15	2,529	14	3,137
Nebraska	8		9		8		7	
Michigan	142	1,567,890	165	1,828,870	158	980,742	168	1,651,448
Wisconsin	110		118		116		118	
South Dakota	1	9	---	---	---	---	2	132
Ohio	258	7,013,146	278	7,173,926	276	4,274,412	290	6,748,630
Total North Central	954	14,977,899	1,050	16,086,555	1,028	8,813,826	1,057	14,545,594
Arizona	4	72	2	43	1	22	1	32
Nevada								
New Mexico								
Colorado	16	320,514	15	371,688	17	136,366	19	368,054
Utah								
Idaho	4	2,805	5	482	4	196	5	275
Wyoming								
Montana								
Total Rocky Mountain	24	323,391	22	372,213	22	136,584	25	368,361
Oregon	16	8,223	18	6,810	18	4,927	19	5,636
Washington	35		41		33		37	
California	90	137,266	94	151,959	90	88,464	95	155,770
Total Pacific Coast	141	145,489	153	158,769	141	93,391	151	161,406
Total United States	2,265	30,098,634	2,440	34,056,527	2,396	18,504,349	2,465	31,457,767

World production.—World production of pig iron (including ferro-alloys) in 1939 increased 23 percent over 1938 to 102,000,000 metric tons and was 19 percent above the 1925–29 average. The United States supplied 32 percent of the 1939 total compared with 23 percent in 1938. Thus, while American production increased 66 percent, that for the rest of the world increased only 10 percent.

World production of pig iron (including ferro-alloys), 1935–39, by countries, in metric tons

[Compiled by M. T. Latus]

Country [1]	1935	1936	1937	1938	1939
Australia [2]	709,704	795,804	963,163	941,551	[3] 1,100,000
Belgian Congo			565	[4] 600	[4] 600
Belgium	3,029,600	3,161,340	3,803,750	2,426,130	3,068,200
Brazil	64,082	78,418	98,108	118,580	150,000
Canada	667,028	766,625	996,671	773,573	844,760
China (Manchuria)	607,949	647,402	[4] 650,000	[4] 700,000	[4] 700,000
Chosen	245,196	216,752	168,344	[4] 200,000	[4] 200,000
Czechoslovakia	810,938	1,139,886	1,675,064	1,233,987	[3] 1,000,000
Finland	11,035	13,107	11,258	27,000	[4] 30,000
France	5,789,780	6,230,420	7,916,000	6,061,322	[3] 7,900,000
Germany [5]	12,846,204	15,302,477	15,959,806	18,596,000	[3] 20,300,000
Austria	193,170	248,111	389,118		
Hungary	185,883	306,290	357,935	335,016	[3] 460,000
India, British	1,489,216	1,568,089	1,655,457	1,583,284	[3] 1,800,000
Italy	703,844	815,490	865,305	928,847	[3] 1,000,000
Japan	1,964,613	2,072,445	2,750,000	[4] 2,800,000	[4] 3,000,000
Luxemburg	1,872,372	1,986,604	2,512,495	1,500,000	[3] 1,800,000
Mexico	64,139	88,032	89,717	98,376	[4] 100,000
Netherlands	253,616	274,883	311,773	266,956	284,004
New Zealand	4,981				
Norway	130,751	167,357	181,238	173,748	[4] 175,000
Poland	394,097	581,869	724,296	967,668	[3] 1,000,000
Rumania	81,989	97,096	127,234	130,388	[4] 140,000
Spain	348,078	220,815	128,000	439,897	[3] 500,000
Sweden	612,596	631,736	692,865	713,579	[3] 640,000
Union of South Africa	173,486	202,186	276,236	294,406	300,227
U. S. S. R.	12,606,100	14,546,077	14,520,000	15,179,856	[3] 15,200,000
United Kingdom	6,527,105	7,844,922	8,629,313	6,871,546	[3] 8,300,000
United States	21,715,541	31,571,224	37,749,575	19,474,677	32,321,653
Yugoslavia	21,793	44,453	41,006	58,458	[4] 60,000
	74,125,000	91,620,000	104,200,000	82,895,000	102,000,000

[1] In addition to countries listed, pig iron is produced in Chile and the Philippine Islands, but production figures are not available.
[2] Year ended June 30.
[3] Approximate production as published by Steel, vol. 196, No. 1, January 1940, p. 269.
[4] Estimated production.
[5] Beginning with March 1935, production of the Saar is included with that of Germany. Production of the Saar in January and February 1935 amounted to 302,196 metric tons.

FERRO-ALLOYS

Production and shipments.—The production of ferro-alloys was 735,171 gross tons in 1939 compared with 584,724 in 1938, an increase of 26 percent. In 1939 ferro-alloys were made at 13 blast-furnace plants, 16 electric-furnace plants, and 3 aluminothermic plants; in addition 3 plants made ferrophosphorus and 2 plants made ferrosilicon as a byproduct. Of the 1939 total, 486,098 tons were made in blast furnaces and 245,236 tons in electric furnaces.

Shipments of all classes of ferro-alloys in 1939 rose 81 percent in quantity and 79 percent in total value over 1938. Compared with the 5-year average for 1925–29 (715,250 tons), 1939 shipments increased 18 percent.

Ferro-alloys shipped from furnaces in the United States, 1938–39, by varieties

Variety of alloy	1938		1939	
	Gross tons	Value	Gross tons	Value
Ferromanganese	223,720	$19,144,884	296,631	$24,137,211
Spiegeleisen	24,939	[1] 728,830	84,739	2,484,042
Ferrosilicon (7 percent or more silicon)	163,775	7,999,661	343,822	16,850,356
Ferrophosphorus	6,593	469,940	13,320	898,471
Ferrotungsten	484	1,453,227	1,609	4,846,386
Other varieties [2]	44,601	12,662,971	101,041	26,940,122
	464,112	[1] 42,459,513	841,162	76,156,588

[1] Revised figures.
[2] Ferroboron, ferrochromium, ferrocolumbium, ferromolybdenum and calcium-molybdenum compounds, ferrotitanium, ferrovanadium, ferrozirconium, silicomanganese, silicospiegeleisen, and zirconium ferrosilicon.

Ferromanganese.—Shipments of ferromanganese in 1939 increased 33 percent over 1938 but were 2.4 percent below the 5-year average for 1925–29 (303,883 gross tons). The average value per ton, f. o. b. furnaces, reported for ferromanganese was $81.37 in 1939 compared with $85.58 in 1938.

The production of ferromanganese in 1939 increased 11 percent over 1938 and was made at seven blast-furnace plants and one electric-furnace plant in both 1938 and 1939. In both years most of the output was made in blast furnaces.

Ferromanganese produced in the United States and metalliferous materials consumed in its manufacture, 1935–39

Year	Ferromanganese produced			Materials consumed (gross tons)				Manganese ore used per ton of ferromanganese made (gross tons)
	Gross tons	Mn contained		Manganese ore (35 percent or more Mn, natural)		Iron and manganiferous iron ores	Cinder, scale, and purchased scrap	
		Percent	Gross tons	Foreign	Domestic			
1935	214,290	79.41	170,168	401,846	4,286	9,195	8,921	1.895
1936	316,000	79.09	249,933	595,114	5,987	12,467	2,821	1.902
1937	376,443	79.54	299,425	698,052	9,444	17,511	6,017	1.879
1938	242,994	78.65	191,104	416,738	22,548	9,696	8,462	1.808
1939	270,111	79.24	214,040	502,986		8,324	6,250	1.862

The tonnage of manganese ore used per ton of ferromanganese produced increased slightly in 1939. As shown in the following table all manganese ore used in making ferromanganese in 1939 came from foreign sources.

Quantity and tenor of manganese ore used in manufacture of ferromanganese in the United States, 1938–39

Source of ore	1938		1939	
	Gross tons	Manganese content (percent, natural)	Gross tons	Manganese content (percent, natural)
Africa	152,698	48.99	129,227	48.14
Brazil	64,060	41.44	58,284	43.75
Chile			856	48.16
Cuba	36,295	48.07	58,999	48.16
India	55,965	49.24	86,309	49.84
U. S. S. R.	107,720	47.61	169,311	47.54
United States	22,548	53.20		
	439,286	47.72	502,986	47.72

Spiegeleisen.—Shipments of spiegeleisen from domestic furnaces in 1939 rose 240 percent over 1938. The average value per ton at the furnaces was $29.31 in 1939 compared with $29.22 (revised figure) in 1938. The entire production, which increased to 91,491 tons in 1939 from 11,311 tons in 1938, was made in blast furnaces. Output in 1939 averaged 20.18 percent manganese. Most of the spiegeleisen was manufactured from domestic ores in 1939, only 206 tons of foreign manganese ore being used.

Ferrosilicon.—Shipments of ferrosilicon in 1939 increased 110 percent over 1938. The production of ferrosilicon in 1939 totaled 279,964 gross tons, including 144,948 tons made by blast furnaces, 134,844 tons by electric furnaces, and 172 tons as a byproduct in the manufacture of artificial abrasives in electric furnaces. The silicon content of the production in 1939 ranged from 7 to 95 percent but averaged 24 percent. Most of the raw material used in making ferrosilicon was of domestic origin.

Ferrophosphorus.—Production of ferrophosphorus decreased slightly to 15,465 gross tons containing 24.37 percent phosphorus in 1939 from 15,842 tons containing 24.14 percent phosphorus in 1938, but shipments from furnaces increased 102 percent. Most of the 1939 output was made in electric furnaces, and all of it was manufactured from domestic materials.

Ferrotungsten.—Shipments of ferrotungsten gained 232 percent in quantity and 233 percent in total value over 1938. The 1939 shipments contained 78.43 percent (2,827,282 pounds) tungsten and were valued at $1.71 per pound of contained tungsten. Production totaled 1,586 gross tons containing 78.45 percent tungsten (2,786,686 pounds). In addition to domestic ores (chiefly from California, Colorado, and Nevada), foreign ores from China, the Malay States, Mexico, and South America were used. All ferrotungsten was made in electric furnaces.

Foreign trade.—Imports of all alloys of the rarer metals are not recorded separately but are grouped as shown in the following table. Ferromanganese and spiegeleisen comprised most of the imports in both 1938 and 1939. Imports of ferromanganese for consumption (chiefly from Norway and the Netherlands) were 41,227 gross tons—57 percent more than in 1938. Imports of spiegeleisen for consumption (chiefly from Canada) were 38,264 tons, an increase of 122 percent over 1938. The duty on ferrosilicon containing 8 percent but less than 30 percent silicon was cut from 1½ cents to 1 cent per pound of silicon content, effective January 1, 1939, in the new trade agreement with Canada. That country supplies most of the imports of this material.

Exports of ferro-alloys, which are relatively unimportant in tonnage, rose in 1939 over 1938. Exports of ferromanganese and spiegeleisen in 1939 were 2,923 gross tons and of other ferro-alloys 4,042 tons.

Ferro-alloys and ferro-alloy metals imported for consumption in the United States, 1938–39, by varieties

Variety of alloy	1938			1939		
	Gross weight (gross tons)	Content (gross tons)	Value	Gross weight (gross tons)	Content (gross tons)	Value
Ferromanganese:						
Containing over 1 percent carbon	26,001	20,903	$1,739,501	40,210	32,565	$2,815,465
Containing not over 1 percent carbon	257	215	31,447	1,017	849	119,749
Manganese silicon (manganese content)	----	----	----	[1]	17	1,240
Manganese boron, manganese metal, and spiegeleisen not more than 1 percent carbon (manganese content)	[1]	19	8,798	[1]	22	9,247
Spiegeleisen	17,248	[1]	625,480	38,264	[1]	1,329,814
Ferrochrome or ferrochromium:						
Containing 3 percent or more carbon	[2]	[3]	5	6	3	646
Containing less than 3 percent carbon	175	121	29,953	188	127	38,558
Ferrosilicon	5,325	626	134,067	8,203	1,036	237,543
Chrome or chromium metal	39	[1]	48,343	56	[1]	59,520
Chromium and zirconium silicon and calcium silicide	899	[1]	93,319	1,773	[1]	225,312
Ferromolybdenum, molybdenum metal and powder, calcium molybdate, and other compounds and alloys of molybdenum (molybdenum content)	[1]	[4]	81	[1]	12	32,327
Ferrotitanium	----	----	----	[1]	[5]	77
Tungsten and combinations, in lumps, grains, or powder:						
Tungsten metal (tungsten content)	[1]	9	23,994	[1]	18	41,440
Combinations containing tungsten or tungsten carbide (tungsten content)	[1]	1	7,523	[1]	[6]	1,430
Tungsten acid and other compounds of tungsten, n. s. p. f. (tungsten content)	[1]	[7]	1,606	[1]	[8]	4,424

[1] Not recorded.
[2] 100 pounds.
[3] 60 pounds.
[4] 25 pounds.
[5] 350 pounds.
[6] 251 pounds.
[7] 241 pounds.
[8] 700 pounds.

Ferromanganese and ferrosilicon imported for consumption in the United States, 1938–39 by countries

Country	Ferromanganese (manganese content)				Ferrosilicon (silicon content)			
	1938		1939		1938		1939	
	Gross tons	Value	Gross tons	Value	Gross tons	Value	Gross tons	Value
Canada			(1)	$50	626	$134,067	1,036	$237,543
Czechoslovakia [2]	3,043	$211,356	2,050	162,091				
France	1,137	152,068	846	100,905				
Germany [2]			391	24,622				
Japan	308	37,118						
Netherlands	5,843	403,561	7,974	561,509				
Norway	10,547	953,045	19,563	1,909,610				
Poland and Danzig [2]			1,598	118,015				
Sweden			22	3,356				
Yugoslavia	240	13,800	970	55,056				
	21,118	1,770,948	33,414	2,935,214	626	134,067	1,036	237,543

[1] Less than 1 ton.
[2] For statistical purposes, trade with the Sudeten area, as far as ascertainable, is included with Germany, while trade with the other Czechoslovak Provinces occupied by Germany and Poland has been included with these countries since March 18 or 19, 1939. After November 16, 1939, trade with Danzig and that part of Poland occupied by Germany has been included with Germany.

Ferro-alloys and ferro-alloy metals exported from the United States, 1938–39, by varieties

Variety of alloy	1938		1939	
	Gross tons	Value	Gross tons	Value
Ferromanganese and spiegeleisen	247	$18,799	2,923	$247,798
Other ferro-alloys [1]	1,197	1,171,869	4,042	1,024,826

[1] Includes ferrosilicon, ferrotungsten, ferrovanadium, and other ferro-alloys.

STEEL

Production.—The domestic steel industry operated at 53 percent of capacity in the first half of 1939, maintaining production at the level of the latter half of 1938. During the second half of 1939, however, the operating rate increased progressively from 52.4 percent of capacity in July to 93.3 percent in November but dropped to 85.6 percent in December. Slightly more than one-third of the 1939 output of steel was made in the final 3 months, when the production rate rose to an all-time high. The average operating rate was 64 percent in 1939 compared with 40 percent in 1938. The following figures covering the output of steel were compiled by the American Iron and Steel Institute. Production of steel ingots and castings in 1939 totaled 47,141,709 gross tons, 4 percent below the 1925–29 average but an increase of 66 percent over 1938.

Of the 1939 total, 91.7 percent was made in the open hearth, 6.4 percent in bessemer converters, 1.9 percent in electric furnaces, and only 831 tons in crucible furnaces. The bulk (42,704,197 tons) of the total open-hearth output in 1939 was made in basic furnaces.

Of the total output of steel ingots and castings, 46,908,428 gross tons were ingots in 1939 compared with 28,210,841 tons in 1938.

A large part of the steel production comes from the contiguous States Pennsylvania and Ohio. In 1939 these two States produced about 50 percent of the total steel, 49 percent of the open-hearth steel, and 76 percent of the bessemer steel.

Open-hearth steel ingots and castings manufactured in the United States, 1935–39, by States, in gross tons

[Includes only that portion of the steel for castings produced in foundries operated by companies manufacturing steel ingots]

State	1935	1936	1937	1938	1939
New England States	248,778	301,161	276,021	163,658	256,116
New York and New Jersey	1,275,496	2,109,946	2,789,413	1,347,802	2,346,348
Pennsylvania	7,850,710	12,913,903	14,561,700	7,072,157	12,162,743
Ohio	7,702,018	9,789,985	9,067,944	5,372,234	8,851,298
Indiana	4,376,998	5,963,501	5,947,368	3,435,360	5,791,520
Illinois	2,534,811	3,663,011	3,913,318	1,950,224	3,292,745
Other States	6,726,618	8,794,621	9,716,539	6,622,865	10,522,266
	30,715,429	43,536,128	46,272,303	25,964,300	43,223,036

Bessemer-steel ingots and castings manufactured in the United States, 1935–39, by States, in gross tons

[Includes only that portion of the steel for castings produced in foundries operated by companies manufacturing steel ingots]

State	1935	1936	1937	1938	1939
Ohio	1,361,933	1,639,329	1,747,710	1,074,032	1,285,383
Pennsylvania	764,403	952,971	830,440	348,060	990,251
Illinois	375,445	866,157	871,777	458,569	723,398
Other States	333,250				
	2,835,031	3,458,457	3,449,927	1,880,661	2,999,032

Steel electrically manufactured in the United States, 1935–39, in gross tons

[Includes only that portion of the steel for castings produced in foundries operated by companies manufacturing steel ingots]

Year	Ingots	Castings	Total	Year	Ingots	Castings	Total
1935	521,818	19,674	541,492	1938	468,610	36,414	505,024
1936	704,213	68,242	772,455	1939	849,573	69,237	918,810
1937	814,310	31,227	845,537				

The steel-production figure for 1939 includes 2,867,817 gross tons of alloy-steel ingots and castings, which represent 6 percent of the total. This figure includes steels in which the minimum of the range specified in any of the elements named exceeds the following percentages: Nickel, 0.40 percent; chromium, 0.30 percent; copper, 0.50 percent; manganese, 1.65 percent; silicon, 0.50 percent; molybdenum, 0.10 percent; vanadium, tungsten, cobalt, titanium, and zirconium, any percent. The output of alloy steels in 1939 increased 94 percent and that of total steel 66 percent over 1938. Of the total alloy-steel output in 1939, 72 percent came from basic open hearths, 5 percent from acid open hearths, 23 percent from electric furnaces, 206 tons from crucible furnaces, and 3,113 tons from bessemer furnaces.

Production of alloy-steel ingots and castings, 1935–39, by processes, in gross tons

[Includes only that portion of the steel for castings produced in foundries operated by companies manufacturing steel ingots]

Process	1935	1936	1937	1938	1939
Open hearth, basic	1,633,541	2,239,885	2,285,000	1,052,706	2,055,601
Open hearth, acid	73,400	115,766	146,835	91,151	139,804
Bessemer				12	3,113
Crucible	154	209	241	4	206
Electric	412,563	527,762	600,550	332,475	669,093
	2,119,658	2,883,622	3,032,626	1,476,348	2,867,817

From the foregoing tables it will be seen that most of the steel made in electric furnaces (73 percent in 1939) is alloy steel. Typically, steels with higher alloy content are made in electric furnaces and steels with lower alloy content by the open-hearth process.

Foreign trade.—Although exports of iron and steel products (excluding scrap) in 1939 did not approach the high figure established in 1937, they were 16 percent above 1938 and surpassed those in any other year since 1929. Because of unsettled conditions and expanded armament activities foreign producers have been unable to meet demands in their own countries, and buyers have turned to the United States for supplies. Shortage of necessary raw materials, inadequate smelting capacity, and finishing and fabricating facilities insufficient to meet expanded demands in other nations have caused abnormal exports in a wide range of semimanufactured and manufactured American products. The situation abroad, however, is being rectified by the construction and equipment of new plants and the search for and development of sources of raw material. The success of these programs may make other nations more important factors in export markets, with a consequent lower demand in this country. Barter methods now being used may make competition difficult for American producers.

Exports of iron ore, pig iron, and ferro-alloys are covered in other sections of this report. All important items in the 1939 movement of iron and steel products, except pig iron and rails, registered gains. Exports of iron and steel scrap (including tin-plate scrap), although lower than the unprecedented total of 4,101,549 tons in 1937, amounted to 3,584,439 tons. Of the 1939 scrap exports 83 percent went to three countries—Japan (57 percent), United Kingdom (14 percent), and Italy (12 percent).

Although exports of American iron and steel products in 1939 reached most of the world markets, seven countries took 52.6 percent of the total—Canada 15.6 percent, Japan 8.1 percent, the United Kingdom 6.5 percent, Brazil 6.0 percent, Sweden 5.9 percent, the Philippine Islands 5.8 percent, and the Netherlands 4.7 percent.

Iron and steel exported from the United States, 1938–39

Article	1938		1939	
	Gross tons	Value	Gross tons	Value
Semimanufactures:				
Steel ingots, blooms, billets, slabs, and sheet bars	167, 641	$5, 905, 201	215, 750	$8, 090, 822
Iron and steel bars and rods:				
Iron bars	1, 310	100, 803	866	89, 298
Concrete reinforcement bars	26, 105	1, 366, 775	47, 255	2, 267, 422
Other steel bars	123, 417	8, 873, 068	160, 446	12, 897, 431
Wire rods	23, 465	1, 381, 414	31, 450	1, 330, 141
Iron and steel plates, sheets, skelp, and strips:				
Boiler plates	6, 753	460, 613	9, 278	536, 366
Other plates, not fabricated	214, 355	10, 883, 283	244, 800	11, 479, 538
Skelp iron or steel	59, 867	2, 465, 104	81, 662	3, 359, 890
Iron and steel sheets, galvanized	76, 037	7, 020, 398	110, 968	9, 594, 599
Steel sheets, black, ungalvanized	205, 278	16, 442, 444	269, 025	19, 698, 555
Iron sheets, black	7, 566	614, 633	10, 448	812, 392
Strip band, and scroll iron or steel:				
Cold-rolled	25, 514	2, 714, 356	26, 243	2, 811, 861
Hot-rolled	37, 041	2, 469, 958	62, 710	3, 740, 975
Tin plate, terneplate, and taggers' tin	161, 576	19, 078, 015	311, 016	33, 032, 832
Manufactures—steel-mill products:				
Structural iron and steel:				
Water, oil, gas, and other storage tanks complete and knocked-down material	37, 730	3, 284, 095	28, 735	2, 646, 797
Structural shapes:				
Not fabricated	83, 691	4, 507, 428	115, 465	5, 549, 454
Fabricated	38, 057	3, 666, 049	37, 154	3, 505, 595
Plates fabricated, punched, or shaped	2, 348	219, 003	6, 701	505, 833
Metal lath	863	160, 272	1, 656	303, 258
Frames, sashes, and sheet piling	4, 909	519, 986	8, 878	797, 021
Railway track material:				
Rails for railways	82, 721	3, 111, 734	59, 092	2, 375, 481
Rail joints, splice bars, fishplates, and tieplates	7, 343	444, 081	8, 814	618, 666
Switches, frogs, and crossings	1, 645	325, 514	2, 009	365, 830
Railroad spikes	2, 606	186, 529	3, 513	253, 848
Railroad bolts, nuts, washers, and nut locks	1, 236	148, 132	1, 950	221, 653
Tubular products:				
Boiler tubes	8, 124	1, 541, 236	15, 170	1, 959, 587
Casing and oil-line pipe	63, 703	6, 916, 700	87, 905	8, 717, 000
Seamless black pipe, other than casing and oil line	7, 459	1, 286, 813	10, 219	1, 355, 699
Welded black pipe	13, 779	1, 407, 519	23, 957	2, 279, 376
Welded galvanized pipe	17, 404	1, 762, 457	33, 398	3, 245, 345
Malleable-iron screwed pipe fittings	3, 102	1, 088, 644	4, 608	1, 440, 524
Cast-iron screwed pipe fittings	1, 891	506, 202	2, 365	582, 190
Cast-iron pressure pipe and fittings	20, 045	1, 312, 048	31, 805	1, 618, 952
Cast-iron soil pipe and fittings	9, 957	656, 704	11, 978	744, 917
Riveted-steel or iron pipe and fittings	945	189, 307	7, 574	2, 115, 909
Wire and manufactures:				
Barbed	33, 942	2, 457, 339	53, 323	3, 743, 725
Galvanized wire	25, 792	1, 946, 316	28, 259	2, 098, 188
Iron or steel wire, uncoated	24, 080	1, 830, 283	32, 235	2, 417, 065
Wire rope, and strand	4, 372	1, 181, 125	6, 058	1, 514, 691
Woven-wire fencing and screen cloth	3, 541	682, 452	5, 294	1, 155, 051
All other	6, 262	1, 504, 675	11, 899	2, 491, 593
Nails and bolts (except railroad):				
Wire nails	20, 720	1, 369, 771	25, 796	1, 697, 071
Horseshoe nails	888	179, 128	931	208, 364
All other nails, including tacks and staples	4, 348	476, 580	5, 527	610, 143
Bolts, nuts, rivets, and washers (except railroad)	8, 057	2, 082, 898	8, 856	2, 349, 658
Castings and forgings:				
Horseshoes and calks	103	13, 114	224	29, 576
Iron and steel, including car wheels and axles	37, 634	4, 536, 947	51, 854	7, 033, 534
Advanced manufactures:				
House heating boilers and radiators		333, 101		279, 443
Oil burners and parts		1, 125, 993		1, 085, 111
Tools:				
Axes		476, 610		607, 445
Shovels and spades		248, 392		316, 817
Hammers and hatchets		232, 008		303, 707
Saws, wood and metal cutting		1, 225, 686		1, 754, 048
All other tools		9, 356, 596		11, 923, 674

Imports for consumption of iron and steel (exclusive of scrap) in 1939 were 19 percent greater than in 1938. The import trade was much lower than the export trade. Ferromanganese, pig iron, and spiegeleisen accounted for most of the increase in 1939, as manufactured and unmanufactured articles gained only 4 percent. Imports came principally from European countries, Canada, and British India. Imports of scrap in 1939 were only 29,492 long tons (21 percent above 1938), and 92 percent of the 1939 total came from Canada.

Iron and steel imported for consumption in the United States, 1938–39, by commodities

Commodity	1938		1939	
	Gross tons	Value	Gross tons	Value
Semimanufactures:				
Steel bars:				
Concrete reinforcement	1,531	$51,924	2,364	$74,289
Solid or hollow, n. e. s.	18,899	1,122,228	17,060	906,873
Hollow and hollow drill steel	865	131,386	1,357	198,753
Iron slabs, blooms, or other forms	(1)	5		
Bar iron	504	29,005	930	76,488
Wire rods, nail rods, and flat rods up to 6 inches in width	5,280	410,454	10,692	928,639
Boiler or other plate iron or steel, except crucibles and saw-plate steel	355	18,900	18	967
Sheets or plates of iron or steel	(1)	17	10	13,017
Steel ingots, blooms, and slabs	205	5,586	18	4,009
Billets, solid or hollow	553	65,413	727	90,907
Die blocks or blanks; shafting, etc.	96	34,191	89	7,847
Circular saw plates	32	14,233	52	23,659
Sheets of iron or steel, common or black and boiler or other plate iron or steel	5,651	290,289	750	31,287
Sheets and plates and steel, n. s. p. f.	361	29,634	604	39,528
Tin plate, terneplate, and taggers' tin	109	32,013	99	24,809
Manufactures:				
Structural iron and steel	39,624	1,494,869	39,533	1,351,831
Rails for railways	3,336	98,020	7,020	175,814
Rail braces, bars, fishplates or splice bars, and tie plates	288	14,935	765	29,800
Pipes and tubes:				
Cast-iron pipe and fittings	1,619	59,420	1,841	69,732
Other pipes and tubes	29,102	2,481,334	30,587	2,621,288
Wire:				
Barbed	12,528	720,378	15,249	926,511
Round iron and steel	1,531	308,223	2,310	497,233
Baling	152	10,170	202	13,231
Telegraph, telephone, etc., except copper, covered with cotton jute, etc.	27	14,144	8	3,241
Flat and steel strips not thicker than ¼-inch and not over 16 inches wide	2,696	1,626,961	3,153	1,727,657
Rope and strand	2,020	376,406	1,663	291,361
Galvanized fencing wire and wire fencing	1,459	96,865	1,474	89,382
Hoop or band iron or steel for baling	9,403	406,246	23,227	855,545
Hoop, band, strips, or scroll iron or steel, n. s. p. f.	16,728	644,974	443	52,876
Nails	7,598	649,998	7,287	557,898
Castings and forgings, n. e. s.	3,815	427,788	1,124	148,508

[1] Less than 1 ton.

MANGANESE AND MANGANIFEROUS ORES

By Robert H. Ridgway and H. W. Davis [1]

SUMMARY OUTLINE

The outbreak of war in Europe in September and the sudden increase in steel-plant activities in this country during the last quarter of the year were the principal factors influencing the manganese industry in 1939. The low rate of steel activity, the large stocks on hand, and active selling programs weakened the market during the first half of the year, and domestic quotations which opened the year at $0.30 a long-ton unit (before duty) declined, continuing the slump of 1938. Developments in Europe during the second half of the year increased demand, restricted shipping, and caused large increases in ocean-freight and war-risk-insurance rates. Meanwhile the domestic consuming industry revived sharply, with the result that prices jumped to $0.50 per unit before duty. The situation eased slightly at the close of the year. Restrictions placed on supplies from a number of sources may have hampered exports.

Despite the increase in imports for consumption, stocks in bonded warehouses increased, reaching a new year-end peak, according to data of the Bureau of Foreign and Domestic Commerce. As most of the domestic consumption is supplied by imports, the apparent consumption of manganese ore paralleled the 30-percent gain in imports for consumption. Stimulated by higher prices and possible Government purchases, activity at domestic manganese operations increased, but production was still small and the increase of little significance. Much new activity, however, was reported.

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

Salient statistics of the manganese industry in the United States, 1925–29 (average) and 1935–39, in long tons

	1925–29 (average)	1935	1936	1937	1938	1939
Manganese ore:						
Total shipments containing 35 percent or more Mn	59,312	26,428	32,119	40,241	25,321	29,307
Shipments of metallurgical ore	[1] 41,892	16,679	18,557	26,419	16,989	18,580
Shipments of battery ore	17,420	7,264	7,747	6,447	4,959	7,767
Imports for consumption	600,000	383,500	813,362	911,919	483,586	627,131
Stocks in bonded warehouses at end of year	304,000	418,302	366,381	681,290	842,048	903,561
Indicated consumption (35 percent or more Mn)	659,000	413,286	848,491	954,503	509,930	656,438
Ferro-alloys:						
Production of ferromanganese	306,360	214,290	316,000	376,443	242,994	270,111
Imports of ferromanganese [2] [3]	[4] 50,590	21,830	30,593	23,888	21,118	33,414
Production of spiegeleisen	95,463	60,018	95,137	([5])	11,311	91,491
Imports of spiegeleisen [2]	7,298	32,384	52,011	16,841	17,248	38,264
Exports of spiegeleisen and ferromanganese	3,769	131	466	1,725	247	2,923
Stocks of ferromanganese in bonded warehouses	[3] [4] 7,765	5,796	9,902	11,788	8,392	4,253

[1] Includes small quantity of miscellaneous ore.
[2] Imports for consumption.
[3] Manganese content.
[4] Includes small quantity of other manganese alloys.
[5] Bureau of Mines not at liberty to publish figures.

The process for making electrolytic manganese, developed and patented by the Bureau of Mines, has been installed in a small commercial plant at Knoxville, Tenn., by the Electromanganese Corporation, Rand Tower, Minneapolis, Minn. The Bureau is now investigating new uses for the metal.[2] Tests of samples of low-grade or complex ores from nine localities in Alabama, California, Colorado, Idaho, Missouri, Nevada, and New Mexico showed that the manganese occurred in mineralogic forms that would not permit high-grade concentrates to be produced by usual ore-dressing methods. The application of roasting and leaching, however, to the production of manganese by the electrolytic process was indicated in most of the samples.[3]

The trend in imports and domestic production of manganese ore is shown graphically in figure 1.

Emergency stock pile.—The Strategic Materials Act (Public, No. 117, 76th Cong., ch. 190, 1st sess.), which was signed by the President on June 7, 1939, authorized the expenditure of $100,000,000 over a 4-year period for the purchase of strategic materials. Only $10,000,000 was appropriated in the Third Deficiency Bill, approved August 2, 1939 (Public, No. 361, 76th Cong., ch. 633, 1st sess.), and purchases were restricted largely to the high-priority mineral commodities on the strategic list. Of all strategic mineral commodities, manganese ore is required in the largest quantities.

Only high-grade ore suitable for the manufacture of ferromanganese, the form in which manganese is usually added in steel manufacture, has been designated as strategic. Specifications for this type of material were drawn in three grades as follows:

[2] Dean, R. S., Anderson, C. T., Moss, C., and Ambrose, P. M., Progress Reports—Metallurgical Division. 33. Manganese and Its Alloys: Bureau of Mines Rept. of Investigations 3477, 1939, pp. 1–47.
[3] Engel, A. L., and Shelton, S. M., Progress Reports—Metallurgical Division. 36. Ore-dressing Studies, 1938–39: Bureau of Mines Rept. of Investigations 3484, 1940, pp. 3–12.

Specifications for ferrograde manganese ore, percent

Item	Grade A	Grade B	Grade C
Manganese (minimum)	48	48	48
Iron (maximum)	7	[1] 7	7
Silica (maximum)	9	[2] 10	7
Phosphorus (maximum)	.12	.18	.15
Alumina (maximum)	3	6	6
Zinc (maximum)	1	1	1

[1] Iron content to be not less than 1 percent.
[2] For each additional percent of manganese content over 48 percent an additional 0.2 percent silica content is allowable.

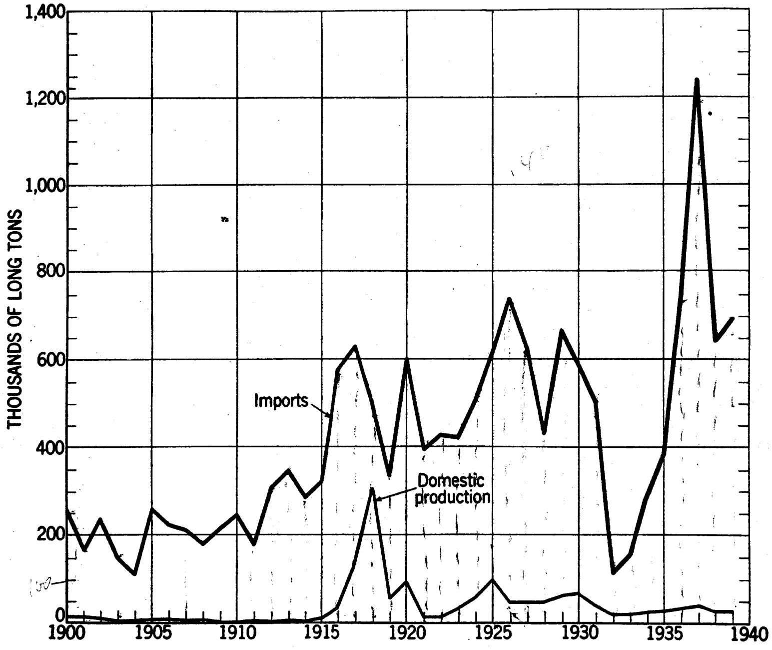

FIGURE 1.—Imports and domestic production of manganese ore, 1900–1939. Statistics on imports shown in the graph represent "general imports" for the period 1900–1933; beginning with 1934 data classified as "general imports" were not available, and the figures plotted for 1934–39 represent imports for consumption adjusted for changes in stocks in bonded warehouses and are closely comparable with the record for earlier years.

It was further provided that all ore should pass a 6-inch screen and that not more than 12.5 percent should pass a 20-mesh screen.

Proposals for supplies (S–1 and S–2), for opening October 19, 1939, were sent out September 19, 1939. In all, 15 bids were received, of which 7 proposed to furnish ore from domestic deposits and 8 from foreign sources. On October 30, 1939, two contracts were awarded, both on Grade B ore. One for 25,000 long tons at $0.612 per unit, c. i. f. Baltimore, Md., was awarded to the Cuban-American Manganese Corporation, which proposed to furnish nodulized concentrates from Cuba; Cuban manganese ores are not dutiable. Delivery on this contract was begun late in 1939 and was completed early in 1940. The other contract, which called for 5,000 tons at $0.75 a unit, f. o. b. Army Ordnance Depot, Curtis Bay, South Baltimore, Md., was awarded to the Greenbrier Mining Co. The bidder proposed to supply ore from an undeveloped property in West Virginia, but the contract was later canceled as the bidder failed to provide performance bond. Further proposals (S–13) for bids were issued December 1, 1939, for opening on December 19, 1939. No satisfactory bids were received, and no awards were made. The third proposals (S–17) were issued February 1, 1940, for opening February 20, 1940. Eighteen bids were received. Ten proposed to furnish ore from domestic deposits and eight from foreign sources. On March 5, 1940, five contracts were awarded—three on Grade B ore and two on Grade A ore. Derivatives, Inc., and Tonerde, Inc., New York, were awarded two contracts on Grade B ore, one for 2,000 tons at $0.49 per unit, exclusive of duty, c. i. f. Baltimore, and one for 11,000 tons at $0.53 per unit, exclusive of duty, c. i. f. Baltimore. This ore will come from India, South Africa, and Brazil. Two contracts were let on Philippine ore—one for 2,000 tons of Grade A ore at $0.628 per unit, c. i. f. Baltimore, to C. Tennant & Sons, New York, acting as agents for Fernadez Hermanos, and the other to L. W. Lambert for 18,000 tons of Grade B ore at $0.65 per unit, c. i. f. Baltimore. Philippine ores are not dutiable. The fifth contract was awarded to the Commercial Engineering Co. of Washington, D. C., for 8,000 tons of Grade A ore from Canada (Nova Scotia) at $0.60 per unit, exclusive of duty, c. i. f. Baltimore. The contract was not accepted by the bidder as price was based upon supplying 20,000 tons. On March 16 a further award was made to L. L. Patrick for 5,000 tons of domestic Grade B ore at $0.62, f. o. b Army Ordnance Depot, Ogden, Utah.

On February 18, 1940, proposals (S–18) for opening March 6 were issued for 5,000 tons of Grade B ore to replace a canceled contract on a previous letting. Nine bids were received, four on domestic ore and five on foreign ore. On March 16, 1940, a contract was let to L. W. Lambert (at $0.65 per unit, c. i. f. Baltimore, with an allowance of 75 cents a ton for unloading), who proposed to supply Philippine ore. The total awards involve about 68,000 long tons of ore and have obligated approximately $2,000,000, exclusive of handling and storage charges.

Government exploration.—Under section 7 of the Strategic Materials Act the Bureau of Mines and the Geological Survey undertook to search for and appraise ore deposits containing metals that have been designated as strategic by the Secretaries of War, Navy, and the Interior upon advice of the Army and Navy Munitions Board. The bill authorized the expenditure of $500,000 a year, $350,000 by the Bureau of Mines and $150,000 by the Geological Survey, for each of the fiscal years ending June 30, 1940, 1941, 1942, and 1943. The geologists of the Survey and engineers of the Bureau are cooperating closely to accomplish the objectives of the act.

The Bureau of Mines, in carrying out its part [4] of the program, seeks to determine (1) the extent and quality of the ore, (2) the most suitable method of mining and beneficiating it, and (3) the cost at which it may be produced.

An investigation of the deposits on the Olympic Peninsula of Washington was begun in 1939. Although the deposits in this area have been developed relatively little in the past, one mine made a

[4] Finch, John W., Strategic Minerals Investigations—Procedure Followed by the Bureau of Mines. Bureau of Mines Inf. Circ. 7097, 1939, pp. 1–5.

rather substantial production of good-grade ore. Some 4,000 feet of diamond drilling at the Crescent mine disclosed a small body of high-grade ore. Three deposits on the peninsula have been selected for probable project work during the coming fiscal year. One-ton samples were taken from several deposits in Colorado, Idaho, Nevada, and Utah and sent to the Bureau laboratories for ore-dressing tests.

Under the strategic minerals program, the Geological Survey completed its survey in the Little Florida Mountains area in Luna County, southwestern New Mexico. A report has been prepared which is now in process of publication. The program also added impetus to work on the detail survey of the Artillery Peak region in Mohave County, Ariz. Work continued in the Olympic Mountains, but this is a large area and conditions are difficult; the following is a published abstract of a report [5] on the results of the geological investigations to date.

The Olympic Peninsula, Wash., is bordered on the northern, eastern, and southern parts by a thick sequence (30,000 feet) of volcanic rocks, argillites, graywackes, and limestones of lower Eocene age. These rocks are much deformed, and dips of less than 45° are uncommon. The less competent strata, particularly the limestones and limy argillites, are much contorted, both as a result of the mountain-building processes and of the pouring out of lava on the limy muds of the sea bottom. Chocolate-red limestone that contains as much as 10 percent of finely divided hematite is of special interest, as it forms the common host rock for the manganese. The limestones are associated with lavas, particularly pillow basalts. They underlie and overlie the lava, form the matrix between pillows or agglomerate fragments, and in some places form beds at the edges of lava flows. * * * In a few places the manganese minerals have replaced lava, as indicated by remnants of pillow structures. The manganiferous bodies are generally small and contain from a few to a few hundred tons of ore, but some bodies are considerably larger. At the Crescent mine about 25,000 tons (16,000 tons—corrected figure) of high-grade hausmannite (Mn_3O_4) have been mined. Exploration, however, has been for the most past superficial and insufficient to determine the limits of the ore bodies.

The mineral composition of the ores is unique, in that the ore consists of hausmannite and a fine-grained mixture of manganese silicates commonly called "bementite." Small quantities of cinnabar and native copper are widely distributed throughout the deposits. The hausmannite deposits, notably of the Crescent mine, are low in silica. Other deposits contain small amounts of oxides and are chiefly manganese silicates. Still other bodies contain only manganese silicates and jasper and grade into bodies of bright-red jasper that may or may not contain small amounts of manganese silicates.

The manganese ore deposits at Philipsburg, Mont., were resurveyed, and an appraisal of the manganese-ore situation at Butte was undertaken. Minor geologic investigations were made in the Lake Creek district, Jackson County, Oreg.; in the Piedmont region, Va.; in northeastern Arizona; and in San Miguel County, Colo. Some preliminary work was done on the tungsten-bearing manganese deposits in the Golconda district and East Range area, Humboldt County, Nev., as well as the Sodaville area in Mineral County, Nev. All the projects undertaken in connection with the strategic-minerals program will be covered by brief economic reports, including maps, of the localities investigated.

Tables of domestic shipments of manganese ore, imports of manganese ore and ferromanganese, and apparent consumption of manganese, from 1910 to 1938, which present the historical background for a study of the strategic position of manganese ore, are given in Minerals Yearbook, 1939 (pp. 579–580).

[5] Park, Charles F., Jr., Manganese Deposits in the Olympic Peninsula, Wash.: Soc. Econ. Geol. (abs. of paper to be presented at 20th annual meeting), vol. 34, No. 8, December 1939, pp. 944–945.

DOMESTIC PRODUCTION

The domestic production (shipments from domestic mines) of manganese ore increased 16 percent over 1938. Of the manganese ore shipped to metallurgical plants in 1939, 5,708 long tons contained (natural) 48 percent or more Mn.

Manganiferous raw materials shipped by producers in the United States, 1935–39, in long tons

Year	Metallurgical ore (ferrous metallurgy only)				Battery ore	Miscellaneous manganese 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		
1935	16,679	93,291	430,893	113,997	7,264	2,485
1936	18,557	98,962	841,557	124,288	7,747	5,815
1937	26,419	151,955	1,189,017	115,998	6,447	7,375
1938	16,989	33,620	275,240	39,079	4,959	3,373
1939	18,580	239,544	469,703	129,238	7,767	2,960

Shipments of the various grades of manganese ore during the last 5 years are given, by States, in the following tables. In addition, battery-grade ores were produced in Montana; manganiferous zinc residuum was produced from New Jersey zinc ores; and miscellaneous manganese ores came from Alabama, California, Montana, Tennessee, Virginia, and West Virginia.

Metallurgical manganese ore shipped from mines in the United States, 1935–39, by States, in long tons

State	1935	1936	1937	1938	1939	State	1935	1936	1937	1938	1939
Alabama	59	377	31	111	103	Texas	------	------	38	------	------
Arkansas	3,809	4,557	3,931	2,987	5,365	Utah	------	1,635	32	------	50
California	306	------	------	------	------	Virginia	1,972	196	952	1,314	475
Georgia	6,960	3,821	689	3,058	2,646	Washington	------	------	------	------	10
Montana	2,155	5,154	16,854	5,300	2,243	West Virginia	------	138	1,800	56	------
New Mexico	------	------	878	560	339						
North Carolina	------	------	------	------	43		16,679	18,557	26,419	16,989	18,580
Tennessee	1,418	2,679	1,214	3,603	7,306						

Ferruginous manganese ore shipped from mines in the United States, 1935–39, by States, in long tons

State	1935	1936	1937	1938	1939	State	1935	1936	1937	1939	1939
Alabama	647	540	279	356	519	Nevada	------	------	533	------	------
Arkansas	145	3,285	7,509	3,477	1,970	New Mexico	------	170	18,581	6,093	31,999
Colorado	2,625	10,568	11,577	655	7,516	North Carolina	------	------	------	------	51
Georgia	3,735	2,717	4,045	2,807	7,156	Tennessee	------	104	902	456	294
Idaho	------	------	------	------	163	Utah	190	2,974	3,436	------	262
Massachusetts	------	------	------	230	649	Virginia	645	874	1,170	1,670	4,584
Michigan	555	9,627	------	------	------						
Minnesota	77,931	47,796	84,263	17,424	182,260		93,291	98,962	151,955	33,620	239,544
Montana	6,818	20,307	19,660	452	2,121						

Manganiferous iron ore shipped from mines in the United States, 1935–39, by States, in long tons

State	1935	1936	1937	1938	1939
Alabama			149		
Colorado	56				
Georgia		427	5,492		
Michigan	4,847		9,739	16,057	
Minnesota	419,373	840,725	1,173,637	259,183	469,703
Wisconsin	6,617	405			
	430,893	841,557	1,189,017	275,240	469,703

Manganese and manganiferous ores shipped by mines in the United States in 1939, by States

	Ore containing 35 percent or more Mn			Ore containing 10 to 35 percent Mn			Ore containing 5 to 10 percent Mn		
	Shippers	Long tons	Value	Shippers	Long tons	Value	Shippers	Long tons	Value
Metallurgical:									
Alabama	1	103	$1,416	3	519	$4,561			
Arkansas	2	5,365	(1)	1	1,970	(1)			
Colorado				1	7,516	(1)			
Georgia	3	2,646	45,171	4	7,156	35,959			
Idaho				1	163	(1)			
Massachusetts				1	649	(1)			
Minnesota				2	182,260	(1)	3	469,703	$1,213,924
Montana	[2] 1	2,243	(1)	1	2,121	(1)			
New Mexico	2	339	(1)	2	31,999	(1)			
North Carolina	1	43	796	1	51	632			
Tennessee	[2] 4	7,306	109,661	2	294	2,030			
Utah	2	50	(1)	5	262	1,550			
Virginia	[2] 2	475	(1)	4	4,584	27,004			
Washington	1	10	(1)						
Undistributed			196,662			862,661			
Total metallurgical	19	18,580	353,706	28	239,544	934,397	3	469,703	1,213,924
Battery: Montana	[3] 2	7,767	377,544						
Miscellaneous:									
Alabama	1	84							
California	1	6	22,746						
Montana	[2] 2	1,129							
Tennessee	[2] 1	529	18,515						
Virginia	[2] 7	1,186	21,855						
West Virginia	1	26	380						
Total miscellaneous	13	2,960	63,496						
	31	29,307	794,746	28	239,544	934,397	3	469,703	1,213,924

[1] Included under "Undistributed."
[2] 1 producer each in Montana, Tennessee, and Virginia shipped both metallurgical and miscellaneous ore.
[3] Mills through which all ore was shipped; producers not counted.

Alabama.—Shipments of manganese ore from Alabama in 1939 were made by J. B. Bynum, who operates the Walnut Grove mine at Walnut Grove, Etowah County, and by the Manganese Corporation, which buys ore from small operators chiefly in Calhoun and Cleburne Counties. Shipments comprised 103 long tons averaging (natural) 35.09 percent Mn to metallurgical plants and 84 tons averaging (natural) 70.18 percent MnO_2 for miscellaneous uses. Shipments of ferruginous manganese ore came from Calhoun and Etowah Counties and averaged (natural) 30.83 percent Mn.

Arkansas.—Two shippers, Walter H. Denison Manganese & Contracting Co. and Arkansas Manganese Co., supplied the Arkansas total (5,365 long tons) of manganese ore in 1939 from operations in the Batesville-Cushman district of Independence County. The ore averaged (dried) about 48 percent Mn. In addition, 1,970 tons of ferruginous manganese ore averaging (dried) 32.25 Mn were shipped.

California.—The Pacific Coast Manganese Corporation shipped 6 tons of ore containing 70 percent MnO_2 in 1939 from the Daisy mine in the Paymaster district, Imperial County.

Colorado.—No manganese ore was shipped from Colorado in 1939, but 7,516 long tons of ferruginous manganese ore, containing (natural) 17.06 percent Mn and 22.79 percent Fe, were shipped by the Chrysolite Co. from the Allright, Chrysolite, and Fairview claims in Lake County.

Georgia.—Manganese ore shipped from Georgia in 1939 amounted to 2,646 long tons, of which the White Manganese Corporation and Knight & Beatty supplied the larger part. The ore averaged (natural) 39.15 percent Mn and came from the Cartersville district in Bartow County. Shipments of ferruginous manganese ore totaled 7,156 tons averaging (natural) 14.25 percent Mn. Aside from a small quantity from the Gibson mine in Floyd County, all ferruginous manganese ore shipped from Georgia came from the Cartersville district. No manganiferous iron ore was shipped from Georgia in 1939, but shipments of iron ore that contained less than 5 percent Mn were continued in 1939.

Idaho.—The Lava Manganese Mining Co., operating the Vanza mine in Bannock County, shipped 163 long tons of ferruginous manganese ore in 1939 containing (natural) 32.6 percent Mn and 7.1 percent iron.

Massachusetts.—Shipments of ferruginous manganese ore from Massachusetts in 1939 came from the Taconic mine in Hampshire County.

Minnesota.—All shipments of manganese-bearing ores, that is, ore containing 5 percent or more Mn (natural), came from the Cuyuna range in Crow Wing County. The ferruginous manganese ore averaged (natural) 11.69 percent Mn and 35.93 percent iron and came from the Allstead-Hillcrest, Louise, and Merritt mines. The manganiferous iron ore shipped in 1939 contained 7.21 percent Mn and 36.67 percent iron and came from the Hopkins, Louise, Sagamore, and Mahnomen mines.

Montana.—Shipments of manganese ore from Montana in 1939 were 7 percent less than in 1938. Of the 1939 total, one-fifth was nodulized rhodochrosite from the Emma mine in Butte, which averaged (dried) 58.85 percent Mn, and 70 percent was battery-grade concentrates from the Philipsburg district, which averaged (dried) about 70 percent MnO_2. Rhodochrosite was also shipped from the Emma mine to several miscellaneous consumers. Shipments of ferruginous manganese ore comprised 1,192 long tons of ore and 929 tons of tailings from operations at the Trout mine in the Philipsburg district.

New Mexico.—Shipments of manganese ore from New Mexico in 1939 came from Luna County and averaged (natural) 43 percent Mn and 3 percent iron. Most of the shipments came from the Manganese Valley mine operated by Edwin A. Stone; W. T. Blackwell shipped 1 car from the American Mining Co. mine in the Little Florida Mountains. Shipments of ferruginous manganese ore consisted of 31,379 long tons containing (natural) 13 percent Mn and 38 percent iron from the Boston Hill mine near Silver City in Grant County and 620 tons containing (natural) 31 percent Mn and 9 percent iron from the Lake Valley mine in Sierra County.

North Carolina.—One producer (Weber, Magann & Co.) shipped 1 car of ore containing (natural) 35 percent Mn from the North Cove mine in McDowell County and 1 car of ferruginous manganese ore containing (natural) 31 percent Mn. These 2 cars constituted the total shipments from North Carolina in 1939.

Tennessee.—Operations in four counties—Hamilton, Johnson, Monroe, and Unicoi—supplied the total output of Tennessee in 1939, which comprised 7,306 long tons averaging (natural) 35.05 percent Mn shipped to metallurgical plants and 529 tons averaging (natural) 70 percent MnO_2 shipped to chemical plants. The largest production came from the Embree Iron Co. in Unicoi County near Embreeville. The remainder was supplied by N. T. Dixon, W. E. Michael, and J. L. Akus. Shipments of ferruginous manganese ore, which averaged (natural) 22.11 percent Mn, came chiefly from Unicoi County.

Utah.—Two small carloads, one containing (natural) 35.4 Mn and 4.5 percent iron from the Kramer mine in Tooele County and the other containing (natural) 41 percent Mn and 1 percent iron from the Last Chance and Desert Rock mines in Grand County, constituted the total manganese-ore shipments from Utah in 1939. Shipments of ferruginous manganese ores, which averaged 28 percent Mn and 1 percent iron, were made by producers in Juab, Grand, and Tooele Counties.

Virginia.—Shipments of manganese ore from Virginia in 1939 were lower than in 1938 and comprised 475 long tons of metallurgical ore containing (natural) 45 percent Mn and 1,186 tons of miscellaneous ore averaging (natural) 44 percent Mn. The manganese ore originated in Appomattox, Augusta, Bland, Campbell, Smyth, and Tazewell Counties. Shipments of ferruginous manganese ores in 1939 came from Augusta, Bland, and Pulaski Counties and averaged (natural) 25 percent Mn.

Washington.—A trial lot of 10 tons of manganese ore from the Coon Creek mine in Grays Harbor County constituted the 1939 shipments from Washington.

West Virginia.—One small carload of manganese ore containing (natural) 43 percent Mn and 2 percent iron was shipped from the Sweet Springs mine in Monroe County. A new mill was completed on the property early in 1940.

Puerto Rico.—No manganese ore was shipped from Puerto Rico in 1939.

IMPORTS OF MANGANESE ORE

Imports for consumption of manganese ore containing 35 percent or more manganese increased 30 percent in 1939 over 1938. Decreases in receipts from Cuba and the U. S. S. R., two of the largest sources of supply, were more than balanced by increases from Brazil, Gold Coast, and British India, other important sources. Gold Coast, with an increase of 91 percent over 1938, supplied the largest quantity—39 percent of the total. In addition to the 1939 imports shown in the following table, 30,684 long tons of ore containing 8,452 tons of manganese (28 percent Mn) came from the Union of South Africa.

Manganese ore (35 percent or more Mn) imported for consumption in the United States, 1937–39, by countries

Country	Manganese ore (long tons)			Mn content (long tons)			Value		
	1937	1938	1939	1937	1938	1939	1937	1938	1939
Brazil	77,987	29,698	42,713	35,505	13,307	19,499	$597,413	$220,328	$366,597
Cuba	122,937	131,422	105,936	56,385	61,534	51,719	2,185,800	2,242,425	1,689,547
Gold Coast	254,547	126,857	242,924	130,147	63,890	122,769	2,942,430	1,500,813	3,019,368
India, British	70,380	25,480	89,545	36,523	13,121	45,556	679,232	236,945	1,054,718
Philippine Islands		4,002	6,966		1,600	3,483		44,075	89,784
Union of South Africa	209		3,401	119		1,697	3,125		45,716
U. S. S. R.	383,949	166,042	135,243	186,736	80,673	68,882	3,959,955	2,661,557	2,204,304
Other countries	1,910	85	403	1,019	43	206	83,647	13,254	28,016
	911,919	483,586	627,131	446,434	234,168	313,811	10,451,602	6,919,397	8,498,050

General imports (containing 35 percent or more Mn), which represent the movement of ore into this country, were greater than imports for consumption, and totaled 698,490 long tons containing 341,816 tons of manganese. Of this quantity, 200,781 long tons came from the U. S. S. R., 155,123 from Gold Coast, 108,984 from British India, 105,936 from Cuba, 103,526 from Brazil, and 24,140 from other sources. In addition, 30,684 long tons of ore containing 8,452 tons of manganese (28 percent Mn) were imported from the Union of South Africa.

STOCKS

Stocks of manganese ore in bonded warehouses rose for the third consecutive year and according to figures of the Bureau of Foreign and Domestic Commerce reached a peak of 903,561 long tons containing 441,806 tons of Mn at the end of 1939. This abnormally high level of stocks resulted from low activity in the domestic steel industry and overbuying in recent years.

PRICES

Prices of manganese ore according to grade and origin, as quoted by the various trade journals, apply to imported ore and (except for battery ore) are on a unit basis. The unit is 1 percent of a long ton, or 22.4 pounds of contained manganese. Prices of battery-grade ore are quoted on a per-ton basis, with a minimum requirement of manganese dioxide.

The quotations in the following table are from the Engineering and Mining Journal.

Domestic prices of metallurgical manganese ore in 1939, in cents per long-ton unit

[C. i. f. North Atlantic ports, cargo lots, exclusive of duty]

	Beginning of year	End of year		Beginning of year	End of year
Brazilian, 46–48 percent Mn	$0.27	$0.45	South African:		
Chilean, 47 percent Mn	.28	.45	50–52 percent Mn	$0.28	$0.49
Indian, 50 percent Mn	.30	.48	44–48 percent Mn	.25	.45
Caucasian, 52–55 percent Mn	.30	.50			

According to the Engineering and Mining Journal, the prices for chemical (battery-grade) ores per long ton in carlots at the end of 1939 were as follows: Domestic, containing 70 to 72 percent manganese dioxide, $45; and foreign, containing 80 to 85 percent MnO_2, $50 to $70. Foreign quotations increased $5 to $10 a ton during the year.

CONSUMPTION OF MANGANIFEROUS RAW MATERIALS

The following table shows the indicated consumption of manganiferous raw materials in the United States in 1939. The table does not consider differences in consumers' stocks at the beginning and end of the year. As such stocks are largely imported ore and the import figure used in the table is that for imports for consumption it is thought that the change in stocks would not be great because the manganese ore may be kept in bond until withdrawn for consumption. The duty is then paid, and the ore is reported as imports for consumption.

Indicated consumption of manganiferous raw materials in the United States in 1939

	Ore containing 35 percent or more Mn		Ore and residuum containing 10 to 35 percent Mn		Ore containing 5 to 10 percent Mn	
	Long tons	Mn content (percent)	Long tons	Mn content (percent)	Long tons	Mn content (percent)
Domestic shipments	29,307	42	368,782	13	469,703	7.2
Imports for consumption	627,131	50	30,684	28	[1] 62,757	8.7
Total available for consumption	656,438	50	399,466	14	532,460	7.4

[1] Estimated.

Besides the material shown in the foregoing table, 652,900 long tons of ore containing 2 to 5 percent Mn were used, presumably in the manufacture of manganiferous pig iron, in 1939 compared with 358,200 tons in 1938. Figures are not available for imports of ore of this class.

METALLURGICAL INDUSTRY

Although some manganese is used in both the ferrous and nonferrous metallurgical industries the bulk is consumed in the manufacture of iron and steel. Most of the ore entering this industry is used in the manufacture of ferromanganese and spiegeleisen, the forms in which manganese usually is added to steel.

Chief manganese alloys imported into and made from domestic and imported ores in the United States, 1938–39, in long tons

	1938		1939	
	Alloy	Manganese	Alloy	Manganese
Ferromanganese:				
Imported	26,258	21,118	41,227	33,414
Domestic production	242,994	191,104	270,111	214,040
From domestic ore [1]	13,926	10,996	104	83
From imported ore [1]	229,068	180,108	270,007	213,957
Total	269,252	212,222	311,338	247,454
Ratio (percent) of Mn in ferromanganese of domestic origin to total Mn in ferromanganese made and imported		5.18		.03
Number of plants making ferromanganese	8		8	
Spiegeleisen:				
Imported	17,248	[1] 3,450	38,264	[1] 7,653
Domestic production	11,311	2,289	91,491	18,463
From domestic ore [1]	11,060	2,249	91,114	18,388
From imported ore [1]	251	40	377	75
Total	28,559	5,739	129,755	26,116
Ratio (percent) of Mn in spiegeleisen of domestic origin to total Mn in spiegeleisen made and imported		39.19		70.41
Number of plants making spiegeleisen	3		5	
Total available supply of metallic manganese as alloys		217,961		273,570
Percent of available supply of manganese in—				
Ferromanganese and spiegeleisen imported		11.27		15.01
Ferromanganese made from imported ore		82.63		78.21
Spiegeleisen made from imported ore		.02		.03
Ferromanganese made from domestic ore		5.05		.03
Spiegeleisen made from domestic ore		1.03		6.72
Ferromanganese and spiegeleisen made from domestic ore		6.08		6.75
Spiegeleisen made and imported		2.63		9.55
Total open-hearth and Bessemer steel	27,844,961		46,222,068	

[1] Estimated.

Ferromanganese.—The domestic output of ferromanganese in 1939, which increased 11 percent over 1938, was produced at the following plants:

Bethlehem Steel Co., Johnstown, Pa.
Carnegie-Illinois Steel Corporation, Etna, Pa.
Electro Metallurgical Co., Alloy, W. Va.
Jones & Laughlin Steel Corporation, Aliquippa, Pa.
E. J. Lavino & Co., Reusens, Va., and Sheridan, Pa.
Sloss-Sheffield Steel & Iron Co., North Birmingham, Ala.
Tennessee Coal, Iron & Railroad Co., Ensley, Ala.

In addition to the above plants, shipments were made by the Colorado Fuel & Iron Corporation, Pueblo, Colo., and the Pittsburgh Metallurgical Co., Niagara Falls, N. Y.

The larger part of the ferromanganese produced in this country is made from foreign ores, as shown in the following table.

Ferromanganese produced in the United States and metalliferous materials consumed in its manufacture, 1935–39

Year	Ferromanganese produced			Materials consumed (long tons)				Manganese ore used per ton of ferromanganese made (long tons)
	Long tons	Manganese contained		Manganese ore (35 percent or more Mn, natural)		Iron and manganiferous iron ores	Cinder, scale, and purchased scrap	
		Percent	Long tons	Foreign	Domestic			
1935	214,290	79.41	170,168	401,846	4,286	9,195	8,921	1.895
1936	316,000	79.09	249,933	595,114	5,987	12,467	2,821	1.902
1937	376,443	79.54	299,425	698,052	9,444	17,511	6,017	1.879
1938	242,994	78.65	191,104	416,738	22,548	9,696	8,462	1.808
1939	270,111	79.24	214,040	502,986	----------	8,324	6,250	1.862

The sources of the foreign ore used in the production of ferromanganese are shown in the following table.

Foreign manganese ore used in manufacture of ferromanganese in the United States, 1935–39, in long tons

Source of ore	1935	1936	1937	1938	1939
Africa	69,857	199,143	150,112	152,698	129,227
Brazil	47,663	86,032	112,238	64,060	58,284
Chile	2,941	832	186	----------	856
Cuba	56,411	32,317	60,012	36,295	58,999
India	76,983	105,289	62,199	55,965	86,309
Philippine Islands	520	----------	----------	----------	----------
U. S. S. R.	147,471	171,501	313,305	107,720	169,311
	401,846	595,114	698,052	416,738	502,986

Shipments of ferromanganese in 1939 increased 33 percent over 1938. The record of shipments during the past 5 years is as follows:

Ferromanganese shipped from furnaces in the United States, 1935–39

Year	Long tons	Value	Year	Long tons	Value
1935	194,627	$16,374,328	1938	223,720	$19,144,884
1936	322,353	24,088,298	1939	296,631	24,137,211
1937	359,842	30,696,748			

Although there is a small export trade in ferromanganese, the quantity manufactured in the United States is supplemented by imports. Ferromanganese imported for consumption in 1939 included 1,017 long tons containing not over 1 percent carbon, 14,136 tons containing over 1 but less than 4 percent carbon, and 26,074 tons containing not less than 4 percent carbon.

Ferromanganese imported into and exported from the United States, 1935–39

Year	Imports for consumption			Exports [1]	
	Gross weight (long tons)	Mn content (long tons)	Value	Gross weight (long tons)	Value
1935	27,240	21,830	$1,731,411	131	$10,389
1936	37,953	30,594	2,251,951	466	26,540
1937	29,559	23,888	2,163,616	1,725	72,502
1938	26,258	21,118	1,770,948	247	18,799
1939	41,227	33,414	2,935,214	2,923	247,798

[1] Includes spiegeleisen; not separately classified.

Norway supplied 59 percent of the imports in 1939. Distribution of imports by countries is shown in the following table:

Ferromanganese imported for consumption in the United States, 1938–39, by countries

Country	1938		1939	
	Mn content (long tons)	Value	Mn content (long tons)	Value
Canada			(1)	$50
Czechoslovakia	3,043	$211,356	2,050	162,091
France	1,137	152,068	846	100,905
Germany [2]			391	24,622
Japan	308	37,118		
Netherlands	5,843	403,561	7,974	561,509
Norway	10,547	953,045	19,563	1,909,610
Poland and Danzig [2]			1,598	118,015
Sweden			22	3,356
Yugoslavia	240	13,800	970	55,056
	21,118	1,770,948	33,414	2,935,214

[1] Less than 1 ton.
[2] For statistical purposes, trade with the Sudeten area, as far as ascertainable, is included with Germany, while trade with the other Czechoslovak Provinces occupied by Germany and Poland has been included with these countries since March 18 or 19, 1939. After November 16, 1939, trade with Danzig and that part of Poland occupied by Germany has been included with Germany.

Customs districts through which imported ferromanganese entered in 1938 and 1939 are as follows:

Manganese content of ferromanganese imported for consumption in the United States, 1938–39, by customs districts, in long tons

Customs district	1938	1939	Customs district	1938	1939
Buffalo	389	892	New York	1,090	934
Chicago	1,585	3,434	Ohio		2,497
Connecticut	163	362	Oregon	334	249
Galveston		425	Philadelphia	3,526	2,773
Los Angeles	96	257	San Francisco	160	296
Maryland	12,157	18,079	Washington (State)	131	118
Massachusetts	39	243			
Michigan	322	1,773		21,118	33,414
New Orleans	1,126	1,082			

Stocks of ferromanganese in bonded warehouses at the end of 1939 were 4,253 long tons containing 3,603 tons of Mn compared with 8,392 tons containing 6,971 tons of Mn at the end of 1938.

The quoted prices of ferromanganese dropped $5.25 per long ton in February but increased $10 a ton in September and $10 a ton in October, as shown in the following table.

Prices per long ton of ferromanganese in the United States, 1937–39 [1]

[80 percent—delivered at Pittsburgh]

Month	1937	1938	1939	Month	1937	1938	1939
January	$84.79	$107.49	$90.58	July	$107.29	$97.77	$85.33
February	84.79	107.49	85.33	August	107.29	97.77	85.33
March	92.29	107.49	85.33	September	107.29	97.77	95.33
April	99.79	107.49	85.33	October	107.29	97.77	105.33
May	107.29	107.77	85.33	November	107.39	97.83	105.33
June	107.29	107.77	85.33	December	107.49	97.83	105.33

[1] Steel, vol. 106, Jan. 1, 1940.

Spiegeleisen.—Shipments of spiegeleisen in 1939 increased 240 percent over 1938.

Spiegeleisen produced and shipped in the United States, 1935–39

Year	Produced (long tons)	Shipped from furnaces		Year	Produced (long tons)	Shipped from furnaces	
		Long tons	Value			Long tons	Value
1935	60,018	54,793	$1,303,574	1938	11,311	24,939	[2] $728,830
1936	95,137	92,336	2,249,217	1939	91,491	84,739	2,484,042
1937	(1)	134,983	3,969,822				

[1] Bureau of Mines not at liberty to publish figures. [2] Revised figures.

Spiegeleisen was manufactured at the following plants in 1939:

Carnegie-Illinois Steel Corporation, Duquesne, Pa.
E. J. Lavino & Co., Sheridan, Pa.
New Jersey Zinc Co., Palmerton, Pa.
Sloss-Sheffield Steel & Iron Co., North Birmingham, Ala.
Tennessee Coal, Iron & Railroad Co., Ensley, Ala.

In addition to these plants the Keokuk Electro-Metals Co., Keokuk, Iowa, and E. J. Lavino & Co., Reusens, Va., made shipments from stock.

Most of the spiegeleisen produced in the United States in recent years has been made from domestic raw materials, but 206 long tons of foreign ore containing 49.55 percent Mn were consumed in 1939 in the manufacture of spiegeleisen.

Imports of spiegeleisen for consumption in 1939 increased 122 percent over 1938. Canada, with 37,470 long tons, furnished 98 percent of the supply, while the remaining tonnage came from Norway and the Netherlands.

Spiegeleisen imported for consumption in the United States, 1935–39

Year	Long tons	Value	Year	Long tons	Value
1935	32,384	$915,134	1938	17,248	$625,480
1936	52,011	1,404,983	1939	38,264	1,329,814
1937	16,841	589,766			

The quoted prices of spiegeleisen at producers' furnaces increased $2 a long ton in September and $2 a ton in October, remaining at $32 a ton the rest of the year.

Manganiferous pig iron.—Precise data are not available on the consumption of manganiferous ores in the production of manganiferous pig iron; however, 469,703 long tons of domestic ore containing 5 to 10 percent Mn and 652,900 tons containing 2 to 5 percent Mn were shipped in 1939. Foreign manganiferous iron ore (62,757 tons) also was consumed in the manufacture of pig iron. The sources of the foreign ores for the past 3 years are given in the following table. Import figures are not available on ore containing 2 to 5 percent Mn.

Foreign ferruginous manganese ore and manganiferous iron ore consumed in the United States, 1937–39, in long tons

Source of ore	Ferruginous manganese ore			Manganiferous iron ore		
	1937	1938	1939	1937	1938	1939
Africa:						
Egypt	57,176					
Undistributed		11,753	1,184	446		
Asia:						
Palestine	323		1,133			
Philippine Islands	2,257	2,887				
Undistributed	2,541					
Australia				140,372	61,473	54,941
Brazil		2,829			9,597	6,831
Spain				1,658		
Sweden					4,215	985
Undistributed	6,982	6,005	582			
	69,279	23,474	2,899	142,476	75,285	62,757

BATTERY INDUSTRY

Shipments of manganese ore to battery makers by domestic producers in 1939 totaled 7,767 long tons. No ore was shipped from Puerto Rico in 1939. Imported manganese ore also was consumed in the battery industry, but no figures are available on such imports.

Manufacturers of dry cells apparently use two grades of material.[6] Although not less than 70 percent MnO_2 was required for one grade it is expected that the MnO_2 content would average 72 percent, and individual shipments as low as 70 percent would not be rejected. The ore should be free from particles bearing lead in any concentrated form. Not more than 1 gram of easily recognizable iron pyrite should be present in 100 pounds of ore.

[6] Engel, A. L., and Shelton, S. M., Progress Reports—Metallurgical Division. 36. Ore-dressing Studies, 1938–39, Ore-testing Studies of the Ore-dressing Section: Bureau of Mines Rept. of Investigations 3484; 1940, pp. 31–34.

Specifications for manganese ore used by various dry-cell manufacturers

Constituent	Percent						
MnO_2 [1]	[2] 70.0	84.0	70.0	80.0	70.0	85.0	70.0
Fe	2.0	2.0	2.0	2.5	1.5		
Pb	.15	.10	.25	.015	.25		
Cu	.025	.03	.03	.025	Trace		
Ni				.07	do		
Co				.04	do		
Ni-Co	.005	.10	.001	.08			
As	.03		.05		Trace		
As_2O_3				.10			
Sb					Trace		
As-Sb		.05					
Ag	.005	.05					
SiO_2					15.0	3.0	
Magnetic iron	.50	.50					
Water			3.0	2.0			
N	.005	.005					
CO_2	2.0	.50					

[1] Computed from available oxygen content. [2] Peroxidation not less than 93 percent.

MISCELLANEOUS INDUSTRIES

Certain manganese ores with peculiar physical or chemical properties are required for the manufacture of special articles in the chemical, ceramic, and glass industries. The glass and paint industries require an ore containing about 85 percent MnO_2 and not more than 1 percent iron. Low iron content is especially desirable in ores for the glass industry, and uniform quality is particularly sought.[7]

WORLD PRODUCTION

The following table shows, insofar as statistics are available, the world production of manganese ores from 1935 to 1939 and their average manganese content. Most of the figures are from official statistics of the countries concerned; they are supplemented by data from semiofficial and other sources.

Manganese ore produced in principal countries of the world, 1935–39, in metric tons

[Compiled by R. B. Miller]

Country [1]	Percent Mn	1935	1936	1937	1938	1939
North America:						
Canada (shipments)		91	200	77		359
Costa Rica				100	304	(2)
Cuba	36–50+	35,269	48,471	131,299	123,844	102,415
Mexico	40+	3,217	3,377	17	117	27
United States:						
Continental (shipments)	35+	26,852	32,635	40,887	25,727	29,777
Puerto Rico (exports)	48–51	3,412	3,058	2,381	1,039	
South America:						
Argentina	35–38	[3] 439	[3] 443	606	437	(2)
Bolivia	50					[3] 500
Brazil	38–50	41,767	156,201	253,661	221,961	192,956
Chile (exports)	40–50	4,370	5,180	13,014	19,967	12,550
Peru				157	24	4,024

[1] In addition to the countries listed, Belgium is reported to produce a small quantity of manganese ore, but statistics of output are not available. Czechoslovakia reports a production of manganese ore, but as it has been ascertained that the product so reported averages less than 30 percent Mn and therefore would be considered ferruginous manganese ore under the classification used in this report, the output has not been included in the table.
[2] Data not available.
[3] Shipments by rail and river.

[7] Engel, A. L., and Shelton, S. M. Progress Reports—Metallurgical Division. 36. Ore-dressing Studies, 1938–39, Ore-testing Studies of the Ore-dressing Section: Bureau of Mines Rept. of Investigations 3484, 1940, pp. 31–34.

Manganese ore produced in principal countries of the world, 1935–39, in metric tons—Continued

Country	Percent Mn	1935	1936	1937	1938	1939
Europe:						
Bulgaria	30–45	----------	1,500	3,000	1,887	(2)
Germany	30+	224	242	226	163	(2)
Greece	30+	423	1,680	6,952	7,075	(2)
Hungary	35–48	6,291	27,228	25,088	22,221	(2)
Italy	34–37	9,127	24,132	33,532	48,282	(2)
Portugal	40+	158	290	317	557	225
Rumania	30–36	19,795	33,856	50,749	60,173	41,546
Spain	31–34	1,260	(4)	(4)	(4)	(2)
Sweden	30–50	6,495	5,943	5,845	5,347	(2)
U. S. S. R.	41–48	2,384,600	3,002,000	2,752,000	2,272,800	(2)
Yugoslavia	32–38	928	2,739	4,420	3,759	5,655
Asia:						
China (exports)	45–46	827	23,794	51,446	1,247	1
India:						
British	47–52	651,779	826,498	1,068,472	983,464	(2)
Portuguese	42–50+	4,064	2,662	4,077	9,478	8,204
Indochina	----------	1,568	3,430	5,287	2,214	2,440
Japan	49–51	71,659	67,753	(4)	(4)	(2)
Netherland India	50–55	12,353	8,619	11,083	9,687	(2)
Philippine Islands (exports)	45–50	519	255	12,206	49,359	(2)
Turkey	30–50	9,200	4,600	530	2,186	3,339
Unfederated Malay States	30	28,504	37,366	33,319	32,483	31,953
Africa:						
Belgian Congo	56	----------	----------	27,471	7,725	(2)
Egypt	30+	87,303	134,972	186,320	153,112	119,882
Gold Coast (exports)	50+	437,571	417,621	535,495	329,411	(2)
Morocco:						
French	40–50+	24,865	39,360	76,460	86,597	(2)
Spanish	38	----------	----------	660	152	(2)
Northern Rhodesia	30–48	4,040	3,071	2,379	2,779	3,018
Union of South Africa	30–51	95,450	258,244	631,194	551,739	419,697
Oceania:						
Australia:						
New South Wales	----------	150	73	109	221	(2)
Queensland	----------	----------	----------	1,052	382	----------
New Zealand	----------	----------	----------	5	91	(2)
	----------	3,975,000	5,178,000	6,040,000	5,108,000	(2)

[2] Data not available.
[4] Estimate included in total.

Brazil.—Production in Brazil was at a lower rate in 1939 than in 1938, but exports were higher—189,003 metric tons and 136,843 tons, respectively. Shipments of ore from the mines to the ports were reduced in September and October owing to coal shortages that curtailed train schedules. European coal had been used, but the outbreak of hostilities early in September suddenly reduced supplies. In November the situation was relieved somewhat, as coal was obtained from other sources. The export tax on manganese ore, which had been reduced during the first quarter of 1939, was increased again during the second quarter. Although the tax rate was not changed the official value was increased considerably, thereby increasing the tax payable. The tax on ore containing 45.01 to 46 percent manganese—the grade constituting the bulk of the exports—was raised from 2.633 milreis per metric ton in the first quarter to 6.400 in the second quarter compared with 3.240 in 1938.

Cuba.—All the manganese ore from Cuba comes from the Province of Oriente. Output by the Cuban-American Manganese Corporation, the principal producer in Cuba, totaled 102,415 metric tons (dried) in 1939, of which 96,779 tons were nodulized concentrates containing 51 percent Mn; the remainder was jigged ore containing 42 percent Mn or sorted ore containing 49 percent Mn. Exports by the company were 104,361 metric tons, of which 90,177 tons were nodulized concentrates and 14,184 tons washed or jigged ore averaging 38 percent Mn. Operations have been described by Norcross.[8] The company also buys ore offered by small producers. Other Cuban shipments amounted to 2,102 metric tons. Activities were reported near Baire, La Maya, Guisa, Los Negros, El Trumfo, and Maffo in Oriente, but independent producers exported only about 100 tons.

Gold Coast.—The African Manganese Mines Co., Ltd., which operates at Nsuta near Tarkwa, Wasaw district, Western Province, is the only producer of manganese ore in Gold Coast Colony. Exports were prohibited without license by proclamation on September 3, 1939.

India, British.—Water-borne exports from India, normally the second largest producer in the world, increased from 526,661 metric tons in 1938 to 664,893 in 1939. These figures do not include exports through Mormugao, which were 132,491 metric tons in 1938. A 3-percent ad valorem special armament tax on all exported mineral substances was imposed in November 1939. Export licenses have been required on movement of manganese ore from India since September 1939.

Union of South Africa.—Output in the Union of South Africa in 1939 was lower than in 1938. Virtually the entire production came from deposits north of Postmasburg in Griqualand West, Cape Province. All Cape ore is exported; exports in 1939 totaled 332,702 metric tons compared with 319,049 in 1938. The renewal of the Clearance Agreement with Germany, the largest buyer of South African ores, near the end of 1938 was a bright spot in an otherwise dull market during the first half of 1939. Several grades of ore containing 28 to more than 50 percent Mn are shipped, but a large part of the shipments contain less than 45 percent Mn. Small quantities (227 metric tons in 1939) of wad, together with some high-grade pyrolusite and psilomelane, are produced in the Krugersdorp district, Transvaal, for local consumption only.

U. S. S. R.—Data showing production in 1939 are not available. Of the 1937 production, 57 percent came from the Chiaturi deposits in Gruzia, 33 percent from the Nikopol deposits in the Ukraine, and the other 10 percent from the Republics of Russia, Bashkiria, and Krasnoyar. Virtually all the Chiaturi ore is exported, while Nikopol supplies the bulk of the domestic consumption. The Chiaturi deposits furnish a large proportion of the imports of manganese ore into the United States. Typically, the composition of washed Caucasian manganese ore is as follows:

Analysis of Caucasian washed manganese ore, percent

Mn	51 –52	$BaSO_4$	0.3 –0.5
SiO_2	6.8– 9.5	P	.155– .170
Fe	.4– 1.5	CaO	.90 –1.20
Al_2O_3	1.6– 2.5	MgO	.15 – .40

[8] Norcross, F. S., Jr., Development of the Low-grade Manganese Ores of Cuba: Am. Inst. Min. and Met. Eng. Tech. Pub. 1188, February 1940, pp. 1–13.

CHROMITE

By Robert H. Ridgway

SUMMARY OUTLINE

The first half of 1939 was uneventful in the chromite industry. The quiet condition of the market established in 1938 continued, as the domestic industrial rate showed little change. After midyear, however, the abrupt rise in the domestic steel-making rate to 93 percent of capacity in November, together with threats of an advent of war in Europe, were bullish demand factors. This increase in demand was offset somewhat by the scarcity of ship bottoms and the high ocean-freight and war-risk-insurance rates. Another factor hampering international flow during the last quarter of 1939 was application of various forms of export licenses, embargoes, and taxation by the producing countries. With international movement restricted by lack of demand during the first half of the year and by shipping difficulties during the second half, it is doubtful whether world production equaled that in 1938 or reached 1,000,000 long tons. Output in Turkey, one of the principal producers, held up well, while that in Southern Rhodesia and the Union of South Africa, other large producers, declined.

Owing to the tightening of supplies, quotations increased in October and again in December, but consumers' stocks cushioned the effect of the sharp increase in demand. Most of the increase in prices was due to increased transportation charges and did not revert to the producers.

Imports into the United States during the last half of 1939 were more than double those during the first half and would have been greater had conditions permitted. Higher prices and unsettled world conditions focused attention on the development of domestic production. Although output was small (a few thousand tons), known deposits and promising areas were being examined by private concerns and Government agencies. California, Oregon, Montana, Washington, and Wyoming were the scene of much of this activity. So far, however, exploration has revealed no extensive deposits of high-grade metallurgical ore but has developed deposits suitable for the refractory and chemical industries. The largest output in 1939 came from California, where the principal producer is planning operations at the Pilliken mine in Eldorado County that will yield 750 to 1,000 tons of concentrates a month beginning in March 1940.

The following table compares the salient statistics of the chromite industry during the last 5 years with the yearly average from 1925 to 1929.

Salient statistics of the chromite industry in the United States, 1925–29 (average) and 1935–39

	1925–29 (average)	1935	1936	1937	1938	1939
Apparent available supply:						
Imports..................long tons..	224, 357	259, 063	324, 258	553, 916	352, 085	317, 511
Shipments from domestic mines long tons..	276	515	269	2, 321	812	3, 614
	224, 633	259, 578	324, 527	556, 237	352, 897	321, 125
Imports:						
Africa [1]............percent of total..	63	36	37	50	48	37
Cuba.........................do....	15	18	22	17	11	21
Greece.......................do....	9	8	8	5	3	3
New Caledonia................do....	6	22	20	9	8	5
Turkey.......................do....		6	6	7	6	5
U. S. S. R...................do....		1	1			
Other countries..............do....	7	9	6	12	[2] 24	[2] 29
World production............long tons..	428, 000	780, 000	1, 051, 000	1, 260, 000	1, 107, 000	(3)

[1] Originated in Southern Rhodesia and Union of South Africa.
[2] Principally from the Philippine Islands.
[3] Figures not yet available.

Figure 1 shows trends in consumption, prices, and domestic shipments during the past 15 years.

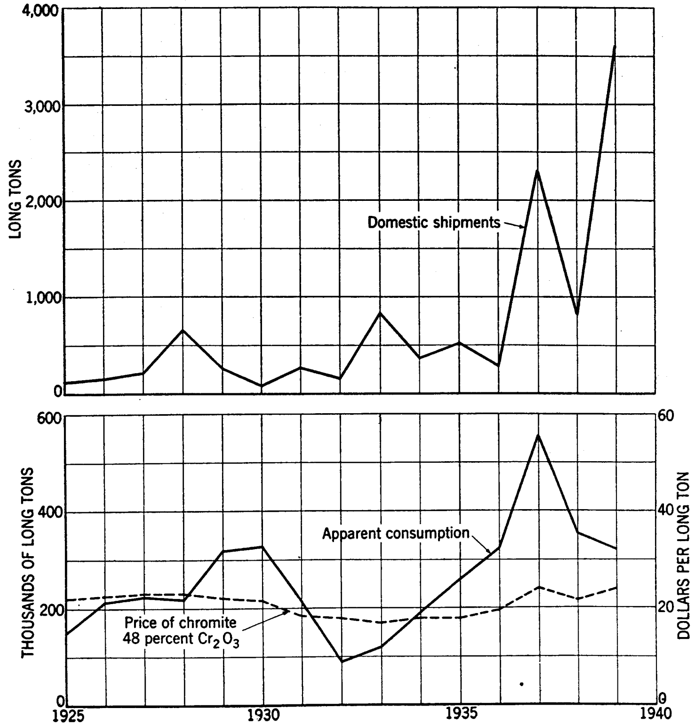

FIGURE 1.—Trends in consumption, prices, and domestic shipments of chromite, 1925–39.

Emergency stock pile.—On June 7, 1939, the President signed the Strategic Materials Act (Public, No. 117, 76th Cong., ch. 190, 1st sess.) which authorized the expenditure of $100,000,000 over a period of 4 years for the purchase of stock piles of strategic materials. Only $10,000,000 was appropriated in the Third Deficiency Bill, approved August 2, 1939 (Public No. 361, 76th Cong., ch. 633, 1st sess.), however, and purchases were restricted largely to the high-priority mineral commodities on the strategic list. Chromite is one of the four mineral commodities comprising the first priority class for stock-pile reserves. Its importance is appreciated more readily when it is realized that the steel industry is charged with three-fourths of the domestic consumption.

The following specifications were drawn for high-grade metallurgical lump ore:

Cr_2O_3 (minimum)	48 percent.
Fe (maximum)	⅓ of Cr content.
S (maximum)	0.50 percent.
P (maximum)	0.20 percent.

The specifications also provided that all lumps shall pass a 6-inch screen and that not more than 10 percent shall pass a ½-inch sieve.

Proposals for supplies (S. 3 and S. 4) dated September 20, 1939, for opening October 20, 1939, were sent to a large number of bidders, but only two offers were received. The disturbed conditions in ocean shipping at the time were not without effect on the ability of possible suppliers to guarantee delivery on a contract price. As neither bidder met the conditions of the proposal no awards were made, and under dates of October 30 and 31, telegrams were sent to five recognized handlers and potential suppliers requesting bids on 5,000 to 40,000 long tons of ore. Three offers were received, and two contracts were awarded. On November 20, a purchase order was issued to Dorothea Reddy Maroney for 25,000 tons of chromite at $33.744 per long ton, delivered New Cumberland, Pa. The bidder proposed to furnish ore from undeveloped properties on the Kenai Peninsula in Alaska. At this writing no ore has been received. The other bid was let to the Mutual Chemical Co. for 20,000 tons of ore at $26.50, c. i. f. Philadelphia. This concern proposed to supply the chromite from deposits in Turkey; the ore is of known good grade and very acceptable to consumers in this country. Delivery on this contract was begun early in 1940.

Earlier in the year 1,801 short tons of chromite from Southern Rhodesia was purchased by the Navy Department at $20.74 per short ton. The ore, delivered in June, was supplied by E. J. Lavino & Co. This purchase covered a previous contract on chromite from domestic sources that was canceled because of nondelivery.

Government exploration.—Under section 7 of the Strategic Materials Act the Geological Survey and the Bureau of Mines undertook to search for and appraise ore deposits containing metals that have been designated as strategic by the Secretaries of War, Navy, and the Interior upon advice of the Army and Navy Munitions Board. The bill authorized the expenditure of $500,000 a year, $350,000 by the Bureau of Mines and $150,000 by the Geological Survey, for each of the fiscal years ending June 30, 1940, 1941, 1942, and 1943. Close cooperation of the geologists of the Survey and engineers of the Bureau will be necessary to accomplish the objectives of the act.

The Bureau of Mines, in carrying out its part [1] of the program, seeks to determine (1) the extent and quality of the ore, (2) the most suitable method of mining and beneficiating it, and (3) the cost at which it may be produced.

Three exploration projects were set up on chromite. Deposits in Sweetgrass and Stillwater Counties, Mont., Casper Mountain, Wyo., and near John Day, Oreg., were investigated and drilled by the Bureau in 1939. In one area there is definite indication of a large tonnage of ore that will concentrate to about 42 to 45 percent Cr_2O_3 with a Cr-Fe ratio of 1.7 to 1. In another area, although the proved tonnage is not so large, the results of the work indicate that the tonnage possibilities have by no means been fully tested. The results of exploration on both areas have been so encouraging that the Bureau feels that further exploratory work is justified and is definitely planning additional work on one area during the next fiscal year. The metallurgical problem in connection with utilization of these ores is being investigated by the Bureau, and some encouraging results have been obtained. Indications are that these ores would supplement supplies in an emergency.

Under the strategic minerals program, the Geological Survey investigated chromite in Wyoming, Montana, Oregon, and California. A magnetometric survey of the Casper Mountain (Wyo.) deposit was completed in the early summer. Detailed geologic mapping of the chromite zone in the Stillwater basic complex east of the Stillwater River, Mont., was completed. The principal chromite deposits in the eastern half of the serpentine belt on the north slope of the Strawberry Mountains in Grant County, Oreg., were mapped in detail. Geologic maps were completed of the Sourdough area, Curry County, and the Sordy area, Josephine County, Oreg. The High Plateaus area, Del Norte County, and the Pilliken area of disseminated chromite, Eldorado County, Calif., were mapped. Additional work in Montana, Oregon, and California is planned for the field season of 1940.

DOMESTIC PRODUCTION

Domestic production, as measured by shipments from the mines, increased to 3,614 long tons in 1939 from 812 tons in 1938 and was the largest since 1919. Except for 100 tons from Oregon, the entire output was from California. The bulk of the chromite came from the Pilliken mine where operations during 1939 were conducted by the United States Chrome Mines, Inc. The concentrates, all of which were shipped but not consumed, contained about 46 percent Cr_2O_3, 21 percent FeO, and 6 percent SiO_2. The Rustless Mining Co. took over this property on November 1, 1939, immediately dismantled the mill, and is installing new equipment. Production was expected to begin early in 1940, and plans called for a monthly output of 750 to 1,000 tons of concentrates. Much smaller shipments came from Calaveras, Del Norte, Placer, Plumas, Siskiyou, and Tuolumne Counties, Calif., and from Grant County, Oreg.

[1] Finch, John W., Strategic Minerals Investigations—Procedure Followed by the Bureau of Mines: Bureau of Mines Inf. Circ. 7097, 1939, pp. 1–5.

Chromite (ores and concentrates) shipped from mines in the United States, 1935–39

[All from California except in 1937 and 1939, as indicated]

Year	Ore containing 45 percent or more chromic oxide		Ore containing 35 to 45 percent chromic oxide		Total	
	Long tons	Value	Long tons	Value	Long tons	Value
1935	74	(1)	[2] 441	(1)	[2] 515	[2] $6,163
1936	(3)	(3)	[3] 269	[3] $2,978	269	2,978
1937	[4 5] 2,006	[4 5] $11,568	[2 5] 315	[2 5] 3,320	[2 4] 2,321	[2 4] 14,888
1938	[5] 812	[5] 10,730	(5)	(5)	812	10,730
1939	3,056	(1)	[6] 558	(1)	[6] 3,614	46,892

1 Included in total value; Bureau of Mines not at liberty to publish figures separately.
2 Includes a small quantity of ore containing less than 35 percent chromic oxide.
3 Ore containing 45 percent or more chromic oxide included with ore containing 35 to 45 percent.
4 Includes 288 long tons of ore valued at $880 shipped from mines in Oregon, a small part of which contained 35 to 45 percent chromic oxide.
5 A small quantity of ore containing 35 to 45 percent chromic oxide included with ore containing 45 percent or more.
6 Includes 100 tons of ore from Oregon.

Although chromite has been produced in Wyoming the work at Casper Mountain by the Geological Survey and the Bureau of Mines attracted attention during the year. No official statement has been made regarding this area, but in 1939 Beckwith [2] described the deposits as follows:

> The chromite of Casper Mountain occurs disseminated, and in bands or lenses in tremolite-chlorite-talc schist, originally on ultrabasic rock. The best ore would require concentration to meet market requirements. Some laboratory concentrates contain sufficient Cr_2O_3 for the manufacture of ferrochromium; others contain an excessive amount of iron.

The utilization of domestic chromite has interested the Bureau of Mines for some time. In connection with work on the matte smelting of chromium,[3] [4] attempts were made in 1939 to desulfurize such mattes by treating them with metallic manganese.[5] Preliminary work also was done on the production of chromium and chromium alloys by electrolysis in fused electrolytes. The results of gravity-concentration tests on a sample of lower-grade California ore indicated that recovery would be low—about 70 percent.[6] The Bureau has also developed a novel laboratory technique for the production of pure sponge chromium from chromite of lower grade than that now required by industry.

IMPORTS [7]

Imports of chromite in 1939 decreased 10 percent from the 1938 total, owing principally to a large decrease in shipments from Africa. Of the principal suppliers, only Cuba showed an increase. Shipments to this country were slow during the first half of the year, less than

2 Beckwith, R. H., Asbestos and Chromite Deposits of Wyoming: Econ. Geol., vol. 34, No. 7, September 1939, pp. 812–843.
3 Koster, J., Studies on the Treatment of Domestic Chrome Ores. Progress Reports—Metallurgical Division. 13. Electrometallurgical Investigations: Bureau of Mines Rept. of Investigations 3322, 1936, pp. 3–27.
4 Dean, R. S., and others, Progress Reports—Metallurgical Division. 14. Annual Report of the Metallurgical Division, Fiscal Year 1936: Bureau of Mines Rept. of Investigations 3331, 1937, pp. 7–10.
5 Dean, R. S., and others, Progress Reports—Metallurgical Division. 34. Annual Report of the Metallurgical Division, Fiscal Year 1939: Bureau of Mines Rept. of Investigations 3480, 1940, p. 22.
6 Engel, A. L., and Shelton, S. M., Progress Reports—Metallurgical Division. 36. Ore-dressing Studies, 1938–39: Bureau of Mines Rept. of Investigations 3484, 1940, pp. 19–20.
7 Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

one-third of the year's total being received in this period. With the upturn in general business conditions and the outbreak of war in Europe, shipments increased materially and doubtless would have been greater but for the uncertainty of shipping and high ocean freight rates. The chromite imported in 1939 contained only 42 percent Cr_2O_3. The low average content was due to a drop in receipts from Africa whose chromite, particularly that from Rhodesia, is high grade. Of the principal imports in 1939, those from New Caledonia had the highest content of chromic oxide (53 percent) and those from Cuba the lowest (33 percent).

Crude chromite imported into the United States, 1935–39, by countries

Country	1935 (long tons)	1936 (long tons)	1937 (long tons)	1938 (long tons)	1939		
					Long tons		Value
					Gross weight	Chromic oxide content	
Africa [1]	92,682	120,011	277,420	168,299	118,233	54,992	$1,799,397
Cuba	47,743	69,963	93,098	39,529	66,002	21,764	361,340
Greece	20,692	26,688	24,583	10,000	11,000	4,322	111,684
India, British	14,926	14,795	23,939	4,051	16,468	8,170	254,263
New Caledonia	55,686	65,450	51,831	28,520	14,359	7,572	280,783
Philippine Islands	787	4,986	43,648	78,233	71,914	28,624	634,784
Turkey	16,060	19,490	39,391	20,392	16,632	8,015	323,704
U. S. S. R.	3,412	2,310					
Other countries	7,075	565	6	3,061	2,903	1,432	48,989
	259,063	324,258	553,916	352,085	317,511	134,891	3,814,944

[1] Originated in Southern Rhodesia and Union of South Africa; recorded by Foreign and Domestic Commerce as imported from Union of South Africa, Other British South Africa, Other British West Africa, and Mozambique.

The following tables give imports of chromium alloys and compounds into the United States from 1935 to 1939.

Chromium compounds imported for consumption in the United States, 1935–39

Year	Chromic acid		Chromate and dichromate of potash		Chromate and dichromate of soda	
	Pounds	Value	Pounds	Value	Pounds	Value
1935	4,281	$2,198				
1936	2,685	1,225	1,653	$469	909	$198
1937	2,310	1,184	672	330		
1938	525	614	551	163		
1939	1,155	614				

Ferrochrome or ferrochromium and chrome or chromium metal imported for consumption in the United States, 1935–39, in long tons

Class	1935	1936	1937	1938	1939
Ferrochrome or ferrochromium—					
Containing 3 percent or more carbon (chromium content)	30	4	96	(1)	3
Containing less than 3 percent carbon (chromium content)		66	164	121	127
Chrome or chromium metal	49	57	78	39	41

[1] 60 pounds.

CONSUMPTION

Owing to lack of data on consumers' stocks, it is impossible to estimate accurately the total consumption of chromite in the United States. However, the apparent available supply decreased because imports were lower.

Domestic sales, imports, and apparent available supply of crude chromite in the United States, 1935–39, in long tons

Year	Sales from domestic mines	Imports	Apparent available supply	Year	Sales from domestic mines	Imports	Apparent available supply
1935	515	259,063	259,578	1938	812	352,085	352,897
1936	269	324,258	324,527	1939	3,614	317,511	321,125
1937	2,321	553,916	556,237				

The steel industry consumes more than three-fourths of the supply of chromite either as a refractory or as a raw-material source of an important alloying element. The improvement in the steel industry, particularly the precipitous rise in operations during the last quarter of the year, increased the demand for chromite and resulted in a rise in price. The domestic automobile industry, one of the important users of alloy steel and chromium plating, expanded its output from 2,489,635 units in 1938 to 3,577,058 in 1939. The construction industry uses stainless steel for decorative purposes and large quantities of chromium-plated plumbing fixtures. Activity in this field, which has been increasing since 1933, improved over 1938 but was only about three-fourths of the average annual volume of the peak years 1926 to 1929, inclusive.

USES

Industrial uses of chromite fall into three groups—metallurgical, refractory, and chemical.

Metallurgical.—Chromium is one of the principal elements used in the manufacture of alloy steel. For this purpose most of the chromite is converted into ferrochromium in the electric furnace before it is added to the steel bath, although one domestic concern makes chromium-alloy steels in the electric furnace directly from alloy-steel scrap, mild-steel scrap, and chromite. Standard grades of ferrochromium contain 60 to 70 percent chromium, and a lower content generally is not acceptable. Ferrochromium is made in two grades, depending on the carbon content; the high-carbon grade contains 4 to 6 percent carbon, while the low-carbon grade contains less than 2 percent. High-carbon ferrochromium is made by smelting chromite in a single-phase electric furnace with coke as a reducing agent. Recovery is approximately 65 percent.[8] Low-carbon grades are produced by smelting the high-carbon alloy with SiO_2 and coke to produce a ferrochrome-silicon low in carbon which is then smelted in a Heroult-type furnace. Ores containing 48 to 50 percent Cr_2O_3 and as little iron as possible are required in this process; the chromium-iron ratio

[8] Udy, Marvin J., The Utilization of High-iron Chrome Ores: Trans. Canadian Inst. Min. and Met., vol. 41, 1938, p. 204.

should be at least 3:1 as, if the ratio is less, the melt will not yield a 60- to 70-percent chromium content in the ferro even if the ore contains as much as 50 percent Cr_2O_3.

Although chromium is used in many alloy steels, its largest and best-known use is in the manufacture of stainless steels. Increasing quantities are being used also in the field of low-alloy, high-strength steels where chromium imparts strength and adds to corrosion resistance. In recent years chromium plating has had a wide field of uses and become important industrially, but the amount of raw material consumed is small owing to the thinness of the layer of metal deposited. The nature of hard-chromium deposits and the many uses for hard-chromium plating, including files, gages, bearing surfaces, cutting tools, and molds, have been described by Goodsell.[9]

Refractory.—Chromite with certain physical and chemical properties is used for refractories. Lump and ground chromite and chromite cements are used in bricks and in building and patching furnaces. The possible use of chromite in open-hearth roofs continued to attract attention in 1939.

The domestic trade-journal quotation for chromite brick in 1939 was steady at $47 per short ton at producers' plants.

Chemical.—In addition to the chromite used in the manufacture of chromic acid for electroplating, considerable chromite is consumed in chemicals employed principally in the dyeing, tanning, and pigment industries. In recent years increasing quantities of chromium chemicals have also been used in pickling solutions in the nonferrous-metals industry.

The entire domestic production of chromium chemicals, made by only five companies, is from foreign ores. The results of a study conducted by the Federal Bureau of Mines and the State College of Washington of methods for producing chromates and dichromates from domestic ores and estimates of the economic possibilities of the methods have been given by Doerner [10] and others.

PRICES

Prices of chromite quoted in the domestic trade journals cover imported ore and are given in dollars per long ton, c. i. f. North Atlantic ports. The quotations are largely nominal, and the market was weak during the first half of the year. However, the rise in steel operations increased the demand for chromite; and the outbreak of war in Europe, which resulted in a scarcity of ship bottoms, higher ocean freight rates, and higher insurance rates, brought about a rise in the price of chromite during the latter half of the year. The possibility of a shortage of supply due to interruption of shipping also tended to increase the price but was offset somewhat by the trade knowledge regarding stocks on hand. According to Steel, chromite containing 48 percent Cr_2O_3 opened the year at $23 to $24 per ton. In October the quotation rose to $25 to $26 and in December to $26 to $28. Ore with a lower chromic oxide content usually brings a lower price.

[9] Goodsell, R. M., The Application of Hard Chromium Plating: Met. Ind., vol. 37, No. 9, September 1939, pp. 415–419.

[10] Doerner, H. A., and others, A Study of the Methods for Producing Chromate Salts from Domestic Ores: State College of Washington Bull. 5, 1939, pp. 1–51.

WORLD PRODUCTION

Complete data are not yet available on world output of chromite in 1939. The sharp drop in the output of Southern Rhodesia and the Union of South Africa, two of the principal producers, undoubtedly resulted in a lower world output in 1939 than in 1938 despite gains in some other countries. Excluding the U. S. S. R., for which no recent data are available, Turkey was the largest producer in 1939 followed by Southern Rhodesia and the Union of South Africa.

World production of crude chromite, 1935–39, by countries, in metric tons [1]

[Compiled by R. B. Miller]

Country [1]	1935	1936	1937	1938	1939
Australia (New South Wales)	605	422	466	967	(2)
Brazil (exports)	5	3,890	2,980	934	(2)
Bulgaria	325	270	2,350	1,745	(2)
Canada (shipments)	1,037	837	3,876	----	----
Cuba [3]	48,509	71,086	94,592	40,163	67,061
Cyprus (shipments)	1,198	508	1,641	5,667	(2)
Greece	29,779	47,347	52,620	42,464	(2)
Guatemala [3]	----	----	----	----	1,933
India, British	39,755	50,280	63,307	44,858	(2)
Japan	36,309	39,039	(4)	(2)	(2)
Levant	800	----	----	500	(2)
New Caledonia	55,311	47,840	48,022	52,216	52,000
Norway	----	----	176	508	(2)
Philippine Islands (exports)	1,292	11,891	69,856	66,911	[4] 73,068
Sierra Leone	----	----	741	505	(2)
Southern Rhodesia	105,913	183,395	275,617	186,019	139,083
Turkey (Asia Minor)	150,472	163,880	192,508	213,630	(2)
Union of South Africa	90,430	175,669	168,620	176,561	160,014
U. S. S. R.	177,900	217,000	(4)	(2)	(2)
United Kingdom	----	----	305	473	(2)
United States (shipments)	523	273	2,358	825	3,672
Yugoslavia	53,027	54,044	59,932	50,194	(2)
	793,000	1,068,000	1,280,000	1,125,000	(2)

[1] In addition to countries listed, chromite mining was reported in Albania in 1938; no production figures are available.
[2] Data not yet available.
[3] Imports into the United States.
[4] Estimate included in total.

WORLD TRADE

Except for the U S. S. R., the principal producing countries consume only small quantities of chromite, and the major consuming countries produce only a small fraction of their requirements. Most of the chromite produced thus enters international trade. World exports in 1939 declined for the second successive year from the record figure established in 1937. Turkey, Southern Rhodesia, and the Union of South Africa were the principal exporters.

Figures on imports of chromite into consuming countries are not yet complete, but available data indicate that the three principal importing countries, in order of quantity, were the United States, Germany, and France.

A brief summary of the activities in the principal chromite producing and consuming countries follows.

Albania.—It was reported during the year that large deposits of chromite had been discovered in several localities in the region of Pogradek, near Lake Okrida, in the vicinity of Memlichte and Kukes. Several hundred tons were mined during 1938, and the chromite is reported to average about 48 percent Cr_2O_3 with a silica content not exceeding 9 percent. Production is expected to increase considerably

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in 1939; unofficial figures indicate an output of 3,000 tons. The deposits are being developed by the Azienda Minerali Metallici Italiani (Italian Metallic Minerals Concern), of Rome, which hopes to supply all of Italy's needs.

Canada.—Chromite production in Canada is small and is confined to the Thetford-Black Lake area of the Eastern Townships of Quebec. No commercial production was reported in 1938 or 1939. Ferrochromium is made in Canada by the Electrometallurgical Co. at Welland, Ontario; and Chrom X, a chromium compound that may be used to introduce chromium into the melt, is made by the Chromium Mining & Smelting Corporation, Ltd., at Sault Ste. Marie, Ontario. Imported ores are used by these companies. Imports of chromite into Canada in 1939 were given as 15,055 metric tons valued at $232,851. It was reported during the year that chromite had been discovered in the Arrow Lake district north of Nelson, British Columbia.

Cuba.—The entire Cuban production is shipped to the United States; imports into the United States from Cuba in 1939 were 67,061 metric tons compared with 40,163 tons in 1938. Cuban ores have a low content of Cr_2O_3 and are used in the refractory industry.

Cyprus.—The concentrating plant of the Cyprus Chrome Co., Ltd., at Ayios Nikolaos, which was completed about the middle of 1937 but because of technical difficulties did not begin full operation until the end of the year, worked satisfactorily during 1938. Approximately 15,740 metric tons of ore were treated and 9,161 tons of concentrates produced. In 1938 exports totaled 7,561 tons of concentrates averaging 50.4 percent Cr_2O_3, and during the first 6 months of 1939 exports were 1,118 tons. Shipment to ports other than British was prohibited without license in September 1939. A later order required bond, pending certificate of arrival at a country of destination.

France.—France depends on foreign sources for its domestic requirements. Imports during the first 7 months of 1939 were 32,632 metric tons, of which 9,713 tons came from French colonies, compared with 27,650 tons, of which 3,301 tons came from colonies, in the same period of 1938. Data for the closing months of 1939 are not available; total imports in 1938 were 40,178 tons, of which 3,305 tons came from French colonies. New Caledonia is the only French colony where any appreciable amount of chromite is found.

Germany.—Germany does not produce chromite. Imports were 136,434 metric tons during the first 7 months of 1939 compared with 78,948 tons during the same period in 1938; in 1939, 62 percent came from Turkey and 20 percent from the Union of South Africa. Although Turkey replaced the Union of South Africa as the principal source of German imports during the first part of 1939, the Russian-German trade pact, announced about midyear, may foster the movement of Russian chromite to Germany.

Greece.—Exports of chromite from Greece were 52,360 metric tons in 1939 compared with 35,661 tons in 1938. Of the 1939 total, 22,278 tons went to Germany compared with 18,160 tons in 1938. Exports to the United States were 14,080 tons in 1939 compared with 5,600 tons in 1938. Since September 1939 exports have been subject to ministerial permission. The principal mines are those of the Société Union Minière at Xinia, northwest of Lamia, and of A. Apostolides at Tsagli, west of Volos.

India.—Chromite is mined in Baluchistan, Mysore, the Singhbhum district of Bihar, and Seraikela State. Production data for 1939 are not available, but in 1938 the output in Baluchistan was 22,244 metric tons; in Mysore, 17,241 tons; in Bihar, 5,277 tons; and in Seraikela State, 96 tons. The chief mines in Baluchistan are near Hindubagh in the Zhob Valley. Water-borne exports during the first 11 months of 1939 were 19,083 tons. A 3-percent ad valorem special armament tax on all exported mineral substances was imposed in November 1939. Export licenses have been required on chromite shipped from India since September 1939.

Italy.—No chromite has been produced in Italy, and no imports have been recorded in the official statistics. Necessary supplies are imported usually in the form of alloys, but data regarding the small imports of chromium alloys have been combined with those of other alloys in statistical publications.

New Caledonia.—Preliminary figures show that exports of chromite from New Caledonia in 1939 were 39,394 metric tons compared with 42,263 in 1938. A large part of the New Caledonia ore comes from two mines, the Tiebaghi mine operated by British interests and the Fantouche mine operated by American interests. New Caledonia ores are high grade, the Tiebaghi ore running 55 to 56 percent Cr_2O_3. Effective November 1, 1939, an armament tax on the export of chromite amounting to 12½ percent of the official valuation was established for a period of 2 years. Previously, certain export restrictions had been decreed.

Norway.—Imports of chromite into Norway in 1939 decreased to 19,580 metric tons from 50,022 tons in 1938. Much of the chromite sent to Norway is smelted into ferrochromium, because of the available electric energy, and exported. Exports of ferrochromium increased to 15,689 tons in 1939 from 11,605 tons in 1938. Shipments abroad were prohibited (except by license for individual consignments) by Provisional Decree of August 28, 1939.

Philippine Islands.—In recent years the Philippine Islands has become an important producer of chromite. Most of the output in 1939 came from the following operators: The Benquet Consolidated Mining Co., operating the Consolidated mine in Zambales Province and the Florannie mine in Camarines Sur; the Acoje Mining Co. and the Zambales Mining Co., both operating in Zambales Province; and the Dinagat Mines Co. and the Tagobomar Development Co., operating on Dinagat. The following are analyses of the ore shipped by these producers:

Analyses of Philippine chromites

Producer	Cr_2O_3	SiO_2	Al_2O_3	Fe
Consolidated Mines, Inc	33.60	3.66	30.16	11.54
Acoje Mining Co	51.13	2.92	(1)	13.63
Florannie Mining Co	51.72	3.72	11.38	11.61
Zambales Mining Co	48.22	3.69	(1)	13.75
Dinagat Mines Co	47.44	1.18	(1)	11.30

[1] Data not available.

Commercial or potentially commercial quantities of chromite have been found in Zambales, Camarines Sur, and Ilocos Norte Provinces, Luzon; in Antique Province, Panay; in southern Samar; on Homonhon

Island; on the northern end and eastern side of Dinagat Island; on Ambil Island; and in Misamis Oriental and Surigao Provinces, Mindanao. Zambales Province is the most outstanding reserve area. The largest single chromite deposit known in the Philippines occurs about 24 kilometers east of Masinloc and is reported[11] to contain 10,000,000 tons of ore. The ore, however, is low grade but finds an outlet in the refractory industry. The Florannie ore, which was used in the metallurgical industry, was exhausted in 1939 and the operation closed.

The following paragraph concludes an excellent article[12] on Philippine Chromite by Dean Frasche.

> In the Philippines there are large areas of widely scattered chrome-bearing ultrabasic rocks which are principally confined to two belts along the eastern and western borders of the islands. Geographically the eastern belt rises in Camarines Sur, trends southeast into Samar, Homonhon Islands, Dinagat Island, and terminates in Surigao Province, Mindanao; while the western belt commences in Ilocos Norte, trends southward through Zambales Province, the Lubank Island group, northern Mindoro, western Panay, and ends in north central Mindanao. The known commercially important chromite deposits have been discovered in the more easily accessible areas within these belts, but only an insignificant part of the chrome-bearing areas have been systematically prospected. Because of poor transportation facilities and lack of development work, little information is available concerning many localities in which chrome ores are known to exist. With the remaining large areas yet to be explored and the known existence of undeveloped chrome deposits, it is not unreasonable to assume the Philippine Islands will become more important as a source of chromite in the future.

Rumania.—Development of chromite deposits in the Severin Mountains near the Danube River is being contemplated by newly formed Rumanian-German companies. The ore is reported to contain 30 to 50 percent Cr_2O_3 and 15 to 30 percent iron oxide. It has been estimated that the rich strata in the Banat may yield 10 million tons of chrome ore.

Southern Rhodesia.—The output of chromite in Southern Rhodesia during 1939 was lower than in 1938, continuing the rate attained by the sharp drop in December 1938. Production during 1939 was 139,083 metric tons compared with 186,019 tons during 1938. Output increased materially in December.

Present output comes from two districts (the Selukwe district and along the Great Dike). Foremost among the Rhodesia deposits are those in the Selukwe district where three mines are now producing.[13] These mines are the Railway Block, the Selukwe Peak, and the Iron Peak, 1½, 8, and 4 miles, respectively, from Selukwe. Most of the ore mined from underground workings is extracted by top slicing. The bulk of the chromite is shipped after hand sorting and blending. Only a small proportion is treated; ore is concentrated by classifiers, jigs, and tables. Much of the Rhodesia output is controlled by a British syndicate. Exports were prohibited without license by proclamation of September 4, 1939.

Sweden.—Imports of chromite into Sweden for the first 9 months of 1939 were 33,608 metric tons compared with 40,657 tons for the same period in 1938. Exports of ferrochromium from Sweden were 11,250 tons in 1938. Licenses were required for exports by decree dated August 26, 1939.

[11] Frasche, Dean, Philippine Chromite: Min. Cong. Jour., vol. 25, No. 12, December 1939, pp. 22–27.
[12] Frasche, Dean, work cited in footnote 11.
[13] Musgrave, J., Chrome Mining at Selukwe, Southern Rhodesia: Trans. Inst. Min. and Met., Nov. 17, 1938, pp. 1–16.

Turkey.—Exports of chromite from Turkey during 1939 were 192,832 metric tons compared with 208,055 tons in 1938.

Chromite deposits are distributed widely in Turkey, and this country is rapidly reestablishing itself as the world's largest producer. In the past most of the production has come from deposits in the western part of the country in the Marmaris, Eskisehir, and Dag Ardi districts. Since 1936, however, increasing quantities of ore have been mined from the Guleman and other newly developed deposits in Elazig Province, eastern Anatolia. This district is rapidly becoming one of the most important chromite-mining centers of the world. Output now comes from the Guleman mines, where the ore is extracted by open-cut methods. The product from the various workings is assembled at the head of an aerial tram which connects with the Ergani-Diyarbekir Railway at Erganimaden some 20 miles distant. From Erganimaden the chromite moves by rail to the port of Mersin, 630 kilometers away, where it is lightered to steamers for export. The ore is lumpy and of good metallurgical grade. Typical analyses have been given by Perkins [14] as follows:

Analyses of Guleman ore shipped into the United States

Cr_2O_3	Fe	SiO_2	Cr : Fe ratio	Cr_2O_3	Fe	SiO_2	Cr : Fe ratio
50.42	10.86	2.21	3.18:1	51.74	11.20	------------	3.147:1
49.83	10.87	2.79	3.13:1	51.74	10.91	------------	3.245:1
50.08	10.97	3.17	3.12:1	51.74	10.91	------------	3.245:1
52.32	11.13	2.18	3.29:1	51.77	11.17	2.63	3.17 :1
49.60	10.63	2.11	3.19:1	51.78	11.17	2.62	3.17 :1
52.06	10.82	------------	3.29:1				

The tax on chromite exported from Turkey ranges from 116.7 piasters per ton for an ore containing 40 percent Cr_2O_3 to 253.8 piasters per ton on an ore containing 54 percent Cr_2O_3 for companies operating under final concessions. Companies operating on research permits are limited to exports of 200 tons, and the tax is 20 percent of the export value. The law passed in 1933, which provided a refund of part of the export tax should the yearly exports of a company be higher than those during 1932, apparently was canceled in 1937. Exports also are subject to license control.

Union of South Africa.—Output in the Union of South Africa was lower in 1939 than in 1938; production increased materially after midyear. Exports, however, were 150,482 metric tons in the first 9 months of 1939 compared with 117,562 tons in 1938.

The available ores are generally friable, only a small quantity of hard, lumpy ore being recovered from time to time. Demand in recent years has resulted in the opening of new deposits, particularly in the Rustenburg district which contains large and easily minable occurrences. This activity resulted in the development of deposits where limited quantities of higher-grade and hard, lumpy ores were revealed. The iron content in most ores is high, ranging from 20 to 27 percent FeO, while the Cr_2O_3 content ranges from 42 to 48 percent. Ores containing 43 to 46 percent Cr_2O_3 are available in large tonnages, but some time will be required before production of higher-grade ores can be accelerated.

[14] Perkins, Enoch, Turkey and Its Chrome Ore: Eng. and Min. Jour., vol. 140, No. 6, June 1939, pp 29–34.

U. S. S. R.—The U. S. S. R. is one of the largest producers of chromite. Output is reported to have reached 217,000 metric tons in 1936, but no subsequent data are available. The deposits are in the Ural Mountains, and the most important district is Saranovskoye, where reserves are said to be adequate to maintain current production for many years. Exports are small or nonexistent, as the output is consumed in the domestic industries.

United Kingdom.—Imports of chromite into the United Kingdom in 1938 were 38,242 metric tons, of which 80 percent came from members of the British Empire. The imports are used in the chemical and refractory industries, as no ferrochromium is made in the United Kingdom. Imports of ferrochromium, largely from Norway and Sweden, were 10,654 tons in 1938 compared with 18,432 tons in 1937.

Yugoslavia.—Production of crude chromite in Yugoslavia in 1939 was 44,097 metric tons. The Allatini Mines, Ltd., the principal producer, operates the mines at Orasje, 26 kilometers northwest of Skoplje. Deposits of chromite were reported to have been discovered in 1939 in the Ozreh Mountains, between Maglaj and Sprece, Yugoslavia. Exports of chromite are controlled by permits issued by the National Bank of Yugoslavia.

NICKEL AND COBALT

By H. W. Davis [1]

SUMMARY OUTLINE

NICKEL

The great improvement in the heavy industries in the United States and Canada and the general speeding up of industry in Europe and other parts of the world to augment the production of necessary war supplies were outstanding, and these helped to raise world production and consumption of nickel to all-time highs in 1939. The increase in consumption over 1938 centered largely in the United States, although there were substantial gains in the British Empire. Precise data on domestic consumption of nickel are not available, but the 1939 total may be estimated roughly at 52,000 short tons, an increase of 136 percent over 1938. As usual, domestic production of primary metal was insignificant (394 short tons). Figures on output of secondary nickel are not yet available for 1939; however, such production is small, averaging only 2,100 tons annually during the 5 years 1934–38. Domestic quotations for electrolytic nickel remained unchanged at 35 cents a pound throughout 1939.

Salient statistics for nickel, 1937–39

	1937	1938	1939
United States:			
Production (all byproduct of copper refining) short tons	219	416	394
Secondary production do	2,400	2,300	(1)
Imports [2] do	54,438	29,546	64,796
Exports [3] do	4,473	6,581	10,167
Price per pound [4] cents	35	35	35
Canada:			
Production short tons	[5] 112,453	105,286	113,053
Imports do	491	491	697
Exports do	111,385	98,852	117,391
World production (approximate) do	132,000	127,000	(1)

[1] Figures not yet available.
[2] Excludes "All other manufactures of nickel"; weight not recorded.
[3] Excludes "Manufactures"; weight not recorded.
[4] Price quoted by International Nickel Co. of Canada, Ltd., for electrolytic nickel at New York, in 2-ton minimum lots.
[5] Excludes small quantity produced in British Columbia.

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

The steel industry continued to absorb over half of the world output of nickel. Although some of the increase in consumption of nickel in 1939 undoubtedly can be attributed to the accelerated rate of naval construction and armament production, the major portion of the nickel used for steel continued to be absorbed in constructional steel for the automotive industry, in nickel-chromium stainless steels, and in nickel-alloy steels for a wide variety of other industrial purposes.

Canada furnished about 85 percent of the world's nickel. The International Nickel Co. of Canada, Ltd., alone supplied 82 percent of the total nickel used in 1939.

Search for commercial deposits of nickel in the United States was continued in 1939. The Cobalt Gold Mining Co. did 2,518 feet of diamond drilling at its property near Gold Hill, Colo. According to Goddard and Lovering:[2]

> Numerous samples of the primary ore taken by the company yielded from 0.41 to 6 percent nickel, 0 to 0.60 percent cobalt, and small amounts of copper. Samples of supergene ore contained from 1.32 to 13.02 percent nickel, 0.22 to 6.22 percent cobalt, and 0.05 to 31.60 percent copper. There appear to be several thousand tons of ore in sight that contain from 2 to 5 percent nickel. The deposit seems to be comparatively small, but the ore-bearing beds are so dislocated by the diorite stock and by pegmatite dikes that it is impossible to project their extensions far beyond the mine workings. The ore is probably genetically related to the pre-Cambrian diorite stock. There are several copper deposits of this general type in other parts of the Front Range, but the only other known nickel-bearing deposit lies about 120 miles to the south.

The nickel deposits of Jackson County, N. C., are discussed in a recent article.[3]

A study has been completed on the treatment of a precious-metal-bearing nickel-copper ore from a deposit in the Bunkerville district of Clark County, Nev., and a paper[4] containing the results of this investigation shows how combined electrothermal and electrolytic methods may be used to recover the nickel, copper, and precious metals from ore containing these elements.

The various phases of the nickel industry are discussed by Roush.[5]

PRODUCTION

Domestic production of nickel includes only minor quantities of secondary metal recovered from scrap-nickel anodes, nickel-silver, and copper-nickel alloys (including Monel metal) and small quantities of primary metal recovered in copper refining, as listed in the following table. Further details on the production of secondary nickel will be found in the chapter on Secondary Metals.

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[2] Goddard, E. N., and Lovering, T. S., A Nickel Deposit near Gold Hill, Colo.: Soc. Econ. Geol. (abs. of paper presented at 19th annual meeting in conjunction with Am. Inst. Min. and Met. Eng.), New York, February 13-16, 1939, p. 131.

[3] Pawel, G. W., Nickel in North Carolina: Eng. and Min. Jour., vol. 140, October 1939, pp. 35-38.

[4] Koster, J., and others, Recovery of Nickel, Copper, and Precious Metals from Domestic Ores by a Combined Electrothermal and Electrolytic Method. Progress Reports—Metallurgical Division. 35. Electrometallurgical Investigations: Bureau of Mines Rept. of Investigations 3483, 1939, 28 pp.

[5] Roush, G. A., Strategic Mineral Supplies: McGraw-Hill Publishing Co., New York, 1939, 485 pp. (Nickel. pp. 70-96).

Nickel produced in the United States, 1935–39

Year	Primary[1]		Secondary[2]	
	Short tons	Value	Short tons	Value
1935	160	$129, 500	1, 950	$1, 365, 000
1936	107	(3)	1, 965	1, 375, 000
1937	219	(3)	2, 400	1, 680, 000
1938	416	(3)	2, 300	1, 610, 000
1939	394	(3)	(4)	(4)

[1] Nickel content of nickel salts and metallic nickel produced as a byproduct in the electrolytic refining of copper.
[2] Nickel recovered as metal and in nonferrous alloys and salts.
[3] Bureau of Mines not at liberty to publish value.
[4] Figures not yet available.

FOREIGN TRADE

The principal nickel imports of the United States are metallic nickel and nickel alloys, matte (containing approximately 55 percent nickel and 25 percent copper), and nickel oxide. All the oxide and matte and 98 percent of the metallic nickel and alloys were obtained from Canada in 1939; Europe supplied the remaining metallic nickel and alloys. The matte is refined to Monel metal and other products at the plant of the International Nickel Co., Inc., Huntington, W. Va. Imports of nickel in 1939 were the largest on record.

Exports comprise largely products manufactured from imported raw materials; Europe is the principal market.

Nickel imported for consumption in the United States, 1937–39, by classes

Class	1937		1938		1939	
	Pounds	Value	Pounds	Value	Pounds	Value
Unmanufactured:						
Nickel ore and matte	25, 085, 947	$3, 258, 221	14, 579, 441	$1, 939, 888	28, 433, 530	$3, 749, 992
Nickel pigs, ingots, shot, etc	81, 740, 134	20, 299, 368	43, 926, 858	11, 013, 604	99, 309, 184	24, 914, 172
Nickel bars, rods, tubes, etc	4, 889	7, 103	29, 505	21, 577	216, 874	98, 848
Nickel oxide	2, 044, 395	385, 644	555, 181	94, 899	1, 631, 558	311, 128
Manufactured:						
Nickel silver or German silver in sheets, strips, rods, and wire			296	219		
All other manufactures of nickel	(1)	35, 668	(1)	19, 316	(1)	4, 060
		23, 986, 004		13, 089, 503		29, 078, 200

[1] Quantity not recorded.

Nickel exported from the United States, 1937–39, by classes

Class	1937		1938		1939	
	Pounds	Value	Pounds	Value	Pounds	Value
Nickel, Monel metal, and other alloys	7, 633, 189	$2, 685, 305	11, 877, 498	$2, 896, 806	18, 978, 606	$5, 076, 383
Manufactures	(1)	2, 464, 518	(1)	606, 892	(1)	495, 639
Nickel-chrome electric resistance wire	494, 848	562, 693	490, 640	552, 470	554, 027	609, 611
Nickel silver or German silver in bars, rods, or sheets	818, 539	181, 037	794, 811	91, 290	800, 456	136, 397
		5, 893, 553		4, 147, 458		6, 318, 030

[1] Quantity not recorded.

WORLD ASPECTS

World production.—World production of nickel in 1939 may be estimated roughly at 121,000 metric tons, or about 5 percent more than in 1938. Canada increased its output 7 percent and supplied about 85 percent of the total. The output in New Caledonia, the second largest producer, apparently declined.

World production of nickel (content of ore), 1935–39, by countries, in metric tons

[Compiled by R. B. Miller]

Country	1935	1936	1937	1938	1939
Australia				20	(1)
Brazil	5	478	104	375	25
Burma	1,488	1,312	1,233	959	921
Canada	62,830	76,992	(2) 102,015	95,514	102,559
Egypt			14	33	(1)
Germany	272	660	890	550	(1)
Greece	1,109	1,255	957	1,207	(1)
Italy		(3)	68	(4) 150	(1)
Japan	4	24	(1)	(1)	(1)
Morocco, French	208	85	132	163	(1)
Netherland India				(4) 500	(1)
New Caledonia	8,230	9,200	11,600	11,700	(4) 9,300
Norway	1,235	1,270	877	1,245	(1)
Southern Rhodesia	12	14	4	76	(4) 490
Union of South Africa				45	407
U. S. S. R.	1,829	2,000	2,000	2,500	(1)
United States (5)	145	97	199	377	357
	77,400	93,400	120,100	115,500	(1)

1 Data not yet available.
2 Excludes small quantity produced in British Columbia.
3 Less than 1 ton.
4 Estimated.
5 Byproduct in electrolytic refining of copper.

World consumption.—World consumption of nickel in 1939, estimated at 128,000 short tons compared with 102,000 tons in 1938, attained a new peak.[6] Figures are not available on consumption by countries, but most of the increase over 1938 occurred in the United States and the British Empire.

REVIEW BY COUNTRIES

Brazil.[7]—The nickel mines and rights of the Empreza Commercial do Goyaz S. A., a Brazilian corporation, formerly owned by a German group, have been bought by a Japanese organization. The mines are in the State of Goyaz, municipality of Sao José de Tocantins, 1,000 miles from the port of Santos. Ten trucks have been purchased for transporting the ore to the railway station, 210 miles away. The nickel reserves of Tocantins are the largest in Brazil. There are 2.2 million tons containing about 5 percent nickel; some samples contained 14 percent. However, the long distance to the railway station and the transportation difficulties of four railway systems to the port of Santos aggravate economic operation of the mines, although the cost of production is low on account of the low wages and easy accessibility of the ore, which is only 5 to 10 meters below the surface.

Burma.—The nickel produced in Burma is derived from a nickel-bearing speiss made by the Burma Corporation, Ltd., at Namtu in the

6 International Nickel Co. of Canada, Ltd., Annual Report, 1939.
7 Mining Journal (London), vol. 206, September 2, 1939, pp. 812–813.

Northern Shan States. The speiss contains approximately 30 percent nickel, 8 percent copper, and 7 percent cobalt, as well as 17 ounces of silver to the ton.

Canada.—Virtually the entire Canadian output is derived from the copper-nickel ores of the Sudbury district, Ontario; and two companies—International Nickel Co. of Canada, Ltd., and Falconbridge Nickel Mines, Ltd.—are the principal producers. Production in Canada was 113,053 short tons valued at $50,920,305 in 1939 compared with 105,286 tons valued at $53,914,494 in 1938.

The International Nickel Co. of Canada, Ltd.,[8] operated continuously at or near capacity during 1939. Four mines—Frood (4,722,563 tons), Creighton (1,298,752 tons), Levack (926,908 tons) and Garson (325,612 tons)—produced 7,273,835 short tons of ore. The open-pit department of the Frood mine had an initial production of 1,521,694 tons in 1939, and plans have been made to increase the output to 12,000 tons a day. A program of open-pit mining is under way at the Stobie mine, where there is a large body of low-grade ore. Proved ore reserves at all Canadian mines of the company were 224,594,000 tons containing 7,214,000 tons of copper and nickel on December 31, 1939, compared with 212,368,000 tons containing 6,806,000 tons of copper and nickel on December 31, 1938.

The concentrator treated 5,876,501 tons of ore in 1939. Plans have been approved to increase its capacity to 20,000 tons a day to treat additional tonnages of ore from the open-pit operations. The Port Colborne nickel refinery produced 65,865 tons of refined nickel in 1939. Sales of nickel in all forms were 105,097 tons in 1939 (82,189 tons in 1938).

Falconbridge Nickel Mines, Ltd.,[9] operated at a higher rate than in 1938 and treated 576,801 tons of ore (490,938 tons in 1938) comprising 332,724 tons of milling ore and 244,077 tons of smelting ore. The ore, which averaged 1.78 percent nickel and 0.93 percent copper in 1939, is smelted in Canada and the matte shipped to Norway for refining. Ore reserves were 7,502,000 tons averaging 1.80 percent nickel and 0.94 percent copper on December 31, 1939, compared with 6,881,000 tons averaging 1.80 percent nickel and 0.97 percent copper on December 31, 1938.

Finland.[10]—Work on the mine and smelter of the Petsamon Nikkeli O/Y at Kolosjoki continued until the invasion of Finland in November. Before the outbreak of hostilities the indications were that the mine would come into production not later than the early months of 1941.

Germany.—Nickel-ore imports into Germany were 34,215 metric tons in 1938 (19,990 tons in 1937), of which 16,572 tons came from Netherland India, 13,368 tons from Canada, and 3,306 tons from Burma. Nickel-metal imports were 3,984 metric tons in 1938 (3,365 tons in 1937), of which 1,273 tons came from Great Britain, 949 tons from the United States, 924 tons from Norway, and 652 tons from Canada.

Greece.—It is reported, but not confirmed so far, that output of nickel at the Karditsa mine in Thessaly, northern Greece, has been suspended.[11] The mine is controlled by Krupp.

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8 International Nickel Co. of Canada, Ltd., Annual Report, 1939.
9 Falconbridge Nickel Mines, Ltd., 11th Annual Report, 1939.
10 International Nickel Co. of Canada, Ltd., Annual Report, 1939, p. 10.
11 Daily Metal Reporter, vol. 39, April 26, 1939, p. 6.

The first shipments of nickeliferous iron ore from Greece to Italy took place recently, and a regular business is expected in the future.[12] Hitherto all this ore has gone to Germany.

It is said that the production of nickeliferous ore containing a minimum of 2.25 percent nickel plus cobalt has been sold to Italy but that Germany is strenuously endeavoring to obtain the output of grades running from 1.5 to 2.25 percent nickel plus cobalt, which will, it is anticipated, total fully 150,000 tons a year.[13]

Italy.[14]—The mining and concentration of nickel ore have been resumed in the Alps and Sardinia. In the Alps the group of mines (Doccio, Vocca, and Sella Bassa) nearest Varallo are being worked. The deposits in this region contain pyrrhotite, pentlandite, chalcopyrite, and traces of cobalt. These ores are treated at a washing plant at Varallo Sesia. In Sardinia work has been resumed at the old mines of Perdas S'Oliu and Perdas de'Fogu, where new veins of considerable interest have been found. The ores are niccolite and smaltite, rich in nickel but rather difficult to treat, especially as they are mixed with silver, galena, blende, chalcopyrite, and marcasite. The nickel ores from the Sardinian mines are washed to obtain rich nickel concentrates for smelting, in which process cobalt, silver, and arsenic also are recovered.

Japan.[15]—The Showa Kogyo Kaisha is producing ferronickel in a pilot plant from nickel ore mined in Oye-yama. It is proposed to adopt the Krupp process for making ferronickel. The original intention of producing metallic nickel has been abandoned temporarily owing to lack of technical knowledge.

Netherland India.[16]—At the annual meeting of the Oost-Borneo Maatschappij it was stated that the concern is to increase its participation in the nickel-mining enterprise of Bonitolo. The other partner is Fried. Krupp A. G. The erection of a treatment plant at the mine is being considered.

New Caledonia.—The new Yamato nickel mine at Kua has been opened; it is 4 kilometers from the Oulie-Oulié mine.[17] It is stated that the Société le Nickel has completed huge smelting works at Doniambo and that at Noumea wharves were being built for the company and the municipality.[18]

During the first 6 months of 1939, exports of ore (4 to 6 percent nickel content) were 20,301 metric tons, of which France took 15 percent, Germany 34 percent, and Japan 51 percent; exports of matte were 5,022 metric tons, of which 23 percent went to Belgium and 77 percent to France.

Norway.—The Falconbridge refinery at Kristiansand operated steadily throughout 1939 but was hampered somewhat by delayed shipments of matte at the beginning of the war. It operated on matte from the Falconbridge smelter near Sudbury, Ontario, Canada, and custom matte. The refinery produced 9,233 short tons of nickel in 1939 (8,013 tons in 1938). In 1939, sales of nickel were 9,337 short tons (7,142 tons in 1938).

12 Metal Bulletin (London), No. 2395, June 6, 1939, p. 16.
13 Metal Bulletin (London), No. 2402, June 30, 1939, p. 17.
14 Mining Journal (London), vol. 208, January 13, 1940, p. 28.
15 Metal Bulletin (London), No. 2419, September 1, 1939, pp. 14–15.
16 Metal Bulletin (London), No. 2414, August 15, 1939, p. 16.
17 Metal Bulletin (London), No. 2377, March 28, 1939, p. 16.
18 Doyle, A. M., American consul, Sydney, Australia, April 3, 1939.

Southern Rhodesia.—It was stated that the Noel nickel mine at Gwanda had ceased production.[19] In July ore valued at £7,380 was produced.

United Kingdom.—The Clydach nickel refinery of the Mond Nickel Co., Ltd., produced 23,830 short tons of nickel in pellets in 1939 (21,981 tons in 1938) and 901 tons of nickel in salts (1,224 tons in 1938).

Yugoslavia.—Rich nickel deposits have been discovered in the ore-bearing region between Caak and Valjevo.[20]

COBALT

Consumption of cobalt in the United States in 1939, as indicated by imports, increased substantially; as in the past, the demand was supplied entirely by imports, as there was no domestic output. Total imports measured by cobalt content, which established an all-time high, increased about 113 percent over 1938. Probably as a result of higher shipping costs and war-risk insurance, domestic quotations for 97 to 99 percent metal in lots of 100 pounds or more were advanced during the latter part of October to $1.50 a pound from $1.36 and black oxide (70 to 71 percent grade) in lots of 350 pounds or more to $1.84 a pound from $1.67.

World production may be roughly estimated at 6,000 metric tons in 1939 compared with 4,500 tons in 1938. Output in Northern Rhodesia was two and one-half times that in 1938.

PRODUCTION

There was no marketed production of cobalt from domestic deposits in 1939. A western electrolytic-zinc plant recovered 27 short tons of residue containing 3.11 percent cobalt, but no shipments were made.

The United States, a large consumer of cobalt, has thus far failed to develop substantial supplies, but search for commercial deposits and experiments on the recovery of cobalt from iron ore mined at Cornwall, Pa., were continued in 1939. In Graham County, Ariz., cobalt prospects have been under development, and ore estimated to contain about 14,000 pounds of cobalt has been mined; the ore is reported to average about 2 percent cobalt. Near Salmon City, Idaho, a deposit said to contain cobalt, gold, copper, and nickel is being developed. Samples of the primary ore taken from the property of the Cobalt Gold Mining Co. near Gold Hill, Colo., yielded 0 to 0.6 percent cobalt, and samples of supergene ore contained 0.22 to 6.22 percent cobalt. The nickel-cobalt deposits in Cottonwood Canyon, Churchill County, Nev., which are reported to have yielded about 500 tons of high-grade nickel-cobalt ore in the eighties, were studied by Ferguson.[21]

FOREIGN TRADE

Imports of cobalt into the United States in 1939 established an all-time record and total imports of cobalt, measured by cobalt content, increased about 113 percent over 1938. Imports of ore gained 36 percent, metal 127 percent, and oxide 82 percent. Exports of cobalt

[19] South African Mining and Engineering Journal, vol. 50, pt. 2, September 30, 1939, p. 136.
[20] Chemical Age, vol. 38, April 2, 1938, p. 270.
[21] Ferguson, H. G., Nickel Deposits in Cottonwood Canyon, Churchill County, Nev.: Univ. of Nevada Bull. 5, Geol. and Min. Ser. 32, December 1, 1939, 21 pp.

and cobalt products are not reported separately, but they are believed to be relatively unimportant.

Cobalt ore, metal, and oxide imported for consumption in the United States, 1938–39, by countries, in pounds

Country	Ore		Metal		Oxide	
	1938	1939	1938	1939	1938	1939
Austria			[1] 33			
Belgium			617,088	1,910,580	22,050	242,900
Canada	432,201	573,226	80,779			
Chile	17,783	37,857				
Finland			240,575	219,716	89,250	118,300
France					120,540	128,100
Germany			[1] 1		141,375	191,344
	449,984	611,083	938,476	2,130,296	373,215	680,644

[1] Austria included with Germany, beginning May 6, 1938.

Cobalt ore, metal, oxide, and other compounds of cobalt imported for consumption in the United States, 1936–39

Class	1936		1937		1938		1939	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Ore	1,039,760	$77,965	587,499	$44,352	449,984	$32,354	611,083	$54,446
Metal	883,377	1,014,965	1,073,129	1,341,928	938,476	1,146,559	2,130,296	2,711,677
Oxide	813,642	885,566	842,847	1,059,432	373,215	519,201	680,644	944,836
Sulfate	46,472	16,502	56,540	21,858	41,811	18,277	75,290	34,343
Other salts and compounds	186	277	45	187	56	98	1,374	3,405

USES

As a result of extensive research the use of cobalt continues to expand, consequently world production has increased greatly. Cobalt oxide is used in the ceramic industry; cobalt salts in the preparation of driers for use in paints, varnishes, and linoleums and as a catalyst; and cobalt metal in various types of high-grade steels (especially metal-cutting and magnet steels), as a catalyst, and in electroplating.

The importance of cobalt as a fertilizer for granite soils has been the subject of experiment in Nelson and Auckland Provinces, New Zealand, and investigations are being extended to cobalt-deficient areas in the Waikaremoana district in the center of the North Island.[22] In the United States there is a serious deficiency of cobalt in sections of Florida, and experimental work has been done by the Florida Experiment Station of the Department of Agriculture. A good discussion of the problem has been presented by Neal and Ahmann.[23]

WORLD PRODUCTION

Lack of statistics on the production of cobalt in the Belgian Congo, one of the chief producers, and in several smaller producing countries precludes an accurate statement of total world output. However, such

[22] American Fertilizer, vol. 90, April 29, 1939, p. 7.

[23] Neal, W. M., and Ahmann, C. F., The Essentiality of Cobalt in Bovine Nutrition: Jour. Dairy Sci., vol. 20, December 1937, pp. 741–753.

figures as are available indicate a world production of about 6,000 metric tons in 1939. Production in Northern Rhodesia was about 2½ times that in 1938.

World production of cobalt, 1937–39, in metric tons

[Compiled by M. T. Latus]

Country [1]	Cobalt-bearing material	1937		1938		1939	
		Gross weight	Cobalt content	Gross weight	Cobalt content	Gross weight	Cobalt content
Belgian Congo	Cobaltiferous copper ore	(2)	1,500	(2)	(2)	(2)	(2)
Bolivia	Cobalt ore	5	(3)	(2)	(2)	(2)	(2)
Burma [4]	Cobaltiferous nickel speiss	4,389	298	3,399	238	3,322	229
Canada: Ontario	Cobalt ores, oxide, and metal	(2)	230	(2)	208	(2)	332
Morocco, French	Cobalt ore [5]	5,280	581	6,541	720	(2)	(2)
Northern Rhodesia	Cobaltiferous copper ore	(2)	884	(2)	1,461	(2)	3,581

[1] In addition to the countries listed, Chile, China, Finland, Germany, Italy, Japan, and Mexico produce cobalt, but production data are not available.
[2] Data not available.
[3] Less than 1 ton.
[4] Year ended June 30 of year stated.
[5] Average cobalt content estimated at 11 percent.

Belgian Congo.—The Belgian Congo is one of the largest producers of cobalt, but accurate details are not available. However, as the cobalt-producing capacity of the country has been increased considerably by the discovery of further reserves of rich cobalt minerals and as a fourth electric furnace for the treatment of cobaltiferous minerals was installed at the Jabotville-Panda works, production probably increased in 1939. Moreover, imports of cobalt (content) into the United States from Belgium, where Belgian Congo cobalt is refined, increased 229 percent; receipts of metal advanced to 1,910,580 pounds (617,088 pounds in 1938) and oxide to 242,900 pounds (22,050 pounds in 1938).

Preliminary work has begun at the Kabolela cobalt mine, and a concentrator is under construction.[24] At Lubumbashi and Shituru the roasting and electrolytic plants were extended.

Burma.—Cobalt is produced in Burma largely as a byproduct of lead-zinc mining at the Bawdwin mines of the Burma Corporation, Ltd. A nickel speiss obtained at the lead smelter contains about 7 percent cobalt.

Canada.—Canadian output, including cobalt in ores exported, in oxides sold, and in metal made at Deloro, Ontario, totaled 732,561 pounds valued at $1,137,599 in 1939 compared with 459,226 pounds valued at $790,913 in 1938. In the Cobalt camp, Ontario, silver has been mined in close association with cobalt for many years, and the drop in the price of silver about midsummer 1939 adversely affected the output of cobalt. The O'Brien mine, the last major producer in the camp, ceased operations early in 1940.[25]

Cobalt Products, Ltd., a newcomer in the Cobalt camp, is now the main producer in Canada.[26] Late in 1938 a concentrating unit of 100 tons capacity was built and is now functioning smoothly. The

[24] South African Mining and Engineering Journal, vol. 50, pt. 1, August 12, 1939, p. 749.
[25] Dominion Bureau of Statistics, Preliminary Report on the Mineral Production of Canada during the Calendar Year 1939: Ottawa, 1940.
[26] Mining and Metallurgy, vol. 21, January 1940, pp. 10–11.

ore is obtained from various surface dumps and from underground operations at the Agaunico property. Flotation concentrate carrying 10 to 18 percent cobalt either is sold directly or treated in a cupola to produce cobalt-silver matte.

Chile.—Exports of cobalt from Chile (all to the United States) in 1939 comprised 6.9 metric tons of ore and 10.2 metric tons of concentrates.

Finland.—Figures are lacking on output in Finland. Imports of cobalt metal into the United States from Finland declined to 219,716 pounds in 1939 from 240,575 pounds in 1938, but imports of oxide increased to 118,300 pounds from 89,250 pounds in 1938.

Italy.[27]—Italian production of ores containing nickel and cobalt has increased greatly during the past 2 years as a result of Government stimulation. It is predicted that the domestic production soon will be adequate to supply the greatest part of the country's requirements of nickel, estimated at 2,500 tons a year, while the production of cobalt will then afford a surplus for exportation. The production of nickel and cobalt ores in 1937 amounted to 7,591 metric tons containing 0.9 to 15 percent nickel and 0.7 percent cobalt. In 1938 the output had increased to 13,421 tons, of which 130 tons contained 14 to 16 percent nickel and 2 to 6 percent cobalt. Cobalt is also said to be obtained through electrolysis of certain zinc ores that average 50 grams of cobalt per ton. The principal deposits of ores containing nickel and cobalt appear to occur in the Piedmont district of northwestern Italy. The principal localities in which nickel- and cobalt-bearing minerals now are being recovered are Val di Sesia, Valle Strona, and Valle del Toce. Plants for the concentration of these minerals are at Varallo. The richer ores are found in Sardinia, which produced 130 tons containing 14 to 16 percent nickel and 2 to 6 percent cobalt in 1938.

Morocco, French.—Production of cobalt ore in French Morocco was 2,880 metric tons during the first 6 months of 1939 and exports were 3,833 metric tons. In 1938 the output of ore was 6,541 metric tons and exports were 5,300 metric tons.

The producing mines are about 155 miles west of Agadir in the Atlas Mountains; cobalt occurs on the surface in the form of erythrite, a hydrous cobalt arsenate, and at depth in the form of smaltite, a cobalt diarsenide.[28] From 1932 to 1938 the output of concentrate contained a minimum of 13.25 percent cobalt and 3 percent nickel, but in 1939 the output contained 10.5 percent cobalt and 4.9 percent nickel. Most of the cobalt is exported to Belgium for refining.

Northern Rhodesia.—The Rhokana Corporation, Ltd., sold 1,124 short tons of cobalt in alloy and refined products during the year ended June 30, 1939, compared with 831 tons during the corresponding year 1938. During the fiscal year ended June 30, 1939, the cobalt plant produced 4,511 short tons of alloy containing 1,761 tons of cobalt compared with 2,854 tons of alloy containing 1,183 tons of cobalt during the corresponding fiscal year 1938.[29] The third electric furnace was operated continuously. The differential flotation of copper and cobalt was practiced until the end of May 1939, when it was stopped to permit a new segregation experiment to be conducted

[27] Sholes, W. H., American consul general, Milan, Italy, September 20, 1939.
[28] Bureau of Foreign and Domestic Commerce, Minerals Circ. 21, December 29, 1939, pp. 32-33.
[29] Rhokana Corporation, Ltd., Directors' Report and Statement of Accounts for the Year Ended June 30, 1939.

in the smelter. Until differential flotation ceased 73,152 short tons of concentrates had been produced, averaging 2.62 percent cobalt, of which 53.22 percent was recovered. At the end of May 1939 a new experiment was begun for recovery of cobalt from the converter slags. The results obtained to date are most encouraging, and the experiment is being continued.

According to the Rhodesia Chamber of Mines, production of cobalt in Northern Rhodesia was 3,947 short tons during the calendar year 1939 compared with 1,610 tons during the calendar year 1938.

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MOLYBDENUM, TUNGSTEN, AND VANADIUM

By Robert H. Ridgway and H. W. Davis[1]

SUMMARY OUTLINE

MOLYBDENUM

The phenomenal rise in molybdenum production was checked in 1939, when world output declined about 9 percent. Although production dropped, shipments from the mines increased over 1938, resulting in a new all-time high. Extensive armament activities in foreign countries, together with the abrupt rise in steel operations in this country during the last quarter of 1939, created demands that were met not only by upward revision of operating schedules during the latter part of the year but also by withdrawals from producers' stocks. Thus in this country—the predominant producer—shipments of molybdenum in the form of concentrates exceeded output by 2 million pounds.

Of the world output of 33,000,000 pounds of molybdenum in 1939 the United States supplied 30,324,000 pounds (92 percent). The relatively small amount produced by other countries came mainly from Mexico and Norway; Norwegian production was less in 1939 than in 1938, while Mexican output maintained about the same level. Recovery of molybdenum was inaugurated at the Braden operations in Chile during 1939.

Molybdenum is one of the few ferro-alloying elements of which this country has ample supplies for its own needs. Much of the domestic production is exported; in 1939 exports of concentrates were 43,554,310 pounds valued at $14,066,501. Movement during the first half of the year was sluggish but increased during the last 6 months, reaching nearly 8.5 million pounds in October.

The Climax mine of the Climax Molybdenum Co., Colorado, is the principal producer of molybdenum, having supplied about 66 percent

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

of the world output and 72 percent of the domestic output in 1939. Of particular interest in 1939 was the large increase in output of molybdenite concentrates as a byproduct from copper operations at Bingham, Utah; Chino, N. Mex.; and Miami, Ariz. Output from these sources comprised nearly one-fourth of the domestic output and was more than double that in 1938. A small production—the first ever reported—was made in Wisconsin in 1939.

Salient statistics of the molybdenum industry in the United States, 1937–39

	1937	1938	1939
Concentrates:			
Production .... short tons..	30,357	36,157	32,347
Molybdenum contained:			
Average .... percent..	48.46	46.05	46.87
Total .... pounds..	29,419,000	33,297,000	30,324,000
Shipments (molybdenum contained):			
Pounds	30,122,000	25,727,000	32,415,000
Value [1]	$20,571,000	$17,977,000	$22,157,000
Exports:			
Pounds	(2)	(2)	43,554,310
Value	(2)	(2)	$14,066,501
Imports for consumption (molybdenum contained):			
Pounds	7,707	25	26,347
Value	$13,491	$81	$32,327

[1] Estimated by Bureau of Mines. [2] Not separately recorded.

Moral embargo.—Following the President's statement of December 2 regarding exports of airplanes and materials essential in airplane manufacture to nations guilty of unprovoked bombing of civilian populations from the air, the State Department on December 15 addressed a letter to all producers of molybdenum, including this metal on the embargo list. Molybdenum steels have been widely employed in aircraft construction during the last decade.

PRICES

Prices for molybdenite concentrates carrying 90 percent MoS_2 were quoted nominally by the Engineering and Mining Journal at 45 cents per pound of contained MoS_2 throughout 1939; this is equivalent to 75 cents per pound of contained Mo. Although the London quotations, in shillings per long-ton unit, remained steady throughout most of the year, the effect of the exchange rate was to reduce the quotation in equivalent dollars. For example, in January the quotation of 43 shillings per long-ton unit was equivalent to 44.83 cents per pound of contained MoS_2, whereas in December the quotation jumped to 50 shillings per long-ton unit but was equivalent to only 43.82 cents per pound of contained MoS_2 owing to the lower rate of exchange.

DOMESTIC PRODUCTION

Arizona.—Three mines in Arizona produced 4,395 short tons of molybdenum concentrates containing 752,539 pounds of molybdenum in 1939 compared with five mines producing 4,784 tons of concentrates containing 1,139,593 pounds of molybdenum in 1938. The reduction in 1939 was due to the closing of operations by the Arizona Molybdenum Corporation, the largest producer in Arizona in 1938. The company, however, continued to make shipments from stocks, which were exhausted during 1939.

Molybdenum was recovered as a byproduct at operations in Arizona during 1939. The Miami Copper Co. increased the recovery and shipment of molybdenite concentrates resulting from the re-treatment of copper sulfide concentrates at Miami, Gila County. Recovery of molybdenum at this property was begun in August 1938 and totaled 431,652 pounds of molybdenite in 1939. The process [2] involves treatment of the limed copper concentrate with live steam for about 80 minutes in a series of three agitators. From the last agitator the pulp is passed to a Hunt-type flotation machine, which produces a cut of froth for making a final molybdenite concentrate. The finished flotation concentrate is made in a Denver Sub-A machine and is at least 90 percent MoS_2 and 2 to 3 percent copper. The reagents used are kerosene distillate, an alcohol frother, and sodium silicate. The final market product is made by a leaching process, which further reduces the copper to a low figure. The other output was oxide concentrates from the mill of the Mammoth-St. Anthony, Ltd., where gold, silver, lead, molybdenum, and vanadium are recovered by selective flotation. In addition to treating ore from its Mammoth mine, the company continued during part of the year to treat similar ore from the oxide zone of the nearby Mohawk and New Year claims of the Molybdenum Gold Mining Co., a subsidiary of the Molybdenum Corporation of America. The Mohawk and New Year mines, however, were acquired by the Mammoth-St. Anthony, Ltd., early in the year and closed on May 15, 1939. A head frame, ore bins, and a 1,200-foot aerial tram were completed at the Mammoth mine in 1939.

California.—There was a small production of molybdenite concentrates from a tungsten operation in Inyo County in 1939.

Colorado.—The Climax Molybdenum Co., the world's largest producer of molybdenum, has a rated milling capacity of 12,000 tons of ore daily. From January to about midyear the flotation plant operated at about 7,500 tons daily and later in the year at capacity. In all, 3,430,952 short tons of ore containing 0.576 percent MoS_2 were mined and milled from which 20,485 tons of concentrates containing 21,796,116 pounds of molybdenum were recovered compared with 4,344,734 short tons of ore containing 0.606 percent MoS_2, from which 27,591 short tons of concentrates containing 28,242,085 pounds of molybdenum were recovered in 1938. Shipments exceeded production, resulting in lowering of stocks.

Molybdenum (element) contained in concentrates produced from the Climax deposit, Colorado, 1934–39

	Pounds		*Pounds*
1934	8, 378, 683	1937	22, 750, 368
1935	10, 168, 635	1938	28, 242, 085
1936	15, 216, 806	1939	21, 796, 116

There was also a small production (but no shipments) from the F. R. M. mine near Cowdrey, Jackson County, in 1939. The United States Molybdenum Corporation was doing development work on its property near Empire, Clear Creek County.

[2] Engelmann, E. W., Ore Concentration and Milling: Min. and Met., vol. 21, No. 397, January 1940, p. 38.

Nevada.—There was no production or shipments from Nevada during 1939, but the Freeport Sulphur Co. was prospecting and drilling the Elm Gulch property near Goldfield, Esmeralda County.

New Mexico.—The Molybdenum Corporation of America continued to operate its mine and mill some 7 miles east of Questa along the Red River. The ore is relatively high grade and the tonnage treated comparatively small. Development work on lower levels is reported to have given encouraging results.

Molybdenite concentrates also were produced by the Nevada Consolidated Copper Corporation at the Chino property incident to the treatment of copper ores.

Utah.—All production in 1939 came from the Utah Copper Co., where molybdenite is recovered as a byproduct in the concentration of copper ores and re-treatment of molybdenum-bearing concentrates. As the molybdenum content of the ore is very low the molybdenite concentrates are entirely byproduct, and production fluctuates with the output of copper; thus output was greater in 1939 than in 1938. Shipments, however, were not as large as production, resulting in an accumulation of stocks.

Further steps [3] were taken by the Utah Copper Co. in 1939 to reduce the copper and insoluble matter in the molybdenite concentrate. The improvement consists of an additional heat treatment of what formerly was the finished flotation concentrate in a small roaster at temperatures approximating 400° to 500° F., followed by grinding in a 4-foot by 5-foot 4-inch ball mill and cleaning in three more flotation cells. The first cleaner cell is used to remove a small amount of insoluble material by means of an alcohol frother. The two following cells are used to clean the molybdenite further. This supplementary treatment lessens the difficulty of removing the copper in the finished molybdenite concentrate to the desired point.

Washington.—The Deertrail Monitor Mines Co. mined about 2,000 short tons of ore containing 0.5 percent MoS_2 at its Monitor mine on Adams Mountain 6 miles east of Fruitland, Stevens County. About 2,000 tons were milled in the 40-ton flotation mill, and the concentrates (10 tons) were stored at the mine.

Wisconsin.—The Wisconsin Molybdenum Corporation produced and shipped a small quantity of concentrates from a property near Middle Inlet, Marinette County.

IMPORTS AND EXPORTS

Exports of molybdenum, principally in the form of concentrates, provide an important outlet for the domestic molybdenum industry. Shipments of concentrates abroad during the latter half of 1939 were more than three times as large as during the first half. Exports by countries of destination are shown in the following table for 1939, the first year for which such data are available.

[3] Engelmann, E. W., Ore Concentration and Milling: Min. and Met., vol. 21, No. 397, January 1940, p. 38.

Molybdenum concentrates exported from the United States in 1939, by countries

Country	Pounds	Value	Country	Pounds	Value
Belgium	621,116	$55,560	Mexico	2,000	$60
Canada	188,828	84,433	Netherlands	2,734,211	707,368
Czechoslovakia [1]	42,262	14,800	Norway	2,357	1,107
France	2,960,543	792,000	Sweden	766,294	310,186
Germany [1]	134,960	51,532	U. S. S. R.	18,142,378	6,832,104
Hungary [1]	37,089	16,216	United Kingdom	7,556,560	1,049,488
India, British	112	58			
Italy	1,004,440	409,701		43,554,310	14,066,501
Japan	9,361,160	3,741,888			

[1] For statistical purposes, trade with the Sudeten area, as far as ascertainable, has been included with Germany, while trade with the other Czechoslovak Provinces occupied by Germany and Hungary has been included with these countries since March 18 or 19, 1939.

Imports of molybdenum or molybdenum compounds are small.

Molybdenum ore and concentrates, ferromolybdenum, molybdenum metal and powder, calcium molybdate, and other compounds and alloys of molybdenum imported for consumption in the United States, 1935–39

Year	Molybdenum content (pounds)	Value	Year	Molybdenum content (pounds)	Value
1935	68,758	$40,721	1938	25	$81
1936	49	213	1939	26,347	32,327
1937	7,707	13,491			

In addition to the quantity shown in the above table, 87,232 pounds of ore and concentrates containing 49,613 pounds of molybdenum valued at $34,192 were imported for smelting, refining, and export in 1939, of which 10,232 pounds containing 5,541 pounds of molybdenum valued at $3,638 came from Mexico, 44,000 pounds containing 22,440 pounds of molybdenum valued at $17,710 came from Morocco, and 33,000 pounds containing 21,632 pounds of molybdenum valued at $12,844 came from Turkey.

USES

Molybdenum is used principally in the iron and steel industry for making special alloy steels. Continued research is broadening the field of applications both in new outlets and as a substitute for and in addition to other alloying elements. Molybdenum may be used alone to impart certain desired properties to iron and steel, but more frequently it is employed with one or more of the other ferro-alloying elements. During the past decade the use of molybdenum high-speed steel has been increasing. The most popular analysis at present is: Carbon 0.72 to 0.81, silicon 0.20 to 0.45, manganese 0.30 maximum, chromium 3.50 to 4.00, tungsten 1.30 to 1.80, vanadium 0.90 to 1.30, and molybdenum 8.00 to 9.50.[4] Molybdenum steels are used extensively in the automotive, oil, and aircraft industries.

For most purposes molybdenite (MoS_2), the principal raw material, is converted before using to ferromolybdenum (a product carrying 60 to 65 percent molybdenum) or to calcium molybdate (a compound

[4] Breeler, Walter R., Development in Molybdenum High-speed Cutting Steels: Trans. Am. Soc. Metals, vol. 27, No. 2, June 1939, p. 289.

containing 35 to 45 percent molybdenum and resulting from the roasting of molybdenite with lime). The latter is the cheaper method of preparing molybdenum for industrial applications. Molybdenum oxide briquets also are used in making additions of molybdenum to iron and steel.

Molybdenum compounds find limited use in chemical and ceramic industries, but consumption is not large.

WORLD PRODUCTION

World production of molybdenum comes from a small but increasing number of mines. Operations in Mexico, Norway, and the United States furnish most of the world requirements. The search for new sources was intensified in 1939; but, as far as is known, there were no significant developments.

World production of molybdenum ores and concentrates, 1935–39, in metric tons

[Compiled by M. T. Latus]

Country [1]	1935	1936	1937	1938	1939
Australia:					
New South Wales (concentrates)		(2)	16	9	(3)
Queensland (concentrates)	11	20	23	14	12
Victoria (concentrates)			31	36	(3)
Burma			(2)		(3)
Canada (concentrates)			7		1
Chile (Mo content)					30
Chosen (ore)	106	80	(3)	(3)	(3)
Greece (ore)				1,560	(3)
Italy (ore)		861	46	12	(3)
Japan (dressed ore)	6	7	(3)	(3)	(3)
Mexico (Mo content)	687	534	629	483	(3)
Morocco, French (concentrates) (exports)	190	187	149	258	(3)
Norway (Mo content)	388	422	344	462	423
Peru (concentrates)	13	19	83	185	239
Rumania (Bi-Mo ore)	14	46	27	164	(3)
Turkey (ore)			43	80	(3)
United States (Mo content)	5,222	7,795	13,344	15,103	13,755
Yugoslavia	18		84	19	(3)

[1] In addition to countries listed, molybdenum ore is also produced in China, but data of production are not available.
[2] Less than 1 ton.
[3] Data not available.

Canada.—The only commercial shipment of molybdenite reported in 1939 (1 long ton of concentrates) came from operations of the Molybdenite Corporation of Canada in Abitibi County, Quebec. Molybdenite concentrates also were produced in the Michipicoten district of Ontario by the Regnery Metals, but statistics relating to output are not yet available. Prospecting and development work were widespread; other properties under exploration included the Moss mine (leading world producer during the World War) in Onslow Township, Quebec; Kindale mine, Masham Township, Gatineau County, Quebec; Puritan, North American, and Zenith mines, Renfrew County, Ontario; and Powell River and Endako, British Columbia. An association known as the Molybdenum Institute of Canada was formed by interested parties in August 1939 to foster and encourage molybdenum production in Canada.

Chile.—The recovery of molybdenite concentrates from the copper operations of the Braden Copper Co. at Sewell was inaugurated in 1939, when 111,561 pounds of molybdenite were produced in an experimental plant. Exports totaled 40 metric tons in 1939 and were shipped to Great Britain.

Mexico.—Output in Mexico, which in 1939 was about the same as in 1938, comes principally from the Greene Cananea Copper Co., where molybdenite concentrates are recovered as a byproduct in the treatment of copper ores. Exports during the first 10 months of 1939 amounted to 690 metric tons.

Morocco, French.—French Morocco is the largest producer in Africa, and output may have reached 250,000 pounds of molybdenum in 1939. Much of the output comes from the mine of the Société de Molybdène near Azegour.

Norway.—The Knaben Mölybdan Gruber was the chief producer in Norway in 1939. The Laxadalen Mölybdängruber, which installed a mill at its property near Gildeskal, northern Norway, produced about 65 metric tons in 1939. Exports of molybdenum concentrates in 1939 were 676 metric tons compared with 796 in 1938.

Peru.[5]—Molybdenum is of growing importance in Peru's export trade. From an output of 13 metric tons in 1935 production of molybdenum concentrates jumped to an output of 239 tons in 1939. Molybdenum prospects are reported to occur in the Provinces of Huarochiri and Cajatambo in the Department of Lima, in the districts of Bolognesi, Recuay, Ticapampa, and Conchucos in the Department of Ancash, and near Solceantay in the Urubamba district of Cuzco. The principal producing mine, however, is that of the "Peru Molibdeno" near Ricran in the Department of Junin.

TUNGSTEN

World production of tungsten increased slightly in 1939. Lessened demand related—in part, at least—to the low rate of steel operations maintained in this country during the first 8 months of the year. The abrupt increase in domestic industrial activity during the closing months of 1939, together with the outbreak of war, caused unusual demands that resulted in increased prices in this country, but as the revival occurred late in the year its effect is not apparent in the production data for 1939. Conditions in the Far East continued to hamper the Chinese tungsten industry, which normally furnishes a large part of the world's supply. Major producing areas in Kwangtung were reported still in Chinese hands and are being worked extensively. Although the tungsten-producing area held by the invader is small and not yet pacified, the Japanese control the main routes of outflow, namely, via Shanghai or Canton. Adequate supplies, however, are reaching Hong Kong by devious routes, but the fear that Chinese supplies might be cut off undoubtedly had had some influence on the market.

The United States is now one of the principal producers of tungsten, and shipments from domestic mines in 1939 were the highest of any before and since the war years 1916–18, when exorbitant prices and shortage of supplies stimulated a country-wide search for strategic minerals. Although shipments from domestic mines increased, production declined 10 percent, resulting in reduced stocks at mines or

[5] Wright, C. W., Mineral Resources, Production and Trade of Peru: Bureau of Mines Foreign Minerals Quarterly, vol. 3, No. 1, January 1940, p. 38.

mills. Further impetus was added to the development and reequipment of properties in our Western States by conditions during the closing quarter of 1939. Governmental purchases for strategic stockpile purposes provided an additional incentive.

Tables of domestic shipments, imports, exports, and apparent consumption of tungsten in the United States from 1910 to 1938, which present the historical background for consideration of the strategic nature of tungsten, are given in Minerals Yearbook, 1939, p. 621.

Salient statistics of the tungsten industry in the United States, 1938–39

	1938		1939	
	Short tons	Value	Short tons	Value
Production (60 percent WO_3)	4,000	(1)	3,603	(1)
Concentrates shipped (60 percent WO_3)	3,044	$3,161,498	4,287	$4,402,182
Imported for consumption (W content)	81	138,693	743	997,971
Stocks in bonded warehouses, Dec. 31:				
Ore (W content)	325	202,371	843	1,357,219
Metal (W content)	10	26,664	6	14,975

1 Figures not available.

Emergency stock pile.—The Strategic Materials Act (Public No. 117, 76th Congress, ch. 190, 1st sess.) which was signed by the President on June 7, 1939, authorized the expenditure of $100,000,000 over a 4-year period for the purchase of strategic materials. Only $10,000,000 was appropriated in the Third Deficiency Bill, approved August 2, 1939 (Public No. 361, 76th Congress, ch. 633, 1st sess.), and purchases were restricted largely to the high-priority mineral commodities on the strategic list, including tungsten concentrates.

The following specifications were drawn up as to chemical analysis of high-grade tungsten concentrates:

Tungsten trioxide (WO_3)	percent minimum	60.0
Tin (Sn)	percent maximum	1.0
Copper (Cu)	do	.05
Phosphorus (P)	do	.035
Arsenic (As)	do	.50
Antimony (Sb)	do	.05
Bismuth (Bi)	do	.12
Molybdenum (Mo)	do	.40
Sulfur (S)	do	.50

Proposals for supplies (S–5) to be opened Friday, October 20, 1939, were issued on September 20, 1939. The proposals called for delivery, f. o. b. cars, United States Army General Depot, Columbus, Ohio. Four bids were received, two proposing to supply material from domestic sources and two from foreign sources. The ore from domestic sources was eliminated because the material the bidders offered was not up to specification. On October 26, 1939, a contract was awarded to the Wah Chang Trading Corporation of New York for about 425 short tons of concentrates from China at $15.82 per short-ton unit, exclusive of duty. Deliveries on the contract were well under way at the year end.

As a result of competitive bids opened September 14, 1939, the Navy Department on September 25, 1939, purchased about 245 short tons of tungsten concentrates with the small appropriation it received to provide for stock piles of strategic commodities. The contract, at \$25 per short-ton unit, Brooklyn, N. Y., was let to the Metal & Ore Corporation of New York City, which proposed to supply ore from mines in Nevada, Arizona, and California. Delivery on this contract was under way in 1939.

Government exploration.—Under section 7 of the Strategic Materials Act, the Bureau of Mines and the Geological Survey undertook to search for and appraise ore deposits containing metals that have been designated as strategic by the Secretaries of War, Navy, and the Interior upon advice of the Army and Navy Munitions Board. The bill authorized the expenditure of \$500,000 a year, \$350,000 to the Bureau of Mines and \$150,000 to the Geological Survey, for each of the fiscal years ending June 30, 1940, 1941, 1942, and 1943. Close cooperation by the geologists of the Survey and the engineers of the Bureau of Mines will be necessary to accomplish the objectives of the act.

The Bureau of Mines, in carrying out its part [6] of the program, seeks to determine (1) the extent and quality of the ore, (2) the most suitable method of mining and beneficiating it, and (3) the cost at which it may be produced.

A tungsten project was completed in 1939 in the Nightingale district of Nevada, exploring the possibility that a large amount of high-cost tungsten could be obtained in an emergency from various contact deposits of the kind that are known to occur in the Western States. Exploration consisted of trenching, diamond drilling, and sampling of underground workings. Although the deposit was not delimited entirely, additional ore, mostly marginal, was indicated, and some commercial ore was found. A number of other deposits of similar geologic occurrence in California, Nevada, and Arizona were examined with a view to initiating other project work.

As part of its program of investigation of strategic mineral deposits the Geological Survey made detailed geologic maps of several tungsten districts in California and Nevada. In California, field work on the Atolia district was completed, and mapping of several districts near Bishop—Pine Creek, Tungsten Hills, and Black Rock—is well advanced and scheduled for completion during 1940. A 2-year program of mapping was begun in the Eugene Mountains, Nev., in which the Mill City district is situated. A small area near Rose Creek was mapped, and further study was made of the Nightingale district; all three districts are in Pershing County. In addition, three deposits of tungsten-bearing manganese ore were examined near Golconda, Humboldt County; in the East Range, Pershing County; and near Sodaville, Mineral County.

Several tungsten deposits in Arizona were examined briefly, notably those in the Little Dragoon Mountains, Cochise County.

PRICES

The quotations on tungsten ore or concentrates continued to decline during the first 8 months of 1939. The market moved in a desultory fashion despite the constant threat of stoppage of Chinese concentrates, owing to expanding Japanese control over transportation routes.

[6] Finch, John W., Strategic Minerals Investigations—Procedure Followed by the Bureau of Mines: Bureau of Mines Inf. Circ. 7097, December 1939, pp. 1–5.

London prices for Chinese wolframite concentrates containing 65 percent WO_3, as given by the Mining Journal (London), were 59s.–61s. per long-ton unit at the beginning of the year. The quotations declined steadily until August, when they reached 47s.–48s. With the advent of the European War the quotations jumped sharply, reaching 55s.–60s. per unit in September; subsequent prices were nominal. Domestic quotations followed the same pattern, but the post-war rise was more pronounced owing to the control scheme adopted by the British and French Governments. Thus quotations on domestic scheelite of good analysis, which opened the year at \$16 to \$19 per short-ton unit, declined to \$15 to \$17 in August but rose to \$25 in September, from which there was a slight weakening at the year end. During most of the year some western buyers were paying \$12 a unit at the mines; later this was increased. The average price for the 1939 production as reported to the Bureau of Mines was \$17.11 per short-ton unit of WO_3.

DOMESTIC PRODUCTION

Activities in the domestic tungsten-producing industry in 1939 continued at the higher level maintained in 1937 and 1938. Relatively slack demand curtailed operations during the early months of the year, but the abrupt rise in price in September brought new producers into operation. Although production of concentrates dropped 10 percent from 1938, shipments in 1939 increased 41 percent, reducing materially the stocks at the mills. Output in 1939, amounting to 3,603 tons of concentrates (reduced to an equivalent of 60 percent WO_3), came from a number of widely scattered operations in Arizona, California, Colorado, Idaho, Montana, Nevada, Utah, and Washington. Developments in the domestic tungsten-producing industry in recent years are tending to make the United States more nearly self-sufficient in this strategic mineral commodity at prices that have held. This situation, however, depends on the tariff, which at present amounts to \$7.931 per short-ton unit of WO_3 in ore and concentrates.

Tungsten ore and concentrates shipped from mines in the United States, 1935–39

Year	Quantity		Reported value f. o. b. mines		
	Ore and concentrates, 60 percent WO_3 (short tons)	Tungsten content (pounds)	Total	Average per unit of WO_3	Average per pound of tungsten
1935	2,395	2,279,369	\$1,921,017	\$13.37	\$0.84
1936	2,612	2,485,893	2,323,818	14.83	.93
1937	3,500	3,331,020	4,094,000	19.50	1.23
1938	3,044	2,897,036	3,161,498	17.31	1.09
1939	4,287	4,080,024	4,402,182	17.11	1.08

Arizona.—Shipments of tungsten concentrates from Arizona operations totaled 88 short tons containing 68.38 percent WO_3 in 1939 compared with 35 tons containing 63.09 percent WO_3 in 1938. Output comprised scheelite, wolframite, huebnerite, and ferberite concentrates. The largest output came from the Boriana mine in Mohave County, which was idle during the first 9 months of the year. J. J. Seeman shipped 27 short tons of scheelite concentrates containing 72.42 percent WO_3 from the Tungsten Reef mines in Cochise County in 1939. Scattering shipments came from other deposits in Mohave and Cochise Counties, as well as in Pima County.

California.—Shipments of tungsten concentrates (all scheelite) from California amounted to 1,250 short tons containing 60.63 percent WO_3 in 1939, compared with 770 tons containing 65.44 percent WO_3 in 1938. The largest producer—the Atolia Mining Co. near Atolia in San Bernardino County—shipped 470 short tons of concentrates containing 52.70 percent WO_3. The company treated 4,979 short tons of ore containing 1.98 percent WO_3 and 16,107 tons of tailings containing 1.40 percent WO_3. Eleven other producers—5 in Inyo, 1 in San Bernardino, 2 in Mono, 1 in Kern, 1 in Tulare, and 1 not placed—contributed to the California total. Inyo was the largest producing county. Activities there continued to increase in the region around Bishop. The tungsten deposits of Inyo County have been described by Tucker and Sampson.[7]

Colorado.—Output of tungsten in Colorado was higher in 1939 than in 1938. Total shipments were 617 short tons of concentrates averaging 46.59 percent WO_3. All shipments were ferberite concentrates from Boulder County, the largest coming from operations of the Wolf Tongue Mining Co. near Nederland, where the Illinois shaft was sunk to the 400-foot level. The mill treated 1,603 short tons of ore containing 4.78 percent WO_3 in 1939. The Vanadium Corporation of America shipped 204 short tons of concentrates containing 50.66 percent WO_3 from the Conger mine near Nederland in 1939. The mine was reopened late in 1938, and a new mill was built which in 1939 treated 12,115 short tons of ore containing 1.20 percent WO_3.

The following is an abstract of a paper by Lovering [8] regarding the genesis of Boulder County ores.

> The wall-rock alteration adjacent to the tungsten veins shows a narrow sericitized casing surrounding the vein, giving away abruptly to an argillized envelope extending to as much as 50 feet from the vein. The argillitic alteration indicates attack by early acid solutions, and the narrow sericitized sheath shows a change to neutral and alkaline solutions at a late stage. In the gold telluride veins the sericitic alteration is dominant, and the argillitic envelope is generally lacking. The early vein quartz shows that the clay minerals and marcasite immediately preceded the deposition of contemporaneous pyrite and ferberite. Hypogene brown iron oxide is later than the ferberite and is followed by barite and adularia. This mineralogy indicates a progressive change from acid to alkaline solutions and harmonizes with the evidence of wall-rock alteration. Ferberite was apparently precipitated in slightly acid solutions, but galena, tetrahedrite, chalcopyrite, sphalerite, and miargerite are later and were presumably precipitated in alkaline solutions. Gold telluride is still later in the normal sequence and also is believed precipitated in alkaline solutions. Field evidence suggests that the source rock was a biotite latite heavily charged with volatiles and represented by dikes of latite and latitic explosion breccia. It is suggested that emanations from the underlying magma rose through the hot porous explosion breccia with little change in character, but soon dropped their load above the upward termination of the breccia in the overlying fissures where they reacted with the wall rock and became neutralized and finally alkaline through the acquisition of bases from the quartz monzonite that makes up the country rock of the deposit.

Idaho.—The Ima mine on Patterson Creek about 11 miles east of May was the only producer in Idaho in 1939. The mill treated 38,778 short tons of ore containing 0.6 percent WO_3, from which 226

[7] Tucker, W. B., and Sampson, R. J., Mineral Resources of Inyo County: California Jour. Mines and Geology, Division of Mines, Dept. of Natural Resources, State of California, vol. 34, No. 4, October 1938, pp. 462–467.

[8] Lovering, T. S., The Genesis of the Ferberite and Gold Telluride Ores of Boulder County, Colo.: Soc. Econ. Geol. (abs. of paper to be presented at the 20th annual meeting), vol. 34, No. 8, December 1939, p. 939.

tons of huebnerite concentrates averaging 66 percent WO_3 were recovered. The mill also makes a sulfide concentrate carrying silver, copper, lead, and zinc. The ore minerals are huebnerite, tetrahedrite, scheelite, galena, sphalerite, chalcopyrite, and molybdenite. New flotation equipment, slime tables, screen classification, and all auxiliaries were being installed late in 1939. A new 700-foot haulage level was completed and put into operation during 1939. Mining is accomplished by a filled square-set system of stoping, and the tungsten values are recovered from the ore by gravity methods following by roasting to remove the sulfur and then by magnetic separators.[9]

Montana.—The Jardine Mining Co., the only producer in Montana in 1939, shipped 20 tons of scheelite concentrates averaging 68.2 percent WO_3 from operations at the Jardine mine in Park County. The principal output is gold, and tungsten is produced entirely as a byproduct.

Nevada.—Nevada retained its position as the principal domestic tungsten producer in 1939; shipments of concentrates (virtually all scheelite) totaled 2,091 short tons reduced to an equivalent 60 percent WO_3. A large part of the output was scheelite concentrates from the mines of the Nevada-Massachusetts Co. near Mill City. The ore comes from three mines, the Stank, the Humboldt, and the Sutton. The Stank shaft has been sunk 1,325 feet, and the lower level has been prepared for mining. It was reported that the grade of ore is about the same as it had been on the upper levels. At the Humboldt mine the shaft is being sunk from the 1,225- to the 1,350-foot level. The Sutton mine is a new development and is down only about 150 feet. New discoveries of ore have been reported at the Sutton and Humboldt mines. The average grade of ore at Mill City is 1 percent WO_3, while the concentrates average 75 percent WO_3.[10] There was no production from company operations at Mina in Mineral County in 1939. The Tungsten Metals Corporation, which enlarged its milling capacity near Ely, White Pine County, produced from three mines and was the largest of several other small producers that contributed to the Nevada total in 1939.

Utah.—Shipments from Utah in 1939 were only 3 short tons of scheelite concentrates averaging 58 percent WO_3 from Tooele and Box Elder Counties.

Washington.—Virtually all shipments of tungsten concentrates from Washington in 1939 came from the Germania mine near Fruitland, Stevens County. Shipments from the Germania mine comprised 56 short tons of wolframite concentrates averaging 65 percent WO_3 and 165 tons of wolframite jig concentrates averaging 14 percent WO_3. The concentrates came from surface workings and reworking of tailings. The only other shipment from Washington was 1 ton of scheelite concentrates, also from Stevens County.

FOREIGN TRADE

Domestic supplies of tungsten are supplemented by imports, principally of concentrates but also in other forms. Imports of ore and concentrates for consumption (tungsten content) increased from 162,744 pounds in 1938 to 1,485,157 in 1939. China supplied 61 per-

9 Barton, W. P., and Arentz, S. S., Jr., Mining and Milling Tungsten at the Ima Mine: Min. Cong. Jour., vol. 25, No. 8, August 1939, pp. 16–19.
10 Mining World, America's Largest Tungsten Mine: Vol. 1, No. 4, October 1939, pp. 2–6.

cent of the 1939 total. The distribution of imports for consumption is shown in the following table for 1938 and 1939.

Tungsten ore and concentrates imported for consumption in the United States, 1938–39, by countries

Country	1938			1939		
	Gross weight (pounds)	Tungsten content (pounds)	Value	Gross weight (pounds)	Tungsten content (pounds)	Value
Argentina				141,872	76,524	$50,324
Australia				102,216	56,639	42,196
Bolivia	2,286	705	$961	180,019	96,164	77,342
British Malaya	108,765	67,460	58,346	200,843	123,682	113,063
Burma				24,576	12,878	8,683
China	138,380	69,986	42,350	1,656,307	899,806	587,489
Ecuador				37,440	21,326	7,500
French Indochina				5,630	2,876	2,832
Mexico	27,585	1,360	1,051	306,907	146,637	89,352
Peru				87,662	48,625	19,190
Union of South Africa	45,069	23,233	35,985			
	322,085	162,744	138,693	2,743,472	1,485,157	997,971

General imports of tungsten ore or concentrates, which represent the movement of ore to this country, amounted to 5,894,995 pounds containing 3,111,629 pounds of tungsten in 1939. Of the total general imports of tungsten China supplied 45 percent, Bolivia 24 percent, Australia 8 percent, Argentina 8 percent, Mexico 5 percent, Peru 3 percent, Burma 3 percent, Portugal 2 percent, and British Malaya and Chile 1 percent each.

In addition 589,828 pounds of tungsten in concentrates were imported for smelting, refining, and export in 1939 compared with 828,660 pounds in 1938. There is no record of any exports of tungsten ore or concentrates from this country.

Imports of tungsten and tungsten carbide, and of tungstic acid and other compounds of tungsten, increased in 1939.

Tungsten in metal and compounds imported for consumption in the United States, 1938–39, by countries

Country	Tungsten (metal) and tungsten carbide [1]				Tungstic acid and other compounds of tungsten			
	1938		1939		1938		1939	
	Tungsten content (pounds)	Value	Tungsten content (pounds)	Value	Tungsten content (pounds)	Value	Tungsten content (pounds)	Value
Austria	[2] 220	[2] $701						
France					28	$523		
Germany	[2] 1,565	[2] 6,822	251	$1,430	169	680	438	$2,002
Hungary					44	403	262	2,422
United Kingdom	21,029	23,994	39,247	41,440				
	22,814	31,517	39,498	42,870	241	1,606	700	4,424

[1] Includes combinations containing either metal or carbide.
[2] Austria included with Germany beginning May 6.

USES

The principal quantitative use of tungsten is in the manufacture of tools for metal cutting. For this purpose it is employed either in certain types of steel known as high-speed tool steels (the more common one containing 18 percent tungsten, 4 percent chromium, and 1 percent vanadium) or in cemented carbides, either alone or with other elements. Tungsten finds important application in electric-light and radio-tube filaments, but the quantities used are not large. Tungsten salts are used in the chemical, pigment, and tanning industries.

WORLD PRODUCTION

World production apparently was at a slightly higher level in 1939 than in 1938, which was somewhat below the record figure established in 1937. Although complete figures are not available, preliminary data indicate that world production in 1939 may have reached 34,000 metric tons.

World production of tungsten ores, 1935–39, by countries, in metric tons of concentrates containing 60 percent WO_3

[Compiled by M. T. Latus]

Country [1]	1935	1936	1937	1938	1939
North America:					
Mexico	54	57	33	76	(2)
United States (shipments)	2,173	2,370	3,175	2,761	3,889
	2,227	2,427	3,208	2,837	(2)
South America:					
Argentina	579	702	866	1,195	(2)
Bolivia (exports)	1,423	1,741	1,802	2,530	3,334
Brazil (exports)			6	2	7
Chile	7	3	5	(2)	(2)
Peru	57	92	30	170	(2)
	2,066	2,538	2,709	(2)	(2)
Europe:					
France				22	(2)
Great Britain (Cornwall)	256	221	148	258	(2)
Italy			3	4	(2)
Norway			3	19	(2)
Portugal	1,140	1,414	2,069	2,810	3,851
Sweden		62	127	180	(2)
	1,396	1,697	2,350	3,293	(2)
Asia:					
Burma	4,527	5,382	5,924	6,334	(2)
China (exports)	7,998	7,638	17,895	13,387	11,580
Chosen	949	1,849	2,058	(2)	(2)
India, British			15	12	(2)
Indochina (Tonkin)	417	503	648	545	(2)
Japan	96	61	(2)	(2)	(2)
Malay States:					
Federated Malay States	1,720	1,712	955	667	297
Unfederated Malay States	315	325	279	333	(2)
Netherland India	1	1	(3)	(3)	(2)
Thailand	82	82	221	251	(2)
	16,105	17,553	[4] 27,995	(2)	(2)

[1] In addition to countries listed, tungsten ore is produced in Spain and the U. S. S. R., but no data of production are available for the period under discussion.
[2] Data not available.
[3] Less than 1 ton.
[4] Exclusive of Japan.

World production of tungsten ores, 1935–39, by countries, in metric tons of concentrates containing 60 percent WO_3—Continued

Country	1935	1936	1937	1938	1939
Africa:					
Egypt			193	(2)	(2)
Morocco, French				7	(2)
Nigeria	16	11	9	49	(2)
Southern Rhodesia	26	88	275	329	270
South-West Africa	53	46	41	48	49
Tanganyika Territory	6	2	2	5	(2)
Uganda			2	2	(2)
Union of South Africa	11	30	40	127	100
	112	177	562	(2)	(2)
Oceania:					
Australia:					
New South Wales	63	18	66	113	(2)
Northern Territory	126	141	345	515	354
Queensland	27	22	110	167	33
Tasmania	275	245	345	390	472
New Zealand	61	49	28	54	(2)
	552	475	894	1,239	(2)
	22,458	24,867	[4] 37,718	(2)	(2)

[2] Data not available. [4] Exclusive of Japan.

Argentina.—Argentina is the second-largest producer of tungsten in South America. All tungsten produced is exported, and shipments abroad have trebled since 1934. Since September 1939 exports have moved to the United States; previously the ore was shipped to European countries. Output comes principally from the Provinces of San Luis and Cordoba; much smaller amounts are produced in San Juan and Catamarca. The Sominar, Sociedad Minera Argentina, S. A., is the largest producer, supplying about 50 percent of the Argentine total. It has recently completed a modern concentrating plant that will increase output.

Bolivia.—Bolivia is the largest tungsten producer in South America. The tungsten mines are found throughout the tin belt, usually in separate deposits and rarely associated with tin ores. The principal mines are in the Departments of La Paz and Oruro, with smaller producers in the Departments of Cochabamba and Potosí. Transportation is the foremost problem, and there are still inaccessible areas with important ore deposits that will not be productive until roads or railroads are built. With enough capital for mine and mill-plant installations, together with competent technical advice, it would be possible to increase present Bolivian output substantially. A report giving information on the ore deposits, descriptions of mines, cost, and other data will be found in Mineral Trade Notes.[11]

The new mining decree of June 7, 1939, provides that—

> The State constitutes itself as the only "reseatador" or middleman buyer of minerals of all kinds, the respective operations to be carried out by the Banco Minero de Bolivia. The mineral buyers operating in the country shall liquidate their operations within 120 days and shall place the minerals which they fail to liquidate and retain in their warehouses at the disposal of the Banco Minero.

This portion of the new decree does not affect the large mining companies who produce tungsten concentrates and export their product direct to foreign smelters. Much of the export in recent years has gone to Belgium for transshipment to Germany.

Burma.—Burma is the most important producer of tungsten in the British Empire. Output comes principally from the Hermyingyi

[11] Bureau of Mines Mineral Trade Notes, Tungsten, Bolivia: Vol. 9, No. 3, September 20, 1939, pp. 13–24.

mine near Tavoy and the Mawchi mine in the southern part of Karenni State. Exports of tin-tungsten concentrates during 1939 were 12,212 metric tons compared with 10,602 in 1938. Exports were prohibited without license after October 9, 1939; licenses are granted only to the United Kingdom and France.

The mineralization at Mawchi has been described by Dunn,[12] while the mining and milling operations have been described by Denyer and Heath.[13] Dunn [14] has also described the mineralization at the Hermyingyi mine.

China.—The Sino-Japanese hostilities continued to handicap the movement of tungsten ore from China, the largest world source. Exports of tungsten concentrates were lower in 1939 (11,580 metric tons) than in 1938 (13,387 tons), and a larger part of the movement passed through Hong Kong, owing partly to the establishment in Hong Kong of the Foreign Trade Office of the Chinese National Resources Commission, which has general charge of the sales of minerals in behalf of the Chinese Government. An exclusive sales agency was granted in 1939 to the Pekin Syndicate, Ltd., a British concern, for the sales rights on tungsten produced in Kiangsi, Hunan, and Kwantung. This agency has little or no control over export prices or production, which are handled by the commission. Sales from other Chinese sources also are handled by the commission. The reported wolframite monopoly in South China, granted by the Japanese army to three Japanese firms, apparently was ineffective, as the army does not control sources of production.

The tungsten-producing area in the hands of the Japanese is small and not yet pacified. Producing mines, particularly in Kwangtung, were being worked extensively, and with the routes to Shanghai and Canton under Japanese control ores were reaching Hong Kong and other export points by devious routes through parts of South China not in Japanese hands, as well as through Indochina or Burma.

Exports of tungsten concentrates from Hong Kong during 1939 were 7,741 metric tons, of which 478 tons went directly to the United States. Apparently sales to Germany stopped with the outbreak of the war, while shipments were being made to the U. S. S. R. under the Sino-Soviet barter agreement.

Cuba.—Activities were reported in 1939 aimed at production of commercial quantities of tungsten ore on the Isle of Pines by the Pan American Tungsten Corporation. No shipments were made in 1939, but a mill for the recovery of wolframite concentrates was erected which is expected to be in production early in 1940.

India, British.—There is little or no production of tungsten in India. Output previously credited to India came from Burma, which was split from India as a separate State as of April 1, 1937.

Malay States.—The Kramat Pulai mine near Ipoh is the principal producer in the Malay States. The ore body is composed almost entirely of scheelite and fluorite. The scheelite is of good quality, but the reserves are limited, which explains declining production in recent years. Exports from the Malay States in 1939 were 661 metric tons, of which 220 tons were scheelite and 441 tons wolframite.

[12] Dunn, J. A., Tin-tungsten Mineralization at Mawchi, Karenni States, Burma: Records, Geol. Survey India, vol. 73, part 2, 1938, pp. 209–237.

[13] Denyer, J. E., and Heath, K. C. G., Mining and Milling Tin-tungsten Ore at the Mawchi Mine, Burma: Bull. Inst. Min. and Met., Bull. 426, March 7, 1940, pp. 1–30.

[14] Dunn, J. A., Tin-tungsten Mineralization at Hermyingyi, Tavoy District, Burma: Records, Geol. Survey India, vol. 73, part 2, 1938, pp. 238–246.

Exports were prohibited without permit to all ports and destinations abroad other than British.

Portugal.—Output in Portugal, the largest European producer, in 1939 increased 37 percent over 1938. The Beralt Tin & Wolfram, Ltd., with properties at Panasqueira in the Province of Beira Baixa, district of Castello Branco, was the largest producer. Exports were 3,142 metric tons in 1939 compared with 2,450 in 1938 and have been subject to license since October 1939.

Southern Rhodesia.—The African Continent produces little tungsten; the principal output comes from Southern Rhodesia, where production decreased to 270 metric tons in 1939 from 329 metric tons in 1938. Exports were prohibited without license after September 4, 1939.

VANADIUM

Vanadium output in 1939 exceeded the high level reached in 1937 and 1938. The world supply comes from a limited number of operations, principally in four countries, of which Peru and the United States are now the most important. Production in Peru, all from the Minasragra mine, was 23 percent higher in 1939 than in 1938. The revival of the domestic producing industry continued, as shipments from the mines also recorded a 23-percent increase. New deposits were being explored and developed during the year, and it was reported that activities were being revived in the Rifle district, Garfield County, Colo. Production in Northern Rhodesia was increased slightly in 1939, while that in South-West Africa dropped 8 percent. World sources of vanadium may be supplemented in future by the recovery of vanadium from the treatment of pig iron made from vanadium-bearing iron ores at ferrous smelters in Germany. The process involves the treatment of converter slags, which, it is claimed, may run as high as 10 percent V. Enough vanadium to supply one-third of Italy's annual requirements is recovered from the caustic soda solution employed in the Bayer process of refining bauxite.[15] Vanadium is also recovered from the boiler and stack soot of ships burning Venezuelan and Mexican oil for fuel. Other byproduct sources are being investigated for recovery of vanadium.

Despite the increase in domestic production, imports for consumption into this country increased. Purely nominal quotations for vanadium ore were unchanged throughout 1939 at 27½ cents per pound of contained V_2O_5.

Salient statistics of the vanadium industry in the United States, 1938–39

	1938		1939	
	Quantity	Value	Quantity	Value
Shipments:				
Carnotite ores [1] ....short tons..	4,290	$158,779	6,256	$174,660
Vanadium contained ....pounds..	173,859	(2)	206,509	(2)
Vanadium and complex ores ....short tons..	[3] 247,397	[4] 740,000	273,098	[4] 879,000
Vanadium contained ....pounds..	1,439,296	(2)	1,777,559	(2)
Imports:				
Vanadium ores ....short tons..	9,981	891,475	15,694	991,511
Vanadium contained ....pounds..	1,384,320	....	2,132,548	....

[1] Also contained radium and uranium as follows: Radium—1938, 7,821 milligrams; 1939, 8,964 milligrams. Uranium—1938, 51,705 pounds; 1939, 59,269 pounds.
[2] Figures not available. [3] Revised figures. [4] Estimated by Bureau of Mines.

[15] Light Metals, Light Alloys and the Light-metal Industries in Italy: Vol. 3, No. 27, April 1940, p. 103.

DOMESTIC PRODUCTION

United States production (as measured by shipments) of vanadium contained in all types of ores from which it was recovered totaled 1,984,068 pounds in 1939 compared with 1,613,155 in 1938. Output came from Arizona, Colorado, and Utah.

Arizona.—Vanadium was produced from operations of the Molybdenum Gold Mining Co. and the Mammoth-St. Anthony, Ltd., near Mammoth, where complex ores containing recoverable values in gold, silver, lead, molybdenum, and vanadium are treated in the flotation mill operated by the latter company. The mines of the Molybdenum Gold Mining Co. were acquired by the Mammoth-St. Anthony, Ltd., early in the year and were closed on May 15, 1939. New facilities were installed at the Mammoth mine during 1939.

Colorado.—The production of vanadium in Colorado in 1939 amounted to 1,755,489 pounds in vanadium and carnotite ores. The roasting and leaching plant of the United States Vanadium Corporation, the largest producer, at Uravan, Montrose County, was run throughout the year, treating an average of 240 tons of ore daily. The ore runs about 2 percent V_2O_5; and the vanadium is recovered as V_2O_5 by roasting the ore with salt, leaching the sodium vanadate with water, and precipitating the V_2O_5 with acid. The precipitate is then sintered to a product containing about 88 percent V_2O_5. The company produces from its own properties, the coal and salt used in treating the ore and in addition to treating its own ores purchases small quantities from minor producers in the district.

The new mill erected near Gateway, Mesa County, by the Gateway Alloys, Inc., was not put into operation until the latter part of October 1939.

Utah.—Vanadium-bearing ores were produced from a number of rather widely scattered places in Utah. Shipments, which were higher than in 1938, totaled 189,902 pounds of contained V_2O_5 in 1939 and originated in Grand and San Juan Counties in the southeastern part of the State. The largest shipment came from the Shumway property near Blanding, San Juan County, and amounted to 1,400 short tons of ore containing 2.45 percent V_2O_5. The Harbro mines near Cisco, Grand County, made substantial shipments of concentrates containing carnotite.

FOREIGN TRADE

Imports of vanadium ores in 1939, all from Peru, totaled 15,694 short tons containing 3,808,122 pounds of V_2O_5 (2,132,548 pounds of V). Data on exports are not given by the Bureau of Foreign and Domestic Commerce. No exports were reported by producers in 1939.

USES

The principal use of vanadium is in the manufacture of special alloy steels and irons. A minor quantity is employed as a catalyst in the manufacture of sulfuric acid in the form of ammonia metavanadate and in the nonferrous, glass, ceramic, and color industries. The importance of vanadium as one of the principal alloying elements of ferrous metallurgy today is as great or greater than 10 years ago.

There have been numerous changes in its application during the last decade, both in tool and in constructional steels.[16]

WORLD PRODUCTION

World output in 1939 exceeded that in 1938 owing to larger production from most of the principal sources. Output in Peru comes from the Minasragra mine of the Vanadium Corporation of America. The richer ore from the mine goes to the sorting floor, where a shipping product containing about 11 percent V_2O_5 is sorted out, while the low-grade ore and discarded material from the sorting floor goes to the calcining plant, where it is first crushed to under a quarter inch and then burned in a furnace to eliminate the carbonaceous matter, leaving an ash with about 22 percent V_2O_5. This product is then sacked and shipped to Bridgeville, Pa., for reduction to ferrovanadium in the electric furnace.[17] Exports from Peru in 1939 comprised 11,601 metric tons of ore and 2,726 tons of concentrates, all of which moved to the United States. Three mines—the Abenab and Baltika of the Southwest Africa Co., Ltd., and the Nageib of the Otavi Minen und Eisenbahn Gesellschaft—contributed to the total in the Territory of Southwest Africa. All the ore, which runs about 19.75 percent V_2O_5, is exported to England and Europe. Production in Northern Rhodesia was fused vanadic oxide from operations of the Rhodesian Broken Hill Development Co., Ltd., which also produces zinc. The main source of supply of vanadium at present is surface dumps, which will soon be exhausted. Experiments are being conducted on the recovery of vanadium from the ores by selective flotation in order that production of vanadium can be continued.

World production of vanadium in ores and concentrates, 1935–39, in metric tons

[Compiled by R. B. Miller]

Country	1935	1936	1937	1938	1939
Mexico			45	180	
Northern Rhodesia	173	204	235	374	386
Peru	67	161	583	826	1,016
South-West Africa	176	547	591	557	514
United States (shipments)	(1)	63	493	732	900

1 Bureau of Mines not at liberty to publish figure.

16 Strauss, Jerome, Vanadium: Metals and Alloys, vol. 10, No. 10, October 1939, p. A 58.
17 Wright, C. W., work cited in footnote 5, pp. 36–38.

BAUXITE AND ALUMINUM

By HERBERT A. FRANKE AND M. E. TROUGHT [1]

SUMMARY OUTLINE

Production of aluminum in the United States in 1939 shattered all previous records, and consumption equaled the peak reached in 1937. Exports and total sales of metal by the Aluminum Co. of America were the largest in history. These achievements were abnormal in that the demand for aluminum was enhanced by preparations for national defense and the wars abroad. The aviation industry consumed twice the quantity of aluminum it did in 1937, the previous peak. Another noteworthy year for the metal is predicted for 1940 as war demands continue and uses for aluminum products widen. Domestic aluminum production in 1939 was 14 percent above that for 1938 and exceeded the previous high attained in 1937 by 12 percent. Primary producers withdrew 56 percent of the metal added to stocks in 1938, and apparent domestic consumption increased 87 percent. Imports of crude and semicrude aluminum rose 62 percent and exports were almost 6 times those in 1938 (3 times the previous record year, 1918). The quoted price of primary aluminum remained unchanged throughout 1939, but on March 25, 1940, the price was reduced from 20 to 19 cents per pound.

Domestic shipments and imports of bauxite likewise advanced in 1939. The larger demand came chiefly from the aluminum industry, but the abrasive, chemical, and other industries also increased their use of bauxite during the year. The greater production (shipments) of bauxite from Arkansas mines sufficed to increase the total for the United States 21 percent over that in 1938. Imports of bauxite exceeded those of any other year, increasing 14 percent over those in 1938. Exports (dried-ore basis) declined 4 percent. Apparent consumption increased 19 percent over that of 1938 and 7 percent over that of 1937, the previous peak. The domestic output was equivalent

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

to 45 percent and net imports to 55 percent of total consumption. The quoted range of prices for bauxite was slightly less than that in 1938.

Salient statistics of the bauxite and aluminum industries in the United States, 1937–39

	1937	1938	1939
Bauxite:			
Production (mine shipments) [1] ... long tons	[2] 425,076	[2] 310,916	375,307
Value [3]	$2,444,686	$1,812,545	$2,166,236
Imports [3] ... long tons	507,423	455,693	520,179
Exports (including concentrates) [3] ... do	123,191	57,726	51,635
World production ... do	3,700,000	3,801,000	[4] 4,300,000
Aluminum:			
Primary production ... short tons	146,341	143,441	163,545
Value	$55,609,000	$56,659,000	$64,600,000
Quoted price per pound [5] ... cents	20.1	20.0	20.0
Secondary production ... short tons	62,560	38,800	(6)
Imports	$8,177,600	$3,379,018	$4,766,260
Exports	$2,943,214	$5,484,047	$23,630,885
World production ... short tons	530,800	638,000	[4] 713,600

[1] Dried bauxite equivalent. [2] Revised figures. [3] As shipped. [4] Estimated.
[5] New York: 99 percent plus, pure virgin ingot, according to Metal Statistics 1940, published by American Metal Market. [6] Figures not yet available.

Although official data on world bauxite and aluminum production and trade are more incomplete than heretofore on account of hostilities in Europe and Asia, new high records are believed to have been established again in 1939. Estimated world output of aluminum increased 12 percent over 1938. The United States probably remained second to Germany as the largest producer of aluminum. Of the total world output, it is estimated that Germany contributed 28 percent, the United States 23 percent, Canada 12 percent, the U. S. S. R. 8 percent, and France 8 percent. The world race for supremacy in the air explained the outstanding demand for metal as consumption broke all previous records. Larger quantities of aluminum also were used in other transportation industries, in electric transmission lines, in many other established fields, and in new industrial uses developed by the industry's active research laboratories.

World bauxite output kept pace with aluminum production in 1939, increasing an estimated 14 percent. France's large output was followed by that of Hungary, Surinam, British Guiana, Italy, the United States, and Yugoslavia. The United States ranked sixth in importance and produced about 9 percent of the total.

BAUXITE

PRODUCTION

Bauxite production (mine shipments) in the United States increased 21 percent in quantity and 20 percent in value in 1939 compared with 1938 (fig. 1). Arkansas mines were responsible for all the increase as shipments from Alabama and Georgia decreased. Of the total domestic output, Saline and Pulaski Counties, Ark., contributed 96 percent, of which an estimated 60 percent came from underground mines and 40 percent from open-pit mines. Barbour and Henry Counties, Ala., and Sumter County, Ga., supplied the remaining 4 percent of the output, chiefly from open-pit operations.

Bauxite shipped from mines in the United States, 1935–39, by States

State and year	Long tons					Value f.o.b. mine, as shipped
	Crude	Dried	Calcined	Total		
				As shipped	Dried bauxite equivalent	
Alabama and Georgia:						
1935	100	14,021		14,121	[1] 14,114	$91,293
1936	91	16,971		17,062	[1] 17,056	109,327
1937	3,410	14,627		18,037	[1] 17,614	121,825
1938	5,532	[2] 12,542		18,074	[1] 17,253	132,882
1939	2,727	11,318		14,045	13,617	91,282
Arkansas:						
1935	21,594	164,349	33,848	219,791	[1] 231,331	1,465,302
1936	49,243	268,900	36,800	354,943	[1] 363,255	2,089,196
1937	98,340	257,023	46,832	402,195	[1] 407,462	2,322,861
1938	72,097	194,945	[2] 26,238	293,280	[1] 293,663	1,679,663
1939	99,215	225,355	[3] 36,686	361,256	361,690	2,074,954
Total United States:						
1935	21,694	178,370	33,848	233,912	[1] 245,445	1,556,595
1936	49,334	285,871	36,800	372,005	[1] 380,311	2,198,523
1937	101,750	271,650	46,832	420,232	[1] 425,076	2,444,686
1938	77,629	[2] 207,487	[2] 26,238	311,354	[1] 310,916	1,812,545
1939	101,942	236,673	[3] 36,686	375,301	375,307	2,166,236

[1] Revised figures. [2] Includes small quantity of activated. [3] Includes sintered.

The quantities in the foregoing and succeeding tables under the heading "As shipped" show the actual tonnage of material moved. Bauxite is shipped in several forms—crude, dried, activated, calcined, and sintered—in which the moisture content varies considerably; therefore all shipments must be converted to a common unit to permit correct interpretation of the statistical trend and more accurate comparisons of domestic production and shipments with imports and foreign production. This is accomplished by reducing all shipments to a "dried-bauxite equivalent," also listed in the tables.

Mine shipments which are used throughout this report to indicate production, formerly were classified according to use. These data, however, did not picture the true consumption in any particular year accurately, because of the large fluctuations in inventories held by some consumers who operate large processing plants near the mines to convert crude ore received from the mines into more concentrated products for delivery direct to places of ultimate consumption. The table showing shipments by uses has been modified this year to include bauxite shipped direct from the mines to ultimate consumers and that shipped from intermediate processing plants to final consumers. The variations in stocks held by processing plants thus have been eliminated, thereby giving a more accurate annual statement of consumption of domestic bauxite.

The dried bauxite shipped from Arkansas mines usually contains 55 to 60 percent Al_2O_3, 4 to 6 percent SiO_2, 2 to 4 percent Fe_2O_3, 2.5 to 3 percent TiO_2, and 27 to 30 percent combined moisture. The crude or undried ore normally contains 12 to 18 percent free moisture. The calcined bauxite contains about 80 to 84 percent Al_2O_3, 4 to 6 percent SiO_2, 5 to 8 percent Fe_2O_3, and 3.5 to 5 percent TiO_2. Ore shipped from Alabama and Georgia usually contains slightly less alumina and iron oxide and more silica than that from Arkansas. Stocks of bauxite on hand at all mines and processing plants on December 31, 1939, totaled 149,377 long tons of crude ore and 9,367 tons of processed ore compared with 99,800 tons of crude ore and 7,880 tons of processed ore on December 31, 1938.

Except for the Pulaski Bauxite Co., all bauxite producers and processing plants active in the United States in 1938 (Minerals Yearbook, 1939, p. 635) again operated mines and plants in 1939.

In Arkansas the American Cyanamid & Chemical Corporation developed the Heckler property, adjoining the Rauch mine, Pulaski County, and the Ozark No. 24 property, a few miles northeast of the Ozark No. 28 mine, Saline County. A bauxite-sintering plant was placed in operation at the Ozark No. 28 mine during the summer of 1939. Its equipment includes a crusher, screens, a standard Dwight-

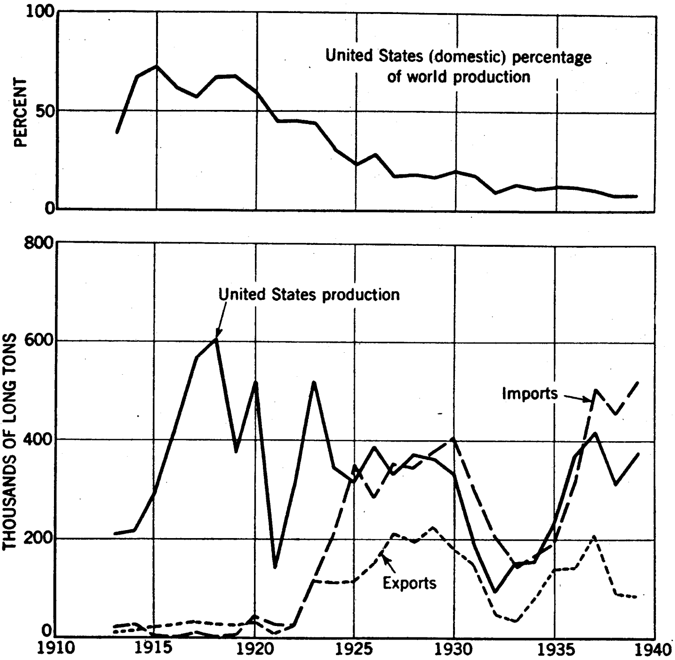

FIGURE 1.—Trends in production, imports, and exports of bauxite, 1913–39.

Lloyd sinter machine, and storage silos. The product is comparable in analysis and suitable for the same purposes as calcined bauxite. In the spring of 1939 the Porocel Corporation, owned jointly by the company and the Attapulgus Clay Co., began to produce activated bauxite at Berger, Ark., using a new dry process.

In 1939 the Arkansas Bauxite Corporation operated its McDonald mine and developed its Townsend property, both in Saline County. Operations ceased at the company Standard mine in April 1939 and at the Bizzell mine early in 1938. The company employs a special wet process at its activated bauxite plant at West Bauxite, which is owned jointly with Max B. Miller & Co., Inc. The Consolidated Chemical Industries, Inc., temporarily abandoned its Alexander No. 1 mine (Rogers Tract) near Bryant, Ark., in the fall of 1938 and began to produce bauxite from its No. 2 mine (Gates lease) near Mount

Olive early in 1939. The Crouch Mining Co., Inc., continued to operate the England mine, Pulaski County, in 1939, but planned to begin production in 1940 at the Young property, Saline County. The Dixie Bauxite Co., Inc., and the Republic Mining & Manufacturing Co. (the largest producer) produced ore in 1939 from the same properties operated in 1938. In Arkansas the Republic Co. mined bauxite from open-pit as well as from underground operations, while all other companies produced only from underground.

In Alabama, the Republic Co. continued to produce bauxite from various pocket deposits in the Eufaula district, Barbour and Henry Counties. The Floridin Co. also mined ore in this district, shipping it undried to its activated-bauxite plant at Quincy, Fla. In Georgia the American Cyanamid & Chemical Corporation shipped ore which had been mined in 1936 and 1937 from its drying plant, and Benjamin Easterlin installed a rotary drying kiln.

CONSUMPTION

Apparent consumption figures shown in the following tables differ from those published in previous reports of this series, inasmuch as they are based on shipments from mines and intermediate processing plants to ultimate consumers rather than shipments from mines irrespective of destination. Net imports (imports minus exports) comprised 55 percent of the apparent bauxite consumption in 1939 compared with 56 percent in 1938 and only 41 percent in 1937. (See fig. 1.) Canada takes most of the bauxite and alumina exported and uses a substantial quantity of it to manufacture crude abrasives, which are returned to the United States for final manufacture and consumption.

Data on production, imports, exports, and apparent consumption of bauxite in the United States from 1910 to 1938 were published in Minerals Yearbook, 1939, p. 636. These historical figures, however, as explained in the preceding paragraph, are not exactly comparable with those in the following table.

Shipments, imports, exports, and apparent consumption of bauxite in the United States, 1935–39, dried-bauxite equivalent, in long tons

Year	Domestic shipments to industry [1]			Imports	Exports	Apparent consumption
	From Arkansas	From Alabama and Georgia	Total			
1935	253,771	14,114	267,885	199,959	141,060	[2] 326,784
1936	352,919	17,056	369,975	322,790	144,445	[2] 548,320
1937	415,050	17,614	432,664	507,423	210,657	[2] 729,430
1938	275,078	17,253	292,331	455,693	90,341	[2] 657,683
1939	335,647	13,689	349,336	520,179	86,540	782,975

[1] From mines and processing plants. [2] Revised figures.

BY INDUSTRIES

Shipments of domestic bauxite to ultimate consuming industries from mines and processing plants are listed in the following table according to the condition actually shipped and the dried-bauxite equivalent. Detailed information is not available on the consumption, by industries, of bauxite imported. Unless otherwise noted, all mention of production and consumption in the discussion that follows is in terms of dried bauxite.

Bauxite shipped from mines and processing plants in the United States, 1935-39, by consuming industries, in long tons

Industry	1935		1936		1937		1938		1939	
	As shipped [1]	Dried-bauxite equivalent	As shipped	Dried-bauxite equivalent	As shipped [1]	Dried-bauxite equivalent	As shipped [1]	Dried-bauxite equivalent	As shipped [1]	Dried-bauxite equivalent
Aluminum	112,154	112,154	194,764	194,764	209,476	209,476	144,208	144,208	161,008	161,008
Chemical	66,316	66,309	74,512	74,741	78,261	79,150	63,940	63,350	81,444	79,536
Abrasive [2]	51,566	86,889	63,654	98,069	88,685	135,849	48,999	74,614	55,346	82,326
Oil refining, refractory, [2] and other	1,758	2,533	1,680	2,401	7,107	8,189	10,332	10,159	14,238	26,466
Total quantity	231,794	267,885	334,610	369,975	383,529	432,664	267,479	292,331	312,036	349,336
Total value	$1,715,927		$2,282,301		$2,722,403		$1,823,307		$2,448,038	

[1] Includes crude, dried, and calcined, 1935-39: also activated, 1938-39, and sintered, 1939.
[2] Small quantity of bauxite shipped to makers of refractories probably included under "Abrasive."

Principal bauxite consumers [1] in the United States in 1939

Chemical manufacturers:
- Activated Alum Corporation, Baltimore, Md.
- Aluminum Ore Co., subsidiary of Aluminum Co. of America, Gulf Building, Pittsburgh, Pa.
- American Cyanamid & Chemical Corporation, 30 Rockefeller Plaza, New York, N. Y.
- American Phosphate & Mfg. Co., Sand Springs, Okla.
- Blockson Chemical Co., Joliet, Ill.
- Brown Co., Berlin, N. H.
- Brush Beryllium Co., Lorain, Ohio.
- Calco Chemical Division, American Cyanamid Co., Bound Brook, N. J.
- Consolidated Chemical Industries, Inc., Petroleum Building, Houston, Tex.
- Charles Cooper & Co., Newark, N. J.
- Davison Chemical Corporation, Rouse Building, Baltimore, Md.
- Diamond Alkali Co., Koppers Building, Pittsburgh, Pa.
- E. I. du Pont de Nemours & Co., Incorporated, 1007 Market Street, Wilmington, Del.
- Gaylord Container Corporation, Bogalusa, La.
- General Chemical Co., 40 Rector Street, New York, N. Y.
- Gulf Oil Corporation, Gulf Building, Pittsburgh, Pa.
- Hercules Powder Co., Wilmington, Del.
- Hilton-Davis Chemical Co., Langdon Farm Road & Pa. R. R., P. O. Box 8, Pleasant Ridge Station, Cincinnati, Ohio.
- Hooker Electrochemical Co., Niagara Falls, N. Y.
- William F. Jobbins, Incorporated, Aurora, Ill.
- Kalunite, Incorporated, 81 Navajo Street, Salt Lake City, Utah.
- Kimberly-Clark Corporation, Neenah, Wis.
- Charles Lennig & Co., Incorporated, 222 West Washington Square, Philadelphia, Pa.
- Mallinckrodt Chemical Works, St. Louis, Mo.
- Mineral Products Corporation, Marysvale, Utah.
- Monsanto Chemical Co., Everett, Mass.
- National Aluminate Corporation, 6216 West 66th Place, Chicago, Ill.
- Natural Products Refining Co., Jersey City, N. J.
- Niagara Chlorine Products Corporation, Box 96, Lockport, N. Y.
- Ohio Apex, Inc., Nitro, W. Va.
- Pennsylvania Salt Manufacturing Co., Widener Building, Philadelphia, Pa.
- Southwest Chemical Corporation, Little Rock, Ark.

[1] Some of the companies may consume aluminous raw materials other than bauxite. The list excludes oil-refining companies (chiefly in Pennsylvania and Mid-Continent fields), municipal water-treatment plants, and steel concerns that use bauxite.

Stauffer Chemical Co., 624 California Street, San Francisco, Calif.
S. D. Warren Co., Cumberland Mills, Maine.
Westvaco Chlorine Products, Incorporated, Carteret, N. J.

Other manufacturers:

Abrasive Co., Philadelphia, Pa.
Atlas Lumnite Cement Co., Chrysler Building, New York, N. Y.
The Carborundum Co., Niagara Falls, N. Y.
The Exolon Co., Blasdell, N. Y.
Federal Abrasives Co., Anniston, Ala.
General Abrasive Co., Inc., Niagara Falls, N. Y.
General Refractories Co., Philadelphia, Pa.
Harbison-Walker Refractories Co., Pittsburgh, Pa.
Laclede-Christy Clay Products Co., St. Louis, Mo.
Massillon Stone & Fire Brick Co., Massillon, Ohio.
Norton Co., Worcester, Mass.

Aluminum.—Shipments of bauxite from Arkansas to the aluminum industry in 1939 comprised 46 percent of the total domestic ore shipments. This quantity was relatively small, however, as almost three-fourths of the industry's bauxite requirements were imported from Surinam.

Abrasive.—In 1939, shipments of domestic bauxite to American and Canadian abrasive plants increased 10 percent from 1938, and amounted to 24 percent of the total tonnage. Technical advances made in the manufacture of abrasives have been very important in today's mass-production methods. Crystalline or fused aluminum oxide and silicon carbide are two standard abrasives that are hard enough to grind almost every material commonly used in the arts.[2]

Chemical.—Domestic bauxite consigned to the chemical industry increased 26 percent in 1939 and represented 23 percent of the total ore shipments. Shipments of aluminum salts advanced 20 percent and of alumina 3 percent. Returns from producers of primary aluminum salts and alumina show the consumption in 1939 of approximately 178,000 long tons of dried bauxite (58 percent domestic, 42 percent foreign), 8,546 short tons of alumina, 1,587 tons of aluminum, and a small quantity of clay, alunite, and chromite residue. Of the alumina shipped, 28 percent was used in the manufacture of aluminum salts.

Aluminum salts and alumina produced in the United States, 1938–39

	1938		1939	
	Producers	Short tons	Producers	Short tons
Aluminum salts:				
Alum:				
Ammonia	7	3,754	7	5,112
Potash	3	1,715	4	2,537
Aluminum chloride:				
Liquid	6	2,167	6	3,145
Crystal	2	6,240	4	8,340
Anhydrous	4		5	
Aluminum sulfate:				
Commercial:				
General	16	353,044	17	403,813
Municipal	10	10,278	10	11,239
Iron-free	8	15,082	9	23,640
Sodium-aluminum sulfate	2	24,961	2	31,545
Sodium aluminate	7		8	
Total aluminum salts		417,241		489,371
Alumina [1]	7	29,043	10	30,695

[1] Excludes alumina produced for use in making aluminum; includes activated, calcined, crude, light and heavy hydrate, and monohydrate D produced for sale.

[2] Tone, Frank J., Abrasives, 1918–38: Chem. Ind., vol. 45, No. 2, pt. 1, August 1939, pp. 133–139.

Aluminum salts and alumina shipped by producers in the United States, 1938–39

	1938				1939			
	Shippers	Short tons	Value		Shippers	Short tons	Value	
			Total	Average			Total	Average
Aluminum salts:								
Alum:								
Ammonia	7	4,079	$218,019	$53	7	5,570	$294,866	$53
Potash	3	2,085	121,174	58	5	2,709	156,358	58
Aluminum chloride:								
Liquid	6	2,174	99,208	46	6	3,121	136,792	44
Crystal	2	6,166	521,492	85	4	8,351	830,347	99
Anhydrous	4				5			
Aluminum sulfate:								
Commercial:								
General	16	349,051	7,345,471	21	17	408,324	8,031,897	20
Municipal	10	10,689	161,160	15	10	11,010	166,590	15
Iron-free	8	14,508	417,446	29	9	23,695	587,573	25
Sodium-aluminum sulfate	2	24,153	1,313,384	54	2	31,252	1,608,876	51
Sodium aluminate	7				8			
Total aluminum salts		412,905	10,197,354			494,032	11,813,299	
Alumina [1]	7	29,175	1,955,383	67	11	30,178	2,143,522	71

[1] Excludes alumina produced for use in making aluminum; includes activated, calcined, crude, light and heavy hydrate, and monohydrate D.

Aluminum salts shipped in, imported into, and exported from the United States, 1935–39

Year	Domestic shipments		Imports		Exports: Aluminum sulfate		Exports: Other aluminum compounds	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1935	402,717	$10,082,936	1,424	$68,636	33,091	$685,347	691	$126,435
1936	444,660	10,965,660	2,106	50,608	28,788	578,001	1,483	250,262
1937	466,894	12,092,992	2,864	61,665	31,807	679,214	2,609	423,363
1938	412,905	10,197,354	1,871	40,189	27,715	578,330	1,770	257,545
1939	494,032	11,813,299	828	22,335	34,734	744,755	1,792	208,455

Oil refining, refractory, and other.—The consumption of activated bauxite in the percolation filtration of paraffin-base oils continued to increase in 1939. The term "activated bauxite" refers to a product that has undergone more careful crushing, screening, sizing, beneficiating, and drying steps than most bauxite. There is no other specific treatment of the product that must have particular physical rather than chemical properties. The granular activated bauxite marketed usually contains 5 to 10 percent combined water and may be furnished in 20/60, 30/60, or some other special mesh grade, in bulk or in 100- or 125-pound bags. It is sold under the trade names Porocel, X-Yte, and Florite, at prices ranging upward from $33 per ton, f. o. b. Arkansas plants.

The very small percentage of bauxite reported shipped to the refractory industry probably is too low, as some products classed as abrasives are used chiefly because of their refractory properties. Aluminous refractories are fused electrically and cast economically in large blocks, and although particularly sensitive to thermal shocks, high-density fused refractories have great chemical resistance at high temperatures.[3] These dense products are rigid and relatively brittle and do not withstand heat shock, therefore they are not widely applicable in the steel industry. Imported bauxite, chiefly from Greece, continued to be used in the domestic production of calcium aluminate cement. In 1939 small quantities of domestic dried and calcined bauxite were consumed by the steel industry as a fluxing material.

PRICES

In 1939 the average selling price, f. o. b. mines and processing plants, was $4.35 per long ton for crude (undried) bauxite; $5.36 for crushed dried bauxite; $12.48 for calcined bauxite; and $37.08 for activated bauxite. The average value for all grades of domestic ores as shipped by mine producers was $5.77 per ton ($5.82 in 1938).

Quotations on domestic and foreign bauxite are nominal, and a definite price per ton can be ascertained only by direct negotiation between the buyer and seller. The open market for bauxite is relatively small because some of the larger consumers operate their own mines and others obtain supplies on a contract basis. Quotations given in the following table are from Engineering and Mining Journal Metal and Mineral Markets.

Range of quotations on bauxite, 1937–39

Type of ore	Chemical specifications (percent)		Prices during year		
	Al_2O_3	SiO_2	1937	1938	1939
Domestic ore (per long ton):					
Chemical, crushed and dried [1]	55–58	(2)	$6.00–$7.50	$6.00–$7.50	$6.00–$7.00
Other grades [3]	56–59	5–8	6.00– 7.50	6.00– 7.50	6.00– 7.00
Pulverized and dried [3]	56–59	8–12	10.00–12.00	9.00–12.00	9.00–11.00
Abrasive grade, crushed and calcined [3]	78–84	(4)	12.50–15.00	12.00–15.00	12.00–14.00
Foreign ore (per metric ton):					
Dalmatian [5]	50–55	1–3	4.50– 7.50	6.00– 7.50	6.00– 8.00
Greek [5]	56–58	3–5	7.50– 8.50	7.00– 8.50	7.00– 8.00
French [5]	56–59	2–4	5.50– 9.00	7.00– 9.00	7.00– 8.00

[1] F. o. b. Alabama and Arkansas mines.
[2] SiO_2 not specified; Fe_2O_3, 1.5–2.5 percent.
[3] F. o. b. Arkansas mines.
[4] Not specified.
[5] C. i. f. Atlantic ports.

FOREIGN TRADE

Imports of bauxite (chiefly dried ore) in 1939 were the highest ever recorded (fig. 1), exceeding those received in 1938 by 14 percent and in 1937 (the previous peak) by 3 percent. Exports (dry equivalent) declined 4 percent compared with 1938. Of the 1939 imports Surinam supplied 477,094 long tons, British Guiana 29,586, Greece 8,190, France 5,280, and Netherland India 29. Imports, by custom districts, were as follows: 255,708 tons to Mobile, 189,341 to New Orleans, 40,104 to Philadelphia, 17,365 to Massachusetts, 8,190 to Chicago, 6,145 to Florida, 3,297 to Sabine, and 29 to New York. In addition to bauxite, 11 long tons of alumina were imported.

[3] Kraner, Hobart M., Alumina and Silica Refractories: Iron Age, vol. 145, Nos. 3 and 4, January 18 and 25, 1940, pp. 25–30 and 34–39.

Of the exports in 1939, 45,168 long tons were classified as bauxite and other aluminum ores, 6,372 tons as other bauxite concentrates, and 95 tons as alumina of which Canada was consigned 45,136 tons, 4,963 tons, and 93 tons, respectively. Of the remainder of "other bauxite concentrates," 900 tons went to Norway, 488 to Japan, 20 to Mexico, and 1 to Denmark.

Bauxite imported into and exported from the United States, 1935–39

Year	Imports for consumption [1] [2]		Exports (including bauxite concentrates) [3]		Year	Imports for consumption [1] [2]		Exports (including bauxite concentrates) [3]	
	Long tons	Value	Long tons	Value		Long tons	Value	Long tons	Value
1935	199,959	$1,448,592	82,491	$2,191,167	1938	455,693	$3,521,325	57,726	$1,459,491
1936	322,790	2,370,778	84,471	2,322,915	1939	520,179	3,765,140	51,635	1,117,564
1937	507,423	3,609,063	123,191	3,456,916					

[1] Also "alumina" as follows: 1935, 67 long tons valued at $7,680; 1936, 117 tons, $11,618; 1937, 182 tons, $16,461; 1938, 64 tons, $5,464: 1939, 11 tons, $850.
[2] Chiefly dried ore.
[3] As shipped.

ALUMINUM

PRODUCTION

Primary.—Primary aluminum production in the United States in 1939 increased 14 percent in quantity and value over that in 1938 and was the largest on record (fig. 2). Output would have been greater had it not been for the unusually low rainfall in certain areas, which reduced the amount of power available. The value of aluminum produced averaged 19.75 cents per pound in 1939, the same as in 1938. Of the total output, 41 percent was made at Alcoa, Tenn.; 35 percent at Massena, N. Y.; 13 percent at Badin, N. C.; and 11 percent at Niagara Falls, N. Y.

Aluminum produced in the United States, 1935–39

Year	Primary metal		Secondary metal		Year	Primary metal		Secondary metal	
	Pounds	Value	Pounds	Value [1]		Pounds	Value	Pounds	Value [1]
1935	119,295,000	$22,070,000	102,800,000	$19,018,000	1938	286,882,000	$56,659,000	77,600,000	$15,326,000
1936	224,929,000	41,612,000	103,000,000	19,055,000	1939	327,090,000	64,600,000	(2)	(2)
1937	292,681,000	55,609,000	125,120,000	23,773,000					

[1] Based on average price of primary aluminum as reported to Bureau of Mines.
[2] Figures not yet available.

In 1939 the Aluminum Co. of America completed a $26,000,000 expansion program begun in 1937 and later announced the beginning of other developments to cost $30,000,000. A new aluminum-reduction plant to be finished about January 1, 1941, at Vancouver, Wash., will utilize Bonneville power and alumina shipped from existing plants, and it will be capable of producing 30,000 short tons of metal annually. This plant, together with a 20-percent increase in capacity of the Alcoa works, will enable the company to produce more than 215,000 tons of aluminum annually. In addition to the development of reduction works, the new program will include: A bauxite beneficiating and drying plant at Paranam, Surinam, of 450,000 tons annual capacity; acquisition of additional ore-carrying vessels by the Ocean Dominion Steamship Co. to take care of increased bauxite shipments from South America; additions to the alumina works at Mobile, Ala., and East St. Louis, Ill.; hydroelectric station improvements along the Little Tennessee River; improved laboratory facilities; and enlarged manufacturing capacities at Alcoa, Tenn., Cleveland, Ohio, Lafayette, Ind., Los Angeles, Calif., Massena, N. Y., and New Kensington, Pa.

Early in 1940 the company began operating a powerful testing machine at New Kensington, Pa., capable of exerting a force of 3,000,000 pounds in compression and 1,000,000 pounds in tension at speeds as high as 36 inches per minute. To meet the increasing demand for aluminum from the aircraft industry, the company installed new production equipment and accumulated stocks in standard aircraft products. A 500-ton hammer for forging propellers, crankcases, and landing gears and a large corrugating press for the manufacture of airplane wings and other aluminum products were put in service. Other domestic fabricators of aluminum products also considerably expanded manufacturing facilities.

For the first time under the present capitalization, holders of common stock of the Aluminum Co. of America were paid a cash dividend in 1939 ($6.00 per share and a stock dividend on December 27). A second cash dividend was paid in 1940 ($1.00 per share on April 15). The consolidated net income of the company was $36,633,389 in 1939 compared with $15,563,145 in 1938.

Until June 1, 1939, the Government continued to present testimony (in District Court of the United States for the Southern District of New York) in support of its suit (filed April 23, 1937) asking dissolution of the Aluminum Co. of America, charging that it is a monopoly in violation of the antitrust laws. The court adjourned until June 21, when the company began to present its testimony which continued the rest of the year, except for the recess period ordered by Federal Judge Francis G. Caffey from August 4 to November 8, 1939. On September 13, 1939, the United States of America, through the Department of Justice, filed another suit against the company and two of its subsidiaries in the Federal District Court, New Orleans, La. This petition charges conspiracy to offset freight rates on bauxite from New Orleans to East St. Louis, Ill., in violation of the Elkins Act. This suit did not come to trial in 1939. On August 9, 1939, the Securities and Exchange Commission announced that the company and certain power subsidiaries were exempt from registration under the holding-company act on the ground that they were not public utility concerns.

On November 16, 1939, the Aluminum Co. of America signed 2-year contracts with two unions of the Congress of Industrial Organizations, which provide for some changes in working conditions and seniority ratings and affect plants at Alcoa, Tenn.; Edgewater, N. J.; New Kensington, Pa.; Detroit, Mich.; and Garwood, N. J. There are no company unions at any plants; and at Massena, N. Y., and East St. Louis, Ill., the unions of the American Federation of Labor are the bargaining agents. The company inaugurated a paid-vacation plan for employees in 1939 which will be continued in 1940.

Because of the interest in aluminum as a strategic material, historical data on production, imports, exports, and apparent consumption of primary aluminum and production of secondary aluminum were included in Minerals Yearbook, 1939, pp. 642–643. Figures on production of primary aluminum are given from 1893 to 1938, other data from 1910 to 1938.

Secondary.—In 1939 the Bureau of Mines began revising its statistical canvass of the secondary-metal industries; owing to the extra

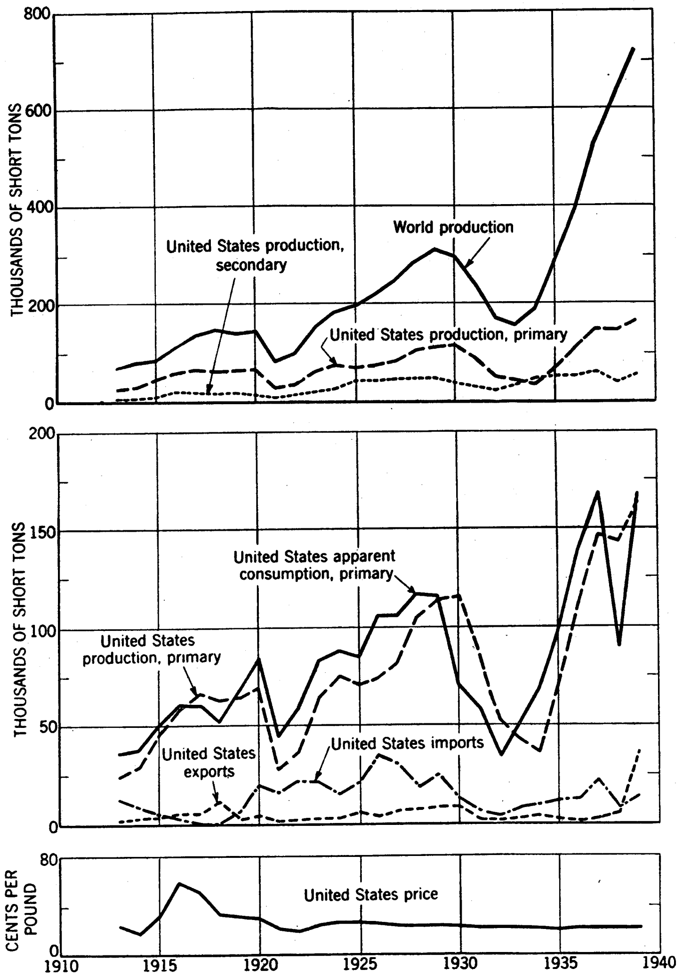

FIGURE 2.—Trends in production, imports and exports, apparent consumption, and average quoted prices of aluminum, 1913–39. Price is for No. 1 virgin 98–99 percent at New York through 1929, thereafter for 99 percent plus virgin ingot, as reported by American Metal Market.

time necessary for this revision, data on the output of secondary aluminum were not available when this report was prepared. It is believed, however, that the recovery of alloyed and unalloyed aluminum in 1939 approached the record high of 1937. Further details on secondary aluminum in 1939 are given in the chapter on Secondary Metals—Nonferrous, Minerals Yearbook, 1940.

CONSUMPTION

The apparent domestic consumption of primary aluminum in 1939 increased 87 percent over that in 1938 and was about the same as that in 1937, a record year (fig. 2). Secondary-aluminum consumption also increased substantially.

The abnormally large demand for aluminum in 1939 was attributable directly to the high rate of activity in the aircraft and other industries stimulated by military preparedness as well as hostilities abroad. Aluminum alloy comprises more than 60 percent of the structural or net weight of an airplane, and in 1939 the aviation industry consumed twice the quantity of aluminum that it did in 1937, the previous peak year. Consumption in this field is expected to set an even greater record in 1940.

The quantity of aluminum used for truck bodies in 1939 was double that of 1938, and that used for windows, spandrels, and other architectural purposes was 80 percent higher than in the previous year. Further progress is expected in use of the metal in the transportation, architectural, and numerous "borderline" fields as a result of the March 1940 price reduction, which gives aluminum a better price relationship with competing materials.

Production, imports, exports, and apparent consumption of primary aluminum and production of secondary aluminum in the United States, 1935–39, in pounds

Year	Primary aluminum				Secondary aluminum (production)
	Production	Imports	Exports	Apparent consumption[1]	
1935	119,295,000	[2] 21,291,235	3,970,347	191,645,888	102,800,000
1936	224,929,000	[2] 25,562,571	1,605,753	275,443,818	103,000,000
1937	292,681,000	[2] 45,178,069	5,383,516	335,958,553	125,120,000
1938	286,882,000	[2] 17,740,281	12,618,078	179,045,203	77,600,000
1939	327,090,000	18,579,940	73,218,080	335,337,860	(3)

[1] Data not available on fluctuations in consumers' stocks. Withdrawals from producers' stocks totaled 55,030,000 pounds in 1935, 26,558,000 in 1936, 3,483,000 in 1937, and 62,886,000 in 1939; additions to producers' stocks totaled 112,959,000 pounds in 1938.
[2] Crude and semicrude, some of which may be secondary aluminum.
[3] Figures not yet available.

The electrical conductor industry continued in 1939 to be second only to transportation as a major consumer of aluminum. The total mileage of aluminum cable, steel-reinforced, in the United States increased to 850,000 miles. More than 100,000 miles of cable were used in rural electrification, and over 1,000 miles of large-diameter cable were shipped for use in construction of the 220,000-volt power lines on the Bonneville Dam project. The strength of aluminum-alloy trains was tested in the severe wreck of the Union Pacific Railroad streamliner "City of San Francisco," when only 3 out of 17 cars were damaged enough to require replacement. Wider recognition of the permanence and insulating value of aluminum foil[4] resulted in its increased use, and in 1939 it was adapted to insulation of locomotive boilers. A single-purpose aluminum house paint was placed on the market, and aluminum-alloy automotive bearings were developed.

[4] Wilkes, Gordon B., Reflective Insulation: Ind. Eng. Chem., vol. 31, No. 7, July 1939, pp. 832–838.

From 1933 to 1938, inclusive, the percentage of aluminum used in various industries in the United States was approximately as follows: Transportation (land, air, and water), 29 percent; machinery and electrical appliance, 15; cooking utensil, 14; electrical conductor, 10; building construction, 8; food and beverage, 6; chemical, 5; iron and steel metallurgy, 5; miscellaneous foundry and metal working, 4; and general miscellaneous, 4.

PRICES

Throughout 1939 open-market quotations in New York for 99-percent-plus pure virgin ingot aluminum, delivered, remained unchanged at 20 cents a pound, carload lots. However, on March 25, 1940, the base price was reduced to 19 cents a pound for 10,000 pounds or more by the Aluminum Co. of America, which attributed the reduction to lowered production costs resulting from its extensive research and expansion program. Quotations for smaller lots down to 1 ton demand a ½-cent premium and for less-than-ton lots a 1-cent premium. The 1940 reduction also included a downward adjustment in prices of fabricated products. European quotations for aluminum ingot on December 30, 1939, were (converted into American money): 19.4 cents per pound in the United Kingdom, 24.2 cents in Germany, 15.6 cents in France, and officially 25.2 cents in Italy (actually 41 to 46 cents was the open-market price). According to Metal Statistics 1940, dealers' 1939 buying prices per pound in New York for principal grades of domestic aluminum scrap averaged 7.47 cents for cast aluminum and 13.90 cents for new-aluminum clips. The average selling price of remelted metal, 98½ to 99 percent grade, was 19.38 cents, and of No. 12 alloy, No. 2 grade, 13.28 cents.

FOREIGN TRADE

Crude and semicrude aluminum exports were nearly six times higher in 1939 than in 1938 and three times the previous peak reached in 1918 (12,068 short tons). The large increase in exports is attributed to defense and wartime demands and the abandonment by Canada of some of its world markets to the United States so that it could better supply the United Kingdom. In the middle of December 1939 the Government added aluminum, because of its use in the manufacture of aircraft, to the list of metals morally embargoed to countries for unprovoked bombing and machine-gunning of civilians. This measure chiefly affects Japan and the U. S. S. R. Of the exports of crude in 1939 (28,121 short tons), 9,933 tons went to the United Kingdom, 8,143 to France, 4,503 to Japan, 1,790 to the U. S. S. R., 1,378 to Belgium, and 551 to Germany; of scrap (476 tons), 364 tons went to Japan; and of semicrude (8,488 tons), 5,533 tons went to the United Kingdom, 1,721 to France, 366 to Canada, 359 to China, 146 to Japan, and 145 to Australia.

Aluminum imported for consumption in the United States, 1937–39, by classes

Class	1937		1938		1939	
	Pounds	Value	Pounds	Value	Pounds	Value
Crude and semicrude:						
Crude form, scrap, alloy, etc	44, 701, 669	$6, 770, 400	17, 511, 819	$2, 430, 828	[1] 28,060,094	[1] $3,251,484
Plates, sheets, bars, rods, circles, squares, etc	476, 400	112, 139	228, 462	60, 566	612, 773	133, 629
	45, 178, 069	6, 882, 539	17, 740, 281	2, 491, 394	28, 672, 867	3, 385, 113
Manufactures:						
Leaf (5½ by 5½ inches)	(2)	67, 979	(2)	17, 361	(2)	26, 003
Powder in leaf (5½ by 5½ inches)	(3)	212			(3)	90
Bronze powder and powdered foil	295, 299	124, 276	186, 418	77, 425	110, 995	42, 959
Foil less than 0.006 inch thick	2, 724, 550	996, 513	1, 831, 309	734, 176	2, 827, 010	1, 266, 436
Table, kitchen, and hospital utensils, and other similar hollow ware	86, 114	48, 815	37, 129	23, 747	26, 776	16, 191
Other manufactures	(4)	57, 266	(4)	34, 915	(4)	29, 468
	(4)	1, 295, 061	(4)	887, 624	(4)	1, 381, 147
Grand total	(4)	8, 177, 600	(4)	3, 379, 018	(4)	4, 766, 260

[1] Includes 10,092,927 pounds of scrap valued at $760,913; not separately classified before 1939.
[2] 1937: 29,279,568 leaves; 1938: 8,389,969 leaves; 1939: 13,589,224 leaves; equivalent in pounds not recorded.
[3] 1937: 54,150 leaves; 1939: 70,000 leaves; equivalent in pounds not recorded.
[4] Quantity not recorded.

Aluminum exported from the United States, 1937–39, by classes

Class	1937		1938		1939	
	Pounds	Value	Pounds	Value	Pounds	Value
Crude and semicrude:						
Ingots, scrap, and alloys	4, 719, 034	$967, 342	9, 670, 398	$1, 860, 796	[1] 57,194,509	[1] $11,693,276
Plates, sheets, bars, strips, and rods	664, 482	293, 453	2, 947, 680	2, 050, 995	16, 975, 233	9, 178, 275
	5, 383, 516	1, 260, 795	12, 618, 078	3, 911, 791	74, 169, 742	20, 871, 551
Manufactures:						
Tubes, moldings, castings, and other shapes	588, 960	279, 361	576, 377	313, 758	1. 366, 218	929, 131
Table, kitchen, and hospital utensils	765, 810	411, 864	672, 290	364, 240	537, 532	302, 406
Foil	422, 850	121, 269	144, 999	66, 771	1, 133, 031	488, 010
Aluminum and aluminum bronze powder	316, 482	114, 760	82, 232	33, 944	182, 323	80, 960
Other manufactures of aluminum	(2)	755, 165	(2)	793, 543	(2)	958, 827
	(2)	1, 682, 419	(2)	1, 572, 256	(2)	2, 759, 334
Grand total	(2)	2, 943, 214	(2)	5, 484, 047	(2)	23, 630, 885

[1] Includes 951,662 pounds of scrap valued at $160,283; not separately classified before 1939.
[2] Quantity not recorded.

Imports of crude and semicrude metal were 62 percent higher than in 1938 but for the first time since 1918 were less than exports. Imports (exclusive of scrap) comprised only 6 percent of the apparent consumption of primary aluminum in 1939. Of the imports of crude

(8,984 tons), 3,766 tons came from Canada, 2,083 from Norway, 1,666 from France, and 1,125 from Switzerland; of scrap (5,046 tons), 3,475 tons came from the United Kingdom and 1,167 from France; and of semicrude (306 tons), 225 came from the United Kingdom and 75 from Switzerland. The value of aluminum manufactures exported increased 76 percent and of those imported 56 percent.

TECHNOLOGIC DEVELOMENTS

An outstanding development during 1939 was the successful brazing of aluminum alloys. Brazing differs from welding primarily in that no substantial quantity of the parent material is melted. Although the strength of brazed and torch-welded joints is about the same the cost is reduced, neater joints are provided requiring less finishing, and thinner parts can be joined by brazing.[5] Furnace-, torch-, and dip-brazing methods have been devised, which use filler materials (aluminum-base alloys) and fluxes melting and flowing at temperatures (1,050° to 1,185° F.) below that of the parent material.

A new aluminum-base die-casting alloy (Alcoa 218) containing 8 percent magnesium is said to have high strength and resistance to corrosion.[6] Alclad (72S)3S, a comparatively new wrought product, is particularly suited for combating localized corrosion and perforation.

Some of the other recent technologic developments in regard to aluminum include work on anodic coating and electroplating of aluminum alloys (Travers process),[7] aluminum-coated steel,[8] and the property of aluminum of restricting grain growth in steel metallurgy.[9]

WORLD BAUXITE AND ALUMINUM INDUSTRIES

BAUXITE PRODUCTION

World production of bauxite continued to increase and in 1939 established another new record. Output is estimated as 4,400,000 metric tons, a 14-percent increase over 1938. The principal producing countries, in the probable order of importance, were: France, Hungary, Surinam, British Guiana, Italy, United States, Yugoslavia, U. S. S. R., and Netherland India. Reports indicate that in 1939 the Unfederated Malay States increased bauxite output approximately 67 percent, Surinam 34 percent, British Guiana 27 percent, United States 21 percent, Hungary 18 percent, France 17 percent, and Italy 16 percent, while Yugoslavia decreased production 21 percent.

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[5] Hoglund, G. O., Brazing the Aluminum Alloys: Ann. Meeting, American Welding Soc., Chicago, October 23–27, 1939.

[6] Dix, E. H., Jr., Aluminum and Its Alloys: Metal Progress, vol. 36, No. 4, October 1939, pp. 355–356.

[7] Edwards, Junius D., Anodic Coating of Aluminum: Internat. Convention, Am. Electroplaters' Soc., June 1939, 22 pp.

Bregman, Adolph, Electroplating on Aluminum: Iron Age, vol. 145, No. 6, February 8, 1940, pp. 40–42.

[8] Allen, A. H., Mirrors of Motordom: Steel, vol. 104, No. 14, April 3, 1939, p. 30.

[9] McQuaid, H. W., The Use of Aluminum for the Control of Grain Size in Commercial Steels: Metals Handbook, 1939, pp. 810–813.

World production of bauxite, 1935–39, by countries, in metric tons

[Compiled by M. T. Latus]

Country	1935	1936	1937	1938	1939
Australia:					
New South Wales	111		6,793	442	(1)
Victoria	1,064	752	1,097	1,341	(1)
Brazil (exports)		7,000	8,770	12,928	(1)
British Guiana (exports)	113,290	172,884	305,533	382,409	483,652
Czechoslovakia			846	(1)	(1)
France	512,850	649,500	688,200	682,440	(1)
Germany	8,547	12,425	18,212	19,703	(1)
Greece	9,489	129,898	137,412	179,886	(1)
Hungary	211,079	329,091	532,657	540,718	(1)
India, British	7,758	3,702	15,393	15,005	(1)
Indochina		30	7,000	160	(1)
Italy	170,064	262,246	386,495	360,837	(1)
Netherland India	16,708	133,731	198,970	245,354	(1)
Portuguese East Africa	30	29			(1)
Rumania	6,218	10,829	10,701	11,807	(1)
Surinam (Dutch Guiana)	112,682	234,845	392,447	377,213	504,062
Unfederated Malay States: Johore		37	19,305	55,965	93,740
U. S. S. R.	132,000	203,200	[2] 230,000	[2] 250,000	(1)
United States (dried bauxite equivalent)	249,384	386,415	431,898	315,906	381,331
Yugoslavia	216,197	292,174	354,233	396,368	314,439
	1,767,000	2,829,000	3,746,000	3,849,000	(1)

[1] Data not available.
[2] Estimated.

ALUMINUM PRODUCTION

World aluminum production continued to rise and in 1939 reached a new peak despite the general shortage of hydroelectric power in much of the Northern Hemisphere. Production is estimated as approximately 650,000 metric tons, an increase of 12 percent over 1938. Germany is believed to have remained the principal producer, accounting for an output 21 percent greater than that of the United States. Estimates for 1939 indicate that Japan increased its metal output 35 percent, Italy 16 percent, Canada, the U. S. S. R., and the United States each 14 percent, France 10 percent, and the United Kingdom and Norway each 7 percent.

World production of aluminum, 1935–39, by countries, in metric tons

[Compiled by R. B. Miller]

Country	1935	1936	1937	1938	1939
Canada	21,400	26,200	41,700	66,000	75,000
France	22,000	29,700	34,500	45,300	50,000
Germany	70,800	97,200	127,200	161,100	(1)
Austria	2,500	3,300	4,400	4,500	(1)
Hungary	300	800	1,000	1,500	1,500
Italy	13,800	15,900	22,900	25,800	30,000
Japan	4,400	7,000	10,000	17,000	23,000
Norway	15,000	15,400	23,000	29,000	31,000
Spain	1,200	600		800	(1)
Sweden	1,800	1,800	1,800	2,400	(1)
Switzerland	11,700	13,700	25,000	27,000	28,000
U. S. S. R.	25,500	30,000	37,700	43,800	(1)
United Kingdom	15,100	16,300	19,300	23,300	25,000
United States	54,100	102,000	132,800	130,100	148,400
Yugoslavia			200	1,200	(1)
	259,600	359,900	481,500	578,800	647,400

[1] Estimate included in total.

ALUMINUM CONSUMPTION

According to the Metallgesellschaft, world consumption of aluminum in 1938 totaled 515,100 metric tons, a 3-percent increase over 1937. Of the total, Germany accounted for 34 percent and all of Europe for 74 percent. The absence of complete official production and foreign trade statistics does not permit a reliable estimate of apparent consumption by countries for 1939, but it is safe to say that an all-time record was established, chiefly because of the military demand for the metal. The apparent primary consumption of the United States in 1939 totaled 152,100 metric tons (152,400 in 1937 and 81,200 in 1938), 14 percent less than that consumed by Germany in 1938 (176,600 tons). During recent years world aluminum-consuming countries have tended to become more self-sufficient in regard to metal output but more dependent on foreign sources for bauxite.[10]

REVIEW BY COUNTRIES

When hostilities were begun in Europe and Asia, many countries ceased to publish statistical information and therefore only incomplete and estimated data for 1939 regarding production, trade, and developments are available for some nations. Official foreign trade statistics, however, are available on the European belligerents for the first 7 or 8 months of 1939. Since the outbreak of the wars both neutral and belligerent countries have issued various restriction decrees, particularly in regard to exports of strategic materials. Permits or licenses are necessary to export bauxite, alumina, or aluminum from the United Kingdom and France and their possessions (including Canada, Australia, British Guiana, Unfederated Malay States, and British India), and from Germany, Greece, Italy, Japan, Norway, Yugoslavia, and other countries.

British Guiana.—Bauxite production in 1939 aggregated 477,693 metric tons of ore containing 60 percent or more Al_2O_3 and 82,932 tons containing 30 to 50 percent Al_2O_3. Exports, chiefly to Canada, the United Kingdom, and the United States, totaled 483,652 tons in 1939 (382,409 in 1938). The Demerara Bauxite Co. extended mining operations to both banks of the Demerara River, and an investigation was made of bauxite occurrences in the Essequibo and Northwest districts of British Guiana.

Canada.—Production and exports of aluminum broke all previous records in 1939. Of the 1939 exports (64,028 metric tons), 35,342 tons went to the United Kingdom, 19,089 to Japan, 2,629 to Germany, 1,800 to the United States, 1,500 to France, 1,078 to China, and 818 to Poland and Danzig. Of the bauxite imported in 1939 (459,924 tons), 405,214 tons came from British Guiana and 54,693 from the United States. Alumina (89 tons) came from the United States and the United Kingdom and cryolite (3,128 tons) from Greenland and the United States.

In the summer of 1939 the Aluminum Co. of Canada, Ltd., began a $7,000,000 expansion program to be completed by May 1940, which included a 15-percent increase in reduction capacity at Arvida and Shawinigan Falls, Quebec (apparently bringing total annual capacity to 100,000 tons). Other recent construction includes a new fabrica-

[10] Anderson, Robert J., Primary Aluminium: Mining Mag. (London), vol. 60, No. 4, April 1939, pp. 206–209.

tion plant near Kingston, Ontario, and a plant at Arvida for the manufacture of Alpaste, an aluminum paint pigment. Early in 1940 the British Government contracted for the entire exportable surplus of aluminum in Canada during 1940 and 1941, or about 90 percent of the output. Apparently, the Government also agreed to finance a further expansion of the aluminum industry. Permits and licenses are required for the exportation of bauxite, alumina, aluminum, and artificial abrasives from Canada.

France.—French bauxite production in 1939 is estimated as 800,000 metric tons. During the first 7 months of 1939 France exported 237,438 tons of bauxite, of which 166,069 were to the United Kingdom, 46,368 to Germany, 14,168 to Sweden, 5,365 to the United States, and the remainder to others. Alumina exports for the same period totaled 19,023 tons, of which 9,762 went to Norway and 9,246 to Switzerland. For the same period in 1938 France exported only 171,259 tons of bauxite and 9,970 tons of alumina.

Germany.—Decrees issued in the fall of 1939 restrict the consumption of light metals and their alloys and limit the expansion of the aluminum industry in Germany. Both decrees probably were influenced by difficulties experienced in obtaining enough electric energy because of the shortage of hydroelectric power in Bavaria and Austria and the inadequate supplies of coal at steam power plants and the limited equipment available for plant extensions. Thus handicapped, it is believed that German and Austrian output of aluminum in 1939 totaled only about 180,000 metric tons instead of the planned 200,000 tons. If land and Danube River transport facilities are available and high prices are no hindrance, the German aluminum industry should not lack adequate supplies of bauxite because of the British-French blockade, as large reserves of aluminum ore are available in Hungary and the Balkans. Despite apparent interruptions in Yugoslav and Greek shipments in 1939, it is estimated that German bauxite imports exceeded 1,100,000 tons. During the first 7 months of 1939 Germany imported 645,149 tons of bauxite, 4,940 tons of crude aluminum, and 2,749 tons of aluminum scrap. Of the bauxite imported, 223,445 tons came from Hungary, 201,555 from Yugoslavia, 63,617 from Greece, 57,570 from Netherland India, 47,678 from France, 45,542 from Italy, and 5,742 from Denmark (probably cryolite).

Recent German expansions include an alumina and aluminum-reduction works (Lippewerk) at Lünen, Westphalia, with an annual capacity of 40,000 tons of metal, and an 8,000-ton alumina plant at Lautawerk which decomposes German clay with sulfurous acid.[11]

Greece.—Of 178,811 metric tons of bauxite exported in 1939 (139,245 in 1938), 89,622 tons went to Germany, 34,074 to Norway, 23,959 to Japan, and 19,335 to the United Kingdom. The Hellenic-Hydro-Electric Metallurgical Co. (American) plans to construct an alumina and aluminum-reduction plant in Greece, using power transmitted from the Acheloos River Falls to Hea. Despite low production costs Greece reports difficulty disposing of all its bauxite output, and large stocks accumulated in 1939.

[11] Metall und Erz (New Methods of Light-metal Production): Vol. 36, No. 3, 1939, pp. 63–72; also vol. 35, No. 19, 1938, pp. 499–510.
Singer, F., Methods of Extracting Alumina from Clay: Brick and Clay Record, vol. 94, No. 6, June 1939, pp. 54–58.

Hungary.—In 1939 bauxite exports (probably all to Germany) totaled 570,170 tons. The new aluminum-reduction plant of the Hungarian United Coal Mining Co., Ltd., at Tatabanya (Totis) began operating early in 1940, and a third Hungarian plant is proposed by the Hungarian Bauxite Trust and the Vereinigte Glühlampen und Elektrizitäts A.-G. for the Bakony district.

Italy.—Although the bauxite reserves of Italy (in Istria and in central and southeastern parts) are estimated to exceed 34,000,000 metric tons, two-thirds of this quantity is high in silica and unsuitable for the Bayer alumina process.[12] Montecatini recovers vanadium from the caustic soda solution in the Bayer process and uses a portion of the red mud in the production of pig iron by means of sintering and the electric arc furnace.[13]

Japan.—Productive capacity of the six established Japanese aluminum companies at the end of 1938 was about 27,000 metric tons. On the basis of reported and estimated exports from Netherland India, Unfederated Malay States (Johore), Greece, Palao Island, and British India, Japanese bauxite imports approached 300,000 tons in 1939. Japanese interests have developed bauxite deposits on Palao Island, though shallow in depth, and on Hainan Island, which were rejected previously by British interests because of their low grade. Most of the older Japanese aluminum companies have ceased to experiment with unsuitable low-grade ore (alunite, shale, etc.) and have turned to imported bauxite despite the Government subsidy recently granted those using Empire raw materials. Under the recently enacted national policy bill, new firms are accorded preferred financing methods, certain tax exemptions, and free import privileges, but the Government controls production through licensing and can require plant experimental work.[14] So far, national expansion of the industry has been much slower than desired because of the shortage of coal, hydroelectric power, and coke, as well as slow equipment deliveries. In 1939 more than 28,000 tons of aluminum were exported to Japan from Canada, the United States, Norway, and Switzerland compared with approximately 21,500 tons in 1938.

Netherland India.—Bauxite exports in 1939 totaled 217,630 metric tons, of which 168,428 tons went to Japan and 49,072 to Germany. The N. V. Billiton Maatschappij began constructing a hydroelectric plant on the Asahan River, Sumatra, below Toba Lake, and later alumina (20,000-ton capacity annually) and aluminum-reduction works (5,000-ton capacity) will be built at Tandjong Balei, Sumatra.

Norway.—In 1939 imports of bauxite totaled 32,697 metric tons (25,942 in 1938) and of alumina, 45,639 tons (43,737 in 1938). Crude aluminum exports decreased from 28,577 tons in 1938 to 24,084 in 1939, of which 3,420 tons went to Japan, 2,799 to the United Kingdom, 2,242 to Sweden, 1,800 to Poland and Danzig, 1,727 to France, 1,775 to the U. S. S. R., 1,669 to Denmark, 1,600 to Switzerland, and 1,437 to the United States.

Surinam.—The N. V. Billiton Maatschappij has abandoned its plans to mine bauxite in Surinam.

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[12] Anderson, Robert J., The Aluminium Industry of Italy: Mining Mag. (London), vol. 61, No. 1, July 1939, pp. 13-27.

[13] Light Metals, Light Alloys and the Light Metal Industries in Italy: Vol. 3, No. 27, April 1940, pp. 103-106.

[14] Bureau of Mines, Mineral Trade Notes: Vol. 9, No. 6, December 20, 1939, pp. 3-9.

Sweden.—The A. B. Swenska Aluminium Kompaniet will erect an alumina plant, using a corundum type of ore found at the Boliden gold mines or imported bauxite, and has increased capacity of its reduction plant at Månsbo 80 percent.

U. S. S. R.—The hitherto unsatisfactory progress of the Russian aluminum industry is attributed to a shortage of electrical power, obsolete equipment, high sulfur content (2.5 percent) in the alumina produced as blast-furnace slag,[15] and other difficulties.[16] Except for a few deposits in the Urals, most of the Russian bauxite reserves,[17] estimated at 53,000,000 tons, consist of low-grade ore. Bauxite from Turinsk is employed in the new Bayer alumina and the aluminum-reduction plant at Kamensk in the Urals, which produced its first half ton of metal in September 1939. During the fall of 1939 the first unit of the alumina plant at Kirovsk, Kola Peninsula, was scheduled to begin utilizing nepheline tailings from apatite ore. This alumina is to be shipped to the enlarged Volkhov reduction works.

Thermic silumin, an aluminum-silicon alloy, is to be produced direct from the ore in Miguet furnaces at the Dnepr reduction plant as soon as higher-grade raw material (kaolin, kyanite, etc.) is available and the iron content of the alloy can be reduced. In 1940 the U. S. S. R. plans to complete the Sosnovets reduction works south of Kandalaksha and to produce 90,000 tons of metal. Metal output is estimated as only 50,000 tons in 1939.

Switzerland.—In 1939 exports of virgin aluminum ingots, etc., totaled 14,930 metric tons (21,814 in 1938) and of bars, sheets, stampings, etc., 3,299 tons. Aluminum-alloy ingots, etc., exported aggregated 5,450 tons, and other aluminum fabrications comprised 6,942 tons. Of the 14,930 tons of new metal exported, 10,885 tons were consigned to the United Kingdom, 1,090 to Belgium, 789 to Germany, 670 to Japan, and 600 to the United States. The Aluminium Industrie A.-G., Neuhausen, regrouped all its affiliated companies early in 1940 because of the European hostilities and became a holding company for financing its subsidiaries.

Unfederated Malay States: Johore.—Three open-pit mines—the Bukit Pasir and Sri Medan mines near Batu Pahat and the Sungei Kim Kim mine near Pulau Nanas—produced bauxite in 1939.[18] Virtually all the 85,745 metric tons of washed, undried ore exported in 1939 went to Japan through the ports of Batu Pahat and Penggerang. The Pasir ore contains 53 to 61 percent Al_2O_3, 2 to 4 percent SiO_2, 6 to 16 percent Fe_2O_3, 1 percent TiO_2, and 27 to 30 percent combined water, while the average Kim Kim ore contains 55.5 percent Al_2O_3, 6.5 percent SiO_2, 9 percent Fe_2O_3, 0.25 percent TiO_2, and 29 percent combined water.[19]

United Kingdom.—Early in 1940 the British Government apparently agreed to finance aluminum production and fabrication facilities in addition to those completed by the British and Canadian industries during 1939. To satisfy the strong demand for aluminum by the air-

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[15] Bureau of Mines, Mineral Trade Notes: Vol. 10, No. 3, March 1940, p. 3.

[16] Reidemeister, von F., Die Aluminium-lage in der U. S. S. R.: Aluminium (Berlin), vol. 21, No. 11, November 1939, pp. 793–798.

[17] U. S. S. R. All Union Scientific Research Institute of Economic Mineralogy, Bauxite: Trans., Nos. 110, 112, 120, and 151; 1937, 1938, and 1939.

[18] Imperial Institute, Progress in Colonial Mineral Industry: Bull., vol. 37, No. 2, April–June 1939, pp. 270–271.

[19] Fermor, L. L., Report upon the Mining Industry of Malaya: 1940, pp. 17, 32–33, 194, 202.

craft and other war industries, orders were placed with Canada, the United States, Switzerland, and Norway. Soon after war was declared against Germany in September 1939, the Ministry of Supply assumed control of supplies and prices of aluminum, invoking a licensing system and prohibiting delivery of metal except in fulfillment of Government or existing written contracts. Export licenses were required from the Board of Trade; on October 10 imports of aluminum were added to the free list, and on February 1, 1940, imports became subject to license. On November 24 the Ministry of Supply became the sole vendor of aluminum; it raised the price on primary metal from £94 to £110 per long ton, delivered, and withdrew the maximum price control on aluminum scrap.

Foreign trade statistics are available only for the first 8 months of 1939, and imports during this period totaled 35,412 metric tons of crude aluminum and its alloys; 8,004 metric tons of sheets, plates, circles, bars, etc.; and 231,443 long tons of bauxite. Of the crude and alloy aluminum imported, 24,461 tons came from Canada, 10,123 from Switzerland, and 539 from Norway.

MERCURY

By H. M. Meyer and A. W. Mitchell

SUMMARY OUTLINE

World events in 1939 had a marked influence on the mercury industry in the United States and, combined with conditions within the industry itself, caused sharp fluctuations in price. Political tension abroad plus uncertainty as to the selling policy of the Franco government after its victory in the Spanish Civil War combined to increase prices early in the year. In May, resumption of combined selling of Spanish and Italian metal by Mercurio Europeo brought a drop in price, signaling an effort by the Cartel to dispose of as much metal as possible rather than to run up the price. On September 5, following declaration of war by the United Kingdom, the price jumped $20 a flask to $110 and continued up sharply until it reached $165 on September 18, with the prices quoted as nominal during the period. This abrupt rise undoubtedly was brought about in part by factors other than the anticipated increase in consumption for war requirements. Mercury had been imported into the United States at a very low rate since late in 1937, whereas in 8 of the 10 years preceding 1938 imports represented 24 to 68 percent of new supply available for consumption. Domestic production had not risen to meet the drop in imports, and presumably consumers had been drawing on their stocks. Consumers undoubtedly feared that competition for mercury among the nations at war or preparing for war threatened supplies. Added to the above, war-risk insurance greatly increased shipping costs. Despite these conditions, however, the increase in prices apparently was temporarily overdone, and prices dropped to $132 late in November.

From September to November price gains abroad lagged greatly behind those in the United States. For example, the average monthly price in New York had been $6 to $11 above the London quotation for the first 8 months of the year, but in September the differential skyrocketed to $49, largely because of the decline in the exchange rate of the pound. Late in December, however, these conditions were reversed; supplies in the United States were more plentiful because of increased domestic output, larger receipts of metal from abroad, and lowered rate of domestic consumption. The situation abroad, on the other hand, became more acute, and price conditions became so confused that at times it was difficult to learn the exact quotation on mercury. The sharp upward price trend continued at an accelerated pace in the first 2 months of 1940. An advance of $50 in one day was purported to be due to an Allied order for 10,000 flasks, to be delivered over a 3-month period. The domestic price policy during this period was conservative. The price was unable to withstand the tremendous pressure from foreign influences, however, and advanced, although it failed to reach the dizzy heights attained by the foreign price. Notwithstanding the domestic tariff of $19, and insurance rates that totaled about $5 (according to Metal and Mineral Markets), the domestic price was $178 to $182 a flask during most of February 1940, while that of the Cartel was $200 a flask f. o. b. Spanish and Italian mines. Late in February the Cartel price was quoted as $205, c. i. f. New York, duty unpaid.

During the early part of 1940 it was rumored that Spain and Italy were producing at a high rate. Past production records for these countries give evidence that they should be able to supply world industrial and war requirements amply, provided mining operations are not impeded. Spain, for example, produced approximately 72,000 flasks in 1927 and in 1929, and there is every reason to believe that she can at least duplicate that record. Italy must be recovering metal at not less than the record rate of 67,000 flasks in 1937. When the output from the United States, the third largest producing country, is added, a total of about 160,000 flasks of mercury seems assured. This total will be supplemented by the outputs of smaller producing nations. For many years before and including the World War period the world output failed to exceed 121,000 flasks.

It is reasonable to assume, therefore, that artificial factors were responsible for the hectic rise in prices abroad late in 1939 and early in 1940. The concentration of production control and possible lack of inventories in some important consuming nations may have accentuated fears regarding supplies, led to excessive orders, and paved the way for abuses in regard to price.

Salient statistics of the mercury industry in the United States, 1935–39

[Flasks of 76 pounds]

	1935	1936	1937	1938	1939
Production ... flasks	17,518	16,569	16,508	17,991	18,633
Number of producing mines	90	87	101	91	107
Average price per flask:					
New York	$71.99	$79.92	$90.18	$75.47	$103.94
London	$60.74	$64.33	$69.65	$66.92	$88.26
Imports for consumption:					
Pounds	593,904	1,374,652	1,437,712	179,522	265,944
Equivalent flasks	7,815	18,088	18,917	2,362	3,499
Exports:					
Pounds	(1)	19,980	34,485	54,161	91,789
Equivalent flasks	(1)	263	454	713	1,208
Apparent new supply ... flasks	25,200	34,400	35,000	19,600	20,900
From domestic mines ... percent	69	47	46	88	83
Stocks in warehouses (bonded) at end of year ... flasks	3,582	2,513	4,286	553	3,110

[1] Not separately classified for 1935.

London ceases to be sales center.—Beginning with January 1, 1940, Spanish and Italian mercury was to have been sold by a Belgian agency rather than in London, obviously in order to have the metal marketed in neutral territory. This plan ran into difficulties, and London continued to market the metal until it was announced in February that the Cartel was selling its mercury directly.

World trade trends.—Available statistics for foreign countries indicate some mystery concerning events abroad. Despite preparations for war, the United Kingdom failed to maintain a high average surplus of imports and, as a matter of fact, barely showed an excess of imports in the first 8 months of 1939, with total imports of 24,154 flasks and re-exports of 23,220 flasks. The destination of these re-exports has not been disclosed. A report early in the year that the French Government would take 11,000 flasks of metal from the United Kingdom did not explain the large movement from London, inasmuch as imports into France for the first 7 months of 1939 totaled only 3,997 flasks. Presumably Japan was the destination of the larger part of exports from the United Kingdom, but there are no statistics to substantiate this assumption.

Germany's rate of importation declined from the high rate attained in 1938, the total for the first 7 months being 13,915 flasks compared with 32,881 flasks in all of 1938—a decline of 27 percent in the monthly rate. As in 1938, virtually all the imported metal originated in Italy.

Italy's exports for 7 months of 1939 totaled 25,602 flasks, indicating a monthly rate 18 percent below that for all of 1938 and 35 percent below the record rate established in 1937. Production totaled 38,639 flasks in the first 7 months of 1939 compared with 41,307 flasks in the corresponding period of 1938.

Monthly compilations.—The strategic nature of mercury made it desirable for the Bureau of Mines to obtain current data covering production and stocks, and monthly canvasses of producers, dealers, and consumers were begun in September 1939. The original list covered mines that supplied more than 95 percent of domestic production in 1938, virtually all dealers and importers, and nearly 500 consumers. Large new mines are added to the list from time to time, whereas many of the smaller dealers and consumers have been dropped. In all, the canvasses probably cover more than 95 percent of these phases of the industry. Owing to the excellent cooperation received from virtually all of the companies approached, the results obtained are believed to be accurate. These monthly figures indicate that extensive enlargements at present mines and new developments have borne fruit and that the monthly rate of output has advanced from 1,500 flasks in September and October 1939 to 2,500 in March 1940. Results of the canvasses are shown in the following table.

Monthly production, consumption, and stocks of mercury in the United States, September 1939 to March 1940, in flasks of 76 pounds

	Production	Consumption	Stocks	
			Consumers	Dealers
1939:				
September	1,500	2,900	9,900	3,000
October	1,500	3,100	8,900	2,400
November	1,600	2,400	8,700	2,400
December	1,750	1,700	9,900	2,700
1940:				
January	1,800	2,300	10,900	2,100
February	2,200	2,000	9,900	1,200
March	2,500	1,800	9,300	1,500

Stock-pile provisions.—The $10,000,000 appropriated by Congress for the purchase of strategic materials in the fiscal year 1940 were expended without provision for any mercury. This omission coincides with the knowledge that the deficiency with regard to mercury in the United States is not as great as it is for some other commodities. Moreover, several other strategic materials have a higher order of priority. For 1941 both the Senate and the House of Representatives have agreed on expenditure of $12,500,000 for strategic minerals, and the Committee has accepted a compromise that would make $3,000,000 available immediately. Both houses must approve the conference report before the bill goes to the President.

Preliminary examinations were made at a number of mercury properties in the United States in 1939 by the Mining Division of the Bureau of Mines, and present plans call for carrying on exploratory work at one of these properties in 1940.

The Geological Survey has laid the groundwork for extensive studies of mercury deposits in the Western States and has undertaken detailed examination of several districts. In 1938 the principal active mercury mines in and near Lake County, Calif., were studied, and a report thereon is in preparation. In the summer of 1939, 28 districts in Washington, Oregon, Nevada, California, and Arizona were visited to get a perspective on the industry. Data obtained in 1939 in the small but important Mount Diablo district near San Francisco have been assembled in a report that should soon be ready for publication. The Bottle Creek and Buckskin districts in northwestern Nevada were studied in 1939, and reports on both are in preparation. Extensive field work in and near San Luis Obispo County, Calif., is still in progress and is resulting in substantial contributions to our knowledge of an area that contains such well-known mines as the Oceania, Klau, and Rinconada.

PRICES

The average monthly price for mercury in New York was slightly higher in January 1939 than the annual average for 1938—$77.44 compared with $75.47. In the early months of the year the price was strengthened by war fears abroad and by uncertainty over the sales policy of Spanish and Italian producers, should the Spanish Civil War terminate in favor of Franco. Franco won the war in the spring, and Mercurio Europeo resumed combined selling for properties formerly represented by that Cartel. The average for April was $90.80; and the price eased, instead of rising, following the renewing of Cartel activity. By August the monthly average was down to $84.41. Following declaration of war between Germany and Great Britain and France in September, the price situation assumed an entirely different aspect. The domestic price advanced to $110 on September 5, $120 on September 7, $135 on September 8, $135–$140 on September 12, $145 on September 15, and $165 on September 18, then eased during the remainder of the month. The average for September was $140 and for October $145.60. An understandable reaction carried the monthly average to $134.98 for November and $141.20 for December.

In general, London prices followed those in the United States for the first 8 months of 1939, the differential in favor of marketing in New York ranging from $6.47 to $10.75. As outlined in the opening statement of this report, the decline in the rate of importation of mercury into the United States for several years, combined with a static domestic production during that period, paved the way for increases in price and, with the current drop in the exchange rate of the English pound, led to a sharp increase in the price differential to $49.22 in September. The differential dropped to $37.60 in October, to $25.23 in November, and—as conditions of supply reversed themselves—to only $5.20 in December, the lowest for the year. The December trend continued into 1940, and in the early months of this year it was to the producers' advantage to sell abroad.

Mercurio Europeo did not renew its contract to sell metal in London at the end of 1939 but, owing to difficulties in arranging for a new agent, continued to sell metal there for several weeks in 1940, after which it began to sell directly to consumers from Spain and Italy.

Average monthly prices per flask (76 pounds) of mercury at New York and London and excess of New York price over London price, 1937–39

Month	1937			1938			1939		
	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	$90.25	$69.52	$20.73	$79.24	$64.31	$14.93	$77.44	$70.97	$6.47
February	91.00	69.98	21.02	76.46	64.54	11.92	85.23	75.21	10.02
March	91.78	70.43	21.35	72.44	63.61	8.83	87.28	77.81	9.47
April	92.00	70.61	21.39	71.02	63.07	7.95	90.80	82.40	8.40
May	95.52	75.89	19.63	74.64	65.63	9.01	86.77	79.87	6.90
June	96.65	75.29	21.36	80.73	68.98	11.75	86.62	76.09	10.53
July	93.90	73.41	20.49	76.86	68.58	8.28	86.96	76.21	10.75
August	91.42	67.70	23.72	75.50	67.90	7.60	84.41	76.08	8.33
September	89.02	67.30	21.72	74.42	66.83	7.59	140.00	90.78	49.22
October	86.14	65.61	20.53	73.48	68.90	4.58	145.60	108.00	37.60
November	83.44	65.01	18.43	74.07	68.81	5.26	134.98	109.75	25.23
December	81.04	65.02	16.02	76.77	70.99	5.78	141.20	136.00	5.20
Average	90.18	69.65	20.53	75.47	66.92	8.55	103.94	88.26	15.68

[1] Engineering and Mining Journal, New York.
[2] Mining Journal (London) prices in terms of pounds sterling converted to American money by using average rates of exchange recorded by the Federal Reserve Board, through August, after which prices were quoted in American money.

CONSUMPTION AND USES

Statistics covering apparent consumption of mercury in the United States, as shown in the following table, indicate that there was an increase in 1939 over 1938. The data undoubtedly are incomplete, however, because in both years metal was recovered in the United States from concentrates received from Mexico, which are not included in import figures. These imports of concentrates added about 2,000 flasks to the total for 1939 and 2,400 flasks for 1938. In addition, consumers' stocks probably were depleted during both years, although there are no figures to substantiate this assumption.

The civilian and military uses of mercury are, to a large extent, indispensable. Its military uses are principally in the manufacture of fulminate for detonating high explosives, drugs (calomel, corrosive sublimate, etc.), dental amalgam, antifouling paint for ship bottoms, storage batteries, and barometers. Its civilian uses, in addition to the above, include the generation of power (mercury boilers), mercury vapor lamps, and the manufacture of felt.

Supply of mercury in the United States, 1935–39

[Flasks of 76 pounds]

Year	Production (flasks)	Imports for consumption (flasks)	Exports (flasks)	Apparent new supply		
				Total (flasks)	From domestic mines (percent)	Imported (percent)
1935	17,518	7,815	(1)	[2] 25,200	69.0	31.0
1936	16,569	18,088	263	34,400	47.4	52.6
1937	16,508	18,917	454	35,000	46.0	54.0
1938	17,991	2,362	713	19,600	88.0	12.0
1939	18,633	3,499	1,208	20,900	83.3	16.7

[1] Not separately classified for 1935. [2] Estimated by Bureau of Mines.

An article on mechanical engineering in power stations [1] contains the following notes on mercury boilers:

Some years ago, when the efficiency of steam stations was of the order of 20 percent to 22 percent, with heat-consumption rates of 17,000 B. t. u. to 15,500 B. t. u. per kilowatt-hour, attempts were made to utilize other systems and much attention was paid to the binary fluid mercury cycle, especially in the United States. Plants utilizing this cycle were, in fact, installed in more than one area. It is known, however, that these have not been altogether satisfactory in practice. Considerable trouble has been experienced with the boilers installed at Kearney and Schenectady, and the former has been completely replaced. The new boiler has only one drum, and "porcupine" tubes with internal cores and close clearances have been eliminated. The convection surface, instead of being completely filled with a liquid, carries a mixture of liquid and vapor, so that the amount of mercury required per unit of heating surface is much reduced, although, by reason of the elimination of tube cores, the total quantity of mercury in the boiler is somewhat increased. In spite of various improvements, the boiler retains a number of complications, and, as Sir Leonard points out, its adoption is being retarded by the steady improvements which have taken place in the steam cycle. Heat rates of 11,000 B. t. u. per kilowatt-hour have, in fact, been obtained on certain steam plants, and even lower figures are contemplated for new stations at present under consideration.

Wehrly [2] summarized mercury uses as follows:

In this country about 45 percent of the total mercury consumed is used in the preparation of mercurial salts—calomel, corrosives, oxides, organic mercurials, and other chemical compounds. In this class—the chemical uses—is also placed the production of fulminate, taking normally about 6 percent; vermilion, 6 percent; acetic acid, 2½ percent; and dyestuffs, slightly over 1 percent. The total for this class is over 60 percent. Mechanical adaptations calling for a total of about 13 percent comprise meters, measuring instruments such as barometers, hydrometers, thermometers, and gages; thermostats, vacuum tubes and pumps and pressure-control instruments. Of these, meters consume the most—about 6½ percent. In the electrical field, using a little over 8 percent, are such applications as battery zincs, diffusion lamps, cells for the preparation of caustic soda and chlorine, and arc rectifiers. Batteries and lamps take about equal quantities—2.7 percent. These uses total about 81 percent. Of the remainder, the most important use is in the preparation of hatters' felt, using over 10 percent of the total. Others are gold amalgamation, about 2 percent; dental amalgams, over 2½ percent; thermostatic and plating alloys, ½ percent; and laboratory use, about 2 percent.

In the chemical field the use is slightly decreasing; substitutes are available in the case of vermilion and fulminate. As a war measure, however, the use of ful-

[1] Engineering (London), Mechanical Engineering in Power Stations: Vol. 149, No. 3869, March 8, 1940, pp. 256–257.

[2] Wehrly, Chas. S., Mercury: Columbia University Bull. Information, 40th ser., No. 25, June 1, 1940, pp. 57–61.

minate would expand so greatly as to require more than is normally used even with this possibility of substitution. In the mechanical field all the uses are increasing with replacements, either as raw material or as finished products, practically nil. Electrical uses are increasing at a still greater rate, with substitution possible in but a minor part. In the manufacture of felt, however, there is definitely a move to replace mercury by other chemicals.

REVIEW BY STATES

The surprising thing about mercury production in the United States is that under varying conditions during the past 6 years, with numerous changes in the number of operating properties, with old-established mines closing and with new ones making good records, the output for the country has ranged only from 15,445 flasks in 1934 to 18,633 in 1939. This variation did not mark a continuous uptrend, however, for output in 1935 was 17,518 flasks; in 1936, 16,569; in 1937, 16,508; and in 1938, 17,991. In the years noted the price was between \$70 and \$80 in 1934, 1935, 1936, and 1938; a little over \$90 in 1937; and just under \$104 in 1939. The number of producing mines was approximately 90 in all years but 1937 and 1939, when it was 101 and 107, respectively. During these years a relatively few mines have dominated the picture, but there have been changes among the principal producers, particularly in 1938 and 1939. The Oceanic and Cloverdale mines, for example, were important producers in 1938, but both were closed at the end of the year. The Horse Heaven mine assumed importance in 1935 and the Mount Diablo mine in 1936–37; the Bonanza mine jumped to prominence in 1938 and was the second largest producer in 1939; and the Idaho Almaden mine, discovered in 1936, became one of the leading producers in 1939. The Bretz mine, Oregon, was one of the four largest producers in 1934 but failed to produce in 1939. Output at Texas mines declined during the period. The principal producing mines in 1939 were as follows:

Arkansas—Pike County, Valley mine.

California—Contra Costa County, Mount Diablo mine; Lake County, Great Western, Mirabel, and Sulphur Bank mines; Napa County, Oat Hill mine; San Benito County, New Idria mine; San Luis Obispo County, Klau mine; Santa Clara County, New Almaden mine.

Idaho—Washington County, Idaho-Almaden mine.

Nevada—Humboldt County, Wootan and McCown mine.

Oregon—Douglas County, Bonanza mine; Jefferson County, Horse Heaven mine; Lane County, Black Butte mine.

Texas.—Brewster County, Chisos and Rainbow mines.

These 16 mines produced 88 percent of the country's total compared with 91 percent by the 16 principal mines in 1938.

Mercury produced in the United States, 1936–39

Year and State	Producing mines	Flasks of 76 pounds	Value [1]
1936:			
California	51	8,693	$694,744
Nevada	11	211	16,863
Oregon	13	4,126	329,750
Utah	1	25	1,998
Arkansas, Texas, Arizona, and Washington	11	3,514	280,839
	87	16,569	1,324,194
1937:			
Arizona	3	37	3,337
California	54	9,743	878,624
Nevada	20	198	17,855
Oregon	14	4,264	384,527
Arkansas, Texas, and Washington	10	2,266	204,348
	101	16,508	1,488,691
1938:			
California	52	12,277	$926,545
Nevada	17	336	25,358
Oregon	13	4,610	347,917
Alaska, Arkansas, Texas, and Washington	9	768	57,961
	91	17,991	1,357,781
1939:			
Arkansas	5	364	37,834
California	59	11,127	1,156,540
Nevada	25	828	86,062
Oregon	14	4,592	477,293
Arizona, Idaho, and Texas	4	1,722	178,985
	107	18,633	1,936,714

[1] Value calculated at average price at New York.

Arizona.—Mercury was reported produced at the Sunflower mine, Sunflower district, Maricopa County, in 1939, and there was some activity at other properties in Gila, Maricopa, Pinal, and Yavapai Counties looking toward possible future output.

Arkansas.—The output of 364 flasks of mercury in Pike and Clark Counties was reported in 1939. This came from the properties that have produced in the past—that is, the Valley, Mid-Continent, and Parker Hill—and from the new producers—United States Mercury Co. and Jack-Fork Quicksilver Mining Co. United States Mercury Co. reported having recovered 104 flasks of metal in retorts from ore averaging about 4 percent. The company plans to install a new rotary furnace. Mid-Continent Mercury Producers, Inc., anticipates some plant changes, including a concentrating table for fines and new retorts to handle fines from the table. A new Cottrell rotary furnace is being installed at the Big-Six mine.

California.—As usual, California was the most important mercury-producing State in 1939, but her proportion of the country's total was lower than in 1938. Whereas output in 1939 was from a greater number of mines and operations were expanded at some properties that were active also in 1938, the total for the State was only 11,127 flasks compared with 12,277 in 1938. The decline is explained largely by the shut-downs at the Oceanic and Cloverdale mines, although output at three of the other large producers—the Great Western, New Idria, and Klau—was curtailed somewhat. Expansion of productive operations, particularly at Sulphur Bank and Mirabel, together with output from some newly opened properties, offset in part the reductions noted above. Production in 1939 came from the following 18 counties: Contra Costa, Fresno, Inyo, Kern, Kings, Lake, Mono, Monterey, Napa, San Benito, San Luis Obispo, Santa Barbara, Santa Clara, Siskiyou, Solano, Sonoma, Trinity, and Yolo. Except for the addition of Mono County, these are the same as in 1938. The New Idria mine, San Benito County, again was the largest producer not only in California but in the United States as well. Other large producers were Mount Diablo mine, in Contra Costa County; Sulphur Bank, Mirabel, and Great Western mines, in Lake County; Oat Hill mine, in Napa County; Aurora mine, in San Benito County; Klau mine, in San Luis Obispo County; Guadalupe and New Almaden mines, in Santa Clara County; and Contact and Culver-Baer mines, in Sonoma County.

The California State Division of Mines, Department of Natural Resources, issued a comprehensive map in 1939 showing the situation of all known quicksilver deposits in the State, together with marginal data covering output for California and the world, some geologic notes, and other items. This map is entitled "Economic Mineral Map of California, No. 1, Quicksilver."

The Mount Diablo mine, Contra Costa County, operated by the Bradley Mining Co., produced 1,423 flasks of mercury in 1939 from approximately 12,000 tons of ore and was one of the largest producing properties in the country. A 40-ton rotary kiln and ¼-ton D retort for soot are used at this mine.

Ben Byles reported production in retorts at the Archer mine, Fresno County.

There was some activity again in the Coso district, Inyo County, and a reduced quantity of mercury was produced.

The Walabu Mining Co. operated the Cuddeback mine, Kern County, for part of the year and increased its output over 1938.

Production was reported for the Dawson, Kings, and Canyon mines in Kings County. Retorts were used at all three properties.

In 1939 Lake County produced 4,132 flasks of mercury (22 percent of the country's total), which gave it first rank among the mercury-producing counties in the United States. As usual, the principal properties were the Sulphur Bank and Great Western mines of the Bradley Mining Co. and the Mirabel mine of the Mirabel Quicksilver Co. A 20-ton Herreshoff furnace is in use at the Great Western mine, a 50-ton rotary furnace with a double D retort for the treatment of soot at the Sulphur Bank, and a 25-ton rotary furnace at the Mirabel. Early in 1940 an electric hoist was to replace the air hoist in the main shaft at Great Western. Three new stainless-steel pipes in the condenser system were being tested at Mirabel. Production was reported also for the Anderson Springs, Bullion, Helen, and Abbott mines in Lake County. Development work was being carried on at some other mines in the county, and the installation of some new furnace and retort equipment was under way or in prospect.

A little mercury ore was retorted at the Ishtar Cinnabar Co. property in Mono County, but principally assessment work was done.

A small amount of mercury was reported produced in Monterey County in 1939 at the Franciscan and G. W. D. mines.

In Napa County 680 flasks of mercury were recovered, and the principal producing mine was the Oat Hill, where a 4-by 60-foot rotary furnace was in use. The mine was operated until June 1 by Humboldt Mercury Mines and thereafter by Oat Hill Mine, Inc. The Aetna, Ivanhoe, James Creek Placer, La Joya, Manhattan, Oat Hill Extension, and Toyon mines also produced in 1939. At the end of the year preparations were reported under way for reopening the Knoxville mine, idle except for dump operations since 1932. Furnaces were used for reducing metal at Aetna and La Joya, and retorts were employed at the other mines. A new 10-ton rotary furnace, however, was planned for the Manhattan mine, where 33 flasks of mercury were recovered from 66 tons of ore. The Knapp Construction Co. was experimenting with new concentrating equipment late in the year.

A dozen mines in San Benito County were reported to have produced mercury in 1939, the famous New Idria property being outstanding. In all, 3,815 flasks were recovered, and the county ranked second only to Lake County in output in the United States. The New Idria mine again ranked as the leading producer in the country. Trade reports indicated that 135 men were employed at the property in September and that extensive development work was under way on the 300-foot level in the adjoining San Carlos property, which is being operated in conjunction with the New Idria mine. The concentrating plant outside of No. 3 tunnel at New Idria was reported to have been improved and in September to have had a capacity of 400 tons daily. Mining for this mill is done by means of a dragline, using a Sullivan electric hoist. The material is sized to 5 inches by means of grizzlies, then screened and washed to one-half inch. The oversize is sorted on a belt, which acts both as a sorter and as a waste conveyor. The minus-one-half-inch material is run through a Bendelari jig and a drag washer. Nearly all water is recovered by means of a Wemco 14-foot thickener. Two 100-ton furnaces were in operation during most of the year. The second-largest producer in San Benito County was the Aurora mine, which changed hands in December. Production was made in the 25-ton rotary furnace. Other producers included the Florence Mac, Stayton, Valley View, and Wonder mines.

A marked decrease was noted in production of mercury in San Luis Obispo County during 1939, when 253 flasks were recovered compared with 1,111 flasks in 1938. The decline was due mainly to the fact that the Oceanic mine, the largest producer in 1938, was closed during all of 1939; in addition, output at the Klau mine decreased in 1939. Nevertheless, the Klau mine was the principal producer during 1939 and recovered mercury in a 3- by 40-foot Gould rotary furnace. Development work included sinking of a winze below the lowest old workings, together with development drifts and crosscuts on this level. The Buena Vista or Mahoney, Deer Trail, La Libertad, and Little Bonanza mines also produced in 1939.

Production of mercury was reported in 1939 for the Falcon (Santa Ynez), Lion Den, and Los Prietos mines in Santa Barbara County. Retorts were used at Lion Den and furnaces at the other properties.

Santa Clara County supplied 293 flasks of California's total. The mercury was from newly mined ore retorted at Guadalupe and from mined ore and dump material retorted by several lessees at the New Almaden mine. Early in 1940 a new company—the New Almaden Corporation—was formed to acquire and operate properties formerly comprising the New Almaden mine. If this corporation succeeds in financing the project, the various leases presumbly will be operated as a unit.

Small quantities of mercury were recovered from old workings at the Great Northern mine, Siskiyou County, and from clean-up operations at the St. Johns mine, Solano County, in 1939.

The sharp contraction in output in Sonoma County was due to the failure of the Cloverdale mine to produce. Operations at the Cloverdale mine were described by Burr.[3] The Contact mine was the principal producing property in 1939, followed by the Culver-Baer. Press reports indicated that the Contact mine was preparing to install a 40-ton furnace. No information is available regarding the Wyatt furnace reported to have been constructed there in 1938. Production was on record also for the Jumbo property and the Sonoma Quicksilver group. The entire output of the county was from retort operations. Indications were that the Mount Jackson mine, adjoining the idle Great Eastern and itself idle for many years, changed hands late in the year and that preliminary work anticipating resumption of mining was under way early in 1940.

The Altoona mine in Trinity County produced mercury in 1939 in its 50-ton rotary furnace.

A small quantity of mercury was recovered from dumps at the Reed mine in Yolo County, said in the press to have been idle since 1880, and production was also indicated for the Harrison mine. A new rotary furnace was reported under construction at the Harrison mine in the latter part of the year, but production in 1939 was from a retort. Press reports claimed that a large output was anticipated at this property.

Idaho.—The Idaho Almaden mine, situated 17 miles west of Weiser, Washington County, was discovered in 1936. It began to produce in May 1939 and in the remaining months of the year made an important contribution to the country's total, which ranked it as the seventh largest producing mine in the United States. Ore is crushed in a jaw crusher and delivered to the 50-ton rotary furnace at approximately minus 1 inch. A short description of the property was published in 1939.[4]

Nevada.—There was considerable activity in mercury development and mining in Nevada in 1939, new production coming particularly from Humboldt County, and plans are under way for greater expansion at a number of properties. The State produced 828 flasks of metal (compared with 336 flasks in 1938) from Elko, Esmeralda, Humboldt, Lander, Mineral, Nye, Pershing, and Storey Counties. Five counties—Esmeralda, Humboldt, Mineral, Nye, and Pershing—produced the total for 1938.

No production was reported for Churchill County in 1939, but a a 2-by 24-foot Gould rotary furnace was being installed in December at the Wild Horse mine near Fallon, located by Clyde Garrett early in the year. Production was begun early in 1940.

The Rand Co. acquired an option on the Mayflower and Wildhorse claims in the Ivanhoe mining district, Elko County, and produced mercury in 1939.

Production for Esmeralda County was from newly mined ore at the Red Rock mine and from clean-up operations at the B and B mine. The furnaces at both properties were idle, as the metal produced was from retorts.

Production in Humboldt County totaled 404 flasks in 1939, or more than four times that for 1938; thus, the prophecy of larger output of

[3] Burr, Geo. H., Mining and Treating Low-grade Quicksilver Ores at the Cloverdale Mine: Min. Cong. Jour., vol. 25, No. 6, June 1939, pp. 15–17.
[4] Mining World, Idaho Almaden, Gem State's First Quicksilver Mine: Vol. 1, No. 4, October 1939, pp. 9–11.

mercury in the Bottle Creek district was fulfilled in part in 1939, and greater expansion in 1940 was anticipated. Four retorts were reported to be in operation at the Blue Can, Bottle Creek (Scossa), Blue Bird, and Wootan and McCown mines. A furnace was reported installed at the Scossa property, and one or two others are in prospect in the district. The retort capacity at the Wootan and McCown mine was increased during the year, and approximately 350 tons of ore were treated to recover 165 flasks of mercury. Niebuhr, who owns the Blue Can mine which is leased to Greenan interests, reported a new claim in the Jackson Mountains northwest of Winnemucca. A retort was reported under construction at this property early in 1940. A small rotary furnace was constructed late in 1939 at the Cahill mine in the Paradise Valley district. Prospects were reported to be good for installing a large reduction plant at the McCormick-Dermody property on Buckskin Mountain.

The Hot Springs mine, Lander County, produced 3 flasks of mercury from 10 tons of ore retorted in 1939.

Production of mercury in Mineral County was reported for the Red Wing, Reward, Allen, Lost Steers, and Crystal Quick mines and was entirely from retorts; the total reported for the county was 26 flasks. Press reports indicated that some expansion was in prospect in 1940, with particular reference to acquisition of the Mina Mercury mine by new interests late in 1939 and reconditioning of reduction equipment there.

In Nye County the Van Ness, Mercury, Cinnabar, and Senator mines, and one other property, reported production of mercury in 1939. At the Van Ness mine 32 flasks were recovered from 160 tons of ore treated in retorts and at the Mercury mine 83 flasks from 630 tons of ore retorted. These two properties produced by far the major part of the county total. Prospects for expansion of output in this county included leasing of the Nevada Quicksilver (Doonan) mine at Ione and preparation of the mine for output early in 1940. A 30-ton furnace was reported to have been installed at the mine.

Mercury production in Pershing County increased in 1939, when metal was reported recovered at the Goldbanks, Miner's Dream, Red Bird, and one other mine. Melvin McCoy treated 320 tons of ore in a retort at Goldbanks and produced 80 flasks of mercury. Alvin Guthrie had a lease on this mine for part of the year and produced an additional quantity. The Miner's Dream mine was reported in the press to have been discovered in 1928. The Goldbanks mine was described by Dreyer [5] in a cooperative publication of the Nevada State Bureau of Mines and the Federal Geological Survey.

In 1939 the American Quicksilver Corporation was reported to have put the furnace at the Castle Peak mine, Storey County, in condition for treating 40 tons of ore a day, and the property was operated after being idle since 1935. Early in 1940 the company stated that it had relinquished its lease.

Oregon.—Oregon's output of mercury was relatively the same in 1939 as in 1938 (4,592 flasks compared with 4,610), despite the sharp increase in output at the Bonanza mine, Douglas County, which assumed second place in 1939 among the principal mercury-producing mines of the country. Production at the Horse Heaven and Black

[5] Dreyer, Robt. M., Goldbanks Mining District, Pershing County, Nev.: Univ. of Nevada Bull., vol. 34, No. 1, January 15, 1940, pp. 30-36.

Butte mines, in Jefferson and Lane Counties, the other most important producers in the State, declined from 1938. Monthly production in Oregon advanced rapidly in the early months of 1940, owing mainly to expanded activity at Bonanza. In addition to the mines already mentioned properties in Clackamas, Crook, Jackson, and Malheur Counties contributed to the total output in 1939. The counties are the same as in 1938, except for the addition of Jackson County.

Two properties—the Oak Grove and the mine of D. E. Kiggins—reported all the mercury produced in Clackamas County in 1939. Production was made in small furnaces at both mines.

The Oregon Department of Geology and Mineral Industries has issued a geologic map and description of the Round Mountain Quadrangle east of Prineville. Cinnabar is the principal important economic mineral in the area.

Six properties produced mercury in Crook County during 1939—almost as many as in the remainder of the State—but none was outstanding. At the Mother Lode mine 266 tons of ore were treated in a furnace to recover 35 flasks of mercury. The company reported that the plant was in operation only 30 days. Reports indicate that two or three new plants were completed recently or were under construction in the Prineville district early in 1940.

As already stated the Bonanza mine east of Sutherlin, Douglas County, increased its production greatly in 1939 so that it became the largest producer in the State and the second largest in the United States. During the year a 50-ton Herreshoff furnace was in operation, but in the late months a 70-ton Gould rotary furnace was under construction to supplement the output at the original plant. Press reports stated that with completion of the new plant early in 1940 the operating crew was raised from 20 to 45 men and that before the new installation the mine had been producing about 10 flasks of metal daily.

Mercury was recovered from dumps at the War Eagle mine, Jackson County. A new Johnson-McKay retort was reported under construction early in 1940.

The Horse Heaven mine, Jefferson County, was the second largest producer in the State and ranked fifth in the country. The Nichols-Herreshoff furnace at the mine had a daily capacity of 20 tons. It was reported in the press that two additional hearths, with a rating of 30 tons a day, were installed late in the year and that no change was required in the condenser system. A shut-down of only 5½ days was required for the addition, and plant capacity was raised to 45–50 tons.

The Black Butte mine, operated by the Quicksilver Syndicate, at Blackbutte, 17 miles south of Cottage Grove, produced 540 flasks of mercury in 1939 from treating 17,456 tons of ore. There are two 75-ton rotary furnaces at the property. A short description of operations at this property was published in the Mining World.[6]

The Bradley Mining Co. produced 12 flasks of mercury from 32 tons of ore and 23 flasks from furnace soot in retorts at the Opalite mine in 1939. Option on the Bretz mine again was taken up by the company late in the year. These two mines are 20 and 12 miles, respectively, west of McDermitt, Nev., across the border in Malheur County, Oreg.

[6] Mining World, Black Butte Quicksilver: Vol. 2, No. 1, January 1940, pp. 17–19.

Texas.—As usual, mercury was produced in Texas at the Chisos and Rainbow properties 90 miles south of Alpine or Marathon, Brewster County. No other production was reported for the State. The mercury deposits of the Terlingua region, where the Chisos and Rainbow mines occur, were described by C. P. Ross in a paper read before the Nineteenth Annual Meeting of the Society of Economic Geologists in New York in February 1939.

FOREIGN TRADE [7]

During the first 10 months of 1939 imports of mercury for consumption in the United States continued at the sluggish rate that characterized 1938. Buying interest increased with the advent of war between Great Britain and Germany, prices rose sharply, and in November imports jumped. In that month 1,111 flasks were entered for consumption and in December 1,776 flasks, a total of 2,887 flasks for the 2 months or 83 percent of the total of 3,499 flasks imported in 1939. With resumption of the operations of Mercurio Europeo the United States again began to receive an overwhelmingly large proportion of its total imports of mercury from Spain. The latter country supplied 2,601 flasks, Italy 336, and Mexico 562 in 1939. In addition to the mercury imported from Mexico as metal about 2,000 flasks were produced in the United States from antimony-mercury concentrates received from Mexico. Statistics covering this class of imports are not shown separately in customs statistics. After the beginning of 1940 the price of mercury abroad was higher than that for metal imported into the United States, plus the duty of $19 a flask. It is not surprising, therefore, that imports in January and February 1940 were only 147 and 3 flasks, respectively.

Mercury imported into the United States, 1935–39, by countries

Country	1935		1936		1937		1938		1939	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Hong Kong					5	$5				
Italy	68, 705	$30, 735	491, 714	$385, 236	747, 266	649, 406	84, 454	$50, 434	25, 528	$29, 818
Mexico	4, 182	2, 975	26, 393	21, 708	116, 497	104, 730			42, 745	61, 313
Spain	521, 017	347, 806	774, 785	544, 072	535, 156	440, 804	95, 068	82, 176	197, 671	245, 613
United Kingdom			81, 760	66, 801	38, 788	33, 046				
	593, 904	381, 516	1, 374, 652	1, 017, 817	1, 437, 712	1, 227, 991	179, 522	132, 610	265, 944	336, 744

All classes of mercury compounds imported increased over 1938 except vermilion reds; but the totals, except mercury oxide, were smaller than in 1937. An upward trend of possible significance was indicated early in 1940, however. Imports of mercurous chloride from Italy alone totaled 18,710 pounds in February compared with 6,700 in all of 1939; of oxide (red precipitate) 9,000 and 18,200 pounds, respectively; and of mercury preparations (not specially provided for) 14,700 pounds in February and 15,000 in all of 1939.

[7] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Mercury compounds imported for consumption in the United States, 1938–39

Compound	1938		1939	
	Pounds	Value	Pounds	Value
Chloride (mercuric) (corrosive sublimate)			300	$174
Chloride (mercurous) (calomel)	265	$358	6,850	5,011
Mercury preparations (not specifically provided for)	11,786	7,604	15,061	8,755
Oxide (red precipitate)	1,011	815	18,200	14,948
Vermilion reds (containing quicksilver)	33,884	30,243	22,624	19,755
		39,020		48,643

Exports of mercury totaled 1,208 flasks in 1939, the largest quantity since 1931 and except for that year the largest since 1920. Of the total, 304 flasks were consigned to Canada, 206 to the United Kingdom, 177 each to Japan and South America, 75 to Australia, and the remainder in small lots to roughly 3 dozen scattered countries throughout the world. At the end of the year the European price favored exportation of mercury from the United States, for it was higher than that for metal imported into the United States plus the duty of $19 a flask.

WORLD PRODUCTION

The following table shows available data on world production of mercury, by countries, from 1935 to 1939.

World production of mercury, 1935–39, by countries

[Compiled by R. B. Miller]

[1 metric ton=29.008 flasks of 76 pounds]

Country	1935		1936		1937		1938		1939	
	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons
Algeria			102	3.5	140	4.8	191	6.6	(1)	(1)
Australia: Queensland	17	0.6	78	2.7	9	.3			3	0.1
Bolivia [2]	250	8.6	224	7.7	16	.6			7	.3
Canada							10	.3	6	.2
China [2]	1,313	45.3	2,460	84.8	1,736	59.8	65	2.2	13	.4
Chosen	4	.1	2	.1	2	.1	(1)	(1)	(1)	(1)
Czechoslovakia	2,004	69.1	1,876	64.7	275	94.8	290	100.0	(1)	(1)
Germany	116	4.0	1,093	37.7	[3] 1,775	[3] 61.1	[3] 1,750	[3] 60.2	(1)	(1)
Austria	106	3.7	3	.1	134	4.6	(1)	(1)	(1)	(1)
Italy	28,191	971.8	42,732	1,473.1	66,963	2,308.4	66,748	2,301.0	(1)	(1)
Japan	148	5.1	429	14.8	580	20.0	(1)	(1)	(1)	(1)
Mexico	6,277	216.4	5,307	183.0	4,936	170.2	8,519	293.7	7,376	254.3
New Zealand	7	.3			18	.6	10	.3	(1)	(1)
Rumania	1	.1	2	.1	4	.1	(1)	(1)	(1)	(1)
Southern Rhodesia									(4)	(4)
Spain	35,559	1,225.8	43,424	[2] 1,497.0	28,357	[2] 977.5	(1)	(1)	(1)	(1)
Tunisia	25	.8	62	2.1	25	.9	270	9.3	(1)	(1)
Turkey	25	.9	815	28.1	483	16.7	597	20.6	(1)	(1)
U. S. S. R.	8,700	[5] 300.0	8,700	[5] 300.0	8,700	[5] 300.0	(1)	(1)	(1)	(1)
United States	17,518	603.9	16,569	571.2	16,508	569.1	17,991	620.2	18,633	642.3
	100,261	3,456.5	123,878	4,270.7	130,661	4,589.6	(1)	(1)	(1)	(1)

[1] Data not yet available. [2] Exports. [3] Estimated.
[4] Production less than 1 flask or 0.1 metric ton.
[5] Production figure published by Metallgesellschaft.

Algeria.—According to the Metal Bulletin of March 12, 1940, page 6, the Ras-el-Ma quicksilver mine has recently been re-equipped. It was reported to be expected to produce a high proportion of a normal

French consumption of 130 tons during the first year of operations. In recent years, production in Algeria has averaged little over 100 flasks a year, but in 1931 and 1932 output was somewhat over 1,000 flasks annually.

Canada.—Of particular interest, because the British Empire is at present completely deficient in regard to mercury, is the report that a mercury property at Pinchi Lake in the Omineca mining division of British Columbia is now being developed by the Consolidated Mining & Smelting Co. An article[8] in The Miner states that the deposit was first observed in 1937, examined by Consolidated in June 1938, and optioned to that company in the following November. It reported also that a 50-ton reduction plant of simple design will be constructed at the mine.

As pointed out in the chapter of this series for 1939, a mercury deposit on Mud Creek in Bridge River Valley produced a small quantity of metal late in 1938.

Italy.—In 1939, for the third successive year, Italy dominated the world mercury situation. This dominance is traced partly to dislocation of the Spanish industry by the civil war, which terminated in the spring of 1939, for over a long period these two countries have taken turns in world supremacy. Too, available data regarding size and grades of reserves place Spain above Italy in terms of the future. For the first 7 months of 1939—the latest data available—output was 38,639 flasks compared with 41,307 in the similar period of 1938, when the total for the year was 66,748 flasks. Mercury production was at a record level during 1937 and 1938, and under the conditions of increased demand incident to the opening of hostilities between Great Britain and France and Germany in September there is little reason to believe that output in 1939 was less than in the record years.

Exports for the first 7 months of 1939 totaled 25,602 flasks compared with 30,218 in the similar period of 1938 and 44,707 in that of 1937. The 12-month total for 1938 was 53,352 flasks and for 1937, 67,075 flasks. Of the total for 7 months of 1939, 43 percent went to Germany, 23 to Japan, 10 to Great Britain, and 8 to France compared with 60 percent to Germany in all of 1938, 12 to Japan, 4 to Great Britain, and 6 to France.

In February 1940 the production of mercury was placed under special control for the duration of the war, or for not less than 2 years, according to a report from Consul Lester L. Schnare, Milan, Italy, dated March 1. Under the control established, the exportation of mercury ores and their derivatives to foreign countries is prohibited, except under special export licenses, and taxes amounting to 2,000 lire on each flask of mercury and to 50 lire on each kilogram of mercury contained in the ores extracted from the mines have been instituted. The taxes are to be paid when the metal is produced, regardless of the purpose for which it is destined, but the Ministry of Finance is authorized to modify them should developments in the international prices for mercury appear to justify such modification. Heavy penalties are provided for violations of the act.

According to continental advices, quoted in the Metal Bulletin of February 13, 1940 (p. 14), despite rapid advances in the export quotation of the Italo-Spanish Quicksilver Cartel since the beginning of the war, the Italian home price of 1,040 lire a flask remained unchanged

[8] The Miner, Development of the Empire's Largest Mercury Producer: Vol. 13, No. 4, April 1940, p. 37.

until Ministry of Corporations recently raised it to 1,400 lire ($71). This price still bore little relation to the export price ($200). The spread between domestic and export prices would seem to give Italian producers of mercurials a marked advantage in world markets. As a possible substantiation of this assumption, imports of mercurials into the United States trended upward early in 1940.

The annual report of Soc. Stabilimento Minerario del Siele (Leghorn) stated that copper sulfate for use in the vineyards can be replaced by certain quicksilver compounds. Such a trend would aid Italy, which now must import large quantities of copper sulfate.

Mexico.—Production of mercury in Mexico was 6,989 flasks in the first 11 months of 1939 compared with 8,519 flasks in all of 1938. Exports during the first 11 months of 1939 were 6,799 flasks compared with 8,274 flasks in the full year 1938. As in previous years, the United States and the United Kingdom were the principal recipients of metal exported from Mexico. Mercury consigned to the United States in the early part of 1939 is believed to have been diverted largely to the United Kingdom.

The Huitzuco mine treated 39,858 short tons of ore in its mill from January 1 to November 4, 1939, and produced concentrates containing 146,886 pounds of mercury. In the entire year 1938, 50,881 tons were treated, and concentrates contained 197,486 pounds of mercury. Concentrates shipped during the period covered for 1939 contained 156,999 pounds of mercury compared with 201,119 pounds in all of 1938. Reports received late in 1939 said that 1,814 flasks of mercury were recovered from January 1 to November 4, 1939, compared with 2,430 flasks in all of 1938. Concentrates from the Huitzuco mine are shipped to Los Angeles, Calif., for the production of mercury and antimony.

Spain.—It continued to be virtually impossible to obtain authentic information on mercury production in Spain. The civil war, which interfered with mining operations at the famous Almaden mine and caused the cessation of reports from Spain, ended in the spring of 1939, and the mines were transferred to the rebel government under Franco. After the war terminated, Italian and Spanish producers resumed the combined selling of mercury under Mercurio Europeo, with sales headquarters in London. The declaration of war on Germany by the United Kingdom and France in September 1939 made it desirable to revise marketing arrangements, so that the metal would be disposed of in neutral territory; therefore, the contract to sell mercury in London was not renewed at the end of 1939. A plan to sell in Belgium proved impractical, and London continued to market the metal during the first weeks of 1940, after which Mercurio Europeo began to sell its metal directly. Reports of the proposed establishment of a Mercurio Europeo sales office in Switzerland came from London in March 1940.

There were rumors that the Almaden mines produced at a high rate late in 1939, some estimates running as high as 12,000 flasks for December. A source believed to be reasonably accurate stated that at the end of 1939 output was proceeding at a rate of 40,000 flasks annually. Operations were reported hampered early in the year by the condition in which the Franco Government found the property, and no stocks were reported at the mine at the end of the Spanish war. Future production should be able at least to reach levels attained in the past, so that an output of 72,000 flasks probably can be anticipated. This rate has been attained twice in the past—in 1927 and in 1929. Hewett [9] stated that output at the Almaden mine probably began about 400 B. C.; that the record of production since 1500 is known and showed an almost constant rise to a peak in 1888, except for temporary declines during the Napoleonic wars; and that the deposits have been owned by the State for 600 years and exploited by it for nearly 400 years. A new peak was reached in 1927, when output totaled 72,316 flasks; this production was almost matched by the record of 71,832 flasks for 1929. The long history of production and the known and probable reserves of the Almaden mine justify its position as the greatest mecury mine now known. The grade of ore produced—approximately 8 percent, of which approximately 6 percent is recovered—is several times as high as that in ores from Italy, the other of the two leading sources of mercury. Tenor of ores in the United States, the third-ranking world producer, averages less than 0.5 percent.

Roura & Forgas, selling agents for Almaden metal until the end of 1939, reported that exports from Spain totaled 53,441 flasks in 1939 compared with 36,000 flasks in 1938.

A commercial agreement between the French and Spanish Governments was reached early in 1940. This agreement included the delivery of 672 metric tons (almost 20,000 flasks of mercury) to France by the end of 1940 and, it is stated, cannot be denounced by either party.

United Kingdom.—Combined selling of mercury by Mercurio Europeo, which includes the principal world producers in Spain and Italy, was resumed in May following termination of the Spanish Civil War. Headquarters of this agency had been in London; but in September the outbreak of war between Great Britain and France and Germany caused some difficulties in former marketing arrangements, and the contract to sell in London was not renewed at the end of the year. A plan to use Brussels as a center was discarded as impractical, and London continued to market the mercury for the first few weeks of 1940. Then Mercurio Europeo began to sell metal direct to consuming companies and governments. Statistics covering imports into and re-exports from the United Kingdom indicated that consumption in 1938 was large. Although war was closer in 1939 and hostilities actually were begun in September, statistics on foreign trade for the first 8 months of the year barely indicated an import surplus. Imports during that period were 24,154 flasks and re-exports 23,220 flasks, whereas in all of 1938 the figures were 44,317 and 15,535 flasks, respectively, and in 1937, 49,894 and 28,127 flasks.

Roura & Forgas, London agents for Mercurio Europeo, reported that mercury stocks in London were 17,804 flasks at the end of 1938 and only 900 flasks at the end of 1939.

Mercury and mercurials were placed under control by the Government late in 1939 and dealings in quantities exceeding 7 pounds permitted only under license. Maximum prices were established. Mercury is one of the few commodities for which the British Empire virtually depends completely on foreign sources of supply. Some efforts are being made in the Dominions to exploit occurrences of mercury ores.

[9] Hewett, D. F., Cycles in Metal Production: Am. Inst. Min. and Met. Eng. Tech. Pub. 183, 1929, pp. 20-22.

TIN

By E. W. Pehrson and John B. Umhau

SUMMARY OUTLINE

The most important event affecting the tin industry during 1939 was the declaration of war by England and France against Germany. Although this tragedy created many factors that influenced statistical and economic trends in the tin industry, the most significant development was the threat to the industrial economy and national defense of the United States through the tin shortage this war will make possible.

As stated in Minerals Yearbook, 1939 (p. 673), tin ranks high among our deficient strategic materials because of the essential usefulness of the metal industrially, the lack of domestic deposits, and our almost total dependence on supplies from relatively few overseas sources, the most important of which is southeastern Asia.

The importance of this region as a source of tin and other raw materials was emphasized by Secretary of State Hull in April 1940 as follows:

> I have noted with interest the statement by the Japanese Minister for Foreign Affairs expressing concern on the part of the Japanese Government for the maintenance of the *status quo* of the Netherlands Indies.
>
> Any change in the status of the Netherlands Indies would directly affect the interests of many countries.
>
> The Netherlands Indies are very important in the international relationships of the whole Pacific Ocean. The islands themselves extend for a distance of approximately 3,200 miles east and west astride of the Equator, from the Indian Ocean on the west far into the Pacific Ocean on the east. They are also an important factor in the commerce of the whole world. They produce considerable portions of the world's supplies of important essential commodities such as rubber, tin, quinine, copra, et cetera. Many countries, including the United States, depend substantially upon them for some of these commodities.
>
> Intervention in the domestic affairs of the Netherlands Indies or any alteration of their *status quo* by other than peaceful processes would be prejudicial to the cause of stability, peace, and security not only in the region of the Netherlands Indies but in the entire Pacific area.

An important step toward ameliorating the dangers inherent in our dependence on distant sources of supply for tin and other essential raw materials, was taken in 1939 when Congress passed the Strategic

Materials Act. This law provides for the purchase of stock piles of these commodities for use in a national emergency. It also authorizes an investigation of domestic deposits of strategic minerals with a view to determining the extent to which domestic resources can be relied upon in time of stress. Although this action is somewhat belated as respects the present situation, it is reassuring to note that the importance of strategic minerals to national defense has received official recognition and that a stock pile of tin actually is being accumulated. Details of Government activity since the passage of the bill are given later in this chapter.

Keeping pace with increased industrial activity in the United States during 1939, apparent domestic consumption of tin rose 38 percent over 1938. Leading the advance in the use of tin in 1939 was the tin-plate industry, which increased production 56 percent in consequence of the building up of inventories by can manufacturers, a small gain in the food pack, and a 92-percent advance in exports of tin plate. The use of tin in solder, babbitt, and bronze was substantially higher in 1939 than in 1938, but there was little change in demand from the collapsible-tube and foil trade. Consumers' stocks of virgin pig tin rose 21 percent during the year, and visible inventories, including metal afloat, rose 72 percent. Total stocks at the end of 1939 were equivalent to a 6.5-month supply at the average rate of consumption during the year. The New York quotations for Straits tin, prompt delivery, averaged 50.20 cents per pound in 1939 compared with 42.26 cents in 1938. Following the outbreak of war in Europe, fears of a domestic shortage of tin precipitated a buying wave; as a result the New York price broke away from parity with London and advanced to a peak of 75.00 cents on September 13. It is believed that no large tonnage changed hands during the panic. Meanwhile the International Tin Committee had removed virtually all restrictions on exports, and by the end of the year the domestic price settled to 49.00 cents. Imports of tin totaled 70,102 long tons in 1939 (80 percent came from Asia and 19 percent from Europe). Receipts from Europe were proportionately greater in 1939 than in 1938. Domestic mine production of tin in 1939, as in previous years, was insignificant. Late in the year it was announced that two large mining companies were planning to smelt Bolivian ores in the United States.

Salient statistics for tin in the United States, 1925–29 (average) and 1935–39

	1925–29 (average)	1935	1936	1937	1938	1939
Production—						
From domestic mines .... long tons	24	44.5	101.0	168.4	95	[1] 34
From secondary sources .... do	30,600	24,900	25,000	27,100	21,080	([2])
Imports for consumption (metal) .... do	78,009	64,258	76,029	88,115	49,699	70,102
Exports (domestic and foreign) .... do	1,740	[3] 2,292	[3] 386	[3] 313	[3] 205	[3] 1,997
Monthly price of Straits tin at New York:						
Highest .... cents per pound	70.67	52.29	51.85	62.71	46.23	63.50
Lowest .... do	39.79	46.91	42.22	42.85	36.84	45.62
Average .... do	56.64	50.39	46.42	54.24	42.26	50.20
World production .... long tons	163,000	135,300	179,000	208,100	159,900	181,000
Ratio United States imports to world production .... percent	48	47	42	42	31	39

[1] Subject to revision.
[2] Data not available.
[3] Figures for 1935–39 cover foreign only; domestic not separately recorded.

Full statistical data covering the last 5 months of 1939 are not available for other countries than the United States. However, the International Tin Research and Development Council estimates that apparent consumption of tin declined 5 percent abroad. Presumably most of the decline was due to curtailment of shipments by the Allied blockade of Germany and the countries over which Germany now has military control. World mine production increased 13 percent over 1938. Production in countries signatory to the International Tin Control Scheme was 17 percent higher, whereas that elsewhere was 4 percent lower than in 1938. The European War has diverted most of the ore which formerly went to continental European smelters to plants in the United Kingdom and the Straits Settlements. To meet the unexpected demand for tin in the last 4 months of 1939, the International Tin Committee raised export quotas for the third quarter from 45 to 120 percent retroactively, and for the fourth quarter from 60 to 100 percent. On September 18 the British Ministry of Supply fixed tin prices on the London Metal Exchange at £230 per long ton, but as world quotations rose considerably above this level pressure was exerted to remove the restrictions. They were removed on December 11, whereupon the price rose abruptly to £272 and declined again to about £248 at the close of the year. Apparently the Buffer Pool stock was used in an endeavor to stabilize prices in 1939, but official data are not available on this activity.

Government stock-piling program.—Although the Strategic Materials Act (Public No. 117, 76th Cong.) was approved by the President on June 7, 1939, funds for carrying out the provisions of the act were not made available until the Third Deficiency Appropriation Act was signed on August 9. The Executive Branch of the Government requested that $25,000,000 be appropriated for stock-pile purchases during the fiscal year 1939–40, but Congress reduced the sum to $10,000,000. The first and second proposals on tin, which were issued by the Procurement Division of the Treasury Department on October 4 and November 13, respectively, called for bids on three grades of tin, specifications for which were designed to meet the requirements of manufacturers of various products. Owing to the custom of the tin trade of buying tin almost exclusively on the basis of brand and the general reluctance of dealers to obligate themselves to deliver tin with narrow tolerances on composition, only a few offers were received. In the third proposal, issued December 15, the specifications were changed, and the following brands were considered as qualifying: Chempur, Pyrmont, Straits Trading, O. T. Lempriere & Co., E. S. Coy (Penang), Billiton, Mellanear (guaranteed 99.9 percent pure), Hawthorne Refined, Banka, Union Minière du Haut Katanga, and any other brand that will meet specifications. These specifications stipulate that all tin shall be new metal, free from scrap or remelted metal; that the tin content shall be not less than 99.80 percent; and that maximum impurities, in percent, shall be as follows: Antimony 0.040, arsenic 0.050, lead 0.050, bismuth 0.015, copper 0.040, iron 0.015, silver 0.001, cadmium 0.001, nickel plus cobalt 0.010, and sulfur 0.010. Tin meeting these requirements is suitable for the manufacture of tin plate, which requires a high-purity metal and is considered as one of the most essential uses of tin. Tin offerings increased under the revised specifications.

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Awards made under the three proposals issued in 1939 totaled approximately 3,680 long tons, and the net purchase price f. o. b. New York averaged 47.8 cents per pound.

The Navy Department has acquired a small reserve of tin under the strategic material stock-piling program authorized in the Navy Appropriation Bills for the fiscal years 1938, 1939, and 1940.

Licensing of exports of tin-plate scrap.—According to the Fourth Annual Report of the National Munitions Control Board, 172 licenses for the export of tin-plate scrap were issued in 1939 (187 in 1938), involving 10,699 (13,237 in 1938) long tons of scrap valued at $200,498 or $18.74 per ton, based upon values stated in the applications for license. All licenses issued in 1939 named Japan as the country of destination. The maximum export quota authorized by the board was 15,000 tons. Allotments requested totaled 22,225 tons and allotments granted, 13,636 tons. Licenses were applied for on 13,413 tons, and actual exports, as reported by the Bureau of Foreign and Domestic Commerce, were 10,204 tons. Imports of tin-plate scrap totaled 12,633 tons in 1939.

The National Munitions Control Board estimates the production of tin-plate scrap in the United States at 251,000 tons in 1937 and 215,000 tons in 1938, and receipts at detinning plants for the respective years were 250,000 and 213,000 tons. Thus, the net effect of the tin-plate export licensing act has been to reserve the equivalent of virtually all domestic scrap production for the detinning industry. Data are not available for 1939, but as imports of tin-plate scrap exceeded exports, the detinning plants probably received more scrap in 1939 than was produced domestically. For the 4 years 1935 to 1938, the Board estimates total receipts by domestic detinning plants at 885,000 tons, which checks closely reports to the Bureau of Mines of 879,000 tons treated at detinning plants during the same period.

An attempt was made in 1939 to restrict exports of other forms of tin scrap. H. R. 61, introduced in the House of Representatives January 3, 1939, would have included "other scrap containing tin together with drosses" by amending the Faddis-Barbour Act licensing the export of tin-plate scrap; and H. R. 5840, which passed the House of Representatives May 1, 1939, proposed amending the same act by including "other scrap, drosses, or residues, the tin content of which is in excess of 10 percentum in which the copper content does not exceed the tin content." H. R. 2644, introduced January 16, 1939, also proposed a similar amendment to the same act to include "other scrap, drosses, or residues, the tin content of which is in excess of 1 percentum (instead of 10 percentum as in H. R. 5840) in which the copper content does not exceed the tin content." Official data on exports of these scrap items are not available, but from inquiries in the trade it is not believed that the quantity of tin so exported would exceed 2,000 tons in a peak year. None of the proposals has yet been enacted into law.

H. Res. 275, introduced July 26, 1939, provides for an investigation of the extent to which the United States depends on foreign nations for its supply of tin. It was referred to the House Committee on Rules, which recommended (Report 1680) February 26, 1940, that the resolution pass. Further action had not been taken by May 1940.

Investigation of domestic resources.—The investigation of domestic resources of deficient strategic minerals has been emphasized in the

Bureau of Mines program of technologic research in recent years. The chapter on tin in Minerals Yearbook, 1939, called attention to several Bureau reports on tin. In 1939 Information Circular 7069, entitled "Tin Deposits of the Black Hills, S. Dak.," by E. D. Gardner, was issued. Tin occurs in two areas in the region—in the Southern Hills and near Tinton. Gardner summarizes the possibilities for production in these districts as follows (pp. 47 and 71):

About 230,000 pounds of tin has been produced in the Southern Hills section of the Black Hills, and the known tin-bearing dikes were extensively developed by the early operators. The ore bodies so far found are small and widely scattered, therefore individual mining operations are necessarily on a small scale.

If a custom treatment plant was available in the district and the price of tin were high enough, an intermittent daily production of about 50 tons of ore containing up to 1 percent tin could be expected. * * *

About 148,000 short tons of ore assaying 7.5 pounds of tin per ton (about 500 long tons of metallic tin) has been partly blocked out on the Rough & Ready claim of the Black Hills Tin Co.; an additional 50 long tons of tin is contained in ore partly blocked out on other claims in the district. If it is assumed that the ore zones on the Rough & Ready continue downward, and of the same grade, each 100-foot vertical interval would contain 840 long tons of metallic tin. If the block that contains 4.1 pounds per ton is included, the total tin content per 100 feet would be 1,102 tons. The apparent average daily consumption of new tin in the United States in 1937 was 237 long tons.[1]

The partly blocked out ore on the Rough & Ready claim would run the 150-ton mill on the ground for about 3 years. For profitable operation, however, the price of tin would have to be higher than in normal times. A small production of tin also could be expected from other claims in the area if the price of tin were high enough.

Government work in this field was accelerated in 1939 by the passage of the Strategic Materials Act, section 7a of which provides $500,000 annually to the United States Department of the Interior for investigation of domestic resources of deficient minerals. The Bureau of Mines is allotted $350,000 and the Geological Survey $150,000 of the annual appropriations. During 1939 the Bureau of Mines conducted extensive investigations of tin occurrences at Tinton, S. Dak., and in Catron County, N. Mex., and made a preliminary survey of deposits in Alabama. The tin property at Majuba Hill, Nev., was reexamined. At Tinton sampling of surface outcrops and old underground workings and about 4,000 feet of diamond drilling were completed. A small tonnage of low-grade ore was indicated which might be workable under war prices. The work in New Mexico included sampling of placer deposits by trenches and test pits, several hundred feet of underground work, and underground and surface sampling of deposits in place.

The Geological Survey investigated deposits at Tinton, S. Dak.; Catron County, N. Mex.; Irish Creek, Va.; Lincolnton and Gaffney, in the Carolinas; and Majuba Hill, Nev.

Domestic tin smelters.—Of unusual interest in 1939 was the announcement late in the year that the Phelps Dodge Corporation and the American Metal Co., Ltd., were establishing plants for treating Bolivian and other available tin ores. Presumably these companies have been investigating the smelting of refractory Bolivian ores for some time, so that the ventures did not result entirely from war conditions, although events in the last 4 months of the year undoubtedly were a factor in the determination to begin commercial produc-

[1] Miller, R. B., Tin: Bureau of Mines Minerals Yearbook, 1938, p. 616.

tion. Commenting on these new projects in a lecture on tin at Columbia University on November 20, Tuthill[2] stated:

> To some extent, ore contracts have already been entered into, and several thousand tons will be arriving here shortly. It is only a matter of 2 or 3 months' time before we shall be once more turning out American refined tin mostly from refractory ores. And the good thing about it is that this strategically important industry is to stand on its own legs, without benefit of subsidy. Test runs indicate that the quality of this domestic refined tin, to be produced by new and more efficient methods, will be entirely acceptable to American consumers. Output, as now contemplated, will not be large—we shall still have to import the bulk of our metal requirements—but it is a vital and most interesting step toward self-sufficiency.

Although no commercial production was recorded in 1939, in December the American Metal Co., Ltd., was awarded a contract to supply the Government with 100 short tons of domestically refined high-grade tin at 47.22 cents per pound, subject to delayed delivery. This contract was made as part of the stock-pile purchasing program authorized by the Strategic Materials Act.

DOMESTIC PRODUCTION

Primary tin.—Only 34 long tons of tin were produced in 1939, a decline of 64 percent from 1938. Alaska again supplied virtually all the output.

According to the Federal Geological Survey (Bull. 917–A, p. 90):

> The principal producing tin properties in Alaska lie in the extreme western part of Alaska near the western tip of Seward Peninsula. In addition to a few small one- and two-man camps that are fairly widely distributed in this general region the main tin-mining activity is on the property of the American Tinfields, Inc., near Tin City. The tin-bearing placers occur around the eastern border of Cape Mountain, a granite mass that forms the westernmost limit of the North American Continent and has been intruded into a country rock consisting of limestones and slates that had been much metamorphosed even before the intrusion of the granite. The tin minerals have been found in place in the contact zone of the granite, and attempts have been made in the past to develop some of the richer areas as lode mines.

Early in 1940 it was reported that prospect drilling at the properties of the American Tinfields, Inc., failed to disclose substantial new deposits, and at the present rate of production commercial gravels would be exhausted within 4 or 5 years.[3]

In addition to Alaska, small shipments were reported from South Dakota, Montana, and New Mexico in 1939. Producers included W. C. Driskill and the Dakota Tin & Gold Co., both near Tinton, S. Dak.; George A. Mayer, near Basin, Mont.; and Paul Bellamy, Taylor Creek district, Catron County, N. Mex.

The Bear Creek mine near Tinton, S. Dak., operated by the Fansteel Mining Corporation in 1938, was idle in 1939. Martin T. Anderson and associates sunk 28 test pits in the Squaw Creek placer, Taylor Creek mining district, New Mexico, which disclosed tin-bearing gravel (grade not given) ranging from 4 to 18 feet in thickness. No production was reported.

During 1939 there was considerable discussion regarding the possibility of tin production in the vicinity of Marquette, Mich. In response to an inquiry from the Bureau of Mines, United States

[2] Tuthill, Marshall W., Tin: Columbia Univ. Bull. of Information, The School of Engineering, 1940, p. 65.
[3] Mining World, Tin Mining at America's Farthest West: Vol. 2, No. 3, March 1940, pp. 18–20.

Department of the Interior, the Geological Survey Division of the Michigan Department of Conservation replied as follows:

We have investigated the rumors of tin ore deposits in Marquette County, Michigan, and have found no facts to substantiate these reported discoveries.

A historical table of mine production of tin in the United States, by States, from 1910 to 1938, inclusive, was published in Minerals Yearbook, 1939, page 679.

Mine production of tin (content) in the United States, 1935–39, by States

Year	Long tons				Value
	Alaska	South Dakota	Other States [1]	Total	
1935	44.1	0.4		44.5	$50,200
1936	101	(2)		101	105,000
1937	166	.8	1.6	168.4	205,300
1938	94	1		95	90,000
1939	[3] 33	.5	.5	[3] 34	[3] 38,000

[1] Montana, New Mexico, and Wyoming. [2] Less than 0.1 ton. [3] Subject to revision.

Secondary tin.—Complete statistics on the recovery of secondary tin in 1939 were not available when this summary was written. The Bureau of Mines annual survey has been delayed because of revisions adopted to obtain detailed information on the flow of various types of tin scrap and to segregate the recovery of tin from old and new materials. A very large part of the secondary tin produced in the United States is recovered from industrial or new scrap, and curtailment in consumption of virgin tin is reflected immediately in secondary-tin production figures. Because of these facts, the significance of secondary tin from the standpoint of national defense frequently has been overemphasized. Should foreign sources of tin be cut off, the quantity of secondary tin available would soon shrink to small proportions. Although the reclamation of tin is highly desirable as a conservation measure it should be borne in mind that it is not to be depended upon for large tonnages of metal in an emergency. Most of the uses of tin are dissipative, and there is no great store of metal in use that could be tapped should regular imports stop. Additional information on secondary tin is given in the chapter on Secondary Metals—Nonferrous.

Secondary tin recovered in the United States, 1925–29 (average) and 1935–39 [1]

Year	Tin recovered at detinning plants			Tin recovered from all sources			
						Total	
	As metal (long tons)	In chemicals (long tons)	Total (long tons)	As metal (long tons)	In alloys and chemicals (long tons)	Long tons	Value
1925–29 (average)	900	2,000	2,900	7,500	23,100	30,600	$38,034,120
1935	1,100	2,200	3,300	8,600	16,300	24,900	27,498,200
1936	2,300	1,500	3,800	6,500	18,500	25,000	25,621,500
1937	2,500	1,500	4,000	7,400	19,700	27,100	32,124,100
1938	2,200	1,300	3,500	4,300	16,700	21,000	19,284,600
1939	3,600	600	4,200	(2)	(2)	(2)	(2)

[1] Figures compiled by J. P. Dunlop and James S. Earle, of the Bureau of Mines.
[2] Data not yet available.

CONSUMPTION

Apparent consumption.—Apparent consumption of primary pig tin is determined by adding domestic smelter production to net imports. As there was no smelter output from 1925 to 1939, inclusive, apparent consumption for this period was equivalent to net imports. This computation does not consider fluctuations in dealer and consumer stocks, information on which is not always available; consequently the figures do not reveal the actual trend in consumption. Nevertheless, statistics on apparent consumption are useful in determining long-time trends. A table giving these data from 1910 to 1938 was published in Minerals Yearbook, 1939, page 680.

Apparent consumption of primary tin in 1939 was 68,105 tons, a 38-percent increase over the 49,494 tons recorded for 1938 but 22 percent below the all-time peak of 87,802 tons established in 1937. The figure for 1937 exaggerates actual consumption, however, as there were large accretions to consumers' stocks in that year. Actual consumption reached a peak in 1929.

Consumption by uses.—The following tables show actual consumption of primary and secondary tin as reported to the Bureau of Mines. Figures for 1939 were not available when this manuscript was prepared. The items included in the table of consumption by uses represent the products of the first cycle of manufacture; for the purpose of this canvass, any virgin tin emerging from this stage as scrap is considered secondary metal. The figures thus understate consumption of primary tin, and much of the secondary tin listed duplicates data on the virgin metal because it is metal reclaimed from such byproducts as tin-plate clippings and virgin drosses from tinplate and tinning mills and other plants consuming virgin tin. In 1938, for example, domestic consumers purchased 48,551 tons of virgin metal, of which 165 tons were added to inventories and 48,386 tons processed. Of the tin processed, 46,712 tons emerged from the first stage of manufacture in the products shown in the accompanying tables and 1,674 tons were sold as scrap, lost, or added to stocks of metal in process.

Consumption of primary and secondary tin in the United States, 1936–38, in long tons

	1936	1937	1938
Stocks on hand Jan. 1	14,981	17,978	25,984
Net purchases during year [1]	89,232	101,354	59,811
Available supply	104,213	119,332	85,795
Stocks on hand Dec. 31	17,978	25,984	25,172
Total processed during year	86,235	93,348	60,623
Intercompany transactions in scrap (tin content)	2,827	2,782	2,109
Total consumed in manufacturing	83,408	90,566	58,514
Plant losses	358	436	239
Tin content of manufactured products	83,050	90,130	58,275
Primary	68,232	72,928	46,712
Secondary	14,818	17,202	11,563

[1] 1936: Primary, 73,137; secondary, 2,176; terne, 994; scrap, 12,925. 1937: Primary, 82,946; secondary, 3,461; terne, 1,052; scrap, 13,895. 1938: Primary, 48,551; secondary, 1,983; terne, 787; scrap, 8,490.

Consumption of tin in the United States, 1936–38, by finished products (tin content), in long tons

	1936			1937			1938		
	Primary	Secondary	Total	Primary	Secondary	Total	Primary	Secondary	Total
Tin plate	33,750		33,750	[1] 39,221		39,221	[1] 23,545		23,545
Terneplate	369	943	1,312	382	1,015	1,397	264	743	1,007
Solder	12,068	6,682	18,750	12,026	7,832	19,858	7,590	5,208	12,798
Babbitt	5,070	1,609	6,679	4,501	2,272	6,773	2,893	1,264	4,157
Bronze	3,559	2,631	6,190	3,712	2,784	6,496	2,334	1,598	3,932
Collapsible tubes	3,556		3,556	3,571	(2)	3,571	3,427		3,427
Tinning	2,377	13	2,390	2,585	67	2,652	1,738	35	1,773
Foil	1,645	43	1,688	1,456	4	1,460	879	(2)	879
Chemicals (other than tin oxide)	209	1,346	1,555	171	1,331	1,502	166	910	1,076
Pipe and tubing [3]	1,401	82	1,483	1,278	18	1,296	948	(2)	948
Tin oxide	969	361	1,330	793	411	1,204	547	444	991
Type metal	253	919	1,172	221	1,140	1,361	134	978	1,112
Galvanizing	1,016		1,016	997	(2)	997	792		792
Bar tin	656	84	740	652	174	826	456	213	669
Miscellaneous alloys	418	62	480	482	24	506	238	19	257
White metal	358	9	367	374	33	407	390	44	434
Miscellaneous	558	34	592	506	97	603	371	107	478
	68,232	14,818	83,050	72,928	17,202	90,130	46,712	11,563	58,275

[1] Includes small quantity of pig tin derived from detinning operations; Bureau of Mines not permitted to publish separate figures.
[2] Small quantity included under "Miscellaneous."
[3] In 1936 pure tin tubing required 1,476 tons and tin-lined tubing 7 tons; in 1937, 1,286 and 10 tons, respectively; not reported separately after 1937.

Tin is employed principally in the manufacture of tin plate. Normally this industry consumes approximately half the virgin tin used in the United States. Production of tin plate increased 56 percent in 1939 compared with 1938. This was attributed to the building up of inventories by can companies, a small increase in the total food pack, and the large increase (92 percent) in exports of tin plate.

According to the American Bureau of Metal Statistics, the use of virgin tin in various other products increased as follows in 1939: Solder, 29 percent; babbitt, 34 percent; and bronze, 32 percent; collapsible tubes and foil decreased 2 percent.

FOREIGN TRADE [4]

The principal items in the foreign trade of the United States in tin are imports of pig tin, which supply virtually all the domestic tin requirements, and exports of tin plate. Of minor importance are the import and export trade in tin-plate scrap; exports of tin-plate circles, strips, cobbles, etc.; and exports of waste—waste tin plate. There is also an appreciable export of miscellaneous tin manufactures, tin-plated hollow ware, and tin compounds. Virtually all the trivial domestic output of tin ore is exported, and a small quantity of ore is imported annually.

Metallic tin imported for consumption in 1939 increased 41 percent over 1938 but was 20 percent below the all-time record established

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

in 1937. Eighty percent of the total imports came from Asia, 19 percent from Europe, and 1 percent elsewhere. Receipts from Asia increased only 31 percent in 1939, whereas shipments from Europe more than doubled owing to much larger purchases from the United Kingdom. Imports of tin concentrates although small were the largest since 1923. They came largely from Bolivia and were consigned chiefly to the plants experimenting with tin smelting.

Foreign trade of the United States in tin and tin concentrates, 1935–39

Year	Imports				Exports of tin (metal)[1] (long tons)
	Tin (metal)		Tin concentrates (tin content)		
	Long tons	Value	Long tons	Value	
1935	64,258	$69,815,287	178	$106,078	2,292
1936	76,029	75,450,941	179	94,738	386
1937	88,115	104,284,762	151	132,810	313
1938	49,699	44,860,324	(2)	298	205
1939	70,102	70,590,764	500	418,004	1,997

[1] Imported as pigs, bars, etc., and exported as such. [2] Less than 1 ton.

Tin[1] imported for consumption in the United States, 1938–39, by countries

Country	1938		1939	
	Long tons	Value	Long tons	Value
Argentina	482	$437,762	251	$256,516
Australia	130	126,914	250	256,498
Belgian Congo	75	77,376	100	123,220
Belgium	395	394,518	1,320	1,429,471
Bolivia	25	22,355		
British Malaya	36,673	32,952,813	46,785	47,139,136
Canada	11	8,908	3	2,358
China	2,084	1,807,756	3,259	3,015,954
Cuba	1	481		
Germany	20	17,109		
Hong Kong	1,204	1,034,384	1,062	999,133
Indochina, French			25	24,877
Netherland India	3,096	2,716,274	5,316	5,442,528
Netherlands	2,216	2,062,990	1,008	1,018,181
Panama (Canal Zone)			(2)	91
Portugal			25	27,227
Sweden	(2)	15		
United Kingdom	3,287	3,200,669	10,698	10,855,574
	49,699	44,860,324	70,102	70,590,764

[1] Bars, pigs, blocks, grain, granulated, or scrap, and alloys, chief value tin, n. s. p. f.
[2] Less than 1 ton.

Foreign trade in tin plate, taggers tin, and terneplate in various forms, 1935–39, in long tons

Year	Tin-plate scrap		Tin-plate circles, strips, cobbles, etc., exports	Waste—waste tin plate, exports	Tin plate, taggers tin, and terneplate	
	Imports	Exports			Imports	Exports
1935	9,185	34,928	(1)	[1] 24,525	187	134,499
1936	9,873	14,375	(1)	[1] 44,621	233	238,880
1937	12,916	14,126	13,062	26,259	246	360,683
1938	10,444	12,495	4,467	7,254	109	161,576
1939	12,633	10,204	6,552	9,132	99	311,016

[1] Tin-plate circles, strips, cobbles, e tc., included in waste—waste tin plate.

Foreign trade in miscellaneous tin manufactures and tin compounds, 1935–39

Year	Miscellaneous tin manufactures		Tin compounds (pounds)	
	Imports [1]	Exports [2]	Imports	Exports
1935	$71,421	$776,855	22	128,632
1936	86,962	1,295,484	5,959	344,578
1937	50,545	2,532,747	1,715	218,006
1938	19,453	2,064,515	865	172,467
1939	20,106	1,098,140	5	204,362

[1] Includes tin manufactures, n. s. p. f.; tin foil; tin powder, flitters, and metallics.
[2] Includes tin dross and tin-bearing scrap material other than tin-plate scrap.

Exports of tin plate, etc., increased 92 percent in 1939, regaining much of the loss sustained in 1938. Shipments to virtually all markets participated in the general improvement. Japan was a notable exception, having received only 287 tons in 1939 compared with 12,799 tons in 1938 and 42,689 in 1937. The export movement was exceptionally heavy in the last 4 months of the year after the outbreak of war in Europe.

Tin plate, terneplate (including long ternes), and taggers tin exported from the United States, 1938–39, by principal countries and customs districts

Country and customs district	1938		1939	
	Long tons	Value	Long tons	Value
COUNTRY				
Argentina	4,434	$556,383	9,838	$1,150,280
Belgium	1,005	111,145	9,118	974,065
Brazil	11,743	1,429,917	39,300	4,178,659
British Malaya	3,175	389,012	10,827	1,061,607
Canada	16,298	1,996,210	33,283	3,769,152
Chile	2,915	335,211	8,172	848,527
China	4,466	589,723	12,520	1,305,364
Colombia	2,332	296,381	5,544	620,279
Cuba	8,075	1,014,551	10,516	1,172,546
Egypt	2,429	249,686	8,179	871,062
Hong Kong	2,654	268,949	5,403	520,453
India, British	5,372	595,999	1,648	167,548
Indochina, French	1,306	138,718	7,396	735,036
Japan	12,799	1,649,174	287	29,126
Mexico	8,646	1,049,305	16,213	1,854,404
Netherland India	4,192	452,890	10,498	1,056,749
Netherlands	12,093	1,487,499	32,784	3,511,715
Norway	2,499	265,487	6,714	651,750
Peru	3,099	351,811	2,775	279,664
Philippine Islands	8,940	991,154	16,298	1,685,486
Portugal	853	87,747	6,256	658,545
Spain	7,154	736,343	2,725	281,327
Sweden	3,871	400,781	13,069	1,269,567
Syria	2,433	257,337	3,769	361,025
Turkey	6,949	736,020	3,289	342,575
Union of South Africa	4,668	515,199	12,563	1,307,478
U. S. S. R	5,659	775,304		
Uruguay	4,567	562,579	6,610	752,093
Other countries [1]	6,950	787,500	15,422	1,616,750
	161,576	19,078,015	311,016	33,032,832
CUSTOMS DISTRICT				
Buffalo	1,582	185,389	9,653	1,100,024
Chicago	3,181	370,041	7,173	721,511
Dakota	6,481	867,323	6,817	799,893
Maryland	72,827	8,461,736	130,690	13,402,067
Michigan	4,984	564,271	9,960	1,098,984
Mobile	102	10,481	2,526	264,558
New Orleans	244	27,540	8,180	866,947
New York	67,688	8,072,602	117,669	12,793,821
Philadelphia	2,938	331,334	10,830	1,133,081
Other districts [1]	1,549	187,298	7,518	851,946
	161,576	19,078,015	311,016	33,032,832

[1] Includes all exports not exceeding $250,000.

PRICES

The average price of Straits tin for prompt delivery in New York in 1939 was 19 percent above that in 1938 but 7 percent below the 1937 average. At the beginning of 1939 the quotation was 46.40 cents a pound, having dropped 0.25 cent over the New Year holidays. The weakness in the London market was evidenced by the gradual decline in the New York price to 45.00 cents on February 15, which proved to be the low for the year. Thereafter, improvement in domestic demand, particularly from the tin-plate trade, was largely responsible for a rise in price to 49.25 cents about the first of May. From May through August minor fluctuations paralleled the trend in the London market and changes in the dollar exchange value of sterling. After the outbreak of war between Germany and the United Kingdom and France on September 1, domestic consumers became apprehensive of a possible shortage and quickly absorbed available spot supplies. As a result, the New York market broke away from parity with London and rose abruptly to 75.00 cents on September 13, the high for 1939. To meet the increased demand for tin and to allay fears of a real shortage the International Tin Committee removed virtually all restrictions on production. This action promptly affected quotations for future deliveries, and by the close of the year the price of spot tin had declined to 49.00 cents.

In London monthly average prices for standard tin, spot delivery, in 1939 ranged from £213.91 per long ton in February to £248.97 in December; the average for August was £229.87. On September 1 the London Metal Exchange was closed temporarily because of the war emergency, but on September 6 quotations were resumed at no appreciable change from August levels. On September 18 the Ministry of Supply for the United Kingdom fixed the maximum price of tin at £230, London and Singapore, but London Metal Exchange quotations continued below this level until October 9, when the fixed price was adopted. On October 16 the Ministry of Supply announced that British firms could sell tin abroad above the maximum price of £230; however, this level was maintained as the official exchange quotation through December 8. Following the removal of all Government restrictions on tin prices on December 11, quotations rose abruptly to £272 but gradually settled to £247.75 at the close of the year.

Tin price data, 1925–29 (average) and 1935–39

	1925–29 (average)	1935	1936	1937	1938	1939
Average prices:						
New York: [1]						
Straits tin……cents per pound	56.64	50.39	46.42	54.24	42.26	50.20
99.75-percent tin (English refined)……do	(2)	50.07	46.29	54.06	42.07	[3] 47.84
99-percent tin……do	55.50	49.28	45.72	53.01	40.84	[4] 46.35
London: [5]						
Standard tin……£ per long ton	254.6	225.7	204.6	242.3	189.6	226.3
Do……cents per pound	55.17	49.39	45.40	53.48	41.39	44.81
Premium allowed over standard:						
Straits……£ per long ton	5.1	4.4	2.6	3.0	4.3	(2)
Banka……do	6.9	5.3	1.7	----	----	(2)
English……do	-.7	.5	-.4	.4	1.3	(2)
Price indexes (1925–29 average=100):						
Straits tin (New York)	100	89	82	96	75	89
Copper (New York)	100	59	65	90	70	75
Lead (New York)	100	54	63	80	63	68
Nonferrous metals [5]	100	69	72	91	74	79
All commodities [6]	100	81	82	88	80	79

[1] American Metal Market. [2] Data not available. [3] 10-month average. [4] 9-month average.
[5] Metal Bulletin, London, as compiled by International Tin Research and Development Council.
[6] Based on price indexes of United States Department of Labor.

Monthly price of Straits tin for prompt delivery in New York, 1937–39, in cents per pound [1]

Month	1937			1938			1939		
	High	Low	Average	High	Low	Average	High	Low	Average
January	51.50	49.80	50.89	42.87½	40.00	41.52	46.80	45.15	46.38
February	55.65	49.90	51.94	42.62½	40.50	41.27	46.37½	45.00	45.62
March	66.62½	54.10	62.71	42.00	38.00	41.15	46.70	45.75	46.21
April	63.50	55.00	58.99	39.90	36.60	38.34	49.25	46.10	47.20
May	57.12½	54.62½	55.63	38.25	35.00	36.84	49.25	48.70	49.02
June	57.25	54.62½	55.84	43.00	37.50	40.35	49.10	48.25	48.85
July	60.25	57.50	59.31	44.25	42.60	43.37	48.75	48.40	48.52
August	60.37½	58.25	59.40	43.90	42.80	43.26	49.50	48.12½	48.76
September	59.87½	55.62½	58.62	44.50	42.65	43.38	75.00	50.00	63.50
October	57.37½	47.62½	51.46	46.40	43.50	45.22	56.00	55.00	55.25
November	47.62½	41.00	43.30	46.70	45.60	46.23	54.00	50.00	52.24
December	44.75	41.00	42.85	46.75	45.85	46.18	52.25	49.00	50.64
Year	66.62½	41.00	54.24	46.75	35.00	42.26	75.00	45.00	50.20

[1] Metal Statistics, 1940, pp. 409 and 411.

STOCKS

Total stocks of virgin tin on hand in the United States at the end of 1939, including metal afloat, increased 38 percent over 1938. Stocks in licensed warehouses were reduced considerably by the sharp demand for spot metal following the outbreak of war in Europe, but tin afloat to the United States and stocks at landings registered substantial gains. Total visible supplies rose 72 percent and consumers' stocks 21 percent during the year. Total stocks on hand at the end of the year, including metal afloat, were equivalent to only a 6.5-month supply at the average rate of consumption in 1939.

World visible supply, exclusive of consumers' stocks, decreased 3 percent in 1939, as the accompanying table shows. These data do not include stocks of metal accumulated by various countries as war reserves.

Stocks of virgin pig tin in the United States December 31, 1935–39, in long tons

	1935	1936	1937	1938	1939
Location of stocks:					
Afloat to United States [1]	7,650	10,857	7,678	4,150	12,663
At landings in New York [1]	2,192	4,990	4,106	1,837	2,415
In licensed warehouses in New York [1]	120	105	2,279	3,320	887
Total visible supply [1]	9,962	15,952	14,063	9,307	15,965
Consumers' stocks [2]	7,786	10,238	[3] 17,678	17,843	[4] 21,600
Total stocks on hand	17,748	26,190	31,741	27,150	37,565

[1] As reported by Commodity Exchange, Inc.
[2] As reported to the Bureau of Mines; does not include tin in process or secondary pig tin.
[3] Revised figures.
[4] Partly estimated.

Visible stocks of tin in the world and in the United States at end of each month, 1925–29 (average) and 1935–39, in long tons [1]

Month	1925–29 (average)		1935		1936		1937		1938		1939	
	World[1]	U. S.	World[1]	U. S.	World[1]	U. S.	World[1]	U. S.	World[1]	U. S.	World[1]	U. S.
January	18,912	2,986	20,345	2,581	19,652	2,985	29,099	5,478	30,493	4,866	39,100	4,624
February	19,620	3,027	23,757	3,571	19,291	3,525	26,341	4,956	29,002	5,116	40,035	5,486
March	18,312	2,803	22,908	4,531	21,448	3,968	27,526	5,731	34,872	4,458	37,788	5,806
April	17,765	2,189	21,001	4,295	19,004	2,713	27,168	4,741	35,359	4,447	37,224	3,385
May	19,085	2,384	20,076	4,930	21,147	2,941	27,320	5,144	33,051	3,679	33,715	3,387
June	18,250	2,390	17,543	5,467	18,583	3,054	27,073	4,810	35,844	4,247	30,039	4,388
July	18,164	2,675	18,174	3,227	18,027	2,151	28,938	6,193	39,119	4,071	29,615	5,339
August	18,339	2,450	17,855	2,681	19,229	3,095	29,371	5,850	41,701	5,232	26,338	3,613
September	18,317	2,425	16,168	2,849	18,403	2,860	26,099	3,538	40,544	4,573	31,168	3,413
October	18,356	2,899	17,411	1,389	20,726	3,315	24,858	3,280	38,945	4,500	38,206	3,536
November	19,058	2,373	18,039	1,472	25,333	3,030	26,176	5,285	37,145	5,060	38,035	3,283
December	20,557	2,277	17,331	2,312	26,846	5,095	29,416	6,385	37,712	5,157	38,280	3,302
Average	18,744	2,573	19,217	3,275	20,641	3,228	27,449	5,116	36,149	4,617	34,962	4,130

[1] Metal Statistics, 1940, pp. 401 and 403. In this table figures for world stocks 1935–39 include carry-over in the Straits Settlements (on lighters and warrants) and carry-over at principal European smelters.

WORLD ASPECTS OF TIN INDUSTRY

International Tin Control Scheme.—During the first quarter of 1939 countries signatory to the production-control scheme were operating under quotas representing 35 percent of standard tonnages. An additional 10 percent was alloted for contributions to the Buffer Pool Scheme described in the Tin chapter in Minerals Yearbook, 1939. At the end of March allotments for the Buffer Pool were terminated. Production quotas for the second quarter were established at 40 percent. On June 14, quotas for the third quarter were fixed at 45 percent, but owing to the sharp increase in demand occasioned by the war the quotas were increased retroactively to 60 percent on September 1, to 80 percent on September 12, to 100 percent on September 18, and to 120 percent on October 11.

Despite the availability of mine stocks previously accumulated in some countries, producers were unable to step up exports fast enough to meet the greatly enlarged permissible quotas. In the third quarter of the year permissible exports for the seven major signatory countries totaled 62,391 long tons, whereas actual exports were only 40,274 tons, leaving an underexport for the 3 months of 22,117 tons. This situation was partly rectified in the fourth quarter, when production schedules overtook export quotas, permitting an overexport of 12,640 tons. For the entire year there was an underexport of 7,456 tons. Nigeria, Netherland India, and Thailand (Siam) more than met their export allotments, but Malaya, French Indochina, Bolivia, and the Belgian Congo fell behind. With a permissible total of 34,944 tons, Bolivia exported 27,215 tons of tin.

Quotas for the final quarter of 1939 originally had been fixed at 60 percent on September 1, raised to 70 percent on October 11, and advanced to 100 percent on November 1. On this date it was agreed that the quota for the first quarter of 1940 should be not less than 60 percent. On December 1 the quota was established at 100 percent but on December 28 it was changed to 120 percent.

The initial stock of 15,000 tons for the Buffer Pool Scheme was completed in March 1939. This stock was to be used to stabilize the price of tin between £200 and £230 per long ton. As the price of tin in London did not go below £208.75, presumably there was no reason for market support from the Pool organization; however, in February the spread between quotations for "spot" and "3-month" tin began to widen, and there was agitation for action by the Buffer Pool. In May it was announced that the Pool was lending tin to the London Metal Exchange to keep the backwardation in check, and in June the Pool actually began selling as the price for spot tin reached £230. In August accumulated sales of the Pool were estimated at more than 3,000 tons. During most of the last 4 months of the year the London price of tin was subject to Government control, and apparently the activity of the Pool was greatly curtailed. On October 16 it was announced that owing to the temporary shortage of tin the Buffer Pool had arranged to sell a small daily quota (25 tons) on the London Metal Exchange.

E. Baliol Scott,[5] editor of the Mining Journal of London, has commented on the International Tin Control Scheme as follows:

> As a price-stabilizing factor international control of tin was as unsuccessful as ever. Owing to the war, it is difficult to say what the range of prices actually was, and on a superficial view it will doubtless be said that the war and not the Control should be blamed for prices reported to have run up in the United States to 70 cents per pound, or say £390 a ton for Straits. But if the situation be examined more closely, it will be realized that this rush to buy tin, after the outbreak of war, was due principally to the United States shortage of supply caused by the belief that the Buffer Pool would keep prices at, or below, £230 per ton for standard. As usual, the I. T. C. delayed the increase of quota too long.

The International Tin Research and Development Council, which consists of delegates appointed by the governments of the principal tin-producing countries, reorganized its activities in 1939. Formerly research was financed at widely dispersed institutions especially equipped to handle special problems. This arrangement did not meet the growing needs for research, and a program of centralization was adopted. In 1939 permanent headquarters were built near London, which contain administrative, laboratory, and library facilities. A research organization also was established at the Battelle Memorial Institute to study general problems and problems peculiar to the tin-consuming industry in the United States. The statistical office of the Council remains at The Hague, Netherlands.

World mine production.—World mine output of tin in 1939 is estimated at 181,000 tons, an increase of 13 percent over 1938 but 13 percent below the record established in 1937. Production in the countries participating in the International Tin Control Scheme in 1939 was 17 percent higher than in 1938, whereas that elsewhere was 4 percent lower. The output of the unrestricted producers comprised 16 percent of the total in 1939 compared with 19 percent in 1938, 15 percent in 1937, and 11 percent from 1925 to 1929. The Malay States continued to be the largest producer and contributed 30 percent of the 1939 total. Netherland India ranked second with 17 percent, Bolivia third with 15 percent, Thailand (Siam) fourth with

[5] Scott, E. Baliol, Tin: Eng. and Min. Jour., vol. 141, No. 2, February 1940, p. 47.

9 percent, and Nigeria fifth with 6 percent. All these countries increased production substantially in 1939. China, which ranked fifth in 1938, produced 10 percent less tin in 1939. There were no outstanding new producers in 1939.

World mine production of tin (content of ore), 1925–29 (average) and 1935–39, by countries, in long tons

[Compiled by R. B. Miller]

Country	1925–29 (average)	1935	1936	1937	1938	1939
Restricted production:						
Belgian Congo	967	5,301	6,301	8,084	8,820	9,663
Bolivia [1]	37,169	25,007	24,052	25,128	25,484	27,211
Indochina	691	1,309	1,381	1,577	1,599	1,470
Malay States:						
Federated [1]	54,606	40,780	64,680	75,117	41,206	52,232
Unfederated	2,206	1,542	1,979	2,075	2,041	2,470
Straits Settlements	25	52	58	72	114	212
Netherland India	33,266	20,184	30,728	39,133	27,299	[1] 31,281
Nigeria	8,319	6,299	9,648	10,782	8,977	[1] 10,855
Portugal	(2)	750	858	(2)	(2)	(2)
Thailand (Siam)	8,204	9,876	12,633	15,786	14,704	[1] 16,991
United Kingdom	(2)	2,050	2,099	(2)	(2)	(2)
Total signatory countries	145,453	113,150	154,417	177,754	130,244	152,385
Unrestricted production:						
Argentina	32	700	940	1,423	1,886	(3)
Australia	2,830	3,130	3,027	3,256	3,329	3,435
Burma	2,228	4,102	4,546	4,636	4,412	(3)
Cameroun, French		217	217	231	242	(3)
China [1]	7,085	9,035	11,082	12,871	11,605	10,422
Germany	98	26	50	[4] 100	[4] 300	(3)
Italy			36	131	271	229
Japan	625	2,197	2,382	2,175	2,186	[4] 1,700
Mexico	2	621	368	373	249	273
Morocco, French	4	40	25	14	27	(3)
Peru			97	173	103	(3)
Portugal	625	(5)	(5)	1,095	1,037	1,490
Portuguese East Africa	5	7	15	6	4	(3)
Rhodesia:						
Northern		5	5	5	3	
Southern	15	7	47	139	267	450
Somaliland, Italian						[4] 40
South-West Africa	149	164	162	169	164	53
Spain	145	300	104	127	110	(3)
Swaziland	138	127	128	108	122	114
Tanganyika	22	145	207	243	241	222
Uganda	98	397	409	361	399	340
Union of South Africa	1,174	622	634	537	558	482
United Kingdom	2,658	(5)	(5)	1,987	1,999	1,890
United States	24	45	101	168	95	34
Total nonsignatory countries	17,957	21,887	24,582	30,328	29,609	28,600
Grand total	163,000	135,000	179,000	208,100	159,900	181,000

[1] Exports. [2] See entry under "Unrestricted production." [3] Estimate included in total.
[4] Estimated. [5] See entry under "Restricted production."

World smelter production.—As considerable tin enters world trade in the form of ore, geographical data on world smelter output differ materially from those on mine output. For example, virtually all ore from Bolivia and Nigeria is smelted in Europe. An appreciable part of the tin ore from Netherland India normally is smelted in the Netherlands, and the product of Siam and Indochina is smelted in British Malaya. The only commercial tin-ore smelter in the Western Hemisphere is in Argentina, and its output has increased somewhat in recent years.

The European War has altered the flow of tin ores to some extent. The smelter at Arnhem, Netherlands, was partly shut down in September, and the ore from Netherland India, formerly smelted at this plant, has been diverted to smelters in British Malaya. Some Bolivian ore formerly was smelted in Germany, but the Allied blockade has stopped this flow. The greater part of the Bolivian output now moves to the United Kingdom, although small tonnages come to the United States, where two new tin-smelting ventures were announced late in 1939. Smelting facilities in the Belgian Congo are to be increased to treat local ores that formerly were shipped to Belgium.

World smelter production of tin, 1925–29 (average) and 1935–39, by countries, in long tons

[Compiled by R. B. Miller]

Country	1925–29 (average)	1935	1936	1937	1938	1939
Argentina	----------	591	591	734	1,093	(1)
Australia	2,952	2,837	2,717	2,907	3,229	(1)
Belgian Congo	----------	1,588	1,955	2,313	2,283	(1)
Belgium [2]	720	4,000	5,100	4,900	6,800	(1)
British Malaya [3]	88,855	60,479	84,591	95,372	63,746	81,536
China	[4] 7,080	9,700	10,400	11,100	11,200	(1)
Germany [5]	3,444	2,042	2,293	2,671	3,000	(1)
Italy	----------	241	286	75	271	(1)
Japan	606	2,036	1,841	1,850	1,900	(1)
Netherland India [4]	14,749	11,221	12,854	13,757	7,207	14,788
Netherlands [2]	[6] 1,000	15,600	20,900	26,600	25,561	15,024
Norway	(1)	454	233	241	254	(1)
Portugal	[7] 2	1	----------	----------	39	(1)
Thailand (Siam)	[8] 113	(9)	(9)	(9)	----------	(1)
United Kingdom [2]	45,800	29,100	34,200	33,800	36,200	(1)
	165,000	139,900	178,000	196,300	162,800	(1)

[1] Data not yet available.
[2] Estimated.
[3] Exports plus difference between carry-over at end and beginning of year.
[4] Exports.
[5] Includes production of some secondary tin.
[6] Estimated production in 1929.
[7] Average for 1926–27.
[8] Average for 1926–28.
[9] Less than 1 ton.

World consumption.—Apparent world consumption of tin in 1939 increased 10 percent over 1938, according to a preliminary estimate of the International Tin Research and Development Council. The figures released by this authority indicate that apparent consumption in the United States advanced 39 percent, whereas that in the rest of the world declined 5 percent. A substantial increase is noted for the United Kingdom, and estimates for 11 months indicate that Japan's apparent consumption was well-maintained in 1939. Data for Germany, France, and Italy are available only for part of the year. If it is assumed that France and possibly Italy had full access to available tin supplies after the Allied blockade was established in September, the decline in apparent consumption of tin outside the United States must be due largely to curtailment of supplies to Germany and the countries over which Germany now has military control. Figures for 7 months indicate a substantial decline in consumption in the U. S. S. R. during 1939.

Apparent tin consumption of the world, 1926–29 (average) and 1935–39, by countries, in long tons [1]

Country	1926–29 (average)	1935	1936	1937	1938	1939
Belgium	1,231	1,250	1,336	1,520	1,618	(3)
Canada	2,346	2,086	2,164	2,625	2,355	(3)
Czechoslovakia	1,513	1,277	1,684	1,731	1,560	(3)
France	10,260	8,210	9,748	9,175	9,049	(3)
Germany [2]	12,444	11,083	9,164	12,368	13,774	(3)
India, British	2,704	2,541	2,293	2,595	2,494	3,131
Italy	4,268	6,641	3,928	3,601	4,618	(3)
Japan	4,506	6,221	6,403	8,190	10,963	(3)
Netherlands	980	1,232	1,284	1,470	1,400	1,220
Poland	589	907	1,322	1,272	1,819	(3)
Spain	1,565	1,713	661	942	1,082	(3)
Sweden	1,373	1,900	1,692	1,889	2,883	(3)
Switzerland	1,742	1,001	1,109	1,100	1,259	1,101
United Kingdom	21,988	21,427	21,860	25,971	18,290	27,279
U. S. S. R	3,791	7,311	9,664	25,125	16,174	(3)
United States	76,539	62,470	73,039	86,663	50,724	70,336
Other countries	15,036	11,930	12,549	12,863	11,438	[4] 1,816
	162,875	149,200	159,900	199,100	151,500	166,000

[1] As estimated by the Tin Research and Development Council.
[2] Includes Austria; the Saar is also included after Feb. 17, 1935.
[3] Included in total.
[4] Denmark and Norway only; others included in total.

REVIEW BY COUNTRIES

The outbreak of hostilities in Europe during the latter part of 1939 resulted in the establishment of many additional barriers to the international flow of minerals. Various prohibitions, restrictions, and control measures were adopted by belligerents and neutrals. The reader is referred to the chapter entitled "World Production of Minerals and Economic Aspects of International Mineral Policies" for details of this aspect of the tin industry in 1939.

Argentina.—Argentine exports of tin concentrates decreased from 988 metric tons during the first 6 months of 1938 to 534 tons for the same period of 1939. Further reduction is expected, as more of the ore will be smelted locally to meet domestic requirements because of the difficulties of obtaining a supply from Europe. Tin smelted in Argentina contains a high percentage of lead.

Belgian Congo.—Increased smelter production of tin in the Belgian Congo is indicated by the announcement that Geomines is expanding its smelting facilities to treat custom tin ores previously shipped to the smelter at Hoboken, Belgium. Transportation difficulties resulting from the war prompted this action.

Bolivia.—Bolivia again failed to produce its quota of tin allowable under the International Tin Control Scheme. Permissible exports for 1939 totaled 34,944 long tons, whereas actual exports were only 27,211 tons. The failure of Bolivia to produce its assigned quotas in recent years has been ascribed chiefly to the shortage of labor resulting from casualties in the Chaco War.

In an excellent summary of the Bolivian tin industry, C. W. Wright,[6] foreign mineral specialist of the Bureau of Mines, makes the following statement on Bolivia's capacity for production:

> Bolivia's tin production is mostly from narrow-vein deposits, and the production costs are in general considerably higher than those in the large-scale dredging operations of the principal tin-producing countries.

[6] Wright, C. W., The Tin-mining Industry and Future Problems: Bureau of Mines Foreign Minerals Quarterly, vol. 2, No. 4, October 1939, 67 pp.

Were it not for the International Tin Cartel which controls and allocates production of the world's tin producers and in which Bolivia has a quota amounting to 23.6 percent, it is doubtful if the Bolivian producers would be able to compete on an open market. Present production capacity is estimated at 3,000 tons of tin a month, but with a somewhat higher price for tin, and mining laws that will encourage mine developments as well as expenditures on plant improvements, it is believed that the monthly output of tin could be increased to 4,000 tons, Under the influence of high prices that prevailed during the Great War, and again from 1926 to 1929, small mines were brought into production.

Various unsuccessful attempts have been made in the past to smelt tin ores in Bolivia. Failures have been ascribed to the refractory nature of the Bolivian ores, the lack of cheap fuel within the country, or the lack of cheap power. The electrochemical plant (Lamy process) started by Mauricio Bony at Oruro, mentioned in previous editions of Minerals Yearbook, apparently has not been successful. It has been reported [7] that after the expenditure of $200,000 work was suspended owing to financial difficulties, and the plant never was completed. It is also reported that the Bony plant will be taken over by G. B. Cobb, of Toronto, who proposes to install six electric furnaces, each capable of producing 10 tons of tin daily. The total cost of the plant is estimated at $350,000, the capital to be supplied by North American interests. According to Cobb, smelting costs will not exceed $40 per ton of tin. Electric power probably will be obtained from the plants of the Bolivian Power Co., Ltd., on the Miguilla River 70 miles north of Oruro. As the present price for power is 2 cents per kilowatt-hour, the possibility of electrosmelting tin economically has been questioned.[8]

A process for distilling tin from low-grade sulfide concentrates, recovering the tin as oxide and reducing the oxide by electrolytic methods, is being studied by the Hochschild group. Late in 1939 it was announced that two companies in the United States were contemplating the smelting of Bolivian tin ores, as was done on a large scale during the World War of 1914–18.

Political events continue to play an important role in the Bolivian tin industry. On June 7, 1939, the administration of President German Busch issued a decree establishing more rigid regulation of the tin industry and imposing 100-percent control over the foreign-exchange realizations on tin exports. The decree was greatly ameliorated by the government that succeeded President Busch upon his death in August.

Dr. Friedrich Ahlfeld, of the Bolivian Bureau of Mines and Petroleum, divides the Bolivian tin deposits into three groups—those associated with plutonic rocks, designated as the normal type; those associated with porphyritic rocks; and alluvial deposits. Deposits of the normal type are the source of 38.4 percent of the total production and constitute 41.1 percent of the reserves, whereas those of the porphyry types represent 58.7 and 57.2 percent, respectively. The alluvial deposits are relatively unimportant, contributing only 2.9 percent of the productive capacity and 1.7 percent of the reserves. The monthly productive capacity of the larger mines is 2,925 metric tons of tin and that of the smaller mines 275 tons, a total of 3,200 tons. The total visible and probable reserve is 520,000 tons of tin, of which the larger mines produce 489,450 tons. Allowing for a 40-percent

[7] Wright, C. W., Work cited in footnote 6.
[8] Wright, C. W., Work cited in footnote 6.

loss in mining and milling and assuming a yearly production of 25,000 tons, reserves will last about 12 years.[9]

British Malaya.—The standard quota for Malaya under the Tin Control Scheme was 77,335 long tons of tin in 1939. Including Buffer Stock, Malaya's permissible quota for 1939 was 58,968 tons, but only 55,963 tons were exported, leaving an underexport of about 3,000 tons. Nevertheless, exports rose about 30 percent in 1939 in contrast to the 44-percent decline in 1938. Employment conditions were better toward the end of the year as a result of increased activity, which began in September. The number of tin miners employed increased from 46,639 at the end of August to 72,954 at the end of December.

The sudden demand for tin, starting in September, was met largely by increasing the dredge output. In August, dredges operating in Perak (Kinta Valley) and Selangor recovered only 11,652 piculs of ore (29 percent of the total), but in September, output in the region increased to 110,139 piculs (47 percent of the total) as a result of bringing 22 idle dredges into operation.

Ores imported in 1939 for smelting in Straits smelters included 22,961 tons from Siam, 10,775 from Netherland India, 4,863 from Burma, 2,166 from French Indochina, and 659 from other countries, a total of 41,424 tons.

The report[10] of Sir Lewis Fermor, who was engaged to study the various problems of the mining industry of Malaya, was published in 1939. It is decidedly critical of the Government land policies that have been restricting the development of mining in recent years. Fermor states that far too much blame has been thrown on the mining industry for damage done to agriculture and estimates that soil losses resulting from the clean weeding on rubber plantations greatly exceed those resulting from mining. Moreover, the total area set aside for mining at the end of September 1938 was only 206,433 acres in contrast to 1,623,045 acres for rubber and 4,861,440 acres for Reserved Forests. He estimates that, as a result of the most generous mining policy, further discoveries of mining land in the Federated Malay States will not exceed 200,000 acres, so that the maximum probable withdrawal from agricultural lands, forest and other reserves, and State lands for mining purposes probably will not exceed 2 percent. He therefore recommends a more sympathetic attitude toward mining in considering problems relating to land use, drainage, and irrigation.

The Fermor report also recommends encouragement of private prospecting and Government surveys so that the total mineral reserves of Malaya may be determined. No new estimate of tin reserves is given. The estimate of 1,000,000 tons of tin in existing leaseholds, made in 1937 by H. G. Harris, Senior Warden of Mines, is used as a basis for discussion, to which Fermor adds a "guess" of 500,000 tons for reserves in unleased lands. The report recommends that Malaya should participate in a Fourth International Tin Control Scheme in 1942 but that every effort should be made to obtain an increase in quota commensurate with Malaya's capacity for production. As the tin industry is depleting a valuable national asset, Fermor urges that a portion of the revenues accruing annually from

[9] Ahlfeld, Friedrich, Systematics and Ore Reserves of the Bolivian Tin Deposits: Abstract of report presented at 8th Am. Sci. Cong., May 1940, Washington, D. C., 2 pp.

[10] Fermor, Lewis Leigh, Report upon the Mining Industry of Malaya: Federated Malay States Government Press, Kuala Lumpur, 1940, 240 pp.

the export tax on tin be set aside to build up an amortization fund of $200,000,000, the interest on which will be a source of revenue to the Government after the tin-ore deposits are exhausted.

The report apparently was not received enthusiastically by some Government officials, and recent press dispatches suggest that no official action on Fermor's recommendations will be taken until the war is over.

Burma.—A substantial part of the Burmese tin output comes from tin-tungsten ores. The largest producer is the Mawchi mine, whence tin-tungsten concentrates are shipped to Rainham, England, for treatment by Murex, Ltd.; 5,078 tons of concentrates were produced during 11 months of 1939. During 1939 Mawchi Mines, Ltd., renewed its lease to December 3, 1970. Estimated ore reserves at the Mawchi mine, as of April 30, 1938, were 643,380 tons of 3.24-percent tin and tungsten. The Burmese Government proposes increasing the scale of royalties payable on tin produced in Burma and has submitted the matter to producers for consideration.

Lenya Mining Co. recently launched a new electric dredge for recovering alluvial tin in the mangrove swamps at Yomone, Lower Burma.[11]

China.—The output of tin in Yunnan is about 10,000 tons a year, with little likelihood of a substantial increase for many years, according to S. B. Archdeacon, technical adviser to the Yunnan Provincial Government.[12] Modern methods have been introduced at the mines to some extent, but primitive methods still predominate. The National Resources Commission of the Chinese National Government plans modernization and increased production at the less-advanced mines operated by the Government near Kochiu. About 100 mining companies at Kochiu employ 80,000 to 100,000 miners.[13]

Government control has affected operations at Hong Kong refineries. Restrictions on exports from Yunnan during the last 6 months of 1939 appear to have brought about the closing of the Fung Tang and Sing Lee refineries, as the Chee Hing, Tin Hing, and Wing Hong plants were reported to be the only ones operating early in 1940.[14] Some tin ore from Yunnan is refined in Indochina, but the quantity appears to have declined during the latter part of 1939. Shipments of tin from Kochiu through Indochina for treatment at Hong Kong likewise decreased during that period. Official trade statistics of Burma do not indicate the movement of tin ore over the Burma-Yunnan Highway in 1939.

The tin deposits of Kiangsi, Kwangsi, and Kwangtung Provinces, which in the past contributed about 13 percent of the total annual output of China, are now under Japanese control.

The United States Export-Import Bank has extended a $20,000,000 credit to the Chinese Government to be repaid from proceeds of sales of tin and other materials imported into this country. The transaction does not contemplate the acquisition of tin by the United States Government.

France.—France consumes approximately 9,000 long tons of tin annually, virtually all of which comes from foreign sources. Esti-

[11] Mining Journal (London), vol. 208, No. 5456, March 16, 1940, p. 167.
[12] Metal Bulletin (London), No. 2395, June 6, 1939, p. 5.
[13] Mining Journal (London), vol. 205, No. 5411, May 6, 1939, p. 455.
[14] American Metal Market, vol. 57, No. 29, February 10, 1940, p. 3.

mated apparent consumption during the first 7 months of 1939 was about 4,600 tons.

Germany.—Statistical details of Germany's tin situation in 1939 are incomplete. Imports of metallic tin for the first 6 months of 1939 were 4,693 long tons compared with 5,816 tons for the same period of 1938. Imports of tin ore for the respective periods were 2,592 tons and 3,513 tons. Apparent consumption (including figures for Austria) for the first 7 months of 1939 was estimated by the International Tin Research and Development Council at 6,649 tons compared with 13,774 tons for the entire year 1938.

Germany's conquest of Czechoslovakia and Poland has increased her dependence on foreign tin, as these two countries in recent years have consumed more than 3,000 tons annually. According to press reports Germany is making every effort to develop production from low-grade deposits within her borders. The Allied blockade greatly reduced receipts of ore and metal from overseas. Wartime control of metal prices was established on October 14, 1939, and the price of pig tin was fixed at 300 marks per hundred kilos.

Italy.—Italy's tin requirements are supplied largely by imports. Apparent consumption totaled 4,618 long tons in 1938 and 2,650 tons in 7 months of 1939. The small domestic output declined in 1939.

Japan.—Japan's consumption of tin, which has increased rapidly in recent years, totaled 9,685 long tons in 11 months of 1939 compared with 10,963 tons in 1938, showing the effect of recent large imports. The Metal Bulletin (London) of February 2, 1940, questions whether these receipts truly reflect Japan's consumption, stating:

> In view of the fact that Japanese consumption is not believed to be equal to these large shipments, it is thought that some of the tin may have been reexported to Europe.

Netherland India.—The permissible export quota of Netherland India for 1939 was 29,779 long tons, including contributions to the Buffer Stock. Actual exports, however, exceeded this figure and amounted to 31,281 tons. Netherland India's share in the Buffer Stock was 2,930 tons, of which the Billiton Co. was allotted 1,196 tons. Banka's production in 1939 totaled 17,544 tons of fine tin and that of Billiton and Singkep, 12,690 tons.

Interest in the proposed merger of the Banka and Billiton operations was revived in 1939. Early in 1937 a bill designed to effect the merger was voted down by the People's Council of Netherland India, the chief objections being the proposed distribution of profits, the financial basis of the merger, and the suggested establishment of the controlling office in the Netherlands. After restudy of the situation, the Colonial Minister in 1939 drafted a new proposal modified to meet in part the Council's objections. The Government share in the new enterprise is to be increased from 90 to 91 percent and will be increased further to 92 percent if the average price of tin during the next 6 consecutive years falls below 1,360 guilders per long ton (32.4 cents per pound at the average 1939 exchange rate of 53.335 cents). In some quarters it was predicted that the new proposal would be approved in 1940, but with the turn of events in Europe in May 1940 official action probably will be postponed indefinitely.

Modernization of operations at Banka continued in 1939. In November it was announced [15] that as a result of further mechanization it will be possible to reduce the number of Chinese employees and substitute Javanese workers with resultant savings in labor costs. Heretofore the Javanese have not proved to be satisfactory industrial laborers because of their inclination to work only for short periods and then lay off to spend their earnings. The Chinese are steady workers, but it has been necessary to import them at considerable expense and under long-term contracts necessitating payment during periods of idleness. Usually 1,000 Chinese are recruited annually in China, but the number is expected to be reduced to 600 in 1940.

The large new Karimata dredge, which was dredging unsuccessfully for ancient lost treasure in the North Sea in 1938, finally arrived at Billiton the latter part of 1939.

Shortly after the outbreak of war in Europe it was reported [16] that the smelters of the Banka organization in Netherland India were capable of treating all Banka ores; however, Banka ores were diverted to smelters in the Straits Settlements after activities at the Arnhem works in the Netherlands were curtailed sharply in the last quarter of the year. Receipts of Banka, Billiton, and Singkep ores in the Straits Settlements in 1939 totaled 10,775 tons, virtually all of which arrived after September 1.

Netherlands.—Smelter production of tin declined sharply in 1939 owing to the drastic reduction in operations at the Arnhem smelter soon after the war started. This resulted from the ban on exports of tin promulgated by the Government in September, and the sharp curtailment of imports of ore from Netherland India and Bolivia caused by the Allied blockade. The Arnhem smelter is situated close to the German border.

Nigeria.—In 1939 Nigeria exceeded her permissible export quota of 8,304 long tons by 2,551 tons. Shipments were greatly accelerated during the last quarter of the year, and the overexport doubtless was due to orders given by the Nigerian Government in the middle of September to ship all available stocks at the earliest possible opportunity.[17] The principal producer is the Amalgamated Tin Mines of Nigeria, Ltd., a 1939 consolidation of Associated Tin Mines of Nigeria, Ltd., and the London Nigerian Tin Mines, Ltd. This company produced 6,121 tons of concentrates in 1939. A possible shortage of gasoline as a result of the war constitutes a threat to tin mining in Nigeria because motor vehicles are used for transportation between mines and railheads. The question of establishing reserve supplies was under consideration in the latter part of the year. In 1938 Nigeria imported 191,000 barrels of gasoline, of which 127,000 barrels were from the Netherland West Indies and 61,000 barrels from the United States.

United Kingdom.—Most of the tin produced in Great Britain is smelted from ores imported chiefly from Bolivia and Nigeria; 36,200 long tons were produced in 1938. In addition to ores, various forms of metallic tin and its alloys are imported, largely from Netherlands and British Malaya. Approximately 2,000 tons of tin are obtained annually from mines and old dumps in Cornwall.

[15] Metal Bulletin (London), June 16, 1939, p. 5.
[16] Metal Bulletin (London), October 13, 1939, p. 5.
[17] Mining Journal (London), vol. 207, No. 5440, November 25, 1939, p. 1000.

Complete statistical data for 1939 are not available, as publication of official figures on foreign trade was discontinued at the outbreak of the war in September. However, the International Tin Research and Development Council estimates apparent consumption at a new peak of 27,279 tons in 1939, an increase of 49 percent over 1938 and 5 percent over the previous record established in 1937. This large gain resulted from the sharp rise in demand for tin plate, production of which advanced 47 percent during the first 8 months of 1939 compared with a similar period in 1938, and the increase in munitions manufacture. In the latter part of the year available supplies of spot tin reached a very low point, causing suspension of all export licenses in October.

The United Kingdom ranks second among the world producers of tin plate, most of which it usually exports. Some tin plate is used in the domestic canning industry, but the domestic pack does not provide enough canned goods to meet home requirements, particularly for fruits. The United States is the principal supplier of canned fruits and shipped about 6,500,000 cases to the United Kingdom in 1939. The first continuous hot-strip mill in the United Kingdom began operations in 1939 at the tin-plate plant of Messrs. Richard Thomas & Co. at Ebbw Vale, South Wales. The plant can produce about 600,000 base boxes of tin plate a week.

Early in March 1939 five large tin-plate manufacturers in Carmarthenshire undertook to work out a program for dealing with excess capacity as a move toward stabilization of the industry. Under one proposal £1,000,000 was to be subscribed for the purchase of obsolete plants; however, many works in South Wales that had been idle as long as 20 years were reopening to meet the demand for tin plate for military purposes and canned goods for storage. Tin-plate production quotas were suspended on June 14 to permit the industry to take care of this extra internal demand. Export quotas remained in force.

During the first 8 months of 1939 the United Kingdom imported 32,071 tons of tin ore and concentrate, of which 21,544 tons came from Bolivia and 4,260 tons from Nigeria. Imports of blocks, ingots, and bars during this period totaled 3,260 tons, of which 1,100 tons were reexported. Exports of tin during the 8 months ended August 31, 1939, totaled 13,345 tons, of which 7,084 tons went to the United States, 589 tons to Canada, and 850 tons to the U. S. S. R. In the same period of 1938 exports were 7,584 tons, of which only 382 tons went to the United States, 476 tons to Canada, and 2,945 tons to the U. S. S. R.

On October 12 it was announced that a trade agreement had been signed with the U. S. S. R. to exchange Soviet timber for British rubber and tin. The tin is to be the product of Cornish mines.[18] The United States proposed to barter its surplus agricultural products for tin and rubber, but the final agreement involved only an exchange of United States cotton and British rubber.

U. S. S. R.—Until recent years production of tin in the U. S. S. R. was negligible. Although reliable statistics have not been available, it has been reported that production began in 1935 and has increased steadily. A recent press dispatch states that about 5,000 tons were produced in 1937 and some 7,000 tons in 1938. Reserves are reported

[18] Mining Journal (London), vol. 207, No. 5434, October 14, 1939, p. 901.

to have been doubled in 1938 as a result of developments in eastern Siberia, the Far East, Ukraine, Caucasus, Urals, Kazachstan, and Kirgisia. These discoveries are said to make it possible for the U. S. S. R. to achieve self-sufficiency in tin. Heretofore it was generally believed that tin deposits in the U. S. S. R. were relatively low grade and refractory from a metallurgical standpoint. New processes are reported to have been worked out for treating the complex ores. The same dispatch described present and proposed tin operations in the U. S. S. R.[19]

In October consummation of an agreement to exchange Russian timber for British tin and rubber was announced.

[19] American Metal Market, vol. 46, No. 245, December 23, 1939, p. 3.

ARSENIC AND BISMUTH

By Herbert A. Franke [1]

SUMMARY OUTLINE

ARSENIC

Production of white arsenic in the United States in 1939 was the highest on record, exceeding that in 1938 by 34 percent and that in 1924 (the previous peak) by 11 percent. Total domestic consumption was the second highest on record (being surpassed only in 1937), but the sale and use of arsenic from domestic sources were greater than ever before. Net imports comprised only 34 percent of the total consumption, as the European war stopped the increasing flow of foreign material. Exports of domestic white arsenic and calcium and lead arsenate, destined chiefly to South and Central America, also broke previous records. The selling price reported by domestic producers of arsenic was the lowest in history, although at New York the official quotations for white arsenic remained at 3 cents per pound in 1939, the same as in 1938. Federal and State Governments fighting grasshopper, Mormon-cricket, and white-fringed beetle invasions and the fruit-spraying industry consumed the largest proportion of white arsenic. Farmers in the South used less calcium arsenate in dusting cotton fields than in recent years.

World production and consumption of arsenic also increased in 1939 over that in 1938.

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

Salient statistics for arsenic in the United States, 1925–29 (average) and 1936–39

	1925–29 (average)	1936	1937	1938	1939
WHITE ARSENIC					
Domestic sales: [1]					
Crude .... short tons	2,364	8,755	10,903	9,428	17,070
Refined .... do	10,035	6,826	6,733	3,732	5,369
Imports for consumption .... do	10,769	17,586	19,256	14,238	14,674
Apparent consumption [2] .... do	(3)	32,167	34,692	25,098	33,913
Average value for domestic sales: [1]					
Crude .... cents per pound	2.69	1.52	1.33	1.40	1.00
Refined .... do	3.57	2.58	1.86	1.73	1.42
OTHER ARSENICALS					
Imports for consumption:					
Metallic arsenic .... pounds	208,672	81,671	150,659	16,868	39,197
Sulfide (orpiment and realgar) .... do	575,506	355,463	502,418	241,602	656,498
Arsenic acid (H_3AsO_4) .... do	14,692	149	684	55	210
Calcium arsenate .... do	1,452	817,200	796,243	400,000	1,627,193
Lead arsenate .... do	[4] 2,133	....	551	....	11,557
Sheep dip .... do	135,929	224,097	208,060	168,932	306,900
Paris green and London purple .... do	4,402	33,207	108,825	103,556	45,823
Sodium arsenate .... do	82,105	4,694	13,482	11,881	7,482
Exports:					
Calcium arsenate .... do	[5] 2,159,168	6,294,563	5,383,365	5,242,882	6,731,103
Lead arsenate .... do	[5] 1,328,828	827,560	1,042,880	1,021,345	1,712,583

[1] Includes sales by domestic producers for export.
[2] Adjusted for exports by domestic producers.
[3] Complete data not available.
[4] 10,467 pounds in 1925 and 200 pounds in 1929; no imports from 1926 to 1928, inclusive.
[5] Average for 1928–29; exports of calcium arsenate and lead arsenate not separately recorded by Bureau of Foreign and Domestic Commerce prior to 1928.

PRODUCTION

Increased smelter activity in the United States in 1939 effected a 34-percent gain in production of white arsenic (As_2O_3).

The American Smelting & Refining Co. shipped flue, baghouse, and Cottrell dusts, speiss, and other smelter-refinery byproducts containing arsenic for refinement to its Tacoma (Wash.), Murray (Salt Lake City, Utah), and El Paso (Tex.) plants. The Anaconda Copper Mining Co. produced byproduct white arsenic in the treatment of copper ores at its Anaconda (Mont.) smelter, and the United States Smelting, Refining & Mining Co. produced arsenic at Midvale, Utah. In recent years these smelters and refineries have recovered more arsenic per ton of ore treated and more finely divided arsenic than ever before. The increase in recovery is attributed to improvements in plant flue-dust recovery systems and to the higher price received for gold, which permitted the mining of lower-grade gold ore high in arsenious oxide. The finer grain of the product is the result of fine-ore grinding and flotation concentration.

Crude and refined white arsenic produced and sold by producers in the United States, 1935–39

Year	Crude			Refined			Total		
	Production (short tons)	Sales		Production (short tons)	Sales		Production (short tons)	Sales	
		Short tons	Value [1]		Short tons	Value [1]		Short tons	Value [1]
1935	7,583	6,985	$204,681	6,654	5,685	$292,777	14,237	12,670	$497,458
1936	9,937	8,755	266,113	5,442	6,826	352,713	15,379	15,581	618,826
1937	9,936	10,903	290,733	6,878	6,733	250,822	16,814	17,636	541,555
1938	12,619	9,428	264,004	4,066	3,732	129,018	16,685	13,160	393,022
1939	17,499	17,070	343,000	4,842	5,369	152,500	22,341	22,439	495,500

[1] Partly estimated.

Production, as reported by the Bureau of Mines, is measured after the low-grade flue dusts containing 20 to 30 percent As_2O_3 are subjected to a roasting or preliminary refining process. This crude arsenic usually contains 97 to 98 percent As_2O_3. Most of the crude arsenic and a small quantity of better-grade arsenic obtained in certain parts of smelter flue systems are marketed without further refining. Some crude arsenic is refined further. Bureau of Mines statistics on refined arsenic include only products containing 99 percent or more As_2O_3. The arsenic reported as a refined product is not duplicated in the crude arsenic statistics.

CONSUMPTION

Sales of domestic white arsenic advanced 71 percent in 1939, but at a sacrifice in price. Arsenic imported for consumption, however, increased only 3 percent. Apparent consumption (sales plus imports minus approximate exports) of white arsenic in the United States in 1939 totaled 33,913 short tons compared with 25,098 in 1938 and 34,692 in 1937. Net imports represented only 34 percent of consumption in 1939 compared with 48 percent in 1938. However, in addition to white arsenic, other arsenic products were imported for consumption; details are shown in the table of salient statistics at the beginning of this chapter.

Of the domestic arsenic sold, 76 percent was crude and only 24 percent refined. Since 1934 sales of crude arsenic have gained at the expense of the refined product. This condition is attributed to demands by consumers for the lowest-price usable product and to keener competition among producers, who have improved their recovery processes to the point where 97 to 98 percent instead of 93 to 95 percent As_2O_3 is the first crude product. Consumers have become as particular concerning the physical as the chemical specifications, and those outside of the glass industry usually demand a screened product of 200-mesh or finer. The distribution in sales of domestic arsenic in 1939 by uses was approximately as follows: Insecticides, 66 percent; weed killer, 14; glass manufacture, 3; wood preservative, 2; and miscellaneous (including arsenical drugs), 1. Exports comprised 14 percent.

The sale of imported white arsenic by uses was canvassed for the first time in 1939, and reports received from importers accounting for about 47 percent of the imports show that 88 percent of that sold was employed in insecticides, 6 percent in glass, 3 percent in weed killer, 2 percent in wood preservative, and 1 percent in gas-refining, pharmaceutical, and other miscellaneous uses. Minor quantities of foreign arsenic were used in disinfectants and polishing and cleaning soaps; chemical intermediates; colors and printing inks; paints; and steel and other metal manufactures. A third of the arsenic imported contained 99 percent and the remainder 97 to 99.5 percent As_2O_3. Most of the arsenic was consumed by manufacturers on the Atlantic and Pacific seaboards and in Hawaii and a smaller quantity in the Southern States.

No definite data are available on the domestic consumption of arsenical insecticides in 1939. Calcium arsenate consumption is believed to have been below normal (which is about 30,000,000 pounds), because the boll-weevil infestation was severe only in the eastern half of the Southern States and intensive leaf-worm control was necessary only in eastern Texas. Consumption of lead arsenate probably remained about the same as in recent years (about 50,000,000 pounds). Substitution of the rotenone-bearing root poisons and sodium fluoaluminate slightly affected the use of arsenical insecticides, especially those employed on truck crops and to a limited extent on fruit trees. The severe winter of 1939–40 is generally believed to have killed many insects; in consequence, less calcium arsenate should be used in the cotton fields in 1940. Some fruit-growing sections of the United States did not experience a severe winter, and consumption of lead arsenate probably will be about normal.

Federal and State agencies in 1939 extended their war against the grasshopper and Mormon-cricket invasions west of the Mississippi River and the white-fringed beetle menace in the South. The Department of Agriculture bought grasshopper-bait ingredients and shipped them to selected centers, where they were mixed and distributed through State and local agencies to farmers to be spread over their fields. Each ton (2,000 pounds) of grasshopper bait included bran, sawdust, and 10 gallons of liquid sodium arsenite containing 32 percent As_2O_3 or 4 pounds of white arsenic per gallon. Arsenicals used in 1939 by Federal and State agencies totaled 1,536,000 gallons of liquid sodium arsenite for grasshoppers and 84,000 gallons for white-fringed beetles, 338,000 pounds of dry sodium arsenite for Mormon crickets, and 420,000 pounds of calcium arsenate, also for white-fringed beetles. The congressional appropriation for control of incipient or emergency outbreaks of insect pests or plant diseases was reduced from approximately $5,000,000 for the fiscal year 1940 to $2,500,000 for 1941, as an unobligated balance and some insecticidal material remained from the previous year. Although the grasshopper attacks are not expected to be as serious in 1940 as they were in 1939, the Mormon crickets and white-fringed beetles are expected to offer a greater menace than before. It is estimated that in 1940 Federal and State agencies will use 1,170,000 gallons of liquid sodium arsenite in grasshopper bait, 420,000 pounds of dry sodium arsenite in destroying Mormon crickets, and 800,000 pounds of calcium arsenate and 100,000 gallons of liquid sodium arsenite in fighting white-fringed beetles.

Free arsenical drugs distributed by State and Territorial health departments to private physicians and clinics for the control of venereal diseases increased from 2,799,110 doses in the fiscal year 1938 to 4,677,757 in 1939, a gain of 67 percent. Arsenical drugs administered to clinic patients increased 71 percent—from 1,854,735 to 3,166,342 doses.[2] Manufacturers and distributors sold 12,390,837 doses of arsenical drugs in the United States during the calendar year 1939.

Until recently the Army and Navy Munitions Board classed arsenic as an essential material, and it still keeps arsenic under surveillance. Although arsenic is consumed chiefly in insecticides and weed killers, it is used also in the manufacture of "chilled shot," toxic gases, and various alloys. Owing to the present interest in national defense, it seems appropriate to give the following table on production and consumption of white arsenic since 1910.

[2] U. S. Public Health Service, Progress in Venereal Disease Control during Fiscal Year 1939: Reprint 121 from Venereal Disease Information, vol. 20, December 1939, pp. 376–378.

Production,[1] sales, imports, exports, and apparent consumption of white arsenic in the United States, 1910–39, in short tons

Year	Production [1]	Sales	Imports	Exports [2]	Apparent consumption
1910	1,497	(3)	1,348	----------	2,845
1911	3,132	(3)	1,921	----------	5,053
1912	3,141	(3)	3,103	----------	6,244
1913	2,513	(3)	1,519	----------	4,032
1914	4,670	(3)	1,594	----------	6,264
1915	5,498	(3)	1,400	----------	6,898
1916	5,986	(3)	1,071	----------	7,057
1917	6,151	6,151	1,178	----------	7,329
1918	6,323	6,323	1,847	----------	8,170
1919	6,029	6,029	4,389	----------	10,418
1920	11,502	11,502	3,740	----------	15,242
1921	6,158	4,786	1,669	----------	6,455
1922	9,350	10,027	1,081	----------	11,108
1923	14,902	14,271	10,152	(3)	24,423
1924	20,177	14,453	8,877	(3)	23,330
1925	12,119	12,317	9,316	(3)	21,633
1926	6,759	11,805	7,703	(3)	19,508
1927	11,730	11,560	12,517	(3)	24,077
1928	14,163	11,767	11,153	(3)	22,920
1929	16,605	14,546	13,157	(3)	27,703
1930	17,057	17,425	10,471	(3)	27,896
1931	17,137	13,777	7,791	1,400	20,168
1932	12,704	12,483	6,882	2,000	17,365
1933	10,650	11,797	10,583	2,000	20,380
1934	13,096	15,623	14,110	2,700	27,033
1935	14,237	12,670	15,075	800	26,945
1936	15,379	15,581	17,586	1,000	32,167
1937	16,814	17,636	19,256	2,200	34,692
1938	16,685	13,160	14,238	2,300	25,098
1939	22,341	22,439	14,674	3,200	33,913

[1] For years prior to 1910 see Mineral Resources of the United States, 1919, pt. 1, p. 19.
[2] As reported by producers.
[3] Data not available.

PRICES

Although domestic quotations for white arsenic at New York remained at 3 cents per pound, packed in barrels, in carlots, throughout 1939, producers actually received much less for their product than heretofore. Sales increased 71 percent in quantity but only 26 percent in value. The average selling value was 1.00 cent per pound for crude and 1.42 cents for refined arsenic, a reduction of 29 and 18 percent, respectively, from 1938. The lower price is attributed to more severe competition existing in a limited market adequately supplied with both domestic and foreign arsenic and to increased deliveries of arsenic in bulk instead of in costly barreled containers. The following table shows the range in prices of various arsenical compounds.

Range of quotations on arsenic and its compounds at New York (or delivered in East), 1938–39, in cents per pound [1]

	1938	1939
Arsenic metal, lump, cases	40.00–41.00	40.00–60.00
White arsenic (As_2O_3), domestic, kegs, carlots	3.00	3.00
Red arsenic (As_2S_2), imported, cases	15.75–16.50	15.75–20.00
Calcium arsenate, wholesale, drums, carlots	6.75– 7.25	6.75– 7.25
Lead arsenate, wholesale, drums, carlots	11.00–13.00	10.00–11.50
Sodium arsenate, wholesale, drums	8.00	8.00
Sodium arsenite, dry, works, drums, white	9.00–13.00	9.00–11.00
Sodium arsenite, dry, works, drums, gray	7.50– 9.50	7.50– 9.50

[1] As reported by Oil, Paint, and Drug Reporter.

The minimum quotations given in the table often are dealers' prices and in some instances were in effect in 1939 only during the first half of the year. Delivered prices for most arsenicals vary in different sections of the United States. The price for arsenic metal rose from 40 to 60 cents (nominal) in September, after which prices ceased to be quoted. Part of the last half of the year no prices were quoted for red arsenic. Both commodities are imported from Europe (no domestic output) and doubtless became scarce as the war affected shipping conditions. In March 1940, a price war between domestic insecticide manufacturers developed, and minimum prices dropped from 11 to 8.5 cents per pound for lead arsenate and from 6.75 to 6 cents for calcium arsenate.

London quotations for white arsenic soared after the outbreak of European hostilities, rising from £12 per long ton to £22 in October 1939 and to £31 in December for Cornish brands (99 percent As_2O_3). Prices for Mexican (99 percent As_2O_3) and Swedish (99.5 percent As_2O_3) grades of arsenic increased from £10 5s–£10 15s. to £18–£20 in October and to £29–£30 in December.

FOREIGN TRADE

Imports of white arsenic in 1939 increased 3 percent over those in 1938 but were 24 per cent less than those received during the peak year 1937. Of the 1939 total, Mexico supplied 55, Sweden 18, France 15, Japan 7, Canada 3, and Belgium 2 percent. Imports from Mexico and Sweden declined 4 and 7 percent, respectively, whereas those from France increased 87 percent. After war was declared in Europe, the increasing flow of arsenic from France stopped, and shipments from Sweden became scarce.

White arsenic imported for consumption in the United States, 1935–39, by countries

Country	1935		1936		1937		1938		1939	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Australia	56	$2,334	690	$30,500						
Belgium	129	4,450	1,000	30,433	708	$20,373	565	$16,100	323	$10,098
Canada	1,068	65,540	378	25,908	599	48,896	689	29,854	471	24,760
France	2,354	65,609	44	1,419	828	18,838	1,176	30,843	2,200	50,224
Germany	10	906	23	2,213	7	663	112	5,656	(1)	4
Japan	1,058	42,866	887	41,957	798	37,380	482	17,199	963	30,079
Mexico	9,274	525,140	8,174	426,590	11,500	556,097	8,422	415,180	8,124	377,568
Sweden	1,126	30,524	6,390	182,204	4,816	138,617	2,792	93,197	2,593	69,304
	15,075	737,369	17,586	741,224	19,256	820,864	14,238	608,029	14,674	562,037

[1] Less than 1 ton.

Arsenical compounds other than white arsenic appear in the table of salient statistics. Imports of arsenic metal more than doubled those of 1938 but were much less than those of 1937 and the average for 1925–29. Germany supplied 96 percent and France (a new exporter) 4 percent of the metal. Increases in imports also were recorded for the following products: Arsenic sulfide, 172; arsenic acid, 282; calcium arsenate, 307; lead arsenate, 100; and sheep dip, 82 percent. Imports of paris green and London purple decreased 56 percent and of sodium arsenate 37 percent. The 656,498 pounds of arsenic sulfide imported included 336,217 pounds from Belgium, 166,277 from Germany, and 146,386 from France. Of the larger imports of calcium arsenate (1,627,193 pounds), 1,214,050 pounds came from Japan, 260,043 from Belgium, and 153,100 from France.

Domestic producers indicate that about 3,200 tons of white arsenic were sold for export in 1939 compared with 2,300 tons in 1938. Official export data thereon are not available. Exports of calcium and lead arsenate increased 35 percent in 1939 and were larger than ever before. This increase is attributed to larger purchases by South and Central American countries whose European sources of supply were restricted by the war. Of the 6,731,103 pounds of calcium arsenate exported (28 percent more than in 1938), 4,867,580 went to Peru, 653,106 to Mexico, 444,109 to Canada, 286,860 to Brazil, 279,894 to Argentina, 62,936 to Salvador, and 40,000 to Colombia. Of the 1,712,583 pounds of lead arsenate exported (68 percent more than in 1938), 567,845 went to Brazil, 235,050 to Argentina, 200,912 to Chile, 184,352 to the Union of South Africa, 81,710 to New Zealand, 72,305 to Cuba, 60,442 to Canada, 50,724 to Colombia, 47,932 to Australia, 47,549 to Mexico, and 46,725 to Switzerland.

TECHNOLOGIC DEVELOPMENTS

Adding 0.1 percent arsenic has brought about substantial improvements in the lead-tin type wiping solder used to connect joints of lead-sheathed telephone cables. The arsenic-bearing solder forms much less dross and has a finer and more uniform texture than ordinary lead-tin solder.[3]

The production of sodium arsenate from sodium arsenite by electrolysis has been found simple, safe, and economical under certain conditions.[4]

A continuous process for manufacturing arsenic acid (H_3AsO_4) with arsenious oxide (As_2O_3) [5] reduces the consumption of nitric acid. A patent issued to two Swedish inventors [6] simplifies and cheapens the method of manufacturing calcium arsenate, which is usually produced by the reaction of arsenic acid with slacked lime in a suspension in water. In the process covered by the invention, calcium nitrate, the oxidizing agent, and calcium oxide are mixed and heated with arsenious oxide to produce calcium arsenate of any desired composition.

WORLD PRODUCTION AND CONSUMPTION

World output of marketable white arsenic in 1939 is estimated at 58,000 metric tons, a 5-percent increase over that estimated for 1938 (55,000 tons). The increase is attributed to intensified smelter activity, except in Mexico, where production dropped because of depressed mining conditions influenced by Government legislation. Accurate world-production data are not available, because some countries fail to record arsenic statistics and others report only sales or exports.

[3] Schumacher, E. E., and Phipps, G. S., A Lead-tin-arsenic Wiping Solder: Metals and Alloys, vol. 11, No. 3, March 1940, pp. 75–76.
[4] Lowenstein, Leo, Electrolytic Preparation of Sodium Arsenate: Paper presented at 76th meeting, Electrochem. Soc., Preprint 76-3, New York, September 11–13, 1939, pp. 29–33.
[5] Scott, Garnett L. (to General Chemical Co.), Arsenic Acid: U. S. Patent 2,165,944, July 11, 1939.
[6] Lindblad, Axel R., and Palen, Anders G. P. (to Bolidens Gruvaktiebolag), Calcium Arsenate: U. S. Patent 2,156,595, May 2, 1939.

World production of white arsenic, 1935–39, by countries, in metric tons [1]

[Compiled by R. B. Miller]

Country	1935	1936	1937	1938	1939
Australia:					
New South Wales	376	124	------	------	(2)
Western Australia	3,788	3,526	2,087	4,063	1,439
Belgium-Luxemburg Economic Union (exports)	3,093	2,731	3,039	2,706	3,332
Brazil	696	732	717	519	(2)
Canada	1,161	619	630	987	790
China	1,200	(3)	(2)	(2)	(2)
Chosen	373	230	------	(2)	(2)
France	5,887	9,750	6,501	(2)	(2)
Germany (exports)	5,508	2,739	2,852	2,845	(2)
Greece	167	85	234	77	(2)
Hungary	------	------	100	(2)	(2)
Italy	------	------	------	810	(2)
Japan	3,161	2,629	(2)	(2)	(2)
Mexico	9,950	8,527	10,762	8,894	7,063
Portugal	60	150	112	1	(2)
Rumania	------	------	------	6	(2)
Southern Rhodesia	------	------	------	19	------
Sweden (sales) [4]	6,350	8,647	(2)	(2)	(2)
United Kingdom	175	155	97	66	(2)
United States	12,916	13,952	15,253	15,136	20,267
	54,900	55,700	(2)	(2)	(2)

1 Arsenic is also believed to be produced in Czechoslovakia, Peru, Rumania, Turkey, and the U. S. S. R. Production figures are not available for these countries.
2 Data not available. 3 Data not available. Estimate included in total.
4 Arsenic content of ores mined is as follows: 1935, 24,418 tons; 1936, 23,312 tons; 1937, 20,954 tons; and 1938, 21,480 tons.

World consumption of arsenic is estimated to average 55,000 tons annually,[7] of which the larger part is consumed by the insecticide industry. The continued extensive use of arsenic as an insecticide has become endangered by the substitution of certain organic compounds that are less toxic to man than arsenicals (particularly poisonous lead arsenate used on fruit). Consuming countries that import large quantities of arsenic and its compounds include the United Kingdom, Peru, Argentina, Italy, Algeria, Netherland India, the Union of South Africa, Uruguay, and British India. Belgium and Germany, outstanding exporters, import substantial quantities of arsenic-bearing ore. Sweden, Mexico, France, the United States, Japan, and Canada also export considerable white arsenic and arsenical compounds.

Belgium.—The Belgochimie, S. A., 36 rue Ravenstein, Bruxelles, Belgium, produced metallic arsenic in 1939, and the Metallo-Chemical Corporation, 117 Liberty Street, New York, N. Y., was agent for the product in the United States. In 1939 Belgium's imports of arsenic metal totaled 7.6 metric tons (all from Germany) and its exports 5.1 tons. Of the 3,332 tons of white arsenic exported (2,706 in 1938), 1,365 went to the United Kingdom, 549 to the United States, 297 to Brazil, 296 to Argentina, and 253 to Germany.

Canada.—Canada produced 790 metric tons of arsenic (not otherwise specified) in 1939 (987 in 1938) and exported 411 tons (625 in 1938). White arsenic imports totaled 234 tons (91 in 1938). The United States received the 411 tons exported and shipped virtually all of the arsenic imported.

France.—Imports of metallic arsenic during the first 7 months of 1939 totalled 5.2 tons and exports 7.3 tons. Exports of white arsenic during the period totaled 2,494 tons.

7 Roskill & Co., Ltd., O. W., World Economic Review of Insecticides and Allied Products: London, June 1939, p. 41.

Germany.—Of the 1,608 tons of white arsenic imported during the first 7 months of 1939, 1,295 came from Sweden and the rest from Belgium and France. Of the exports in the same period (1,337 tons), 188 tons went to Brazil, 186 to the Netherlands, 169 to Spain, 148 to Hungary, and 118 to Turkey. During the year the Government made available to farmers 5,000 tons of calcium arsenate to fight the potato-beetle menace in western Germany.

Italy.—The S. A. Stabilimenti di Rumianca of Turin, on behalf of the Italian War Ministry, completed a new white-arsenic plant in the spring of 1940. The new works, together with the smaller plant at Pieve Vergonte, will be able to supply all Italian arsenic requirements. Arsenical pyrite from the Val d'Ossola is the raw material.

Mexico.—In 1939 Mexico produced 7,063 metric tons of white arsenic (8,894 in 1938) and exported 6,985 tons (8,854 in 1938). All exports in 1939 were shipped to the United States.

Sweden.—The Bolidens Gruv A.-B. has established several arsenic-salt timber-impregnation plants in Sweden and has begun tests in various parts of the world to prove the advantages of arsenic over creosote in wood preservation.

United Kingdom.—In recent years Cornish tin mines have produced less than 200 tons of white arsenic annually, and it has been necessary to import most of the British requirements (chiefly from Sweden, Belgium, and Mexico). After war was declared, consumers found it difficult to obtain adequate supplies, and arsenic prices more than doubled.

BISMUTH

Consumption of bismuth in the United States is believed to have increased substantially in 1939. Lack of complete data on production, sales, exports, and stocks makes it impossible to determine domestic consumption of bismuth accurately. Ordinarily, output of byproduct bismuth exceeds consumption by the pharmaceutical and alloy industries, but in 1939 greater demand forced producers to withdraw metal from their ample stock piles. Although imports of bismuth gained 98 percent, receipts of bismuth compounds and salts declined 85 percent. After the outbreak of the European war in September 1939 publication of unofficial data on bismuth exports ceased. During the first 8 months of 1939, however, exports gained almost 40 percent over those in all of 1938. The New York and world price for the metal rose in March 1939 from $1.05 to $1.10 per pound and in October 1939 to $1.25. Manufacturers of certain bismuth compounds and salts advanced their prices accordingly in October.

The general increase in smelter activity in 1939 brought about an increase in world production of bismuth. Demand for bismuth in Europe showed marked improvement during the last half of 1939, and world consumption is estimated to have risen about 30 percent. Part of the increased demand abroad probably can be ascribed to the stocking of metal for national defense and against possible further advances in price. The price increase in October is attributable to differences in the world monetary exchange, to the greater demand for bismuth, and to wartime shipping conditions which made some supplies unavailable. After European hostilities began, it is probable that German production, consumption, and exportation of bismuth were severely curtailed. The loss of export trade was advantageous to English, French, and American salt makers, who acquired a large share of the world business.

PRODUCTION

As heretofore, there were three domestic producers of bismuth in 1939. The American Smelting & Refining Co. produced bismuth-lead alloy at its Selby (Calif.), Perth Amboy (N. J.), and Monterrey (Mexico) plants for refinement at Omaha, Nebr. The Kroll-Betterton process [8] employed in lead debismuthization uses calcium, magnesium, and sometimes antimony. The Anaconda Copper Mining Co. obtained bismuth from Montana copper and Utah lead ores. However, the final bismuth recovery was made by the International Smelting & Refining Co. at East Chicago, Ind., which refined Tooele lead-bismuth bullion by the Parkes and Sperry methods and recovered bismuth from the slimes by a process involving various patents. The United States Smelting, Refining & Mining Co. shipped a lead-bismuth bullion from Midvale to the United States Smelting Lead Refinery, Inc., at East Chicago, Ind., where slimes from the Betts electrolytic process were treated for their bismuth content. The Cerro de Pasco Copper Corporation also supplied a substantial part of domestic bismuth requirements in 1939, importing metal derived from copper-lead ore in Peru.

In March 1940 the Bunker Hill & Sullivan Mining & Concentrating Co. began operating a new $500,000 plant for the production of bismuth and antimony, which was added to the lead smelter-refinery at Kellogg, Idaho. The installation was necessitated by impairment of the quality of lead produced by the former pyrometallurgical process, which failed to remove all the bismuth. By means of the new Lee-Muir process hydro-, pyro-, and electro-metallurgy are used to separate the silver, copper, antimony, and bismuth in the tetrahedrite ore from the Big Creek silver belt of the Coeur d'Alene district.

CONSUMPTION

Domestic consumption of bismuth is believed to have advanced in 1939 to approximately 500,000 pounds. Probably 90 percent of the metal was used by manufacturers of pharmaceutical and medicinal compounds, salts, and mixtures and the rest by the metallurgical industry.

The principal bismuth compounds employed by the pharmaceutical trade included bismuth subcarbonate, used in antiacid or stomach remedies and in preparing patients for X-ray examinations; bismuth subnitrate, used in antiacid compounds, dusting powder, and in treating venereal diseases; bismuth subgallate, used to soothe intestinal disorders; and bismuth subsalicylate, used in treating venereal diseases and intestinal troubles. Other compounds included bismuth citrate, nitrate, sulfide, trioxide, betanaphthol, etc. In 1939 a stable alkali metal bismuth saccharate solution was invented (U. S. patent 2,178,126, issued on October 31, 1939, to C. W. Sondern and G. O. Doak) for intramuscular injection in conjunction with the treatment of syphilis.

[8] Betterton, Jesse O., and Lebedeff, Yurii E., Debismuthizing Lead with Alkaline Earth Metals, Including Magnesium, and with Antimony: Trans. Am. Inst. Min. and Met. Eng., vol. 121 (Metallurgy of Lead and Zinc), 1936, pp. 205–225.

The outstanding metallurgical characteristic of pure bismuth metal is its property of expanding 3.32 percent in cooling from the liquid to the solid state. This property, together with its low melting point and the even lower melting point of the alloys of which it forms a part, constitutes the basis for important industrial uses.[9] Low-melting-point and nonshrinking bismuth alloys have numerous applications, and in 1939 the use of bismuth in the metal-products-manufacturing industry continued to advance slowly but steadily. Fusible boiler, sprinkler, and other safety plugs and devices, low-melting solders, dental models, and tempering baths for small tools and parts employed bismuth alloyed with lead, tin, cadmium, mercury, or antimony. An alloy containing 55.5 percent bismuth and 44.5 percent lead changes very little in volume and was used extensively for duplicating patterns, for making master patterns in foundries, and for proof-casting forging dies. Bismuth alloys were employed as thin-walled tube fillers for bending and forming work; as castings for use in making molds for plastics, rubber, seamless hollow objects, and die castings; as matrices for the accurate location and setting of parts of complex punches and dies for forming and cutting operations and for similar machine- and stamping-shop accessories; and as oil-, air-, and water-tight seals between dissimilar materials, such as glass and copper or brass. The Ekko process, developed by the United States Rubber Co. for producing dies or molds in which a photographic likeness can be transferred to iron by the electroforming method, is expected to provide a larger outlet for the bismuth-lead alloy "cerrobase." The use of bismuth in low-melting solders is expected to increase further as a result of experimental work.

PRICES

In March 1939 the New York quoted price for bismuth metal was increased from $1.05 to $1.10 per pound for ton lots, and in October 1939 the price was advanced further to $1.25 per pound, according to Engineering and Mining Journal Metal and Mineral Markets. At the same time, London quotations per pound increased from 4s. 3d. to 4s. 6d. and then to 6s. 3d. for 5-hundredweight lots. According to the Oil, Paint, and Drug Reporter, the minimum price for bismuth subcarbonate increased from $1.53 per pound at the beginning of 1939 to $1.73 (fiber drums) at the end of the year, subnitrate from $1.33 to $1.48, and subgallate from $1.58 to $1.68, but the price for subsalicylate remained at $2.35 until January 1940, when it advanced to $2.50.

FOREIGN TRADE

Imports of bismuth metal in 1939 were the greatest since 1912 (182,840 pounds) and exceeded those of 1938 by 98 percent. The entire 182,832 pounds imported were from Peru. Imports of compounds, mixtures, and salts of bismuth declined 85 percent, indicating the effect of the war on Germany, normally the largest exporter to the United States. France shipped the largest quantity in 1939, supplying 250 pounds valued at $107, but imports from Germany continued highest in value, totaling 28 pounds valued at $406. Bismuth also is imported as lead-bismuth alloy and possibly in other

[9] Bregman, Adolph, Bismuth for Fusible Alloys, Models, and Matrix Work: Iron Age, vol. 144, No. 3, July 20, 1939, pp. 40-42.

intermediate metallurgical products, statistical data for which are not available.

Official export data on bismuth are not separately recorded, but until the outbreak of European hostilities in September the Oil, Paint, and Drug Reporter published shipments from Atlantic and Gulf ports. For the first 8 months of 1939 these shipments totaled about 314,100 pounds, an increase of almost 40 percent over those reported for all of 1938 (225,600 pounds). Bismuth exports probably set a new high record in 1939. Most of the bismuth exported is destined to British and French ports.

Bismuth and "compounds, mixtures, and salts of bismuth" imported for consumption in the United States, 1935–39

Year	Bismuth		Compounds, mixtures, and salts of bismuth	
	Pounds	Value	Pounds	Value
1935	102,051	$78,061	871	$4,798
1936	113,443	86,722	564	4,807
1937	67,225	54,007	3,145	9,117
1938	92,298	74,583	2,004	3,387
1939	182,832	154,339	297	649

WORLD PRODUCTION AND CONSUMPTION

Lack of data makes it difficult to estimate accurately world production and consumption of bismuth. As a result bismuth statistics are somewhat confused. Another factor to be considered in connection with production of bismuth metal is the intermittent operation of bismuth-refining plants. Bismuth residue or concentrates recovered in lead and copper smelters or as byproducts in other nonferrous-metal plants often are not refined the same year but are held until metal stocks become low. Thus, the official data on bismuth production that are available do not necessarily present the actual trend in output by years. Increased smelter output resulted in greater world production of byproduct bismuth in 1939—possibly in excess of 3,000,000 pounds. Of this production, the United States, Peru, Canada, and Mexico supplied almost 90 percent. The rest came from Bolivia, Spain, Argentina, Japan, Belgium, France, Germany, and other countries. Production of bismuth ore from scattered operations in China and elsewhere was handicapped by unfavorable shipping conditions caused by the wars.

European consumption of bismuth is estimated at 1,500,000 pounds in 1938 and 2,000,000 pounds in 1939 and world consumption at about 2,600,000 pounds (2,000,000 in 1938). Perhaps part of the gain in world demand in 1939 was due to stocking for national defense and against a possible increase in price. Substantial quantities of bismuth were withdrawn from producers' stocks in 1939; however, it is believed that with the increased output the large stocks that have accumulated were only slightly reduced. The industry wishes to maintain adequate stocks to prevent a "run-away" price market, such as occurred during the World War. The stabilization of bismuth prices in recent years is due largely to the World Bismuth Cartel and has resulted in a slow but steady increase in world consumption of bismuth, especially its alloys. A great advance in price not only would decrease use of the metal but also would foster output from sources other than the present smelter byproduct production, which now is greater than consumption. Considerable metal doubtless could be obtained from ores valued chiefly for their bismuth content, such as those in Bolivia. However, it is believed that metal cannot be recovered from these ores at the present price level, which must be maintained if consumption is to advance.

North America.—In 1939 Mexico produced 360,859 pounds of bismuth (409,612 in 1938). In Canada the Consolidated Mining & Smelting Co. at Trail, British Columbia, produced 409,449 pounds of bismuth in 1939. The output of Canada in 1938 was only 9,516 pounds. Canadian imports in 1939 included 10,252 pounds of bismuth metal (only 297 in 1938), all of which came from the United States.

South America.—In Peru the Cerro de Pasco Copper Corporation produced 886,320 pounds of refined bismuth (482,382 in 1938), 89,820 pounds of bismuth-lead bullion (containing 71,620 pounds of bismuth), and 79,180 pounds of eutectic alloy (containing 43,940 pounds of bismuth). Peru exported 848,182 pounds of refined bismuth in bars (454,657 in 1938) and 171,385 pounds of bismuth in lead (49,955 in 1938). The metal content of Bolivian bismuth concentrates exported in 1939 totaled 28,660 pounds (42,316 in 1938). Bismuth concentrates containing 40 to 48 percent bismuth were shipped from the Province of Cordoba, Argentina. Pegmatite dikes worked at São José de Brejaúba, Municipality of Ferros, Minas Geraes, Brazil, for their semiprecious stones (beryl and aquamarine) contained isolated bodies of metallic bismuth and bismuth carbonate. Bismuth occurs in the copper-ore deposits in the Pedra Branca region, Paraíba, and Rio Grande do Norte, Brazil.

Europe.—The British-French blockade caused a scarcity of bismuth in Germany, and early in 1940 the medical profession was asked to reduce prescriptions containing bismuth to a minimum. Germany has exported considerable quantities of bismuth compounds and salts; for the first 7 months of 1939 these exports totaled 126,103 pounds compared with 153,662 and 162,481 pounds for all of 1938 and 1937, respectively. The importation of salts into the United States from Germany dropped from 2,000 pounds in 1938 to 28 in 1939. The United Kingdom and France probably continued to be the world's largest importers of bismuth in 1939. Data are not available on British imports in 1939, but in 1937 they aggregated 703,847 pounds, of which 624,557 pounds were reported as from the United States and 75,506 from Canada. Shipments recorded as from the United States doubtless included bismuth metal of foreign origin (shipments en route, or from bonded warehouse, which originated in Peru and Mexico) as well as of domestic origin. The basis for British bismuth quotations was changed from sterling to the dollar in September owing to fluctuations in the monetary exchange. The metal is on the "no export except under license" list. French imports in the first 8 months of 1939 totaled 264,555 pounds (352,740 in all of 1938). In 1939 the Central Scientific Experimental Institute of Rare and Small Metals at Novosibirsk, U. S. S. R., began production of bismuth metal. This experimental plant will continue to recover metal from Zabaikal tungsten-molybdenum concentrates and from Adrasmansky copper-bismuth concentrates. The electrolytic zinc plant at Ordzhonikidze also is producing bismuth, and recovery of bismuth is contemplated from the lead-zinc ores mined at Tetiukhe. Data are not available on the resumption of bismuth-ore production in Spain, once the principal European producer.

Africa, Asia, and Australia.—The Union of South Africa, Uganda, and other countries in Africa probably produced small quantities of bismuth ore in 1939.

Native bismuth produced in the Tavoy district, Burma, totaled 224 pounds in 1935, 112 in 1936, 246 in 1937, and none in 1938. Bismuth ore originating in China and exported from Hong Kong totaled only 9,733 pounds in 1939 (51,454 in 1938) and went to Australia and the United Kingdom.

Queensland, Australia, produced concentrates containing 1,120 pounds of bismuth metal and 5,600 pounds of bismuth-tungsten ore in 1939. Operations were resumed at the wolframite-molybdenite-bismuth mines, Bamford Hill.

MAGNESIUM

By Herbert A. Franke and M. E. Trought

SUMMARY OUTLINE

Production (sales) of primary magnesium in the United States in 1939 was more than double the previous peak established in 1938, owing to large increases in domestic and foreign demand for the metal. The aircraft industry was chiefly responsible for the sharp advance in domestic demand. It not only produced more planes in 1939 but also substituted magnesium products for other materials in many parts of airplanes. The automobile, portable and high-speed equipment, textile, and other industries also extended their use of magnesium. Total consumption of structural and nonstructural products of primary magnesium and magnesium-rich alloys, used in these industries, advanced 77 percent; the use of structural products alone gained 84 percent and the manufacture of castings 73 percent. Nonstructural fabrications consumed by the munitions, chemical, and electrical industries increased 26 percent in 1939 over those in 1938. Doubtless the quantity of magnesium employed as a component in aluminum and other alloys and as a scavenger and deoxidizer in the metallurgical industry also rose appreciably. Although official data are not available, it is believed that a substantial part of the sales of domestic magnesium were exports, chiefly to the United Kingdom. Demand for metal from domestic and foreign consumers was so great in 1939 that exports had to be restricted. The lack of data on exports and stocks makes it impossible to evaluate the actual increase in domestic consumption of magnesium in 1939 compared with previous years.

The Dow Chemical Co., sole domestic producer of magnesium, enlarged its production facilities at Midland, Mich., in 1939 and began construction of a new plant at Freeport, Tex., in March 1940. The new magnesium plant will more than double the company capacity and will give the United States facilities to produce about 25,000,000 pounds of metal annually.

The quoted nominal price of magnesium at New York was reduced from 30 cents per pound (prevailing since 1931) to 28 cents in March 1939 and 27 cents in August 1939.

As a result of the rapid increase in demand for military aircraft abroad, consumption of magnesium probably established new peaks in 1939 in other countries. World output of magnesium may have increased about 35 percent over that indicated for 1938. Germany continued to be the chief producer and consumer, using magnesium alloys extensively in airplanes and automobiles and in place of heavier imported materials in other industries. The United Kingdom probably exceeded the United States in production and consumption of the metal, and France and Japan advanced rapidly.

Some authorities believe that consumption of magnesium will continue to expand because of the abundance of magnesium raw materials, the metal's lightness and strength, the improvements being made in corrosive resistance and fabrication technique, and the recent reductions in prices. America has not progressed as far as Europe in the use of magnesium alloys as construction materials, owing largely to the availability of aluminum and other alloys, the lower resistance to corrosion of magnesium, and the greater difficulties in fabrication.

Salient statistics of the magnesium industry in the United States, 1937–39

	1937	1938	1939
Primary magnesium sold or used....short tons..	2,270	2,410	5,325
Quoted price per pound [1]....cents..	30.0	30.0	27.0
Imports....pounds..	1,321	60	76
World production (estimated)....short tons..	21,900	26,400	36,200

[1] Lowest nominal price (New York) for primary metal ingot 99.8 percent pure, carload lots.

PRODUCTION

Production (sales) of primary magnesium in the United States in 1939 was the largest in history and totaled more than the combined output in 1937 and 1938; however, the 10,650,121 pounds sold or used in 1939 included some metal withdrawn from stocks.

Magnesium sold or used by producers and imported into the United States, 1935–39

Year	Sold or used by producers		Imports for consumption [1]	
	Pounds	Value	Pounds	Value
1935	4,241,218	(2)	884	$1,292
1936	3,903,312	(2)	1,126	1,479
1937	4,539,980	(2)	1,321	1,727
1938	4,819,617	(2)	60	188
1939	10,650,121	(2)	76	49

[1] Includes alloys and scrap (magnesium content).
[2] Bureau of Mines not at liberty to publish figures.

The Dow Chemical Co. enlarged its production facilities at Midland, Mich., in 1939 and to meet the tremendous demand for metal began construction of a $5,000,000 plant at Freeport, Tex., in March 1940 for completion late in the summer of 1940. The Texas plant will more than double the present annual capacity of 12,000,000 pounds. Magnesium chloride for the electrolytic process to be used at the Freeport plant will be obtained from sea water instead of underground brines, as at Midland. No data are available on the method to be used for extracting the $MgCl_2$ from the sea water, but apparently the reduction process will be similar to the one now employed at Midland, which was described by Gann in 1930 and 1932.[1] Minor changes

[1] Gann, John A., The Magnesium Industry: Ind. Eng. Chem., vol. 22, 1930, p. 694; Magnesium: Min. and Met., vol. 13, 1932, pp. 179-183.

since Gann described the process include the use of near-anhydrous $MgCl_2$ in the feed to 60,000-ampere cells.

Figure 1 shows trends in magnesium production and prices since 1915.

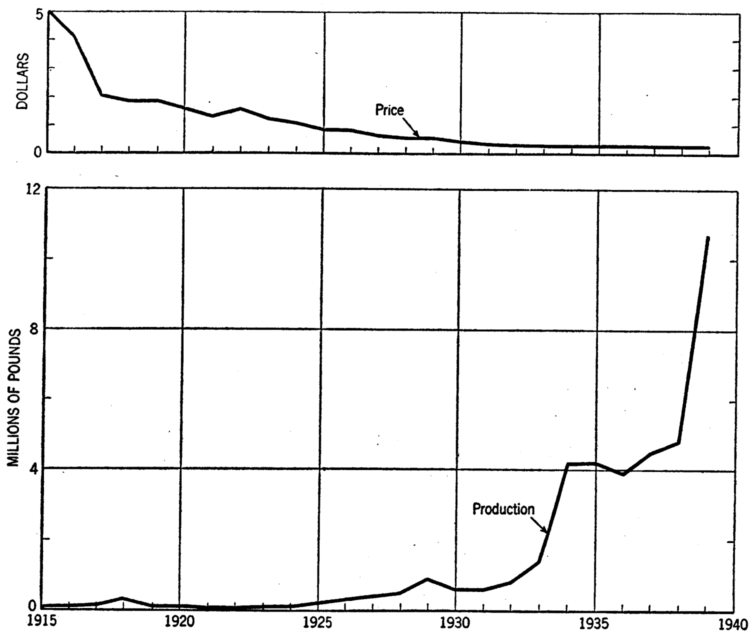

FIGURE 1.—Trends in quoted price and production of magnesium in the United States, 1915–39.

CONSUMPTION

As stated the large increase in demand for magnesium in the United States in 1939 is attributed chiefly to consumption by the aircraft industry. There was also a broader adoption of magnesium products in 1939 by certain nonaircraft industries, such as textiles, sewing machines, automobiles, conveying equipment, typewriters and other business machines, and heavy machinery.

The huge advance in use of magnesium alloy in the aircraft industry indicates not only augmented aircraft production but also the use of magnesium for more parts than formerly. Both military and civil authorities have accepted magnesium alloys to a greater extent since the corrosion resistance of the alloys has been improved. Because of the lightness and strength of these alloys, their use in aircraft results in increased pay loads and improved performance.[2] As aircraft-production capacity is expected to exceed 2,000 planes monthly in 1940, consumption of magnesium should be larger than ever.

[2] Winston, A. W., Magnesium Alloys and Their Use in Aircraft: Metal Progress, vol. 36, No. 3, September 1939, pp. 237–242.
Grant, L. B., Magnesium Alloys for Aircraft Parts (paper presented before Nat. Aircraft Production Meeting of Society of Automotive Engineers, Los Angeles, October 7, 1939): Iron Age, vol. 144, No. 18, November 2, 1939, pp. 36–39.

Quantitative data are not available on the increase in total consumption of domestic magnesium owing to the lack of information on exports and stocks. Complete data, however, are available on the manufacture of structural and nonstructural products of magnesium or high-magnesium alloys, sales of which gained 77 percent in 1939. Sales of structural products advanced 84 percent and nonstructural products 26 percent.

Magnesium products (other than ingot and stick magnesium) manufactured in the United States and sold or used by the companies manufacturing the products, 1937–39

[This table includes only the products made from magnesium or alloys containing high percentages of magnesium. It does not include the large quantity of metal used as a deoxidizer and in alloys with low magnesium content]

Product	1937		1938		1939	
	Pounds	Value	Pounds	Value	Pounds	Value
Structural products:						
Castings:						
Sand and permanent mold	1,180,190	$1,375,884	1,067,310	$1,392,882	1,321,080	$2,030,175
Die					525,372	385,770
Sheet	118,284	74,924	124,930	79,764	180,896	116,287
Structural shapes, rods, and tubing	[1] 86,954	[1] 94,250	80,206	49,972	308,443	185,746
Forgings	31,939	18,568	5,924	6,541	17,065	26,925
Other structural	1,024	1,797			3,404	2,553
Total structural products	1,418,391	1,565,423	1,278,370	1,529,159	2,356,260	2,747,456
Nonstructural products:						
Wire and ribbon	[1] 811	[1] 3,020	184,223	259,256	232,244	228,129
Shavings	[2] 59,354	[2] 26,042				
Powder	[2] 40,502	[2] 75,110				
Total nonstructural products	100,667	104,172	184,223	259,256	232,244	228,129
Grand total	1,519,058	1,669,595	1,462,593	1,788,415	2,588,504	2,975,585

[1] Some products formerly classified as "Wire and ribbon" are included under "Structural shapes, rods, and tubing."
[2] Minor quantities of shavings included under "Powder"; separate figures not available.

Castings comprised 78 percent of the structural products sold or used in 1939; of these, 72 percent were sand and permanent-mold castings (chiefly the former) and 28 percent die castings. The value of magnesium sand and permanent-mold castings in 1939 averaged $1.54 per pound; die castings, $0.73 per pound; and all castings, $1.31 per pound (the same as in 1938). Approximately 60 percent of all castings were used in airplane and aircraft-engine construction, and the remainder by the automobile, portable-equipment-and-tool, electric-motor (chiefly in squirrel-cage rotors), and foundry-equipment industries. Magnesium-alloy die castings were adopted for three starter and generator parts of a popular low-priced automobile and for many additional applications in the textile, business machine, and optical equipment fields. The engine hood, radiator shell and grille unit, control quadrant, and most of the instrument panel of a new lightweight tractor also are made of magnesium alloy. The European automotive industry has made wide use of magnesium alloys for a number of years, particularly for castings for bus and truck crankcases and transmission housings.[3]

[3] Alwicker, H., Use of Magnesium Alloys in the European Automotive Industry: Soc. Automotive Eng. Jour., vol. 45, No. 3, September 1939, pp. 9–13, 17–19.

In 1939 sales of sheet rose 45 percent; structural shapes, rods, and tubing, 285 percent; and forgings, 188 percent. The aircraft industry, which for the last few years has used increasing quantities of sand castings, also began using rolled sheet, extruded shapes, tubing, forgings, and die castings in 1939. In the United States magnesium-alloy sheet was produced for the first time for such interior parts of airplanes as walls, floors, seat and berth parts, partitions, doors, and other secondary structures. The Railway Express Co., Inc., adopted a portable roller-type gravity conveyor made almost entirely of magnesium alloy for loading and unloading. In Europe considerable quantities of magnesium alloy were used to construct tubes for thermit type incendiary bombs.[4] Magnesium wire was employed by the domestic electrical-equipment industry; magnesium ribbon for chemical uses; and magnesium shavings, powder, and sawdust for pyrotechnic, chemical, and welding applications. Shavings and coarse powder also were used for the synthesis of certain organic chemicals by the Grignard reaction, as in the production of phenyl ethyl alcohol and butyl alcohol.

Pure magnesium ingot and some magnesium alloy were used as scavengers and deoxidizers in the metallurgical industry, particularly for the degasification and cleansing of nickel, nickel-silver, monel metal, copper, brass, bronze, and aluminum. Magnesium also was employed to debismuthize lead by the Betterton refining process. Aluminum alloys carrying as much as 10 percent magnesium are more resistant to alkaline corrosion than other aluminum alloys and, when heat-treated, develop the highest tensile strength of any aluminum casting alloy.

All the magnesium fabricators in the United States in 1938 (listed in Minerals Yearbook, 1939, pp. 708–709) were active in 1939 except the Madison-Kipp Corporation. The Hoover Co., however, discontinued production and use of magnesium die castings during the year. The Ford Motor Co., 3674 Schaefer Road, Dearborn, Mich., resumed manufacture of magnesium sand castings in 1939, and the Magna Manufacturing Co., Inc., Haskell, N. J., began producing magnesium powder early in 1940. The Dow Chemical Co. began operating a new foundry at Bay City, Mich., and during the summer of 1940 will complete construction of a new sheet-rolling mill at Midland, Mich. The American Magnesium Corporation began operation of a magnesium foundry at 5151 Magnolia Avenue, Los Angeles, Calif., and Magnesium Fabricators, Inc.,[5] a division of the Bohn Aluminum & Brass Corporation, extended its plant at Adrian, Mich. Magnesium Products, Inc., 1119 Santa Fe Avenue, Los Angeles, Calif., and the Hills-McCanna Co., 2353 Nelson Avenue, Chicago, Ill., made magnesium products for the first time in 1939. Doubtless, other fabricating concerns mentioned in Minerals Yearbook, 1939, also enlarged manufacturing facilities in 1939.

Only a little magnesium scrap is on the market, and it is remelted by the Dow Chemical Co. and a new firm, Aluminum & Magnesium, Inc., Sandusky, Ohio, which produces secondary magnesium ingots. Most foundries remelt their own scrap, adding it to primary-alloy charges.

[4] Astbury, A. R., Materials in Relation to A. R. P.: Chem. and Ind. (London), vol. 58, No. 3, January 21, 1939, p. 43.
[5] Allen, A. H., Molding and Casting Magnesium: Steel, vol. 105, No. 26, December 25, 1939, pp. 36–38.

PRICES

The nominal New York price for 99.8-percent ingot magnesium, carload lots, was reduced from 30 cents per pound (prevailing since 1931) to 28 cents in March 1939 and 27 cents in August 1939. Ingot quotations for less than carload lots, 100 pounds or more, fell to 29 cents per pound. The price for extruded sticks, carload lots, was reduced to 34 cents per pound; for less than carload lots, 100 pounds or more, to 36 cents per pound. Alloy ingot normally is quoted at 3 cents per pound more than pure magnesium ingot. London quotations for magnesium ingot and stick advanced from 1s. 5d. to 1s. 6d. late in 1939. At the close of the year powder ranged from 3s. 9d. to 8s. 6d. per pound, according to grade and specification.

FOREIGN TRADE

Although official export data on magnesium are not separately recorded, it is reported that a substantial quantity of metal was exported in 1939, chiefly to the United Kingdom. Owing to the enlarged domestic demand and limited production facilities the domestic producer was unable to meet the greater demand from abroad in 1939. Imports in 1939 comprised only 66 pounds of magnesium metal and scrap valued at $24 and 10 pounds of magnesium alloys valued at $25, all from Germany. In 1938 imports totaled 60 pounds of sheets, tubing, ribbons, etc., valued at $188.

TECHNOLOGIC DEVELOPMENTS

The Dow Chemical Co. now can produce magnesium with improved resistance to corrosion by reducing such harmful impurities as iron by a special settling process. Surface-treatment methods for the decoration and protection of magnesium alloys from corrosion were developed further in 1939.[6] Exposure tests on magnesium alloys coated with chemicals and paint showed higher stability and very satisfactory performance. Magnesium-manganese alloys and magnesium-aluminum alloys with additions of zinc or tin offered more resistance to corrosion, and surface treatments using either the phosphoric-acid or chrome-pickle process seem satisfactory.[7] New primers also were developed for painting magnesium-alloy surfaces not chemically treated.

The art of die-casting magnesium alloys has advanced rapidly, and sound, dense metal now can be obtained at costs comparable to those of other die-cast alloys. The principle improvements in die casting have been the construction of strong, rigid, high-pressure machines that fill the die rapidly through well-placed gates and the introduction of cast-steel melting pots designed to maintain sulfur dioxide in contact with the molten metal and thus to inhibit active oxidation. An experimental die-casting alloy with superior tensile and yield strength after heat treatment was developed in 1939.

Alloys with improved mechanical properties and chemical stability that were introduced in 1939 included a sand-casting alloy, Dow-

[6] Grant, Leo, Surface Treatment of Magnesium Alloys: Metal Ind. (New York), vol. 37, Nos. 11 and 12, November and December 1939, pp. 544–545 and 605–606.

[7] Mutchler, W., and Galvin, W. G., Tidewater and Weather-exposure Tests on Metals Used in Aircraft, also The Effect of Continuous Weathering on Light Metal Alloys Used in Aircraft: Nat. Advisory Comm. Aeronautics, Repts. 736 and 663, 1939, 28 and 27 pp.

metal C (AM 260), characterized by better pressure tightness and more uniform properties; a sheet alloy, Dowmetal J-1 (AM C57s), characterized by high strength and resistance to corrosion; and a relatively low cost extrusion alloy, Dowmetal FS (AM 52s), which has greater stability than those used before.[8] An experimental wrought alloy containing 5.5 percent silver, Dowmetal Z, exhibits high hardness and high yield and ultimate strengths when heat-treated and aged. Extrusion and forging alloys put on the market have better resistance to corrosion than heretofore and are specified both by the Navy Bureau of Aeronautics and the Army Air Corps. Better corrosion resistance is obtained from new magnesium alloys by adjustment of the alloy composition and careful control of iron, copper, and nickel impurities.

Manufacturers also learned more about the art of forming and drawing magnesium-alloy sheet, particularly as to correct temperature control, rate of deformation, and type of equipment required.[9] Electric-spot- and gas-welding methods progressed and proved important in aircraft assemblies.

The Metallurgical Division of the Bureau of Mines obtained an appropriation in 1939 to continue its magnesium research at Pullman, Wash., and during the year discovered that better results are obtainable in the concentration of low-grade magnesite ores by flotation when cationic and anionic collectors are used alternately in successive steps. Other developments included a floating cathode cell which produces a superior quality of metal in electrolyzing crude $MgCl_2$. Hydrocarbon oil is used instead of hydrogen to chill and condense the magnesium vapor produced in the electrothermal reduction of magnesium oxide by carbon, and the magnesium and oil are separated by distillation.[10]

In Italy, Montecatini plans to produce magnesium from sea water by first freeing the water of carbonates by the addition of calcium oxide, then adding milk of lime to precipitate magnesium hydroxide, which is washed with carbonate-free sea water and treated with carbon dioxide. Next the crystalline magnesium carbonate recovered by filtration is treated with sodium chloride and water to give sodium-hydrogen carbonate and $MgCl_2$. The latter is dried, dehydrated, and electrolyzed in the molten form.[11]

WORLD PRODUCTION

Official data on world production of magnesium continues to be unavailable, but recently more trustworthy estimates of output have appeared in the literature than heretofore. Magnesium has strategic importance because of its use in military aircraft, flares, and bombs, therefore information on the industry is shrouded in secrecy in most countries. The figures in the following table are based entirely upon estimates except those for the United States, which represent actual sales. These data show that total world output of magnesium increased 21 percent from 1937 to 1938 and about 35 percent from 1938 to 1939. The United States produced 15 percent of the total in 1939.

[8] Jerabek, H. S., Gross, W. H., and Wood, R. T., Magnesium Alloys—Compositions, Properties, and Designations of American Commercial Alloys: Metal Prog., vol. 37, No. 2, February 1940, p. 159.
[9] Dow Chemical Co., Dowmetal Magnesium Alloys: Handbook, August 1, 1939, pp. 42-44.
[10] Dean, R. S., Progress Reports—Metallurgical Division, 34. Annual Report of the Metallurgical Division, Fiscal Year 1939: Bureau of Mines Rep. of Investigations 3480, 1940, pp. 43-54.
[11] Light Metals, Light Alloys and the Light Metal Industries in Italy: Vol. 3, No. 27, April 1940, p. 104.

Estimated world production of magnesium, 1937–39, by countries, in metric tons

Country	1937 [1]	1938 [1]	1939
France	1,500	1,800	2,500
Germany	12,080	14,100	16,500
Italy	66	102	300
Japan	1,200	1,500	(2)
Switzerland	230	300	700
U. S. S. R.	700	1,000	(2)
United Kingdom	2,000	3,000	5,000
United States (sales)	2,059	2,186	4,831
	19,800	24,000	32,800

[1] Partly based upon data supplied by Consul Sydney B. Redecker, Frankfort on the Main, Germany, and published in Bureau of Mines Mineral Trade Notes, vol. 9, No. 3, September 20, 1939, p. 9; and Lumsden, J., Magnesium, Magnesite, and Dolomite: Imperial Inst. (London), 1939, p. 23.
[2] Estimate included in the total.

Australia.—An electrolytic magnesium plant has been proposed at Hobart, Tasmania, to utilize dolomite occurring near Smithton.

Canada.—Adequate magnesium-bearing raw materials (including brucite, impure magnesite, dolomite, serpentine, and sea water) and cheap hydroelectric power are available in Canada, and, according to reports, Canada soon will begin to produce magnesium. The Consolidated Mining & Smelting Co. of Canada, Ltd., is experimenting with various magnesium-reduction processes. Interests in eastern Canada also are contemplating production of the metal. The National Research Council, Ottawa, is experimenting on electrolytic and electrothermic production methods.[12]

France.—Reports indicate that the four French magnesium producers increased output 40 percent in 1939. The output of the two principal works, at Saint-Auban and Jarrie, is sold by the Sté. Général du Magnesium. The two smaller producers are the Sté. Bozel-Malétra, at Villard, and the Sté. Astral, at Moissac. During the first 7 months of 1939, imports of magnesium totaled 213 metric tons compared with 121 tons during the same period of 1938.

Germany.—The German and Austrian production of magnesium probably reached full capacity in 1939 despite the shortage of power in some sections of the country. Adequate raw materials were available for the plant at Bitterfeld, which utilizes magnesium chloride solution from potash waste liquors in conjunction with domestic dolomite and Austrian magnesite, and for the plant at Heringen, which uses specially selected carnallite. Both plants employ an electrolytic process, whereas the Radenthein (Austria) plant uses magnesite and a new thermal reduction process. Germany has adequate magnesium-fabrication facilities; one of the larger producers and fabricators of magnesium alloys is the Rachwitz plant near Leipzig, belonging to Bernhard Berghaus & Co., a subsidiary of I. G. Farbenindustrie. War demands for magnesium are said to exceed output, and in the fall of 1939 use of the metal was restricted to purposes authorized by control authorities.

Italy.—New magnesium plants under construction in Italy in 1939 included one at Bolzano belonging to the Società Anonima Italiana per il Magnesio e le Leghe di Magnesio, of Milan; another at Cogne, Aosta Valley, owned by the Società Nazionale Cogne; and a third at Apuania, near Rome, to be operated by Montecatini. The first two

[12] Pidgeon, L. M., Production of Magnesium: Canadian Chem. and Process Ind., vol. 23, No. 8, August 1939, pp. 395–400.

plants, each having an annual capacity of 2,400 tons, will utilize dolomite from new deposits discovered in the Dolomite Mountains, while the third plant (1,200 tons annual capacity) plans to use sea water. The dolomite is expected to yield from 8 to 10 percent magnesium. At Bolzano the magnesium oxide will be reduced with ferrosilicon. The plant and dolomite deposits near Palmos Suergiu, Cagliari, Sardinia, belonging to the Società Anonima Magnesio Italiano Sulcis, sole Italian magnesium producer for several years, was purchased by the Società Nazionale Cogne and German interests and apparently was abandoned. The three new plants plan to attain capacity production (6,000 tons) by 1941.

Japan.—Magnesium and aluminum plants will be constructed in Korea and Manchuria to utilize the low-cost power of the Suiho hydroelectric works on the Yalu River, which is to be completed in 1940. Magnesium plants are proposed by the Korean Riken Metals Co. at Heijo (1,000 to 2,000 tons annual capacity), the Dai Nippon Salt Industrial Co. in the Antung-Shingishu district, the Japan Soda Co., Ltd., and the Kokusan Light Metal Industrial Co. Large reserves of magnesite are available in Manchuria and Korea. Three concerns, Minami-Nippon Kagaku, Minami-Nippon Engyo, and Asaki Denka, proposed to establish magnesium plants on the Island of Formosa, but reports indicate that only the last-mentioned concern received official authorization. No data are available on the production of magnesium in 1939 by the established Japanese producers, Nichiman Magnesium Co., Ltd., Japan Magnesium Metal Co., Ltd., Asahi Electro-Chemical Industry Co., Ltd., and Japan Soda Co., Ltd., but it is believed that output increased substantially. Licenses to construct new or to extend old magnesium plants were recently granted to the Kwanto Electro-Chemical Co. at Shibukawa, the Biken Kinzoku Co. at Ube, the Nippon Magnesium Co. at Toyama, the Toyama Keikinzoku Co. at Hakata, and the Okuro Kogyo Co. at Shimada.

United Kingdom.—The number of companies active in the production of magnesium is believed to have increased from two [13] in 1938 to five by the end of 1939. The latter include Magnesium Elektron, Ltd., at Clifton Junction; Magnesium Metal & Alloys, Ltd., at Rainham, Essex; Magnesium Metal Corporation, Ltd., at Port Tennant, Swansea, England; Lancashire Metal Subliming Corporation, at St. Helens, Lancashire; and the Cardiff Corporation, Cardiff, South Wales. In addition, a pilot plant is operated at Avonmouth, England, by the Imperial Magnesium Corporation, Ltd. British dolomite is used as raw material by the first producer, and the others probably use either domestic dolomite or imported magnesite. The direct Government control of supplies and prices of primary aluminum and some other materials has not yet been applied to magnesium.

During the first 8 months of 1939 the United Kingdom imported 1,521 metric tons of magnesium compared with 1,491 tons for the same period in 1938. Most of the tonnage imported in 1939 probably came from the United States, whereas Germany supplied 1,361 tons and the United States only 208 tons in 1938. Metal imports totaled 1,637 tons in 1938, 2,265 in 1937, 2,488 in 1936, 1,449 in 1935, and 995 in 1934.

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[13] Lumsden, J., Magnesium, Magnesite, and Dolomite: Imperial Inst. (London), 1939, pp. 17–18.

ANTIMONY AND CADMIUM

By E. W. Pehrson and John B. Umhau[1]

SUMMARY OUTLINE

ANTIMONY

The antimony industry experienced an unusual year in 1939. The war in Europe and increasing industrial activity in the United States stimulated demand, particularly during the last third of the year when the world supply of ore appeared to be shrinking. For the fourth consecutive year the output of China, formerly the chief world producer, declined substantially. Japanese occupation of eastern China virtually has stopped exportation of antimony over the normal trade routes, but shipments on a reduced scale were maintained via French Indochina. For a portion of the year Oriental shipments were fairly well maintained by deliveries from Hong Kong; but toward the close of 1939 stocks were depleted, and shipments from this port were curtailed sharply. Production in Mexico likewise decreased in 1939, but during the latter part of the year the heavy export taxes that had been imposed in 1938 were removed with respect to the low-grade antimony ores, and exports rose appreciably. World production in 1939 is estimated to have been only a little lower than in 1938, as decreases in China and Mexico were largely offset by increases, chiefly in Bolivia and Yugoslavia.

The divergent trends in production and consumption brought about higher prices, although the increase may be considered moderate in view of the unusual conditions prevailing. For example, the New York price for American brands averaged only 12.36 cents a pound in 1939 compared with 12.35 cents in 1938. From a low of 11.25 cents in February the quotation gradually rose to 14.00 cents the latter part of September and remained at this level the rest of the year. Quoted prices for Chinese brands were nominal throughout 1939, averaging 14.44 cents at New York. After the outbreak of war in Europe the demand for domestically smelted metal became so heavy

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

that the chief domestic producer stipulated in its selling contracts that its metal was not to be used for war or speculation. This action was in line with the request of the Army and Navy Munitions Board that excessive exports of strategic raw materials be avoided to conserve domestic supplies.

Domestic mine output in 1939 was disappointing. Production of antimony from antimony or gold-antimony ores declined 40 percent. The antimony contained in antimonial lead derived from domestic ores (all kinds) was 50 percent less than in 1938, but comprised only 8 percent of the apparent consumption of antimony. The decline in domestic output was offset by larger imports of ore and regulus. As actual consumption of antimony probably increased appreciably because of greater production of storage batteries, bearing metals, oxides, and other compounds, it is believed that producer and consumer stocks were reduced to a considerable extent in 1939.

The Laredo and Los Angeles smelters reported substantial increases in production. Oxide-production facilities at the Laredo plant were enlarged during 1939, making more furnace capacity available for the production of metal. A third producer of antimony metal will begin operations in 1940; the Bunker Hill Mining, Smelting & Concentrating Co. has announced the construction of a new plant at Kellogg, Idaho, to recover electrolytic antimony and other metals from the tetrahedrite contained in the dry-belt silver ores of the Coeur d'Alene region. Formerly these ores were treated in lead furnaces, where the bismuth content was a troublesome impurity.

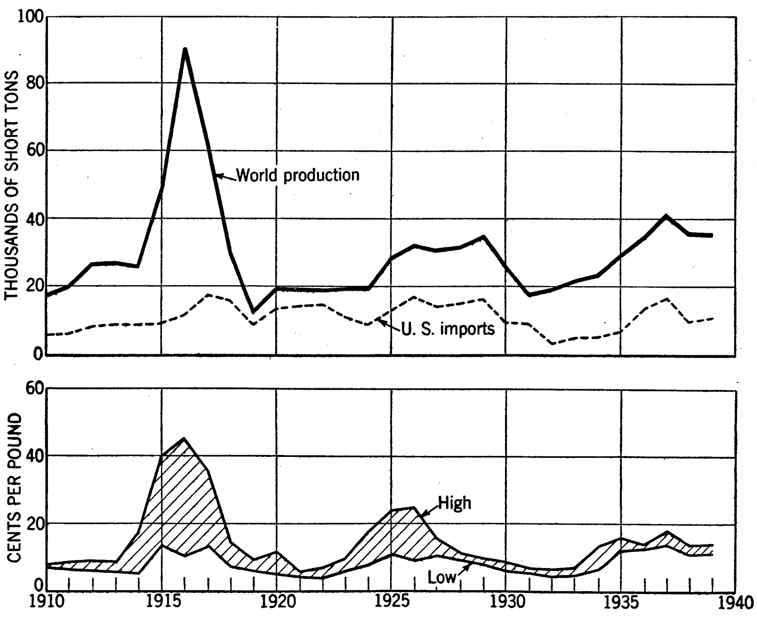

FIGURE 1.—Trends in world production, United States imports, and New York price of antimony, 1910–39.

Figure 1 shows trends in world production, United States imports, and prices from 1910 to 1939.

Late in 1939 the State Department announced that the tariff on antimony oxide would be considered in negotiations for a new reciprocal trade treaty with Belgium. Domestic producers formally protested any reduction in the existing import duty. No official action had been taken by the end of the year.

Salient statistics for antimony in the United States, 1935–39

	1935	1936	1937	1938	1939
Production of antimony ore and concentrates......short tons..	3,616	3,867	4,250	2,730	3,174
Antimony contained......do....	559	755	1,266	650	393
Antimony content of antimonial lead produced from domestic and foreign ores......short tons..	1,136	1,471	1,726	2,080	1,108
Secondary antimony produced......do....	9,600	9,900	12,340	8,500	(1)
Imports for consumption:					
Antimony in ore......do....	4,587	10,545	13,818	8,322	9,448
Needle or liquated antimony......do....	1,352	1,185	772	90	228
Metal......do....	1,248	1,171	1,043	821	1,045
Oxide......do....	594	1,201	1,118	414	167
Exports of foreign antimony......do....	318	392	437	711	58
Primary antimony available for consumption......do....	8,351	15,040	18,132	11,557	11,609
Stocks of antimony in bonded warehouse at end of year short tons..	830	443	656	345	685
Average price of antimony at New York: [2]					
Chinese......cents per pound..	14.08	12.97	15.30	14.59	14.44
American......do....	13.62	12.25	15.35	12.35	12.36
World production......short tons..	32,800	38,900	42,100	35,600	[3] 35,300

[1] Figures not yet available. [2] According to American Metal Market. [3] Estimated.

National defense.—The national defense aspects of antimony, which is classified as a strategic raw material by the Army and Navy Munitions Board, and domestic antimony resources were discussed in detail in Minerals Yearbook, 1939.

The Strategic Materials Act, Public No. 117, 76th Congress (referred to as the Thomas bill, S. 572, 76th Cong., in Minerals Yearbook, 1939) was signed by the President on June 7, 1939. The bill authorizes the expenditure of $100,000,000 over a period of 4 years for the purchase of stock piles of strategic raw materials and $500,000 annually for the investigation of domestic resources of strategic minerals by the United States Department of the Interior. Owing to the limited fund available for stock-piling, purchases have been confined to materials having a higher order of priority than antimony. The Bureau of Mines and the Geological Survey conducted extensive drilling, trenching, and stripping in the Yellow Pine district of central Idaho, but the results of the investigation have not been published as yet. The Bureau of Mines has developed an electrolytic method for improving the recovery of antimony from antimony-gold ores such as are found in that area.

DOMESTIC PRODUCTION

MINE OUTPUT

Antimony produced in the United States is derived from both antimony ores and lead ores. Data on the quantity derived from lead ores are not available, because the Bureau of Mines cannot obtain full information on the output of various commodities made from byproduct antimonial drosses obtained in lead refining. These drosses are used in the manufacture of antimonial lead, other alloys, and chemical compounds, such as oxides and sulfides. In 1939 antimonial lead containing 929 tons of antimony of domestic origin was produced at primary lead refineries, but this antimony was obtained from antimony ores as well as from lead ores in unknown proportions. Likewise, information on the amount of domestic antimony recovered in other alloys and compounds is not available.

The quantity of antimony contained in domestic antimony ores and concentrates produced in 1939 totaled only 393 tons—40 percent less than in 1939. Despite the decline in output, there was considerable interest in antimony deposits during the year. Eighteen producers shipped ore containing 1 ton or more of antimony—1 in Idaho, 1 in Alaska, 7 in Nevada, and 9 in California. As in previous years the Yellow Pine district, Idaho, and the Kantishna district, Alaska, were the outstanding producing areas. Production in both areas declined in 1939.

Alaska.—A small concentrating mill capable of treating 25 to 35 tons of ore a day was installed in 1939 at the Stampede mine of Morris P. Kirk & Son, Inc., in the Kantishna district. The ore contains approximately 22 percent antimony in sulfide form. It is planned to operate the mill during the summer months only and to haul concentrates as well as direct-shipping crude ore to the railroad at Lignite during the winter for reshipment to the company smelter in Los Angeles. Transportation difficulties from mine to railroad were eased in 1939, when trail was broken for 50 miles to permit the use of tractors.

California.—Some activity at antimony deposits was reported in 1939. According to press dispatches, it is planned to reopen the Buzzard mine in the Rattlesnake district near Auburn, Calif. Besides antimony, the mine is said to contain values in gold, copper, silver, lead, and zinc. Some prospecting was done at an antimony property near Frazier Mountain and at another 10 miles west of Randsburg, Calif., which was worked during the World War. The ore body, which outcrops for 1,500 feet, is being developed for production.

A custom antimony concentrator with a daily capacity of 150 tons, known as the Amalia mill and believed to be the only custom mill for antimony ores in the United States, has been completed by the S. T. M. Mines in Pine Tree Canyon near the Los Angeles Aqueduct Station about 17 miles north of Mojave, Calif. The company owns or controls antimony deposits in Kern and Inyo Counties, which it states are large enough to insure continuous operation of the mill for an extended period; however, custom ores are to be given preference.

Idaho.—The Bradley Mining Co. in 1939 produced concentrates containing 209 tons of antimony compared with 379 tons in 1938. More ore was produced in 1939 than in 1938, but the antimony content was lower. The concentrates are largely ferruginous and contain gold and silver as well as antimony. The product is shipped to the lead smelter at Midvale, Utah. The capacity of the mill was enlarged during the year. Formerly the Meadow Creek mine was the chief source of ore, but owing to exhaustion at depth operations were shifted in the latter part of 1938 to surface deposits at the Yellow Pine mine. The activities of the Bradley Mining Co. were described in the May 1940 issue of Mining World.

The Antimony Gold Ores Co. was actively prospecting deposits in the Yellow Pine area during 1939. Early in 1940 it was reported that the company had optioned 63 claims to the New York & Honduras Rosario Mining Co. at a purchase price of $1,500,000, payable over 12 years.

The antimony deposits of Valley County were investigated by the Federal Bureau of Mines and the Geological Survey as part of the program authorized by the Strategic Materials Act. Pamphlet 44, entitled "Geology and Ore Deposits near Edwardsburg and Thunder Mountain, Idaho," by P. J. Shenon and C. P. Ross, was released by the Idaho Bureau of Mines in cooperation with the Geological Survey.

The Bureau of Mines has developed a pyrometallurgical and electrolytic method for treating gold-silver-antimony ores of the type found in Valley County.[2]

Nevada.—Small shipments were reported from Lander, Nye, Pershing, and White Pine Counties in 1939. Some prospecting also was reported under way in Humboldt County.

Washington.—A 20-ton mill was installed at the Cleveland mine in Stevens County 18 miles west of Springdale, Wash. The mine produces ore containing antimony, lead, and zinc.

SMELTER OUTPUT

From 1935 to 1937, inclusive, the only active primary antimony smelter in the United States was that of the Texas Mining & Smelting Co. at Laredo, Tex. In 1938 the Menardi Metals Co. reported the production of antimony at its plant in Los Angeles, Calif. Both plants reported substantial increases in output during 1939.

The Texas Mining & Smelting Co. completed an addition to its oxide plant at Laredo in 1939. In an endeavor to keep domestic consumers supplied during the latter part of the year when the demand for antimony was exceptionally large, the company stipulated in its contracts that none of the metal manufactured at its smelter should be used for war or speculative purposes.

The Los Angeles plant reported production of antimony metal from foreign and domestic ores in 1938 for the first time. The antimony is derived largely from livingstonite concentrates produced in Mexico. The principal product of the plant to date has been mercury.

Data on production of antimonial lead at primary lead refineries are shown in the accompanying table. The figures cover only part of the antimonial lead output, as large quantities are produced at plants that operate exclusively on scrap, and some hard lead is made by mixing antimony and soft lead.

Antimonial lead produced at primary lead refineries, 1935–39, in short tons

Year	Production	Antimony content				
		From domestic ores	From foreign ores [1]	From scrap	Total	
					Quantity	Percent
1935	16,384	1,110	26	593	1,729	10.6
1936	23,230	1,434	37	691	2,162	9.3
1937	27,524	1,636	90	853	2,579	9.4
1938	24,123	1,871	209	729	2,809	11.6
1939	21,995	929	179	923	2,031	9.2

[1] Includes lead ores, antimony ores, and metallic antimony.

[2] Koster, J., and Royer, M. B., Progress Reports—Metallurgical Division. 37. Electrolytic Recovery of Antimony from Antimonial Gold Ores: Bureau of Mines Rept. of Investigations 3491, 1940, 19 pp.

According to press reports, high-grade electrolytic antimony soon will be produced by the Bunker Hill Mining, Smelting & Concentrating Co. at Kellogg, Idaho. A new plant is being constructed to treat the concentrates produced in the dry-ore silver belt of the Coeur d'Alene region by the Lee-Muir process, which employs a combination of hydro-, pyro-, and electro-metallurgy. The concentrates consist largely of tetrahedrite, the bismuth content of which is an undesirable impurity in lead smelting. The new process separates the silver, copper, bismuth, and antimony of the tetrahedrite.

Secondary production.—Data on the recovery of secondary antimony in 1939 were not available when this report was written. The Bureau of Mines canvasses of the secondary-metal industries are being revised to develop more detailed information on the origin and flow of scrap, and the revision has delayed completion of the figures for 1939. Additional information on developments in 1939 is given in the Secondary Metals—Nonferrous chapter of this volume.

DOMESTIC CONSUMPTION

Precise data on the consumption of primary antimony in the United States are not available owing to lack of information on dealer and consumer stocks and on the quantity of domestic antimony recovered in alloys other than antimonial lead and in compounds; however, an approximate idea of the trend of consumption can be obtained from the following table, which shows the annual supply available for consumption.

Primary antimony available for consumption in the United States, 1935–39, in short tons [1]

	1935	1936	1937	1938	1939
Domestic antimony recovered in antimonial lead	1,110	1,434	1,636	1,871	929
Imports for consumption (antimony content):					
Antimony ore	4,587	10,545	13,818	8,322	9,448
Needle or liquated [2]	946	830	540	63	160
Compounds [3]	502	975	909	336	138
Type metal, etc	209	309	410	355	121
Regulus	1,248	1,171	1,043	821	1,045
Total available	8,602	15,264	18,356	11,768	11,841
Exports under draw-back	251	224	224	211	232
Available for consumption	8,351	15,040	18,132	11,557	11,609

[1] Excludes domestic antimony recovered as miscellaneous alloys, oxides, and other compounds.
[2] Content estimated at 70 percent. [3] Content estimated at 80 percent.

Apparent consumption of primary antimony in 1939 increased only slightly over 1938, a moderate rise in imports having been offset largely by a decline in domestic output. Actual consumption, on the other hand, is believed to have gained substantially. One of the principal uses of antimony is in the manufacture of storage batteries. According to the American Bureau of Metal Statistics, 106,500 tons of antimonial lead were used for this purpose in 1939 compared with 92,000 tons in 1938. The antimony content of this material ranges from 4 to 12 percent, and although a large part of the total is supplied by battery scrap a substantial quantity of new antimony is required annually to "sweeten" the alloy.

Another important use of antimony is in the manufacture of babbitt metals employed in bearings. According to the Bureau of the Census, shipments of white-base antifriction bearing metals, produced for sale and for plant consumption by 39 manufacturers representing approximately 84 percent of the total industry, increased from 8,259 tons in 1938 to 11,785 in 1939.

The use of antimony in the manufacture of chemicals rose 75 percent in 1939 compared with 1938. In 1939, 7,668 tons of oxides and other compounds with an estimated antimony content of 6,188 tons were produced, whereas in 1938 only 4,393 tons (3,539 content) were made. Figures for the 3 preceding years are as follows: 1937, 6,992 tons (5,667 content); 1936, 4,852 tons (3,940 content); and 1935, 3,969 tons (3,227 content). Foreign ores are used largely in the manufacture of chemicals. The principal compound is the oxide, which is employed extensively as a pigment in sanitary enamelware and nitrocellulose enamels. The following companies reported production of antimony oxide and other salts in 1939:

American Smelting & Refining Co., 120 Broadway, New York, N. Y.
Antimony Corporation, New Brunswick, N. J.
Harshaw Chemical Co., Elyria, N. Y.
John D. Lewis, Inc., Mansfield, Mass.
McGean Chemical Co., Cleveland, Ohio.
Texas Mining & Smelting Co., Laredo, Tex.

FOREIGN TRADE

The following tables show imports and exports of antimony and antimony products.

Antimony imported for consumption in the United States, 1935–39

Year	Antimony ore			Needle or liquated antimony		Antimony metal		Antimony oxides and other compounds	
	Short tons	Antimony content		Short tons	Value	Short tons	Value	Short tons	Value
		Short tons	Value						
1935	14,205	4,587	$544,608	1,352	$165,446	1,248	$250,771	628	$94,783
1936	30,486	10,545	1,200,132	1,185	139,784	1,171	243,474	1,219	217,505
1937	42,453	13,818	1,775,011	772	101,963	1,043	228,485	1,136	249,152
1938	19,811	8,322	1,095,497	90	12,016	821	155,420	420	94,400
1939	21,000	9,448	1,132,359	228	30,102	1,045	196,812	173	29,786

Antimony imported for consumption in the United States, 1938–39, by countries

Country	Antimony ore			Antimony metal	
	Gross weight (short tons)	Antimony content		Short tons	Value
		Short tons	Value		
1938					
Argentina	1,101	715	$69,931		
Belgium				25	$5,009
Bolivia	1,880	1,133	159,407		
Chile	1,201	776	127,156		
China	70	43	4,571	661	118,199
France				11	2,260
Japan				(1)	24
Mexico	14,896	5,250	670,185	112	25,784
Morocco	2	1	162		
Peru	661	404	64,085		
United Kingdom				11	3,799
Yugoslavia				1	345
	19,811	8,322	1,095,497	821	155,420
1939					
Argentina	332	218	21,700		
Belgium				191	35,954
Bolivia	3,926	2,454	371,099		
China				661	117,072
France				56	10,566
Mexico	16,036	6,346	676,471	125	29,915
Peru	706	430	63,089		
United Kingdom				12	3,305
	21,000	9,448	1,132,359	1,045	196,812

[1] Less than 1 ton.

Estimated antimony content in type metal, antimonial lead, and other alloys imported for consumption in the United States, 1935–39, in short tons [1]

Year	Type metal and antimonial lead	Other alloys [2]	Total	Year	Type metal and antimonial lead	Other alloys [2]	Total
1935	89	120	209	1938	[3] 59	296	355
1936	[3] 56	253	309	1939	59	62	121
1937	[3] 17	393	410				

[1] For details of gross weight and values see imports shown in Lead chapter of this volume.
[2] Chiefly in special antimony-lead alloys containing high percentage of antimony.
[3] Type metal only.

Foreign antimony (regulus or metal) exported from the United States, 1935–39

Year	Short tons	Value	Year	Short tons	Value
1935	318	$62,167	1938	711	$96,836
1936	392	56,308	1939	58	16,736
1937	437	86,991			

As in other recent years imports of antimony ore in 1939 came principally from Mexico and Bolivia. Shipments from both countries were larger than in 1938. Imports credited to Argentina and Chile probably originate in Bolivia.

In addition to the foreign exports reported above, 232 tons of antimony were exported in 1939 in manufactures (chiefly storage batteries) under the draw-back provisions of the tariff law; 211 tons were so exported in 1938. Stocks of needle or liquated antimony and rejects on hand in bonded warehouses totaled 685 tons at the end of 1939 compared with 345 tons on December 31, 1938.

PRICES

The antimony market always has been subject to rapid and wide fluctuations in price; however, in recent years variations have been less violent, and quotations have been maintained at higher levels.

The price of antimony, which dropped very low after the World War of 1914–18 (less than 5 cents per pound in 1921), continued at that level until 1924, when an upward trend was noted. For 5 years quotations were well-maintained, but with the advent of the depression they again slumped. In 1934 there was a noticeable increase, and for the past 5 years yearly quotations have continued above 12 cents per pound at New York. The average spot quotation for domestic metal in New York in 1939 was 12.36 cents compared with 12.35 cents in 1938. The year 1939 opened with the price at 11.75 cents, New York, and remained at a fraction over 11 cents (low for the year, 11.25 cents) until May 25, when it advanced to 12 cents as industrial activity moved upward; then the price increased gradually to 14 cents on September 25, where it remained until the close of the year.

Throughout the year Chinese antimony was scarce, owing to Japanese blockade of the normal trade routes from producing cities. Prices were nominal throughout the year and higher than those for domestic metal. On January 3 the quotation for Chinese metal, duty paid, was 14.00 cents at New York. This price was maintained until October 27, when it advanced to 16.50 cents and remained at this figure for the rest of the year. The average price for the year for Chinese metal was 14.44 cents compared with 14.59 cents in 1938.

On the London Metal Exchange quotations for English brands (99 percent minimum) remained stable at £70–71 per long ton from July 1, 1938, through August 1939. At the beginning of September there was a slight increase to £71–73; in October it rose decidedly to £80–82; and on November 1, it reached £87½, which figure was maintained for the rest of the year. Foreign regulus (spot deliveries from warehouse, duty paid) was quoted at £52–53 on January 1. For the first 8 months of the year the price fluctuated between £49 and £54; it increased to £58 on September 1, and in October to £78–80, and from November 1 to the close of the year it was £87½.

Average monthly quoted prices of antimony, prompt delivery at New York, 1935–39, in cents per pound [1]

Month	Chinese brands (duty paid)					American brands			
	1935	1936	1937	1938	1939	1936	1937	1938	1939
January	14.36	12.96	14.14	15.56	14.00	12.74	14.14	13.75	11.68
February	14.50	13.05	14.69	15.74	14.00	12.99	14.55	13.75	11.25
March	14.50	13.42	16.92	15.75	14.00	13.07	16.37	13.75	11.27
April	14.30	13.50	16.79	15.65	14.00	12.67	16.02	13.65	11.50
May	13.91	13.50	14.79	14.46	14.00	12.41	14.79	12.46	11.70
June	12.75	13.20	14.70	13.94	14.00	11.72	14.70	11.73	12.00
July	12.75	13.00	14.79	14.00	14.00	11.24	14.81	11.02	12.00
August	12.93	12.57	15.53	14.00	14.00	11.12	15.34	10.88	12.00
September	13.54	12.50	(2)	14.00	14.00	11.76	16.59	11.32	12.87
October	15.62	12.50	(2)	14.00	14.24	12.07	16.92	12.06	14.00
November	15.30	12.50	15.91	14.00	16.50	12.21	15.87	12.25	14.00
December	14.54	12.93	14.69	14.00	16.50	12.95	14.12	11.56	14.00
Average	14.08	12.97	15.30	14.59	14.44	12.25	15.35	12.35	12.36

[1] Metal Statistics, 1940, pp. 521, 529.
[2] No average owing to lack of offerings during greater part of month.

Quotations for antimony ore on January 5, 1939, were reported as follows by Engineering and Mining Journal Metal and Mineral Markets: "Per (short-ton) unit of antimony contained, 50 to 55 percent, $1.20 @ $1.25; 58 to 60 percent, $1.30 @ $1.40; 60 to 65 percent, $1.40 @ $1.60. London, 60 to 65 percent, 6s. 6d. @ 6s. 9d. per long-ton unit." There was no variation in the domestic market price and very little in the London quotation until the latter part of April, when the domestic price for 50- to 55-percent ore was $1.25 @ $1.35; 58- to 60-percent ore, $1.40 @ $1.50; and 60- to 65-percent ore, $1.50 @ $1.60. In London the quotation for 60- to 65-percent ore was 6s. 6d. @ 7s. per long-ton unit. For the rest of the year there was a slight gradual increase in the domestic market price; the highest quotation was for the weeks of December 7 and 14, when domestic antimony ore was offered for $1.55 @ $1.60 for 50- to 55-percent ore; $1.60 @ $1.65 for 58- to 60-percent ore, and $1.80 @ $1.90 for 60- to 65-percent ore. The London market price for these respective weeks was 9s. 6d. @ 10s. 6d. for 60- to 65-percent material. The year closed with the domestic price of the lower-grade ore $1.50 @ $1.60 and of the other grades $1.60 @ $1.70 and $1.80 @ $1.90. The London price closed at 10s. 6d. for 60- to 65-percent ore.

WORLD PRODUCTION

Data on world production in 1939 are incomplete, but statistics from countries that contributed 89 percent of the total in 1938 indicate a 1-percent decline to an estimated 32,000 metric tons. China, formerly by far the outstanding source of antimony, dropped to third place in 1939, its output (exports) having been exceeded by that of Bolivia and of Mexico. Bolivia increased its output (exports) 7 percent in 1939 compared with 1938, whereas Chinese exports declined 17 percent and Mexico's output fell 2 percent. Yugoslavia, the fourth largest producer, made a notable gain in production, as did Canada where the recovery of byproduct antimony recently was inaugurated at the lead smelter at Trail, British Columbia. In 1939 Bolivia produced 29 percent, Mexico 23 percent, China 20 percent, and Yugoslavia 10 percent of the world supply of antimony; the United States produced only 1 percent.

World production of antimony, 1935–39, by countries, in metric tons [1]

[Compiled by R. B. Miller]

Country	1935	1936	1937	1938	1939
North America:					
Canada	----------	----------	[2] 18	34	[3] 550
Honduras	5	1	----------	----------	----------
Mexico [4]	4,204	6,719	9,788	7,391	7,243
United States	466	630	1,056	542	328
South America:					
Argentina	----------	----------	31	174	(5)
Bolivia [6]	3,376	6,040	6,556	8,682	9,255
Peru	288	696	848	963	775
Europe:					
Czechoslovakia	1,944	829	997	[3] 800	(5)
Germany (Austria)	----------	100	200	145	(5)
Greece	29	159	----------	----------	(5)
Italy	369	402	414	740	(5)
Portugal	----------	20	49	131	(5)
Yugoslavia	162	1,301	1,447	2,739	3,337

See footnotes at end of table.

World production of antimony, 1935–39, by countries, in metric tons—Continued

Country	1935	1936	1937	1938	1939
Asia:					
Borneo, British	16	30	4	---------	(5)
Burma	8	82	28	84	(5)
China [7]	17,700	16,348	14,702	7,797	6,497
Chosen	2	14	8	(5)	(5)
India, British	---------	---------	---------	11	(5)
Indochina	16	38	5	83	(5)
Japan	47	110	(5)	(5)	(5)
Turkey (Asia Minor)	103	457	536	398	460
Africa:					
Algeria	810	983	778	744	(5)
Morocco:					
French	179	88	20	125	(5)
Spanish	---------	12	158	93	(5)
Southern Rhodesia	---------	68	64	63	50
Union of South Africa	4	15	---------	10	6
Oceania:					
Australia:					
New South Wales	24	45	70	70	(5)
Queensland	---------	4	(8)	7	---------
Victoria	5	94	145	195	100
Western Australia	---------	---------	[3] 245	196	(5)
New Zealand	---------	---------	---------	1	(5)
	29,800	35,300	38,200	32,200	[3] 32,000

[1] Approximate recoverable metal content of ore produced exclusive of antimonial lead ores. 80 percent of reported gross content is used as a basis of calculations for all countries except Bolivia, Mexico, Peru, and the United States, where 92 percent is used.
[2] Recoverable metal content of concentrates exported. [3] Estimated.
[4] Includes antimony content of antimonial lead. [5] Date not available. [6] Exports.
[7] Figures represent antimony content of regulus, crude antimony, and oxide exported. [8] 434 kilos.

REVIEW BY COUNTRIES

Bolivia.—The antimony situation in Bolivia is described in a report by C. W. Wright, foreign mineral specialist, Bureau of Mines, entitled "Bolivia's Mineral Resources, Production, and Trade," La Paz, Bolivia, September 15, 1939. The section on antimony is quoted in full:

General statement.—Mining of antimony in Bolivia started in 1903, and from 1915 to 1917 Bolivia was second only to China in world's output. From 1926 to 1929 this industry was again active, and since 1934 production has increased steadily each year from 2,000 tons to 16,576 tons of concentrates or 9,427 tons of metal in 1938.

Antimony production in Bolivia is not restricted to any single area but is found in many of the provinces. The Districts of Tupiza, Department of Potosi, and of Challapata, in the Department of Oruro, are the most important.

Excepting the few antimony-producing mines belonging to the larger mining companies, most of the mines are small and subject to intermittent operations dependent upon the market price for antimony and the local cost of mining. The average grade of the concentrate produced is from 60 to 65 percent. Lead, arsenic, and copper are sometimes present in the product and tend to reduce its selling value. Gold is also present, amounting in some instances to 20 grams or more, and this naturally adds to the selling value.

An attempt was made during the World War to smelt the antimony ore at Uyuni, in Bolivia, but the plant was soon abandoned. Plans are being studied whereby this may now be done by the use of domestic crude oil. At present all of the product is exported, 75 percent of it going to Belgium in 1938 and most of this was re-exported to Germany. The average tenor of the product is 60 percent antimony, 1 percent lead, 0.2 percent copper, and 0.2 percent arsenic.

Were the market for antimony to improve as it did during the World War, it is probable that Bolivia could again increase the output of antimony ore to a few times present production.

General occurrence of antimony ore.—Though the antimony deposits occur in the tin belt, the ore occurrence is not directly associated with that of the tin deposits.

Quartz veins traversing narrow belts of fractured black slates, often tens of miles in length, carry the antimony ore. These veins are usually narrow and irregular, and often ore masses occur where the veins intersect one another. At some of the mines veins 3 feet or more in width occur, and in these the antimony ore is found in large masses and disseminated in the quartz. A brief description is given in the following text of the principal mine in each of the nine zones.

The antimony deposits are more frequent in the southern part of the mineral belt away from the granite intrusive masses, which are exposed on the surface to the north. This granite intrusive, even though it does not outcrop on the surface, underlies this southern portion of the mineral zone, and it is believed that both the granite and the mineral deposits have been derived from the same underlying igneous magma.

In general, the development of these deposits is limited to the preparation of sufficient ore for only a few months' output. If capital were available to open up new ore bodies along the antimony-bearing zones, under proper technical guidance, it is probable that the present known ore reserves could be increased many times.

Descriptions of principal mines.—Nearly 60 percent of the antimony output, as well as the richest product, comes from the mines in the Department of Potosi. These occur in the vicinity of Tupiza, and the antimony veins here are usually wider and more persistent than in the other districts. This district is on the east slope of the Andes at a relatively low altitude. Next in importance are the mines near Challapata in the Department of Oruro.

In discussing the principal mines, first those in the Department of La Paz are described, followed by those in the antimony mineral belts to the south.

Espiritu Santo mine.—(Bustos, owner, Rafael Taborga lessor.) This mine is in the Caracata District, Province of Loayza, 40 miles from La Paz.

At this mine irregular quartz veins containing antimony occur in a zone of black shale 160 feet wide which crosses the Caracata River diagonally, in a northwesterly direction and with an easterly dip of 60°. The ore bodies are developed by several adits, and the ore is mined by hand drilling without any special system and only the richer ore is stoped. From the mine the ore is trammed to the sorting floor at the mouth of the lowest adit, where it is concentrated by the usual hand methods. Present production of concentrates is 50 tons a month. As much of the ore is disseminated in the quartz and is discarded, it would be possible with a small mechanical concentrating plant to double the present output. The locality, however, is unfavorable, as the water supply is small and malaria dominant. The mineral zone extends for some miles beyond this mine, and in it the reserves of possible ore are believed to be large.

Malliri mine.—(Empresa "Junkers," Jose Domingues, owner.) This mine is in the Province of Abaroa, northeast of Challapata, 15 miles from the railway station.

Here stibnite is found in quartz veins forming masses from 2 to 8 feet wide, and from 30 to 80 feet in length and depth. The general strike of these veins and the black slate country rock in which they occur is north-south and the dip 75° to the east. The ore is mined by open-cuts and adits up to 600 feet in length. The monthly output is 75 tons of 60-percent antimony product, which is made by 15 hand sorters, a hand crusher, a hand jig, and two buddles. Fifty men and women are employed, and the output per man-shift is about 60 kilos of product. It is claimed that, with higher metal prices, the output could be largely increased.

Challviri mine.—(M. Hochschild, owner.) The Challviri mine is located 25 miles north of Uncia on the southeast side of the Morocala plateau at an elevation of 11,200 feet.

The ore deposits are quartz veins with stibnite occurring in masses and disseminated in the quartz. Chalcopyrite is also present in small amounts. The country rock is the friable black slate. Monthly output is 50 tons, all of which is hand mined and treated. Ore reserves are small.

La India mine.—(Fadic, owner.) This mine is in the Province of Bustillos, 30 miles south of Uncia. This mine lies in a mineral zone 984 feet wide traceable for 20 miles in a southeast direction from La India to Terremoto.

Small irregular deposits of stibnite in quartz are found at a number of places along this zone of black slates. The India mine is at 13,200 feet elevation. Formerly this mine produced 100 tons a month, but present output is limited to 25 tons. Ferberite is also found in this mine in separate veins, and of this ore an output of from 1 to 2 tons a month is made, averaging 70 percent WO_3. Although ore reserves are small, it is believed that this zone is a potential source of antimony ore.

Irpa Irpa mine.—(Manuel Solares, owner.) The mine is located in the Province of Chayante 40 miles southeast of Uncia.

This mine also lies in a zone of black slates extending from Amayapampa to beyond Morochata on the Colorado River, a distance of about 40 miles. Within this zone several other mines have been worked in the past, namely at Amayapampa, Capacirca, Cebadillas, and Chuquiuta. In general, these deposits are irregular quartz veins or lenses containing stibnite, and the product contains gold in payable quantities. At the Irpa Irpa mine the monthly production is 30 tons of concentrates and 34 workmen are employed. All work is done by hand. The ore reserves within this zone are very limited, but with exploration work it is believed that new important deposits will be found.

Churata mine.—(Stevenson, owner.) This mine is located in the Province of Porco near Canton Yura.

This is only one of a number of mines which occur in the slate zone extending from Aguas Castillas to Tupiza, a distance of 85 miles. There are about 100 small mines along this zone which were largely responsible for the high output of antimony ore during the World War. Besides the Churata mine in the northern part of the zone, mining is in progress at the Putina, Dolores, and Uyuni Chico mines, owned by Rocsabado, and the Oropeza mine near Tocla, owned by Guerra and Paredes. In the southern part of the zone on Rio Blanco are the Huarojla and Thapi mines, owned by Hugo Gericke. The Churata mine, which is representative of the others, happens to be the largest producer at present. The ore deposit consists of a series of quartz stibnite veins with occasional ore concentrations in masses as at the other mines already described. This mine alone produced 407 tons in 1937. The total annual output of the zone is about 1,500 tons of concentrates.

Churquini mine.—(Prisk & Wright, owners.) The Churquini mine is in the Province of Sur Chichas 20 miles north of Escoriani.

Here a large number of small quartz veins with nests of antimony occur in a much disturbed zone of friable slates. In places a network of these veins is formed, and it is in these that the concentrations of antimony usually occur. This mine has been one of the largest producers in recent years, and in 1937 the output was 660 tons containing 68 percent antimony. The ore reserves at this mine are limited and the mineral zone is relatively small.

Cobija mine.—(Rocabado, owner.) This mine is situated 25 miles west of the railway station of Oro Ingenio. This mine is the most important of several that have been developed along a fractured zone in a black slate belt extending for 20 miles in a northwesterly direction. The ore body at Cobija is a rich antimony quartz vein 3 feet in width which is being mined from a shaft 500 feet in depth. Other mines along this zone are Candelaria, owned by Pedro San Juan, and La Tesorera, owned by Hugo Gericke. No estimate can be made of the possible ore reserves along this zone, but it is believed that it is one of the richest antimony zones in Bolivia. At the Cobija mine there is a small mechanical concentrating mill with a Krupp ball mill, two jigs, and one table, also a sorting floor with hand jigs and buddles. The production in 1937 was 328 tons.

Santiago mine.—(Cia. Minera y Agricola Oploca de Bolivia, owners.) The Santiago mine is situated 3 miles west of Oploca.

In this area a mineralized zone of black slates has been traced for 3 miles, beginning with the San Pedro mine, of Hugo Gericke, on the south which has been intensely worked in the past and ending at the Santiago mine to the north. The zone at Santiago is 300 feet wide. Within it is a wide barren quartz vein and on each side of it a number of irregular and nested quartz veins with stibnite. At this mine the known ore reserves are estimated at 9,000 tons of antimony metal, but because of the lead content of from 2 to 4 percent in the concentrate the mine is not now being worked. The mine is well-developed by several adits.

Methods of mining and concentrating the ores.—With few exceptions all of the antimony mines in Bolivia are worked by the most primitive methods, and much of the ore is wasted in the attempt to produce a high-grade concentrate. Only the richer portions of the ore bodies can be mined by this system. As is usual at most mines in mountainous districts, the ore bodies are first explored by surface cuts and trenches along the veins and then by adits to explore the deposits in depth. These adit levels are usually from 50 to 100 feet apart vertically and up to 600 feet or more in length. They are connected by raises, and from these stopes are started and the ore between the levels is stoped and sorted underground, the richer ore being dumped down the raises and trammed to the surface by car or wheelbarrow, while the waste rock and low-grade ore is usually left in the stopes as filling. Most of the mines are limited to hand mining operations.

The sorting floor is usually near the mouth of the lowest adit. Here women sort out the rich ore, using hammers to break off bits of waste rock from the larger pieces. The remaining poor ore is crushed and concentrated by hand methods.

The total cost of mining, concentrating, and transport of the antimony concentrates to the railway station, according to schedules filled in by the operators, varies from 600 to 1,000 Bolivianos, or $20 to $30 a ton, and of this total only about 40 percent is for labor, the rest being for supplies, transport, and overhead, including local taxes.

Marketing of antimony concentrates.—Until recently the producers of antimony concentrates sold their product to one of the several ore-purchasing firms, who in turn advanced funds to the mine operators for supplies and wages. Today, however, the Banco Minero is the sole local purchaser in Bolivia. The concentrates are usually purchased at a fixed price based upon the London market quotations, and for delivery at the railway station nearest the mine.

The large companies, however, make contracts directly with the smelting companies for specified amounts within a definite period.

Prices are based on a 60-percent product, and a premium of B. 20 is paid per unit above this and a deduction of B. 30 is made per unit below 60 percent.

Generally there is no fixed penalty for copper in antimony ores, but concentrates containing a considerable amount of copper (over 0.5 percent) can only be sold with difficulty or may be unsalable.

Arsenic and lead contents combined are usually free of penalty up to 0.5 percent in the "pure" ores and up to 1 percent in the "impure" ores. In the United States for excess content of lead, a deduction of 1 unit of antimony is made for each unit of lead in excess of 1 percent and 2 units for each unit of arsenic in excess of 0.2 percent arsenic. The "impure" ores are sold for the most part to Japanese ore buyers, who also pay for the gold content.

Ores containing over 10 percent lead may be sold without lead penalty, and only in case of a 15-percent or greater lead content is it possible to obtain payment for lead.

Exports of antimony concentrates since 1937 and their value per ton were:

1937—11,971 valued at $1,264,330 or $105.59 per ton
1938—16,576 valued at $1,167,474 or $73.08 per ton
1939—7,400 valued at $584,137 or $78.94 per ton
(6 months)

These figures are from the official export statistics, the average grade of the ore shipped being 60.5 percent antimony.

Possibility of increasing antimony output.—The output of antimony jumped from 6,093 tons of concentrates in 1929 to 15,976 tons in 1938. Just how much the output can be further increased will depend, first of all, on the market price of the metal and to what extent the Government will encourage production by a reduction of present high taxes and by financial and technical assistance through the Banco Minero, which bank is now the sole local purchaser of ores in Bolivia. Any increase in the output of antimony in Bolivia will thus depend largely upon the attitude the Government takes toward the industry and the extent of its financial and technical aid to the industry. It is the announced intention of the Government to give financial and technical aid to the small mine operators through the Banco Minero and the Department of Mines and Petroleum. In some instances this aid may consist in helping the operator to install a small mechanical plant for the treatment of low-grade ores, and in other cases in the construction of a road to facilitate transport.

The Department of Mines and Petroleum estimates the total reserves of probable antimony ore at 50,000 tons metal content, while the possible reserves are much greater—sufficient for some decades at the present rate of production. There is thus plenty of ore available from which, with favorable market conditions and Government assistance, Bolivia could more than double her present output.

Bolivia as a source of antimony supply for the United States.—Present-day world conditions justify an opinion that there may soon be a real opportunity for Bolivia to enter the United States market.

In 1937 the United States consumed 18,132 tons of antimony metal, over 80 percent of which was imported. Of this tonnage Bolivia supplied 1,678 tons of concentrates containing 1,047 tons of metal in 1937, and 1,880 tons of concentrates with 1,133 tons of metal in 1938.

Purchases of Bolivian antimony ore by American consumers would have to be made through the Banco Minero or from the large producing companies. If long-term contracts could be concluded for specific tonnages at a fixed price over a period of years, this would be a big help to stimulate a greater output of antimony in Bolivia. Because of the impurities in the antimony concentrates, exports to the United States have been relatively small, even though the grade of the product is high.

Canada.—Antimony production consisted of antimony metal produced at the new plant of the Consolidated Mining & Smelting Co., Ltd., at Trail, British Columbia, and antimony in ores exported from a property near Fort St. James, British Columbia. The output totaled 606 short tons. Imports of metallic antimony declined from 428 tons in 1938 to 119 in 1939. At the Trail plant it was reported that production was being obtained from accumulated antimony-arsenic flue dusts. An excellent product was being made, but all of the difficulties that developed in the process have not yet been overcome.

China.—Japanese occupation of eastern China caused a further decline in exports during 1939. Apparently the Chinese have maintained control of the producing areas, but Japan controls the normal trade routes. Early in 1940 it was reported that reopening of the Yangtze River by the Japanese had not resulted in any increase in shipments. Most of the material exported in 1939 went via French Indochina. According to official reports, Chinese exports of crude antimony increased from 544 metric tons in 1938 to 1,053 in 1939. In 1938, 531 tons were shipped to Hong Kong, whereas in 1939 only 2 tons were consigned there. In the latter year 1,051 tons were sent to "other countries," presumably largely to French Indochina. Exports of regulus declined from 7,183 tons to 5,707. No oxide (etc.) was shipped in 1939 compared with 257 tons in 1938. In 1939, 5,228 tons of regulus were sent to French Indochina and 474 to Hong Kong, whereas in 1938, 6,617 went to Hong Kong and only 378 to French Indochina.

Exports from Hong Kong increased from 2,994 to 5,721 tons, but toward the end of the year it was reported that stocks were nearly exhausted and exports almost nil. Ore shipments from this port declined from 545 tons to 1 ton.

Germany.—German imports of antimony increased from 2,105 metric tons in 1936 to 3,642 in 1938. Receipts during the first 6 months of 1939 were 1,597 tons. Of the 1938 total China supplied 71 percent, Czechoslovakia 13 percent, Yugoslavia 8 percent, and other countries 8 percent. Germany has intensified mining operations in conquered territory in an endeavor to meet its mineral deficiencies. In Slovakia antimony ores have been produced near Medzibrod, near Poproc, and near Spisska Bana. Exploration is under way at various other localities. An antimony smelter at Vajskova has produced about 1,300 tons of metal annually in recent years.

Mexico.—Antimony is derived from three types of ore in Mexico. The most important source is straight antimony ore, which is mined in several localities, chiefly in San Luis Potosi, Oaxaca, Nuevo Leon, and Sonora. Considerable antimony is recovered in elemental form and in alloys at the lead refineries near Monterrey as a byproduct of lead ores. The third source is the mercury-antimony ores of the Huitzuco district, Guerrero. The greater part of the straight antimony ore is shipped to the smelter at Laredo, Tex., and imports of these ores into the United States increased during 1939. Mixed concentrates from the Huitzuco district are treated at a Los Angeles plant where both mercury and antimony are recovered. Production of antimony from this source was higher in 1939 than in 1938.

The 12-percent export tax imposed in 1938 on virtually all products shipped from Mexico proved unduly burdensome on producers of low-grade antimony concentrates. To alleviate the situation the Government in August 1939 removed the tax on all ores containing less than 25 percent antimony.

Yugoslavia.—The increase in output reported for Yugoslavia in 1939 resulted from the first full-year operation of the new 1,800-ton per year smelter of Podrinje Consolidated Mines, Ltd., near Krupanj and completion of another smelter near Loznica, owned by Montania A. G.

CADMIUM

The cadmium industry experienced a more satisfactory year in 1939 than in 1938. Domestic production of cadmium as metal and in compounds increased 15 percent over 1938 and nearly equaled the record output of 1937. Apparent consumption was 37 percent higher in 1939 than in 1938, and in consequence the United States returned to its former position as a net importer. Imports of metal increased fourteenfold, whereas exports fell from 458,283 pounds in 1938 to none in 1939. Sales of metallic cadmium more than doubled and exceeded production by 19 percent. Producers' stocks of metal declined from an estimated 1,750,000 pounds at the end of 1938 to approximately 950,000 pounds on December 31, 1939.

Most of the increase in demand in 1939 came from the plating and pigment industries. The high prices for cadmium in 1937 and 1938 stimulated the use of substitutes for cadmium plating, but with the return of more normal prices in 1939 some manufacturers employed cadmium again. The use of cadmium in bearing metals, which exhibited such a meteoric rise a few years ago, apparently did not increase in 1939 in proportion to the advance in automobile production. Production of the red and yellow cadmium lithopones, as well as straight cadmium sulfide, was substantially higher in 1939 than in 1938.

Data on the cadmium industry in 1939 are not available for many countries. Canada and South-West Africa established new output records. These countries and the United States, which supplied 58 percent of the 1938 output, produced 21 percent more cadmium in 1939 than in 1938. Production in Australia declined. Germany is reported to have restricted the use of cadmium in pigments, whereas British Empire resources were said to be adequate for all essential needs.

The downward trend in prices evident in 1938 continued during the first half of 1939. The New York quotation for commercial sticks, wholesale lots, dropped from 60 to 50 cents a pound between January 2 and the latter part of March. Early in August, as buying improved in anticipation of the European crisis, the price began moving to higher levels, and at the close of the year stood at 75 cents. The average quotation for the year was only 64.1 cents compared with 98.0 cents in 1938, but the price made a substantial net gain during the year. In March the premium for platers' sticks was reduced from 25 to 5 cents a pound.

Cadmium produced, sold by producers, imported, and consumed in the United States, 1935–39, in pounds

Year	Produced			Metallic cadmium sold by producers	Metallic cadmium imported	Apparent consumption
	Metallic cadmium	Cadmium compounds (estimated Cd content)	Total cadmium			
1935	3,477,091	507,400	3,984,000	4,023,900	185,387	4,169,000
1936	3,633,495	626,800	4,260,000	3,626,669	576,139	4,836,000
1937	3,995,739	828,000	4,824,000	3,801,321	828,535	5,652,500
1938	3,753,323	431,000	4,184,000	[1] 2,191,035	22,582	3,748,000
1939	4,141,242	679,000	4,820,000	4,933,778	309,874	5,130,000

[1] Of this quantity 458,283 pounds were exported.

DOMESTIC PRODUCTION

The figures on cadmium production in the foregoing table include metal derived from domestic and foreign raw material refined in the United States. Data are not available on the quantity produced from each source, but foreign metal apparently represents a substantial part of the total. In the first 11 months of 1939 Mexico reported shipments of crude material to the United States containing 816 tons of cadmium compared with 838 tons in all of 1938.

Cadmium is derived chiefly as a byproduct from zinc ores, and its production depends to some extent on the rate of zinc output. In recent years, however, stocks of cadmium-bearing flue dusts and similar products accumulated over several years have made possible an increase in cadmium production that is relatively more rapid. By 1937 much of this material had been used, and since then production has been limited to some extent to that derived from current zinc operations. The recovery of metallic cadmium was discontinued at the Herculaneum (Mo.) plant of the St. Joseph Lead Co., and the Baltimore plant of the Chemical & Pigment Co., Inc. No new producers were reported in 1939.

The following companies produced cadmium or cadmium compounds in 1939:

	Location of plant
American Smelting & Refining Co	Denver, Colo.
American Steel & Wire Co	Donora, Pa.
American Zinc Co. of Illinois	Fairmont City, Ill.
Anaconda Copper Mining Co	Great Falls, Mont.
Ceramic Color & Chemical Manufacturing Co	New Brighton, Pa.
Chemical & Pigment Co., Inc	Baltimore, Md.
E. I. du Pont de Nemours & Co	Cleveland, Ohio.
Eagle-Picher Mining & Smelting Co	Henryetta, Okla.
Harshaw Chemical Co	Elyria, Ohio.
New Jersey Zinc Co	Palmerton, Pa.
St. Joseph Lead Co	Josephtown, Pa.
Sherwin-Williams Co	Chicago, Ill.
Sullivan Mining Co	Kellogg, Idaho.
United Color & Pigment Co	Newark, N. J.
U. S. Smelting, Refining & Mining Co	Midvale, Utah.

A small but increasing quantity of secondary cadmium is recovered from scrap resulting largely from the manufacture of automobile bearings. It is not included in the statement of production, as it would represent duplication of metal previously reported.

Recent additions to the technical literature on production processes include a description of operations at the cadmium plant of the Sullivan Mining Co. at Kellogg, Idaho.[3] The separation of cadmium from zinc by the use of granular aluminum is described by Townsend and Cade.[4] Patent 2,178,763, issued November 7, 1939, covers various methods of purifying cadmium by the addition of caustic soda while the metal is in the molten state.

DOMESTIC CONSUMPTION

The statistical trends in consumption during 1939 have been discussed in the summary at the beginning of the cadmium section of this chapter.

Sanderson [5] has described the uses of cadmium as follows:

> Cadmium is a metal which, in various forms, is becoming of increasing economic importance. It has been used, when tin was scarce, as its substitute in solders, but this is not now a particularly valuable application. Its main value is as an alloy of copper for the production of telegraphic, telephonic, and power transmission wires, because of the properties it gives to wire so produced. It has durability, good tensile strength, hardness, a high annealing temperature, and electrical conductivity, all of which are desirable properties in these uses. It thus possesses the virtues of both hard-drawn copper and the bronzes. Copper-cadmium trolley wire for tramcar systems has, in fact, proved extremely successful, having three times the life of hard-drawn copper wire.
>
> Copper-cadmium rolled plates have been used with some success for locomotive firebox plates, and castings made from a similar alloy have been used in electrical apparatus. Alloys into whose composition the metal enters have been used for watch and clock hairsprings, because they have certain of the characteristics of steel, but add to these a resistance to corrosion and a nonmagnetic property. A small proportion of the cadmium produced is used with cerium earth metals for producing spark-emitting alloys for use in cigarette lighters.
>
> Alloys of cadmium with gold have been used in making jewelry. Silver-cadmium alloys are used for producing domestic silver. The most encouraging employment of the metal today, however, is as a constituent of bearing metals, on account of the low coefficient of friction obtained. Alloys of lead and cadmium appear to be the best for this purpose, though magnesium has also been introduced with good results. Cadmium in combination with bismuth and lead bismuth and tin, or lead and tin, has produced a range of fusible alloys for the production of fire-extinguishing devices, safety devices, electric fuse wires, and for certain copies for the reproduction of type matter in newspaper work. Cadmium is also a good deoxidizer for alloys of aluminum, silver, and nickel.
>
> Cadmium is also used for electroplating and rustproofing, having certain advantages, such as thinness of coating, freedom from peeling, etc. Another valuable use is for accumulator cells, often in combination with nickel. Cadmium amalgams have been used in dentistry, but only where better and more expensive alloys could not be used. Cadmium oxide has been used as an electric-furnace high-temperature resistance material. A cadmium vapor arc lamp has been designed. Nor can one omit the very great use of the metal in paints, colors, and glazes; in photography for preparing the sensitive plates; and in medicine as "salts."

The toxic effect of cadmium in foods contaminated by contact with cadmium-plated containers is being investigated by the United States Department of Agriculture (Food Research Division Contribu-

[3] Woolf, W. G., and Crutcher, E. R., Making Electrolytic Zinc at the Sullivan Plant: Eng. and Min. Jour., vol. 140, No. 8, August 1939, p. 77.

[4] Townsend, F. E., and Cade, G. N., Separation of Cadmium from Zinc: Ind. Eng. Chem., vol. 12, No. 3, March 1940, pp. 163–164.

[5] Sanderson, L., Cadmium: Canadian Min. Jour., vol. 60, No. 8, pp. 481–483.

tion No. 455). Anemia and marked enlargement of the heart were observed in rats fed on a diet containing 0.0031 to 0.025 percent cadmium. The Food and Drug Administration filed a libel action in the Federal Court of New York for the seizure of 40,000 lipsticks imported from France on the grounds that the cadmium and selenium they contained rendered them dangerous and in violation of section 601 (*a*) of the new food, drug, and cosmetic act.[6]

FOREIGN TRADE

Official statistics record separately only the imports of metallic cadmium. There is a limited import and export trade in cadmium compounds, and some metal is known to have been exported in former years, but the quantities involved are believed to be relatively unimportant except in 1938 when exports totaling 458,283 pounds were reported to the Bureau of Mines. No exports of metal were reported in 1939. Exports of cadmium with benefit of draw-back, mostly in bearings, totaled 52,149 pounds in 1939 and 36,081 in 1938. Imports of metallic cadmium in 1939 were much larger than in 1938 but were considerably below those of 1936 and 1937. Of the 309,874 pounds shipped in 1939 Belgium supplied 197,454 pounds, Netherlands 38,038, Italy 35,304, Canada 30,068, Norway 6,720, Poland and Danzig 2,240, and Germany 50. Belgium contributed 20,067 pounds of the 22,582 imported in 1938. The average value of the cadmium imported in 1939, as reported by the Customs Bureau, was $0.42 a pound compared with $1.35 in 1938, $1.30 in 1937, and $0.71 in 1936. The United States also imports crude materials containing cadmium for refining. Shipments of material of this type from Mexico to the United States for 11 months of 1939 contained 816 tons of cadmium compared with 838 tons for all of 1938.

PRICES

According to Engineering and Mining Journal Metal and Mineral Markets, the average price of cadmium in 1939 was 64.1 cents a pound compared with 98.0 cents in 1938, $1.223 in 1937, 97.8 cents in 1936, and 55 cents in 1933 and 1934. These prices represented the average of the producers' and platers' quotations. As stated in Minerals Yearbook, 1939, this authority established in 1939 another average monthly price based solely upon quotations by producers for ordinary commercial shapes, quantity business. For 1939 this average was 59.2 cents a pound. Incomplete data obtained by the Bureau of Mines from producers indicate that the average value realized on sales of metallic cadmium in 1939 was 54 cents a pound compared with 75 cents in 1938, $1.14 in 1937, 80 cents in 1936, and 50 cents in 1935.

At the beginning of 1939 patented shapes for platers were quoted at 85 cents a pound, New York, and quantity business, commercial sticks, at 60 cents a pound, but before the end of the month (January 23) these prices were reduced 5 cents owing to the weakness of the foreign market. On March 28 there was a second reduction of 5 cents in the price of commercial sticks, whereas the price on cadmium in patented shapes, for platers, was reduced 25 cents; thus the quotations became 50 and 55 cents, respectively. Prices remained at these

[6] Oil, Paint and Drug Reporter, Cadmium and Selenium Held Dangerous in Cosmetics: Vol. 135, No. 26, June 26, 1939, p. 3.

levels until August 9, when the quotation for each item was advanced 5 cents. On September 5, commercial sticks were quoted at 65 cents a pound and patented shapes at 70 cents a pound; again on October 3, there was a further increase of 10 cents to 75 cents for commercial sticks and 80 cents for patented shapes. These prices remained unchanged for the rest of the year.

Effective January 1, 1939, the duty on cadmium was reduced from 15 cents to 7.5 a pound under the Canadian Trade Agreement.

The London quotation on January 5 was 2s. 1d. a pound. Between this time and August the trend in prices was downward, but after the outbreak of war in Europe quotations rose from less than 2s. late in August to 5s. 6d. at the close of 1939.

WORLD PRODUCTION

Data on world production of cadmium in 1939 are very incomplete, but production in the United States, Canada, and South-West Africa (which furnished 58 percent of the estimated output of 4,000,000 kilograms in 1938) increased 21 percent. The United States produced 47 percent of the 1938 total and increased its output 15 percent in 1939. Notable gains also were made by Canada and South-West Africa, but Australia produced 12 percent less cadmium in 1939 than in 1938. Press reports indicate that Italy's output should have been about 100,000 kilograms in 1939. Production in Norway and Belgium probably decreased slightly, whereas that in the United Kingdom gained slightly.

World production of cadmium, 1935–39, by countries, in kilograms

[Compiled by R. B. Miller]

Country	1935	1936	1937	1938	1939
Australia (Tasmania)	222,108	251,826	210,608	199,326	175,150
Belgium	150,999	203,997	271,000	182,000	[1] 530,800
Canada	263,323	356,484	338,018	317,122	426,234
France	121,000	84,000	99,000	116,500	(2)
Germany	167,000	302,000	355,000	432,000	(2)
Italy	16,360	54,630	90,850	69,000	(2)
Japan	3,236	23,563	(2)	(2)	(2)
Mexico	(3)	(3)	(3)	(3)	(3)
Norway	118,335	101,876	154,192	207,667[4]	(2)
Poland	120,700	140,900	124,461	244,000	(2)
South-West Africa	[4] 145,150	[4] 98,900	[4] 138,300	116,000	197,000
U. S. S. R.	12,000	50,000	50,000	(2)	(2)
United Kingdom	[1] 5,091	22,160	124,142	124,898	(2)
United States:					
Cadmium compounds [5]	230,152	284,310	375,573	195,000	308,000
Metallic cadmium	1,577,174	1,648,117	1,812,427	1,702,470	1,878,426
	3,150,000	3,600,000	4,200,000	(2)	(2)

[1] Exports.
[2] Data not available.
[3] The Mexican Government reports the total cadmium content of material produced in Mexico as follows: 1935, 597,527 kilos; 1936, 535,017 kilos; 1937, 619,792 kilos; 1938, 762,398 kilos; and 1939, 816,584 kilos. This material is exported for treatment elsewhere; therefore, to avoid duplication of figures, the data are not included in this table.
[4] Cadmium content of quantity exported. Represents in part shipments from stocks on hand.
[5] Estimated cadmium content.

REVIEW BY COUNTRIES

Australia.—The Electrolytic Zinc Co. of Australia, Ltd., produced 172 long tons of cadmium in the year ended June 30, 1939, of which 12 tons came from precipitates produced at the lead smelter at Port Pirie and 160 tons from zinc-plant residues from Risdon.

Canada.—Owing to exhaustion of accumulated stocks of cadmium precipitates, cadmium production at Flin Flon declined farther to 70 short tons compared with 94 tons in 1938 and 154 in 1937. This decline apparently was more than offset by an increase in output at Trail as a result of the larger production of zinc.

Germany.—Cadmium is used chiefly in the manufacture of metal bearings, and consumption for this purpose is understood to have increased in recent years. Owing to the relative scarcity of the metal, its use in pigments was restricted in 1939. Cadmium is being substituted for nickel in some plating applications.

South-West Africa.—The Otavi Mines Co. is the sole producer of cadmium dust in the territory. The dust is recovered as a smelter byproduct from the copper-lead-zinc ores of the Tsumeb mine. No output of this product was made in 1937, but in 1938 production amounted to 387 metric tons as against 351 in the first 9 months of 1939. Exports, marked for Antwerp, rose sharply from 436 metric tons in 1937 to 672 in 1938 and for the first 9 months of 1939 totaled 214 metric tons. The estimated value of these exports was £50,784 in 1937, £51,072 in 1938, and £16,078 in 1939.

PLATINUM AND ALLIED METALS

By H. W. Davis

SUMMARY OUTLINE

Although the United States is by far the largest consumer of platinum metals in the world, before 1935 it had contributed only a negligible quantity to the world output. For example, during the 10 years 1925–34 production averaged only about 8,300 ounces annually—1,000 ounces of placer platinum, 600 ounces of palladium-bearing copper ore, and 6,700 ounces as byproducts of gold and other metals. Since 1935, however, chiefly because of large-scale mining in Alaska, production of platinum metals in the United States advanced progressively from 11,552 ounces in 1935 to 48,269 ounces in 1938—40,932 ounces of placer platinum, 7,247 ounces recovered from gold and copper refining, and 90 ounces obtained from platinum-bearing ore. Thus, the United States attained the rank of fourth largest producer of platinum metals in 1938. Although production dropped to 43,760 ounces in 1939, the country retained its rank.

Salient statistics of platinum and allied metals in the United States, 1938–39, in troy ounces

	1938	1939
Production:		
Crude platinum from placers	40,932	[1] 35,060
New metals:		
Platinum	[2] 30,444	[2] 36,033
Palladium	3,653	3,491
Other	2,116	1,917
	36,213	41,441
Secondary metals:		
Platinum	44,654	45,432
Palladium	13,489	13,039
Other	6,148	4,972
	64,291	63,443
Stocks in hands of refiners, Dec. 31:		
Platinum	71,058	71,393
Palladium	30,071	29,273
Other	16,782	16,884
	117,911	117,550
Imports for consumption:		
Platinum	127,832	190,226
Palladium	26,858	96,829
Other	6,499	19,572
	161,189	306,627
Exports:		
Unmanufactured	33,635	46,329
Manufactures (except jewelry)	796	4,041

[1] Subject to revision.
[2] In 1938 includes 6,376 ounces of new platinum from domestic sources, comprising 2,590 ounces derived from crude placer platinum, 25 ounces recovered from ore, and 3,761 ounces obtained from domestic gold and copper ores as a byproduct of refining; in 1939 includes 8,205 ounces of new platinum from domestic sources, comprising 2,919 ounces derived from crude placer platinum, 16 ounces recovered from ore, and 5,270 ounces obtained from domestic gold and copper ores as a byproduct of refining.

In addition to now being the fourth largest source of supply of platinum metals the United States is an important refining center and occupies a prominent position in the international platinum trade. In 1939, for example, 41,441 ounces of new platinum metals and 63,443 ounces of secondary platinum metals were recovered by domestic refiners, 306,627 ounces of unmanufactured platinum metals were imported for consumption, and 46,329 ounces of platinum and

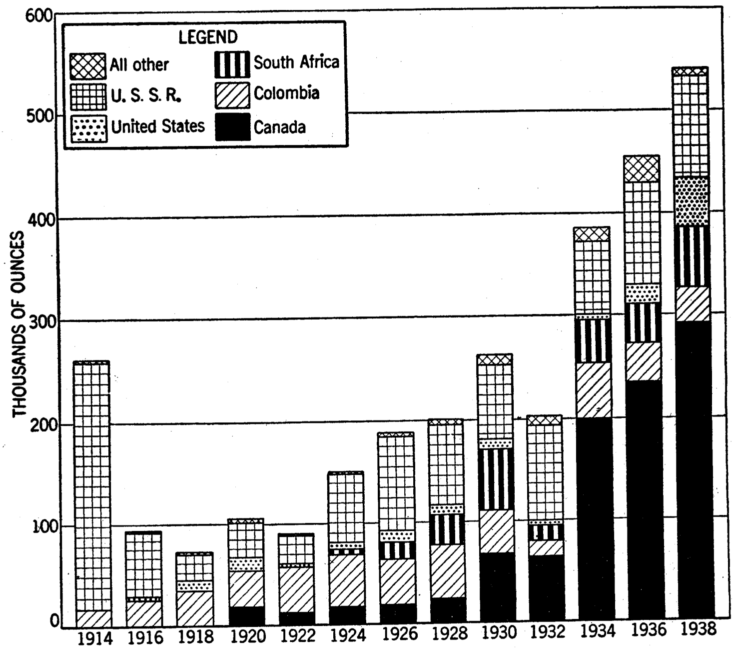

FIGURE 1.—Trend in world production of platinum metals, 1914–38.

allied metals (ingots, sheets, wire, alloys, and scrap) and a considerable quantity of placer platinum were exported.

Despite the much larger output of domestic placer platinum, most of the new platinum metals recovered by refiners in the United States in 1939, as in previous years, were derived from crude platinum from foreign sources, notably Colombia, as most of the Alaska platinum was refined abroad. The major part of the refined new platinum metals now consumed in the United States emanates from the United Kingdom; the metals are recovered there chiefly as byproducts in refining nickel-copper matte from the Sudbury district of Ontario and, to a smaller extent, from matte from the Rustenburg district of the Union of South Africa and from placer platinum originating in the Goodnews Bay district (Alaska).

Figure 1 shows graphically the trend in world production of platinum metals from 1914 to 1938. The prominent position of Canada since 1930 and especially since 1934 is strikingly revealed, as well as the rise in production in the United States since 1936. The figures plotted for the U. S. S. R. for 1918, 1920, 1922, 1936, and 1938 are rough estimates of crude-platinum metals, whereas those for 1930, 1932, and 1934 are exports of refined platinum.

CRUDE PLATINUM

Production.—Mine returns for 1939 indicate a production of 33,900 troy ounces of crude platinum in Alaska, 1,140 ounces in California, and 20 ounces in Oregon—a total of 35,060 ounces. Comparable figures for 1938 are 39,889 ounces in Alaska, 1,000 ounces in California, and 43 ounces in Oregon—a total of 40,932 ounces. Most of the production in Alaska came from placers in the Goodnews Bay district south of the mouth of the Kuskokwim River. Smaller quantities were recovered in placer-gold mining in the Koyuk district, Seward Peninsula. Some platinum metals, especially palladium, also were obtained by reworking the tailings from earlier lode mining in the Ketchikan district, Kasaan Peninsula. In California most of the output of platinum was a byproduct of dredges working the gold placers in Merced, Placer, Sacramento, Shasta, Stanislaus, Tehama, Trinity, and Yuba Counties. The principal production in Oregon came from the ocean beach near Cape Blanco in Curry County.

Many gold and copper ores in the United States contain small quantities of platinum metals. In 1939, 8,634 ounces of platinum metals were recovered as a byproduct of refining gold and copper ores compared with 7,247 ounces in 1938.

The platinum deposits of the Goodnews Bay district, Alaska, have been described recently by Mertie,[1] and operations of the Goodnews Bay Mining Co. have been discussed by Spencer.[2] The report by Mertie includes 27 commercial analyses of platinum metals of the Goodnews Bay district, arranged by creeks in numerical order downstream. The average commercial analysis of platinum metals of the streams is as follows:

Average commercial analysis of platinum metals of the Goodnews Bay district, Alaska, in percent

	Platinum Creek	Squirrel Creek	Salmon River	Clara Creek
Platinum	60.09	68.48	73.40	73.29
Iridium	22.04	13.12	8.93	5.90
Osmium	3.91	3.27	2.05	.69
Ruthenium	.36	.26	.15	.13
Rhodium	1.83	1.40	1.88	.42
Palladium	.21	.26	.30	.56
Gold	.28	.41	2.22	1.01
Impurities	11.26	12.80	11.07	18.00

Purchases.—Platinum refiners in the United States reported purchases of domestic crude platinum from the following sources in 1939: Alaska, 3,222 ounces; California, 1,225 ounces; and Oregon, 32 ounces—a total of 4,479 ounces (4,993 ounces in 1938). Domestic refiners also reported purchases of 35,135 ounces (28,324 ounces in 1938) of foreign crude platinum in 1939—53 ounces from Canada, 31,748 ounces from Colombia, 1,624 ounces from Ethiopia, and 1,710 ounces from the Union of South Africa.

Prices.—Buyers reported purchases at $19.39 to $40.80 an ounce for domestic and $22.06 to $38 an ounce for foreign crude platinum in 1939.

[1] Mertie, J. B., Jr., Platinum Deposits of the Goodnews Bay District, Alaska: Geol. Survey Bull. 910-B, 1939, 145 pp.

[2] Spencer, W. W., Alaskan Development at Goodnews Bay Makes United States Platinum Production Important: Min. and Met., March 1940, pp. 132-135.

REFINED PLATINUM METALS

New metals recovered.—Reports from refiners of crude platinum, gold bullion, and copper indicate that 41,441 ounces of platinum metals were recovered in the United States from these sources in 1939, an increase of 14 percent over 1938. It is estimated that 12,299 ounces of the total output in 1939 were derived from domestic sources.

New platinum metals recovered by refiners in the United States in 1939, by sources, in troy ounces

	Platinum	Palladium	Iridium	Osmiridium	Others	Total
Domestic from—						
Crude platinum	2,919	12	295	344	29	3,599
Ore	16				50	66
Gold and copper refining	5,270	3,330	34			8,634
	8,205	3,342	329	344	79	12,299
Foreign from crude platinum	27,828	149	722	383	60	29,142
Total recovery: 1939	36,033	3,491	1,051	727	139	41,441
1938	30,444	3,653	1,247	384	485	36,213

New platinum metals recovered by refiners in the United States, 1935–39, in troy ounces

Year	Platinum	Palladium	Iridium	Osmiridium	Others	Total
1935	37,284	1,432	2,438	449	457	42,060
1936	39,728	4,682	1,678	541	317	46,946
1937	36,174	5,945	1,998	640	501	45,258
1938	30,444	3,653	1,247	384	485	36,213
1939	36,033	3,491	1,051	727	139	41,441

Secondary metals recovered.—In 1939, 63,443 ounces of secondary platinum metals were recovered from the treatment of scrap metal, sweeps, and other waste products of manufacture that contain platinum, a decrease of 1.3 percent from 1938.

Secondary platinum metals recovered in the United States, 1935–39, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1935	47,107	7,852	2,191	1,975	59,125
1936	55,959	6,786	2,204	1,217	66,166
1937	55,926	12,680	2,320	1,280	72,206
1938	44,654	13,489	2,150	3,998	64,291
1939	45,432	13,039	3,150	1,822	63,443

Prices.—Refiners reported the following prices for platinum, palladium, and iridium: Platinum, high \$45, low \$26, and average \$36 an ounce for 1939 compared with \$43, \$24, and \$33.83 an ounce, respectively, for 1938; palladium, high \$25, low \$19, and average \$23.25 an ounce for 1939 compared with \$28, \$17, and \$23.21 an ounce, respectively, for 1938; iridium, high \$200, low \$50, and average \$112.67 an ounce for 1939 compared with \$90, \$50, and \$69.29 an ounce, respectively, for 1938.

Consumption and uses.—Platinum and its allied metals (palladium, iridium, rhodium, ruthenium, and osmium) are characterized by high melting point, white color, and resistance to oxidation at high temperatures and to attack by destructive chemical compounds. As pure metals, combined, clad, or alloyed with other metals, the platinum metals are used in jewelry and dentistry, in the chemical and electrical industries, and for numerous miscellaneous purposes.

A material gain in world output of platinum metals, owing chiefly to improvements in metallurgical processes used in refining copper-nickel ores, has made available large quantities of platinum, palladium, iridium, rhodium, ruthenium, and osmium. For example, in 1938 world production of platinum metals was about 540,000 ounces, of which about 57 percent was recovered as byproducts in the refining of nickel, copper, and gold ores, whereas in 1929 world production was about 231,000 ounces, of which about 17 percent was so obtained. With increased supplies, relative stability in the price of platinum and palladium has been reached at levels that permit their use for plant equipment and other industrial purposes. Despite the rapid advance in output of the platinum metals during the past decade, research has found new uses for them, and developmental activities are opening up larger and more diversified markets in which these uses are becoming accepted.

The most widely used metal of the group is platinum, which constituted 100,266 ounces (63.3 percent) of the total platinum metals sold by domestic refiners in 1939. The largest single consumer of platinum is the jewelry industry, where, alloyed with iridium, it is used as a setting for diamonds and other precious stones in rings and various forms of jewelry. About 47 percent (47,385 ounces) of the total sales of platinum by domestic refiners went to the jewelry trade in 1939.

Second in magnitude as a consumer of platinum in 1939 was the chemical industry, which took 20 percent (20,306 ounces) of the total domestic sales. It is used as a catalyst to produce sulfuric acid and for ammonia oxidation to produce nitric acid and nitric oxide, lining processing and reaction vessels, hydrogenation of organic compounds, rayon spinnerets, nozzles for the production of glass fiber, glass insulators for the bases of electric-light bulbs, tubing, valves, siphons, and safety disks for handling corrosive liquids and gases, anodes for the production of "per" salts, gas-analysis cells, crucibles, and laboratory equipment.

The dental industry ranked third as a consumer of platinum in 1939, taking 14 percent (13,755 ounces). Platinum, either pure or alloyed, is used in tooth pins, bridges, and bracings for artificial teeth, as matrices on porcelain inlays, and in orthodontic appliances.

The electrical industry, the fourth largest consumer of platinum in 1939, took 12 percent (11,952 ounces). It is used for thermocouples, temperature measuring and recording instruments, precision resistance thermometers, high-temperature furnace windings, spark-plug electrodes, magneto contacts, electrical contacts, relays, thermostats, automobile voltage regulators and direction indicators, and switches for potentiometric recorders.

Platinum leaf was made available during 1939 for outdoor signs and for interior decoration and book stamping. Palladium leaf was first introduced for somewhat similar purposes in 1933.

Next to platinum, palladium is the most extensively used metal of the platinum group; it is about half as common as platinum but less costly. It comprised 51,406 ounces (32.5 percent) of the total platinum metals sold by domestic refiners in 1939. Palladium, pure or alloyed, is adapted to many of the uses of platinum and during the past 2 decades has been employed in increasing quantities by the dental, electrical, and jewelry industries. The conservation of gold by many countries has stimulated the demand for the platinum metals, particularly palladium, and the use of palladium as a substitute for gold alloys for dental restoration, pen points, and articles of jewelry has made substantial progress. The largest consumers of palladium in 1939 were the dental and electrical industries, which purchased 22,989 and 21,510 ounces, respectively, from domestic refiners. The jewelry industry is the next largest consumer of palladium, and small quantities are used in the manufacture of chemical ware.

Iridium ranks third in consumption among the platinum-group metals. Of the total sales of platinum metals in 1939, 4,322 ounces (2.7 percent) were iridium. This metal is used chiefly as a hardening addition to platinum, rendering it suitable for laboratory vessels, surgical tools, hypodermic needles, thermoelements, and jewelry. Its compounds are used as fixing agents, porcelain pigment, and (in the form of black) as a catalyst.

The consumption of the other platinum metals—rhodium, osmium, and ruthenium—is small and comprised only 1.5 percent of the total for the group in 1939. Rhodium is alloyed with platinum for high-melting-point thermocouple wire, furnace windings, and laboratory ware for certain special uses. Rhodium plating is employed as a finish for glassware and silverware and in surfacing reflectors for searchlights and projectors. During 1939 platinum-rhodium spinnerets replaced the older platinum-gold spinnerets, because of their superior resistance to the various corrosive agents used in the production of rayon. Osmium, in association with other metals, provides pen points that will resist wear and corrosion by ink. These alloys also replace jewels as bearings in fine instruments. The oxide is used as a biological stain for fats and for fingerprint work. Ruthenium also is used as a hardener for platinum metals, and one of its salts serves as a biological stain.

The following table shows sales of platinum metals to domestic consumers by refiners in the United States in 1939. The figures include sales of platinum metals recovered from crude platinum, gold bullion, copper and nickel bullion and matte, electrolytic muds, and scrap materials and sweeps; in addition they include sales of imported platinum metals that are handled by domestic refiners. Sales by refiners totaled 158,357 ounces in 1939 compared with 127,306 in 1938.

Platinum metals sold by refiners in the United States in 1939, by domestic consuming industries, in troy ounces

Industry	Platinum	Palladium	Iridium	Others	Total	Percent of total
Chemical	20,306	468	187	626	21,587	14
Electrical	11,952	21,510	917	429	34,808	22
Dental	13,755	22,989	120	19	36,883	23
Jewelry	47,385	5,899	3,014	432	56,730	36
Miscellaneous and undistributed	6,868	540	84	857	8,349	5
	100,266	51,406	4,322	2,363	158,357	100

Stocks.—On December 31, 1939, 117,550 ounces of platinum metals were in the hands of refiners compared with 117,911 ounces at the end of 1938.

Stocks of platinum metals in the hands of refiners in the United States, Dec. 31, 1935–39, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1935	50, 265	27, 807	9, 202	6, 273	93, 547
1936	56, 886	29, 853	8, 943	8, 235	103, 917
1937	60, 236	21, 942	9, 785	7, 536	99, 499
1938	71, 058	30, 071	8, 041	8, 741	117, 911
1939	71, 393	29, 273	7, 796	9. 088	117, 550

FOREIGN TRADE [3]

Imports of platinum metals into the United States during 1939 amounted to 306,627 ounces, establishing an all-time high. The principal sources of imported platinum metals in 1939 were the United Kingdom (250,699 ounces), Colombia (26,747 ounces), and the U. S. S. R. (19,846 ounces). Imports of palladium (chiefly from the United Kingdom) were noteworthy in 1939, increasing to 96,829 ounces from 26,858 ounces in 1938 and 45,427 in 1937, the previous record year.

Platinum metals imported for consumption in the United States, 1935–39

Year	Troy ounces	Value	Year	Troy ounces	Value
1935	164, 149	$4, 228, 022	1938	161, 189	$4, 366, 912
1936	210, 440	5, 996, 034	1939	306, 627	9, 881, 531
1937	206, 937	7, 418, 364			

Platinum metals imported for consumption in the United States, 1938–39, by metals

Metal	1938		1939	
	Troy ounces	Value	Troy ounces	Value
Platinum:				
Ores of platinum metals (platinum content)	3, 263	$71, 504	5, 943	$137, 500
Grain and nuggets	26, 176	688, 166	32, 266	905, 315
Sponge and scrap	54, 299	1, 496, 491	83, 995	2, 910, 159
Ingots, bars, sheets, or plates not less than ⅛-inch thick	44, 091	1, 371, 246	68, 022	2, 173, 260
	127, 829	3, 627, 407	190, 226	6, 126, 234
Manufactures of, not jewelry	3	150	([1])	8
Iridium	1, 717	118, 849	6, 363	686, 560
Osmiridium	2, 501	61, 391	2, 204	51, 162
Osmium	440	16, 349	623	22, 229
Palladium	26, 858	448, 152	96, 829	2, 099, 104
Rhodium	1, 613	87, 276	5, 352	643, 703
Ruthenium	228	7, 338	5, 030	252, 531
	161, 189	4, 366, 912	306, 627	9, 881, 531

[1] Less than 1 troy ounce.

[3] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Platinum metals (unmanufactured) imported for consumption in the United States in 1939, by countries, in troy ounces

Country	Platinum				Iridium	Osmium and osmiridium	Palladium	Rhodium and ruthenium	Total
	Ores of platinum metals (platinum content)	Grain and nuggets	Sponge and scrap	Ingots, bars, sheets, or plates not less than ⅛-inch thick					
Argentina		1,218	552				3		1,773
Australia						5			5
Belgium				216					216
Canada		129	276				251		656
Colombia	3,435	23,310	2						26,747
Ethiopia	2,491								2,491
France					96	26		64	186
Guiana, British			10						10
Japan			775						775
Netherlands			243	554					797
Norway		123	318	230	318		207	1,040	2,236
Panama, Republic of			10						10
Peru		160							160
Philippine Islands			15						15
Union of South Africa			5						5
U. S. S. R.				15,562	4,284				19,846
United Kingdom	17	7,326	81,789	51,460	1,665	2,796	96,368	9,278	250,699
	5,943	32,266	83,995	68,022	6,363	2,827	96,829	10,382	306,627

Exports.—Exports of unmanufactured platinum metals totaled 46,329 ounces in 1939 (33,635 ounces in 1938), of which France took 13,709, Germany 11,401, and Japan 5,726 ounces.

Platinum and allied metals exported from the United States, 1935–39

Year	Unmanufactured		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value
1935 [1]	3,271	$105,895	1,954	$84,601
1936	55,454	2,069,205	2,590	123,891
1937	59,567	2,908,552	2,874	100,944
1938	33,635	1,156,644	796	31,111
1939	46,329	1,528,563	4,041	213,445

[1] Excludes exports by parcel post.

Platinum and allied metals exported from the United States in 1939, by countries

[Includes exports by parcel post]

Country	Unmanufactured (ingots, sheets, wire, alloys, and scrap)		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value
Argentina	3,312	$116,743	68	$5,204
Australia			166	13,178
Belgium	2	104	418	31,199
Brazil	1,085	46,467	61	3,598
Canada	2,591	73,995	104	4,566
China	150	4,751		
Cuba	118	4,608	1	47
France	13,709	502,527		
Germany	11,401	303,484		
Japan	5,726	176,731	18	1,169
Netherlands	383	14,885	1,456	84,858
Palestine	4	99	240	8,596
Switzerland	4,170	132,344	1,320	51,381
Turkey	201	8,394		
United Kingdom	2,859	110,407	2	151
Other countries	618	33,024	187	9,498
	46,329	1,528,563	4,041	213,445

WORLD PRODUCTION

The following table shows world production of platinum metals by countries from 1935 to 1939, insofar as statistics are available. Returns for 1939 are incomplete, but except for the U. S. S. R. those for 1938 are nearly complete. If the production of the U. S. S. R. is estimated roughly at 100,000 ounces in 1938, world production of about 540,000 ounces is indicated, of which Canada furnished 54 percent, U. S. S. R. 19 percent, Union of South Africa 11 percent, United States 9 percent, and Colombia 6 percent—a total of 99 percent. The 1938 production comprised about 57 percent of platinum metals recovered as byproducts of nickel, copper, and gold ores, 33 percent of crude platinum metals from placers, and 10 percent recovered from sulfide and oxidized ores.

World production of platinum and allied metals, 1935–39, in troy ounces

[Compiled by M. T. Latus]

Country and product	1935	1936	1937	1938	1939
Australia:					
New South Wales: Placer platinum	98	47	46	8	(1)
Tasmania: Placer osmiridium	235	281	586	191	283
Belgian Congo: From refineries:					
Palladium	5,144	12,571	12,507	1,575	(1)
Platinum	965	3,183	2,122	225	(1)
Canada:					
Placer platinum	39	20	22	16	25
From refineries: [3]					
Platinum	105,335	131,551	139,355	161,310	148,877
Other platinum metals	84,772	103,671	119,829	130,893	135,402
Colombia: Placer platinum (exports)	38,020	38,333	29,315	34,549	39,070
Ethiopia: Placer platinum	6,320	8,038	(1)	(1)	(1)
Italy: From refineries: Platinum	772	836	1,286	1,029	(1)
Japan: Placer platinum	51	34	(1)	(1)	(1)
Netherland India (probably placer platinum)	----------	----------	----------	21	(1)
New Zealand: Placer platinum	14	29	55	1	(1)
Panama: Placer platinum	16	19	267	----------	----------
Papua: [2]					
Placer platinum	46	21	20	41	2
Placer osmiridium	9	17	8	4	4
Sierra Leone: Placer platinum	750	484	308	180	83
Union of South Africa:					
Platinum (content of platinum metals)[4]	19,954	19,751	17,776	18,256	18,067
Concentrates (content of platinum metals)[4]	11,317	13,163	21,849	35,124	41,218
Osmiridium [5]	5,047	5,431	5,790	5,354	6,568
U. S. S. R.: Placer platinum [6]	100,000	100,000	100,000	100,000	100,000
United States:					
Placer platinum	9,069	9,785	10,803	40,932	[7] 35,060
Ore (content of platinum metals)	----------	110	124	90	66
From refineries: [8]					
Platinum	1,361	4,443	4,761	3,761	5,270
Other platinum metals	1,122	4,541	5,817	3,486	3,364
	390,000	456,000	[9] 473,000	[9] 537,000	(1)

[1] Data not available.
[2] Year ended June 30 of year stated.
[3] Recovered from nickel-copper mattes.
[4] Produced from platinum ores.
[5] Produced from treatment of gold ores on the Rand.
[6] Estimated production.
[7] Subject to revision.
[8] New platinum metals recovered in gold and copper refining of domestic materials.
[9] Exclusive of Ethiopia and Japan.

Canada.—Recoveries of platinum metals from the nickel-copper ores of the Sudbury district, Ontario, were 148,877 ounces of platinum and 135,402 ounces of other platinum-group metals in 1939 compared with 161,310 ounces of platinum and 130,893 ounces of other platinum-group metals in 1938.[4] Residues from the Port Colborne and Copper Cliff refineries are shipped to the International Nickel Co. precious-

[4] Dominion Bureau of Statistics, Preliminary Report on the Mineral Production of Canada During the Calendar Year 1939: Ottawa, 1940.

metals refinery at Acton, England, for the recovery of platinum, palladium, iridium, rhodium, and ruthenium. The platinum and palladium contained in the ore of the Falconbridge Nickel Mines, Ltd., are recovered at the precious-metals separating plant at Kristiansand, Norway. It is announced that this plant is now ready for separation of iridium, rhodium, and ruthenium. The Sudbury copper-nickel ore does not contain enough osmium to make recovery of this metal commercially important. Placers in British Columbia yielded 25 ounces of stream platinum in 1939 compared with 16 ounces in 1938.

Sales of platinum metals by the International Nickel Co. of Canada, Ltd., were 240,778 ounces in 1939 compared with 193,195 ounces in 1938. The metals were sold principally in the United States and the United Kingdom.

Colombia.—Colombia exported 39,070 ounces of crude platinum in 1939 (34,549 ounces in 1938). Of the 1939 exports, apparently about 64 percent went to the United States and 36 percent to Germany; a small amount went to Japan.

The South American Gold & Platinum Co. produced 27,975 ounces of crude platinum and 59,416 ounces of crude gold in 1939 compared with 20,714 ounces of crude platinum and 63,622 ounces of crude gold in 1938.

Union of South Africa.—According to the Department of Mines and Industries, the estimated content of platinum metals produced in the Union of South Africa was 65,853 ounces in 1939 compared with 58,734 ounces in 1938.

The enlarged Rustenburg plant of Potgietersrust Platinum, Ltd., for handling sulfidic ores, which was brought into operation in July 1938, was operated at capacity in 1939. The output, in the form of crude platinoids and matte, was shipped to England for treatment.[5]

Sales of platinum metals from South Africa were 47,914 ounces valued at £302,370 (£6.31 an ounce) in 1939 compared with 38,862 ounces valued at £223,776 (£5.76 an ounce) in 1938. The average composition of the product sold in 1938 was platinum 78.20 percent, palladium 16.33 percent, iridium 0.13 percent, osmium and osmiridium 0.08 percent, ruthenium 1.20 percent, and gold 4.06 percent.

Sales of osmiridium were 6,094 ounces valued at £36,665 (£6.02 an ounce) in 1939 compared with 5,884 ounces valued at £36,523 (£6.21 an ounce) in 1938. The average composition of the product sold in 1938 was osmium 28.90 percent, iridium 26.56 percent, ruthenium 13.81 percent, platinum 10.78 percent, gold 2.37 percent, rhodium 0.52 percent, and undetermined 17.06 percent.

[5] South African Mining and Engineering Journal, vol. 50, pt. 2, December 16, 1939, p. 505.

MINOR METALS

By Paul M. Tyler

SUMMARY OUTLINE

In Minerals Yearbook, 1937, brief references were made to the commercial status and utilization of all metallic elements, but space limitations have restricted subsequent annual reviews of the minor metals to the presentation of such information as seemed timely and important enough to include in the record for a given year. Therefore, the following review makes no reference to certain elements that are more important commercially and even scientifically than those discussed at some length.

A glance backward shows that most of the metals falling within the purview of this chapter had little or no commercial significance until a relatively few years ago. As recently as 1919 a compendium on Our Mineral Supplies [1] grouped the minor elements in a single chapter, and the only commodities discussed therein were antimony, arsenic, bismuth, molybdenum, nickel, tin, tungsten, and vanadium. Attesting the wider variety of materials demanded by modern industry, all of these items are now considered important enough to be discussed elsewhere in this volume; and most of those now included in the coverage of the present chapter as "minor metals"—even those that now have well-established commercial uses—were deemed quite unimportant laboratory curiosities only 20 years ago.

At the threshold of a new decade, one wonders how many more obscure metals may emerge from the laboratory and be put to work. Even more beguiling speculations are the possible harnessing of atomic energy and the refabrication of elements. The accomplishments of nuclear physicists have been amazing, particularly in view of the few short years in which they have been aided in their researches by massive, modern atom-smashing devices. Natural transmutation of radioactive elements was discovered in 1898, when Mme. Curie identified the element that she named polonium. Artificial transmutation has been accomplished on an accelerated scale in various laboratories for more than a decade, but not until January 1939 did we know that it could do more than modify existing atoms to make them slightly heavier or slightly lighter. As noted in the chapter of this series for 1938, news of the actual splitting of an atom surprised

[1] Hess, Frank L., Our Mineral Supplies—the Rarer Metals: Geol. Survey Bull. 666–U, 1919, 13 pp.

the world of physics and, more important, opened new vistas of research. It is premature to assume that these disclosures will enable man to utilize atomic energy. The implications of such a revolutionary development, however, are indicated by Princeton's Prof. Malcolm C. Henderson, who calculated that if one could split economically the atoms of 8 pounds of uranium, enough energy would be released to drive the largest ocean liner across the Atlantic, in substitution for 6,300 tons of oil.[2] Discouraging is the statement that 16 times as much energy is needed to split a uranium atom as can be obtained from it; there is the further possibility that the only one of the various uranium isotopes that can be split is present to the extent of only about 1 percent; its atomic weight is 235. On the other hand, it is possible that one or more new neutrons actually are released by the initial splitting and that these in turn may make the disintegration continue, once it is initiated.

More immediate practical results are being obtained by less violent transmutations. Common table salt may be made artificially radioactive, so that for a time it will emit rays similar to those from natural radium. Neutron yields equivalent to what would be obtained by using 50,000 grams of radium are obtained by allowing the accelerated positive ion (proton) beam from the Cyclotron to bombard beryllium, which is thereby transmuted to boron and an ejected neutron. Another important use of the products of nuclear transformation, as recently described by Prof. John R. Dunning, of Columbia University,[3] arises from the artificially radioactive isotopes produced. Isotopes of iodine are being investigated for the treatment of malignant diseases. Single atoms—such as those of phosphorus, sulfur, and carbon—may be made radioactive and then used for biological tracer work. Sensitive detecting apparatus makes it possible to follow them wherever they go in the body. Radioactive copper has been used in research on the diffusion of metals. The dream of the alchemists to transmute common elements into precious metals no longer seems impossible. Already precious metals have been converted into more common ones, accomplishing the transmutation in reverse; for example, silver has been changed into cadmium.

The rarer metals used in only small amounts commercially and needed chiefly for scientific or academic purposes hitherto have been produced principally in Germany and so were virtually eliminated by wartime blockade after September 1939. In contrast with the conditions that followed similar elimination of German laboratory products and supplies in 1914, the substances most needed are now being produced in American laboratories, and necessary readjustments in price have been surprisingly few. Hafnium, however, has proved an exception and even small orders for experimental purposes are almost impossible to fill. Enough cyrtolite raw material is available, but extraction of the metal has proved overdifficult. On the other hand, a prominent dealer reports that a new process has been worked out in the United States for obtaining rhenium, another German specialty, but that it could not be commercialized owing to lack of domestic raw materials.

Imports of specified rare metals and alloys during the last 3 years are summarized in the accompanying table.

[2] Jeffries, Zay, Rare Metals and Minerals: Min. and Met., vol. 21, No. 397, January 1940, p. 12.
[3] Mining and Metallurgy, vol. 21, No. 397, January 1940, p. 23.

Imports of minor metals for consumption in the United States, 1937–39 [1]

Commodity	1937		1938		1939	
	Quantity	Value	Quantity	Value	Quantity	Value
Barium, boron, columbium or niobium, strontium, tantalum, thorium, titanium, uranium, vanadium, and zirconium:						
Metals……pounds	258	$748	610	$1,553	----	----
Alloys of the foregoing with one another……pounds	5,106	3,004	4,056	2,434	2,291	$1,610
Alloys of the foregoing with aluminum, chromium, cobalt, copper, manganese, nickel, or silicon……pounds	388,801	22,510	79,357	5,113	715,881	39,264
Beryllium, caesium, lithium, and potassium metal……pounds	567	881	1,475	2,383	198	454
Beryl or beryllium ore……do	364,463	8,031	291,415	5,990	917,447	14,574
Boron carbide……do	5,524	7,973	2,165	3,243	5,064	5,849
Calcium:						
Calcium metal……do	23,767	10,087	41,299	16,144	41,718	17,758
Calcium silicide……do	3,751,918	205,173	1,402,314	77,003	3,972,571	225,312
Cerium:						
Cerium metal……	----	----	----	12	----	----
Ferrocerium and other cerium alloys……pounds	809	2,367	468	1,255	585	1,184
Cerite or cerium ore……do	----	----	----	----	----	----
Cerium compounds……do	----	----	----	----	----	----
Columbium and tantalum:						
Ductile columbium, tantalum, and alloys……pounds	----	----	49	357	----	----
Columbium ore……do	922,654	306,086	645,141	228,078	109,132	37,062
Tantalum ore……do	20,897	40,742	41,706	80,092	56,561	82,990
Radium salts……grams	15.29	377,659	38.75	787,025	78.631	1,953,820
Radioactive substitutes……	----	711	----	5,746	----	966
Selenium and salts……pounds	92,523	161,382	101,034	163,598	124,830	193,168
Sodium metal……do	----	----	----	----	----	----
Thorium nitrate……do	----	----	----	----	----	----
Titanium:						
Ilmenite……do	344,944,588	770,757	451,462,220	1,018,430	573,152,770	1,126,200
Rutile……do	1,330,738	67,643	460,446	26,533	883,674	23,170
Ferrotitanium……do	4,500	608	----	----	350	77
Uranium ore……do	----	----	----	----	5	10
Zirconium:						
Zirconium ore……do	17,868,139	129,576	4,183,506	62,111	2,965,026	49,919
Ferrozirconium, zirconium ferrosilicon……pounds	230,449	13,085	244,126	13,520	799,269	50,169
Other ferro-alloys, not specially provided for……pounds	----	----	----	----	----	----
Ores, metallic, not elsewhere specified……pounds	172,577	1,966	----	----	----	----

[1] Compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

BERYLLIUM

The beryllium industry was featured on the front pages of newspapers throughout the country as the result of the open hearings by the Temporary National Economic Committee which began on February 28, 1939. The reports of these hearings, minutes of which were subsequently printed,[4] tended to show an international interest entirely out of proportion to the small size of this infant industry.

Definite progress was made commercially in 1939, however, and the gradual expansion in sales (interrupted in 1938) was resumed. For several years the metal or its compounds has been produced in the United States by two companies, both of which are prepared to supply master alloys for fabrication by other companies. Early in 1939 the Beryllium Corporation of Pennsylvania undertook to integrate its operations and subsequently has produced not only master alloys but castings, low-spark tools, fabricated products, and mis-

[4] Temporary National Economic Committee, 76th Cong., 1st sess., Hearings; Investigation of Concentration of Economic Power: Part 5, 1939, pp. 2011-2163, 2276-2304.

cellaneous items. The fabricated products include beryllium-copper rod available in diameters up to 3 inches, strip up to 8 inches wide, and wire drawn to a minimum of 10/1000 inch. Arrangements have been made with another metal-fabricating company to produce drawn tubing in desired sizes. An interesting new development is the use of beryllium copper in cast-setting diamond core bits and reaming shells. J. K. Smit & Sons, Inc., has in recent years developed a mechanical setting method that permits a very large number of small diamonds to be set in drill bits at perfectly spaced intervals. This is one phase of the general trend away from former methods of using a few large, high-priced carbonados for core drilling and toward the employment of a large number of smaller stones, including bort or ordinary diamonds of nongem quality. A typical bit may contain 178 stones having an aggregate weight of 7 carats or, roughly, 25 stones to a carat. Instead of setting stones by hand, methods for casting metal around the stones have been developed. Alloys with high melting points must be avoided, as excessive heat may harm the diamonds. The new bit composition, "Vankolite," is a beryllium-copper alloy and is claimed to have, among other advantages, increased tensile strength and improved holding qualities.

The main advantages of beryllium copper are the combination of extraordinary high-fatigue properties with good electrical conductivity. In contrast with certain competitive materials, it has the further advantage that it can be worked soft and hardened later instead of its hardness being rolled into it at the mill. Several new applications in electrical devices and office machines are reported.

Hitherto reductions in the price of the beryllium content of master alloys have not been made available to consumers. Some years ago, when beryllium content of the alloy was quoted at $30 a pound, a 96-cent base price on strip was established, but later when the price was cut to $15 the base price of the fabricated product was held at $1.15. The 96-cent price has been reestablished on the basis of copper at 10 cents (98 cents at 12-cent copper) for strip 2 to 8 inches wide and No. 16 gage or heavier; this applies to the standard alloy containing 2 to 2¼ percent Be. Alloys containing smaller percentages are offered, including a No. 70 at 65 cents base. Base prices on wire and tubing are higher, and new lists of extras have been established to cover smaller sizes and orders under 1,000 pounds.

In addition to alloys, the Brush Beryllium Co., 3714 Chester Avenue, Cleveland, Ohio, produces the pure metal and various beryllium compounds, such as the oxide, sulfate, nitrate, and fluoride. Notable commercial progress has been made with its high-fired flux-free oxide for use in ceramic materials, where good electrical resistance and thermal conductivity may be required. This company first put pure beryllium metal on the market in 1939, after several years, experimentation. A certain amount of somewhat impure metal was made several years ago in Germany and sold in this country for experimental purposes. With domestic metal available at a substantial reduction below the $100 heretofore asked for imported beryllium, commercial applications may be developed.

Beryl, the only ore of beryllium, nominally is quoted unchanged at $30 to $35 a short ton at the mine or around $45 to $55 at consuming plants. However, imported ore can be bought for around $3.25 or $3.50 per short ton unit f. o. b. United States Atlantic ports. The blockade of Germany has diverted South American supplies to the United States, and one distress lot was offered at $30 a ton delivered in New York. A little beryl is used in ceramics, and small quantities are consumed in England, Italy, Japan, and France, but with Germany cut off the two American beryllium companies are the only consumers of any substantial tonnage and their consumption is far from large. Imports of beryl into the United States rose to 459 short tons valued at $14,574 in 1939 compared with 146 tons valued at $5,990 in 1938, 182 tons ($8,031) in 1937, and 162 tons ($6,681) in 1936. No data are available as to shipments of domestic beryl, but probably they have not exceeded about 100 or at most 150 short tons a year, and the consumption in the United States has been supplied principally by imports.

BORON

Boron alloys are supplied by domestic manufacturers, small quantities being used in the nonferrous-metals industries and in steel making. In cast iron,[5] boron opposes graphitization on solidification and exerts an energetic whitening effect, producing a hard, strong iron but reducing malleability. The Metallurgical Division of the Bureau of Mines recently investigated the electrometallurgical production of calcium boride, metallic boron, and boron alloys from colemanite.

COLUMBIUM AND TANTALUM

The world's meager needs of columbite continue to be supplied mainly from Nigeria and of tantalite from the Pilbarra district of Australia. However, Geomines, the important tin producer at Manono, Katanga (Belgian Congo), reported an output of 105 metric tons of tantalum-columbium ore during the fiscal year ended June 30, 1939. Shipments of columbite in Nigeria dropped to 530 long tons in 1938 compared with 707 tons in 1937; exports declined to 324 tons. According to official statistics, the output of tantalite in Uganda was less in 1938 than during the preceding year, owing to a drop in price and the rather low tantalum content of the ores from that colony; the hope was expressed, however, that 60 percent Ta_2O_5 concentrates might be produced from alluvial workings in the Buhwezu district. Two occurrences of columbite are reported in Chosen;[6] and the European press reported active development during 1939 of loparite deposits in the Kola Peninsula, from which columbium and tantalum as well as thorium and various rare-earth metals may be separated. Tantalite deposits and operations in Northern Territory of Australia were described recently.[7]

Tantalum is used in pure wrought form for a variety of purposes, and the hard carbide is used in cutting tools. The bulk of the domestic production of tantalite hitherto has come from the Black Hills of South Dakota. The Fansteel Mining Corporation, a wholly owned subsidiary of the Fansteel Metallurgical Corporation which is the leading manufacturer of tantalum metal and compounds, has a

[5] Bastien, P., Propriétés des fontes au titane et des fontes au bore: Chim. et ind., vol. 41, No. 5, May 1939, pp. 835–852.

[6] Hata, S., and Iimori, T., Columbite from Korea: Phys. Chem. Research, Tokyo, vol. 17, 1938, pp. 642–643; Chem. Abs., vol. 33, No. 16, Aug. 20, 1939, p. 6201.

[7] Williams, A. E., Tantalite in the Northern Territory: Chem. Eng. and Min. Rev., vol. 31, No. 367, Apr. 10, 1939, pp. 285–289.

property at Tinton, S. Dak. The deposit and the mill on this property have been described by Guiteras.[8]

Shipments of tantalum-bearing ores in the United States, 1935–39

Year	Pounds	Value	Year	Pounds	Value
1935	7,681	$4,521	1938	36,189	$35,127
1936	----------	----------	1939	340	200
1937	16,307	13,317			

Ferrocolumbium, 50 to 55 percent Cb, has been quoted recently at $2.25 to $2.35 a pound. Ore prices are subject to negotiation between buyer and seller. For tantalite, nominal quotations by Engineering and Mining Journal at the end of 1939 were $1.50 to $2.50 a pound of contained Ta_2O_5 in 60-percent concentrate.

GALLIUM, GERMANIUM, AND INDIUM

As noted in previous volumes of Minerals Yearbook, gallium, germanium, and indium could be produced in substantial quantities as byproducts of the zinc industry and from other sources, provided commercial outlets were available. In 1939, J. W. Whittemore and P. S. Dean, professors in the ceramic department of Virginia Polytechnical Institute, were credited with the discovery of a mineral containing 0.2 percent gallium, which is probably the richest "ore" of this metal known so far.

No use at all has been found for germanium. Gallium has been made in Germany by the Vereinigten chemischen Fabriken in Leopoldshall from metallurgical residues of the Mansfeld copper-slate ores, but the total output has been reported as being only 50 kilograms a year and used mainly for experimental purposes. Prices have been quoted usually at more than $2 or $3 a gram, although manufacturers of medium-high-temperature thermometers, which seem to be almost the only quasicommercial outlet, may have made purchases at $1.50 a gram. According to a usually well-informed dealer, however, the metal could be had in quantities at 60 to 80 cents a gram. The German press reported that the price was 10 RM. a gram (about $4) in 1939 compared with 200 RM. some years ago, also that gallium was used in the manufacture of optical reflectors and dental alloys.

Uses for indium have been investigated in many laboratories, and a long list of possible applications may be compiled. But aside from its use in silverware by one or more companies, in quite small quantities in dental and certain other alloys, and for contact points for certain electrical apparatus, no commercial consumption has developed. There are still promising possibilities for indium in superquality automobile bearings but not at more than about half the present "bottom" price of say $20 an ounce for fairly large quantities. Similar bearings are used in at least one airplane engine. Small quantities of indium for laboratory requirements are quoted in dollars per gram. The Belgochimie in Belgium and the Furukawa Mining Co. in Japan were understood to have undertaken the production of indium in 1939. Domestic supplies could be developed by the

[8] Guiteras, J. R., Mining and Milling Methods and Costs at the Black Hills Tin Co., Tinton, S. Dak.: Bureau of Mines Inf. Circ. 7084, 1939, 16 pp.

Grasselli Chemical Co., the Anaconda Copper Co., the American Smelting & Refining Co., and other smelting concerns or producers of lithopone.

RADIUM

Imports of radium salts into the United States, after jumping to an all-time record of 38.75 grams valued at $787,025 in 1938, more than doubled in 1939, reaching 78.631 grams valued at $1,953,820. Undoubtedly much of the increased imports went into stock; nevertheless, in 1939, the National Bureau of Standards under the supervision of Dr. L. F. Curtiss tested 2,448 radium preparations containing 21.95 grams compared with 1,280 preparations containing 10.5 grams in 1938 and 1,703 preparations containing 9 grams in 1937. As noted in Minerals Yearbook, 1939, a marketing agreement was concluded early in the year between the two leading producers, and during 1939 virtually all the imports (except 2.797 grams valued at $70,753) came from Belgium. The New York office of the Eldorado Gold Mines, Ltd. (Canada), was discontinued and the syndicate's sales to the United States subsequently have been handled by the Radium Chemical Co., Inc., 570 Lexington Avenue, New York, N. Y.

The price of radium, after reaching $135 a milligram during the World War, was cut to $70 in 1923 and to $50 in 1930. The quotation since August 1936 has been nominally $40, but competition resulted in sales at $20 or even less in 1937, after which the price became firmer and at the end of 1939 was around $27.50 a milligram for orders of 1 to 5 grams. For hospital use, radium salts can be leased at 40 cents a milligram a month. Radon or emanation implants are sold on a sliding scale ranging from $2.50 for those having a radium content of 1 millicurie (at hour used) to $7.50 for those containing 3.0 millicuries.

The Eldorado mine in the Great Bear Lake district of Canada, which currently produces nearly 40 percent of the world's radium, yielded 1,100 tons of concentrate during the year ended August 31, 1939. Ore reserves are increasing; and as the capacity of the refinery at Port Hope, Ontario, was doubled in 1939 the radium output is understood to be in the neighborhood of 8 grams monthly. After completing a 100-ton mill building, Canada Radium Mines, which owns property in the Wilberforce area in Ontario, began construction of a chemical plant and was reported to be planning to start actual production in 1940 from ore reserves estimated to be adequate for 2 years milling.[9]

The St. Joachimsthal mines, formerly part of Czechoslovakia, were incorporated in the German Reich in October 1938. These deposits are estimated to contain more than 300 grams of radium still unmined and at the time of their incorporation into Germany were producing about 180 to 190 metric tons of pitchblende ore yielding about 5 grams of radium a year. Operations were under control of the Czech Government; and the output, ranging from 2 to 10 grams annually in recent years, has been purchased principally in England. In March 1939 the Auergesellschaft A. G., Berlin, Germany's leading manufacturer of radioactive metals (one of its products being mesothorium from gas-mantle residues) obtained a concession from the German Government to operate the Joachimsthal mines under lease

[9] Jeffries, Zay, Work cited in footnote 2, pp. 11-12.

and extract the radium at its works in Berlin. Henceforth the entire product doubtless will be used in Germany, and under the stimulus of Germany's Four-Year Plan it was thought that production would be increased to cover not only Germany's own needs (3 grams in 1935) but possibly exports, even though production costs exceed the world price. Before the radium mines were acquired, the only German source of radium, apart from imports, was an annual accumulation of about 20 metric tons of radioactive silt at Bad Kreuznach, yielding about 1.75 milligrams of radium per ton in addition to certain quantities of thorium and actinium.[10]

Uranium and radium are byproducts of the vanadium-mining operations of the Union Carbide & Carbon Corporation. Nearly 8 grams of radium came from this source in 1938 and 3¼ grams in 1937.[11]

World production of radium since the earliest experiments by Mme. Curie in 1898 probably has aggregated almost 1,000 grams. A statement posted at the New York World's Fair credited 800 grams to the following sources: United States, 338; Belgium, 160; Czechoslovakia, 55; France, 51; England, 42; Sweden, 8; Denmark, 4; Argentina, 2; unaccounted for, 140. It will be noted that these figures do not include Canada, which has produced at least 180 grams; according to the meager data available in the files of the Bureau of Mines the output of the United States probably has not exceeded 300 grams so far, whereas the Belgian output from ores mined in the Belgian Congo since 1922 undoubtedly has exceeded that amount. The production of radium in France and England and probably in Sweden and Denmark as well has been derived in large part from ore mined elsewhere. As no substantial production has been reported in these countries except in the Cornwall district of the United Kingdom, additional sources of of radium-bearing ores include, in the order named, Portugal, Madagascar, the U. S. S. R., Australia, and South Africa, although the total production from these minor sources probably has not been 5 percent of the world total.

The dangers accompanying actual manipulation of bare radium salts are well known to most of those who have worked in this field. Lead usually has been the principal means of protecting the medical operator or investigator from actual exposure to the damage-dealing radiations, but in certain procedures lead may restrict the work. To avoid danger to the operator a new technique of protection has been described by De Ment [12] which depends on electromagnetic diversion of the rays from their normal paths, positive particles being absorbed upon a negatively charged magnetic pole and negative particles by a positive pole. The operator then can station himself in the field of minimal radiation.

The National Bureau of Standards has undertaken to prepare a series of radium standards covering the weakly radioactive range equivalent to between 10^{-4} and 10^{-11} grams of radium. These standards are needed by investigators of the radioactive content of geological specimens, particularly those used for determining the age of the earth. They are also needed in standardizing equipment for measuring artificial radioactivity.

[10] Redecker, Sydney B., American consul, Frankfort on the Main, Germany, German Chemical Notes: Consular Rept., February 25, 1939, 13 pp.; abs. in Bureau of Mines Mineral Trade Notes: Vol. 8, No. 4, April 20, 1939, pp. 11–12.

[11] Engineering and Mining Journal, vol. 140, No. 11, November 1939, p. 78.

[12] De Ment, Jack, Electrical Protective Devices in Radium Work: Am. Jour. Roentgenology and Radium Therapy, vol 42, No. 6, December 1939, pp. 930–933.

Uranium.—Increased output of radium has raised again the question of disposing of the jointly recoverable uranium. At present the chief use of uranium is in the form of oxides which produce golden glazes on pottery and yellow- and orange-colored glasses. In small amounts uranium oxide produces luster or irridescence. At the close of 1939 sodium uranate, Na_2UO_4, was quoted unchanged at $1.75 and $1.80 a pound; uranium oxide, 96 percent U_2O_6, in 100-pound lots at $2.65 a pound for the black and $1.75 for the yellow or orange product.

Ionium.[13]—The Canadian National Research Council has investigated extraction of radioactive substances other than radium from Great Bear Lake pitchblende, which contains the amazing number of 53 different elements. Ionium, the product intermediate between uranium and radium, has a much slower break-down (100,000 years) than radium (2,500 years). Under equilibrium conditions an ore carrying about 120 milligrams of radium a ton should contain about 4,800 milligrams of ionium. As ionium gives off only alpha rays, it would not be useful like radium for therapeutic purposes, but it should be serviceable for such uses as the preparation of luminous paints. Although it is less potent, weight for weight, the total ionium content of the ore would equal in value the total radium content, insofar as production of luminous paints is concerned.

Polonium.[14]—Polonium has an average life of about 6 months, so the equilibrium amount present in the ore is very small, although very potent. Like ionium, it is lost in the present Port Hope refinery process; but radium D, which accompanies and is inseparable from the lead isolated in the process, continually generates polonium during its entire 24-year life, so that by the time a given quantity of polonium disappears a corresponding amount may be generated from a stock of radium lead. Polonium emits only alpha rays, but unlike ionium it is afterward "dead," a distinct advantage for some purposes. The chief established use of polonium is in meteorological stations for measuring the electrical potential of the air, and the meager supply needed for the purpose is obtained from old radon seeds.

RARE EARTHS

To encourage research in the field of rare earths and illumination the Auer Research Foundation, named for the Austrian chemist who invented the Welsbach mantle, posted in 1939 a 10,000-RM. ($4,000) prize for the best process submitted for better utilization of gases and more effective lighting with mantles containing thorium and cerium oxides. Although the use of Welsbach mantles has declined in Europe, as in America, they are still used extensively in Germany for portable lanterns and street lighting. Another Auer prize of similar amount was put up for the development of new commercial uses of lanthanum compounds. So far no practical use has been found for lanthanum, although its suggested use in compounds for loading silk and rayon is being reconsidered now that the patent has expired. Lanthanum oxide is the major rare-earth constituent of the residues from the extraction of thorium and cerium oxides from monazite, and the quantities of such residues have increased owing to the greater pro-

[13] Whitby, G. S., Some New Metals: Canadian Min. and Met. Bull. 333, January 1940, pp. 56–64.
[14] Whitby, G. S., work cited in footnote 13, pp. 56–64.

duction of thorium, especially for use as a catalyst in the Fischer-Tropsch benzine synthesis.[15]

Cerium, praseodymium, and neodymium compounds, which also occur in Welsbach mantle residues, have been used extensively in the glass and ceramic industries for coloring and glazing. A recent patent (United States 2,150,694) covers nonsilicate glasses formed by the fusion of rare earth and other metallic oxides without silica. In the search for more rapid and efficient photographic lenses, Dr. George W. Morey of the Carnegie Institution, to whom this patent is issued, has created an entirely new series of optical glasses with indexes of refraction roughly midway between that of the best ordinary flint glass and that of the diamond. As these new glasses combine low dispersion with high index of refraction they can be used for camera lenses of greater light-gathering power and afford better corrections for chromatic aberration. One glass, with 60 percent lanthana and 40 percent boron oxide, has a refractive index of 1.72 and dispersion index of 54. Another, with 33 percent lanthana, 41 percent thoria, and 26 percent boron oxide, has a refractive index of 1.76 and dispersion index of 52.

A pure oxide of cerium, called [illegible]aline, recently has been developed for the production of gray nickel or cobalt ground enamels for sheet metal and is claimed to have remarkable opacity and to be unaffected by furnace atmospheres.[16] Misch metal, though hitherto used almost exclusively in making sparking alloys and lighter flints, often has been proposed for use in the iron and steel industry. In cast iron, cerium opposes graphitization, and misch-metal additions in small amounts afford interesting possibilities for making malleablized iron. According to a French authority,[17] cerium and allied metals have even more affinity than manganese for sulfur; moreover, they form harmless rounded particles.

One of the important uses of rare-earth compounds at present is in the textile industry, wherein they are used in printing and dyeing and also, to an increasing extent, for mothproofing and rotproofing fabrics.

RHENIUM

A little rhenium finds its way into radio and power tubes, but the consumption is very small and hitherto Germany has been the only commercial source. According to Wm. G. Rinehart, who collected the samples, Dr. Clarence F. Hiskey, University of Wisconsin, found rhenium in 30 out of about 150 manganese-bearing samples from the Batesville-Cushman district, Arkansas, but the content is only about 1 part in 10 million.

SELENIUM AND TELLURIUM

Selenium finds its chief use in glassmaking; a few ounces added to clear glass batches neutralize the greenish cast imparted by traces of iron in the sand. Ruby signal lenses carry 0.25 percent Se. Minor uses are for photoelectric cells, to improve machinability of stainless steel, in rubber goods, and in red-paint pigments containing

[15] Chemical and Metallurgical Engineering, German Industrial Groups Push Research in Field of Rare Earths: Vol. 46, No. 6, June 1939, p. 387.
[16] Esme, A., Cerium and Its Compounds: Argile, No. 95, 1939, pp. 5-11; Ceramic Abs., vol. 18, No. 10, October 1939, p. 278.
[17] Guillet, Leon (fils), Les Fontes au cobalt et au cerium: Chim. et ind., vol. 41, No. 5, May 1939, pp. 853-860.

cadmium and barite. It also has been employed in antiknock compounds for gasoline, in insecticides and bactericides, in certain organic syntheses, and to protect magnesium metal from corrosion—but never in any substantial amounts.

Tellurium is used to toughen rubber and to harden lead.

Prices of selenium (black, powdered, 99.5 percent) and of tellurium remained at $1.75 a pound. To offset declining exchange the London prices at the end of the year had risen to 8s. 6d. and 7s. to 7s. 6d. respectively.

Production, sales, and imports of selenium and production and sales of tellurium in the United States, 1935–39

Year	Selenium				Tellurium	
	Production (pounds)	Sales [1] (pounds)	Imports		Production (pounds)	Sales [1] (pounds)
			Pounds	Value		
1935	244, 710	232, 831	179, 331	$322, 332	37, 096	22, 610
1936	352, 480	226, 402	122, 806	215, 835	57, 956	25, 453
1937	435, 821	282, 598	92, 523	161, 382	51, 409	23, 365
1938	225, 674	166. 494	101, 034	163, 598	11, 076	26, 944
1939	227, 131	345, 726	124, 830	193, 168	25, 234	63, 431

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

THORIUM

Welsbach's invention of an incandescent gas mantle composed of 99 percent thorium oxide created after 1890 a world-wide demand for thorium, which was furnished by working monazite sands produced successively in North Carolina, Brazil, Ceylon, and Travancore. The wider use of electric lighting, following introduction of ductile tungsten filaments in 1910, virtually eliminated gas mantles, except for liquid-fuel equipment in remote regions. In 1890 thorium oxide cost $125 a pound; by 1910 it had dropped to $2.50 a pound. It can be made from thorium nitrate, which recently averaged a little over $2 a pound. Monazite, the ore of thorium, has recently been quoted at $60 a ton for 8-percent grade.

Thorium metal is soft and malleable and probably could be produced at prices not greatly exceeding that of platinum. It has been used to eliminate brittleness in the manufacture of ductile filaments. Other alloys might be developed; those with aluminum, chromium, cobalt, copper, molybdenum, tungsten, and vanadium already have been briefly investigated.[18] An alloy claimed to be suitable for neon-sign electrodes contains copper plus 0.005 to 10 percent thorium and a third element (United States Patent 2,136,918, November 15, 1938, F. R. Hensel and Earl I. Hensel, assigned to P. R. Mallory & Co., Indianapolis, Ind.). Some thoria is used in high-quality refractories, and diminishing quantities are employed in gas mantles. Monazite is the chief source. Mesothorium is also obtained from monazite residues. No data are available as to domestic production, but in 1939 the National Bureau of Standards tested only three specimens containing 49 milligrams of mesothorium compared with 18 specimens and 373 milligrams during the preceding year.

[18] Fink, Colin, Thorium and Chemical Research: Ind. Eng. Chem., News ed., vol. 17, No. 24, December 20, 1939, p. 775.

TITANIUM

The Bureau of Mines is not at liberty to publish figures for domestic production of ilmenite and rutile. As in former years, Virginia was the leading producing State for both these minerals, but in 1939 Arkansas furnished a substantial quantity of rutile-brookite concentrate and could have produced more had the concentrating plant been able to operate steadily during the prolonged drought. According to the California State mineralogist, Harry R. Smith shipped ilmenite sand, containing over 30 percent TiO_2 and valued at $10 a ton, for use as roofing granules. The duPont interests continued to develop titanium deposits in the San Gabriel Mountains, Los Angeles County, Calif.

The bulk of the ilmenite used in the United States is imported from British India and is consumed in the manufacture of titanium pigments. Domestic production of rutile exceeds imports, but both domestic and imported rutile is sold abroad. The principal uses of rutile are in welding-rod coatings and ceramics.

Imports of ilmenite rose in 1939 to still another all-time record. Early in the year the second unit of the National Lead Co. titanium pigment plant at Sayreville, N. J., was opened, and a third unit is expected to begin producing in 1940, tripling the capacity of the original unit completed in 1935. The first commercial production of titanium white was probably in 1919, and in 1922 Travancore made its first shipment of ilmenite. As recently as 1926 the British Indian output of ilmenite was only about 5,000 tons, and the 50,000-ton mark was not approached until 1932. The mining of ilmenite and associated minerals in India has been described by the vice president of the Foote Mineral Co.[19] who presents the following composite analysis of recent shipments: TiO_2, 60.35; Fe, 22.69; SiO_2, 0.41; S, 0.01; and P, 0.03 percent.

Imports of rutile were almost twice as large in 1939 as in the preceding year but failed to equal the high record of 665 tons valued at $67,643 in 1937. Australia is the leading foreign source, with Brazil second. However, rutile has also been separated from mineral concentrates imported from British India. Actually the import figures reveal little, because, on the one hand, some of the rutile so reported has to be reconcentrated after arrival in the United States and, on the other hand, rutile is recovered from ores imported under other statistical classifications, chiefly as "Zirconium ore." Other countries that have produced rutile are Norway, Cameroons, and South Africa. Brazilian rutile has been exported to other countries besides the United States, notably Germany and the United Kingdom. Australian operations, which lie along the coast of New South Wales, some 300 miles from Sydney, have been described by Poole.[20]

Kennametal, a tungsten-titanium carbide, is a new, high-priced, ultrahard carbide used in cutting tools, valve seats, and other wearing surfaces.

Engineering and Mining Journal quotations in 1939 were the same as in 1938: Ilmenite, 45 to 55 percent TiO_2, f. o. b. Atlantic seaboard,

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[19] Chambers, G. H., Zircon, Ilmenite, and Monazite Mining in India: Foote-Prints, vol. 12, No. 1, Philadelphia, June 1939, pp. 1–11.

[20] Poole, W. R., Zircon and Rutile from Beach Black Sand Deposits: Chem. Eng. and Min. Rev., vol. 31, Nos. 365–366, February–March 1939.

$10 to $12 per gross ton according to grade and impurities; rutile, guaranteed minimum 94 percent concentrate, 10 cents per pound (nominal); 88 to 90 percent, $55 per ton, c. i. f. New York; ferrocarbon-titanium, $142.50 per short ton f. o. b. producer's plant. The price of titanium dioxide after dropping to 14 cents at the beginning of the year was reduced further to 13 cents a pound. Barium- or magnesium-base titanium pigment was quoted at 5¼ cents and calcium-base pigment at 5 cents early in 1940.

ZIRCONIUM

Domestic consumption of zirconium compounds is growing but falls far short of the quantity indicated by the importation of zirconium ores as officially reported. It is common knowledge that the bulk of the imports so classified comprises rutile-bearing concentrates from Australia, which are not all zircon. Moreover, not all the zircon content of the concentrates after separation of rutile is utilized currently but goes into stock pile.

An important outlet for zirconium compounds is as opacifier in all kinds of vitreous enamels, replacing tin oxide. The potential size of this market is indicated roughly by the world output of tin oxide, which the International Tin Research and Development Council estimates as averaging 3,500 to 4,000 short tons a year for 1929–37. According to Chambers: [21]

> A composite analysis of many shipments from F. X. Pereira and Company to Philadelphia is given below: ZrO_2 66.80 percent, SiO_2 31.50 percent, TiO_2 0.84 percent, Fe 0.08 percent, P_2O_5 0.07 percent.
>
> One of the first commercial uses for zircon was in refractory crucibles and for this purpose it has some excellent properties. It has the lowest linear thermal expansion among the usual ceramic raw materials, having even less expansion than sillimanite and fused aluminum oxide. It has a melting point of about 4622° F. and a softening point of approximately 3272° F. For these reasons zircon refractories show excellent resistance to spalling and fusion except in the presence of iron oxide and certain basic fluxes.
>
> Zircon is of even greater interest in the field of specialized porcelains. Vitreous porcelain bodies containing 30 to 70 percent zircon have a long firing range, exceptional mechanical strength, good heat shock resistance and remarkable dielectric strength at high temperatures. All of these properties are particularly necessary in electrical appliances as well as in sand molds for stainless steel and alloy castings.
>
> Considerable quantities of zircon sand are also employed in refractory insulating cements for electrical appliances as well as in sand molds for stainless steel and alloy castings.
>
> Zircon is now used in certain types of heat-resisting glass and it is possible that the glass industry will eventually be the largest market for this versatile mineral. The most desirable feature of zirconia glasses is their greater impact strength and thermal endurance. In other words, the addition of zircon to the batch produces tougher glass which is less likely to break in use. It also increases the chemical durability of glass, particularly its resistance to caustic soda. Until recently these advantages were outweighed by the cost, but the present low-market price of zircon now puts it approximately on a parity with alumina.
>
> Zircon is also the usual raw material for manufacturing zirconium oxide and zirconium salts. The most important of these are the zirconium opacifiers which to a large extent have supplanted tin oxide in vitreous enamels and ceramic glazes. Other zirconium compounds such as the pure oxide, tetrachloride and tetraiodide are used in producing zirconium metal. The metal is used in photo-flash bulbs, radio transmitting tubes, ammunition primers, spot welding electrodes, and a number of other unusual applications.

[21] Chambers, G. H., Work cited in footnote 19, pp. 8–10.

Engineering and Mining Journal quotations during 1939 were still nominal: Zircon ore, 55 percent ZrO_2, f. o. b. Atlantic seaboard, carloads, \$55 a short ton; crude granular zircon, \$70 f. o. b. Suspension Bridge, N. Y., milled, \$90. Zirconium metal, commercially pure, powdered, \$7 a pound. Zirconium alloys, 12 to 15 percent Zr, 39 to 43 percent Si, \$97.50 to \$102.50 a gross ton; 35 to 40 percent Zr, 42 to 52 percent Si, 14 and 16 cents a pound.

PART III. NONMETALS

BITUMINOUS COAL[1]

By M. E. McMillan, R. L. Anderson, and W. H. Young

SUMMARY OUTLINE

Bituminous-coal production in 1939 was considerably greater than in 1938. During the first quarter production was high to fill orders purchased for storage by consumers in anticipation of possible suspension of mining when the wage contract expired on March 31. Output declined sharply in April and May when work ceased pending the signing of a new wage contract. The outbreak of war in Europe in September stimulated general business, particularly the heavy industries, and the production of coal increased substantially.

During the year the Bituminous Coal Division, United States Department of the Interior (formerly the National Bituminous Coal Commission), proceeded with the task of building a minimum price structure that would comply in detail with requirements of the law.

[1] The collection of production statistics of the bituminous-coal industry previously conducted by the Bureau of Mines was transferred to the National Bituminous Coal Commission July 1, 1937. The cooperation of the Coal Commission (now the Bituminous Coal Division, U. S. Department of the Interior) in contributing this chapter to Minerals Yearbook to maintain the continuity of the bituminous-coal series is gratefully acknowledged.
Data for 1939 are preliminary; detailed statistics with final revisions will be released later. Data for 1938 are final.

Production.—The output of soft coal in 1939 was 393,065,000 tons, a 13-percent increase over 1938. The coal industry made substantial gains in common with general business activity during the latter half of the year, and the total output for the year was 27 percent above the record low of 1932, although 27 percent below the 534,989,000 tons of 1929. (See figs. 1, 2, and 4.)

Imports and exports.—Exports of bituminous coal rose from 10,490,-269 tons in 1938 to 11,590,478 in 1939, a 10-percent increase. At the same time imports, which are relatively insignificant, rose 47 percent from 241,305 tons in 1938 to 355,115 in 1939. As in the past, virtually all these imports and more than 90 percent of the exports represented trade with Canada. (See fig. 10.)

Changes in stocks.—The reserve supply of coal in the hands of industrial consumers and retail coal yards rose from a total of 40,720,000 tons at the beginning of the year to 44,571,000 at the close. Between the same periods, stocks on the upper Lake docks declined 295,000

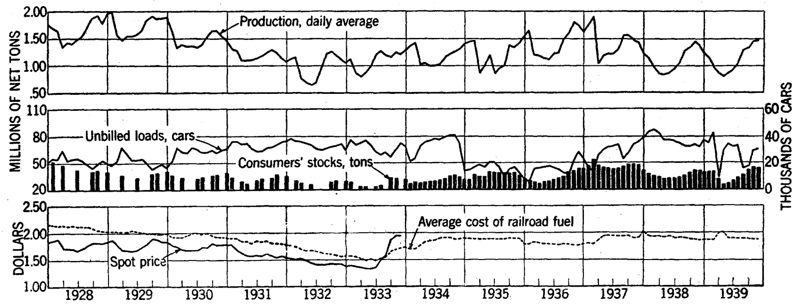

FIGURE 1.—Trends of production, stocks, and prices of bituminous coal, 1928–39.

tons, and unbilled coal in cars at the mines or classification yards fell 74,000 tons. (See fig. 1 and table 18.)

Consumption.—After allowances have been made for foreign trade and changes in consumers' stocks the consumption of bituminous coal in 1939 totaled 377,978,637 tons, an increase of 33,328,837 from 1938. Each of the more important classes of consumers shared the increase, which ranged from 69 percent for beehive coke ovens to 7 percent for railroads. (See fig. 3 and table 4.)

Distribution.—Shipments of bituminous coal during 1939 rose substantially above the 1938 level in each of the primary channels of distribution. Changes in the monthly volume of the more important movements are shown in figure 4.

Freight rates.—The average railroad freight charge per net ton of revenue bituminous coal amounted to $2.23 in 1939 compared with $2.27 in 1938.

Trend of prices.—Spot market quotations indicate that producers averaged less per ton for their coal in 1939 than in 1938. (See tables 1 and 15.)

Mechanization.—Data available early in 1940 [2] indicate continuation of the sharp advance in mechanical loading of bituminous coal.

Sales of mechanical loading equipment for use in bituminous-coal mines, in terms of total capacity, increased 21.4 percent in 1939 over

[2] Coal Age, February 1940, p. 63, and Mining Congress Journal, February 1940, p. 23.

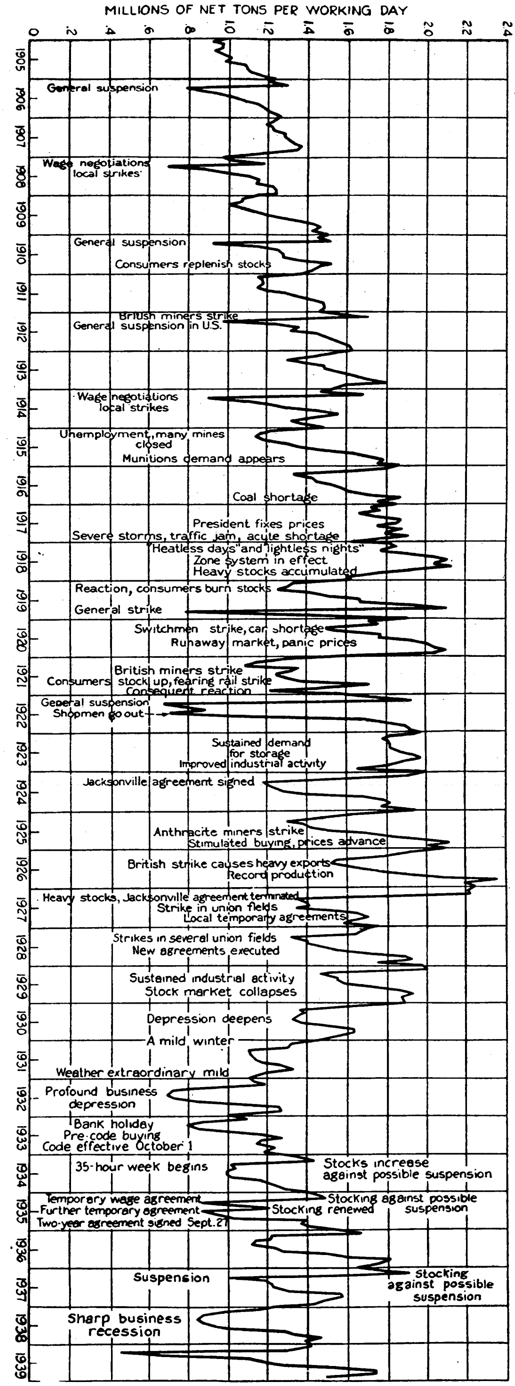

FIGURE 2.—Average production of bituminous coal per working day in each month, 1905–39.

1938. Reports from 31 manufacturers show sales of 292 mobile loaders for the current year as against 241 in 1938 and 344 in the peak year 1936. Conveyor sales totaled 1,095 in 1939 compared with 749 in 1938 and 682 in 1936.

Stripping operations.—The volume of bituminous coal produced by stripping decreased from 31,750,853 tons in 1937 to 30,406,855 in 1938.

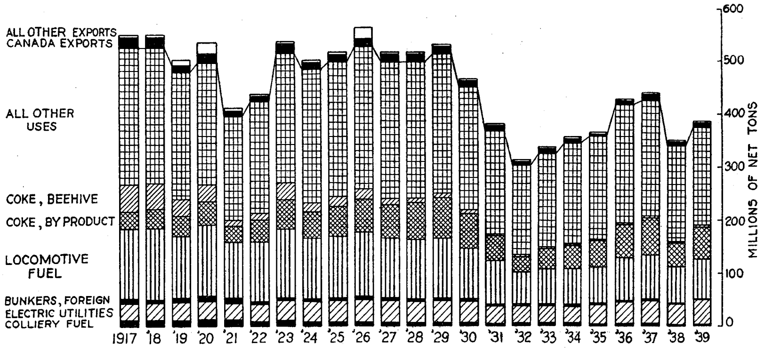

FIGURE 3.—Tonnage of bituminous coal absorbed by the principal branches of consumption, 1917–39.

However, the percentage of total production represented by strip coal rose from 7.1 percent in 1937 to 8.7 percent in 1938.

Trend of employment.—Estimates of the number of men employed at bituminous-coal mines in 1939 indicate a slight drop from the 1938 figure (441,333). Indexes compiled by the Bureau of Labor Statistics

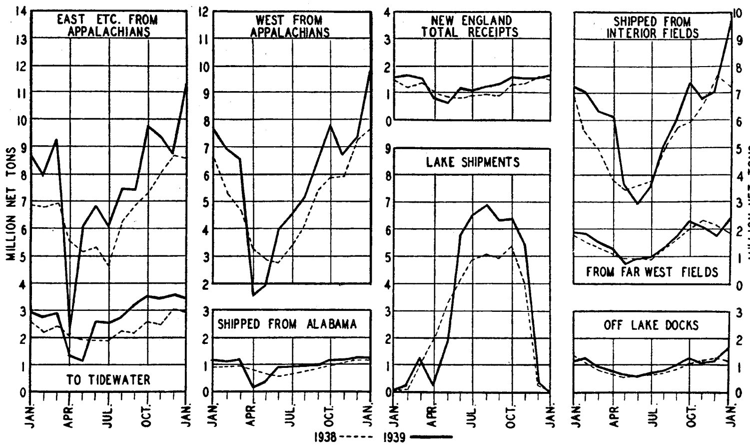

FIGURE 4.—Monthly movement of bituminous coal in the major channels of distribution, 1938–39.

upon the basis of a sample that includes more than half the workers in the industry show a 1-percent drop in employment for 1939 if normal operations during the April-May suspension are assumed. Reports from the mining departments of nine States with more than 60 percent of the bituminous-coal employees in the United States indicate an average decline of 0.4 percent for the same period. These data suggest an estimate of 437,000 employees for 1939. In comparison with 1929, when the average number of men at bituminous-coal mines totaled 502,993, the 1939 figure represents a decrease of 66,000.

Statistics of employment for bituminous-coal workers cannot be interpreted properly without considering the intermittent operations that characterize most coal mines. In 1938, for instance, the bituminous mines were operated an average of 162 days out of the 261 possible under the 5-day week of the union wage agreement. Consequently, a substantial proportion of the manpower on the rolls of the industry was idle throughout the year, the number depending on the market and the season.

Trend of capacity.—The potential full-time output of active mines in the bituminous-coal industry decreased 7 percent between 1937 and 1938. The coal industry reached its peak capacity in 1923 when, upon the basis of 308 operating days, the potential output was 970,000,000 tons. Subsequent liquidations forced the closing or abandonment of thousands of mines and reduced the indicated capacity to 622,000,000 tons in 1934. The potential output upon a 308-day basis was 663,000,000 tons in 1938. Under the 5-day week full-time operations are limited to approximately 261 days. The potential capacity of operating mines upon a 261-day basis was 562,000,000 tons in 1938 compared with the total actual production of 348,544,764 tons.

Trend of fuel efficiency.—Since the World War period, improvements in the technology of fuel application have contributed to a continuing decline in the demand for coal for industrial uses. Although the effect of such improvements is cumulative from year to year, the rate of decline is smaller in recent years as the remaining margin of possible increase in fuel efficiency becomes progressively less.

The class I steam railroads reduced the average coal consumption by coal-fired locomotives from 117 pounds per 1,000 gross ton-miles of freight service in 1938 to 115 pounds in 1939. For all railroad freight service, including oil-burning and electric locomotives, the average energy consumption, converted to coal equivalent, was reduced from 115 pounds per 1,000 gross ton-miles in 1938 to 112 pounds in 1939. During the same period, public utility power plants lowered the average fuel consumption from 1.41 to 1.39 pounds per kilowatt-hour. In the iron and steel industry, the average consumption of coke in iron blast furnaces was reduced from 1.801 in 1938 to 1.778 pounds in 1939 per net ton of pig iron produced, representing a drop from 2,583.9 to 2,547.3 pounds of coking coal per net ton (2,894 and 2,853 pounds per gross ton) of pig iron for 1938 and 1939, respectively.

Improvements in combustion practice among domestic consumers and small industrial and commercial establishments also are helping to decrease the aggregate volume of fuel consumption. Furthermore, increasing economy in combustion methods is being supplemented by improvements in space-heating methods and by progress in building construction and insulation.

Competing sources of energy.—While improvements in fuel technology have acted to lessen the demand for coal in the industries affected, these same improvements have constituted a defense of coal against the spread of other sources of energy into the previous markets for coal. In the electric utility field, for example, consumption of coal has increased coincident with the development of hydroelectric projects. During the past five years, production of public utility electrical energy by steam power plants increased from 54,649,829,000 kilowatt-hours in 1935 to 85,006,941,000 in 1939, an increase of 45 percent. Statistics of current and projected expenditures for new steam plant construction indicate a continuation of this trend in the near future. Edison Electric Institute reports expenditures in 1939 of $70,560,000 for steam plants, and budget estimates for 1940 indicate a probable expenditure of $183,700,000, which will add approximately 1,650,000 kilowatt-hours to the total steam-generating capacity in 1940.

Despite the improvements in fuel economy in the utilities industry, the total coal consumption for power generation has continued to increase since 1933 except in 1938, when there was a 10-percent decrease compared with the previous year, attributable to the general slump in industrial activity and total power consumption. The upward trend was resumed in 1939 with a total coal consumption of 46,223,000 tons, an all-time high record for this industry. In addition, the utilities steam power plants used 17,423,000 barrels of fuel oil (approximately equivalent to 4,356,000 tons of coal) and 191,131,-000,000 cubic feet of natural gas (equivalent to 8,310,000 tons of coal). During the past 20 years the growth of the utilities industry has approximately offset the effect of improved fuel technology in relation to aggregate coal consumption, and the annual tonnage used has moved up and down from the low of 30,000,000 to the high of 46,000,000 as general industrial activity varied. Use of fuel oil also has followed an irregularly horizontal course during this period, but the consumption of gas in utility electric power plants has increased from 22 billion feet in 1920 to 191 billion in 1939.

In the field of domestic heating comparable figures are available for mechanical firing equipment only. In this category, the use of oil and gas appears to be growing more rapidly than coal, basing estimates upon sales of new equipment. Sales of oil burners for domestic use rose from 106,933 units in 1938 to 165,711 in 1939, a 55-percent increase, whereas sales of domestic stokers (under 61 pounds per hour capacity) using bituminous coal, rose from 71,978 units in 1938 to 78,332 in 1939, a 9-percent increase. However, this does not entirely represent the relative positions of the two competing fuels in new plants because the oil-burner sales cover virtually all installations in which oil is used, while the sales of coal cover only mechanical stokers and do not consider new installations of hand-fired equipment. During the same period sales of natural gas for domestic use increased from 352,949,000,000 to 367,733,000,000 feet, a 4-percent gain (not including natural gas in mixtures sold by manufactured-gas companies).

The use of coal for locomotive fuel by railways decreased 17 percent in 1938 compared to 1937 and came back 7 percent in 1939, while the use of fuel oil followed an almost identical course, decreasing 13 percent in 1938 and increasing 3 percent in 1939. The consumption of railroad fuel varies with the fluctuations in volume of traffic.

The use of Diesel fuel increased rapidly, rising from 25,470,248 gallons in 1937 to 34,842,982 in 1938 and 48,754,423 in 1939. In the aggregate, however, Diesel fuel constitutes as yet only about a quarter of 1 percent of the total railroad fuel.

Statistics for 1939 show that the use of coal and oil by railroads, electric utility power plants, and steamships exceeded that in 1938 by 10 percent, while the oil consumption increased 7 percent. In the same period, consumption of natural gas by all industrial, commercial, and domestic consumers increased 7 percent.

Statistical tables—1939.—Tables 1 to 5 give a statistical record of the bituminous-coal industry in 1939, as indicated by available preliminary data. They also show comparative statistics for the indicated earlier years, including final figures for 1938. (See fig. 5.)

TABLE 1.—*Salient statistics of the bituminous-coal industry, 1938–39*

[All tonnage figures represent net tons]

	1938	1939 (preliminary)	Change in 1939
Production	348, 544, 764	393, 065, 000	+12. 8%
Exports to Canada and Mexico [1]	9, 560, 717	9, 975, 919	+4. 3%
Exports overseas and all other [1]	929, 552	1, 614, 559	+73. 7%
Imports [1]	241, 305	355, 115	+47. 2%
Consumption in the United States (calculated) [2]	344, 649, 800	377, 978, 637	+9. 7%
Stocks at end of year:			
Industrial consumers and retail yards	40, 720, 000	44, 571, 000	+9. 5%
Stocks on upper Lake docks	7, 885, 516	7, 590, 254	−3. 7%
Unbilled loads, at mines or in classification yards [3]	1, 607, 200	1, 533, 100	−4. 6%
Price indicators (average per net ton):			
Average cost of railroad fuel purchased, f. o. b. mines [4]	$1. 92	$1. 91	−1¢
Average cost of coking coal at merchant byproduct ovens [5]	$4. 61	$4. 57	−4¢
Average cost of bunker coal to vessels in foreign trade [6]	$4. 85	$4. 83	−2¢
Average value of exports to all countries (at port) [7]	$3. 63	$3. 69	+6¢
Average retail price—38 cities [8]	$8. 61	$8. 52	−9¢
Average railroad freight charge per net ton [9]	$2. 27	$2. 23	−4¢
Underground loading machinery sold to bituminous mines: [10]			
Mobile loading machines (number)	241	292	+21. 2%
Scrapers (number)	6	18	+200. 0%
Conveyors, including those with duckbills (units)	749	1, 095	+46. 2%
Pit-car loaders (units)	139	2	−98. 6%
Average number of men employed at mines operating [11]	441, 333	437, 000	−1. 0%
Fuel-efficiency indicators:			
Pounds coal per kw.-hr. at electric power plants [12]	1. 41	1. 39	−1. 4%
Pounds per 1,000 gross ton-miles—railroads [13]	115	112	−2. 6%

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.
[2] Production plus imports minus exports plus or minus net changes in consumers' stocks.
[3] Association of American Railroads.
[4] Interstate Commerce Commission. Excludes freight charges.
[5] As reported by coke operators to the Bureau of Mines.
[6] Computed from records of the Bureau of Foreign and Domestic Commerce.
[7] Computed from records of the Bureau of Foreign and Domestic Commerce. The figure represents the average value at the point of export of shipments to all foreign countries including Canada.
[8] Bureau of Labor Statistics.
[9] Average receipts per net ton of revenue bituminous coal originated, as reported by the Interstate Commerce Commission.
[10] Fraser, Thomas, Tryon, F. G., Gallagher, J. J., and van Siclen, M., Mechanization Sales: Coal Age, February 1940, pp. 63–65, and Mining Congress Journal, February 1940, pp. 23–27.
[11] The figure for 1938 is based upon reports of mine operators producing over 1,000 tons. The figure for 1939 is estimated from the employment index of the Bureau of Labor Statistics, which covers about half of the men employed in the industry, and from current monthly reports of 9 State mine departments which represent approximately 60 percent of all the bituminous-coal-mine workers in the United States.
[12] Federal Power Commission.
[13] Interstate Commerce Commission; includes coal equivalent of fuel oil consumed.

TABLE 2.—*Salient trends in bituminous mine operation, 1913–38*

	1913	1923	1929	1932	1934	1936	1937	1938
Production:								
Loaded at mines for shipment by rail .... net tons..	392,743,412	488,974,496	474,868,165	276,142,037	313,303,729	370,762,901	399,237,575	295,336,027
Loaded at mines for shipment by water .... do....	10,690,834	16,884,799	23,066,289	9,365,782	15,127,968	24,867,683		16,902,969
Made into coke at mines .... do....	49,458,320	27,859,316	9,128,607	1,028,458	1,647,805	2,728,577	4,884,054	1,359,876
Used at mines for colliery fuel .... do....	11,670,903	8,765,011	4,662,974	2,780,889	3,175,057	3,227,447	3,052,095	2,493,017
Commercial sales by truck or wagon .... do....	13,871,828	22,081,040	23,262,558	20,392,706	[1] 18,739,320	27,929,298	37,762,612	25,592,058
Other local sales, used by employees, etc .... do....					7,374,143	9,571,997		6,860,817
Total production .... do....	478,435,297	564,564,662	534,988,593	309,709,872	359,368,022	439,087,903	[2] 445,531,449	348,544,764
Number of active mines of commercial size:								
Class 1 (200,000 tons or more) .... number..	694	748	827	465	551	660	661	526
Class 2 (100,000 to 200,000 tons) .... do....	837	935	660	477	485	452	469	402
Class 3 (50,000 to 100,000 tons) .... do....	959	1,176	668	469	479	460	448	415
Class 4 (10,000 to 50,000 tons) .... do....	1,558	2,742	1,361	1,111	1,072	1,085	1,117	1,042
Class 5 (1,000 to 10,000 tons) .... do....	1,728	3,730	2,541	2,905	3,671	4,218	3,853	3,392
Total number over 1,000 tons .... do....	5,776	9,331	6,057	5,427	[3] 6,258	[3] 6,875	[3] 6,548	5,777
Percent of output from mines in classes 1 and 2 .... percent..	75.4	70.4	83.1	77.5	80.5	83.8	84.1	81.1
Average number of men employed at mines active:								
Underground .... men..	494,238	600,305	433,999	345,905	384,947	399,367	(4)	370,004
Surface, including strip pits .... do....	77,644	104,488	68,994	60,475	73,064	77,837	(4)	71,329
Total .... do....	571,882	704,793	502,993	406,380	458,011	477,204	491,864	441,333
Average number of days mines operated .... days..	232	179	219	146	178	199	193	162
Nominal length of established full-time week [5] .... hours..	51.6	48.4	48.5	48.6	40.0 and 35.1	35.1	35.1	35.1
Capacity of active mines with existing labor force:								
Per year of 308 days (full time before October 1933) .... net tons..	635,000,000	970,000,000	752,000,000	653,000,000	622,000,000	680,000,000	710,000,000	663,000,000
Per year of 261 days (5-day week basis) .... do....	538,000,000	823,000,000	638,000,000	554,000,000	527,000,000	576,000,000	601,000,000	562,000,000
Output per man per day [6] .... do....	3.61	4.47	4.85	5.22	4.40	4.62	4.69	4.89
Output per man per year .... do....	837	801	1,064	762	785	920	906	790
Underground output cut by machine .... percent..	50.7	68.3	78.4	84.1	84.1	84.8	(4)	87.5
Underground output mechanically loaded .... do....	....	.3	7.4	12.6	12.2	16.3	20.2	(4)
Quantity mined by stripping .... net tons..	[7] 1,280,946	11,940,134	20,268,099	19,641,128	20,789,641	28,125,857	31,750,853	30,406,855
Quantity cleaned by wet or pneumatic processes [8] .... do....	22,069,691	20,140,385	32,271,950	27,357,599	35,853,714	53,332,040	(4)	(4)

[1] The earliest year in which figures were collected in strictly comparable form was 1933, when commercial sales by truck and wagon were 15,462,739 tons.
[2] The total production differs from the sum of the items shown by the amount of the changes in inventory and of tonnage not accounted for in the distribution analysis.
[3] The increase in number of mines shown for 1934–37 over preceding years is due partly to more complete coverage of small trucking mines (producing over 1,000 tons a year). See Minerals Yearbook, 1936, pp. 561–564.
[4] Data not available.
[5] The figures represent the full-time week as reported by the operator, not the hours actually worked by the men.
[6] Affected by changes in length of working day.
[7] Figures for 1914, the year of earliest record.
[8] Exclusive of central washeries operated by consumers.

TABLE 3.—*Preliminary statistics of coal production in 1939, by States, with final figures for earlier years*

State	Production, in thousands of net tons								Change in 1939 (percent)	Percent of total bituminous							
	1913	1923	1929	1932	1936	1937	1938	1939 (preliminary)		1913	1923	1929	1932	1936	1937	1938	1939 (preliminary)
Alaska	2	120	101	103	137	132	155	146	−5.8	(1)	0.02	0.02	0.03	0.03	0.03	0.05	0.04
Alabama	17,678	20,458	17,944	7,857	12,229	12,440	11,062	11,995	+8.4	3.69	3.62	3.35	2.54	2.78	2.79	3.17	3.05
Arkansas	2,234	1,297	1,695	1,033	1,623	1,511	1,197	2,300	−5.8	.47	.23	.32	.33	.37	.34	.34	.58
Oklahoma	4,166	2,885	3,774	1,255	1,540	1,600	1,245			.87	.51	.71	.41	.35	.36	.36	
Colorado	9,232	10,346	9,921	5,599	6,812	7,187	5,663	5,890	+4.0	1.93	1.83	1.85	1.81	1.55	1.61	1.63	1.50
Georgia	256	76	45	27	24	(2)	(2)	(2)	(2)	.05	.01	.01	.01	.01	(2)	(2)	(2)
North Carolina	------	36	52	2		------	------	------	------		.01	.01					
Illinois	61,619	79,310	60,658	33,475	50,927	51,602	41,912	46,450	+10.8	12.88	14.05	11.34	10.81	11.60	11.58	12.03	11.82
Indiana	17,166	26,229	18,344	13,324	17,822	17,765	14,759	16,650	+12.8	3.59	4.65	3.43	4.30	4.06	3.99	4.23	4.24
Iowa	7,526	5,711	4,241	3,862	3,961	3,637	3,103	3,050	−1.7	1.57	1.01	.79	1.25	.90	.82	.89	.78
Kansas	7,202	4,443	2,976	1,953	2,944	2,893	2,654	6,195	+1.7	1.51	.79	.56	.63	.67	.65	.76	1.58
Missouri	4,318	3,403	4,030	4,070	3,985	4,091	3,436			.90	.60	.75	1.31	.91	.92	.99	
Kentucky:																	
Eastern	11,099	33,887	46,025	25,760	39,152	38,523	31,177	34,730	+11.4	2.32	6.00	8.60	8.32	8.92	8.65	8.95	8.84
Western	8,518	10,890	14,437	9,540	8,370	8,563	7,368	8,075	+9.6	1.78	1.93	2.70	3.08	1.91	1.92	2.11	2.05
Maryland	4,780	2,286	2,649	1,429	1,704	1,549	1,281	1,468	+14.6	1.00	.40	.50	.46	.39	.35	.37	.37
Michigan	1,232	1,172	805	446	626	562	494	434	−12.1	.26	.21	.15	.14	.14	.13	.14	.11
Montana [3]	3,241	3,148	3,408	2,125	2,988	2,965	2,732	2,810	+2.9	.68	.56	.64	.69	.68	.67	.78	.71
New Mexico	3,709	2,915	2,623	1,263	1,597	1,715	1,239	1,206	−2.7	.78	.52	.49	.41	.36	.38	.36	.31
North Dakota [3]	495	1,386	1,862	1,740	2,215	2,251	2,050	2,089	+1.9	.10	.25	.35	.56	.50	.50	.59	.53
South Dakota [3]	11	11	13	49	41	47	48	50	+4.2	(1)	(1)	(1)	.02	.01	.01	.01	.01
Ohio	36,200	40,546	23,689	13,909	24,110	25,178	18,591	19,632	+5.6	7.57	7.18	4.43	4.49	5.49	5.65	5.33	4.99
Pennsylvania (bituminous)	173,781	171,880	143,516	74,776	109,887	111,002	77,705	92,190	+18.6	36.32	30.45	26.83	24.14	25.03	24.91	22.30	23.45
Tennessee	6,860	6,040	5,406	3,538	5,108	5,213	4,472	5,280	+18.1	1.43	1.07	1.01	1.14	1.16	1.17	1.28	1.34
Texas [3]	2,429	1,187	1,101	637	843	910	879	810	−7.8	.51	.21	.20	.21	.19	.20	.25	.21
Utah	3,255	4,720	5,161	2,852	3,247	3,810	2,947	3,340	+13.3	.68	.84	.97	.92	.74	.85	.85	.85
Virginia	8,828	11,762	12,748	7,692	11,662	13,795	12,283	13,230	+7.7	1.85	2.08	2.38	2.48	2.66	3.10	3.52	3.37
Washington	3,878	2,926	2,521	1,591	1,812	2,002	1,567	1,690	+7.8	.81	.52	.47	.51	.41	.45	.45	.43
West Virginia	71,254	107,900	138,519	85,609	117,926	118,646	93,288	107,938	+15.7	14.89	19.11	25.89	27.64	26.86	26.63	26.76	27.46
Wyoming	7,393	7,575	6,705	4,171	5,781	5,918	5,204	5,383	+3.4	1.55	1.34	1.25	1.35	1.32	1.33	1.49	1.37
Other States [4]	73	20	20	23	15	24	34	34	------	.01	(1)	(1)	.01	(1)	.01	.01	.01
Total bituminous	478,435	564,565	534,989	309,710	439,088	445,531	348,545	393,065	+12.8	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Pennsylvania anthracite	91,525	93,339	73,828	49,855	54,580	51,856	46,099	51,487	+11.7	------	------	------	------	------	------	------	------
Grand total	569,960	657,904	608,817	359,565	493,668	497,387	394,644	444,552	+12.6	------	------	------	------	------	------	------	------

[1] Less than 0.01. [2] Included in "Other States." [3] Lignite figures from Bureau of Mines.
[4] Includes Arizona, California, Georgia, Nebraska, Nevada, and Oregon. The States reporting are not identical from year to year.

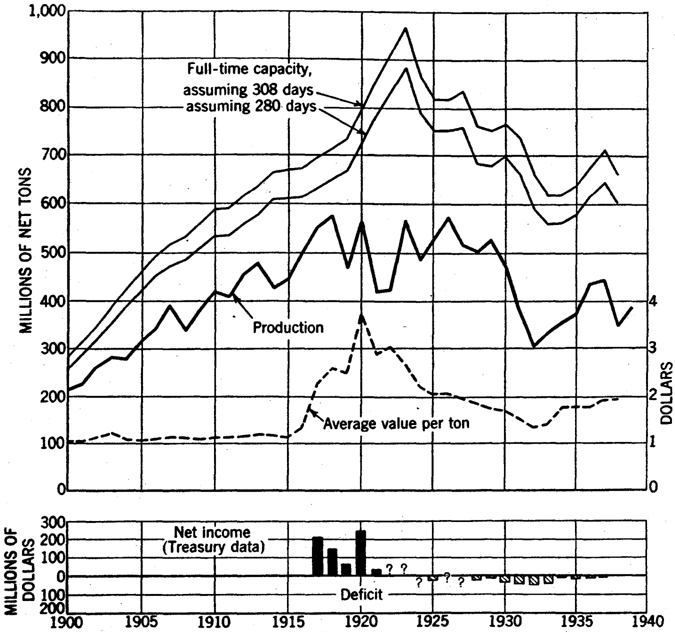

FIGURE 5.—Trends of bituminous-coal production, realization, mine capacity, and net income or deficit in the United States, 1900–39.

TABLE 4.—*Changes in the United States consumption of bituminous coal by such classes of consumers as report currently, and by all other consumers, 1929 and 1934–39, in thousands of net tons* [1]

[Information on several other classes of consumers is available for certain years. The items shown in this table are selected because they are available in strictly comparable form for each year]

Year	Consumed in the United States								Exported [3]		Total of consumption and exports [8]
	Colliery fuel	Electric power utilities [2]	Bunkers, foreign trade [3]	Locomotive fuel, class I roads [4]	Coke [5]: Beehive ovens	Coke [5]: By-product ovens	All other uses [6]	Total consumption [7]	To Canada and Mexico	To other countries (seaborne)	
1929	4,663	44,937	4,287	113,894	10,028	76,759	264,987	519,555	14,727	2,702	536,984
1934	3,175	33,555	1,321	70,496	1,635	44,343	192,518	347,043	10,213	656	357,912
1935	3,103	34,807	1,576	71,335	1,469	49,046	198,956	360,292	9,044	698	370,034
1936	3,227	42,025	1,622	81,130	2,698	63,244	228,850	422,796	9,912	743	433,451
1937	3,052	44,766	1,832	82,667	4,927	69,575	221,678	428,497	12,052	1,093	441,642
1938	2,493	40,212	1,352	68,794	1,360	45,266	185,173	344,650	9,561	929	355,140
1939 [9]	2,810	46,223	1,477	73,833	2,298	61,216	190,122	377,979	9,976	1,614	389,569

[1] Comparable data for other earlier years in Minerals Yearbook, 1937, p. 799.
[2] Geological Survey and Federal Power Commission. Represents all coal consumed by public utility power plants in power generation, including a small amount of anthracite.
[3] Bureau of Foreign and Domestic Commerce.
[4] Interstate Commerce Commission. Represents bituminous coal consumed as locomotive fuel by class I steam railways, excluding switching and terminal companies.
[5] Bureau of Mines.
[6] Obtained by subtracting the known items from the calculated total consumption. Includes general manufacturing, domestic, and many miscellaneous uses.
[7] Production plus imports minus exports, plus or minus changes in consumers' stocks.
[8] Includes imports. [9] Subject to revision.

TABLE 5.—*Trends in distribution of bituminous coal, 1923, 1929, 1934, 1936–39*

[For details and sources of data see Monthly Report on Distribution of Coal Shipments; tonnage figures shown in thousands of net tons]

	1923		1929		1934		1936		1937		1938		1939 (preliminary)	
	Quantity	Percent	Quantity	Percent	Quantity	Percent	Quantity	Percent	Quantity	Percent	Quantity	Percent	Quantity	Percent
New England receipts:														
Via rail across the Hudson	9, 634	41. 9	6, 781	31. 9	5, 422	31. 6	5, 078	28. 8	4, 885	27. 5	4, 104	29. 2	4, 626	28. 5
Via tidewater from northern ports	3, 703	16. 1	1, 570	7. 4	1, 089	6. 3	755	4. 3	364	2. 0	125	. 9	222	1. 4
Via tidewater from southern ports	9, 671	42. 0	12, 875	60. 7	10, 662	62. 1	11, 774	66. 9	12, 553	70. 5	9, 808	69. 9	11, 390	70. 1
Total New England	23, 008	100. 0	21, 226	100. 0	17, 173	100. 0	17, 607	100. 0	17, 802	100. 0	14, 037	100. 0	16, 238	100. 0
Tidewater loadings:														
By ports:														
At New York and Philadelphia	14, 693	39. 2	12, 226	32. 1	9, 120	31. 7	9, 203	29. 7	9, 683	29. 2	8, 565	31. 1	9, 404	28. 9
At Baltimore, Hampton Roads, and Charleston	22, 828	60. 8	25, 825	67. 9	19, 623	68. 3	21, 823	70. 3	23, 467	70. 8	19, 018	68. 9	23, 083	71. 1
Total	37, 521	100. 0	38, 051	100. 0	28, 743	100. 0	31, 026	100. 0	33, 150	100. 0	27, 583	100. 0	32, 487	100. 0
By fields of origin:														
From Pennsylvania and northern West Virginia	19, 760	52. 7	15, 516	40. 8	10, 647	37. 1	11, 344	36. 6	11, 859	35. 8	10, 394	37. 7	12, 165	37. 4
From southern low-volatile fields	13, 619	36. 3	17, 103	44. 9	13, 745	47. 8	15, 021	48. 4	16, 180	48. 8	13, 274	48. 1	16, 012	49. 3
From southern high-volatile fields	4, 142	11. 0	5, 432	14. 3	4, 351	15. 1	4, 661	15. 0	5, 111	15. 4	3, 915	14. 2	4, 310	13. 3
Total	37, 521	100. 0	38, 051	100. 0	28, 743	100. 0	31, 026	100. 0	33, 150	100. 0	27, 583	100. 0	32, 487	100. 0
By destinations:														
To New England	13, 374	35. 6	14, 445	38. 0	11, 751	40. 9	12, 530	40. 4	12, 916	39. 0	9, 933	36. 0	11, 612	35. 7
Foreign	5, 122	13. 7	2, 852	7. 5	715	2. 5	837	2. 7	1, 249	3. 8	1, 029	3. 7	1, 691	5. 2
Bunkers	5, 442	14. 5	5, 507	14. 5	1, 545	5. 4	1, 648	5. 3	1, 758	5. 3	1, 280	4. 7	1, 453	4. 5
Inside capes and other tonnage	13, 583	36. 2	15, 247	40. 0	14, 732	51. 2	16, 011	51. 6	17, 227	51. 9	15, 341	55. 6	17, 731	54. 6
Total	37, 521	100. 0	38, 051	100. 0	28, 743	100. 0	31, 026	100. 0	33, 150	100. 0	27, 583	100. 0	32, 487	100. 0
Lake Erie loadings (cargo and fuel):														
By fields of origin:														
From Ohio	6, 417	20. 9	3, 734	9. 5	2, 625	7. 3	2, 908	6. 4	3, 231	7. 1	2, 390	6. 8	2, 356	5. 7
From Pittsburgh and other Pennsylvania	9, 980	32. 4	8, 586	21. 8	10, 941	30. 4	11, 222	24. 7	11, 763	26. 0	8, 019	22. 8	9, 259	22. 5
From Moundsville, Fairmont, and Cumberland-Piedmont	3, 277	10. 7	2, 184	5. 5	1, 313	3. 7	1, 648	3. 6	2, 319	5. 1	1, 389	4. 0	1, 963	4. 8
From southern West Virginia, high-volatile	4, 994	16. 2	10, 233	26. 0	7, 779	21. 6	10, 459	23. 0	10, 975	24. 3	8, 329	23. 7	10, 883	26. 5
From southern West Virginia, low-volatile	2, 871	9. 3	7, 656	19. 4	6, 864	19. 1	10, 103	22. 3	8, 428	18. 6	7, 612	21. 7	8, 665	21. 1
From east Kentucky, Tennessee, and Virginia	3, 229	10. 5	6, 991	17. 8	6, 449	17. 9	9, 101	20. 0	8, 530	18. 9	7, 392	21. 0	7, 998	19. 4
Total	30, 768	100. 0	39, 384	100. 0	35, 971	100. 0	45, 441	100. 0	45, 246	100. 0	35, 131	100. 0	41, 124	100. 0

TABLE 5.—*Trends in distribution of bituminous coal, 1923, 1929, 1934, 1936–39*—Continued

	1923		1929		1934		1936		1937		1938		1939 (preliminary)	
	Quantity	Percent	Quantity	Percent	Quantity	Percent	Quantity	Percent	Quantity	Percent	Quantity	Percent	Quantity	Percent
Lake Erie loadings (cargo and fuel)—Continued.														
By destinations (cargo only):														
To American points	24,172	81.5	31,943	84.2	28,399	81.5	37,184	84.5	35,123	80.6	27,656	80.9	33,188	83.3
To Canadian points	5,475	18.5	6,007	15.8	6,440	18.5	6,835	15.5	8,479	19.4	6,510	19.1	6,672	16.7
Total	29,647	100.0	37,950	100.0	34,839	100.0	44,019	100.0	43,602	100.0	34,166	100.0	39,860	100.0
Across Lake Michigan car ferry	1,373		1,282		680		799		650		588		592	
West-bound rail to Mississippi Valley (revenue all-rail shipments, excluding railroad fuel, Lake coal, and movement to Kentucky points):														
From Ohio fields	22,970	14.7	12,912	7.8	11,321	11.3	11,811	9.6	11,861	9.5	8,042	8.7	9,052	8.4
From Pennsylvania fields	15,853	10.1	21,885	13.3	12,125	12.1	15,593	12.6	15,091	12.1	9,620	10.4	12,200	11.4
From northern West Virginia and Cumberland-Piedmont	2,509	1.6	5,464	3.3	3,271	3.3	3,425	2.8	3,521	2.8	2,615	2.8	3,227	3.0
From southern West Virginia, high-volatile	17,525	11.2	25,148	15.3	13,800	13.8	17,641	14.3	17,293	13.9	13,668	14.8	15,099	14.0
From southern West Virginia, low-volatile	13,535	8.6	23,691	14.4	14,916	14.9	19,140	15.5	19,575	15.8	13,335	14.5	15,946	14.8
From east Kentucky, Tennessee, and Virginia	17,789	11.3	24,057	14.6	13,463	13.4	17,659	14.3	17,953	14.5	14,120	15.3	15,749	14.7
Total from Appalachian fields	90,181	57.5	113,157	68.7	68,896	68.8	85,269	69.1	85,294	68.6	61,400	66.5	71,273	66.3
From Illinois	48,401	30.9	34,863	21.2	20,208	20.2	26,362	21.4	26,625	21.4	20,719	22.5	24,879	23.1
From Indiana	14,549	9.3	10,589	6.4	8,879	8.8	9,822	8.0	10,594	8.5	8,501	9.2	9,455	8.8
From west Kentucky [1]	3,569	2.3	6,175	3.7	2,208	2.2	1,873	1.5	1,859	1.5	1,661	1.8	1,917	1.8
Total from Middle West fields	66,519	42.5	51,627	31.3	31,295	31.2	38,057	30.9	39,078	31.4	30,881	33.5	36,251	33.7
Grand total	156,700	100.0	164,784	100.0	100,191	100.0	123,326	100.0	124,372	100.0	92,281	100.0	107,524	100.0
Total shipments from other groups (all shipments including, in this case, nonrevenue railroad fuel): [2]														
From Michigan fields	1,086	[3] .2	745	[3] .1	325	[3] .1	210	([4])	181	([3] [4])	166	([3] [4])	120	([3] [4])
From upper Lake commercial docks, all deliveries	([5])		16,689	[3] 3.1	11,535	[3] 3.2	13,768	[3] 3.1	13,518	[3] 3.1	10,845	[3] 3.1	11,111	[3] 2.9
From Iowa, Missouri, and Kansas	12,222	[3] 2.2	9,488	[3] 1.8	7,007	[3] 1.9	7,647	[3] 1.7	7,202	[3] 1.6	6,528	[3] 1.9	6,278	[3] 1.6
From Arkansas, Oklahoma, and Texas	5,125	[3] .9	6,337	[3] 1.2	2,692	[3] .7	3,784	[3] .9	3,739	[3] .8	3,126	[3] .9	3,006	[3] .8
From far western fields	30,286	[3] 5.4	29,705	[3] 5.6	16,368	[3] 4.6	20,849	[3] 4.7	21,867	[3] 4.9	17,612	[3] 5.1	18,432	[3] 4.7
From Alabama field	19,569	[3] 3.5	17,503	[3] 3.3	8,812	[3] 2.5	11,539	[3] 2.6	11,771	[3] 2.7	10,382	[3] 3.0	11,075	[3] 2.8

[1] The figures for west Kentucky cover in recent years a much smaller percentage of the field's production than do those for Illinois and Indiana and may not be fully comparable with earlier years.
[2] Excluding commercial sales by truck and wagon, except from upper Lake docks.
[3] Percent of total national shipments from all mines, all destinations.
[4] Less than 0.1 percent.
[5] Data not available.

SOURCES OF DATA AND ACKNOWLEDGMENTS

Bituminous-coal production statistics for 1939 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 various local operators' associations, including the following: Central Pennsylvania Coal Producers Association, Georges Creek and Upper Potomac Coal Association, Hazard Coal Operators Association, Kanawha Coal Operators Association, Eastern Ohio Operators Association, North Dakota Board of Railroad Commissioners, Utah Coal Operators Association, Virginia Operators Association, Winding Gulf Operators Association, and Operators Association of the Williamson Field. Especial acknowledgment for detailed monthly production reports is made to: Thomas Allen, Colorado inspector of coal mines; James McSherry, director, Illinois Department of Mines and Minerals; Jonas Waffle, managing director, Coal Trade Association of Indiana; J. I. Thomas, secretary, Pennsylvania Department of Mines; N. P. Rhinehart, chief, West Virginia Department of Mines; J. E. Bergin, chief inspector, Washington Department of Mines.

In the estimates for 1939 allowance has been made for commercial truck shipments, local sales and colliery fuel, and small trucking or wagon mines producing over 1,000 tons a year. Production of mines on the border between two States has been credited to the State from which the coal is extracted rather than that in which the tipple is situated. If the coal is mined from lands in both States the tonnage has been apportioned accordingly.

Valuable assistance was rendered in the preparation of this chapter by the following members of the research section of the Bituminous Coal Division: L. H. Barber, E. M. Hall, M. S. Kengla, and J. G. Kirby.

The data in this report on the output of bituminous coal in 1938 are based upon detailed annual reports of production and mine operation courteously 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 data of reasonable accuracy from the records of the State mine departments, which have statutory authority to require such reports, or in a few instances, from railroad carloadings.

Acknowledgment is made to the many individuals and agencies both public and private that have cooperated generously in making the survey possible.

RELATIVE RATE OF GROWTH OF COAL, OIL, AND WATER POWER, 1889–1939

According to preliminary data, the total supply of available energy in the form of coal, oil and natural gas, and water power in 1939 was 24,415 trillion B. t. u., an increase of 7.2 percent over the preceding year. (See fig. 6.)

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 6 summarizes the equivalent of each of the fuels in British thermal units. Water power is represented by the equivalent fuel required to perform the same work. The table covers the years since 1933, but corresponding data are given in graphic form for the entire period back to 1890. Details for 1889 to 1932 are given in Minerals Yearbook, 1937, page 807.

In converting water power into its fuel equivalent, two alternative assumptions have been made. The first, as in previous issues of these tables, assumes a *constant* fuel equivalent of 4.02 pounds of coal for each kilowatt-hour of water power produced throughout the

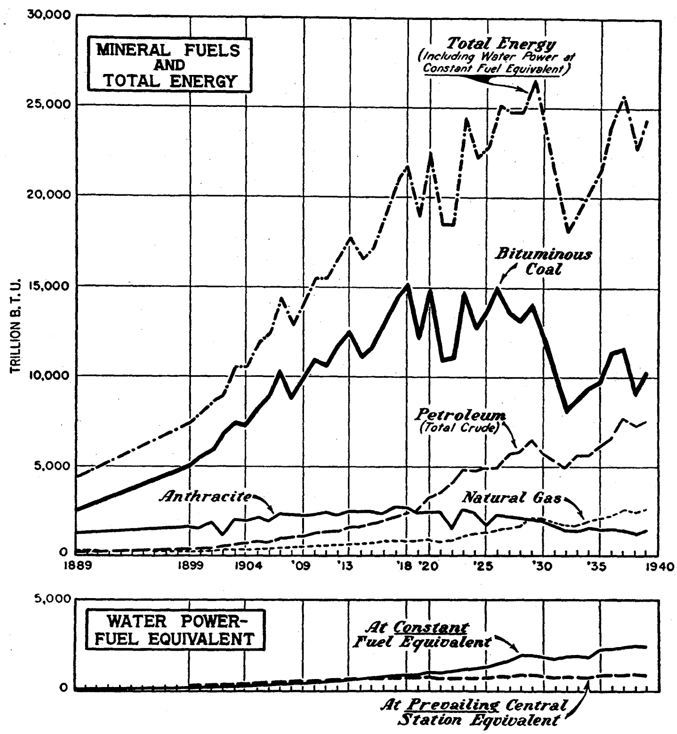

FIGURE 6.—Annual supply of energy from mineral fuels and water power in the United States, 1889–1939.

entire period from 1889 to 1939. This factor was selected because it represents, in round numbers, the average efficiency of all central stations generating steam-electric power in 1913, the midpoint of the period under review. The usefulness of the *constant* factor lies in showing the rate at which water power is being developed. It permits direct comparison between the relative increase in kilowatt-hours of water power and the corresponding increase (or decrease) in tons of coal, barrels of oil, or cubic feet of gas produced. On the other hand, the constant factor makes no allowance for the fact that coal and other fuels produced today are used more efficiently than formerly.

To throw light on the influence of improving fuel efficiency, a second computation of the energy equivalent of water power has therefore been made. This assumes a *prevailing* fuel equivalent, diminishing year by year, which represents the average performance of all fuel-burning central electric stations for the year in question. This average has declined from about 7.05 pounds of coal per kilowatt-hour in 1899 to 1.39 pounds in 1939. (The *prevailing* factor is thus much above the *constant* factor in 1899 and much below it in 1939.) The *prevailing* fuel equivalent indicates more nearly the amount 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 uses to which the water power generated is put often displace fuel burned much less efficiently than in central stations and that in any instance no other important branch of fuel consumption has made advances in fuel efficiency approaching that of the central stations.

As these tables attempt to determine the total energy from all fuels and from water power, the ideal factor for converting water power into fuel equivalent would be the average efficiency of all forms of fuel consumption in each year. No basis for determining such an all-embracing average exists at present, but enough is known to make certain that it would show much less reduction from 1899 to 1939 than did the central stations. For the present, a just comparison of the changing contributions of water power and of fuel to the national energy supply would lie somewhere between the results shown by the *constant* equivalent and the *prevailing central-station* equivalent in these tables.

As in earlier issues of these tables, the figures for oil and natural gas represent the entire production of crude petroleum and of gas. Most of this production does not come into direct competition with coal. Much of the supply of both oil and gas is used in regions of the country, such as California and portions of the Southwest, where coal is available only at unusually high cost because of heavy transport charges. Nearly half of the natural gas is used in the field for drilling or operating oil and gas wells and pipe lines, or for the manufacture of carbon black. More than half the oil is used in the form of gasoline, kerosene, and lubricants, for which purposes coal cannot well compete, except at very much higher levels of oil prices. Even these refined products, however, involve a certain measure of indirect competition with coal, for the energy market of the country is becoming more fluid and competitive, and a demand that cannot be met by one source of supply tends to fall back on the others.

The subject of interfuel competition is exceedingly complex, and an elaborate analysis and the accumulation of data not now available would be required to determine even approximately how much of any one fuel actually has been displaced either by other fuels or by water power. The present tables do not permit determination of such displacement; their purpose is rather to measure the long-time trends in the total demand for energy.

The figures for anthracite represent the output from established operations only and do not include bootleg or stolen coal, the amount of which is not accurately known. The bootleg tonnage has been estimated by the Commonwealth of Pennsylvania Anthracite Coal Industry Commission at the rate of 2,400,000 tons a year during 1936 and 1937, which is equivalent to 5 percent of the output of the legitimate operations. (Trade estimates place the figure as high as 3,000,000 to 3,500,000 tons.) The Pennsylvania Department of Mines estimates the bootleg tonnage at 2,500,000 tons in 1938 and 3,500,000 in 1939. If the additional item of 2,500,000 tons were included, the total energy from anthracite in 1938 would be 1,323 trillion B. t. u. and the total energy from all sources 22,833 trillion B. t. u. If the additional item of 3,500,000 tons were included, the total energy from anthracite in 1939 would be 1,492 trillion B. t. u. and the total energy from all sources 24,510 trillion B. t. u.

Table 7 compares the relative increase in the several sources of energy by means of index numbers in which production for 1918 is represented by 100. Production of anthracite in 1939 was 48 percent below 1918 (44 percent if bootleg coal is included) and of bituminous coal 33 percent below 1918. Production of domestic petroleum increased 255 percent and natural gas 238 percent over 1918.

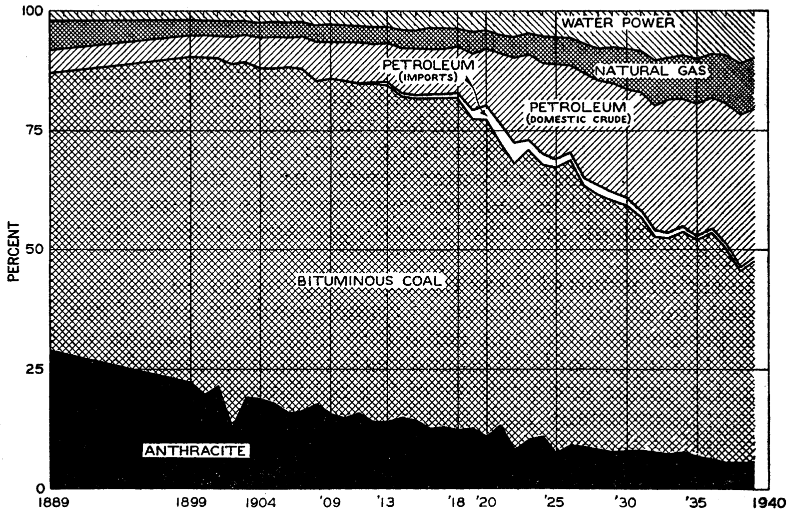

FIGURE 7.—Percent of total B. t. u. equivalent contributed by the several sources of energy, counting water power at constant fuel equivalent, 1889–1939. If water power is counted at the prevailing fuel equivalent of central stations in each year, its proportion is 3.2 percent in 1899 and 3.7 percent in 1939, and the proportions of the other sources of energy are affected accordingly.

There was a 189-percent increase in the amount of water power developed (represented by the constant fuel equivalent).

Table 8 gives the percentage composition of the total energy supply, on the alternative assumptions of water power at constant and at prevailing central-station equivalents in fuel. On the assumption of constant equivalent, the proportion contributed by water power has increased from 1.8 percent in 1899 to 9.9 in 1939. On the assumption of prevailing central-station equivalent, it has remained substantially unchanged at 3 to 4 percent. As already noted, the truth lies somewhere between the two assumptions. Upon either basis, water power furnishes a relatively small fraction of the total energy budget of the Nation, although, of course, a much larger fraction of the electric power produced by public utilities.

Coal remained the largest source of energy in 1939, contributing 47.5 percent with water power counted at constant fuel equivalent and 50.7 percent with water power at prevailing central-station equivalent.

TABLE 6.—*Annual supply of energy from mineral fuels and water power in the United States, 1933–39,*[1] *in trillions of B. t. u.*[2]

Year	Pennsylvania anthracite	Bituminous coal	Total coal	Petroleum (total crude, including that refined)		Natural gas (total production)	Total petroleum and natural gas	Total mineral fuels	Water power (fuel equivalent)		Grand total energy	
				Domestic production	Imports				At constant fuel equivalent [3]	At prevailing central station equivalent [4]	Water power at constant fuel equivalent	Water power at prevailing central station equivalent
1933	1,348	8,741	10,089	5,434	191	1,672	7,297	17,386	1,931	711	19,317	18,097
1934	1,555	9,415	10,970	5,448	213	1,904	7,565	18,535	1,896	698	20,431	19,233
1935	1,419	9,756	11,175	5,980	193	2,060	8,233	19,408	2,207	806	21,615	20,214
1936	[5] 1,485	11,504	12,989	6,598	194	2,330	9,122	22,111	2,256	812	24,367	22,923
1937	[5] 1,410	11,673	13,083	7,675	165	2,588	10,428	23,511	2,446	871	25,957	24,382
1938	[5] 1,255	9,132	10,387	7,286	158	2,468	9,912	20,299	2,466	866	22,765	21,165
1939 [6]	[5] 1,397	10,192	11,589	7,586	199	2,618	10,403	21,992	2,423	838	24,415	22,830

[1] Comparable data for earlier years in Minerals Yearbook, 1937, p. 807.

[2] The unit heat values employed are: Anthracite, 13,600 B. t. u. per pound; bituminous coal, 13,100 B. t. u. per pound; petroleum, 6,000,000 B. t. u. per barrel; natural gas, 1,075 B. t. u. per cubic foot. Water power includes installations owned by manufacturing plants and mines, as well as Government and privately owned public utilities. The fuel equivalent of water power is calculated from the kilowatt-hours of power produced wherever available, as is true of all public utility plants since 1919. Otherwise the fuel equivalent is calculated from the reported horsepower of installed water wheels assuming a capacity factor of 20 percent for manufactures and mines and of 40 percent for public utilities.

[3] Assuming 4.02 pounds per kilowatt-hour, which is the average of central electric station practice in 1913, the midpoint of the period for which data are available.

[4] Assuming the average central-station practice for each of the years for which data are available, which declined from about 7.05 pounds per kilowatt-hour in 1899 to 1.39 pounds in 1939.

[5] Does not include an unknown amount of bootleg or stolen coal. If this were included, the energy for anthracite would be approximately 1,550 trillion B. t. u. in 1936, 1,476 in 1937, 1323 in 1938, and 1,492 in 1939, and the total energy would be increased accordingly.

[6] Subject to revision.

TABLE 7.—*Index numbers for relative rate of growth of coal, oil, and water power in the United States* [1]

[The figures are expressed as a percentage of the 1918 rate]

Year	Pennsylvania anthracite	Bituminous coal	Total coal	Petroleum (total crude)		Natural gas (total production)	Total petroleum and natural gas	Total mineral fuels	Water power (at constant fuel equivalent)	Grand total	
				Domestic production	Imports					With water power at constant fuel equivalent	With water power at prevailing central station equivalent
1933	50	57	56	252	90	205	229	82	231	87	83
1934	58	62	61	255	94	246	241	88	227	94	89
1935	53	64	63	280	85	266	262	92	264	99	93
1936	55	76	73	309	86	301	291	105	270	112	106
1937	[2] 52	77	73	359	73	334	332	112	292	119	112
1938	[2] 47	60	58	341	70	318	316	97	295	104	98
1939 [3]	[2] 52	67	65	355	88	338	332	105	289	112	105

[1] Comparable data for earlier years in Minerals Yearbook, 1937, p. 809.

[2] If illicit or bootleg anthracite were included, the index for 1937 would be 55, that for 1938, 49, and for 1939, 56.

[3] Subject to revision.

TABLE 8.—*Percent of total B. t. u. equivalent contributed by the several mineral fuels and water power in the United States, 1933–39* [1]

Year	Pennsylvania anthracite	Bituminous coal	Total coal	Petroleum (total crude): Domestic production	Petroleum (total crude): Imports	Natural gas (total production)	Total petroleum and natural gas	Total mineral fuels	Water power, fuel equivalent	Grand total, including water power
	Water power counted at *constant* fuel equivalent of approximately 4 lb. per kilowatt-hour									
1933	7.0	45.2	52.2	28.1	1.0	8.7	37.8	90.0	10.0	100.0
1934	7.6	46.1	53.7	26.7	1.0	9.3	37.0	90.7	9.3	100.0
1935	6.6	45.1	51.7	27.7	.9	9.5	38.1	89.8	10.2	100.0
1936	6.1	47.2	53.3	27.1	.8	9.5	37.4	90.7	9.3	100.0
1937	[2] 5.4	45.0	50.4	29.6	.6	10.0	40.2	90.6	9.4	100.0
1938	[2] 5.5	40.1	45.6	32.0	.7	10.8	43.5	89.1	10.9	100.0
1939 [3]	[2] 5.7	41.8	47.5	31.1	.8	10.7	42.6	90.1	9.9	100.0
	Water power counted at *prevailing* central station equivalent for year									
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	[2] 5.8	47.8	53.6	31.5	.7	10.6	42.8	96.4	3.6	100.0
1938	[2] 5.9	43.2	49.1	34.4	.7	11.7	46.8	95.9	4.1	100.0
1939 [3]	[2] 6.1	44.6	50.7	33.2	.9	11.5	45.6	96.3	3.7	100.0

[1] Comparable data for earlier years in Minerals Yearbook, 1937, p. 810.
[2] If bootleg coal were included the proportion from anthracite would be 5.7 percent in 1937, 5.8 in 1938, and 6.1 in 1939 at *constant* and 6.0 in 1937, 6.2 in 1938, and 6.5 in 1939 at *prevailing* water power equivalents.
[3] Subject to revision.

FINAL BITUMINOUS STATISTICS FOR 1938

Tables 9 to 34 give the final detailed statistics of bituminous mine operations in 1938. The subjects covered include production, number and size of mines, employment, fuel economy, stocks, foreign trade, and world production.

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 per year that sell their output by wagon or truck. Unless otherwise indicated, the net or short ton of 2,000 pounds has been used as a standard unit of measurement.

These statistics include for convenience and historical comparison the small output of anthracite and semianthracite produced outside Pennsylvania and the production of lignite. Details regarding these coals are given in tables 26 to 34, inclusive. In the standard statistics of the American coal trade they have ordinarily been combined with bituminous coal.

PRODUCTION

SUMMARY BY STATES

TABLE 9.—*Production, men employed, days operated, man-days of labor, and output per man per day at coal mines in the United States in 1938, by States*

[Exclusive of product of wagon mines producing less than 1,000 tons]

State	Net tons					Number of employees				Average number of days mines operated	Man-days of labor	Average tons per man per day
	Loaded at mines for shipment by rail or water	Shipped by truck or wagon	Coal used by employees or taken by locomotives at tipple or other uses at mines	Used for power and heat or made into coke at mines [1]	Total quantity	Underground	Surface: In strip pits	Surface: All others	Total			
Alabama	10,355,746	539,048	109,524	57,175	11,061,493	18,339	91	2,680	21,110	180	3,795,822	2.91
Alaska	151,656	----	231	2,795	154,682	100	----	44	144	204	29,413	5.26
Arizona, Georgia, Idaho, and Oregon	25,636	8,357	50	----	34,043	82	----	17	99	122	12,059	2.82
Arkansas	1,167,240	20,678	1,723	7,406	1,197,047	3,215	65	541	3,821	112	429,619	2.79
Colorado	3,899,117	1,468,725	90,636	[1] 204,666	5,663,144	6,897	10	1,378	8,285	169	1,400,088	4.04
Illinois	34,562,842	6,281,452	363,901	703,890	41,912,085	29,217	1,698	7,448	38,363	149	5,704,535	7.35
Indiana	12,483,953	1,813,808	309,599	151,124	14,758,484	6,244	1,935	2,350	10,529	149	1,570,984	9.40
Iowa	1,642,445	1,412,311	31,853	16,578	3,103,187	6,234	322	816	7,372	136	1,000,795	3.10
Kansas	2,390,839	246,435	6,266	10,601	2,654,141	1,861	680	545	3,086	170	525,115	5.05
Kentucky	36,910,512	1,039,787	450,115	144,804	38,545,218	45,096	60	7,007	52,163	160	8,351,492	4.62
Maryland	1,050,827	214,817	8,648	7,121	1,281,413	2,083	----	288	2,371	171	405,209	3.16
Michigan	166,143	292,572	8,978	26,788	494,481	1,099	----	106	1,205	163	195,825	2.53
Missouri	2,494,752	888,002	24,452	28,912	3,436,118	3,677	750	786	5,213	151	787,220	4.36
Montana [2]	2,524,145	191,291	13,000	3,614	2,732,050	1,126	40	359	1,525	174	265,784	10.28
New Mexico	1,103,772	87,099	13,579	34,587	1,239,037	1,968	----	506	2,474	153	378,011	3.28
North Dakota [2]	1,465,374	416,904	160,075	7,746	2,050,099	667	344	359	1,370	174	237,751	8.62
Ohio	14,848,698	3,311,408	328,913	101,599	18,590,618	23,306	920	3,167	27,393	145	3,984,353	4.67
Oklahoma	1,124,858	103,575	2,805	13,494	1,244,732	1,756	200	373	2,329	139	323,471	3.85
Pennsylvania	68,757,016	4,768,568	2,890,374	[1] 1,288,579	77,704,537	99,067	613	13,819	113,499	156	17,679,250	4.40
South Dakota [2]	27,148	20,570	340	----	48,058	18	23	9	50	170	8,507	5.65
Tennessee	4,060,006	320,884	50,835	[1] 40,678	4,472,403	7,094	4	1,168	8,266	167	1,383,487	3.23
Texas [2]	833,509	28,892	6,287	9,997	878,685	645	22	109	776	195	151,050	5.82
Utah	2,591,922	314,075	18,942	[1] 22,012	2,946,951	2,338	----	738	3,076	156	479,733	6.14
Virginia	11,726,660	220,247	72,457	[1] 263,672	12,283,036	14,559	----	2,202	16,761	174	2,918,100	4.21
Washington	1,149,909	383,249	13,881	19,934	1,566,973	1,990	----	601	2,591	163	423,119	3.70
West Virginia	89,873,390	985,303	1,849,829	[1] 579,650	93,288,172	87,852	56	15,131	103,039	175	18,082,703	5.16
Wyoming	4,850,881	214,001	33,524	105,471	5,203,877	3,474	44	905	4,423	181	801,879	6.49
	312,238,996	25,592,058	6,860,817	[1] 3,852,893	348,544,764	370,004	7,877	63,452	441,333	162	71,325,374	4.89

[1] Includes coal made into beehive coke at mines in the following States in 1938: Colorado, 84,172; Pennsylvania, 765,253; Tennessee, 10,000; Utah, 15,667; Virginia, 234,765; and West Virginia, 250,019; grand total, 1,359,876 tons.

[2] Includes figures on lignite compiled by L. Mann, Bureau of Mines; see lignite tables, 1938.

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TOTAL PRODUCTION SINCE BEGINNING OF MINING

TABLE 10.—*Coal produced, by States, 1928–38, with production of maximum year and cumulative production from the earliest record to the end of 1938, in thousands of net tons*

State	Maximum production		Production by years											Total production from earliest record to end of 1938
	Year	Quantity	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	
Alabama	1926	21,001	17,621	17,944	15,570	11,999	7,857	8,760	9,142	8,505	12,229	12,440	11,062	639,028
Arkansas	1907	2,670	1,661	1,695	1,533	1,154	1,033	883	857	1,133	1,623	1,511	1,197	73,541
Colorado	1917	12,483	9,848	9,921	8,197	6,604	5,599	5,230	5,211	5,911	6,812	7,187	5,663	396,922
Georgia	1903	416	58	45	7	22	27	41	33	(1)	(1)	(1)	(1)	(1)
Illinois	1918	89,291	55,948	60,658	53,731	44,303	33,475	37,413	41,272	44,525	50,927	51,602	41,912	2,447,803
Indiana	1918	30,679	16,379	18,344	16,490	14,295	13,324	13,761	14,794	15,754	17,822	17,765	14,759	735,849
Iowa	1917	8,966	3,684	4,241	3,893	3,388	3,862	3,195	3,367	3,650	3,961	3,637	3,103	311,842
Kansas	1918	7,562	2,810	2,976	2,430	1,987	1,953	2,218	2,508	2,686	2,944	2,893	2,654	231,718
Kentucky	1927	69,124	61,860	60,463	51,209	39,964	35,300	36,100	38,525	40,761	47,522	47,086	38,545	1,248,514
Maryland	1907	5,533	2,687	2,649	2,271	2,006	1,429	1,531	1,627	1,678	1,704	1,549	1,281	241,228
Michigan	1907	2,036	617	805	661	359	446	407	622	628	626	562	494	44,410
Missouri	1917	5,671	3,733	4,030	3,858	3,621	4,070	3,432	3,352	3,646	3,985	4,091	3,436	215,722
Montana	1918	4,533	3,324	3,408	3,022	2,378	2,125	2,152	2,566	2,759	2,988	2,965	2,732	117,800
New Mexico	1918	4,023	2,712	2,623	1,969	1,553	1,263	1,226	1,259	1,389	1,597	1,715	1,239	106,009
North Carolina	1922	79	61	52	29	2	2	2	3	(1)	(1)	(1)	----	(1)
North Dakota	1936	2,215	1,650	1,862	1,700	1,519	1,740	1,782	1,754	1,956	2,215	2,251	2,050	39,873
Ohio	1920	45,878	15,641	23,689	22,552	20,411	13,909	19,589	20,691	21,153	24,110	25,178	18,591	1,354,138
Oklahoma	1920	4,849	3,501	3,774	2,794	1,908	1,255	1,238	1,208	1,229	1,540	1,600	1,245	130,275
Pennsylvania bituminous	1918	178,551	131,202	143,516	124,463	97,659	74,776	79,296	89,826	91,405	109,887	111,002	77,705	5,965,891
Tennessee	1910	7,121	5,611	5,405	5,130	4,721	3,538	3,775	4,136	4,138	5,108	5,213	4,472	254,669
Texas	1913	2,429	1,182	1,101	834	716	637	822	759	758	843	910	879	58,242
Utah	1920	6,005	4,843	5,161	4,258	3,350	2,852	2,675	2,406	2,947	3,247	3,810	2,947	134,551
Virginia	1926	14,133	11,901	12,748	10,907	9,699	7,692	8,179	9,377	9,667	11,662	13,795	12,283	361,357
Washington	1918	4,082	2,520	2,521	2,302	1,846	1,591	1,394	1,383	1,559	1,812	2,002	1,567	126,678
West Virginia	1927	145,122	132,952	138,519	121,473	101,473	85,609	94,344	98,134	99,179	117,926	118,646	93,288	3,343,619
Wyoming	1920	9,630	6,572	6,705	6,088	4,994	4,171	4,013	4,368	5,177	5,781	5,918	5,204	280,860
Other States	----	----	167	134	160	158	175	173	188	180	217	203	237	61,695
Total bituminous	----	----	500,745	534,989	467,526	382,089	309,710	333,631	359,368	372,373	439,088	445,531	348,545	18,922,234
Pennsylvania anthracite	1917	99,612	75,348	73,828	69,385	59,646	49,855	49,541	57,168	52,159	54,580	51,856	46,099	4,282,457
Grand total	----	----	576,093	608,817	536,911	441,735	359,565	383,172	416,536	424,532	493,668	497,387	394,644	23,204,691

[1] Included under "Other States."

PRODUCTION BY WEEKS AND MONTHS

The following tables summarize the statistics of weekly and monthly production of bituminous coal first published in the Bituminous Coal Division Weekly Coal Reports. The figures are estimates based on daily and weekly statements of cars of coal and beehive coke loaded by the principal railroads and of shipments over the more important originating rivers. The estimates are revised afterward to agree with the results of the annual statistical reports from the coal producers; therefore, the figures given here differ slightly from those issued originally in the weekly reports.

For the method used in counting holidays, see chapter on Coal in Mineral Resources of the United States, 1930, page 631.

TABLE 11.—*Estimated weekly production of bituminous coal in 1938*

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. 1	[1] 50,000	[1] 0.1	[2] 1,221,000	July 9	4,767,000	5	953,000
Jan. 8	6,842,000	6	1,140,000	July 16	5,829,000	6	972,000
Jan. 15	7,750,000	6	1,292,000	July 23	5,914,000	6	986,000
Jan. 22	7,456,000	6	1,243,000	July 30	6,010,000	6	1,002,000
Jan. 29	7,938,000	6	1,323,000	Aug. 6	5,931,000	6	989,000
Feb. 5	7,850,000	6	1,308,000	Aug. 13	6,120,000	6	1,020,000
Feb. 12	6,982,000	6	1,164,000	Aug. 20	6,395,000	6	1,066,000
Feb. 19	6,751,000	6	1,125,000	Aug. 27	6,611,000	6	1,102,000
Feb. 26	6,608,000	5.8	1,139,000	Sept. 3	7,034,000	6	1,172,000
Mar. 5	6,544,000	6	1,091,000	Sept. 10	6,612,000	5	1,322,000
Mar. 12	6,564,000	6	1,094,000	Sept. 17	7,523,000	6	1,254,000
Mar. 19	5,936,000	6	989,000	Sept. 24	8,059,000	6	1,343,000
Mar. 26	5,441,000	6	907,000	Oct. 1	8,100,000	6	1,350,000
Apr. 2	4,639,000	5.2	892,000	Oct. 8	8,140,000	6	1,357,000
Apr. 9	5,714,000	6	952,000	Oct. 15	8,443,000	6	1,407,000
Apr. 16	5,466,000	6	911,000	Oct. 22	8,287,000	6	1,381,000
Apr. 23	5,131,000	6	855,000	Oct. 29	8,802,000	6	1,467,000
Apr. 30	5,105,000	6	851,000	Nov. 5	8,233,000	6	1,372,000
May 7	4,763,000	6	794,000	Nov. 12	8,297,000	5.6	1,482,000
May 14	5,118,000	6	853,000	Nov. 19	8,582,000	6	1,430,000
May 21	5,052,000	6	842,000	Nov. 26	7,895,000	5	1,579,000
May 28	5,434,000	6	906,000	Dec. 3	8,831,000	6	1,472,000
June 4	4,772,000	5.3	900,000	Dec. 10	8,414,000	6	1,402,000
June 11	5,028,000	6	838,000	Dec. 17	8,348,000	6	1,391,000
June 18	5,138,000	6	856,000	Dec. 24	8,610,000	6	1,435,000
June 25	5,197,000	6	866,000	Dec. 31	8,111,000	5	1,622,000
July 2	5,378,000	6	896,000				
					348,545,000	306.0	1,139,000

[1] Figures represent output and number of working days in that part of the week included in the calendar year shown. Total production for the week of January 1, 1938, was 6,225,000 net tons.

[2] Average daily production for the entire week and not for the working days in the calendar year shown.

TABLE 12.—*Monthly production of coal in 1938, by States, in thousands of net tons*

[The totals for the year are based upon final complete returns to the Bituminous Coal Division from all operators known to have produced more than 1,000 tons a year. The apportionment of the known yearly total among the 12 months is based upon the best information available, in some States upon direct tonnage reports by operators to the State mine department, in most cases upon current records of railroad carloadings and waterway shipments.]

State	January	February	March	April	May	June	July	August	September	October	November	December	Total
Alabama	980	998	1,003	890	745	652	674	840	896	1,046	1,098	1,240	11,062
Alaska	12	10	14	12	16	14	11	12	13	15	13	13	155
Arkansas	153	98	38	24	23	34	63	133	163	149	163	156	1,197
Colorado	625	548	439	353	265	274	250	330	522	553	754	750	5,663
Illinois	4,672	3,809	3,152	2,470	2,210	2,432	2,522	3,100	3,773	4,084	4,513	5,175	41,912
Indiana	1,474	1,445	1,286	960	840	896	898	1,060	1,226	1,328	1,520	1,826	14,759
Iowa	368	294	270	197	193	181	160	202	250	298	342	348	3,103
Kansas	338	272	190	158	116	157	143	224	266	250	232	308	2,654
Kentucky:													
Eastern	2,570	2,048	1,980	1,875	2,220	2,250	2,468	2,998	3,222	3,393	3,113	3,040	31,177
Western	802	635	579	429	417	398	444	568	717	722	766	891	7,368
Maryland	109	114	110	84	80	92	93	110	117	115	122	135	1,281
Michigan	70	60	62	27	15	15	13	18	46	52	56	60	494
Missouri	413	360	252	212	174	200	192	253	280	302	375	423	3,436
Montana	286	233	192	149	154	162	168	195	214	314	347	318	2,732
New Mexico	109	97	88	82	81	100	86	100	96	125	144	131	1,239
North Dakota	264	238	125	79	69	57	55	81	161	318	341	262	2,050
Ohio	1,618	1,403	1,538	1,259	1,160	1,242	1,274	1,549	1,692	1,988	1,950	1,918	18,591
Oklahoma	164	117	52	35	33	50	50	105	155	148	165	171	1,245
Pennsylvania bituminous	6,688	6,036	6,595	5,023	4,987	5,140	5,325	6,436	7,196	7,963	8,204	8,112	77,705
South Dakota	6	6	2	2	1	1	1	1	3	10	9	6	48
Tennessee	364	380	303	312	343	309	287	385	450	470	434	435	4,472
Texas	71	67	66	67	68	73	77	82	83	78	73	74	879
Utah	280	243	208	154	128	108	116	203	298	348	413	448	2,947
Virginia	923	935	934	744	821	864	920	1,207	1,220	1,298	1,217	1,200	12,283
Washington	142	124	116	90	92	93	95	145	144	165	182	179	1,567
West Virginia	7,574	6,979	7,277	6,019	6,170	6,801	7,073	8,253	9,095	9,627	9,419	9,001	93,288
Wyoming	456	373	405	318	317	302	304	439	468	577	642	603	5,204
Other States [1]	4	3	4	3	1	1	1	1	3	4	4	5	34
Total bituminous coal	31,535	27,925	27,280	22,027	21,739	22,898	23,763	29,030	32,769	35,740	36,611	37,228	348,545
Pennsylvania anthracite [2]	5,019	4,169	3,652	5,367	5,141	3,577	2,951	3,883	4,840	4,985	3,989	3,914	51,487
Grand total	36,554	32,094	30,932	27,394	26,880	26,475	26,714	32,913	37,609	40,725	40,600	41,142	400,032

[1] Arizona, Georgia, Idaho, and Oregon.

[2] Pennsylvania anthracite figures from Bureau of Mines. Includes Sullivan County, washery and dredge coal, local sales, colliery fuel, and coal shipped by truck from authorized operations.

TABLE 13.—*Number and production of commercial bituminous-coal mines in the United States in 1938, classified by size of output in each State*

[Exclusive of product of truck and wagon mines producing less than 1,000 tons]

State	Class 1A, over 500,000 net tons		Class 1B, 200,000–500,000 net tons		Class 2, 100,000–200,000 net tons		Class 3, 50,000–100,000 net tons		Class 4, 10,000–50,000 net tons		Class 5, less than 10,000 net tons		Total all classes	
	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity
Alabama	4	2,708,945	12	3,927,901	13	1,810,192	23	1,594,784	22	567,250	156	452,421	230	11,061,493
Alaska							1	95,509	2	57,557	3	1,616	6	154,682
Arkansas							4	266,941	33	795,431	32	134,675	69	1,197,047
Colorado			1	243,293	18	2,630,985	16	1,213,571	51	1,160,684	126	414,611	212	5,663,144
Illinois	24	19,072,209	40	14,062,567	21	2,973,303	31	2,023,073	121	2,686,427	327	1,094,506	564	41,912,085
Indiana	6	4,027,318	18	5,720,356	11	1,629,174	19	1,330,775	63	1,358,916	184	691,945	301	14,758,484
Iowa			3	885,859			6	406,424	53	1,158,606	199	652,298	261	3,103,187
Kansas			5	1,324,621	6	745,996	1	73,859	12	234,441	81	275,224	105	2,654,141
Kentucky:														
Eastern	9	7,376,634	42	11,894,403	45	6,321,040	47	3,626,680	55	1,661,900	95	296,815	293	31,177,472
Western	1	549,915	9	2,533,029	17	2,300,308	16	1,158,421	23	568,552	83	257,521	149	7,367,746
Maryland					3	469,900	3	181,248	20	463,081	56	167,184	82	1,281,413
Michigan					1	165,449	2	150,083	8	178,949			11	494,481
Missouri	1	500,146	3	1,014,350	2	303,766	5	340,706	37	815,359	138	461,791	186	3,436,118
Montana, North Dakota, South Dakota, and Texas[1]	1	1,099,106	7	2,606,224	5	762,901	4	265,723	23	470,861	230	504,077	270	5,708,892
New Mexico			2	520,302	2	256,110	2	166,353	9	221,559	24	74,713	39	1,239,037
Ohio	10	6,866,673	14	4,247,302	18	2,448,344	22	1,625,480	88	2,000,619	447	1,402,200	599	18,590,618
Oklahoma			1	237,548	1	122,036	3	179,678	21	517,587	67	187,883	93	1,244,732
Pennsylvania	39	29,657,898	77	24,783,891	68	9,638,978	85	6,224,830	220	4,893,773	701	2,505,167	1,190	77,704,537
Tennessee			4	1,043,107	13	1,863,673	10	792,386	24	573,203	68	200,034	119	4,472,403
Utah			3	1,119,227	6	814,005	8	708,843	9	185,250	32	119,626	58	2,946,951
Virginia	4	2,728,708	15	5,206,706	20	2,796,668	12	917,361	12	355,423	63	278,170	126	12,283,036
Washington			1	212,268	5	762,261	2	133,806	16	354,144	29	104,494	53	1,566,973
West Virginia	39	27,978,480	120	37,725,893	119	17,183,094	91	6,694,233	107	3,034,307	215	672,165	691	93,288,172
Wyoming	1	544,241	10	3,002,439	8	1,076,620	2	108,051	12	368,845	32	103,681	65	5,203,877
Other States[2]									1	25,636	4	8,407	5	34,043
	139	103,110,273	387	122,311,286	402	57,074,803	415	30,278,818	1,042	24,708,360	3,392	11,061,224	5,777	348,544,764

[1] Includes lignite figures from Bureau of Mines.

[2] Arizona, Georgia, Idaho, and Oregon.

TREND OF AVERAGE VALUE PER TON, F. O. B. MINES, 1929 TO 1938

Before the Bituminous Coal Act of 1937 was passed the most valuable single index of the trend of prices at the mines was the "average value per ton, f. o. b. mines," as given in the familiar annual coal reports of the Bureau of Mines, United States Department of the Interior. This series was referred to in the Bureau of Mines reports as representing "bituminous coal," and it covered all coal other than Pennsylvania anthracite produced in the United States. It represented the bituminous-coal industry as the term ordinarily was used in the trade and included the lignite of the Dakotas, Texas, and Montana, as well as any small tonnages of hard coal produced outside of Pennsylvania.

With the passage of the Coal Act the Bureau of Mines relinquished the collection of statistics relating to bitumonous coal, effective June 30, 1937, though continuing to compile data regarding lignite. Effective on the same date, the Coal Commission became responsible for the compilation of data on bituminous coal, though not attempting to collect data regarding lignite, which was specifically exempted by the act. The records of the Commission (now Bituminous Coal Division, United States Department of the Interior), relate to all coal other than Pennsylvania anthracite and lignite, no exemptions other than lignite having been approved under the act.

To permit comparison of the old and new series, therefore, it is necessary to separate the lignites from the bituminous coals, though for convenience of the student the combined average for the two is continued in a form as nearly comparable as possible to the old series.

A more important change in the two series relates to the treatment of selling expenses. The old Bureau of Mines series of "value at the mines" excluded the selling cost. The reporting operator was asked to state the "Amount received at the mines f. o. b. cars less the selling expense." No details were asked regarding the items included in the value, and no systematic effort was made to follow up the exclusion of selling expenses. It was realized at the time that some producers might find it impractical to exclude selling costs and that some part of the selling expenses of the industry might be included in the results. Nevertheless, the reports were checked for consistency from year to year, the questions were retained in the same form without change, and the results are believed to have been comparable from one year to the next. The new series of the Coal Commission represents the total or gross realization on all coal produced and specifically includes the selling cost.

It is also possible that the two sets of data are not precisely comparable with respect to coal produced but not sold on the commercial market. In the Bureau of Mines series the reporting operator was instructed that the "value of coal not sold but used by producer, also mine fuel and coal made into coke should be estimated at average prices that might have been received." The instructions of the Coal Commission regarding such items were in effect similar, though given in greater detail.

A comparison of the two series is possible for 1936. In that year the average value per ton on the old (Bureau of Mines) basis amounted to $1.761 per ton for bituminous coal excluding lignite. The average gross realization, as collected by the Coal Commission, was $1.831 per ton. The difference amounts to $0.07 per ton, an amount somewhat less than the average selling expenditure computed per ton of all coal produced, as reported to the Coal Commission. The comparison confirms previous indications that the great majority of operators reporting in earlier years had followed instructions and omitted selling expenses in computing the average value but that some of them had included the selling expense. The change in method of reporting should be kept in mind in comparing the two sets of data. As the reports to the Commission were submitted on a detailed accounting return and made under oath they are to be accepted. The returns of earlier years, on a voluntary basis and not in all instances uniform as to treatment of selling costs, seem to have been thoroughly comparable from one year to the next and afford the best available index to the rise and fall of the mine prices received by the operator down to 1936.

TABLE 14.—*Trend of average value of bituminous coal and lignite per ton, f. o. b. mines, 1929–38*

Year	Bituminous[1] coal (subject to regulation under 1937 Act)	Lignite[2]	Total
Average value per ton less selling expense (Bureau of Mines series):			
1929	$1.782	$1.548	$1.781
1930	1.702	1.556	1.701
1931	1.542	1.410	1.541
1932	1.313	1.313	1.313
1933	1.337	1.188	1.336
1934	1.751	1.387	1.749
1935	1.772	1.120	1.767
1936	1.761	1.061	1.756
Average gross realization including selling expense (Coal Commission series):			
1936	1.831	[3] 1.061	1.826
1937	1.946	[3] 1.080	1.939
1938	1.955	[3] 1.071	1.947

[1] Includes all coal produced other than Pennsylvania anthracite and the lignite included in the second column.
[2] North Dakota, South Dakota, and the lignite counties of Montana and Texas.
[3] Figures of the Bureau of Mines, excluding selling expense as before. Data on sales realization were not collected from lignite mines by the Coal Commission.

SPOT PRICES

Spot prices afford a basis for measuring the relative strength of the forces of demand and supply in the competitive market for bituminous coal. The market quotations published in the leading trade magazines usually are based upon posted prices of larger producers, and oftentimes represent "asked" rather than "actual" prices.

Spot prices are not to be confused with sales realization, as the latter includes a large volume of coal either sold at relatively stable prices under long-term contracts or consumed by producers and their affiliates at purely nominal prices.

The following table of average spot prices is offered as an indication of trends in 1937, 1938, and 1939.

TABLE 15.—*Trend of spot prices of bituminous coal per net ton, f. o. b. mines, as indicated by trade journal quotations, 1937–39* [1]

[Based upon 130 series of comparable quotations currently published in the Black Diamond, Saward's Journal, and Chicago Journal of Commerce. These have been grouped into prepared sizes, run-of-mine, and screenings or slack, and simple averages obtained. The 3 groups have then been combined into a weighted average, counting prepared sizes at 43 percent, run-of-mine at 27 percent, and screenings or slack at 30 percent. The resulting average for all coal is not intended to show the actual realization obtained, but gives a ready comparison of the trend of prices in the 3 years.]

Month	Prepared sizes			Run-of-mine			Screenings or slack			All coal			Change in 1939 (percent)
	1937	1938	1939	1937	1938	1939	1937	1938	1939	1937	1938	1939	
January [2]	$2.49	$2.58	$2.37	$2.06	$2.22	$2.06	$1.49	$1.81	$1.40	$2.07	$2.25	$2.02	−10.2
February [2]	2.49	2.54	2.35	2.07	2.21	2.06	1.54	1.77	1.40	2.09	2.22	2.01	−9.5
March	2.39	2.48	2.23	2.06	2.07	2.01	1.70	1.50	1.37	2.09	2.08	1.91	−8.2
April	2.30	2.22	(3)	2.11	2.08	(3)	1.77	1.51	(3)	2.09	1.99	(3)	(3)
May	2.30	2.21	(3)	2.13	2.07	(3)	1.77	1.51	(3)	2.10	1.96	(3)	(3)
June [2]	2.29	2.22	2.19	2.13	2.07	2.01	1.77	1.51	1.51	2.09	1.97	1.94	−1.5
July	2.33	2.23	2.22	2.07	2.07	1.99	1.74	1.47	1.50	2.08	1.96	1.94	−1.0
August	2.38	2.28	2.24	2.10	2.06	2.00	1.72	1.41	1.49	2.11	1.96	1.95	−.5
September	2.39	2.34	2.28	2.10	2.10	2.01	1.64	1.37	1.49	2.09	1.98	1.97	−.5
October	2.44	2.47	2.48	2.10	2.10	2.27	1.60	1.38	1.69	2.10	2.04	2.19	+7.4
November	2.45	2.45	2.45	2.11	2.07	2.25	1.59	1.33	1.65	2.10	2.01	2.16	+7.5
December [2]	2.49	2.43	2.35	2.16	2.06	2.22	1.71	1.34	1.60	2.17	2.00	2.09	+4.5
Average:													
12 months	2.40	2.37	2.32	2.10	2.10	2.09	1.67	1.49	1.51	2.10	2.04	2.02	−1.0

[1] Except as noted, these averages are based upon the following number of quotations: Prepared sizes: Chicago market, 25 quotations; Cleveland market, 29 quotations; Norfolk market, 18 quotations; Pittsburgh market, 3 quotations; total, 75 quotations. Run-of-mine: Chicago market, 7 quotations; Cleveland market, 2 quotations; Norfolk market, 7 quotations; Pittsburgh market, 0; total, 16 quotations. Screenings or slack: Chicago market, 19 quotations; Cleveland market, 11 quotations; Norfolk market, 7 quotations; Pittsburgh market, 2 quotations; total, 39 quotations. Total of all quotations used, 130.

[2] Quotations for Cleveland and Pittsburgh in January and February and for Pittsburgh in June and December have been excluded from the computed averages due to lack of comparable data.

[3] Insufficient quotations during the greater part of April and May 1939, owing to suspension of mining operations pending the completion of a new wage agreement.

LABOR STATISTICS

MEN EMPLOYED

An average of 441,333 men was employed at bituminous-coal mines in 1938, a 10-percent decrease from the total of 491,864 for 1937. (See fig. 8.) Statistics of men employed in 1938 represent annual averages of the number of workers on the rolls on the days when the mines were in operation. Except for the slight discrepancy in comparability with 1937, the figures of employment for 1938 are comparable with similar date for earlier years. (See Minerals Yearbook, 1939, pp. 776 and 787–788.)

The method used here in calculating employment gives an accurate measure of the working force in the coal industry, but it does not consider the time lost by men on the rolls through intermittent opera-

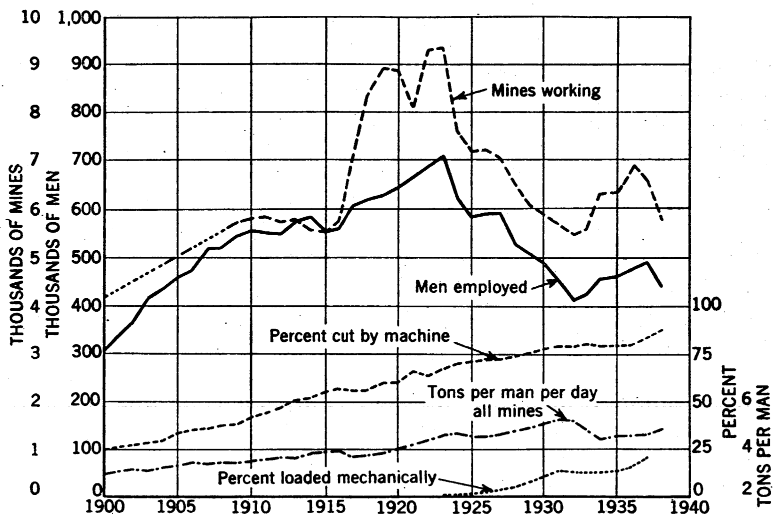

FIGURE 8.—Trends of employment, mechanization, and output per man at bituminous-coal mines, 1900–1938.

tions. To measure the influence of intermittency upon employment the factor of mine activity as indicated by the average number of days of plant operation was recorded separately. The average number of men employed when the mines were in operation was then used, in conjunction with the average number of days of operation, as a measure of the total volume of employment in the industry.

In recent years a special problem has arisen in recording employment through the adoption of local "share-the-work" agreements, by which the employees of a mine are divided into two crews or groups who work on alternate days. Such agreements for "staggering" or alternating the work are not to be confused with the practice of operating both a day and a night shift but relate rather to division of the available work between two groups of workers on the same shift, usually the day shift.

Specific inquiries regarding such agreements by the Illinois Department of Mines and Minerals in 1938 indicated that 45 mines in that State were operating with alternate crews under share-the-work agreements. If the number of men on the pay rolls had been used as a measure of employment instead of the average number of men working, the employment figures for Illinois would have been increased approximately 8 percent. A small number of employees was involved in similar reports from Indiana.

The figures on "number of men employed" as given in this report are therefore somewhat less than the total number of men on the rolls in the States where there were mines that followed the practice of spreading employment by means of share-the-work agreements. No formal agreements for dividing work have been reported to the authors from mines outside of Illinois and Indiana in 1938; however, local share-the-work agreements may have existed in other fields, which were not reported, and occasionally at still other mines a certain amount of work sharing may have been practiced without written agreement between operators and their employees.

DAYS OPERATED

The average number of days of operation at bituminous-coal mines in 1938 was 162. This represents a decline from the average of 193 days for 1937. All statistics on days of mine operation included in this report are weighted averages, in which the operating time of each mine has been weighted by the number of its employees. Several coal-mining States publish series on the number of days worked that are simple averages of the figures for each reporting mine regardless of size. As these unweighted averages are likely to be unduly depressed by small mines, which generally operate fewer days than the larger ones, they tend to understate the working time of the typical mine employee.

MAN-DAYS OF LABOR

Only a small proportion of the bituminous-coal-mine operations, however, keep an accurate record of man-days or man-hours worked. Consequently, man-days have been computed by multiplying the number of workers employed by the number of operating days. Although these computations were made for each individual mine the combined total is necessarily only an approximation.

Until the American coal industry arranges to keep an accurate record of man-days or man-hours of employment all computations of accident rates, daily earnings, and output per man will remain subject to qualification. Meanwhile, the method of multiplying men by days must be accepted as the best available procedure.

Data for 1938 indicate that bituminous-coal-mine employees performed 71,325,374 man-days of labor during the year. Table 9 gives a summary record of men employed, days operated, and output per man per day at bituminous-coal mines by States in 1938. Details by counties for 1938 are shown in table 25.

LENGTH OF WORKING DAY

Data for computing the number of hours in the average working day of bituminous-coal miners have not yet been completed for 1938. As there was no change in the provision of the union wage agreement regarding hours of work it can be assumed that the 7.02-hour-per-day average for 1935 and 1936 also would apply to 1937 and 1938. For further discussion of length of working day and detailed statistics of earlier years see Minerals Yearbook, 1937, pages 821–823.

TABLE 16.—*Bituminous coal mined by different methods in the United States in 1938, by States*

State	From underground workings									From strip pits		Grand total production (net tons)
	Mined by hand		Shot off the solid		Cut by machines		Not specified		Total underground (net tons)			
	Net tons	Percent of total underground	Net tons	Percent of total underground	Net tons	Percent of total underground	Net tons	Percent of total underground		Net tons	Percent of grand total	
Alabama	1, 311, 878	11. 9	1, 605, 453	14. 5	8, 098, 747	73. 5	8, 925	0. 1	11, 025, 003	36, 490	0. 3	11, 061, 493
Alaska	18, 266	11. 8	136, 416	88. 2					154, 682			154, 682
Arkansas			128, 450	11. 0	1, 023, 453	87. 5	17, 516	1. 5	1, 169, 419	27, 628	2. 3	1, 197, 047
Colorado	1, 158, 398	20. 5	264, 975	4. 7	4, 190, 492	74. 1	37, 610	. 7	5, 651, 475	11, 669	. 2	5, 663, 144
Illinois	675, 539	2. 1	2, 064, 178	6. 6	28, 548, 160	91. 1	53, 916	. 2	31, 341, 793	10, 570, 292	25. 2	41, 912, 085
Indiana	127, 270	1. 8	546, 956	7. 5	6, 602, 264	90. 6	9, 812	. 1	7, 286, 302	7, 472, 182	50. 6	14, 758, 484
Iowa	341, 061	12. 9	1, 182, 356	44. 8	1, 099, 182	41. 7	14, 733	. 6	2, 637, 332	465, 855	15. 0	3, 103, 187
Kansas	107, 729	14. 8	416, 603	57. 4	188, 819	26. 0	12, 962	1. 8	726, 113	1, 928, 028	72. 6	2, 654, 141
Kentucky:												
Eastern	1, 149, 857	3. 7	365, 058	1. 2	29, 643, 789	95. 0	18, 768	. 1	31, 177, 472			31, 177, 472
Western	189, 832	2. 8	129, 424	1. 9	6, 438, 633	95. 2	5, 677	. 1	6, 763, 566	604, 180	8. 2	7, 367, 746
Maryland	726, 997	56. 7			544, 345	42. 5	10, 071	. 8	1, 281, 413			1, 281, 413
Michigan					494, 481	100. 0			494, 481			494, 481
Missouri	270, 077	24. 1	53, 514	4. 8	769, 953	68. 8	26, 256	2. 3	1, 119, 800	2, 316, 318	67. 4	3, 436, 118
Montana and Texas [1]	136, 335	5. 6	774, 218	31. 6	1, 529, 428	62. 3	12, 707	. 5	2, 452, 688	1, 158, 047	32. 1	3, 610, 735
New Mexico	384, 623	31. 0	435, 840	35. 2	411, 994	33. 3	6, 580	. 5	1, 239, 037			1, 239, 037
North Dakota [1]	53, 708	6. 8	175, 461	22. 3	535, 696	68. 0	22, 426	2. 9	787, 291	1, 262, 808	61. 6	2, 050, 099
Ohio	370, 386	2. 3	125, 127	. 8	15, 516, 393	96. 6	49, 908	. 3	16, 061, 814	2, 528, 804	13. 6	18, 590, 618
Oklahoma	30, 094	3. 8	91, 969	11. 6	669, 788	84. 1	4, 214	. 5	796, 065	448, 667	36. 0	1, 244, 732
Pennsylvania	13, 121, 993	17. 1	2, 042, 122	2. 7	61, 381, 208	80. 2	27, 587		76, 572, 910	1, 131, 627	1. 5	77, 704, 537
South Dakota [1]	1, 420	35. 4					2, 589	64. 6	4, 009	44, 049	91. 7	48, 058
Tennessee	591, 876	13. 3	475, 076	10. 6	3, 384, 155	75. 7	19, 007	. 4	4, 470, 114	2, 289	. 1	4, 472, 403
Utah	123, 907	4. 2	55, 216	1. 9	2, 762, 751	93. 7	5, 077	. 2	2, 946, 951			2, 946, 951
Virginia	217, 972	1. 8	678, 046	5. 5	11, 381, 055	92. 7	5, 963		12, 283, 036			12, 283, 036
Washington	226, 266	14. 4	643, 657	41. 1	697, 050	44. 5			1, 566, 973			1, 566, 973
West Virginia	4, 769, 638	5. 1	561, 667	. 6	87, 700, 862	94. 3	29, 501		93, 061, 668	226, 504	. 2	93, 288, 172
Wyoming	167, 990	3. 3	161, 118	3. 2	4, 698, 826	93. 4	4, 525	. 1	5, 032, 459	171, 418	3. 3	5, 203, 877
Other States [2]	1, 328	3. 9	28, 874	84. 8	3, 841	11. 3			34, 043			34, 043
	26, 274, 440	8. 3	13, 141, 774	4. 1	278, 315, 365	87. 5	406, 330	. 1	318, 137, 909	30, 406, 855	8. 7	348, 544, 764

[1] Includes lignite figures compiled by Bureau of Mines.

[2] Includes Arizona, Georgia, Idaho, and Oregon.

FUEL EFFICIENCY

TABLE 17.—*Indicators of the effect of fuel economy on consumption of coal per unit of performance since the World War*

	Pounds	Reduction from base period (percent)
Steam railroads:		
Pounds per 1,000 gross ton-miles freight service:		
Average, 1919–20	170	
Average, 1938	115	32.4
Average, 1939	112	34.1
Pounds per passenger-train car-mile:		
Average, 1919–20	18.5	
Average, 1938	14.9	19.5
Average, 1939	14.8	20.0
Electric public utility power plants:		
Pounds per kilowatt-hour, 1919	3.2	
Pounds per kilowatt-hour, 1938	1.4	56.2
Pounds per kilowatt-hour, 1939	1.4	56.2
Iron and steel—pounds coking coal per gross ton of pig: [1]		
1918	3,577	
1938	2,894	19.1
1939	2,853	20.2
Coke manufacture: Savings of heat values through recovery of gas, tar, light oils, and breeze by extension of byproduct in place of beehive coking, 1913–1939, expressed as percent of coal used for all coke in 1939 [2]		20.6

[1] Includes only savings through higher yields of merchantable coke per ton of coal charged and lower consumption of coke per ton of iron. Excludes economies through recovery of byproducts, which are treated in next item.

[2] These byproducts are used in part for boiler fuel, in part for metallurgical purposes, in part for domestic heating and cooking, and to a small extent for automotive fuel.

STOCKS HELD BY CONSUMERS

TABLE 18.—*Stocks of bituminous coal in hands of commercial consumers and of anthracite and bituminous coal in retail dealers' yards, 1938–39*

Date	Total stock of bituminous coal estimated (net tons)	Days' supply at current rate of consumption on date of stock taking									
		Byproduct coke plants	Steel plants	Other industrials	Coal-gas plants	Electric utilities	Retail yards, bituminous	Railroads	Cement mills	Total bituminous	Retail yards, anthracite
1938											
Jan. 1	47,074,000	56	44	42	61	79	25	32	39	40	36
Feb. 1	41,967,000	51	41	37	53	82	22	28	49	37	27
Mar. 1	38,484,000	46	35	33	51	83	22	28	53	35	26
Apr. 1	35,359,000	43	33	33	51	87	22	28	47	36	25
May 1	34,102,000	43	36	35	50	97	36	29	27	41	44
June 1	33,158,000	47	37	39	57	91	53	28	22	45	58
July 1	33,452,000	51	37	40	63	85	64	27	21	46	57
Aug. 1	33,615,000	54	35	43	68	81	69	26	18	47	58
Sept. 1	34,579,000	49	31	41	68	73	52	25	19	43	63
Oct. 1	36,507,000	47	29	42	61	72	39	24	22	41	44
Nov. 1	39,024,000	46	26	42	60	71	40	24	21	40	59
Dec. 1	40,817,000	47	24	39	57	71	34	24	24	38	51
Dec. 31	40,720,000	49	25	35	54	71	25	24	32	35	37
1939											
Jan. 1	40,720,000	49	25	35	54	71	25	24	32	35	37
Feb. 1	39,720,000	48	27	34	49	72	23	25	51	35	29
Mar. 1	39,887,000	48	32	31	45	78	19	29	46	34	25
Apr. 1	40,505,000	46	40	33	47	86	21	34	35	37	22
May 1	31,746,000	32	29	32	41	81	22	32	24	35	35
June 1	25,413,000	24	25	32	32	69	33	27	20	34	61
July 1	26,991,000	24	23	32	41	61	54	23	16	34	71
Aug. 1	29,725,000	30	24	39	48	61	56	22	19	37	61
Sept. 1	33,624,000	34	23	40	55	61	49	22	20	38	58
Oct. 1	36,943,000	34	22	43	58	59	32	20	24	35	47
Nov. 1	42,020,000	35	20	42	62	58	33	21	26	35	57
Dec. 1	45,542,000	38	19	42	58	60	34	22	29	36	58
Dec. 31	44,571,000	37	21	40	56	60	26	23	32	34	37

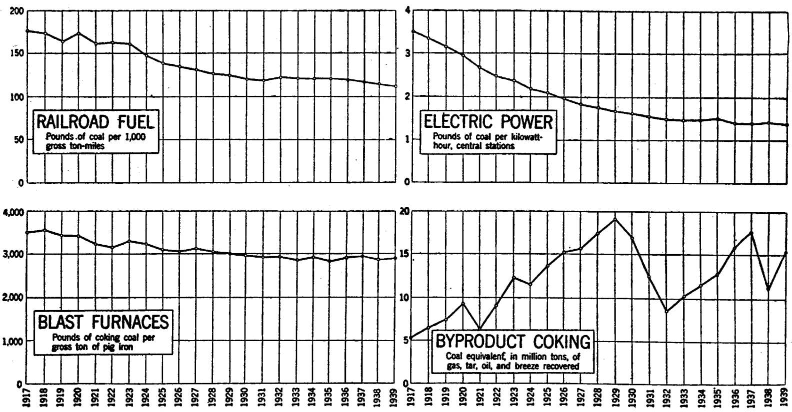

FIGURE 9.—Trends in fuel efficiency in the United States, 1917–39.

COAL LOADED FOR SHIPMENT BY INDIVIDUAL RAILROADS AND WATERWAYS

Table 19 shows the quantity of bituminous coal originated on each railroad and waterway in 1938, as reported by mine operators in answer to the following inquiry:

a. List railroads or waterways on which product was first loaded for shipment:

(Name of road or waterway)	(Net tons loaded on each)
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--	----------------
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b. On coal hauled by truck, if any, to railroad siding or to river for shipment, report below:

Name of railroad -------------------- Shipping point ---------------- Distance hauled ------ miles.

Name of river ------------------------ Loading point ---------------- Distance hauled ------ miles.

As these statistics include nonrevenue railroad fuel they may differ from those compiled by the railroad companies, which often show only revenue freight and include coal received from connecting lines or coal shipped off the Lakes docks, as well as that originating at mines on the lines reporting.

In general, the figures are given under the name reported by the operator, and the Bituminous Coal Division does not attempt to combine them under the name of the larger system, believing that such combination can best be made by those using the figures, as they are probably familiar with coal-traffic problems. If such combination is made, the total usually will be found to check reasonably well with the statistics issued by railroads that keep records of total coal originated.

Where the road serving the district is a subsidiary of a larger road some operators may report their coal as loaded on the subsidiary and others as loaded on the parent system (a few subsidiaries have been consolidated under the name of the parent road).

TABLE 19.—*Bituminous coal loaded for shipment in 1938 by individual railroads and waterways, as reported by operators, in net tons*

Route	State	Quantity: By State	Quantity: Total for route
RAILROADS			
Alabama Central	Alabama	9,298	9,298
Alabama Great Southern	do	140,381	140,381
Alaska	Alaska	151,656	151,656
Algers, Winslow & Western	Indiana	1,652,298	1,652,298
Alton	Illinois	704,755	747,043
	Missouri	42,288	
Artemus-Jellico	Kentucky	373,595	373,595
Atchison, Topeka & Santa Fe	Colorado	173,496	2,191,537
	Illinois	647,061	
	Kansas	394,912	
	Missouri	106,009	
	New Mexico	870,059	
Baltimore & Ohio	Illinois	285,415	21,011,135
	Indiana	406,598	
	Maryland	97,827	
	Ohio	2,264,637	
	Pennsylvania	7,675,869	
	West Virginia	10,280,789	
Bessemer & Lake Erie	Pennsylvania	2,359,640	2,359,640
Bevier & Southern	Missouri	422,405	422,405
Birchwood Lumber Co	West Virginia	1,636	1,636
Birmingham Southern	Alabama	11,244	11,244
Buffalo Creek & Gauley	West Virginia	641,404	641,404
Cambria & Indiana	Pennsylvania	3,152,415	3,152,415
Campbell's Creek	West Virginia	889,739	889,739
Carbon County	Utah	256,648	256,648
Caseyville	Illinois	124,197	124,197
Central of Georgia	Alabama	649,644	675,280
	Georgia	25,636	
Chesapeake & Ohio	Kentucky	6,834,646	38,303,094
	Ohio	450,326	
	West Virginia	31,018,122	
Cheswick & Harmar	Pennsylvania	747,104	747,104
Chicago & Eastern Illinois	Illinois	982,675	2,494,066
	Indiana	1,511,391	
Chicago & Illinois Midland	Illinois	3,554,393	3,554,393
Chicago & North Western	do	2,101,092	2,123,755
	Wyoming	22,663	
Chicago, Burlington & Quincy	Colorado	276,301	6,797,028
	Illinois	5,619,660	
	Iowa	151,166	
	Missouri	66,593	
	Wyoming	683,308	
Chicago, Indianapolis & Louisville	Indiana	1,207,400	1,207,400
Chicago, Milwaukee, St. Paul & Pacific	Illinois	52,571	4,870,094
	Indiana	3,487,038	
	Iowa	595,743	
	Missouri	4,389	
	Montana	677,478	
	North Dakota	[1] 46,994	
	South Dakota	(1)	
	Washington	5,881	
Chicago, Rock Island & Pacific	Arkansas	6,326	1,464,936
	Illinois	655,449	
	Iowa	549,635	
	Missouri	146,490	
	Oklahoma	107,036	
Chicago, Springfield & St. Louis	Illinois	123,457	123,457
Cleveland, Cincinnati, Chicago & St. Louis	do	3,233,646	4,053,599
	Indiana	819,953	
Clinchfield	Kentucky	87,535	1,812,419
	Virginia	1,724,884	
Colorado & Southeastern	Colorado	150,972	150,972
Colorado & Southern	do	379,253	379,253
Colorado & Wyoming	do	241,464	241,464
Conemaugh & Black Lick	Pennsylvania	26,700	26,700
Crystal River & San Juan	Colorado	530	530
Cumberland & Pennsylvania	Maryland	455,127	455,127
Dardanelle & Russellville	Arkansas	37,069	37,069
Denver & Intermountain	Colorado	106,478	106,478
Denver & Rio Grande Western	do	1,103,507	2,744,294
	New Mexico	15,747	
	Utah	1,625,040	
Denver & Salt Lake	Colorado	700,760	700,760
Des Moines & Central Iowa	Iowa	94,831	94,831

See footnotes at end of table.

TABLE 19.—*Bituminous coal loaded for shipment in 1938 by individual railroads and waterways, as reported by operators, in net tons*—Continued

Route	State	Quantity	
		By State	Total for route
RAILROADS—continued			
Detroit, Toledo & Ironton	Ohio	10,253	10,253
East Broad Top Railroad & Coal Co	Pennsylvania	411,896	411,896
Eastern Railway & Lumber Co	Washington	865	865
Erie	Ohio	178	1,061,132
	Pennsylvania	1,060,954	
Evansville & Ohio Valley	Indiana	8,245	8,245
Evansville, Suburban & Newburgh	do	178,383	178,383
Fort Dodge, Des Moines & Southern	Iowa	5,259	5,259
Forth Smith & Western	Oklahoma	113,615	113,615
Fort Smith, Subiaco & Rock Island	Arkansas	10,073	10,073
Galesburg & Great Eastern	Illinois	499,309	499,309
Grand Trunk	Michigan	4,905	4,905
Great Northern	Montana	[2] 788,334	912,033
	North Dakota	(2)	
	Washington	123,699	
Harriman & Northeastern	Tennessee	240,177	240,177
Huntington & Broad Top Mountain Railroad & Coal Co	Pennsylvania	107,849	107,849
Illinois Central	Alabama	195,901	11,634,507
	Illinois	7,047,791	
	Indiana	152,454	
	Kentucky	4,238,361	
Illinois Terminal	Illinois	594,372	594,372
Indiana	Indiana	243,215	243,215
International-Great Northern	Texas	[3] 813,096	813,096
Interstate	Kentucky	44,895	1,780,707
	Virginia	1,735,812	
Iowa Southern Utilities Co	Iowa	145,542	145,542
Johnstown & Stony Creek	Pennsylvania	88,852	88,852
Joplin-Pittsburg	Kansas	278,545	278,545
Kanawha Central	West Virginia	155,602	155,602
Kanawha, Glen Jean & Eastern	do	425,293	425,293
Kansas City Southern	Kansas	19,599	564,300
	Missouri	507,095	
	Oklahoma	37,606	
Kansas, Oklahoma & Gulf	do	20,818	20,818
Kelley's Creek & Northwestern	West Virginia	756,612	756,612
Kentucky & Tennessee	Kentucky	621,915	621,915
Lake Erie, Franklin & Clarion	Pennsylvania	45,136	45,136
Laramie, North Park & Western	Colorado	9,824	9,824
Ligonier Valley	Pennsylvania	174,704	174,704
Litchfield & Madison	Illinois	358,478	358,478
Louisville & Nashville	Alabama	1,800,125	22,517,797
	Illinois	20,189	
	Kentucky	19,871,740	
	Tennessee	682,589	
	Virginia	143,154	
Mary Lee	Alabama	878,258	878,258
Michigan Central	Michigan	6,037	6,037
Midland Valley	Arkansas	279,754	412,387
	Oklahoma	132,633	
Minneapolis & St. Louis	Illinois	690,165	690,165
Minneapolis, St. Paul & Sault Ste. Marie	North Dakota	524,438	524,438
Missouri-Illinois	Illinois	13,411	13,411
Missouri-Kansas-Texas	Kansas	241,092	483,832
	Missouri	60,077	
	Oklahoma	182,663	
	Texas	(3)	
Missouri Pacific	Arkansas	700,693	5,901,685
	Illinois	3,980,749	
	Kansas	834,560	
	Missouri	385,683	
Mobile & Ohio	Alabama	73,372	504,468
	Illinois	431,096	
Monongahela	Pennsylvania	1,915,475	8,257,009
	West Virginia	6,341,534	
Montana	Arkansas	13,231	13,231
Montana, Wyoming & Southern	Montana	298,433	298,433
Montour	Pennsylvania	4,046,461	4,046,461
Nashville, Chattanooga & St. Louis	Tennessee	681,193	681,193
New York Central (includes coal shipped over Kanawha & Michigan, Kelley's Creek, Toledo & Ohio Central, and Zanesville & Western)	Ohio	4,408,038	8,690,598
	Pennsylvania	3,523,819	
	West Virginia	758,741	
Nicholas, Fayette & Greenbrier	do	1,403,696	1,403,696

See footnotes at end of table.

TABLE 19.—*Bituminous coal loaded for shipment in 1938 by individual railroads and waterways, as reported by operators, in net tons*—Continued

Route	State	Quantity: By State	Quantity: Total for route
RAILROADS—continued			
Norfolk & Western	Kentucky	3,574,816	31,498,127
	Virginia	[4] 7,018,344	
	West Virginia	20,904,967	
Northern Alabama	Alabama	216,835	216,835
Northern Pacific	Montana	1,098,293	2,455,778
	North Dakota	582,697	
	Washington	774,788	
Oneida & Western	Tennessee	18,739	18,739
Pacific Coast	Washington	214,704	214,704
Pennsylvania (includes Pittsburgh, Cincinnati, Chicago & St. Louis)	Illinois	152,115	30,104,737
	Indiana	1,584,475	
	Ohio	3,822,069	
	Pennsylvania	24,114,101	
	West Virginia	431,977	
Peoria & Pekin Union	Illinois	24,555	24,555
Peoria Terminal	do	878,146	878,146
Pere Marquette	Michigan	155,201	155,201
Pittsburg & Shawmut	Pennsylvania	698,844	698,844
Pittsburg County	Oklahoma	7,290	7,290
Pittsburgh & Lake Erie	Pennsylvania	2,498,076	2,498,076
Pittsburgh & West Virginia	Ohio	269,919	1,733,471
	Pennsylvania	1,463,452	
	West Virginia	100	
Pittsburgh, Lisbon & Western	Ohio	46,828	54,317
	Pennsylvania	7,489	
Pittsburg, Shawmut & Northern	do	411,769	411,769
Quincy, Omaha & Kansas City	Missouri	27,017	27,017
Rio Grande & Eagle Pass	Texas	12,717	12,717
Rio Grande Southern	Colorado	12,420	12,420
Rockdale, Sandow & Southern	Texas	(3)	(3)
St. Louis & O'Fallon	Illinois	286,625	286,625
St. Louis-San Francisco	Alabama	833,146	2,491,350
	Arkansas	120,094	
	Kansas	611,053	
	Missouri	403,860	
	Oklahoma	523,197	
St. Louis Southwestern of Texas	Texas	(3)	(3)
Seaboard Air Line	Alabama	99,895	99,895
Southern	do	1,436,428	6,462,934
	Illinois	42,423	
	Indiana	1,232,503	
	Kentucky	1,050,185	
	Tennessee	1,596,929	
	Virginia	1,104,466	
Southern Pacific	New Mexico	217,966	217,966
Springfield Terminal	Illinois	273,753	273,753
Susquehanna & New York	Pennsylvania	11,324	11,324
Tennessee	Tennessee	640,852	640,852
Tennessee Central	do	199,527	199,527
Tennessee Coal, Iron & Railroad Co	Alabama	2,536,353	2,536,353
Texas & Pacific	Texas	7,696	7,696
Texas Short Line	do	(3)	(3)
Thomas & Sayreton	Alabama	528,622	528,622
Toledo, Peoria & Western	Illinois	21,822	21,822
Uintah	Colorado	5,003	5,003
Union	Pennsylvania	97,545	97,545
Union Pacific	Colorado	739,109	4,932,609
	Kansas	11,078	
	Utah	7,540	
	Washington	29,972	
	Wyoming	4,144,910	
Unity	Pennsylvania	703,335	703,335
Utah	Utah	702,694	702,694
Virginian	Virginia	(4)	9,974,240
	West Virginia	9,974,240	
Wabash	Illinois	1,079,251	1,502,366
	Iowa	100,269	
	Missouri	322,846	
Western Allegheny	Pennsylvania	88,880	88,880
Western Maryland	Maryland	497,873	3,693,934
	Pennsylvania	308,474	
	West Virginia	2,887,587	

See footnotes at end of table.

TABLE 19.—*Bituminous coal loaded for shipment in 1938 by individual railroads and waterways, as reported by operators, in net tons*—Continued

Route	State	Quantity: By State	Quantity: Total for route
RAILROADS—continued			
West Virginia Northern	West Virginia	75,339	75,339
West Virginia Pulp & Paper Co	do	17,160	17,160
Wheeling & Lake Erie	Ohio	2,871,988	2,871,988
Winfield	Pennsylvania	1,134	1,134
Winifrede	West Virginia	89,452	89,452
Woodward Iron Co	Alabama	868,951	868,951
Youngstown & Suburban	Ohio	10,950	10,950
Total railroad shipments		295,336,027	295,336,027
WATERWAYS			
Allegheny River	Pennsylvania	963,140	963,140
Black Warrior River	Alabama	77,293	77,293
Green River	Kentucky	2,168	2,168
Illinois River	Illinois	82,266	82,266
Kanawha River	West Virginia	1,819,117	1,819,117
Mississippi River	Illinois	1,955	1,955
Monongahela River	Pennsylvania	12,042,824	12,535,515
	West Virginia	492,691	
Muskingum River	Ohio	691,572	691,572
Ohio River	Kentucky	210,656	721,438
	Ohio	1,940	
	Pennsylvania	1,250	
	West Virginia	507,592	
Youghiogheny River	Pennsylvania	8,505	8,505
Total waterway shipments		16,902,969	16,902,969
Grand total, loaded at mines for shipment by railroads and waterways.		312,238,996	312,238,996
Shipped by truck or wagon		25,592,058	25,592,058
Coal used by employees or taken by locomotives at tipple or other uses at mines.		6,860,817	6,860,817
Used for power and heat or made into coke at mines		3,852,893	3,852,893
Total production		348,544,764	348,544,764

[1] South Dakota included with North Dakota. [2] Includes North Dakota and Montana lignite.
[3] Includes Missouri-Kansas-Texas, Rockdale, Sandow & Southern, St. Louis Southwestern of Texas, and Texas Short Line for Texas lignite mines.
[4] Includes Virginian Railroad in Montgomery and Pulaski Counties.

IMPORTS AND EXPORTS [2]

TABLE 20.—*Bituminous coal*[1] *imported for consumption in the United States, 1938–39, by countries and customs districts, in net tons*

	1938	1939
Country		
North America: Canada	240,729	296,701
Europe:		
France	437	
United Kingdom	139	58,414
	241,305	355,115
Customs district		
Alaska	11,634	8,163
Buffalo		101
Chicago		2
Dakota	162	124
Duluth and Superior	78	253
Customs district—Continued		
Los Angeles	1,131	
Maine and New Hampshire	88,314	127,325
Michigan		80
Montana and Idaho	95,511	103,408
New Orleans	437	
New York		40,365
Rhode Island		8,238
St. Lawrence	242	6,796
Vermont	2,313	11,740
Virgin Islands	139	9,811
Washington	41,344	38,709
	241,305	355,115

[1] Includes slack, culm, and lignite.
[2] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

TABLE 21.—*Exports of bituminous coal to Canada and Mexico, the West Indies and Central America, and "overseas" destinations, 1935–39, in thousands of net tons*

Year	Canada and Mexico	West Indies and Central America [1]	"Overseas" (all other countries)							Grand total
			Newfoundland, Miquelon, and Bermuda	South America	Europe	Asia	Africa	Oceania	Total "overseas"	
1935	9,044	456	31	197	9	5	-----	-----	242	9,742
1936	9,912	470	44	163	50	([2])	([3])	16	273	10,655
1937	12,052	732	51	265	10	24	11	-----	361	13,145
1938	9,561	619	23	247	11	29	-----	-----	310	10,490
1939	9,976	599	76	681	165	91	2	-----	1,015	11,590

[1] Includes Bahamas and Panama. [2] 1 ton. [3] 3 tons.

TABLE 22.—*Bituminous coal exported from the United States, 1938–39, by countries, in net tons* [1]

Country	1938	1939
North America:		
Bermuda	5,253	3,923
British Honduras	722	467
Canada	9,559,726	9,974,908
Central America:		
Costa Rica	-----	39
Guatemala	158	217
Honduras	365	327
Nicaragua	26	75
Panama:		
Canal Zone	96,310	153,278
Republic of	11,651	6
Salvador	76	44
Mexico	991	1,011
Miquelon and St. Pierre Islands	1	4,344
Newfoundland and Labrador	17,703	67,869
West Indies:		
British:		
Barbados	609	1,284
Jamaica	83,637	77,786
Trinidad and Tobago	42,779	38,581
Other British	19,206	10,630
Cuba	347,565	292,191
Dominican Republic	74	310
French	13,241	20,204
Haiti	28	47
Netherlands	3,218	3,401
	10,203,339	10,650,942
South America:		
Argentina	15,193	232,406
Bolivia	51	2,136
Brazil	204,294	425,022
Chile	-----	5,011
Colombia	12	46
Ecuador	49	166
South America—Continued.		
Guiana: Surinam	4,532	3,379
Peru	2,249	3,381
Uruguay	20,876	9,193
Venezuela	46	81
	247,302	680,821
Europe:		
Denmark	-----	3,035
France	11,192	-----
Italy	-----	38,612
Norway	-----	42,057
Portugal	-----	4,883
Spain	-----	25,739
Sweden	-----	26,516
Switzerland	-----	24,549
United Kingdom	([2])	-----
	11,192	165,391
Asia:		
China	21,363	53,726
Indochina (French)	-----	7,516
Iran	6	-----
Netherland India	7,067	12,234
Philippine Islands	-----	18,089
	28,436	91,565
Africa:		
Canary Islands	-----	1,701
Union of South Africa	-----	58
	-----	1,759
Grand total	10,490,269	11,590,478

[1] Amounts stated do not include fuel or bunker coal loaded on vessels engaged in the foreign trade which aggregated 1,352,480 tons in 1938 and 1,476,556 tons in 1939.
[2] Less than 1 ton.

TABLE 23.—*Bituminous coal exported from the United States, 1938–39, by customs districts, in net tons*

District	1938	1939	District	1938	1939
North Atlantic:			Pacific Coast—Continued.		
Maine and New Hampshire	189	219	San Francisco	21,382	25,535
Massachusetts	2		Washington	4,845	4,389
New York	3,397	1,157	Northern border:		
Philadelphia	9,116	13,330	Buffalo	605,487	619,911
South Atlantic:			Dakota	7,159	7,494
Maryland	45,171	244,444	Duluth and Superior	30,783	41,273
South Carolina	77,267	82,369	Michigan	1,048,498	1,238,218
Virginia	781,287	1,243,397	Montana-Idaho	263	466
Gulf Coast:			Ohio	6,513,272	6,519,949
Florida	14	3,540	Rochester	1,042,924	1,153,914
Mobile	1,318	6,687	St. Lawrence	295,341	381,796
New Orleans	1,649	1,204	Vermont	122	152
Mexican border:			Wisconsin	112	101
Arizona	280	598	Miscellaneous:		
El Paso	253	102	Alaska	26	114
San Antonio	31	26	Puerto Rico	2	7
Pacific Coast:			Virgin Islands	1	1
Los Angeles	2	1		10,490,269	11,590,478
San Diego	76	84			

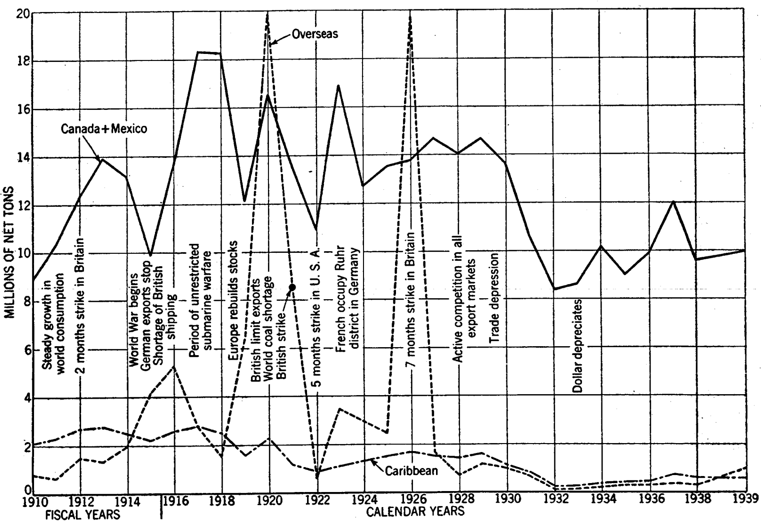

FIGURE 10.—Exports of bituminous coal to Canada and Mexico, the Caribbean, and "overseas" destinations, 1910–39.

Shipments to Alaska, Canton and Enderbury, Hawaii, Midway Islands, Puerto Rico, and the Virgin Islands.—In addition to export trade proper the United States supplies a small tonnage of anthracite and bituminous coal to Alaska, Canton and Enderbury, Hawaii, the Midway Islands, Puerto Rico, and the Virgin Islands. Shipments of bituminous coal to each of these possessions in 1939 were as follows: Alaska, 17,587 net tons; Canton and Enderbury, 3 net tons; Hawaii, 1,540 net tons; Midway Islands, 81 net tons; Puerto Rico, 14,709 net tons; and Virgin Islands, 69,751 net tons. Comparative shipments for 1938 were: Alaska, 23,465; Canton and Enderbury, none; Hawaii, 773; Midway Islands, none; Puerto Rico, 19,967; and Virgin Islands, 93,065.

WORLD PRODUCTION

TABLE 24.—*World production of coal and lignite, 1935–39, by countries, in thousands of metric tons* [1]

[Compiled by R. B. Miller, Bureau of Mines]

Country	1935	1936	1937	1938	1939
North America:					
Canada:					
Coal	9,358	10,308	11,014	9,815	10,985
Lignite	3,241	3,508	3,352	3,153	3,094
Greenland	6	5	6	7	(2)
Mexico	990	1,072	912	893	(2)
United States:					
Anthracite	47,317	49,513	47,043	41,820	46,708
Bituminous	335,315	395,511	401,257	313,473	353,885
Lignite	2,495	2,821	2,920	2,720	2,696
South America:					
Brazil	757	648	763	883	1,030
Chile	1,900	1,875	1,988	2,044	1,882
Colombia	200	282	330	331	(2)
Peru	85	90	99	75	63
Venezuela	6	6	7	6	3
Europe:					
Albania: Lignite	2	3	4	4	(2)
Belgium	26,506	27,867	29,859	29,585	29,847
Bulgaria:					
Coal	93	102	120	142	(2)
Lignite	1,566	1,576	1,732	1,855	(2)
Czechoslovakia:					
Coal	10,894	12,233	16,778	15,800	(2)
Lignite	15,114	15,949	17,895	14,717	(2)
Faroe Islands: Lignite	----------	----------	----------	8	(2)
France:					
Coal	46,213	45,228	44,319	46,498	51,000
Lignite	907	943	1,015	1,057	
Germany: [3]					
Coal	132,379	146,707	171,148	171,788	(2)
Lignite	146,033	160,276	183,538	195,312	(2)
Austria:					
Coal	261	244	230	227	(2)
Lignite	2,971	2,897	3,242	3,342	(2)
Saar [4]	10,624	11,673	13,365	14,389	(2)
Greece: Lignite	83	106	131	108	(2)
Hungary:					
Coal	823	827	917	1,042	(2)
Lignite	6,718	7,105	8,055	8,320	(2)
Irish Free State	115	127	128	120	120
Italy:					
Coal	443	806	964	1,480	1,091
Lignite	545	769	1,059	873	1,410
Netherlands:					
Coal	11,878	12,803	14,321	13,488	12,861
Lignite	86	89	143	171	197
Poland:					
Coal	28,545	29,748	36,218	38,104	(2)
Lignite	18	14	19	10	(2)
Portugal:					
Coal	211	217	259	299	313
Lignite	20	21	23	15	35
Rumania:					
Coal	278	293	303	299	(2)
Lignite	1,667	1,672	1,880	2,097	(2)
Spain:					
Coal	7,016	(5)	(5)	5,289	6,753
Lignite	304	(5)	(5)	68	204
Svalbard (Spitsbergen)	709	784	766	627	(2)
Sweden	424	456	460	444	449
Switzerland	4	3	4	3	3
United Kingdom:					
Great Britain	225,816	232,115	244,268	230,659	236,700
Northern Ireland	4	5	1	(6)	(2)
U. S. S. R.:					
Coal	76,998	93,685	94,525	98,627	(2)
Lignite					
Yugoslavia:					
Coal	390	441	428	450	443
Lignite	4,002	4,035	4,574	5,287	5,604

See footnotes at end of table.

TABLE 24.—*World production of coal and lignite, 1935–39, by countries, in thousands of metric tons*—Continued

Country	1935	1936	1937	1938	1939
Asia:					
British Borneo	(6)	(6)	(6)	(6)	(6)
China	[7] 26,125	[7] 27,116	(5)	(5)	(2)
Chosen	1,999	2,282	2,348	(5)	(2)
Federated Malay States	383	511	638	486	402
India, British:					
Coal	23,540	23,129	25,586	28,972	(2)
Lignite	430	419	488	545	(2)
Indochina:					
Coal	1,775	2,186	2,308	2,340	2,600
Lignite	----------	----------	----------	4	(2)
Japan:					
Japan proper:					
Coal	37,674	41,803	(5)	(5)	(2)
Lignite	109	109	(5)	(5)	(2)
Karafuto	1,516	2,010	(5)	(5)	(2)
Taiwan	1,597	1,744	(5)	(5)	(2)
Levant: Lignite	----------	(6)	5	(6)	1
Netherland India	1,111	1,147	1,364	1,457	1,755
Philippine Islands	----------	25	22	(5)	(2)
Turkey:					
Coal	2,340	2,299	2,307	2,589	2,696
Lignite	73	95	116	129	151
U. S. S. R.:					
Coal, Lignite	32,062	32,785	32,616	34,261	(2)
Africa:					
Algeria	38	7	14	13	(2)
Belgian Congo: Coal	11	14	36	42	(2)
Morocco, French	53	49	107	123	116
Nigeria	262	296	369	368	(2)
Portuguese East Africa	16	8	19	10	8
Southern Rhodesia	695	705	1,029	1,044	1,118
Union of South Africa	13,574	14,842	15,491	16,284	16,888
Oceania:					
Australia:					
New South Wales	8,838	9,347	10,213	9,725	11,376
Queensland	1,069	1,064	1,138	1,131	1,339
Tasmania	126	134	93	85	99
Victoria:					
Coal	484	434	262	312	371
Lignite	2,257	3,094	3,448	3,734	3,710
Western Australia	546	574	562	614	566
New Zealand:					
Coal	838	873	986	994	2,380 (coal and lignite)
Lignite	1,311	1,302	1,329	1,264	
Total, all grades	1,323,000	1,453,000	1,550,000	1,466,000	(2)
Lignite (total of items shown above)	204,000	225,000	254,000	264,000	(2)
Bituminous and anthracite (by subtraction)	1,119,000	1,228,000	1,296,000	1,202,000	(2)

[1] Coal is also mined in Argentina, Iran, and Italian East Africa. Production figures for these countries are not available, but estimates are included in the totals. All figures for 1939 are to be considered as preliminary and subject to revision.
[2] Data not yet available.
[3] Exclusive of mines in the Saar.
[4] Mines under French control until Mar. 1, 1935
[5] Estimate included in total.
[6] Production less than 1,000 tons.
[7] Production of most important coal mines.

DETAILED STATISTICS, BY STATES AND COUNTIES

Detailed production and employment statistics are given in table 25 for each coal-producing county in the United States from which three or more operators submitted reports in 1938. Statistics for counties with less than three reporting producers have been combined with data for other counties in the same State to avoid disclosing individual returns, unless permission to publish has been granted by the operators.

In this series the reported production is classified according to the principal methods of distribution or use. Beginning with 1932 the series was expanded to include data on the growing volume of coal moving from mine to consumer by truck. For 1933–36 this tonnage was shown as "commercial sales by truck or wagon." In 1937 this tonnage was shown as "truck deliveries, including local sales." (See Minerals Yearbook, 1939, p. 813.) In 1938 the truck tonnage was shown as "shipped by truck or wagon." The truck figures for 1933 to 1936, inclusive, and 1938 are reasonably comparable.

The data in this report, like those published for many years by the Bureau of Mines, relate only to mines with an annual output of 1,000 tons or more. Although all mines, regardless of size, are subject to regulation under the provisions of the National Bituminous Coal Act of 1937, it seemed advisable to maintain the continuity of the old series by excluding the very small mines that sell by truck or wagon. This 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 of the 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, which ranges from 2 to 10 men.

Because of a change in the method of reporting, the statistics of average production per man per day for 1932 to 1936 and 1938 are not precisely comparable with those for earlier years. Before 1932 they were based upon the calculated number of man-shifts, obtained by multiplying the average number of men employed at each mine by the number of days worked at the mine. Since 1932 operators have been asked to make a special report of the number of man-shifts actually worked if possible. The number of operators able to furnish this information has been small, although it is increasing from year to year. These reports were utilized to improve the accuracy of the record. Otherwise, the man-shifts were calculated by multiplying the number employed underground and on the surface by the number of days worked by the mine and tipple, respectively.

TABLE 25.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1938*

[Note that figures relate only to active mines of commercial size, excluding truck and wagon mines producing less than 1,000 tons. Waste and refuse are not included in tonnage]

ALABAMA

County	Net tons					Number of employees				Average number of days mines operated	Man-days of labor	Average tons per man per day
	Loaded at mines for shipment by rail or water	Shipped by truck or wagon	Coal used by employees or taken by locomotives at tipple or other uses at mines	Used for power and heat or made into coke at mines	Total quantity	Underground	Surface: In strip pits	Surface: All others	Total			
Bibb	443,972	5,609	1,656	12,650	463,887	1,028	--------	157	1,185	153	181,392	2.56
Blount	91,476	30,931	110	180	122,697	306	24	48	378	174	65,687	1.87
Cullman	------------	26,441	10	------------	26,451	79	--------	16	95	199	18,906	1.40
Etowah	16,435	26,347	117	------------	42,899	90	--------	12	102	205	20,889	2.05
Jefferson	6,459,262	154,744	65,360	13,983	6,693,349	10,536	--------	1,459	11,995	190	2,273,151	2.94
Marion	198,301	52,544	1,475	------------	252,320	640	3	96	739	149	110,300	2.29
St. Clair	749,539	32,325	6,984	28,518	817,366	1,146	--------	101	1,247	194	241,311	3.39
Shelby	289,391	72,782	2,050	768	364,991	665	--------	136	801	185	148,411	2.46
Tuscaloosa	56,549	49,553	------------	------------	106,102	260	14	33	307	174	53,497	1.98
Walker	1,977,237	77,840	31,762	1,076	2,087,915	3,357	50	586	3,993	161	641,040	3.26
Other counties (Fayette, Jackson, Madison, and Winston)	73,584	9,932	------------	------------	83,516	232	--------	36	268	154	41,238	2.03
Total Alabama	10,355,746	539,048	109,524	[1] 57,175	11,061,493	18,339	91	2,680	21,110	180	3,795,822	2.91
ALASKA												
Total Alaska	151,656	------------	231	[1] 2,795	154,682	100	--------	44	144	204	29,413	5.26
ARIZONA, GEORGIA, IDAHO, AND OREGON												
Total Arizona, Georgia, Idaho, and Oregon	25,636	8,357	50	------------	34,043	82	--------	17	99	122	12,059	2.82

ARKANSAS

Franklin	152,847	2,711	761	2,384	158,703	354	10	51	415	140	58,150	2.73
Johnson	150,111	3,274	60	1,321	154,766	440	-------	84	524	96	50,527	3.06
Logan	394,720	443	710	560	396,433	1,162	-------	182	1,344	111	149,482	2.65
Pope	37,069	1,498	102	6	38,675	152	-------	24	176	105	18,434	2.10
Sebastian	432,493	12,752	90	3,135	448,470	1,107	55	200	1,362	112	153,026	2.93
Total Arkansas	1,167,240	20,678	1,723	[1] 7,406	1,197,047	3,215	65	541	3,821	112	429,619	2.79

COLORADO

Boulder	199,788	374,156	6,777	9,630	590,351	618	-------	113	731	212	154,742	3.82
Delta	26,609	24,151	3,200	1,024	54,984	55	-------	23	78	154	12,014	4.58
El Paso	41,163	180,442	36,121	6,582	264,308	221	-------	39	260	228	59,399	4.45
Fremont	175,007	289,149	4,609	2,247	471,012	705	-------	134	839	187	156,503	3.01
Garfield	19,582	24,260	705	365	44,912	37	-------	8	45	239	10,738	4.18
Gunnison	484,422	16,980	8,455	12,214	522,071	529	-------	103	632	169	106,936	4.88
Huerfano	524,475	61,478	3,855	1,859	591,667	815	-------	203	1,018	163	165,945	3.57
Jefferson	106,478	50,087	1,134	2,516	160,215	115	-------	27	142	211	29,950	5.35
La Plata	13,120	18,926	167	320	32,533	44	-------	9	53	185	9,791	3.32
Las Animas	649,788	52,207	3,994	[2] 97,659	803,648	1,321	-------	225	1,546	144	223,335	3.60
Mesa	21,023	40,975	586	2,532	65,116	91	-------	16	107	180	19,309	3.37
Moffat	14,886	18,359	1,960	-----------	35,205	24	-------	4	28	242	6,765	5.20
Rio Blanco	-----------	4,198	56	-----------	4,254	7	-------	-------	7	209	1,462	2.91
Routt	685,874	20,304	4,653	30,600	741,431	1,001	-------	300	1,301	127	165,724	4.47
Weld	926,548	255,666	12,771	36,386	1,231,371	1,267	-------	165	1,432	183	262,310	4.69
Other counties (northern) (Elbert, Jackson, and Larimer)	9,824	9,181	170	732	19,907	14	10	4	28	196	5,487	3.63
Other counties (southern) (Montezuma, Montrose, and Pitkin)	530	28,206	1,423	-----------	30,159	33	-------	5	38	255	9,678	3.12
Total Colorado	3,899,117	1,468,725	90,636	[2] 204,666	5,663,144	6,897	10	1,378	8,285	169	1,400,088	4.04

See footnotes at end of table.

TABLE 25.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1938*—Continued

ILLINOIS

County	Net tons					Number of employees				Average number of days mines operated	Man-days of labor	Average tons per man per day
	Loaded at mines for shipment by rail or water	Shipped by truck or wagon	Coal used by employees or taken by locomotives at tipple or other uses at mines	Used for power and heat or made into coke at mines	Total quantity	Underground	Surface		Total			
							In strip pits	All others				
Bureau	1,603	52,442	2,288	2,758	59,091	236	7	18	261	115	29,979	1.97
Christian	3,628,051	116,371	11,436	17,760	3,773,618	1,839		583	2,422	165	398,664	9.47
Clinton	27,713	89,182	2,603	8,724	128,222	379		57	436	69	30,010	4.27
Edgar	52,571	28,862	200	2,511	84,144	45	16	26	87	129	11,225	7.50
Franklin	7,613,537	65,802	26,328	117,891	7,823,558	4,952		1,556	6,508	142	926,082	8.45
Fulton	2,590,634	330,035	5,417	14,601	2,940,687	655	331	437	1,423	189	269,309	10.92
Gallatin	2,750	47,746	30	3,472	53,998	57		12	69	210	14,502	3.72
Grundy		117,664	512	2,260	120,436	156	19	22	197	151	29,766	4.05
Henry	556,326	103,090	2,105	6,210	667,731	298	70	111	479	192	92,199	7.24
Jackson	1,179,432	102,294	5,660	5,077	1,292,463	575	63	211	849	178	151,152	8.55
Knox	500,631	136,188	1,844	5,747	644,410	211	58	98	367	190	69,740	9.24
La Salle	134,557	204,005	6,014	10,323	354,899	491	102	81	674	180	121,352	2.92
Macoupin	2,918,481	146,126	47,084	126,915	3,238,606	2,009		440	2,449	181	444,013	7.29
Madison	683,524	584,044	13,124	51,172	1,331,864	1,304		260	1,564	148	230,737	5.77
Menard		110,554	676	4,239	115,469	152		30	182	202	36,703	3.15
Mercer		18,863	129	1,027	20,019	66		12	78	150	11,685	1.71
Montgomery	533,892	37,516	5,007	37,767	614,182	469		144	613	117	71,682	8.57
Peoria	889,485	341,558	11,854	2,747	1,245,644	1,406	4	142	1,552	157	243,090	5.12
Perry	2,848,802	62,886	25,288	33,311	2,970,287	800	364	445	1,609	144	231,110	12.85
Randolph	926,154	97,975	8,667	18,322	1,051,118	383	64	175	622	157	97,557	10.77
Rock Island		28,954	348	10	29,312	63		8	71	167	11,836	2.48
St. Clair	795,559	1,377,225	27,252	49,423	2,249,459	1,869	72	439	2,380	146	347,135	6.48
Saline	2,971,723	64,497	13,207	50,927	3,100,354	2,789	85	569	3,443	130	447,224	6.93
Sangamon	1,351,799	533,918	12,865	17,410	1,915,992	2,487		331	2,818	148	416,983	4.59
Schuyler		41,376	182	1,002	42,560	60	8	19	87	219	19,088	2.23
Shelby		6,700	102	26	6,828	29		5	34	194	6,610	1.03
Stark		17,422	17		17,439	37		7	44	211	9,300	1.88

Tazewell	45,338	173,623	247	553	219,761	401	--------	63	464	160	74,312	2.96
Vermilion	1,167,786	271,041	97,372	25,291	1,561,490	1,811	37	242	2,090	138	288,228	5.42
Wabash	--------	9,820	125	130	10,075	21	--------	8	29	143	4,141	2.43
Washington	157,537	62,633	19,589	17,985	257,744	302	--------	72	374	132	49,203	5.24
Williamson	1,716,463	366,753	7,028	37,972	2,128,216	1,538	104	477	2,119	118	250,462	8.50
Other counties [3]	1,268,494	534,287	9,301	30,327	1,842,409	1,327	294	348	1,969	137	269,456	6.84
Total Illinois	34,562,842	6,281,452	363,901	[1] 703,890	41,912,085	29,217	1,698	7,448	38,363	149	5,704,535	[4] 7.35

INDIANA

Clay	713,797	414,942	873	7,822	1,137,434	244	428	208	880	148	129,984	8.75
Daviess	--------	63,139	400	2,494	66,033	66	11	18	95	161	15,252	4.33
Dubois	--------	19,095	150	20	19,265	29		9	38	183	6,970	2.76
Fountain	--------	44,006	67	673	44,746	45	--------	24	69	164	11,330	3.95
Gibson	910,764	111,348	6,193	22,409	1,050,714	614	--------	143	757	147	111,013	9.46
Greene	1,774,539	115,480	8,138	10,215	1,908,372	439	345	275	1,059	163	172,216	11.08
Knox	1,338,212	235,639	6,362	19,369	1,599,582	804	19	232	1,055	153	161,897	9.88
Martin	--------	19,539	85	--------	19,624	42	--------	9	51	178	9,055	2.17
Owen	88,017	4,544	--------	--------	92,561	4	62	38	104	80	8,310	11.14
Parke	--------	113,336	579	4,315	118,230	187	--------	38	225	173	38,908	3.04
Perry	--------	24,083	25	2	24,110	43	--------	7	50	164	8,211	2.94
Pike	2,579,329	46,407	6,266	17,043	2,649,045	134	522	336	992	173	171,161	15.48
Spencer	63,295	17,773	130	120	81,318	20	34	9	63	162	10,207	7.97
Sullivan	1,303,735	63,291	2,714	23,775	1,393,515	1,083	101	258	1,442	119	172,138	8.10
Vermillion	390,987	124,425	991	7,990	524,393	613	51	143	807	103	82,794	6.33
Vigo	2,419,507	167,223	272,707	30,561	2,889,998	1,433	183	384	2,000	166	332,770	8.68
Warrick	842,479	180,542	3,907	4,099	1,031,027	285	179	195	659	154	101,398	10.17
Other counties (Vanderburgh and Warren)	59,292	48,996	12	217	108,517	159	--------	24	183	150	27,370	3.96
Total Indiana	12,483,953	1,813,808	309,599	[1] 151,124	14,758,484	6,244	1,935	2,350	10,529	149	1,570,984	[4] 9.40

See footnotes at end of table.

TABLE 25.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1938*—Continued

County	Net tons					Number of employees				Average number of days mines operated	Man-days of labor	Average tons per man per day
	Loaded at mines for shipment by rail or water	Shipped by truck or wagon	Coal used by employees or taken by locomotives at tipple or other uses at mines	Used for power and heat or made into coke at mines	Total quantity	Underground	Surface: In strip pits	Surface: All others	Total			
IOWA												
Adams		21,341	100	105	21,546	117		10	127	146	18,579	1.16
Appanoose	284,829	106,606	1,985	83	393,503	1,403		190	1,593	113	179,447	2.19
Boone	289,930	77,843	5,663	2,082	375,518	773		89	862	162	139,695	2.69
Dallas	280,350	78,352	6,130	1,302	366,134	613		48	661	152	100,220	3.65
Davis and Taylor	202	24,027	529	16	24,774	39	14	5	58	158	9,158	2.71
Greene		19,001		5	19,006	48	15	5	68	68	4,612	4.12
Guthrie		18,462	118	25	18,605	79		8	87	161	13,998	1.33
Jasper		27,841	486	262	28,589	93		12	105	72	7,581	3.77
Jefferson and Keokuk		12,692	203	51	12,946	21	11	6	38	117	4,462	2.90
Lucas	415,432	13,369	4,893	2,135	435,829	672		63	735	148	108,819	4.01
Mahaska	91,466	111,043	2,908	1,391	206,808	81	107	39	227	173	39,380	5.25
Marion	112,468	326,871	2,375	1,264	442,978	659	107	121	887	130	114,884	3.86
Monroe	75,169	59,446	2,693	1,292	138,600	289	3	41	333	133	44,276	3.13
Page		32,247	225	15	32,487	94		13	107	186	19,896	1.63
Polk	62,128	223,043	2,781	2,048	290,000	738		68	806	124	99,889	2.90
Van Buren	64	18,613	223	35	18,935	28	13	9	50	170	8,521	2.22
Wapello	30,407	116,358	160	1,992	148,917	190	12	35	237	161	38,186	3.90
Warren		79,132	40	2,422	81,594	171	23	35	229	105	23,963	3.40
Wayne		18,426	310		18,736	82		10	92	154	14,177	1.32
Webster		27,598	31	53	27,682	44	17	9	70	158	11,052	2.50
Total Iowa	1,642,445	1,412,311	31,853	[1] 16,578	3,103,187	6,234	322	816	7,372	136	1,000,795	3.10
KANSAS												
Bourbon	136,102	23,841	236	938	161,117		54	25	79	210	16,589	9.71
Cherokee	479,669	33,001	1,454	1,293	515,417	62	144	89	295	150	44,124	11.68
Crawford	1,693,873	83,747	3,886	7,010	1,788,516	1,044	455	262	1,761	157	276,638	6.47
Labette		10,006	1	650	10,657		15	3	18	179	3,222	3.31
Linn	7,036	19,808		710	27,554	64	8	13	85	122	10,411	2.65
Osage	300	66,630	689		67,619	315	4	43	362	141	50,868	1.33
Other counties (Franklin and Leavenworth)	73,859	9,402			83,261	376		110	486	254	123,263	.68
Total Kansas [5]	2,390,839	246,435	6,266	[1] 10,601	2,654,141	1,861	680	545	3,086	170	525,115	5.05

KENTUCKY

Eastern district:												
Bell	1,620,438	73,125	68,175	6,116	1,767,854	2,332	-------	359	2,691	176	474,382	3.73
Boyd	6,222	16,823	300	-------	23,345	99	-------	17	116	125	14,519	1.61
Breathitt	5,587	3,636	31,901	362	41,486	132	-------	23	155	113	17,582	2.36
Carter	-------	38,214	-------	-------	38,214	66	-------	11	77	180	13,830	2.76
Clay	145,200	12,463	1,056	-------	158,719	273	-------	46	319	193	61,516	2.58
Floyd	4,035,311	1,767	10,921	15,722	4,063,721	4,558	-------	768	5,326	173	921,803	4.41
Greenup	-------	3,565	-------	-------	3,565	13	-------	3	16	59	950	3.75
Harlan	10,734,586	17,103	67,933	12,502	10,832,124	12,075	-------	1,601	13,676	179	2,454,104	4.41
Jackson	-------	142,213	-------	3,745	145,958	344	-------	64	408	174	71,153	2.05
Johnson	732,369	1,515	5,398	5,308	744,590	1,045	-------	132	1,177	155	182,659	4.08
Knott	174,679		1,174	-------	175,853	384	-------	59	443	72	31,870	5.52
Knox	533,795	-------	3,233	2,190	539,218	614	-------	106	720	210	151,010	3.57
Laurel	-------	33,829	-------	-------	33,829	98	-------	17	115	221	25,420	1.33
Lee	-------	12,706	35	10	12,751	41	-------	7	48	133	6,394	1.99
Letcher	3,654,423	1,060	29,680	3,547	3,688,710	4,696	-------	582	5,278	160	843,976	4.37
Magoffin	67,697	846	757	-------	69,300	108	-------	19	127	145	18,352	3.78
Martin	187,504	-------	159	-------	187,663	244	-------	41	285	104	29,745	6.31
Perry	3,545,557	3,371	91,023	-------	3,639,951	4,243	-------	797	5,040	141	710,139	5.13
Pike	4,034,429	26,367	24,890	6,078	4,091,764	4,401	-------	650	5,051	169	853,496	4.79
Pulaski	-------	21,618	-------	-------	21,618	38	-------	7	45	140	6,295	3.43
Rockcastle	-------	17,653	30	-------	17,683	41	-------	9	50	128	6,423	2.75
Whitley	222,565	370	2,607	7,965	233,507	554	-------	106	660	123	81,233	2.87
Other counties (Elliott, McCreary, Morgan, Owsley, Wayne, and Wolfe)	621,915	14,590	9,544	-------	646,049	818	-------	130	948	146	138,640	4.66
Total Eastern	30,322,277	442,834	348,816	63,545	31,177,472	37,217	-------	5,554	42,771	166	7,115,491	4.38
Western district:												
Christian	28,177	26,182	161	-------	54,520	97	11	20	128	102	13,109	4.16
Daviess	-------	75,586	228	2,022	77,836	116		23	139	131	18,164	4.29
Henderson	13,419	80,874	5,299	11,764	111,356	180	-------	45	225	145	32,583	3.42
Hopkins	3,043,181	167,095	58,910	12,990	3,282,176	2,670	49	534	3,253	151	490,365	6.69
Muhlenberg	1,783,532	80,238	10,700	32,088	1,906,558	2,502	-------	434	2,936	121	356,667	5.35
Ohio	204,192	19,509	3,791	844	228,336	392	-------	68	460	98	44,873	5.09
Union	443,102	95,334	17,098	18,669	574,203	620	-------	106	726	141	102,324	5.61
Webster	1,072,358	32,619	5,092	2,724	1,112,793	1,239	-------	204	1,443	113	163,716	6.80
Other counties (Butler, Hancock, and McLean)	274	19,516	20	158	19,968	63	-------	19	82	173	14,200	1.41
Total Western	6,588,235	596,953	101,299	81,259	7,367,746	7,879	60	1,453	9,392	132	1,236,001	5.96
Total Kentucky	36,910,512	1,039,787	450,115	[1] 144,804	38,545,218	45,096	60	7,007	52,163	160	8,351,492	4.62

See footnotes at end of table.

TABLE 25.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1938*—Continued

MARYLAND

County	Net tons: Loaded at mines for shipment by rail or water	Net tons: Shipped by truck or wagon	Net tons: Coal used by employees or taken by locomotives at tipple or other uses at mines	Net tons: Used for power and heat or made into coke at mines	Net tons: Total quantity	Number of employees: Underground	Number of employees: Surface: In strip pits	Number of employees: Surface: All others	Number of employees: Total	Average number of days mines operated	Man-days of labor	Average tons per man per day
Allegany	593, 859	165, 657	5, 476	844	765, 836	1, 338		178	1, 516	170	258, 330	2. 96
Garrett	456, 968	49, 160	3, 172	6, 277	515, 577	745		110	855	172	146, 879	3. 51
Total Maryland	1, 050, 827	214, 817	8, 648	[1] 7, 121	1, 281, 413	2, 083		288	2, 371	171	405, 209	3. 16

MICHIGAN

County	Loaded at mines for shipment by rail or water	Shipped by truck or wagon	Coal used by employees, etc.	Used for power and heat or made into coke at mines	Total quantity	Underground	In strip pits	All others	Total	Average number of days mines operated	Man-days of labor	Average tons per man per day
Bay	45, 590	49, 468	2, 571	6, 308	103, 937	288		24	312	132	41, 145	2. 53
Saginaw	6, 037	100, 460	1, 798	9, 388	117, 683	280		35	315	176	55, 463	2. 12
Other counties (Shiawassee and Tuscola)	114, 516	142, 644	4, 609	11, 092	272, 861	531		47	578	172	99, 217	2. 75
Total Michigan	166, 143	292, 572	8, 978	[1] 26, 788	494, 481	1, 099		106	1, 205	163	195, 825	2. 53

MISSOURI

County	Loaded at mines for shipment by rail or water	Shipped by truck or wagon	Coal used by employees, etc.	Used for power and heat or made into coke at mines	Total quantity	Underground	In strip pits	All others	Total	Average number of days mines operated	Man-days of labor	Average tons per man per day
Adair	60, 563	93, 970	2, 400	2, 832	159, 765	311		51	362	172	62, 378	2. 56
Audrain, Lincoln, Montgomery, and Warren		5, 676	10	80	5, 766	21	2	5	28	98	2, 736	2. 11
Barton	228, 003	16, 038	257	1, 285	245, 583	5	125	53	183	106	19, 405	[6] 12. 66
Bates	574, 883	9, 579	168	1, 573	586, 203	27	162	71	260	152	39, 442	[6] 14. 86
Boone		12, 407	32	4	12, 443	33	6	9	48	119	5, 730	2. 17
Callaway		112, 896	10	400	113, 306		44	8	52	233	12, 140	[6] 9. 33
Chariton, Monroe, and Schuyler		9, 131	127	56	9, 314	38	4	9	51	178	9, 090	1. 02
Clay		78, 753	1, 363	1, 812	81, 928	313		50	363	128	46, 593	1. 76
Dade, Jasper, and St. Clair		8, 847	15	510	9, 372	6	7	7	20	203	4, 068	2. 30

Daviess, Grundy, and Platte	1,582	24,999	539	3,502	30,622	140		18	158	142	22,481	1.36
Harrison		12,883	159	628	13,670	46		13	59	156	9,231	1.48
Henry	492,473	82,057	870	6,815	582,215	28	203	83	314	165	51,859	[6] 11.23
Johnson and Morgan		11,944		633	12,577		13	6	19	187	3,552	3.54
Lafayette	177,907	75,110	3,620	3,508	260,145	965		71	1,036	139	144,483	1.80
Linn	17,395	58,706	406	28	76,535	302		55	357	176	62,710	1.22
Macon	441,179	24,434	3,262	1,906	470,781	123	61	63	247	178	44,066	[6] 10.68
Putnam		28,615	200	48	28,863	119		17	136	131	17,865	1.62
Ralls		14,660	25	10	14,695	34	4	8	46	221	10,154	1.45
Randolph	380,012	68,312	4,007		452,331	255	72	80	407	201	81,731	[6] 5.53
Ray	100,739	98,367	6,624	343	206,073	856		92	948	129	122,494	1.68
Vernon	20,016	40,618	358	2,939	63,931	55	47	17	119	126	15,012	[6] 4.26
Total Missouri [5]	2,494,752	888,002	24,452	[1] 28,912	3,436,118	3,677	750	786	5,213	151	787,220	4.36

MONTANA

Blaine and Phillips		12,616			12,616	24		5	29	180	5,226	2.41
Carbon	298,433	29,476	2,742	467	331,118	180		82	262	183	47,867	6.92
Cascade	445,972	42,542	2,073		490,587	288		42	330	191	62,883	7.80
Chouteau		8,001	20		8,021	21		5	26	197	5,110	1.57
Daniels, McCone, and Valley [7]		8,760	20	4	8,784	7	4	1	12	205	2,464	3.56
Dawson [7]		1,428	10		1,438	5		1	6	86	515	2.79
Flathead and Pondera	30	4,114	17	100	4,261	19		4	23	142	3,274	1.30
Hill		8,693	45		8,738	24		5	29	213	6,178	1.41
Musselshell and Rosebud	1,775,771	31,982	5,089	2,865	1,815,707	482	33	189	704	163	114,503	[6] 15.86
Richland [7]	3,939	8,272	700		12,911	22	3	5	30	156	4,688	2.75
Roosevelt [7]		6,582	972	5	7,559	10		4	14	145	2,033	3.72
Sheridan [7]		14,204	893	59	15,156	18		7	25	172	4,289	3.53
Other lignite counties (Custer and Wibaux)[7]		7,697			7,697	5		1	6	182	1,092	7.05
Other bituminous counties (Gallatin, Park, Powder River, and Stillwater)		6,924	419	114	7,457	21		8	29	195	5,662	1.32
Total Montana	2,524,145	191,291	13,000	[1] 3,614	2,732,050	1,126	40	359	1,525	174	265,784	10.28

See footnotes at end of table.

TABLE 25.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1938*—Continued

NEW MEXICO

County	Net tons: Loaded at mines for shipment by rail or water	Net tons: Shipped by truck or wagon	Net tons: Coal used by employees or taken by locomotives at tipple or other uses at mines	Net tons: Used for power and heat or made into coke at mines	Net tons: Total quantity	Number of employees: Underground	Number of employees: Surface: In strip pits	Number of employees: Surface: All others	Number of employees: Total	Average number of days mines operated	Man-days of labor	Average tons per man per day
Colfax	604,898	24,025	4,966	2,641	636,530	808	--------	191	999	138	137,540	4.63
McKinley	393,577	43,730	5,176	24,208	466,691	853	--------	215	1,068	167	178,395	2.62
Rio Arriba	15,747	4,469	129	--------	20,345	23	--------	9	32	232	7,427	2.74
Other counties (Bernalillo, Sandoval, Santa Fe, San Juan, and Socorro)	89,550	14,875	3,308	7,738	115,471	284	--------	91	375	146	54,649	2.11
Total New Mexico	1,103,772	87,099	13,579	[1] 34,587	1,239,037	1,968	--------	506	2,474	153	378,011	3.28

NORTH DAKOTA (LIGNITE) [7]

County	Net tons: Loaded at mines for shipment by rail or water	Net tons: Shipped by truck or wagon	Net tons: Coal used by employees or taken by locomotives at tipple or other uses at mines	Net tons: Used for power and heat or made into coke at mines	Net tons: Total quantity	Number of employees: Underground	Number of employees: Surface: In strip pits	Number of employees: Surface: All others	Number of employees: Total	Average number of days mines operated	Man-days of labor	Average tons per man per day
Adams	14,207	25,860	1,600	15	41,682	59	2	23	84	139	11,654	3.58
Billings, Golden Valley, and Slope	--------	4,496	125	--------	4,621	5	6	5	16	149	2,380	1.94
Bowman	68	5,636	--------	--------	5,704	7	2	2	11	138	1,515	3.77
Burke	184,442	53,822	60	100	238,424	--------	49	33	82	168	13,812	[6] 17.26
Burleigh	199,326	28,063	24	20	227,433	33	30	21	84	226	19,002	[6] 11.97
Divide	153,765	8,114	3,800	702	166,381	12	39	17	68	168	11,455	[6] 14.52
Dunn	--------	3,153	100	100	3,353	--------	5	1	6	125	750	4.47
Grant	5,151	17,176	108	600	23,035	16	4	5	25	148	3,700	6.23
Hettinger	420	16,271	614	210	17,515	7	17	7	31	155	4,809	3.64
McKenzie	--------	5,549	--------	--------	5,549	3	8	4	15	156	2,340	2.37
McLean	103,611	22,477	2,523	188	128,799	80	54	27	161	134	21,563	5.97
Mercer	463,044	2,352	77,674	2,310	545,380	149	60	107	316	175	55,195	9.88
Morton	8,580	17,038	130	2,626	28,374	19	14	11	44	127	5,575	5.09
Mountrail	--------	12,975	--------	21	12,996	19	5	4	28	195	5,470	2.38
Oliver	--------	7,490	87	70	7,647	--------	14	4	18	95	1,711	4.47
Stark	60	17,168	73,052	652	90,932	57	--------	6	63	239	15,046	6.04
Ward	331,930	121,470	178	97	453,675	152	29	62	243	208	50,648	[6] 8.96
Williams	770	47,794	--------	35	48,599	49	6	20	75	148	11,126	4.37
Total North Dakota	1,465,374	416,904	160,075	[1] 7,746	2,050,099	667	344	359	1,370	174	237,751	8.62

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OHIO

Athens	1,544,872	16,273	7,375	17,078	1,585,598	4,048		432	4,480	84	375,943	4.22
Belmont	5,405,411	149,411	57,058	16,572	5,628,452	7,107		734	7,841	156	1,223,162	4.60
Carroll	89,725	179,139	15,508	185	284,557	328	42	39	409	169	68,983	4.13
Columbiana	89,893	269,211	685	8,308	368,097	304	102	52	458	174	79,581	4.63
Coshocton	32,126	141,541	766	819	175,252	225	15	41	281	174	48,912	3.58
Gallia	240	26,165	40		26,445	44		8	52	186	9,690	2.73
Guernsey	484,053	65,905	4,272	1,080	555,310	823		87	910	131	119,511	4.65
Harrison	1,778,444	29,178	1,341	12,118	1,821,081	1,127	83	295	1,505	196	294,254	6.19
Hocking	94,956	113,848	413		209,217	286	4	49	339	143	48,405	4.32
Holmes		30,861	40	80	30,981	39	9	7	55	199	10,951	2.83
Jackson	73,439	73,152	63,872		210,463	212	31	37	280	180	50,482	4.17
Jefferson	3,627,362	306,739	9,616	23,781	3,967,498	3,472	280	607	4,359	174	758,986	5.23
Lawrence		52,576	10,666	25	63,267	117		22	139	183	25,497	2.48
Mahoning	11,128	239,945	3,806	3,774	258,653	154	52	31	237	226	53,524	4.83
Medina		6,683	134	186	7,003	12		3	15	176	2,637	2.66
Meigs	42,528	59,707	822		103,057	122		26	148	201	29,805	3.46
Morgan and Washington	75,141	13,452	312		88,905	434		38	472	62	29,192	3.05
Muskingum	700,818	214,668	1,717	39	917,242	716	23	107	846	205	173,762	5.28
Perry	545,544	195,343	6,872	275	748,034	1,350	27	181	1,558	129	201,490	3.71
Stark	31,020	404,863	14,119	660	450,662	331	111	72	514	177	90,948	4.96
Summit		10,668			10,668	25		4	29	134	3,890	2.74
Tuscarawas	87,114	609,873	121,756	8,488	827,231	1,272	83	215	1,570	138	216,289	3.82
Vinton	10,321	59,753	6,098	195	76,367	57	53	29	139	140	19,469	3.92
Wayne		19,725		100	19,825	49		7	56	167	9,370	2.12
Other counties (Noble and Portage)	124,563	22,729	1,625	7,836	156,753	652	5	44	701	57	39,620	3.96
Total Ohio	14,848,698	3,311,408	328,913	[1] 101,599	18,590,618	23,306	920	3,167	27,393	145	3,984 353	4.67

OKLAHOMA

Coal		13,171	127	14	13,312	44		11	55	143	7,885	1.69
Haskell and Le Flore	334,186	3,763	333	3,248	341,530	827	21	164	1,012	119	120,723	2.83
Latimer	3,927	2,020	36	170	6,153	35		6	41	71	2,921	2.11
Muskogee	3,209	6,067	60	250	9,586	18	12	7	37	98	3,635	2.64
Okmulgee	204,923	17,928	418	1,046	224,315	347		54	401	140	56,116	4.00
Pittsburg	170,202	22,092	689	5,986	198,969	398		72	470	172	80,740	2.46
Tulsa	30,846	6,270	141	25	37,282	80		16	96	154	14,825	2.51
Other counties (Craig, Rogers, and Wagoner)	377,565	32,264	1,001	2,755	413,585	7	167	43	217	169	36,626	[6] 11.29
Total Oklahoma	1,124,858	103,575	2,805	[1] 13,494	1,244,732	1,756	200	373	2,329	139	323,471	3.85

See footnotes at end of table.

TABLE 25.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1938*—Continued.

PENNSYLVANIA (BITUMINOUS)

County	Net tons					Number of employees				Average number of days mines operated	Man-days of labor	Average tons per man per day
	Loaded at mines for shipment by rail or water	Shipped by truck or wagon	Coal used by employees or taken by locomotives at tipple or other uses at mines	Used for power and heat or made into coke at mines	Total quantity	Underground	Surface: In strip pits	Surface: All others	Total			
Allegheny	9,248,431	1,763,612	907,845	68,673	11,988,561	11,714	77	1,746	13,537	178	2,406,107	4.98
Armstrong	2,296,145	45,267	42,493	737	2,384,642	3,396		475	3,871	147	568,279	4.20
Beaver	158,007	253,234	388	4,663	416,292	161	148	58	367	185	67,866	6.13
Bedford	65,835	72,094	181,706	631	320,266	539		78	617	151	93,235	3.44
Blair	61,227	60,721	946		122,894	274		32	306	153	46,756	2.63
Butler	275,296	264,308	6,205	3,109	548,918	1,283	5	182	1,470	126	184,825	2.97
Cambria	10,843,998	394,448	919,115	[8] 175,464	12,333,025	17,073		2,378	19,451	164	3,197,957	3.86
Center	218,625	86,060	18,867	160	323,712	600		101	701	147	102,728	3.15
Clarion	1,108,520	110,889	16,696	40	1,236,145	1,402	20	170	1,592	208	330,554	3.74
Clearfield	2,243,963	150,197	42,454	22,421	2,459,035	4,232	8	508	4,748	153	725,666	3.39
Clinton		33,323	203	38	33,564	52		7	59	212	12,504	2.68
Crawford and Venango		31,344			31,344	47	10	8	65	163	10,606	2.96
Elk	579,161	32,409	6,042	17,225	634,837	869	2	138	1,009	184	185,250	3.43
Fayette	9,484,997	176,743	69,586	[8] 364,505	10,095,831	12,219	77	1,836	14,132	139	1,970,868	5.12
Greene	3,437,820	4,543	18,101	13,810	3,474,274	3,150		577	3,727	168	626,125	5.55
Huntingdon	325,865	59,865	3,046	6,299	395,075	844		74	918	145	132,787	2.98
Indiana	5,209,761	38,359	230,900	[8] 197,777	5,676,797	6,492		732	7,224	173	1,247,072	4.55
Jefferson	1,765,703	83,508	4,660	10,329	1,864,200	2,295	5	376	2,676	175	468,409	3.98
Lawrence	168,434	31,384	2,311	481	202,610	438	4	60	502	155	77,878	2.60
Lycoming	11,324	49,813	260	469	61,866	118	2	19	139	185	25,667	2.41
Mercer	102	109,108	583	1,967	111,760	252	10	41	303	172	52,125	2.14
Somerset	3,717,196	84,651	31,245	62,152	3,895,244	6,112		884	6,996	136	953,147	4.09
Tioga	105,742	77,929	1,691	3,997	189,359	334	18	68	420	152	63,861	2.97
Washington	12,086,834	261,806	224,265	22,740	12,595,645	16,259	225	1,848	18,332	153	2,796,424	4.50
Westmoreland	5,215,985	485,759	159,800	[8] 307,980	6,169,524	8,683		1,402	10,085	128	1,292,518	4.77
Other counties (Bradford, Fulton, and McKean)	128,045	7,194	966	2,912	139,117	229	2	21	252	159	40,036	3.47
Total Pennsylvania	68,757,016	4,768,568	2,890,374	[8] 1,288,579	77,704,537	99,067	613	13,819	113,499	156	17,679,250	4.40

SOUTH DAKOTA (LIGNITE)[7]

Corson, Dewey, and Harding	27,148	15,826	190	----------	43,164	5	20	7	32	199	6,353	6.79
Meade	----------	1,076	100	----------	1,176	6	--------	2	8	93	740	1.59
Perkins	----------	3,668	50	----------	3,718	7	3	--------	10	141	1,414	2.63
Total South Dakota	27,148	20,570	340	----------	48,058	18	23	9	50	170	8,507	5.65

TENNESSEE

Anderson	825,241	48,697	5,551	7,178	886,667	1,215	--------	197	1,412	166	234,514	3.78
Campbell	1,177,409	27,000	19,932	967	1,225,308	1,940	--------	315	2,255	167	375,925	3.26
Claiborne	831,061	24,177	10,993	2,883	869,114	1,357	--------	203	1,560	143	223,071	3.90
Cumberland	----------	8,124	15	175	8,314	21	--------	5	26	172	4,471	1.86
Fentress	214,921	5,825	2,927	5,876	229,549	391	--------	99	490	146	71,475	3.21
Hamilton	----------	23,915	----------	----------	23,915	64	--------	11	75	177	13,279	1.80
Marion	359,588	38,309	3,019	1,030	401,946	588	--------	115	703	181	126,962	3.17
Morgan	240,177	20,750	2,410	8,696	272,033	600	--------	94	694	239	165,845	1.64
Overton	----------	13,831	----------	----------	13,831	29	--------	4	33	171	5,658	2.44
Scott	86,659	20,560	821	2,588	110,628	159	4	26	189	205	38,743	2.86
Van Buren	661	13,110	----------	156	13,927	38	--------	7	45	126	5,679	2.45
Other northeastern counties (Putnam and Roane)	3,345	15,791	----------	----------	19,136	37	--------	7	44	220	9,667	1.98
Other southeastern counties (Bledsoe, Grundy, Rhea, Sequatchie, and White)	320,944	60,795	5,167	[9] 11,129	398,035	655	--------	85	740	146	108,198	3.68
Total Tennessee	4,060,006	320,884	50,835	[9] 40,678	4,472,403	7,094	4	1,168	8,266	167	1,383,487	3.23

TEXAS

Bituminous:												
Palo Pinto, Webb, and Wise	20,413	7,590	42	4,421	32,466	199	--------	71	270	149	40,282	.81
Lignite:[7]												
Bastrop and Milam	104,718	3,800	1,000	761	110,279	88	22	12	122	150	18,266	6.04
Henderson, Titus, and Wood	708,378	17,502	5,245	4,815	735,940	358	--------	26	384	241	92,502	7.96
Total lignite	813,096	21,302	6,245	5,576	846,219	446	22	38	506	219	110,768	7.64
Total Texas	833,509	28,892	6,287	[1] 9,997	878,685	645	22	109	776	195	151,050	5.82

See footnotes at end of table.

TABLE 25.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1938*—Continued

UTAH

County	Net tons					Number of employees				Average number of days mines operated	Man-days of labor	Average tons per man per day
	Loaded at mines for shipment by rail or water	Shipped by truck or wagon	Coal used by employees or taken by locomotives at tipple or other uses at mines	Used for power and heat or made into coke at mines	Total quantity	Underground	Surface: In strip pits	Surface: All others	Total			
Carbon	2,288,757	180,155	16,996	[10] 19,907	2,505,815	1,961	--------	611	2,572	157	403,616	6.21
Emery	255,869	88,795	1,480	2,023	348,167	270	--------	99	369	138	50,885	6.84
Sanpete and Sevier	--------	7,095	5	--------	7,100	10	--------	6	16	155	2,487	2.85
Summit	7,540	24,886	141	--------	32,567	29	--------	8	37	253	9,352	3.48
Other counties (Grand, Iron, and Uintah)	39,756	13,144	320	82	53,302	68	--------	14	82	163	13,393	3.98
Total Utah	2,591,922	314,075	18,942	[10] 22,012	2,946,951	2,338	--------	738	3,076	156	479,733	6.14

VIRGINIA

County	Loaded at mines for shipment by rail or water	Shipped by truck or wagon	Coal used by employees or taken by locomotives at tipple or other uses at mines	Used for power and heat or made into coke at mines	Total quantity	Underground	Surface: In strip pits	Surface: All others	Total	Average number of days mines operated	Man-days of labor	Average tons per man per day
Buchanan	3,731,544	4,865	5,941	120	3,742,470	3,209	--------	406	3,615	189	684,298	5.47
Dickenson	1,355,970	6,926	6,863	747	1,370,506	1,543	--------	246	1,789	225	402,324	3.41
Lee	943,814	32,922	10,684	401	987,821	1,454	--------	261	1,715	163	278,913	3.54
Montgomery and Pulaski [11]	109,642	23,384	1,441	5,265	139,732	400	--------	127	527	135	71,058	1.97
Russell and Scott	430,904	69,117	5,222	4,311	509,554	892	--------	124	1,016	140	142,567	3.57
Tazewell	2,726,515	47,952	20,271	5,711	2,800,449	3,045	--------	547	3,592	205	736,023	3.80
Wise	2,428,271	35,081	22,035	[12] 247,117	2,732,504	4,016	--------	491	4,507	134	602,917	4.53
Total Virginia	11,726,660	220,247	72,457	[12] 263,672	12,283,036	14,559	--------	2,202	16,761	174	2,918,100	4.21

WASHINGTON

County	Loaded at mines for shipment by rail or water	Shipped by truck or wagon	Coal used by employees or taken by locomotives at tipple or other uses at mines	Used for power and heat or made into coke at mines	Total quantity	Underground	Surface: In strip pits	Surface: All others	Total	Average number of days mines operated	Man-days of labor	Average tons per man per day
King	339,213	259,568	4,499	1,405	604,685	853	--------	250	1,103	166	182,699	3.31
Kittitas	630,092	33,265	7,744	12,282	683,383	780	--------	280	1,060	162	171,753	3.98
Lewis	8,791	22,679	72	443	31,985	43	--------	10	53	134	7,099	4.51
Pierce	19,827	17,004	240	100	37,171	64	--------	13	77	165	12,734	2.92
Other counties (Thurston and Whatcom)	151,986	50,733	1,326	5,704	209,749	250	--------	48	298	164	48,834	4.30
Total Washington	1,149,909	383,249	13,881	[1] 19,934	1,566,973	1,990	--------	601	2,591	163	423,119	3.70

WEST VIRGINIA

Barbour	1, 196, 417	6, 788	2, 104	90	1, 205, 399	1, 265		158	1, 423	152	215, 846	5. 58
Boone	2, 752, 576	3, 887	14, 647	631	2, 771, 741	2, 885		436	3, 321	161	535, 074	5. 18
Braxton and Gilmer	4, 209	5, 059	10, 069	4	19, 341	58		12	70	69	4, 831	4. 00
Brooke	303, 042	131, 002	661, 268	109	1, 095, 421	1, 027	30	157	1, 214	140	170, 494	6. 42
Clay	661, 422	1, 469	20, 274	17, 981	701, 146	698		152	850	184	156, 092	4. 49
Fayette	10, 252, 273	15, 047	152, 012	[13] 285, 127	10, 704, 459	10, 533		1, 551	12, 084	206	2, 486, 347	4. 31
Grant		21, 405	88	73	21, 566	57		9	66	242	16, 001	1. 35
Greenbrier	1, 403, 696	30, 615	9, 490	221	1, 444, 022	1, 628		233	1, 861	155	288, 913	5. 00
Hancock	35, 313	99, 834	87	5	135, 239	52	26	22	100	232	23, 193	5. 83
Harrison	3, 077, 742	20, 527	57, 237	5, 144	3, 160, 650	2, 294		384	2, 678	164	439, 563	7. 19
Kanawha	5, 767, 708	58, 406	55, 661	5, 404	5, 887, 179	6, 144		770	6, 914	185	1, 277, 327	4. 61
Lewis		3, 768	7, 144		10, 912	13		4	17	228	3, 880	2. 81
Lincoln and Wayne		23, 149	6		23, 155	40		7	47	179	8, 400	2. 76
Logan	11, 841, 896	5, 772	97, 038	10, 041	11, 954, 747	9, 300		1, 877	11, 177	171	1, 907, 852	6. 27
McDowell	15, 217, 558	48, 442	192, 294	86, 057	15, 544, 351	15, 446		3, 272	18, 718	160	2, 988, 616	5. 20
Marion	6, 484, 473	25, 828	212, 548	39, 400	6, 762, 249	5, 327		819	6, 146	176	1, 079, 801	6. 26
Marshall	253, 717	73, 180	123, 638	2, 077	452, 612	569		99	668	142	94, 543	4. 79
Mason	11, 772	67, 845	886	3, 748	84, 251	163		22	185	156	28, 905	2. 91
Mercer	2, 540, 152	5, 044	23, 756	1, 232	2, 570, 184	3, 045		718	3, 763	155	583, 911	4. 40
Mineral	195, 604	28, 310	1, 990	80	225, 984	386		62	448	186	83, 528	2. 71
Mingo	2, 999, 420	3, 193	28, 535	28	3, 031, 176	2, 767		453	3, 220	162	522, 480	5. 80
Monongalia	5, 291, 800	24, 621	18, 176	71	5, 334, 668	3, 120		671	3, 791	179	680, 000	7. 85
Nicholas	1, 636	23, 857	191	448	26, 132	57		10	67	123	8, 267	3. 16
Ohio	1, 334, 264	118, 778	220	190	1, 453, 452	1, 341		128	1, 469	258	379, 151	3. 83
Preston	310, 235	18, 560	12, 975	[13] 7, 938	349, 708	840		111	951	95	90, 217	3. 88
Putnam	573, 554	4, 266	4, 490	179	582, 489	614		83	697	250	174, 233	3. 34
Raleigh	12, 562, 489	44, 492	111, 676	56, 603	12, 775, 260	12, 582		2, 016	14, 598	188	2, 739, 523	4. 66
Randolph	810, 809	36, 176	4, 518	17, 020	868, 523	927		168	1, 095	163	178, 684	4. 86
Taylor	395, 091	14, 486	994	73	410, 644	616		74	690	125	86, 328	4. 76
Tucker	385, 207	1, 283	6, 360	16, 358	409, 208	460		58	518	167	86, 745	4. 72
Upshur	30, 816	4, 569	122	1, 409	36, 916	178		45	223	41	9, 173	4. 02
Webster	894, 240	3, 817	1, 296	1, 647	901, 000	980		156	1, 136	175	199, 314	4. 52
Wyoming	2, 284, 259	11, 828	18, 039	20, 262	2, 334, 388	2, 440		394	2, 834	189	535, 471	4. 36
Total West Virginia	89, 873, 390	985, 303	1, 849, 829	[13] 579, 650	93, 288, 172	87, 852	56	15, 131	103, 039	175	18, 082, 703	5. 16

See footnotes at end of table.

TABLE 25.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1938*—Continued

WYOMING

County	Net tons					Number of employees				Average number of days mines operated	Man-days of labor	Average tons per man per day
	Loaded at mines for shipment by rail or water	Shipped by truck or wagon	Coal used by employees or taken by locomotives at tipple or other uses at mines	Used for power and heat or made into coke at mines	Total quantity	Underground	Surface		Total			
							In strip pits	All others				
Carbon	528,594	37,350	3,155	20,445	589,544	246	13	108	367	221	80,957	7.28
Converse	----------	10,952	----------	----------	10,952	2	10	2	14	187	2,624	4.17
Fremont	22,663	10,796	121	4,733	38,313	28	--------	10	38	115	4,358	8.79
Hot Springs	37,947	15,951	1,187	6,659	61,744	183	--------	54	237	103	24,507	2.52
Johnson	----------	7,639	----------	----------	7,639	10	--------	3	13	187	2,428	3.15
Lincoln	377,609	35,982	3,819	9,080	426,490	461	--------	101	562	154	86,497	4.93
Sheridan	558,790	63,321	2,992	2,481	627,584	274	--------	92	366	162	59,137	10.61
Sweetwater	3,230,729	8,223	21,574	55,285	3,315,811	2,248	--------	518	2,766	190	526,068	6.30
Uinta	7,978	8,484	114	68	16,644	16	--------	5	21	277	5,817	2.86
Other counties (Campbell, Natrona, and Teton)	86,571	15,303	562	6,720	109,156	6	21	12	39	243	9,486	11.51
Total Wyoming	4,850,881	214,001	33,524	[1] 105,471	5,203,877	3,474	44	905	4,423	181	801,879	6.49

[1] No coal was made into beehive coke at mines in 1938.
[2] Includes 84,172 tons made into beehive coke at mines in Las Animas County, Colo., in 1938.
[3] Other counties include Adams, Bond, Crawford, Greene, Hancock, Jasper, Livingston, Logan, Macon, Marion, Marshall, Morgan, Putnam, Warren, White, Will, and Woodford.
[4] Much of the output of the State is obtained from strip pits or by the use of loading machines, in which types of operations the production per man per day is large.
[5] Production of Home Riverside and Alston mines is credited to Missouri rather than to Kansas.
[6] The output is obtained chiefly from strip pits in which the production per man per day is large.
[7] Data on lignite compiled by L. Mann, Bureau of Mines: see Lignite tables, 1938.
[8] Includes coal made into beehive coke at mines in the following counties in Pennsylvania in 1938: Cambria, 38,777; Fayette, 333,216; Indiana, 121,489; and Westmoreland, 271,771—a grand total of 765,253 tons.
[9] Includes 10,000 tons made into beehive coke at mines in Grundy County, Tenn., in 1938.
[10] Includes 15,667 tons made into beehive coke at mines in Carbon County, Utah, in 1938.
[11] Figures compiled by L. Mann, Bureau of Mines; see Anthracite and Semianthracite Outside of Pennsylvania tables, 1938.
[12] Includes 234,765 tons made into beehive coke at mines in Wise County, Va., in 1938.
[13] Includes 250,019 tons made into beehive coke at mines in Fayette and Preston Counties, W. Va., in 1938.

STATISTICS OF LIGNITE AND OF ANTHRACITE AND SEMI-ANTHRACITE OUTSIDE OF PENNSYLVANIA [4]

PRODUCTION OF LIGNITE

In addition to the study of Pennsylvania anthracite, the Bureau of Mines canvasses the operators of lignite properties included in the areas mapped as "lignite" in Geological Survey Professional Paper 100–A, The Coal Fields of the United States. Subbituminous coal, sometimes known as "black lignite," is not included.

Fewer lignite mines were active in 1938 than in 1937, and output, number of employees, and days of operation decreased. The length of the working day in most mines was 8 hours, but many smaller operations failed to reply to the request for this information. Mechanical loading underground was not practiced to any extent, as only one or two operators in North Dakota recorded the use of mobile loaders in the year. No labor disturbances were reported.

Detailed data of production in 1938 are presented in the following tables. An historical table of world output of lignite is also given.

TABLE 26.—*Summary of production, value, men employed, days operated, man-days of labor, and output per man per day at lignite mines in the United States in 1938, by States* [1]

State	Net tons					Value	
	Loaded at mines for shipment	Commercial sales by truck or wagon	Other sales to local trade, used by employees, or taken by locomotives at tipple	Used at mines for power and heat	Total quantity	Total (thousands of dollars)	Average per ton
Montana	3,939	46,943	2,595	68	53,545	88	$1.64
North Dakota	1,465,374	416,904	160,075	7,746	2,050,099	2,380	1.16
South Dakota	27,148	20,570	340		48,058	65	1.35
Texas	813,096	21,302	6,245	5,576	846,219	679	.80
Total: 1938	2,309,557	505,719	169,255	13,390	2,997,921	3,212	1.07
1937	2,437,702	569,266	195,600	15,851	3,218,419	3,477	1.08

State	Number of employees				Average number of days mines operated	Man-days of labor [2]	Average tons per man per day [2]
	Underground	Surface: In strip pits	Surface: All others	Total			
Montana	67	7	19	93	162	15,081	3.55
North Dakota	667	344	359	1,370	174	237,751	8.62
South Dakota	18	23	9	50	170	8,507	5.65
Texas	446	22	38	506	219	110,768	7.64
Total: 1938	1,198	396	425	2,019	184	372,107	8.06
1937	1,239	462	429	2,130	189	403,510	7.98

[1] Includes 212 active mines of commercial size; excludes wagon mines producing less than 1,000 tons.
[2] Based upon the "reported" number of man-shifts where the operator keeps a record thereof; otherwise upon the "calculated" number of man-shifts obtained by multiplying the average number of men employed underground and on the surface at each mine by the number of days worked by the mine and tipple, respectively. Using the "calculated" man-shifts throughout as developed before the year 1932. the average output per man per day was 8.51 in 1937 and 8.59 in 1938.

[4] Compiled by L. Mann, Coal Economics Division. Bureau of Mines.

TABLE 27.—*Production, value, men employed, days operated, man-days of labor, and output per man per day at lignite mines in the United States in 1938, by States and counties*

MONTANA

County	Net tons					Value		Number of employees				Average number of days mines operated	Man-days of labor [1]	Average tons per man per day [1]
	Loaded at mines for shipment	Commercial sales by truck or wagon	Other sales to local trade, used by employees, or taken by locomotives at tipple	Used at mines for power and heat	Total quantity	Total (thousands of dollars)	Average per ton	Underground	Surface		Total			
									In strip pits	All others				
Daniels, McCone, and Valley		8,760	20	4	8,784	17	$1.94	7	4	1	12	205	2,464	3.56
Dawson		1,428	10		1,438	2	1.39	5		1	6	86	515	2.79
Richland	3,939	8,272	700		12,911	25	1.94	22	3	5	30	156	4,688	2.75
Roosevelt		6,582	972	5	7,559	10	1.32	10		4	14	145	2,033	3.72
Sheridan		14,204	893	59	15,156	23	1.52	18		7	25	172	4,289	3.53
Other counties (Custer and Wibaux)		7,697			7,697	11	1.43	5		1	6	182	1,092	7.05
Total: 1938	3,939	46,943	2,595	68	53,545	88	1.64	67	7	19	93	162	15,081	3.55
1937	4,000	49,299	910	102	54,311	92	1.69	63	6	12	81	167	13,567	4.00

NORTH DAKOTA

County	Loaded at mines for shipment	Commercial sales by truck or wagon	Other sales to local trade, used by employees, or taken by locomotives at tipple	Used at mines for power and heat	Total quantity	Total (thousands of dollars)	Average per ton	Underground	In strip pits	All others	Total	Average number of days mines operated	Man-days of labor [1]	Average tons per man per day [1]
Adams	14,207	25,860	1,600	15	41,682	56	1.34	59	2	23	84	139	11,654	3.58
Billings, Golden Valley, and Slope		4,496	125		4,621	6	1.30	5	6	5	16	149	2,380	1.94
Bowman	68	5,636			5,704	8	1.40	7	2	2	11	138	1,515	3.77
Burke	184,442	53,822	60	100	238,424	269	1.13		49	33	82	168	13,812	[2] 17.26
Burleigh	199,326	28,063	24	20	227,433	274	1.20	33	30	21	84	226	19,002	[2] 11.97
Divide	153,765	8,114	3,800	702	166,381	206	1.24	12	39	17	68	168	11,455	[2] 14.52
Dunn		3,153	100	100	3,353	4	1.19		5	1	6	125	750	4.47
Grant	5,151	17,176	108	600	23,035	29	1.26	16	4	5	25	148	3,700	6.23
Hettinger	420	16,271	614	210	17,515	21	1.20	7	17	7	31	155	4,809	3.64
McKenzie		5,549			5,549	8	1.44	3	8	4	15	156	2,340	2.37
McLean	103,611	22,477	2,523	188	128,799	186	1.44	80	54	27	161	134	21,563	5.97
Mercer	463,044	2,352	77,674	2,310	545,380	573	1.05	149	60	107	316	175	55,195	9.88

Morton	8,580	17,038	130	2,626	28,374	34	1.20	19	14	11	44	127	5,575	5.09
Mountrail		12,975		21	12,996	18	1.39	19	5	4	28	195	5,470	2.38
Oliver		7,490	87	70	7,647	7	.92		14	4	18	95	1,711	4.47
Stark	60	17,168	73,052	652	90,932	100	1.10	57		6	63	239	15,046	6.04
Ward	331,930	121,470	178	97	453,675	516	1.14	152	29	62	243	208	50,648	[2] 8.96
Williams	770	47,794		35	48,599	65	1.34	49	6	20	75	148	11,126	4.37
Total: 1938	1,465,374	416,904	160,075	7,746	2,050,099	2,380	1.16	667	344	359	1,370	174	237,751	8.62
1937	1,577,216	470,778	193,033	9,810	2,250,837	2,639	1.17	689	407	379	1,475	181	267,522	8.41
SOUTH DAKOTA														
Corson, Dewey, and Harding	27,148	15,826	190		43,164	57	1.32	5	20	7	32	199	6,353	[2] 6.79
Meade		1,076	100		1,176	2	1.70	6		2	8	93	740	1.59
Perkins		3,668	50		3,718	6	1.61	7	3		10	141	1,414	2.63
Total: 1938	27,148	20,570	340		48,058	65	1.35	18	23	9	50	170	8,507	5.65
1937	26,444	20,426	104	5	46,979	63	1.34	18	22	7	47	165	7,769	6.05
TEXAS														
Bastrop and Milam	104,718	3,800	1,000	761	110,279	81	.73	88	22	12	122	150	18,266	6.04
Henderson, Titus, and Wood	708,378	17,502	5,245	4,815	735,940	598	.81	358		26	384	241	92,502	7.96
Total: 1938	813,096	21,302	6,245	5,576	846,219	679	.80	446	22	38	506	219	110,768	7.64
1937	830,042	28,763	1,553	5,934	866,292	683	.79	469	27	31	527	218	114,652	7.56

[1] Based upon the "reported" number of man-shifts where the operator keeps a record thereof; otherwise upon the "calculated" number of man-shifts obtained by multiplying the average number of men underground and on the surface at each mine by the number of days worked by the mine and tipple, respectively. Using the "calculated" man-shifts throughout as developed before 1932, the average output per man per day in 1938 was 3.55 in Montana, 9.57 in North Dakota, 5.17 in South Dakota, and 7.67 in Texas.

[2] Output obtained chiefly from strip pits in which the production per man per day is large.

NUMBER AND SIZE OF LIGNITE MINES

There were 212 active lignite mines in 1938, as reported to the Bureau of Mines (exclusive of many small mines in Montana and North Dakota producing less than 1,000 tons annually). Of these, 24 were in Montana, 165 in North Dakota, 15 in South Dakota, and 8 in Texas. In the field as a whole the classification by size of output is as follows:

TABLE 28.—*Number and production of lignite mines in 1938, classified by size of output*

Net tons	Mines		Production		
	Number	Percent of total	Total (net tons)	Average per mine (net tons)	Percent of total
Over 200,000	4	1.9	1,511,698	377,925	50.4
100,000 to 200,000	3	1.4	511,222	170,407	17.1
50,000 to 100,000	3	1.4	210,723	70,241	7.0
10,000 to 50,000	19	9.0	391,957	20,629	13.1
Under 10,000	183	86.3	372,321	2,035	12.4
	212	100.0	2,997,921	14,141	100.0

LENGTH OF WORKING DAY IN LIGNITE MINES

The following table summarizes the replies of mine operators to the question, "Number of hours operated per shift."

Reports from mines in the lignite field in 1938, including those reporting a day of irregular length, indicate that 77 percent of the men employed were in 8-hour mines and that the weighted average working shift was 8 hours.

The established working day does not necessarily measure the length of time actually worked or the time underground, because a miner may work overtime, the mine may shut down before the full day is over, the miner may go home before work at the mine stops, and he may spend considerable time in going to and from his place of work underground. As interpreted in the wage agreements, the day means the hours of labor at the usual working place, exclusive of any time for lunch and exclusive of the time spent in going from the entrance of the mine to and from his working place (see Coal chapter in Mineral Resources, Bureau of Mines, 1930, p. 656).

TABLE 29.—*Number of lignite mines in the United States having established working shift of certain length and number of men employed therein, in 1938, by States*

State	7 hours		8 hours		9 hours		Not reporting and all others [1]		Total	
	Mines	Men	Mines	Men	Mines	Men	Mines	Men	Mines	Men
Montana			12	59	1	3	11	31	24	93
North Dakota	10	104	121	983	3	88	31	195	165	1,370
South Dakota			5	11	1	3	9	36	15	50
Texas			8	506					8	506
	10	104	146	1,559	5	94	51	262	212	2,019

[1] Includes mines in which the day was more than 9 or less than 7 hours, was irregular, or was changed during the year; also mines where the operator has included time when the men were entering or leaving the mine, where the operator has reported the time of men in occupations in which the workday is longer than for other employees (as in stripping overburden), or where the work is staggered and two crews of men overlap.

LIGNITE LOADED FOR SHIPMENT BY INDIVIDUAL RAILROADS

TABLE 30.—*Lignite loaded for shipment by individual railroads in 1938, as reported by operators, in net tons*

Railroad	State	Quantity
Chicago, Milwaukee, St. Paul & Pacific	North Dakota; South Dakota	46,994
Great Northern	Montana; North Dakota	342,332
International-Great Northern	Texas	
Missouri-Kansas-Texas	do	
Rockdale, Sandow & Southern	do	813,096
St. Louis Southwestern of Texas	do	
Texas Short Line	do	
Minneapolis, St. Paul & Sault Ste. Marie	North Dakota	524,438
Northern Pacific	do	582,697
		2,309,557

METHODS OF RECOVERY

TABLE 31.—*Lignite mined by different methods in 1938, by States*

State	From underground workings (net tons)					From strip pits		Grand total production
	Mined by hand	Shot off the solid	Cut by machines	Not specified	Total underground	Net tons	Percent of grand total	
Montana	[1] 78,281	[1] 756,588		5,954	[1] 840,823	[1] 58,941	[1] 6.6	53,545
North Dakota	53,708	175,461	[2] 535,696	22,426	787,291	1,262,808	61.6	2,050,099
South Dakota	1,420			2,589	4,009	44,049	91.7	48,058
Texas	(1)	(1)			(1)	(1)	(1)	846,219
	133,409	932,049	[2] 535,696	30,969	1,632,123	1,365,798	45.6	2,997,921

[1] Texas included with Montana. [2] 22 machines were used—15 "permissible" and 7 of other types.

STRIPPING OPERATIONS

TABLE 32.—*Statistical summary of stripping operations that produced lignite in 1938, by States*

State	Strip pits [1]	Shovels, dragline excavators, and coal-loading machines [2]	Production (net tons)	Value		Number of employees			Average number of days mines operated	Man-days of labor [3]	Average tons per man per day [3]
				Total (thousands of dollars)	Average per ton	In strip pits	All others	Total			
Montana and Texas	4	2	58,941	35	$0.59	29	1	30	115	3,454	17.06
North Dakota	58	31	1,262,808	1,452	1.15	344	142	486	180	87,288	14.47
South Dakota	5	2	44,049	59	1.34	23	7	30	224	6,718	6.56
	67	35	1,365,798	1,546	1.13	396	150	546	178	97,460	14.01

[1] Includes some pits in which the stripping is done by hand.
[2] In some operations the same equipment was used for stripping or excavating and for loading the coal; this duplication has been eliminated. In others the coal was excavated by machine and loaded by hand.
[3] Based upon the "reported" number of man-shifts where the operator keeps an accurate record thereof, otherwise upon the "calculated" number of man-shifts obtained by multiplying the number of men employed at the tipple, in loading coal, etc., and in stripping overburden by the number of days worked in each department, insofar as separately reported by the operator.

WORLD PRODUCTION OF LIGNITE

TABLE 33.—*World production of lignite (including brown coal), 1934–39, in metric tons*

[Compiled by R. B. Miller]

Country	1934	1935	1936	1937	1938	[1] 1939
North America:						
Canada	2,915,589	3,241,118	3,507,895	3,352,316	3,153,377	3,093,514
United States	[2] 2,337,000	2,494,907	2,821,048	2,919,685	2,719,654	2,696,000
Europe:						
Albania	1,824	2,000	3,130	3,500	3,866	(3)
Bulgaria	1,567,956	1,565,971	1,576,098	1,732,119	1,855,198	(3)
Czechoslovakia	15,070,706	15,113,576	15,948,767	17,895,411	14,716,693	(3)
Faroe Islands					8,000	(3)
France	1,025,480	906,730	943,230	1,015,000	1,057,250	(3)
Germany	136,003,366	146,032,747	160,276,036	183,538,054	195,312,067	(3)
Austria	2,850,931	2,970,683	2,897,203	3,241,770	3,341,730	(3)
Greece	104,193	83,325	105,621	131,083	108,010	(3)
Hungary	6,199,085	6,717,677	7,105,004	8,055,123	8,320,000	(3)
Italy	408,616	545,482	768,563	1,059,231	872,950	1,410,000
Netherlands	92,493	86,204	88,779	143,057	170,637	197,000
Poland	26,403	18,288	13,518	18,915	9,526	(3)
Portugal	15,391	19,738	20,677	23,098	14,854	35,113
Rumania	1,623,858	1,666,761	1,671,825	1,880,477	2,096,698	(3)
Spain	298,643	303,827	(4)	(4)	68,099	204,259
U. S. S. R.	11,383,000	13,820,000	(4)	(4)	(4)	(3)
Yugoslavia	3,926,333	4,002,193	4,034,577	4,574,232	5,286,781	5,604,310
Asia:						
India, British	385,914	430,316	419,110	488,408	545,283	(3)
Indochina					4,200	27,000
Japan	124,786	108,526	109,494	(4)	(4)	(3)
Levant	540		493	4,658	700	1,000
Turkey	52,777	73,355	95,234	116,397	129,315	151,267
Oceania:						
Australia (Victoria)	2,659,545	2,257,170	3,093,768	3,448,391	3,734,441	3,709,613
New Zealand	1,248,333	1,310,660	1,301,895	1,328,805	1,264,208	(3)
	190,323,000	203,771,000	224,853,000	254,442,000	264,170,000	(3)

[1] Lignite is also mined in Italian East Africa, but complete production figures are not available. Figures for 1939 are preliminary and subject to revision.
[2] Approximate production.
[3] Data not available.
[4] Estimate included in total.

TABLE 34.—*Production, value, men employed, days mines operated, and output per man per day at the principal hard-coal mines outside of Pennsylvania in 1938*

[Includes coal classified as anthracite and semianthracite in Geol. Survey Prof. Paper 100–A, The Coal Fields of the United States]

	Arkansas	Virginia	Colorado and New Mexico	Total
Production (net tons):				
Loaded at mines for shipment	192,145	109,642	29,475	331,262
Commercial sales by truck or wagon	2,634	23,384	989	27,007
Other sales to local trade, or used by employees, or taken by locomotives at tipple	73	1,441	3,013	4,527
Used at mines for power and heat	1,333	5,265	1,271	7,869
Total production	196,185	139,732	34,748	370,665
Value:				
Total	$531,000	$373,000	$145,000	$1,049,000
Average per ton	$2.71	$2.71	$4.17	$2.83
Number of employees:				
Underground	586	400	92	1,078
Surface	147	127	46	320
Total employees	733	527	138	1,398
Average number of days mines operated	96	135	115	113
Average tons per man per day	2.78	1.97	2.20	2.35

PENNSYLVANIA ANTHRACITE

By M. van Siclen, L. Mann, and J. R. Bradley

SUMMARY OUTLINE

The anthracite industry is of great economic importance in the 500 square miles comprising the Pennsylvania anthracite region. Regardless of the fact that production in the anthracite industry has suffered drastic reductions in recent years, in 1938—when production was the lowest since about the turn of the century—freight-commodity statistics of the Interstate Commerce Commission showed that anthracite ranked second in tonnage originated by class I railways and fourth in revenue produced. In 1939 the value of anthracite production at the mines was $187,175,000, and the gross revenue accruing to the railroads was $102,180,268.

Prices at the mines in 1939 were lower than in 1938; wholesale prices continued to decline, and retail prices in the leading markets remained at about 1938 levels. The index of employment also decreased, although average weekly earnings advanced. Freight rates on intrastate shipments were increased. The Anthracite Institute and Anthracite Industries, Inc., continued their cooperative and trade-promotion activities, and State legislation intended to promote stabilization of the industry was defeated by a narrow margin.

Increasing competition of other fuels, unfavorable weather in several recent years, the production of illicit or "bootleg" anthracite, and competition within the industry have combined to undermine the price structure. Early in 1940 virtually the entire industry agreed to a voluntary scheme of allocation of production that apparently has brought some relief. The fairly low temperatures in the early months of 1940, together with improved business conditions and higher coastwise freight rates on bituminous coal from Hampton Roads to New York and New England, promise further increase in consumption of anthracite in 1940.

More favorable weather conditions, an increase in exports, and improved business conditions resulted in an increase in the output of anthracite in 1939. Production was 51,487,000 tons, a gain of 12 percent over 1938. Commercial shipments (excluding illicit or "bootleg" coal) were 41,063,869 tons in 1938 and 45,992,282 in 1939.

Shipments of anthracite from breakers and washeries in the first quarter of 1939 were less than in the corresponding period of 1938. In the second quarter, however, shipments advanced 13 percent over the second quarter of 1938; in the third quarter they were 32 percent

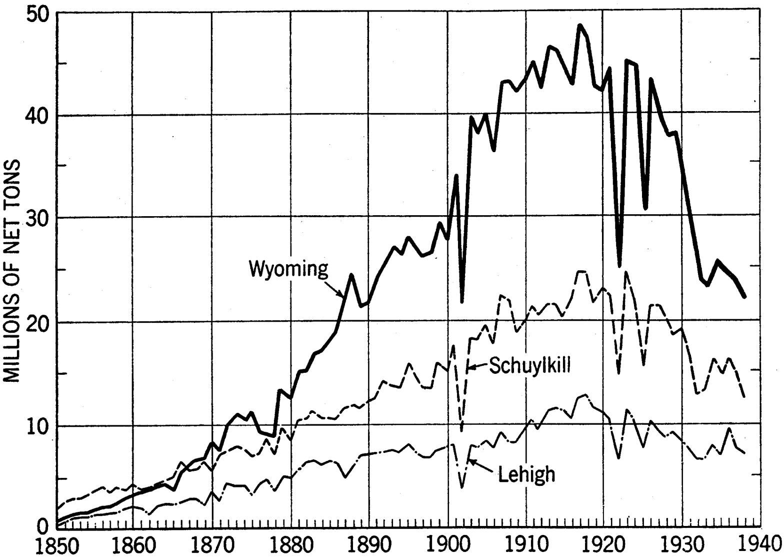

FIGURE 1.—Anthracite shipped from the Lehigh, Schuylkill, and Wyoming regions, 1850–1938.

higher; and in the last quarter shipments were 5 percent above 1938.

Receipts of anthracite at the upper Lake docks increased 8 percent in 1939 over 1938, and stocks declined 2 percent during the year.

Completion of the Huber central breaker of the Glen Alden Coal Co. denotes optimism for the future of the industry. The Huber breaker is one of the first to use Menzies cone separators to treat sized feed. The plant is expected to prepare 7,000 tons of anthracite daily.

The production of anthracite increased steadily from the early years of the nineteenth century to 1924, the last normal year under old competitive conditions. The peak was reached in 1917 at 99,611,811 tons. Since 1924 competitive fuels have increased in importance. Figure 1 shows shipments of Pennsylvania anthracite by regions since 1850.

The second annual anthracite conference of Lehigh University was held at Bethlehem, Pa., April 28–29, 1939, and the third annual conference was held May 9–10, 1940. The papers presented covered a wide field and contained much new and valuable information for both the producer and consumer of anthracite. Research, new uses of anthracite, modern mechanical burning equipment, and problems of the industry arising from the general trend toward smaller sizes were discussed. Papers also were presented on combustion, economics, marketing, mining, and preparation of anthracite. The conferences were attended by persons interested in all phases of the anthracite industry. The following papers presented at the conferences are of economic interest:

CONFERENCE OF 1939

Paper 10. Use of Anthracite Ash in Building Materials and in Agriculture, by Dr. Raymond C. Johnson, Anthracite Industries fellowship, Mellon Institute of Industrial Research, Pittsburgh, Pa.

Paper 13. Some Economic Aspects of Anthracite, by Dr. Neil Carothers, dean of the College of Business Administration, Lehigh University.

CONFERENCE OF 1940

Paper 2. The Present Status of Anthrafilt Illustrated by Case Histories, by Homer G. Turner, filtration consultant, Anthracite Institute.

Paper 4. Mineral Wool from Anthracite Colliery Refuse and Anthracite Ashes, by H. J. Rose and R. C. Johnson, Anthracite Industries fellowship, Mellon Institute of Industrial Research, Pittsburgh, Pa.

Paper 8. Effect Upon the Economy of the Anthracite Industry of Grinding Large Sizes to Pea and Smaller, by Cadwallader Evans, Jr., vice president and general manager, and Harold G. Boyd, engineering statistician, Hudson Coal Co.

TABLE 1.—*Statistical trends of the Pennsylvania anthracite industry, 1935–39*

	1935	1936	1937	1938	1939
Production:					
Loaded at mines for shipment:					
Breakers net tons	44,369,285	46,256,132	44,016,915	39,010,935	[1] 43,660,662
Washeries do	1,794,402	2,066,973	1,837,879	1,679,509	1,766,384
Dredges do	374,142	324,895	348,350	373,425	565,236
Sold to local trade and used by employees net tons	2,874,970	3,226,887	2,981,391	2,722,206	3,081,073
Used at collieries for power and heat net tons	2,745,984	2,704,648	2,671,898	2,312,952	2,414,022
Total production do	52,158,783	54,579,535	51,856,433	46,099,027	51,487,377
Value at breaker, washery, or dredge	$210,131,000	$227,004,000	$197,599,000	$180,600,000	$187,175,000
Average sales realization per net ton on breaker shipments:					
Lump and broken	$5.16	$5.05	$5.08	$5.24	$4.63
Egg	$5.44	$5.60	$5.06	$5.18	$4.73
Stove	$5.87	$6.09	$5.21	$5.33	$4.84
Chestnut	$5.64	$5.91	$5.23	$5.36	$4.87
Pea	$4.16	$4.30	$4.01	$3.88	$3.65
Total domestic	$5.45	$5.67	$5.01	$5.10	$4.64
Buckwheat No. 1	$2.88	$2.91	$2.95	$3.03	$2.90
Buckwheat No. 2 (Rice)	$1.74	$2.01	$2.26	$2.35	$2.20
Buckwheat No. 3 (Barley)	$1.08	$1.23	$1.45	$1.61	$1.62
Boiler	----------	----------	$.78	----------	----------
Other, including Buckwheat No. 4	$.57	$.68	$.79	$.87	$.91
Total steam	$2.03	$2.10	$2.21	$2.33	$2.25
Total, all sizes	$4.29	$4.42	$4.03	$4.16	$3.85
Percentage by sizes in total breaker shipments:					
Lump and broken percent	0.3	0.3	0.4	0.3	0.6
Egg do	7.0	6.5	5.7	5.4	5.2
Stove do	21.8	21.3	22.1	23.7	24.1
Chestnut do	26.1	26.4	26.2	26.0	25.8
Pea do	10.7	10.4	10.8	10.6	11.0
Total domestic do	65.9	64.9	65.2	66.0	66.7
Buckwheat No. 1 do	15.1	15.1	14.7	14.8	14.3
Buckwheat No. 2 (Rice) do	9.3	8.4	7.9	7.7	7.8
Buckwheat No. 3 (Barley) do	7.8	8.8	8.9	8.6	8.5
Boiler do	----------	----------	(2)	----------	----------
Other, including Buckwheat No. 4 percent	1.9	2.8	3.3	2.9	2.7
Total steam do	34.1	35.1	34.8	34.0	33.3
Producers' stocks on Dec. 31 [3] net tons	1,911,000	2,259,000	2,154,000	1,458,000	994,000
Exports do	1,609,000	1,678,000	1,914,000	1,909,000	2,590,000
Imports do	571,000	615,000	396,000	363,000	298,000
Consumption (calculated) do	51,100,000	53,200,000	50,400,000	45,200,000	49,700,000
Capacity in operation (calculated) do	84,000,000	87,000,000	83,000,000	82,000,000	(4)
Average number of days worked	189	192	189	171	(4)
Man-days lost on account of strikes and lock-outs	763,307	407,372	580,462	579,457	(4)
Number of men on strike during year	26,127	27,574	34,346	27,435	(4)
Average number of men employed	103,269	102,081	99,085	96,417	[5] 93,000
Output per man per day net tons	2.68	2.79	2.77	2.79	(4)
Output per man per year do	505	535	523	478	(4)
Quantity cut by machines do	1,848,095	2,162,744	1,984,512	1,588,407	1,881,884
Quantity mined by stripping do	5,187,072	6,203,267	5,696,018	5,095,341	5,486,479
Quantity loaded by machines underground net tons	9,279,057	10,827,946	10,683,837	10,151,669	11,773,833
Distribution:					
Total receipts in New England [6] net tons	5,402,000	5,287,000	4,761,000	4,468,000	4,907,000
Exports to Canada do	1,592,000	1,664,000	1,893,000	1,896,000	2,577,000
Loaded into vessels at Lake Erie [7] net tons	559,000	689,000	674,000	450,000	531,000
Receipts at Duluth-Superior [8] do	182,000	309,000	296,000	155,000	202,000

[1] Includes a small quantity of washery coal. [2] Less than 0.1 percent.
[3] Anthracite Institute. Figures represent prepared coal on the ground at the breaker.
[4] Data not yet available.
[5] Estimated from the report of the Pennsylvania Department of Mines; Bureau of Mines data not yet available.
[6] Commonwealth of Massachusetts, Division on the Necessaries of Life. [7] Ore and Coal Exchange.
[8] U. S. Engineer Office, Duluth, Minn.

TABLE 2.—*Statistical summary of monthly developments in the Pennsylvania anthracite industry in 1939*

[All tonnage figures represent net tons]

	1939													Change from 1938 (percent)	1938 (total)
	January	February	March	April	May	June	July	August	September	October	November	December	Total		
Production, including mine fuel, local sales, and dredge coal:															
Monthly total	5,019,000	4,169,000	3,652,000	5,367,000	5,141,000	3,577,000	2,951,000	3,883,000	4,840,000	4,985,000	3,989,000	3,914,000	51,487,000	+11.7	46,099,000
Average per working day	200,800	177,400	135,300	223,600	197,700	137,600	118,000	143,800	193,600	199,400	166,200	156,600	170,200	+12.0	151,900
Shipments, breakers and washeries only:[1] Monthly total, all sizes	4,046,821	3,381,642	3,231,929	4,841,771	4,205,564	2,959,303	2,611,299	3,146,744	4,286,905	4,333,105	3,329,218	3,434,898	43,809,199	+10.5	39,648,026
Distribution:															
Lake Erie loadings[2]				8,745	100,783	96,534	77,538	95,190	42,949	60,281	49,077	238	531,335	+18.0	450,324
Receipts at Duluth-Superior[3]					27,506	44,066	34,391	35,554	18,258	32,372	9,579		201,726	+29.8	155,462
Upper Lake dock trade:[4]															
Receipts:															
Lake Superior					20,147	62,522	34,402	35,565	18,368	35,654	9,782		216,440	+21.7	177,788
Lake Michigan	447	400	1,414	11,478	40,863	41,051	36,213	54,055	17,377	30,042	37,764	328	271,432	−1.4	275,358
Deliveries (reloadings):															
Lake Superior	19,403	17,062	5,640	18,680	15,367	22,527	11,041	13,312	26,343	28,641	18,146	17,392	213,554	+1.2	210,945
Lake Michigan	22,195	22,306	16,605	17,674	21,455	32,581	30,778	28,276	33,829	27,324	18,245	17,176	288,444	−1.5	292,723
Retail yards—183 selected dealers: Deliveries[4]	367,284	329,162	316,797	275,109	221,047	200,275	251,936	264,116	324,352	298,621	257,652	333,401	3,439,752	(5)	[5]3,638,835
New England receipts:[6]															
By tide (including imports)	51,325	68,442	44,744	89,957	113,915	96,812	84,706	77,550	73,974	61,873	56,734	45,319	865,351	−11.4	977,170
By rail	387,299	343,515	290,356	376,304	437,532	252,589	273,117	257,465	365,884	439,817	323,845	294,203	4,041,926	+15.8	3,490,700
Exports[7]	185,239	173,032	160,662	153,792	376,176	216,768	179,692	145,741	447,956	292,408	141,642	116,892	2,590,000	+35.7	1,908,911
Imports[7]	27,717	34,312	18,768	12,769	43,869	24,151	28,732	35,536	43,577	8,230	13,093	7,399	298,153	−17.8	362,895
Industrial consumption by:															
Railroads (class I only)[8]	138,818	138,516	145,855	195,060	236,468	101,070	110,143	100,967	106,950	127,937	136,320	143,561	1,681,665	+19.6	1,406,245
Electric power utilities[9]	187,886	158,256	163,931	176,076	203,247	178,573	172,467	184,651	189,582	213,611	203,133	212,615	2,244,028	+14.4	1,962,352
Other industrial consumers[10]	118,476	124,902	128,964	91,934	80,310	87,796	60,893	85,893	87,755	98,574	115,554	91,214	1,172,265	+.8	1,162,866

See footnotes at end of table.

TABLE 2.—*Statistical summary of monthly developments in the Pennsylvania anthracite industry in 1939*—Continued

[All tonnage figures represent net tons]

	1939—Continued													Change from 1938 (percent)	1938 (total)
	January	February	March	April	May	June	July	August	September	October	November	December	Total		
Stocks at end of period shown:															
Railroads (class I only)[8]	126,307	99,896	80,604	147,123	111,007	81,655	96,482	116,797	129,162	142,315	129,000	110,329	110,329	−3.3	114,078
Electric power utilities[9]	1,158,188	1,155,559	1,138,115	1,144,083	1,199,910	1,242,902	1,230,017	1,206,468	1,185,397	1,239,136	1,169,209	1,113,839	1,113,839	−8.0	1,210,768
Other industrial consumers[10]	234,974	260,403	212,551	225,169	255,256	246,390	172,644	218,600	237,639	246,010	232,037	165,842	165,842	−22.1	212,790
Stocks on upper Lake docks:[4]															
Lake Superior	129,936	112,868	107,223	87,856	92,630	132,610	155,967	178,211	170,235	177,243	168,872	151,475	151,475	+1.4	149,343
Lake Michigan	130,189	108,151	92,959	86,742	107,514	117,965	128,729	154,644	138,191	140,909	160,456	143,609	143,609	−5.4	151,813
Retail stocks—183 selected dealers[4]	357,083	304,547	225,643	324,817	459,634	516,552	529,988	531,873	547,992	589,898	540,226	445,354	445,354	+5.8	421,092
Producers' stocks[1]	1,046,429	761,174	407,814	85,867	238,194	558,638	715,572	1,129,005	1,172,298	1,218,871	1,364,516	993,848	993,848	−31.8	1,457,533
Wholesale prices:[11]															
On tracks, destination:															
Chestnut	$9.73	$9.70	$9.64	$9.08	$9.15	$9.15	$8.67	$8.60	$8.65	$9.03	$9.16	$9.16	$9.14	−3.2	$9.44
Pea	$8.30	$8.25	$8.19	$7.67	$7.75	$7.81	$7.70	$7.67	$7.70	$7.93	$7.95	$7.97	$7.91	−2.2	$8.09
Index numbers (1926=100)	80.3	79.9	79.4	74.7	75.3	75.5	72.6	72.1	72.5	75.3	76.1	76.1	75.8	−2.8	78.0
Labor conditions:[11]															
Average weekly earnings	$24.74	$28.20	$21.55	$27.08	$35.84	$23.30	$18.65	$23.13	$26.64	$33.03	$26.90	$17.16	$25.52	+9.1	$23.40
Index of employment (1929 average=100)	50.0	52.2	51.7	53.0	52.6	51.2	44.7	48.5	49.4	51.9	51.3	51.0	50.6	−3.3	52.3
Index of pay rolls (1929 average=100)	38.0	45.2	34.2	43.4	57.0	36.1	25.2	33.8	40.1	52.2	42.0	26.6	39.5	+3.4	38.2

1 Anthracite Institute.
2 Ore and Coal Exchange, Cleveland, Ohio.
3 U. S. Engineer Office, Duluth, Minn.
4 Bituminous Coal Division, U. S. Department of the Interior.
5 Data for 1938 not comparable with 1939.
6 Commonwealth of Massachusetts, Division on the Necessaries of Life.
7 Bureau of Foreign and Domestic Commerce.
8 Association of American Railroads.
9 Federal Power Commission.
10 National Association of Purchasing Agents.
11 Bureau of Labor Statistics.

Anthracite Institute.—The usual functions of the Anthracite Institute were carried on during the year, and especial attention was given to proposed Pennsylvania legislation to regulate the industry and to the Canadian market.

Anthracite Industries, Inc.—Laboratory tests of new anthracite-burning equipment were continued by Anthracite Industries, Inc.; approval was given to equipment meeting its requirements; and efforts were redoubled to promote the use of such equipment. Schools in anthracite merchandising were conducted, as well as a series of stoker schools, and a summer selling plan was presented to anthracite dealers. Exhibits of equipment were maintained at Boston, Philadelphia, and New York. Manufacturers cooperated with Anthracite Industries, Inc., in its exhibit at the New York World's Fair where stokers, furnaces, boilers, cooking stoves, thermostats, and other equipment were on display. It is reported that 1,152,330 persons visited the exhibit in 1939, thousands of whom saw anthracite as a thoroughly modern fuel for the first time.

There is little doubt that increased efficiency and the rapid strides made in the modernization of anthracite-burning equipment such as stokers, hand-fired boilers, and water heaters have created a favorable impression on the consuming public.

Nonfuel uses of anthracite and anthracite refuse.—The nonfuel use of anthracite, especially anthrafilt used in the purification of water, continued to expand. During the year attention was also given to the use of anthracite ashes as a soil conditioner and, after processing, as an insulating material.

Technologic developments.—There were no important technologic developments during 1939. The Pennsylvania General Assembly appropriated funds, which were matched by the anthracite industry, for a program of research, and the Secretary of Mines appointed a committee to consider a program to be conducted by the School of Mineral Industries of the Pennsylvania State College. Two specific problems will be studied: The gasification of anthracite and the production of carbon products from anthracite. Certain technologic developments, present or prospective, were discussed at the Third Annual Conference of Lehigh University in May 1940.

Weather.—According to the Monthly Weather Review, the year 1939 was slightly cooler than 1938 but was still warmer than normal in most regions. Departures from normal temperatures in some of the chief anthracite-consuming States were: New England States—January −0.8, February +2.7, March −4.5, April −3.4, October normal, November −3.1 and December +0.5; New York—January +0.2, February +4.1, March −2.2, April −2.5, November −3.0, and December +1.4; Pennsylvania—January +1.8, February +5.3, March +0.9, April −1.9, October +1.0, November −1.6, and December +2.6; New York City (one of the leading anthracite markets)—January +1.4, February +6.1, March +1.1, April −1.6. October +0.1, November −1.0; and December +1.2.

Distribution.—According to the Pennsylvania Department of Mines, rail, tide, and truck shipments of Pennsylvania anthracite to destinations in the United States totaled 44,869,453 tons in 1939 compared with 35,292,731 tons in 1938. In 1939 truck shipments were 4,824,537 tons, or 11 percent of total shipments, as against 9 percent in 1938. Virtually all truck shipments go to the Middle Atlantic States. Rail and tide shipments in 1939 totaled 40,044,916 tons, 63 percent domestic sizes and 37 percent steam sizes. Of the total steam sizes shipped by rail and tide, 95 percent went to the Middle Atlantic States.

Details covering distribution of shipments of Pennsylvania anthracite by rail and tide (truck shipments excluded) for 1937–39 are shown in table 3.

TABLE 3.—*Shipments of Pennsylvania anthracite, 1937–39, by States of destination, in net tons* [1]

[Truck shipments excluded]

	1937	1938	1939
New England States	4,128,408	3,551,572	4,489,970
New York	16,388,675	13,214,996	16,251,195
New Jersey	7,533,475	6,180,129	8,494,964
Pennsylvania	8,797,836	6,827,437	8,407,564
Delaware	213,493	168,316	194,759
Maryland	614,218	545,454	592,627
District of Columbia	290,524	248,577	256,936
Virginia	107,744	103,580	108,418
Ohio	168,565	91,017	112,833
Indiana	90,286	80,153	98,090
Illinois	358,054	254,193	277,166
Wisconsin	429,965	345,445	355,291
Minnesota	120,930	77,461	93,367
Michigan	300,316	214,768	245,519
Other States	91,314	65,873	66,217
Total United States	39,633,803	31,968,971	40,044,916
Canada	1,773,086	1,631,489	2,441,070
Other foreign countries		4,476	4,456
Grand total	41,406,889	33,604,936	42,490,442

[1] Department of Mines, Harrisburg, Pa.

Freight rates.—Increases in freight rates ranging from 3 to 12 cents a gross ton were granted the railroads by the Interstate Commerce Commission on intrastate movement of coal. The so-called motor-compelled railway freight rates initiated in 1935 were extended to June 20, 1940. The trucking of anthracite to market, which became important about 1930, has expanded until it is now estimated at 4,000,000 tons annually, not including several million tons trucked from illicit or "bootleg" operations.

Competitive fuels in the United States and in the principal markets.—Sales of liquefied petroleum gases for domestic purposes throughout the United States totaled 2,084,047 barrels in 1939 compared with 1,376,952 in 1938. Sales for domestic use in 1939 represented 39 percent of total deliveries for all purposes compared with 35 percent in 1938. At the end of 1939, according to the American Gas Association, liquefied petroleum gas was being delivered through mains to consumers in 178 communities in 30 States by 82 companies supplying 49,800 customers.

According to the American Gas Association, sales of natural gas in the United States in 1938 and 1939, respectively, were as follows:

Sales for domestic use, including house heating, 349,285,000,000 and 367,731,500,000 cubic feet, an increase of 5 percent; commercial sales, 99,845,000,000 and 107,769,900,000 cubic feet, an increase of 8 percent; and industrial sales, 565,674,000,000 and 626,096,400,000 cubic feet, an increase of 11 percent.

Shipments of oil burners (for all uses other than ranges, stoves, water heaters, and space heaters) within the United States gained 56 percent over 1938 and to Canada 84 percent. Factory sales of anthracite stokers for domestic purposes were 7 percent less than in 1938.

Sales of heating and range oils in the United States increased about 13 percent in 1939 over 1938. An unusual feature of the sales of heating and range oils in 1938, as revealed in a study by the Petroleum Economics Division of the Bureau, is the fact that in New England 46 percent of the total sales represented range oil.

Principal markets.—In 1939 shipments of Pennsylvania anthracite to the principal markets (New England, New York, New Jersey, Pennsylvania, Delaware, Maryland, and the District of Columbia) were only 5 percent less than in 1936, whereas in 1938 they were 26 percent lower. New England, New Jersey, and Delaware received larger tonnages than in 1936, but receipts in the other States declined. Although these principal markets continue to take by far the greater part of the anthracite produced, their percentage of the total production declined steadily until 1939, when it was slightly greater than in 1936. In 1936, 1937, 1938, and 1939, the respective percentages were 84.2, 80.2, 73.9, and 84.5. Imports of anthracite, virtually all into New England, have declined each year since 1936.

Of the total fuels represented in this study (which do not include bituminous coal, petroleum coke, or wood because of lack of statistics showing the necessary break-down), Pennsylvania anthracite comprised 64 percent in 1936, 60 percent in 1937, and 55 percent in 1938. In the same years coke for domestic use was 7, 6, and 6 percent, and heating and range oil 28, 33, and 38 percent, respectively. Imports of anthracite, briquets, and coke were only about 1 percent in each year. Imported fuel oils are included in the totals.

Of the principal anthracite markets, only New York and Pennsylvania consume much natural gas. In 1939 natural-gas sales in these States for domestic use and home heating (by utility companies making 93 percent of the sales in New York and 56 percent in Pennsylvania) totaled 42,161,945,000 cubic feet, the equivalent of about 1,730,000 tons of coal.

Shipments of briquets to these markets (including imports which declined to 1 ton in 1939) have decreased steadily since 1936, but in 1939 shipments of briquets of domestic origin were slightly higher than in 1938.

Deliveries of coke of domestic and foreign origin for domestic use also declined in 1937 and 1938 but improved in 1939.

Details showing the apparent consumption of anthracite and selected competitive fuels in the principal anthracite markets, 1936–39, are shown in table 4.

TABLE 4.—*Apparent consumption of anthracite and selected competitive fuels in the principal anthracite markets, 1936–39*

[Thousands of net tons]

Fuel	New England	New York	New Jersey	Delaware	Maryland	Pennsylvania	District of Columbia	Total: Quantity	Total: Percent of total fuels
Anthracite:									
All users:[1]									
1936	4,479	[2] 18,217	[2] 8,482	250	713	13,478	348	45,967	64.1
1937	4,129	[2] 16,695	[2] 7,796	238	655	11,777	296	41,586	60.0
1938	3,553	[2] 13,452	[2] 6,421	198	574	9,603	254	34,055	55.0
1939	4,492	[2] 16,716	[2] 9,060	259	634	12,077	264	43,502	--------
Imports:[3]									
1936	612	1	--------	--------	--------	--------	--------	613	.9
1937	395	--------	--------	--------	--------	--------	--------	395	.6
1938	363	--------	--------	--------	--------	--------	--------	363	.6
1939	298	--------	--------	--------	--------	--------	--------	298	--------
Briquets:									
Domestic use:									
1936	60	57	3	1	4	21	1	147	.2
1937	40	36	2	--------	2	14	1	95	.1
1938	38	27	1	--------	3	11	--------	80	.1
1939	46	23	1	--------	2	11	1	84	--------
Imports:[3]									
1936	20	--------	--------	--------	--------	--------	--------	20	(4)
1937	7	--------	--------	--------	--------	--------	--------	7	(4)
1938	14	--------	--------	--------	--------	--------	--------	14	(4)
1939	1	--------	--------	--------	--------	--------	--------	1	--------
Coke:									
Domestic use:									
1936	1,420	2,234	550	7	9	783	2	5,005	7.0
1937 [5]	1,144	1,800	443	6	7	631	2	4,033	5.8
1938 [5]	1,018	1,604	395	5	7	563	1	3,593	5.8
1939 [5]	1,077	1,696	413	5	7	596	2	3,796	--------
Imports:[3]									
1936	83	120	--------	--------	--------	--------	--------	203	.3
1937	43	77	--------	--------	--------	--------	--------	120	.2
1938	21	7	--------	--------	--------	--------	--------	28	.1
1939	12	19	--------	--------	--------	--------	--------	31	--------
Oil: Heating and range:[6]									
1936	8,003	6,370	2,731	87	477	1,740	343	19,751	27.5
1937	9,358	7,457	3,179	110	578	1,985	390	23,057	33.3
1938	9,649	7,677	3,269	101	591	2,052	406	23,745	38.4
1939	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)	--------
Total fuel:[8]									
1936	14,677	26,999	11,766	345	1,203	16,022	694	71,706	100.0
1937	15,116	26,065	11,420	354	1,242	14,407	689	69,293	100.0
1938	14,656	22,767	10,086	304	1,175	12,229	661	61,878	100.0
1939	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)

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 Bureau of Foreign and Domestic Commerce.
4 Less than 0.05 percent.
5 Estimated on the basis of distribution in 1936.
6 Converted to coal equivalent on the basis of 4 barrels of fuel oil equaling 1 ton of coal.
7 Date not yet available.
8 Does not include bituminous coal.

Receipts of Pennsylvania anthracite in the New England States declined nearly 61 percent from 1917 to 1939; receipts by rail decreased 44 percent and by tide 80 percent. The drop in total receipts between 1917 and 1927 was 23 percent and between 1927 and 1937, 52 percent. Table 5 gives details of receipts of anthracite in New England.

TABLE 5.—*Receipts of anthracite in New England, 1917, 1920, 1923, and 1927–39, in thousands of net tons*

Year	Receipts by tide [1]						Receipts by rail [1]	Imports [2]	Total receipts of Pennsylvania anthracite [3]
	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total			
1917	432	47	2, 222	555	1, 165	4, 421	7, 259	1	11, 679
1920	307	6	2, 015	450	743	3, 521	7, 804	1	11, 324
1923	437	27	2, 216	511	891	4, 082	8, 102	145	12, 039
1927	242	33	1, 220	311	615	2, 421	6, 725	106	9, 040
1928	205	35	1, 373	301	528	2, 442	6, 934	369	9, 007
1929	237	17	1, 227	329	450	2, 260	6, 781	483	8, 558
1930	275	17	1, 236	271	422	2, 221	6, 169	658	7, 732
1931	164	18	1, 125	282	348	1, 937	5, 125	611	6, 451
1932	148	10	1, 014	212	275	1, 659	3, 980	574	5, 065
1933	195	7	1, 027	202	259	1, 690	3, 562	443	4, 809
1934	168	20	946	190	266	1, 590	4, 382	477	5, 495
1935	121	7	802	205	237	1, 372	4, 030	559	4, 843
1936	127	14	792	198	267	1, 398	3, 889	612	4, 675
1937	81	11	604	152	200	1, 048	3, 713	395	4, 366
1938	93	2	554	137	191	977	3, 491	363	4, 105
1939	[4]	[4]	[4]	[4]	[4]	865	4, 042	298	4, 609

[1] Commonwealth of Massachusetts, Division on the Necessaries of Life.
[2] Bureau of Foreign and Domestic Commerce.
[3] Total receipts by rail and by tide less imports. [4] Data not available.

According to a survey of the Commonwealth of Massachusetts, Division on the Necessaries of Life, the consumption of domestic sizes of anthracite in Massachusetts in the coal year 1938–39 (2,320,000 tons) decreased about 7 percent compared with 1937–38 and that of Buckwheat (176,000 tons) declined about 8 percent. Consumption of bituminous coal, coke, and briquets also declined, but that of fuel oil increased slightly.

Stocks.—Stocks of anthracite in the hands of railroads, electric-power utilities, and other industrial consumers at the end of 1939 were 10 percent (148,000 tons) less than at the end of December 1938. Producers' stocks declined 32 percent (464,000 tons) during the year.

Consumption.—Calculated consumption of anthracite—production, plus imports, minus exports, and plus or minus changes in producers' stocks at the beginning and end of the year—was 49,700,000 tons in 1939, a 10-percent increase over 1938. Illicit coal has not been considered in either year.

Consumption of anthracite by railroads in 1939 was 20 percent above 1938; consumption by electric power utilities rose 14 percent and other industrial consumption 1 percent over 1938.

Labor.—A new 2-year labor contract (expiring April 30, 1941) was concluded between the anthracite-mine operators and the United Mine Workers of America. The contract provides for recognition of the United Mine Workers of America as the exclusive bargaining agency and continues the 35-hour workweek, the prevailing rates of pay, and the general provisions of the previous agreement.

Favorable relations between the anthracite-producing companies and labor have resulted in closer cooperation on matters vitally affecting the industry.

TABLE 6.—*Total supplies of fuels commonly used for domestic purposes in the United States, 1924 and 1936–39*

[Wherever available the figures represent the quantity actually consumed for domestic heating or for 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 purposes, the total production (or imports) is shown to indicate the trend of growth]

	1924	1936	1937	1938	1939
SOLID FUELS (NET TONS)					
Anthracite:					
Production:					
Shipments of domestic sizes	56, 576, 296	30, 472, 986	29, 092, 974	26, 206, 508	29, 504, 632
Shipments of Buckwheat No. 1 [1]	9, 510, 508	7, 507, 767	6, 859, 707	6, 159, 006	6, 569, 902
Shipments of smaller steam sizes	11, 160, 695	10, 667, 247	10, 250, 463	8, 698, 355	9, 917, 748
Local sales	3, 043, 939	3, 226, 887	2, 981, 391	2, 722, 206	3, 081, 073
Total commercial production	80, 291, 438	51, 874, 887	49, 184, 535	43, 786, 075	49, 073, 355
Exports	4, 017, 785	1, 678, 024	1, 914, 173	1, 908, 911	2, 590, 000
Imports for consumption (chiefly from United Kingdom and U. S. S. R.)	117, 951	614, 639	395, 737	362, 895	298, 153
Fuel briquets [2]	580, 508	[3] 1, 145, 323	977, 254	868, 382	880, 981
Packaged-fuel production		66, 427	146, 037	160, 952	215, 507
Coke:					
Byproduct sales for domestic use	2, 812, 771	9, 643, 507	7, 807, 792	7, 129, 384	7, 549, 937
Beehive sales for domestic use	139, 886	377, 836	299, 726	93, 306	88, 204
Imports for consumption	82, 833	329, 959	286, 364	135, 240	141, 911
Gas-house-coke sales [4]	1, 400, 000	403, 600	350, 700	342, 300	362, 000
Petroleum-coke production	761, 100	1, 378, 200	1, 306, 600	1, 602, 200	[5] 1, 666, 400
Anthracite and semianthracite production outside of Pennsylvania	704, 513	520, 452	468, 852	370, 665	(6)
Lignite production [7]	2, 255, 385	3, 109, 689	3, 218, 419	2, 997, 921	[5] 2, 972, 000
Bituminous-coal sales for domestic use	(8)	(8)	(8)	(8)	(8)
OIL (BARRELS OF 42 GALLONS)					
Oil sales for heating buildings:					
Range oil [9]	(6)	27, 292, 000	[3] 32, 259, 000	33, 707, 000	[10] 36, 500, 000
Heating oils.[11]					
Domestic	5, 021, 000	99, 257, 000	[3] 116,617,000	118, 323, 000	[10] 135,125,000
Commercial	(6)				
Liquefied petroleum gases, domestic	(6)	714, 600	972, 000	1, 377, 000	2, 084. 000
GAS (MILLION CUBIC FEET)					
Natural-gas consumption for domestic and commercial use [12]	285, 152	454, 969	489, 234	482, 068	[5] 510, 000
Manufactured-gas sales for: [13]					
Domestic use	(6)	197, 240	194, 350	197, 052	194, 014
House heating	(6)	41, 146	45, 525	47, 918	56, 048

[1] A considerable part of the Buckwheat No. 1 is used for domestic purposes.
[2] Production plus imports less exports. [3] Revised figures. [4] Partly estimated.
[5] Subject to revision. [6] Data not available. [7] An estimated two-thirds is used for domestic purposes.
[8] Exact data not available; estimated between 55,000,000 and 77,000,000 tons a year, including lignite and anthracite and semianthracite outside of Pennsylvania, which are shown separately.
[9] Range oil is a light distillate used for house heating, hot-water heating, and cooking.
[10] Estimated. [11] Includes all grades of fuel oil used for heating buildings.
[12] Includes gas used for heating offices, hotels, apartments, schools, hospitals, and stores and other large buildings, as well as houses.
[13] American Gas Association. Data revised as of March 1940.

Pennsylvania anthracite industry.—Trade practice and historical usage recognize two major divisions in the coal industry of the United States—bituminous coal and Pennsylvania anthracite. Anthracite and semianthracite also are mined in parts of Virginia, Arkansas, Colorado, and New Mexico. Locally these coals represent distinct and important industries, but the tonnages involved are small and for statistical convenience usually are grouped with the totals of the bituminous-coal industry. Tables in the chapter on Bituminous Coal in this volume record the 1938 production of anthracite and semianthracte outside of Pennsylvania; data for 1939 are not yet available.

The Pennsylvania anthracite industry, as here defined, includes all nonbituminous fields of that State. Trade usage commonly includes with Pennsylvania anthracite the output of the Bernice Basin in Sullivan County, although the coal of this basin is classified officially as semianthracite.

SOURCES AND ACKNOWLEDGMENTS

Annual statistics of the Pennsylvania anthracite-mining industry are prepared from a canvass by mail of all known anthracite operations, including over 400 active producers. About 95 percent of the tonnage is reported directly by producers, and the remaining 5 percent is estimated on collateral evidence. The data on individual operations furnished by the producers are voluntary and confidential, as is customary in the statistical services of the Bureau of Mines.

The standard form of report, as developed by the Bureau and its predecessor in mineral statistics, the Geological Survey, provides for data on production, shipments, mine realization of products, mine stocks, plant and equipment, and employment.

In assembling available detailed information free use has been made of the pertinent figures prepared by the Anthracite Institute, the American Association of Railroads, and the Pennsylvania Department of Mines, to all of whom thanks are extended for their cordial and continued cooperation. Thanks are due especially to the producers for reporting so promptly and, in general, so fully upon their operations in 1939, when the year as a whole was so critical for the industry.

PRODUCTION

By weeks and months.—The following tables summarize the statistics of weekly and monthly production of anthracite. Statistics of current output are estimated from tonnage reports from trade sources and from records of car loadings. The weekly and monthly figures in tables 7 and 8 have been adjusted to the annual total ascertained by direct canvass of the operators.

TABLE 7.—*Estimated weekly production of Pennsylvania anthracite in 1939, in net tons*

Week ended—	Weekly production	Number of working days	Daily average	Week ended—	Weekly production	Number of working days	Daily average
Jan. 7	943,000	5	188,600	July 15	773,000	6	128,800
Jan. 14	1,042,000	6	173,700	July 22	768,000	6	128,000
Jan. 21	1,236,000	6	206,000	July 29	758,000	6	126,300
Jan. 28	1,329,000	6	221,500	Aug. 5	776,000	6	129,300
Feb. 4	1,224,000	6	204,000	Aug. 12	833,000	6	138,800
Feb. 11	1,121,000	6	186,800	Aug. 19	783,000	6	130,500
Feb. 18	865,000	6	144,200	Aug. 26	856,000	6	142,700
Feb. 25	986,000	5.5	179,300	Sept. 2	929,000	6	154,800
Mar. 4	927,000	6	154,500	Sept. 9	832,000	5	166,400
Mar. 11	779,000	6	129,800	Sept. 16	1,215,000	6	202,500
Mar. 18	802,000	6	133,700	Sept. 23	1,362,000	6	227,000
Mar. 25	800,000	6	133,300	Sept. 30	1,271,000	6	211,800
Apr. 1	814,000	5	162,800	Oct. 7	1,262,000	6	210,300
Apr. 8	997,000	6	166,200	Oct. 14	1,240,000	6	206,700
Apr. 15	1,228,000	6	204,700	Oct. 21	1,210,000	6	201,700
Apr. 22	1,539,000	6	256,500	Oct. 28	1,149,000	6	191,500
Apr. 29	1,575,000	6	262,500	Nov. 4	753,000	5	150,600
May 6	1,497,000	6	249,500	Nov. 11	930,000	5	186,000
May 13	1,483,000	6	247,200	Nov. 18	911,000	6	151,800
May 20	936,000	6	156,000	Nov. 25	806,000	5	161,200
May 27	836,000	6	139,300	Dec. 2	856,000	6	142,700
June 3	767,000	5	153,400	Dec. 9	374,000	6	62,300
June 10	839,000	6	139,800	Dec. 16	1,114,000	6	185,700
June 17	763,000	6	127,200	Dec. 23	1,249,000	6	208,200
June 24	746,000	6	124,300	Dec. 30	1,034,000	5	206,800
July 1	878,000	6	146,300				
July 8	491,000	5	98,200	Calendar year	51,487,000	302.5	170,200

TABLE 8.—*Estimated monthly production of Pennsylvania anthracite, 1936–39* [1]

[Production figures represent thousands of net tons]

Month	1936			1937			1938			1939		
	Monthly production	Number of working days	Daily average	Monthly production	Number of working days	Daily average	Monthly production	Number of working days	Daily average	Monthly production	Number of working days	Daily average
January	5,315	26	204	4,236	25	169	4,978	25	199	5,019	25	201
February	6,952	24.5	284	3,671	23.5	156	3,646	23.5	155	4,169	23.5	177
March	3,051	26	117	4,795	27	178	4,257	27	158	3,652	27	135
April	4,757	25	190	6,779	25	271	3,149	25	126	5,367	24	224
May	5,104	25	204	4,361	25	174	4,400	25	176	5,141	26	198
June	4,292	26	165	4,635	26	178	4,450	26	171	3,577	26	138
July	3,912	26	151	2,748	26	106	2,580	25	103	2,951	25	118
August	3,492	26	134	2,903	26	112	2,735	27	101	3,883	27	144
September	3,861	25	154	3,682	25	147	3,388	25	136	4,840	25	194
October	4,593	26	177	4,848	25	194	4,180	25	167	4,985	25	199
November	4,320	23	188	4,439	24	185	3,803	24	159	3,989	24	166
December	4,931	26	190	4,759	26	183	4,533	26	174	3,914	25	157
	54,580	304.5	179	51,856	303.5	171	46,099	303.5	152	51,487	302.5	170

[1] Production is estimated from weekly car loadings as reported by the Association of American Railroads and includes mine fuel, coal sold locally, and dredge coal. Does not include an unknown amount of "bootleg" production. In computing the average rates per working day, New Year's, Eight-hour Day (Apr. 1), Memorial Day, Independence Day, Labor Day, Mitchell Day (Oct. 29), Thanksgiving Day, Christmas, and, since the war, Armistice Day, have been counted as holidays. Beginning with 1927, Washington's Birthday is counted as a half holiday. No allowance, however, has been made for church holy days, which are observed by many of the miners. Monthly statistics from 1905 to 1925 will be found in Coal in 1925, pp. 427–428, and from 1926 to 1930 in Coal in 1930, p. 741.

Illicit coal.—A survey by the Pennsylvania Department of Mines shows that, in the latter part of 1939, 2,500 illicit or "bootleg" holes were in operation in the Pennsylvania anthracite region and that 9,000 men were employed. November production is shown as 340,000 tons. There were 337 breakers in the region, and 1,353 truckers hauled coal to the breakers. The estimated illicit production of coal in the region in 1939 was between 3,500,000 and 4,000,000 tons, or about 8 percent of the total Pennsylvania anthracite output. Competition resulting from the production of illicit coal is out of all proportion to the tonnage produced. Low market prices are possible because the capital invested is small and nothing is paid for the coal. Wages are well below the regular scale. Safety measures are inadequate, and 58 lives were reported lost during the year.

Regions, fields, and counties.—The main anthracite region covers an elongated area of about 480 square miles in eastern Pennsylvania, with its longer axis running northeast and southwest. It embraces three subregions as follows, from the northeast to the southwest: The Wyoming region, which covers a single geologic anthracite basin and is about 54 miles long by 6 miles wide at its widest point; the Lehigh region, which comprises the anthracite lands tributary to the Lehigh River that forms its eastern boundary and contains the Eastern Middle field and the section of the Southern field lying east of Tamaqua; and the Schuylkill region, which consists of the Western Middle field and the section of the Southern field lying west of Tamaqua.

The area may also be divided into four fields, using the grouping of the anthracite geologic basins as a framework, as follows: The Northern field, which is the same as the Wyoming region; the Eastern Middle or Lehigh field, which consists of a group of at least 10 small basins; the Western Middle field, a single basin about 36 miles long by 4½ miles at its widest point; and the Southern field, also a single basin, about 54 miles long by 6 miles at its widest point, which breaks into a long "fishtail" toward its western ends.

Both classifications (by regions and by fields) are used in the Bureau tables.

In order of magnitude of present production, the Northern field comes first, followed by the Western Middle, the Southern, and the Eastern Middle.

In order of length of life, based upon estimated minable reserves, the Southern field comes first, followed by the Western Middle, the Northern, and the Eastern Middle fields.

TABLE 9.—*Pennsylvania anthracite shipped, sold locally, and used as colliery fuel in 1939, 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 [2]	8,034,425	$30,639,000	265,076	$1,219,000	376,432	$655,000	8,675,933	$32,513,000
Dredges	48,054	55,000	14,080	18,000			62,134	73,000
Total Lehigh	8,082,479	30,694,000	279,156	1,237,000	376,432	655,000	8,738,067	32,586,000
Schuylkill:								
Breakers	11,376,935	41,468,000	523,311	1,536,000	306,430	464,000	12,206,676	43,468,000
Washeries	1,675,510	3,652,000	51,642	186,000	35,499	48,000	1,762,651	3,886,000
Dredges	517,182	530,000	106,317	110,000	1,160	1,000	624,659	641,000
Total Schuylkill	13,569,627	45,650,000	681,270	1,832,000	343,089	513,000	14,593,986	47,995,000
Wyoming:								
Breakers	24,242,243	95,849,000	1,971,337	8,202,000	1,592,887	1,731,000	27,806,467	105,782,000
Washeries	90,874	235,000	105,505	347,000	98,724	102,000	295,103	684,000
Dredges			17,067	32,000			17,067	32,000
Total Wyoming	24,333,117	96,084,000	2,093,909	8,581,000	1,691,611	1,833,000	28,118,637	106,498,000
Total, excluding Sullivan County:								
Breakers [2]	43,653,603	167,956,000	2,759,724	10,957,000	2,275,749	2,850,000	48,689,076	181,763,000
Washeries [2]	1,766,384	3,887,000	157,147	533,000	134,223	150,000	2,057,754	4,570,000
Dredges	565,236	585,000	137,464	160,000	1,160	1,000	703,860	746,000
Total	45,985,223	172,428,000	3,054,335	11,650,000	2,411,132	3,001,000	51,450,690	187,079,000
Sullivan County: [3] Breakers	7,059	17,000	26,738	76,000	2,890	3,000	36,687	96,000
Grand total: 1939	45,992,282	172,445,000	3,081,073	11,726,000	2,414,022	3,004,000	51,487,377	187,175,000
1938	41,063,869	166,839,000	2,722,206	10,682,000	2,312,952	3,079,000	46,099,027	180,600,000
Change, 1939 .... percent	+12.0	+3.4	+13.2	+9.8	+4.4	−2.4	+11.7	+3.6

[1] Value given is value at which coal left possession of producing company, f. o. b. mines, and does not include margins of separately incorporated sales companies.
[2] Small quantity of washery coal included with breaker.
[3] 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 10.—*Pennsylvania anthracite produced, by fields, 1935–39, in net tons*

[The figures of breaker product include a certain quantity of culm-bank coal, which amounted to 585,564 tons in 1938. Data for 1913–25 will be found in Coal in 1925, p. 517, and for 1926–30 in Coal in 1930, p. 747]

Field	1935	1936	1937	1938	1939
Eastern Middle: Breakers	5, 248, 176	6, 102, 979	6, 045, 813	5, 217, 169	[1] 5, 444, 335
Western Middle:					
Breakers	10, 231, 664	11, 469, 078	10, 381, 521	8, 877, 485	9, 242, 223
Washeries	1, 483, 023	1, 510, 913	1, 456, 505	940, 938	906, 992
Dredges	231, 711	221, 800	264, 588	223, 961	253, 819
Total Western Middle	11, 946, 398	13, 201, 791	12, 102, 614	10, 042, 384	10, 403, 034
Southern:					
Breakers	6, 091, 307	6, 439, 213	5, 849, 381	5, 447, 804	6, 196, 051
Washeries	99, 204	438, 465	218, 541	625, 335	855, 659
Dredges	339, 529	303, 984	468, 386	317, 572	432, 974
Total Southern	6, 530, 040	7, 181, 662	6, 536, 308	6, 390, 711	7, 484, 684
Northern:					
Breakers	27, 700, 235	27, 448, 035	26, 707, 743	24, 059, 598	27, 806, 467
Washeries	524, 742	405, 615	347, 959	310, 491	295, 103
Dredges	19, 227	20, 900	27, 500	29, 491	17, 067
Total Northern	28, 244, 204	27, 874, 550	27, 083, 202	24, 399, 580	28, 118, 637
Total, excluding Sullivan County:					
Breakers	49, 271, 382	51, 459, 305	48, 984, 458	43, 602, 056	[1] 48, 689, 076
Washeries	2, 106, 969	2, 354, 993	2, 023, 005	1, 876, 764	[1] 2, 057, 754
Dredges	590, 467	546, 684	760, 474	571, 024	703, 860
	51, 968, 818	54, 360, 982	51, 767, 937	46, 049, 844	51, 450, 690
Sullivan County: Breakers	189, 965	218, 553	88, 496	49, 183	36, 687
Grand total	52, 158, 783	54, 579, 535	51, 856, 433	46, 099, 027	51, 487, 377

[1] Small amount of washery coal included with breaker.

TABLE 11.—*Pennsylvania anthracite produced in 1939, by counties*

County	Shipments		Local sales		Colliery fuel		Total	
	Net tons	Value [1]	Net tons	Value	Net tons	Value	Net tons	Value [1]
Carbon	2, 016, 250	$7, 181, 000	83, 468	$344, 000	75, 799	$180, 000	2, 175, 517	$7, 705, 000
Columbia	206, 692	778, 000	32, 181	45, 000	6, 023	7, 000	244, 896	830, 000
Dauphin and Lebanon	517, 076	1, 878, 000	61, 515	92, 000	4, 413	7, 000	583, 004	1, 977, 000
Lackawanna	7, 403, 435	29, 150, 000	801, 767	3, 367, 000	512, 466	659, 000	8, 717, 668	33, 176, 000
Luzerne	20, 519, 161	81, 339, 000	1, 444, 803	5, 938, 000	1, 382, 402	1, 517, 000	23, 346, 366	88, 794, 000
Northumberland	4, 755, 164	16, 512, 000	326, 028	836, 000	48, 437	81, 000	5, 129, 629	17, 429, 000
Schuylkill	10, 327, 279	34, 901, 000	280, 764	988, 000	377, 706	543, 000	10, 985, 749	36, 432, 000
Sullivan	7, 059	17, 000	26, 738	76, 000	2, 890	3, 000	36, 687	96, 000
Susquehanna and Wayne	155, 240	595, 000	3, 692	15, 000	3, 886	7, 000	162, 818	617, 000
Berks, Northampton, and York [2]	84, 926	94, 000	20, 117	25, 000			105, 043	119, 000
	45, 992, 282	172, 445, 000	3, 081, 073	11, 726, 000	2, 414, 022	3, 004, 000	51, 487, 377	187, 175, 000

[1] Value given for shipments is value at which coal left possession of producing company, f. o. b. mines and does not include margins of separately incorporated sales companies.
[2] Counties producing dredge coal only.

Fresh-mined and culm-bank coal, breaker, and washery product.—Anthracite is now produced from three sources—from mines, from old culm banks, and from the rivers that drain the anthracite region. As the three sources contribute to the country's supply, it is important to consider all of them to ascertain the total production. No difficulty is experienced in assembling the figures of production by dredges, as these are separate, distinct operations. A statistical detail requiring especial attention is the occasional practice of putting culm-bank coal through a breaker, either directly from the bank or after preliminary treatment in a washery. Table 14 shows the aggregate annual tonnages of culm-bank coal so treated.

TABLE 12.—*Pennsylvania anthracite produced in 1939, classified as fresh-mined, culm-bank, and river coal and as breaker, washery, and dredge product, by regions, in net tons*

[Exclusive of change in stock]

Region and type of plant	From mines			From culm banks	From river dredging	Total
	Underground		Strip pits			
	Mechanically loaded	Hand-loaded				
Lehigh:						
Breakers [1]	701,710	5,693,188	2,217,799	64,180		8,676,877
Dredges					62,134	62,134
Total Lehigh	701,710	5,693,188	2,217,799	64,180	62,134	8,739,011
Schuylkill:						
Breakers	1,519,048	7,848,985	2,337,985	451,499		12,157,517
Washeries			60,188	1,708,049		1,768,237
Dredges					624,659	624,659
Total Schuylkill	1,519,048	7,848,985	2,398,173	2,159,548	624,659	14,550,413
Wyoming:						
Breakers	9,553,075	17,218,855	853,937	69,885		27,695,752
Washeries			16,570	290,201		306,771
Dredges					17,067	17,067
Total Wyoming	9,553,075	17,218,855	870,507	360,086	17,067	28,019,590
Total, excluding Sullivan County:						
Breakers [1]	11,773,833	30,761,028	5,409,721	585,564		48,530,146
Washeries			76,758	1,998,250		2,075,008
Dredges					703,860	703,860
Total	11,773,833	30,761,028	5,486,479	2,583,814	703,860	51,309,014
Sullivan County: Breakers		36,687				36,687
Grand total: 1939	11,773,833	30,797,715	5,486,479	2,583,814	703,860	51,345,701
1938	10,151,669	27,990,628	5,095,341	2,340,444	571,024	46,149,106
Change, 1939 percent	+16.0	+10.0	+7.7	+10.4	+23.3	+11.3

[1] Small quantity of washery coal included with breaker.

TABLE 13.—*Pennsylvania anthracite produced in 1939, classified as fresh-mined, culm-bank, and river coal and as breaker, washery, and dredge product, by fields, in net tons*

[Exclusive of change in stock]

Field and type of plant	From mines			From culm banks	From river dredging	Total
	Underground		Strip pits			
	Mechanically loaded	Hand-loaded				
Eastern Middle: Breakers [1]	701,710	3,241,003	1,486,049	16,517		5,445,279
Western Middle:						
Breakers	1,438,763	5,969,632	1,584,437	203,947		9,196,779
Washeries			60,188	846,804		906,992
Dredges					253,819	253,819
Total Western Middle	1,438,763	5,969,632	1,644,625	1,050,751	253,819	10,357,590
Southern:						
Breakers	80,285	4,331,538	1,485,298	295,215		6,192,336
Washeries				861,245		861,245
Dredges					432,974	432,974
Total Southern	80,285	4,331,538	1,485,298	1,156,460	432,974	7,486,555
Northern:						
Breakers	9,553,075	17,218,855	853,937	69,885		27,695,752
Washeries			16,570	290,201		306,771
Dredges					17,067	17,067
Total Northern	9,553,075	17,218,855	870,507	360,086	17,067	28,019,590
Total, excluding Sullivan County:						
Breakers [1]	11,773,833	30,761,028	5,409,721	585,564		48,530,146
Washeries			76,758	1,998,250		2,075,008
Dredges					703,860	703,860
Total	11,773,833	30,761,028	5,486,479	2,583,814	703,860	51,309,014
Sullivan County: Breakers		36,687				36,687
Grand total	11,773,833	30,797,715	5,486,479	2,583,814	703,860	51,345,701

[1] Small quantity of washery coal included with breaker.

TABLE 14.—*Culm-bank coal put through breakers, 1935–39, by fields, in net tons*

Year	Northern	Eastern Middle	Western Middle	Southern	Total [1]
1935	236,000	143,000	61,000	177,000	617,000
1936	122,000	84,000	148,000	633,000	987,000
1937	95,000	67,000	102,000	606,000	870,000
1938	52,000	11,000	44,000	455,000	562,000
1939	70,000	17,000	204,000	295,000	586,000

[1] No culm-bank coal is put through breakers in Sullivan County.

SHIPMENTS, BY REGIONS AND SIZES

Shipments of anthracite, by regions and sizes, are given in table 15.

TABLE 15.—*Pennsylvania anthracite shipped in 1939, by regions and sizes* [1]

Size	Breaker shipments						Washery shipments	Dredge shipments	Grand total
	Lehigh region	Schuylkill region	Wyoming region	Sullivan County	Total				
					Excluding Sullivan County	Including Sullivan County			
Net tons									
Lump [2] and broken	40,410	45,811	162,669		248,890	248,890			248,890
Egg	323,367	440,720	1,509,589		2,273,676	2,273,676	1,316		2,274,992
Stove	1,854,824	2,168,049	6,503,860	993	10,526,733	10,527,726	29,955		10,557,681
Chestnut	2,000,644	2,715,965	6,569,994	1,365	11,286,603	11,287,968	168,672		11,456,640
Pea	941,541	1,319,876	2,536,587	952	4,798,004	4,798,956	167,090	383	4,966,429
Total domestic	5,160,786	6,690,421	17,282,699	3,310	29,133,906	29,137,216	367,033	383	29,504,632
Buckwheat No. 1	1,246,469	1,794,366	3,185,426	640	6,226,261	6,226,901	331,589	11,412	6,569,902
Buckwheat No. 2 (Rice) [3]	668,822	1,010,288	1,731,591	1,046	3,410,701	3,411,747	297,990	27,920	3,737,657
Buckwheat No. 3 (Barley)	670,342	1,333,274	1,701,841		3,705,457	3,705,457	450,330	182,626	4,338,413
Buckwheat No. 4	249,721	395,436	251,046		896,203	896,203	289,983	219,066	1,405,252
Boiler								12,300	12,300
Other	33,691	153,150	89,640	2,063	276,481	278,544	34,053	111,529	424,126
Total steam [4]	2,869,045	4,686,514	6,959,544	3,749	14,515,103	14,518,852	1,403,945	564,853	16,487,650
Grand total	8,029,831	11,376,935	24,242,243	7,059	43,649,009	43,656,068	1,770,978	565,236	45,992,282
Value									
Lump [2] and broken	$199,000	$241,000	$713,000		$1,153,000	$1,153,000			$1,153,000
Egg	1,528,000	2,180,000	7,049,000		10,757,000	10,757,000	$6,000		10,763,000
Stove	9,031,000	10,795,000	31,146,000	$4,000	50,972,000	50,976,000	136,000		51,112,000
Chestnut	9,911,000	13,530,000	31,482,000	6,000	54,923,000	54,929,000	741,000		55,670,000
Pea	3,515,000	4,868,000	9,123,000	3,000	17,506,000	17,509,000	578,000	$1,000	18,088,000
Total domestic	24,184,000	31,614,000	79,513,000	13,000	135,311,000	135,324,000	1,461,000	1,000	136,786,000
Buckwheat No. 1	3,657,000	5,095,000	9,315,000	2,000	18,067,000	18,069,000	897,000	28,000	18,994,000
Buckwheat No. 2 (Rice) [3]	1,448,000	2,228,000	3,821,000	1,000	7,497,000	7,498,000	615,000	45,000	8,158,000
Buckwheat No. 3 (Barley)	1,107,000	2,007,000	2,893,000		6,007,000	6,007,000	660,000	178,000	6,845,000

Buckwheat No. 4	215,000	358,000	235,000	----------	808,000	808,000	239,000	141,000	1,188,000
Boiler	----------	----------	----------	----------	----------	----------	----------	12,000	12,000
Other	20,000	166,000	72,000	1,000	258,000	259,000	23,000	180,000	462,000
Total steam [4]	6,447,000	9,854,000	16,336,000	4,000	32,637,000	32,641,000	2,434,000	584,000	35,659,000
Grand total	30,631,000	41,468,000	95,849,000	17,000	167,948,000	167,965,000	3,895,000	585,000	172,445,000
Average value per ton									
Lump [2] and broken	$4.92	$5.26	$4.38	----------	$4.63	$4.63	----------	----------	$4.63
Egg	4.73	4.95	4.67	----------	4.73	4.73	$4.56	----------	4.73
Stove	4.87	4.98	4.79	$4.03	4.84	4.84	4.54	----------	4.84
Chestnut	4.95	4.98	4.79	4.40	4.87	4.87	4.39	----------	4.86
Pea	3.73	3.69	3.60	3.15	3.65	3.65	3.46	$2.61	3.64
Total domestic	4.69	4.73	4.60	3.93	4.64	4.64	3.98	2.61	4.64
Buckwheat No. 1	2.93	2.84	2.92	3.13	2.90	2.90	2.71	2.45	2.89
Buckwheat No. 2 (Rice) [3]	2.17	2.21	2.21	.96	2.20	2.20	2.06	1.61	2.18
Buckwheat No. 3 (Barley)	1.65	1.51	1.70	----------	1.62	1.62	1.47	.97	1.58
Buckwheat No. 4	.86	.91	.94	----------	.90	.90	.82	.64	.85
Boiler	----------	----------	----------	----------	----------	----------	----------	.98	.98
Other	.59	1.08	.80	.48	.93	.93	.68	1.61	1.09
Total steam [4]	2.25	2.10	2.35	1.07	2.25	2.25	1.73	1.03	2.16
Grand total	3.81	3.64	3.95	2.41	3.85	3.85	2.20	1.03	3.75

[1] Figures of shipments from breakers include 585,564 tons of culm-bank coal handled in the breakers.
[2] The quantity of lump included is insignificant.
[3] Includes Birdseye.
[4] Includes all steam sizes.

Table 16 reveals an interregional variation in the breaker production of domestic sizes as related to that of steam sizes and to total production. In 1939 the Wyoming region produced 71 percent domestic sizes and 29 percent steam sizes from a given tonnage of breaker feed; the Lehigh region, 64 percent domestic and 36 percent steam sizes; and the Schuylkill region, 59 percent domestic and 41 percent steam sizes. These percentages are relatively constant from year to year. The variations among the regions are due to differences in the physical situation and condition of the anthracite beds.

TABLE 16.—*Sizes of Pennsylvania anthracite shipped from breakers, 1937–39, by regions, in percent of total*

[Note that shipments of dredge and washery coal are not included]

Size of coal	Percent of total shipments								
	Lehigh region			Schuylkill region			Wyoming region		
	1937	1938	1939	1937	1938	1939	1937	1938	1939
Lump [1] and broken	0.5	0.4	0.5	0.5	0.4	0.4	0.3	0.2	0.7
Egg	4.8	4.5	4.0	4.9	4.2	3.9	6.5	6.3	6.2
Stove	21.0	23.0	23.1	18.1	19.3	19.0	24.7	26.2	26.8
Chestnut	25.6	24.7	24.9	23.0	23.6	23.9	28.1	27.6	27.1
Pea	11.5	12.0	11.8	11.0	11.0	11.6	10.4	10.0	10.5
Total domestic	63.4	64.6	64.3	57.5	58.5	58.8	70.0	70.3	71.3
Buckwheat No. 1	15.9	15.6	15.5	15.8	16.3	15.8	13.7	13.7	13.2
Buckwheat No. 2 (Rice) [2]	8.4	8.3	8.3	8.7	8.8	8.9	7.2	7.1	7.1
Buckwheat No. 3 (Barley)	9.2	8.5	8.4	11.2	10.7	11.7	7.7	7.5	7.0
Boiler	------	------	------	------	------	------	------	------	------
Other, including Buckwheat No. 4	3.1	3.0	3.5	6.8	5.7	4.8	1.4	1.4	1.4
Total steam [3]	36.6	35.4	35.7	42.5	41.5	41.2	30.0	29.7	28.7

Size of coal	Sullivan County			Total					
				Excluding Sullivan County			Including Sullivan County		
Lump [1] and broken	------	11.3	------	0.4	0.3	0.6	0.4	0.3	0.6
Egg	1.8	------	------	5.7	5.4	5.2	5.7	5.4	5.2
Stove	15.9	10.8	14.1	22.2	23.7	24.1	22.1	23.7	24.1
Chestnut	15.8	26.4	19.3	26.2	26.0	25.8	26.2	26.0	25.8
Pea	9.5	16.6	13.5	10.7	10.6	11.0	10.8	10.6	11.0
Total domestic	43.0	65.1	46.9	65.2	66.0	66.7	65.2	66.0	66.7
Buckwheat No. 1	10.2	10.6	9.1	14.7	14.8	14.3	14.7	14.8	14.3
Buckwheat No. 2 (Rice) [2]	12.8	14.7	14.8	7.9	7.7	7.8	7.9	7.7	7.8
Buckwheat No. 3 (Barley)	------	------	------	9.0	8.6	8.5	8.9	8.6	8.5
Boiler	2.3	------	------	(4)	------	------	(4)	------	------
Other, including Buckwheat No. 4	31.7	9.6	29.2	3.2	2.9	2.7	3.3	2.9	2.7
Total steam [3]	57.0	34.9	53.1	34.8	34.0	33.3	34.8	34.0	33.3

[1] The quantity of lump included is insignificant.
[2] Includes Birdseye.
[3] Includes all steam sizes.
[4] Less than 0.1 percent.

AVERAGE SALES REALIZATION

The valuation figures in this study represent value at the breaker or washery reported by the operating companies. The company is requested to "estimate value of the product not sold" and to "exclude selling expenses" in making its report.

From this it will be seen that when a producing company sells its output to a separately organized sales company (the practice of many, including certain larger producers) 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 between different regions shown in the tables for the same sizes of coal.

The average sales realization per net ton on breaker shipments only fell to $3.85 in 1939 from $4.16 in 1938, or 7 percent. By far the greater decrease was in the domestic sizes—9 percent. The drop in steam sizes was only 3 percent.

If local sales, colliery fuel, and washery and dredge coal are included, the average value per net ton on the total 1939 production was $3.64 compared with $3.92 in 1938. (See table 18.)

TABLE 17.—*Average sales realization per net ton on Pennsylvania anthracite shipments from breakers, 1937–39, by regions and sizes*

[Value does not include margins of separately incorporated sales companies]

Size	Lehigh region			Schuylkill region			Wyoming region		
	1937	1938	1939	1937	1938	1939	1937	1938	1939
Lump [1] and broken	$4.96	$5.17	$4.92	$5.24	$5.50	$5.26	$5.01	$5.16	$4.38
Egg	5.01	5.11	4.73	5.14	5.27	4.95	5.04	5.16	4.67
Stove	5.25	5.36	4.87	5.26	5.39	4.98	5.19	5.31	4.79
Chestnut	5.25	5.43	4.95	5.31	5.41	4.98	5.20	5.32	4.79
Pea	4.04	3.93	3.73	3.96	3.80	3.69	4.02	3.91	3.60
Total domestic	5.01	5.10	4.69	5.02	5.09	4.73	5.00	5.10	4.60
Buckwheat No. 1	2.98	3.06	2.93	2.87	2.93	2.84	3.00	3.08	2.92
Buckwheat No. 2 (Rice) [2]	2.29	2.36	2.17	2.17	2.27	2.21	2.31	2.39	2.21
Buckwheat No. 3 (Barley)	1.43	1.61	1.65	1.33	1.50	1.51	1.55	1.69	1.70
Total steam [3]	2.24	2.35	2.25	1.99	2.13	2.10	2.37	2.47	2.35
Total all sizes	3.99	4.13	3.81	3.73	3.86	3.64	4.21	4.32	3.95

Size	Sullivan County			Total					
				Excluding Sullivan County			Including Sullivan County		
Lump [1] and broken	--------	$3.00	--------	$5.08	$5.28	$4.63	$5.08	$5.24	$4.63
Egg	$3.97	--------	--------	5.06	5.18	4.73	5.06	5.18	4.73
Stove	4.46	3.00	$4.03	5.21	5.33	4.84	5.21	5.33	4.84
Chestnut	3.07	3.00	4.40	5.23	5.36	4.87	5.23	5.36	4.87
Pea	2.56	2.52	3.15	4.01	3.88	3.65	4.01	3.88	3.65
Total domestic	3.51	2.88	3.93	5.01	5.10	4.64	5.01	5.10	4.64
Buckwheat No. 1	2.00	1.50	3.13	2.95	3.03	2.90	2.95	3.03	2.90
Buckwheat No. 2 (Rice) [2]	.75	.50	.96	2.26	2.35	2.20	2.26	2.35	2.20
Buckwheat No. 3 (Barley)	--------	--------	--------	1.45	1.61	1.62	1.45	1.61	1.62
Total steam [3]	1.03	.73	1.07	2.21	2.33	2.25	2.21	2.33	2.25
Total all sizes	2.10	2.13	2.41	4.03	4.16	3.85	4.03	4.16	3.85

[1] The quantity of lump included is insignificant. [2] Includes Birdseye. [3] Includes all steam sizes.

TABLE 18.—*Average value per net ton of Pennsylvania anthracite shipped, local sales, colliery fuel, and total production, 1938–39, by regions* [1]

[Note that values in this table include washery and dredge coal]

Region	1938				1939			
	Shipments	Local sales	Colliery fuel	Total production	Shipments	Local sales	Colliery fuel	Total production
Lehigh	$4.11	$4.65	$1.80	$4.01	$3.80	$4.43	$1.74	$3.73
Schuylkill	3.63	3.00	1.56	3.51	3.36	2.69	1.50	3.29
Wyoming	4.31	4.35	1.13	4.12	3.95	4.10	1.08	3.79
Total, excluding Sullivan County	4.06	3.93	1.33	3.92	3.75	3.81	1.24	3.64
Sullivan County	2.13	2.92	.83	2.49	2.41	2.84	1.04	2.62
Grand total	4.06	3.92	1.33	3.92	3.75	3.81	1.24	3.64

[1] Value given for shipments is value at which coal left possession of producing company, f. o. b. mines, and does not include margins of separately incorporated sales companies.

NUMBER OF OPERATIONS

The total number of active plants reporting increased from 390 in 1937 to 442 in 1938. (See table 19.) Figures for 1939 are not yet available, but indications are that the upward trend continued.

TABLE 19.—*Number of active operations in the Pennsylvania anthracite industry in 1938* [1]

Region and type of product	Total active plants reporting [2]	Breakers [3]	Other preparation plant [4]	Washeries [5]	Culm banks operated in conjunction with breakers	Dredges	Reporting strip-pit tonnage
Lehigh:							
Breakers or mines	41	26	1		6		39
Dredges	2		1			2	
Total Lehigh	43	26	2		6	2	39
Schuylkill:							
Breakers or mines	76	34	12		6		35
Washeries	20			9			1
Dredges	31		21			31	
Total Schuylkill	127	34	33	9	6	31	36
Wyoming:							
Breakers or mines	254	76	3		3		36
Washeries	12			3			2
Dredges	1		1			1	
Total Wyoming	267	76	4	3	3	1	38
Total, excluding Sullivan County:							
Breakers	371	136	16		15		110
Washeries	32			12			3
Dredges	34		23			34	
	437	136	39	12	15	34	113
Sullivan County: Breakers	5	4					
Grand total	442	140	39	12	15	34	113

[1] Figures for 1939 not yet available.
[2] The number of active plants contains numerous duplications, that is, successions known and unknown, and leases and subleases. Each report received which was tabulated for production or for employment has been counted separately.
[3] Equipped to prepare standard sizes of fresh-mined coal.
[4] For preliminary crushing, screening, or cleaning. Usually old breakers are used for this purpose. The number reported for dredges represents reports showing men employed at tipple.
[5] Preparation plant for the sizing and cleaning of culm-bank coal.

LABOR STATISTICS

According to the Pennsylvania Department of Mines about 93,000 men were employed in the anthracite region in 1939. The number employed in 1938, as based upon direct reports to the Bureau of Mines from operators and including the employees of dredges and strip contractors, was 96,417.

Man-days lost on account of strikes were 0.2 percent less in 1938 than in 1937, and suspension of work owing to strikes and the number of men involved also declined. Comparable statistics covering 1939 are not yet available, but there were no widespread labor disputes during the year.

According to the Bureau of Labor Statistics, average weekly earnings ranged from a low of $17.16 in December to a high of $35.84 in May and averaged $25.52 during 1939, or 9 percent above the 1938 average. The index of employment (1929 average equals 100) fluctuated between 44.7 in July and 53 in April and averaged 3.3 percent below 1938. The index of pay rolls reached a low of 25.2 in July and a high of 57 in May and averaged 3.4 percent above 1938.

TABLE 20.—*Men employed and days worked at operations producing Pennsylvania anthracite in 1938* [1]

[Includes operations of strip contractors]

Region	Average number of men employed								Average number of days plant operated	Man-days of labor	Average tons per man per day
	Underground			Surface				Grand total			
	Miners and their laborers	Other	Total underground	In strip pits	In preparation plant	Other	Total surface				
Lehigh:											
Breaker	6,936	4,254	11,190	1,604	1,393	2,929	5,926	17,116	165	2,817,785	2.73
Dredge	------	------	------	------	4	12	16	16	166	2,653	20.45
Total Lehigh	6,936	4,254	11,190	1,604	1,397	2,941	5,942	17,132	165	2,820,438	2.75
Schuylkill:											
Breaker	9,694	6,626	16,320	1,453	1,726	3,604	6,783	23,103	180	4,159,058	2.85
Washery	------	------	------	32	229	554	815	815	178	145,393	[2] 10.77
Dredge	------	------	------	------	88	167	255	255	136	34,648	14.06
Total Schuylkill	9,694	6,626	16,320	1,485	2,043	4,325	7,853	24,173	180	4,339,099	3.20
Wyoming:											
Breaker	31,134	13,570	44,704	542	2,709	6,768	10,019	54,723	170	9,319,906	2.58
Washery	------	------	------	11	25	97	133	133	204	27,183	[2] 11.42
Dredge	------	------	------	------	18	6	24	24	204	4,896	6.02
Total Wyoming	31,134	13,570	44,704	553	2,752	6,871	10,176	54,880	170	9,351,985	2.61
Total, excluding Sullivan County:											
Breaker	47,764	24,450	72,214	3,599	5,828	13,301	22,728	[3] 94,942	172	16,296,749	2.68
Washery	------	------	------	43	254	651	948	[3] 948	182	172,576	[2] 10.88
Dredge	------	------	------	------	110	185	295	295	143	42,197	13.53
	47,764	24,450	72,214	3,642	6,192	14,137	23,971	96,185	172	16,511,522	2.79
Sullivan County: Breaker	128	45	173	------	13	46	59	232	95	22,011	2.23
Grand total	47,892	24,495	72,387	3,642	6,205	14,183	24,030	96,417	171	16,533,533	2.79

[1] Figures for 1939 not yet available.
[2] Represents washeries for which both production and employment were separately reported.
[3] The men shown at breakers include a number of washery employees who could not be separated from breaker employees.

TABLE 21.—*Men employed at operations producing Pennsylvania anthracite in 1938, by counties* [1]

[Includes operations of strip contractors]

County	Men	County	Men
Carbon	4,207	Schuylkill	19,317
Columbia	1,032	Sullivan	232
Dauphin	1,090	Susquehanna and Wayne	388
Lackawanna	17,091	Berks, Lebanon, Northampton, and York [2]	53
Luzerne	45,680		
Northumberland	7,327		96,417

[1] Figures for 1939 not yet available. [2] Counties producing dredge coal only.

TABLE 22.—*Strikes, suspensions, and lock-outs in the Pennsylvania anthracite region in 1938* [1]

	Lehigh	Schuylkill	Wyoming	Sullivan County	Total	
					Excluding Sullivan County	Including Sullivan County
Total number employed	17,132	24,173	54,880	232	96,185	96,417
Men on strike	10,194	13,743	3,498		27,435	27,435
Man-days lost on account of strike	127,477	235,052	216,928		579,457	579,457
Average days lost—						
Per man employed	7.4	9.7	4.0		6.0	6.0
Per man on strike	12.5	17.1	62.0		21.1	21.1

[1] Figures for 1939 not yet available.

EQUIPMENT AND METHODS OF MINING

Mechanical loading.—The percentage of total deep-mined production of anthracite loaded mechanically continued to increase. In 1939 the 11,773,833 tons so loaded were 27.7 percent of the total underground output compared with 26.6 percent (10,151,669 tons) in 1938 and 25.1 percent (10,683,837 tons) in 1937. The total tonnage loaded mechanically underground increased 16 percent from 1938 to 1939; hand-loading advanced 10 percent.

There were 8 scrapers and 216 conveyors (including hand-loaded conveyors and conveyors equipped with duckbills or other self-loading heads) sold in the anthracite region in 1939; some were installed late in the year. No sales of mobile loading machines were reported. Returns direct from operators indicated that 535 scrapers and 1,997 conveyors were in use during the year.

TABLE 23.—*Relative growth of mechanical loading, hand loading, and stripping in Pennsylvania anthracite mines, 1935–39*

[Mechanical loading includes coal handled on pit-car loaders and hand-loaded face conveyors]

Year	Net tons			Index numbers, 1927=100		
	Mechanical loading underground	Stripping	Hand loading	Mechanical loading underground	Stripping	Hand loading
1935	9,279,000	5,187,000	34,400,000	417	241	48
1936	10,828,000	6,203,000	33,899,000	487	288	47
1937	10,684,000	5,696,000	31,883,000	481	265	45
1938	10,152,000	5,095,000	27,990,000	457	237	39
1939	11,774,000	5,486,000	30,798,000	530	255	43

TABLE 24.—*Pennsylvania anthracite loaded mechanically underground, 1935–39*

Year	Scrapers		Conveyors and pit-car loaders [1]		Total loaded mechanically	
	Number of units	Net tons loaded	Number of units	Net tons handled	Number of units	Net tons handled
1935	[2] 508	[2] 2,662,026	1,615	6,617,031	2,123	9,279,057
1936	[2] 504	[2] 2,966,407	1,790	7,861,539	2,294	10,827,946
1937	539	2,873,289	[2] 1,855	[2] 7,810,548	2,394	10,683,837
1938	545	2,589,954	[2] 1,831	[2] 7,561,715	2,376	10,151,669
1939	535	3,088,956	1,997	8,684,877	2,532	11,773,833

[1] Includes duckbills and other self-loading conveyors, which account for only a small part of the total.
[2] Includes mobile loaders.

TABLE 25.—*Pennsylvania anthracite handled by mobile loaders and scrapers and by all types of conveyors in 1939, by fields, in net tons*

Field	Scraper loaders	Pit-car loaders	Hand-loaded face conveyors, all types [1]	Total mechanically loaded underground
Northern	2,518,347	----------	7,034,728	9,553,075
Eastern Middle	150,922	17,368	533,420	701,710
Western Middle } Southern }	419,687	67,680	1,031,681	1,519,048
	3,088,956	85,048	8,599,829	11,773,833

[1] Shaker chutes, etc., including those equipped with duckbills.

Cutting machines.—The number of cutting machines in use in 1939 was less than in 1938, but a larger tonnage was cut by machines.

TABLE 26.—*Pennsylvania anthracite cut by machines, 1938–39*

Region	1938			1939		
	Cutting machines		Net tons cut by machines	Cutting machines		Net tons cut by machines
	Permissible	All other types		Permissible	All other types	
Lehigh	----	----	----	145	80	1,881,884
Schuylkill	----	----	----			
Wyoming	150	89	1,583,907			
Total, excluding Sullivan County	150	89	1,583,907	145	80	1,881,884
Sullivan County	----	3	4,500	----	----	----
Grand total	150	92	1,588,407	145	80	1,881,884

Strip-pit mining.—The percentage of fresh-mined anthracite produced from strip pits remained virtually constant—11.4 percent in 1939 and 11.8 percent in 1938. The tonnage mined by this method in 1939 rose in all regions. Table 27 gives the figures for several years.

TABLE 27.—*Relative growth of Pennsylvania anthracite mined from strip pits, 1915, 1920, 1925, 1930, and 1937–39, in net tons*

Year	Number of power shovels in use [1]	Quantity mined by stripping		Percent of fresh-mined total that was stripped	Number of men employed	Average number of days worked
		Total	Average per shovel			
1915	57	1,121,603	19,677	(2)	(2)	(2)
1920	96	2,054,441	21,400	2.5	(2)	(2)
1925	97	1,578,478	16,273	2.7	(2)	(2)
1930	108	2,526,288	23,484	3.7	(2)	(2)
1937	351	5,696,018	16,228	11.9	4,585	184
1938	331	5,095,341	15,394	11.8	3,642	186
1939:						
Lehigh region	134	2,217,799	16,551	25.8	(2)	(2)
Schuylkill region	121	2,398,173	19,820	20.4	(2)	(2)
Wyoming region	91	870,507	9,566	3.2	(2)	(2)
Total, 1939 [3]	[4] 346	5,486,479	15,857	11.4	(2)	(2)

[1] Certain of the equipment reported by stripping contractors may have been counted twice when moved from one small job to another during the year. The amount of such double counting is unknown but presumably is not great.
[2] Data not available.
[3] There was no strip-pit mining in Sullivan County during 1939.
[4] Includes 109 gasoline, 15 steam, 47 electric, 166 Diesel, and 9 other types of shovels.

Dredge operations.—Both the tonnage and average value of anthracite produced by dredges increased in 1939 compared with 1938.

TABLE 28.—*Pennsylvania anthracite produced by dredges, 1938–39, by rivers*

River (including tributaries)	1938			1939		
	Dredges	Net tons	Value	Dredges	Net tons	Value
Lehigh	5	123,452	$124,795	3	62,134	$73,000
Schuylkill				3	67,539	62,000
Susquehanna	29	447,572	445,784	25	574,187	611,000
	34	571,024	570,579	31	703,860	746,000

TABLE 29.—*Average receipts per net ton on all dredge coal sold, 1935–39*

Year	Average receipts	Year	Average receipts
1935	$0.88	1938	$1.00
1936	1.06	1939	1.06
1937	1.11		

FOREIGN TRADE [4]

Exports of anthracite in 1939 increased 36 percent over 1938 and comprised 5 percent of the domestic production. Imports declined 18 percent and were equivalent to 0.6 percent of United States output; the U. S. S. R. supplied 71 percent, Great Britain 23 percent, French Indochina 4 percent, and Canada (reexports) 2 percent.

TABLE 30.—*Anthracite imported for consumption in the United States, 1938–39, by countries, in net tons*

Country	1938	1939	Country	1938	1939
Canada	2,487	7,111	U. S. S. R.	200,480	212,444
China	----------	20	United Kingdom	154,104	66,784
Indochina (French)	5,824	11,794		362,895	298,153

TABLE 31.—*Anthracite imported for consumption in the United States, 1938–39, by customs districts, in net tons*

Customs district	1938	1939	Customs district	1938	1939
Connecticut	11,320	6,655	New York	----------	20
Maine and New Hampshire	32,436	21,354	Rhode Island	54,642	48,240
Massachusetts	264,465	221,883	Vermont	3	1
Michigan	29	----------		362,895	298,153

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

TABLE 32.—*Anthracite exported from the United States, 1938–39, by countries, in net tons*

Country	1938	1939
North America:		
Bermuda	1,175	1,541
Canada	1,895,718	2,577,157
Central America:		
British Honduras	----------	259
Guatemala	13	90
Honduras	----------	1
Nicaragua	22	8
Panama	1	----------
Mexico	179	150
Miquelon and St. Pierre Islands	45	62
Newfoundland and Labrador	7,471	9,349
West Indies:		
British:		
Jamaica	11	----------
Trinidad and Tobago	22	----------
Other British	268	221
Dominican Republic	2	242
French	2,865	----------
North America—Continued.		
West Indies—Continued.		
Haiti	----------	1
Netherland	6	7
South America:		
Bolivia	265	----------
Brazil	672	59
Chile	----------	1
Colombia	3	2
Ecuador	----------	1
Venezuela	15	----------
Europe:		
France	8	----------
United Kingdom	----------	49
Asia:		
Japan	149	----------
Netherland India	----------	778
Saudi Arabia	1	----------
Other Asia	----------	22
	1,908,911	2,590,000

TABLE 33.—*Anthracite exported from the United States, 1938–39, by customs districts and ports of export, in net tons*

Customs district	1938	1939
North Atlantic:		
Maine and New Hampshire	20	703
Massachusetts	294	86
New York	33,756	44,846
Philadelphia	34,908	48,000
South Atlantic:		
Maryland	459	----------
Virginia	2,865	353
Gulf Coast:		
Florida	81	47
New Orleans	6	371
Mexican Border:		
Arizona	59	37
El Paso	108	33
San Antonio	----------	22
Pacific Coast:		
Alaska	269	270
Los Angeles	149	2
San Diego	12	20
San Francisco	8	11
Northern Border:		
Buffalo	1,273,807	1,564,952
Dakota	379	117
Duluth and Superior	4,234	4,556
Michigan	4	----------
Ohio	5,068	14,501
Rochester	165,853	283,465
St. Lawrence	385,011	625,239
Vermont	1,561	2,369
	1,908,911	2,590,000

The Canadian market.—The United States strengthened its position in the important Canadian anthracite market further in 1939, notwithstanding obstacles such as an import duty, the depreciated Canadian dollar in terms of United States currency, and Canadian subventions to aid its own coal industry. In 1939 the United States supplied 66 percent of Canada's total imports of anthracite compared with 53 percent in 1938. On the other hand, of the bituminous coal available in 1939 (production, plus imports, minus exports), the United States supplied 47 percent as against 49 percent in 1938. This decline indicates Canada's efforts to make greater use of its bituminous-coal resources. The tonnage of all coal available in 1939 (29,028,000 tons) was 6 percent more than in 1938. Details of the coal and coke industry and foreign trade of Canada are given in table 34.

TABLE 34.—*Coal and coke industry and foreign trade of Canada, 1938–39* [1]

[Thousands of net tons]

	Coal										Coke from coal	
	Anthracite		Bituminous		Subbituminous		Lignite		Total			
	1938	1939	1938	1939	1938	1939	1938	1939	1938	1939	1938	1939
Production	------	------	10,289	11,597	489	512	3,470	3,410	14,248	15,519	2,356	2,388
Imports:												
United States	1,974	2,606	9,644	9,836	------	------	3	3	11,621	12,445	407	434
Great Britain	1,199	1,035	66	68	------	------	------	------	1,265	1,103	3	2
Germany	407	294	35	------	------	------	------	------	442	294	5	------
Belgium	34	------	------	------	------	------	------	------	34	------	------	------
French Indochina	30	43	------	------	------	------	------	------	30	43	------	------
Netherlands	37	------	------	------	------	------	------	------	37	------	------	------
U. S. S. R.	15	------	------	------	------	------	------	------	15	------	------	------
Morocco	20	------	------	------	------	------	------	------	20	------	------	------
Total imports	3,716	3,978	9,745	9,904	------	------	3	3	13,464	13,885	415	436
Exports	------	------	344	368	------	------	9	8	353	376	31	48
Available for consumption	3,716	3,978	19,690	21,133	489	512	3,464	3,405	27,359	29,028	2,740	2,776

[1] Quarterly Report on Coal and Coke Statistics for Canada, October–December 1938 and 1939. Canadian coal charged to ovens in 1938, 1,064,302 tons; 1939, 1,104,371 tons. Imported coal charged to ovens in 1938, 2,215,469 tons; 1939, 2,207,707 tons.

Imports of anthracite into Canada in 1939 were 3,977,805 tons, a gain of 7 percent over 1938. Of the total imports into Canada in 1938 and 1939, respectively, 60 and 64 percent were received from January to August, inclusive, before the outbreak of war in Europe. Of the total tonnage supplied by the United States in 1938 and 1939, respectively, 68 and 61 percent were received from January to August.

Canadian official statistics for 1939 show that of the total imports of anthracite into Canada 24 percent (941,017) tons were steam sizes—44 percent from Great Britain, 40 percent from the United States, 13 percent from Germany, and 3 percent from French Indochina.

The upward trend in the use of hydroelectricity, natural gas, and doubtless fuel oil continued. Although coal production in 1939 was 1,224,746 tons greater than in 1938, hydroelectric power, in terms of coal, increased 1,623,000 tons. Excluding 1937, coal production was greater in 1939 than in any year since 1929.

The tonnage of Canadian coal moved under assisted (railroad) rates continued to increase.

The additional subvention (not to exceed 50 cents a ton) granted November 8, 1938, by the Canadian Government to aid shipments of Nova Scotia bituminous coal to central Canada was withdrawn effective December 8, 1939.

In 1939 the Canadian Government appointed a coal administrator, and effective December 1, the coal industry and trade were required to operate under license.

The outlook for anthracite in Canada in 1940 is obscured by the international situation and developments that may result therefrom.

Among the possible developments is further depreciation of the Canadian dollar, which would facilitate the purchase of British anthracite. On the other hand, the increased cost of coal production in Britain and high ocean-freight and insurance rates should much more than offset the lower value of the Canadian dollar; however, as Britain will require Canadian timber and grain it seems probable that Canada will continue to receive British anthracite in order to conserve foreign exchange.

The trade agreement between the United States and U. S. S. R. was renewed in August for another year, during which period U. S. S. R. agreed not to ship more than 400,000 tons of anthracite to the United States.

World anthracite production.—Because of the international situation, anthracite production data for 1939 were not released in a number of countries. Available data for 1934–39 are presented in table 35.

TABLE 35.—*World production of anthracite, 1934–39, in metric tons*

[Compiled by R. B. Miller]

Country	1934	1935	1936	1937	1938	1939
Belgium	5,823,787	5,241,026	6,077,907	6,694,049	6,874,520	(1)
Bulgaria	6,921	2,223	2,323	2,542	4,000	(1)
China	5,309,810	(2)	(2)	(1)	(1)	(1)
Chosen	982,370	1,079,330	1,051,853	1,101,500	(1)	(1)
France	5,900,000	5,000,000	8,227,000	(1)	(1)	(1)
Germany	4,539,000	4,886,000	5,511,000	5,627,000	(1)	(1)
Indochina	1,554,600	1,740,606	2,150,654	2,264,978	2,289,832	2,547,000
Irish Free State	91,171	87,114	96,742	106,651	92,157	90,455
Italy	84,547	70,150	79,972	95,060	132,197	100,000
Japan [3]	(2)	(2)	(2)	(1)	(1)	(1)
Morocco, French	36,070	52,696	49,388	107,150	123,200	115,600
Peru	3,600	2,461	3,535	2,918	1,500	1,450
Portugal	196,587	205,373	207,890	241,163	281,740	294,081
Rumania	18,010	17,207	3,708	3,646	3,266	(1)
Spain	644,621	701,789	(2)	(1)	493,539	663,593
Switzerland	3,000	3,500	3,000	4,000	3,000	2,500
U. S. S. R.:						
Asiatic	243,000	350,000	410,000	(1)	(1)	(1)
European	22,003,000	25,200,000	28,100,000	(1)	(1)	(1)
United Kingdom	7,241,117	6,907,530	6,629,955	6,437,465	6,378,904	(1)
United States	51,861,930	47,317,405	49,513,463	47,043,119	41,820,115	46,708,319
World total	106,767,930	104,089,405	113,843,463	(1)	(1)	(1)
Total, exclusive of United States	54,906,000	56,772,000	64,330,000	(1)	(1)	(1)

[1] Data not available.
[2] Estimate included in total.
[3] The anthracite production of Japan is said to average about 225,000 tons a year. Production figures are not available.

COKE AND BYPRODUCTS

By M. van Siclen, M. M. Otero, and M. F. Cooke

SUMMARY OUTLINE

The coke industry in 1939 on the whole recovered strongly from the recession noted in 1938, but output still fell short of that in 1937 and 1936.

The total production of beehive and byproduct coke increased about 36 percent—from 32,495,815 net tons in 1938 to 44,326,641 tons in 1939. The output from beehive ovens in 1939 increased 72 percent over 1938, rising to 1,444,328 tons from the near-all-time low of 837,412 tons in the preceding year. Byproduct coke, representing 97 percent of the total, increased 35 percent in 1939 and totaled 42,882,313 tons compared with 31,658,403 in 1938. Whereas in 1938 the production of byproduct coke at furnace plants declined 43 percent when total byproduct output dropped 36 percent, in 1939 the production from furnace coke plants increased 54 percent, with an attendant gain of 35 percent in all byproduct coke.

Accompanying the upturn in the industry during 1939, producers' stocks of byproduct coke dropped 29 percent—from 3,631,623 net tons on January 1, 1939, to 2,569,690 tons at the beginning of 1940. At beehive plants the decrease in stocks was from 44,931 to 32,409 tons.

The calculated consumption of all coke in 1939 was 44,953,082 net tons, a 45-percent increase over 1938.

Export trade increased 21 percent in 1939; shipments totaled 589,925 net tons compared with 486,571 tons in 1938. Canada again was by far the leading customer, taking nearly one-half million tons. Coke imports into the United States comprised 24 percent of coke exports in tonnage and 36 percent in value.

Fluctuations in price quotations for byproduct foundry coke at various markets included increases of 11 to 12 cents and decreases

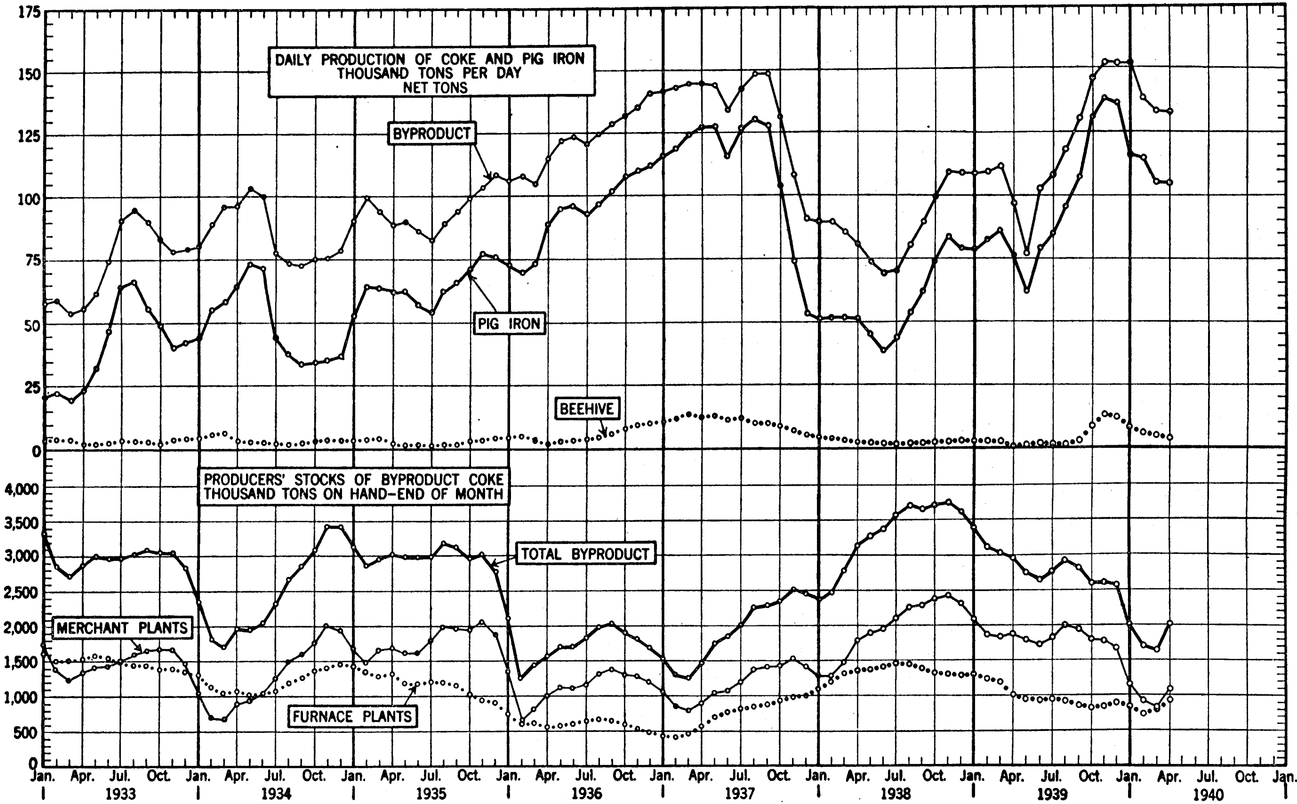

FIGURE 1.—Average daily production of beehive and byproduct coke and pig iron; and producers' stocks of byproduct coke, 1933–40, by months.

ranging from 13 to 35 cents. Connellsville prices rose 16 cents for foundry coke and 23 for furnace coke.

The byproduct-coke industry followed the 1937–39 curve for coke. Except for the tar derivative ("creosote oil, distillate as such," output of which rose to 18,479,962 gallons in 1939—20 percent above the 1937 figure) the yield of all coke byproducts dropped rather sharply in 1938 but recovered a good proportion of the production losses in 1939.

Of special interest is toluol, an important ingredient of TNT, which is obtained as a light-oil derivative from coke-oven operations and tar refineries. The output in 1939 as a byproduct from coke operations was 19,767,200 gallons compared with 13,021,080 in 1938 and 20,896,724 in 1937. These figures do not include toluol obtained from tar refineries. Sales of toluol in 1939 were 20,484,568 gallons valued at $3,974,367, an average of $0.194 per gallon. The trade-journal quotation of $0.27 per gallon advanced 3 cents at the beginning of 1940.

TABLE 1.—*Salient statistics of the coke industry in the United States, 1938–39*

	Byproduct	Beehive	Total
1938			
Coke produced:			
At merchant plants:			
Quantity .... net tons	10, 989, 525		10, 989, 525
Value	$70, 225, 977		$70, 225, 977
At furnace plants:			
Quantity .... net tons	20, 668, 878		20, 668, 878
Value	$93, 253, 062		$93, 253, 062
Total:			
Quantity .... net tons	31, 658, 403	837, 412	32, 495, 815
Value	$163, 479, 039	$3, 702, 795	$167, 181, 834
Screenings or breeze produced:			
Quantity .... net tons	2, 653, 653	46, 211	2, 699, 864
Value	$5, 995, 267	$53, 530	$6, 048, 797
Coal charged into ovens:			
Quantity .... net tons	45, 266, 344	1, 359, 876	46, 626, 220
Value	$177, 330, 916	$2, 790, 978	$180, 121, 894
Average value per ton	$3. 92	$2. 05	$3. 86
Average yield in percent of coal charged:			
Coke	69. 94	61. 58	69. 69
Breeze (at plants actually recovering)	5. 91	5. 34	5. 90
Ovens:			
In existence January 1	12, 718	12, 194	24, 912
In existence December 31	12, 724	10, 816	23, 540
Dismantled during year	201	1, 261	1, 462
In course of construction December 31	146		146
Daily capacity of ovens December 31	167, 868	(1)	(1)
Coke used by producer:			
In blast furnaces:			
Quantity .... net tons	16, 689, 105	102, 853	16, 791, 958
Value	$74, 061, 231	$555, 812	$74, 617, 043
To make producer or water gas:			
Quantity .... net tons	1, 314, 370		1, 314, 370
Value	$7, 418, 916		$7, 418, 916
For other purposes:			
Quantity .... net tons	401, 066	786	401, 852
Value	$2, 069, 263	$3, 346	$2, 072, 609
Disposition of coke:			
Sold to financially affiliated corporations:			
For blast-furnace use:			
Quantity .... net tons	1, 116, 376	41, 567	1, 157, 943
Value	$4, 852, 525	$179, 687	$5, 032, 212
For all other purposes:			
Quantity .... net tons	773, 336	158	773, 494
Value	$4, 668, 821	$869	$4, 669, 690
Sold to other consumers:			
For blast-furnace use:			
Quantity .... net tons	950, 508	169, 777	1, 120, 285
Value	$4, 192, 197	$688, 504	$4. 880, 701
For foundry use:			
Quantity .... net tons	1, 051, 143	164, 637	1, 215, 780
Value	$8, 815, 581	$809, 030	$9, 624, 611

See footnotes at end of table.

TABLE 1.—*Salient statistics of the coke industry in the United States, 1938–39*—Continued

	Byproduct	Beehive	Total
1938—Continued			
Disposition of coke—Continued.			
Sold to other consumers—Continued.			
For manufacture of water gas:			
Quantity ... net tons	397,563	68,427	465,990
Value	$2,537,307	$258,106	$2,795,413
For other industrial use:			
Quantity ... net tons	790,699	215,651	1,006,350
Value	$4,215,669	$953,040	$5,168,709
For domestic use:			
Quantity ... net tons	7,129,384	93,306	7,222,690
Value	$44,000,938	$328,255	$44,329,193
Disposition of screenings or breeze:			
Used by producer:			
For raising steam:			
Quantity ... net tons	1,957,323	122	1,957,445
Value	$4,248,698	$533	$4,249,231
To make producer or water gas:			
Quantity ... net tons	76,089		76,089
Value	$302,092		$302,092
For other purposes:			
Quantity ... net tons	241,806	76	241,882
Value	$452,382	$151	$452,533
Sold:			
Quantity ... net tons	445,180	39,463	484,643
Value	$1,125,035	$47,206	$1,172,241
Average receipts per ton sold:			
Furnace coke (merchant sales)	$4.41	$4.06	$4.36
Foundry coke	$8.39	$4.91	$7.92
Domestic coke	$6.17	$3.52	$6.14
For manufacture of water gas	$6.38	$3.77	$6.00
Other industrial coke	$5.33	$4.42	$5.14
Screenings or breeze	$2.53	$1.20	$2.42
Stocks on hand January 1, 1939:			
Furnace ... net tons	931,644	7,228	938,872
Foundry ... do	88,334	8,336	96,670
Domestic and other ... do	2,611,645	29,367	2,641,012
Breeze ... do	273,285	1,775	275,060
Exports ... do			486,571
Imports ... do			135,240
Calculated consumption ... do			31,063,217
Byproducts produced:			
Gas ... M cubic feet	499,692,522		499,692,522
Wasted ... percent	1.45		1.45
Burned in coking process ... do	33.91		33.91
Surplus sold or used ... do	64.64		64.64
Tar ... gallons	419,579,649		419,579,649
Ammonium sulfate or equivalent ... pounds	1,036,765,357		1,036,765,357
Crude light oil ... gallons	123,559,610		123,559,610
Yield of byproducts per ton of coal:			
Gas ... M cubic feet	11.04		11.04
Tar ... gallons	9.27		9.27
Ammonium sulfate or equivalent ... pounds	23.36		23.36
Crude light oil ... gallons	2.99		2.99
Value of byproducts sold:			
Gas (surplus)	$60,364,983		$60,364,983
Tar:			
Sold	$14,904,501		$14,904,501
Used by producer	$5,780,776		$5,780,776
Ammonium sulfate or equivalent	$12,043,251		$12,043,251
Crude light oil and derivatives	$12,946,483		$12,946,483
Other byproducts [2]	$3,412,631		$3,412,631
Total value of coke, breeze, and byproducts [3]	$278,926,931	$3,756,325	$282,683,256
1939			
Coke produced:			
At merchant plants:			
Quantity ... net tons	11,070,506		11,070,506
Value	$68,432,660		$68,432,660
At furnace plants:			
Quantity ... net tons	31,811,807		31,811,807
Value	$138,025,213		$138,025,213
Total:			
Quantity ... net tons	42,882,313	1,444,328	44,326,641
Value	$206,457,873	$6,426,177	$212,884,050
Screenings or breeze produced:			
Quantity ... net tons	3,354,374	51,543	3,405,917
Value	$7,271,050	$62,170	$7,333,220

See footnotes at end of table.

TABLE 1.—*Salient statistics of the coke industry in the United States, 1938–39*—Continued

	Byproduct	Beehive	Total
1939—Continued			
Coal charged into ovens:			
Quantity — net tons	61,215,899	2,297,785	63,513,684
Value	$229,785,713	$4,584,041	$234,369,754
Average value per ton	$3.75	$1.99	$3.69
Average yield in percent of coal charged:			
Coke	70.05	62.86	69.79
Breeze (at plants actually recovering)	5.52	3.73	5.48
Ovens:			
In existence January 1	12,724	10,816	23,540
In existence December 31	13,010	10,934	23,944
Dismantled during year	------------	453	453
In course of construction December 31	------------	4	4
Daily capacity of ovens December 31	172,479	(1)	(1)
Coke used by producer:			
In blast furnaces:			
Quantity — net tons	27,438,565	219,696	27,658,261
Value	$117,637,251	$1,137,103	$118,774,354
To make producer or water gas:			
Quantity — net tons	1,409,081	------------	1,409,081
Value	$7,693,450	------------	$7,693,450
For other purposes:			
Quantity — net tons	416,595	1,124	417,719
Value	$2,184,305	$4,626	$2,188,931
Disposition of coke:			
Sold to financially affiliated corporations:			
For blast-furnace use:			
Quantity — net tons	2,063,898	196,956	2,260,854
Value	$8,682,688	$855,858	$9,538,546
For all other purposes:			
Quantity — net tons	877,580	16,260	893,840
Value	$5,229,032	$79,349	$5,308,381
Sold to other consumers:			
For blast-furnace use:			
Quantity — net tons	1,137,757	441,685	1,579,442
Value	$4,981,942	$1,909,857	$6,891,799
For foundry use:			
Quantity — net tons	1,482,846	199,354	1,682,200
Value	$12,087,253	$949,269	$13,036,522
For manufacture of water gas:			
Quantity — net tons	506,857	85,191	592,048
Value	$3,203,509	$315,429	$3,518,938
For other industrial use:			
Quantity — net tons	999,826	192,113	1,191,939
Value	$5,292,213	$836,557	$6,128,770
For domestic use:			
Quantity — net tons	7,549,937	88,204	7,638,141
Value	$44,511,672	$311,135	$44,822,807
Disposition of screenings or breeze:			
Used by producer:			
For raising steam:			
Quantity — net tons	2,455,057	1,798	2,456,855
Value	$5,108,827	$2,855	$5,111,682
To make producer or water gas:			
Quantity — net tons	53,283	------------	53,283
Value	$169,687	------------	$169,687
For other purposes:			
Quantity — net tons	355,294	100	355,394
Value	$783,921	$448	$784,369
Sold:			
Quantity — net tons	512,375	25,981	538,356
Value	$1,264,743	$35,441	$1,300,184
Average receipts per ton sold:			
Furnace coke (merchant sales)	$4.38	$4.32	$4.36
Foundry coke	$8.15	$4.76	$7.75
Domestic coke	$5.90	$3.53	$5.87
For manufacture of water gas	$6.32	$3.70	$5.94
Other industrial coke	$5.29	$4.35	$5.14
Screenings or breeze	$2.47	$1.36	$2.42
Stocks on hand January 1, 1940:			
Furnace — net tons	597,550	16,402	613,952
Foundry — do	49,771	8,312	58,083
Domestic and other — do	1,922,369	7,695	1,930,064
Breeze — do	335,709	451	336,160
Exports — do	------------	------------	589,925
Imports — do	------------	------------	141,911
Calculated consumption — do	------------	------------	44,953,082
Byproducts produced:			
Gas — M cubic feet	675,143,201	------------	675,143,201
Wasted — percent	1.27	------------	1.27
Burned in cooking process — do	34.49	------------	34.49
Surplus sold or used — do	64.24	------------	64.24

See footnotes at end of table.

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TABLE 1.—*Salient statistics of the coke industry in the United States, 1938–39*—Continued

	Byproduct	Beehive	Total
1939—Continued			
Byproducts produced—Continued.			
Tar ... gallons	554,406,216		554,406,216
Ammonium sulfate or equivalent ... pounds	1,353,604,372		1,353,604,372
Crude light oil ... gallons	170,963,199		170,963,199
Yield of byproducts per ton of coal:			
Gas ... M cubic feet	11.03		11.03
Tar ... gallons	9.06		9.06
Ammonium sulfate or equivalent ... pounds	22.33		22.33
Crude light oil ... gallons	2.99		2.99
Value of byproducts sold:			
Gas (surplus)	$71,876,455		$71,876,455
Tar:			
Sold	$16,585,734		$16,585,734
Used by producer	$10,081,205		$10,081,205
Ammonium sulfate or equivalent	$14,634,521		$14,634,521
Crude light oil and derivatives	$17,034,214		$17,034,214
Other byproducts [2]	$4,683,510		$4,683,510
Total value of coke, breeze, and byproducts [3]	$348,624,562	$6,488,347	$355,112,909

[1] Data not available.
[2] Includes naphthalene and tar derivatives.
[3] Includes value of tar used by the coke plants.

TABLE 2.—*Statistical trends of the coke industry in the United States, 1923 and 1936–39*

	1923	1936	1937	1938	1939
Coke produced:					
Beehive ... net tons	19,379,870	1,706,063	3,164,721	837,412	1,444,328
Byproduct ... do	37,597,664	44,569,121	49,210,748	31,658,403	42,882,313
Total ... do	56,977,534	46,275,184	52,375,469	32,495,815	44,326,641
Percent of total from byproduct ovens	66.0	96.3	94.0	97.4	96.7
Stocks of producers, end of year, all coke ... net tons	[1] 1,221,737	1,732,066	2,595,287	3,676,554	2,602,099
Exports, all coke ... do	1,237,342	670,312	526,683	486,571	589,925
Imports, all coke [2] ... do	85,002	329,957	286,364	135,240	141,911
Consumption, calculated, all coke ... do	55,173,457	47,032,147	51,271,929	31,063,217	44,953,082
Disposal of coke (beehive and byproduct):					
Furnace coke (including coke used by producer) ... net tons	47,774,408	30,772,156	36,751,969	19,070,186	31,498,557
Foundry coke ... do	3,600,719	1,921,817	2,038,822	1,215,780	1,682,200
Other industrial (including water gas) ... net tons	2,283,888	2,032,774	2,047,140	1,472,340	1,783,987
Domestic coke ... do	2,733,414	10,021,343	8,107,518	7,222,690	7,638,141
Ovens:					
Beehive, in existence, end of year	62,349	13,012	12,194	10,816	10,934
Byproduct, in existence, end of year	11,156	12,849	12,718	12,724	13,010
Byproduct under construction, end of year	629	305	259	146	0
Cost of coal charged, byproduct ovens, average per ton	$4.76	$3.69	$3.74	$3.92	$3.75
Prices of coke:					
Average spot price of Connellsville furnace coke, f. o. b. ovens	$5.33	$3.68	$4.29	$3.86	$4.09
Average realization on byproduct coke sold:					
Furnace coke (merchant sales)	$6.74	$5.09	$4.34	$4.41	$4.38
Foundry coke	$10.54	$7.44	$8.47	$8.39	$8.15
Other industrial (including water gas)	$9.06	$5.51	$6.08	$5.68	$5.64
Domestic	$9.05	$6.07	$6.53	$6.17	$5.90
Yield of byproducts per ton of coal charged:					
Tar ... gallons	8.1	8.86	8.67	9.27	9.06
Ammonium sulfate or equivalent ... pounds	21.2	22.14	21.84	23.36	22.33
Light oil ... gallons	2.7	2.91	2.86	2.99	2.99
Surplus gas sold or used ... M cubic feet	5.9	6.85	6.66	7.14	7.08
Average gross receipts of byproducts per ton of coke produced:					
Tar sold and used	$0.51	$0.541	$0.588	$0.654	$0.622
Ammonia and its compounds	$0.84	$0.287	$0.326	$0.380	$0.341
Light oil and its derivatives (including naphthalene)	$0.51	$0.438	[3] $0.443	$0.423	$0.414
Surplus gas sold or used	$1.37	$1.589	$1.483	$1.907	$1.676
Total byproducts, including breeze	$3.48	$3.057	[3] $3.068	$3.647	$3.315

[1] Furnace and foundry coke only.
[2] Before 1934 the figures represent general imports; beginning with 1934 they represent imports for consumption only.
[3] Revised figures.

SCOPE OF REPORT

This report contains final figures covering production of both beehive and byproduct coke, and the major byproducts of the latter, for 1938 and 1939. Inclusion of the 1939 statistics in final form marks resumption of an earlier custom, made possible through a slight increase in funds allotted to Coal Economics Division. To complete the record by including 1938 final figures, which were lacking in the previous chapter in this series, it has been necessary throughout the report to complete the permanent record by publishing tables covering both years. Preliminary statistics of coke production and the byproducts obtained in 1939 were published as a 2-page supplement on February 26, 1940, to Monthly Coke Report 143. Salient statistics, giving final data on the coke industry and the byproducts obtained, were published as a 2-page supplement to Monthly Coke Report 146 on May 24, 1940.

Coke is produced by four different industries in the United States. In addition to that made in the familiar beehive and byproduct ovens, it is obtained in refining petroleum and tar, and in manufacturing coal gas. Moreover, within the last few years production of a smokeless fuel by low-temperature carbonization of coal has been established commercially in the United States. The commodity produced by each of these processes, however, differs greatly from other cokes in character, and the problems affecting the several industries are quite distinctive.

About 1,666,400 tons of petroleum coke were produced in 1939 compared with about 1,602,200 tons in 1938. A small tonnage of coke from coal tar is also produced commercially. Only coke from byproduct and beehive ovens is adapted to blast-furnace and foundry uses, which consume the larger part of all the coke produced. Practically, therefore, the coke trade is concerned only with byproduct and beehive coke, and the statistics of this report are confined to these two types.

For reasons explained in a later section, the statistics on byproduct coke in this chapter cover operations of all byproduct coke ovens, including those installed and operated by public utilities engaged primarily in manufacturing gas for city supply.

The standard unit of measurement in the coke industry is the short or net ton of 2,000 pounds, and unless otherwise specified that unit is employed throughout this report.

COKE AND COKE BREEZE

MONTHLY AND WEEKLY PRODUCTION

TABLE 3.—*Byproduct, beehive, and total coke produced in the United States, 1936–39, by months, and average per day, in net tons*

Month	1936		1937		1938		1939	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
Byproduct:								
January	3,313,500	106,900	4,360,700	140,700	2,749,100	88,700	3,355,200	108,200
February	3,145,600	108,500	3,992,900	142,600	2,481,600	88,600	3,066,800	109,500
March	3,262,100	105,200	4,495,500	145,000	2,661,700	85,900	3,425,700	110,500
April	3,471,400	115,700	4,350,900	145,000	2,424,100	80,800	2,903,800	96,800
May	3,758,800	121,300	4,479,700	144,500	2,272,100	73,300	2,387,100	77,000
June	3,700,300	123,300	4,024,800	134,200	2,056,300	68,500	3,078,500	102,600
July	3,723,200	120,100	4,423,900	142,700	2,166,100	69,900	3,354,100	108,200
August	3,871,400	124,900	4,573,400	147,500	2,484,000	80,100	3,652,900	117,800
September	3,836,800	127,900	4,427,800	147,600	2,665,100	88,800	3,890,600	129,700
October	4,077,200	131,500	4,035,100	130,200	3,081,200	99,400	4,512,300	145,600
November	4,054,400	135,100	3,222,300	107,400	3,266,300	108,900	4,551,900	151,700
December	4,354,400	140,500	2,823,800	91,100	3,350,800	108,100	4,703,400	151,700
	44,569,100	121,700	49,210,800	134,800	31,658,400	86,700	42,882,300	117,500
Beehive:								
January	133,300	4,900	274,300	10,600	114,100	4,400	78,400	3,000
February	144,500	5,800	294,600	12,300	102,200	4,300	72,000	3,000
March	103,000	4,000	357,300	13,200	95,200	3,500	69,600	2,600
April	85,200	3,300	309,700	11,900	73,100	2,800	20,000	800
May	80,600	3,100	326,500	12,600	56,700	2,200	24,700	900
June	87,300	3,400	274,800	10,600	49,800	1,900	52,300	2,000
July	104,200	4,000	285,100	11,000	42,000	1,700	47,100	1,900
August	120,300	4,600	259,000	10,000	47,700	1,800	44,900	1,700
September	153,900	5,900	253,900	9,800	53,600	2,100	77,000	3,000
October	222,700	8,200	225,500	8,700	60,700	2,300	266,800	10,300
November	225,800	9,000	168,800	6,500	66,700	2,600	362,700	14,000
December	245,300	9,400	135,200	5,200	75,600	2,900	328,800	13,200
	1,706,100	5,500	3,164,700	10,200	837,400	2,700	1,444,300	4,700
Total coke:								
January	3,446,800	111,800	4,635,000	151,300	2,863,200	93,100	3,433,600	111,200
February	3,290,100	114,300	4,287,500	154,900	2,583,800	92,900	3,138,800	112,500
March	3,365,100	109,200	4,852,800	158,200	2,756,900	89,400	3,495,300	113,100
April	3,556,600	119,000	4,660,600	156,900	2,497,200	83,600	2,923,800	97,600
May	3,839,400	124,400	4,806,200	157,100	2,328,800	75,500	2,411,800	77,900
June	3,787,600	126,700	4,299,600	144,800	2,106,100	70,400	3,130,800	104,600
July	3,827,400	124,100	4,709,000	153,700	2,208,100	71,600	3,401,200	110,100
August	3,991,700	129,500	4,832,400	157,500	2,531,700	81,900	3,697,800	119,500
September	3,990,700	133,800	4,681,700	157,400	2,718,700	90,900	3,967,600	132,700
October	4,299,900	139,700	4,260,600	138,900	3,141,900	101,700	4,779,100	155,900
November	4,280,200	144,100	3,391,100	113,900	3,333,000	111,500	4,914,600	165,700
December	4,599,700	149,900	2,959,000	96,300	3,426,400	111,000	5,032,200	164,900
	46,275,200	127,200	52,375,500	145,000	32,495,800	89,400	44,326,600	122,200

TABLE 4.—*Beehive coke produced in the United States in 1939, by weeks*

[Estimated from railroad shipments]

Week ended—	Net tons	Week ended—	Net tons	Week ended—	Net tons
January 7	17,500	May 13	2,400	September 16	12,000
14	17,100	20	5,000	23	17,800
21	19,100	27	10,200	30	33,800
28	20,300	June 3	11,700	October 7	50,200
February 4	18,300	10	11,600	14	50,500
11	19,000	17	12,600	21	67,400
18	18,300	24	13,000	28	72,300
25	18,100	July 1	12,700	November 4	72,800
March 4	17,500	8	11,600	11	78,300
11	15,100	15	11,300	18	94,900
18	15,700	22	11,500	25	83,300
25	16,300	29	9,900	December 2	80,400
April 1	14,800	August 5	9,300	9	80,000
8	6,100	12	11,000	16	82,600
15	3,700	19	9,800	23	70,000
22	3,300	26	10,000	30	65,500
29	5,000	September 2	10,600		
May 6	2,300	9	10,800		1,444,300

TABLE 5.—*Byproduct coke produced in the United States, 1938–39, by months and States, in net tons*

State	January	February	March	April	May	June	July	August	September	October	November	December	Total
1938													
Alabama	332, 800	299, 500	320, 100	302, 400	221, 200	181, 400	183, 700	248, 500	282, 900	321, 700	335, 800	348, 000	3, 378, 000
Colorado	16, 500	15, 900	16, 900	13, 000	12, 000	11, 900	21, 600	24, 800	17, 400	12, 200	13, 500	11, 100	186, 800
Illinois	201, 600	156, 900	158, 900	149, 800	141, 200	130, 200	121, 300	121, 900	128, 200	137, 100	136, 500	150, 900	1, 734, 500
Indiana	203, 100	182, 200	210, 700	200, 100	193, 200	157, 600	186, 900	223, 900	272, 300	329, 800	351, 900	393, 100	2, 904, 800
Maryland	86, 300	96, 700	93, 700	68, 000	64, 900	66, 800	81, 000	101, 900	92, 500	108, 600	125, 400	119, 500	1, 105, 300
Massachusetts	98, 500	89, 900	100, 300	92, 700	78, 100	74, 600	75, 600	74, 600	74, 500	85, 100	83, 500	91, 900	1, 019, 300
Michigan	151, 500	128, 000	135, 200	129, 900	139, 800	134, 300	137, 200	138, 100	138, 900	162, 300	169, 800	177, 800	1, 742, 800
Minnesota	49, 500	44, 900	48, 500	46, 000	48, 500	43, 900	41, 100	42, 400	43, 900	44, 900	43, 100	43, 700	540, 400
New Jersey	87, 300	78, 000	86, 400	84, 000	87, 000	81, 900	83, 700	83, 000	82, 600	85, 200	82, 600	85, 700	1, 007, 400
New York	350, 300	317, 200	327, 500	303, 600	325, 500	294, 600	290, 300	291, 000	310, 900	370, 400	369, 500	394, 600	3, 945, 400
Ohio	282, 500	261, 300	277, 600	228, 400	205, 300	190, 500	219, 300	318, 800	351, 900	411, 600	480, 600	472, 200	3, 700, 000
Pennsylvania	595, 100	541, 700	602, 500	540, 800	505, 000	463, 400	490, 700	554, 400	601, 000	711, 200	767, 000	746, 500	7, 119, 300
Tennessee	7, 100	6, 400	6, 400	6, 000	6, 300	6, 100	6, 300	6, 400	6, 200	6, 400	6, 200	6, 300	76, 100
Utah	15, 900	13, 200	8, 500	8, 600	8, 300	7, 500	7, 100	7, 800	9, 500	13, 500	14, 300	18, 300	132, 500
West Virginia	110, 900	107, 100	113, 900	107, 200	101, 300	94, 400	104, 600	116, 000	108, 300	120, 100	130, 500	132, 500	1, 346, 800
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	160, 200	142, 700	154, 600	143, 600	134, 500	117, 200	115, 700	130, 500	144, 100	161, 100	156, 100	158, 700	1, 719, 000
	2, 749, 100	2, 481, 600	2, 661, 700	2, 424, 100	2, 272, 100	2, 056, 300	2, 166, 100	2, 484, 000	2, 665, 100	3, 081, 200	3, 266, 300	3, 350, 800	31, 658, 400
At merchant plants	1, 038, 600	937, 500	989, 500	930, 300	897, 200	832, 200	815, 900	838, 700	866, 800	943, 100	927, 700	972, 000	10, 989, 500
At furnace plants	1, 710, 500	1, 544, 100	1, 672, 200	1, 493, 800	1, 374, 900	1, 224, 100	1, 350, 200	1, 645, 300	1, 798, 300	2, 138, 100	2, 338, 600	2, 378, 800	20, 668, 900
1939													
Alabama	347, 700	311, 900	332, 800	263, 000	189, 900	296, 100	326, 500	329, 800	338, 500	372, 200	359, 600	386, 500	3, 854, 500
Colorado	15, 400	19, 600	34, 000	33, 400	37, 400	23, 000	30, 900	34, 100	32, 300	41, 500	51, 500	44, 900	398, 000
Illinois	152, 900	136, 700	135, 000	123, 700	115, 500	117, 800	123, 500	126, 200	135, 700	197, 100	247, 600	272, 500	1, 884, 200
Indiana	395, 600	340, 500	401, 200	326, 900	227, 400	329, 900	362, 300	425, 300	463, 800	521, 900	532, 700	550, 500	4, 878, 000
Maryland	113, 400	102, 400	113, 100	113, 200	116, 900	134, 800	148, 700	146, 500	144, 000	150, 100	145, 900	150, 000	1, 579, 000
Massachusetts	91, 000	81, 300	92, 000	85, 200	73, 700	85, 200	76, 600	81, 300	94, 600	97, 600	97, 300	101, 400	1, 057, 200
Michigan	183, 900	179, 100	199, 700	169, 600	143, 300	203, 200	212, 200	197, 500	212, 000	245, 400	238, 600	246, 200	2, 430, 700
Minnesota	42, 800	38, 900	42, 800	38, 900	38, 800	38, 800	38, 300	40, 900	41, 900	46, 200	43, 500	45, 300	497, 100
New Jersey	85, 000	76, 600	84, 800	80, 800	82, 100	82, 300	85, 000	86, 700	83, 400	86, 400	83, 000	87, 100	1, 003, 200
New York	397, 600	341, 900	371, 700	337, 900	284, 500	330, 400	358, 600	371, 900	377, 300	429, 200	426, 200	441, 200	4, 468, 400
Ohio	438, 900	411, 000	481, 600	383, 100	279, 500	416, 000	465, 600	549, 600	585, 800	681, 500	709, 900	733, 500	6, 136, 000
Pennsylvania	778, 300	748, 100	826, 500	676, 700	557, 200	735, 200	811, 100	936, 900	1, 054, 300	1, 290, 200	1, 278, 000	1, 301, 800	10, 994, 300
Tennessee	6, 000	5, 400	6, 000	6, 300	6, 400	6, 300	6, 700	7, 000	7, 000	7, 100	7, 400	7, 800	79, 400
Utah	19, 200	17, 500	18, 900	13, 200	11, 000	16, 300	16, 000	18, 200	18, 800	17, 100	13, 700	9, 300	189, 200
West Virginia	134, 700	123, 400	138, 200	111, 500	91, 200	114, 000	134, 800	138, 900	140, 200	159, 400	154, 600	157, 300	1, 598, 200
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	152, 800	132, 500	147, 400	140, 400	132, 300	149, 200	157, 300	162, 100	161, 000	169, 400	162, 400	168, 100	1, 834, 900
	3, 355, 200	3, 066, 800	3, 425, 700	2, 903, 800	2, 387, 100	3, 078, 500	3, 354, 100	3, 652, 900	3, 890, 600	4, 512, 300	4, 551, 900	4, 703, 400	42, 882, 300
At merchant plants	967, 200	867, 800	930, 700	858, 100	761, 200	848, 300	873, 500	893, 000	930, 200	1, 049, 000	1, 025, 500	1, 066, 000	11, 070, 500
At furnace plants	2, 388, 000	2, 199, 000	2, 495, 000	2, 045, 700	1, 625, 900	2, 230, 200	2, 480, 600	2, 759, 900	2, 960, 400	3, 463, 300	3, 526, 400	3, 637, 400	31, 811, 800

TABLE 6.—*Beehive coke produced in the United States in 1939, by months and States, in net tons*

[Based upon railroad shipments]

State	January	February	March	April	May	June
Colorado	5,700	5,100	5,300	5,700	4,900	4,300
Pennsylvania	47,600	45,200	42,500	9,700	12,500	28,400
Utah	1,300	1,400	1,200	600	500	100
Virginia	17,400	16,000	16,000	700	4,900	12,500
West Virginia	6,400	4,300	4,600	3,300	1,900	7,000
	78,400	72,000	69,600	20,000	24,700	52,300

State	July	August	September	October	November	December	Total
Colorado	3,600	2,600	4,100	5,400	4,700	5,400	56,800
Pennsylvania	30,800	29,700	54,900	226,200	311,500	287,000	1,126,000
Utah	200	500	600	900	800	200	8,300
Virginia	10,400	10,900	15,200	22,600	21,000	17,700	165,300
West Virginia	2,100	1,200	2,200	11,700	24,700	18,500	87,900
	47,100	44,900	77,000	266,800	362,700	328,800	1,444,300

PRODUCTION BY FURNACE AND NONFURNACE PLANTS

The terms "furnace" and "merchant" operators originated in the Connellsville beehive-coke trade. As the name implies, the beehive-furnace interests are those affiliated with the producers of iron and steel whose output does not ordinarily enter the open market. There are, however, a number of byproduct plants financially affiliated with iron furnaces, in which most of the product is nevertheless foundry and domestic coke that must be sold on the competitive market. Inasmuch as the beehive-coke trade has dwindled during the past decade to an insignificant position in the coke industry (supplying only 3.3 percent of the total production in 1939) the statistics presented in the two following tables cover byproduct coke only.

A "furnace" plant is defined herein as one that has for its main business the production of furnace coke and that has an assured outlet for such coke either through financial affiliation with or direct ownership by an ironworks or through long-time contracts. Under this definition the class designated as "other" plants includes a few plants affiliated with local iron furnaces but producing much more coke than the furnaces can absorb and therefore depending chiefly on the foundry and domestic trade or on merchant sales of furnace coke. It also includes merchant producers of furnace coke who have to sell their output on the competitive market; the plants affiliated with alkali works; and, in addition, a number of plants that, although not public utilities, were constructed primarily to supply city gas and that must sell their coke where they can for domestic and industrial as well as metallurgical use.

In 1939, 45 furnace plants produced 31,811,807 tons of byproduct coke and 39 "other" plants produced 11,070,506 tons. The relative proportion furnished by furnace plants has remained fairly constant, except in the years of iron and steel depression. Thus, in 1913 and again in 1918, furnace plants produced approximately 73 percent of the total byproduct coke output. In 1932, a year of great recession in the steel industry, the proportion fell to 54 percent; it rose to 73 percent in 1937, fell again to 65 percent in 1938, and increased to 74 percent in 1939.

TABLE 7.—*Number and production of byproduct coke plants connected with iron furnaces and of other byproduct plants in the United States, 1913, 1918, and 1937–39*

Year	Number of active plants		Coke produced (net tons)		Percent of production	
	Furnace plants	Other plants	Furnace plants	Other plants	Furnace plants	Other 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
1938	44	40	20, 668, 878	10, 989, 525	65. 3	34. 7
1939	45	39	31, 811, 807	11, 070, 506	74. 2	25. 8

TABLE 8.—*Monthly and average daily production of byproduct coke by plants associated with iron furnaces and by all other plants in the United States, 1937–39, in net tons*

Month	1937		1938		1939	
	Furnace plants	Other plants	Furnace plants	Other plants	Furnace plants	Other plants
Monthly production:						
January	3, 241, 600	1, 119, 100	1, 710, 500	1, 038, 600	2, 388, 000	967, 200
February	2, 996, 500	996, 400	1, 544, 100	937, 500	2, 199, 000	867, 800
March	3, 355, 000	1, 140, 500	1, 672, 200	989, 500	2, 495, 000	930, 700
April	3, 310, 300	1, 040, 600	1, 493, 800	930, 300	2, 045, 700	858, 100
May	3, 375, 600	1, 104, 100	1, 374, 900	897, 200	1, 625, 900	761, 200
June	2, 917, 500	1, 107, 300	1, 224, 100	832, 200	2, 230, 200	848, 300
July	3, 316, 100	1, 107, 800	1, 350, 200	815, 900	2, 480, 600	873, 500
August	3, 469, 300	1, 104, 100	1, 645, 300	838, 700	2, 759, 900	893, 000
September	3, 334, 700	1, 093, 100	1, 798, 300	866, 800	2, 960, 400	930, 200
October	2, 910, 500	1, 124, 600	2, 138, 100	943, 100	3, 463, 300	1, 049, 000
November	2, 142, 700	1. 079, 600	2, 338, 600	927. 700	3, 526, 400	1, 025, 500
December	1, 764, 400	1, 059, 400	2, 378, 800	972, 000	3. 637, 400	1, 066, 000
	36, 134, 200	13, 076, 600	20, 668, 900	10, 989, 500	31, 811, 800	11, 070, 500
Average daily production:						
January	104, 600	36, 100	55, 200	33, 500	77, 000	31, 200
February	107, 000	35, 600	55, 100	33, 500	78, 500	31, 000
March	108, 200	36, 800	54, 000	31, 900	80, 500	30, 000
April	110, 300	34, 700	49, 800	31, 000	68, 200	28, 600
May	108, 900	35, 600	44, 400	28, 900	52, 400	24, 600
June	97, 300	36, 900	40, 800	27, 700	74, 300	28, 300
July	107, 000	35, 700	43, 600	26, 300	80, 000	28, 200
August	111, 900	35, 600	53, 100	27, 000	89, 000	28, 800
September	111, 200	36, 400	59, 900	28, 900	98, 700	31, 000
October	93, 900	36, 300	69, 000	30, 400	111, 700	33, 900
November	71, 400	36, 000	78, 000	30, 900	117, 500	34, 200
December	56, 900	34, 200	76, 700	31, 400	117, 300	34, 400
Average	99, 000	35, 800	56, 600	30, 100	87, 200	30, 300

PRODUCTION BY STATES AND DISTRICTS

Except in Minnesota and New Jersey, the losses sustained in 1938 production were recovered to a considerable extent in 1939; in Maryland and Michigan the 1939 output even slightly exceeded that of 1937. The total output of byproduct coke (exclusive of screenings and breeze) in 1939 was 36 percent greater than in 1938 and 13 percent less than in 1937.

As in previous years, Pennsylvania was the leading producing State, contributing 26 percent of the byproduct-coke output, 78 percent of beehive, and 27 percent of the United States total. Next in importance is Ohio, followed by Indiana, New York, and Alabama, in the order named.

TABLE 9.—*Coke produced, value, number of ovens, coal charged, and average yield in the United States in 1938, by States*

[Exclusive of screenings or breeze]

State	Byproduct							Beehive						Total	
	Plants	Ovens	Coal used (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens		Ovens	Coal used (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens		Coke produced (net tons)	Value of coke at ovens
						Total	Per ton					Total	Per ton		
Alabama	8	1,254	4,762,433	70.93	3,378,044	$9,888,292	$2.93							3,378,044	$9,888,292
Colorado	1	189	279,691	66.79	186,805	(1)	(1)	188	84,172	65.01	54,721	(1)	(1)	241,526	(1)
Connecticut	1	61	(2)	(2)	(2)	(2)	(2)							(2)	(2)
Illinois	8	896	2,587,012	67.05	1,734,511	11,706,788	6.75							1,734,511	11,706,788
Indiana	5	1,588	4,131,092	70.32	2,904,779	18,278,201	6.29							2,904,779	18,278,201
Kentucky	1	120	(2)	(2)	(2)	(2)	(2)							(2)	(2)
Maryland	1	361	1,532,049	72.14	1,105,262	(1)	(1)							1,105,262	(1)
Massachusetts	2	215	1,447,392	70.42	1,019,302	(1)	(1)							1,019,302	(1)
Michigan	10	621	2,519,488	69.17	1,742,787	10,135,722	5.82							1,742,787	10,135,722
Minnesota	3	196	770,010	70.19	540,447	4,495,555	8.32							540,447	4,495,555
Missouri	1	64	(2)	(2)	(2)	(2)	(2)							(2)	(2)
New Jersey	2	244	1,402,239	71.84	1,007,394	(1)	(1)							1,007,394	(1)
New York	8	978	5,546,010	71.14	3,945,358	23,529,138	5.96							3,945,358	23,529,138
Ohio	15	1,862	5,209,653	71.02	3,699,995	18,413,808	4.98							3,699,995	18,413,808
Pennsylvania	12	3,348	10,399,653	68.46	7,119,328	30,070,706	4.22	7,567	765,253	63.00	482,105	$1,945,790	$4.04	7,601,433	32,016,496
Rhode Island	1	65	(2)	(2)	(2)	(2)	(2)							(2)	(2)
Tennessee	1	24	110,798	68.70	76,123	480,336	6.31	140	10,000	55.00	5,500	28,435	5.17	81,623	508,771
Utah	1	56	228,175	58.08	132,513	(1)	(1)	93	15,667	48.94	7,668	(1)	(1)	140,181	(1)
Virginia								1,312	234,765	57.04	133,905	645,630	4.82	133,905	645,630
Washington								58							
West Virginia	4	387	1,980,047	68.02	1,346,734	4,144,230	3.08	1,458	250,019	61.40	153,513	675,969	4.40	1,500,247	4,820,199
Wisconsin	2	195	(2)	(2)	(2)	(2)	(2)							(2)	(2)
Combined States			2,360,602	72.82	1,719,021	11,755,364	6.84							1,719,021	11,755,364
Undistributed						20,580,899	5.96					406,971	6.52		20,987,870
	87	12,724	45,266,344	69.94	31,658,403	163,479,039	5.16	10,816	1,359,876	61.58	837,412	3,702,795	4.42	32,495,815	167,181,834

[1] Included under "Undistributed."

[2] Included under "Combined States."

TABLE 9A.—*Coke produced, value, number of ovens, coal charged, and average yield in the United States in 1939, by States*

[Exclusive of screenings or breeze]

State	Byproduct							Beehive						Total	
	Plants	Ovens	Coal used (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens: Total	Value of coke at ovens: Per ton	Ovens	Coal used (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens: Total	Value of coke at ovens: Per ton	Coke produced (net tons)	Value of coke at ovens
Alabama	8	1,254	5,427,742	71.01	3,854,505	$10,917,559	$2.83							3,854,505	$10,917,559
Colorado	1	189	602,787	66.03	398,033	(1)	(1)	188	86,895	65.41	56,836	(1)	(1)	454,869	(1)
Connecticut	1	61	(2)	(2)	(2)	(2)	(2)							(2)	(2)
Illinois	9	916	2,765,927	68.12	1,884,240	11,963,932	6.35							1,884,240	11,963,932
Indiana	5	1,728	6,942,767	70.26	4,878,033	28,532,944	5.85							4,878,033	28,532,944
Kentucky	1	120	(2)	(2)	(2)	(2)	(2)							(2)	(2)
Maryland	1	361	2,166,522	72.88	1,578,973	(1)	(1)							1,578,973	(1)
Massachusetts	2	215	1,494,835	70.72	1,057,158	(1)	(1)							1,057,158	(1)
Michigan	10	747	3,505,312	69.34	2,430,688	12,408,881	5.11							2,430,688	12,408,881
Minnesota	3	196	710,910	69.92	497,079	3,684,811	7.41							497,079	3,684,811
Missouri	1	64	(2)	(2)	(2)	(2)	(2)							(2)	(2)
New Jersey	2	244	1,412,019	71.05	1,003,197	(1)	(1)							1,003,197	(1)
New York	8	978	6,279,848	71.16	4,468,437	25,526,646	5.71							4,468,437	25,526,646
Ohio	15	1,862	8,631,389	71.09	6,135,949	28,502,924	4.65							6,135,949	28,502,924
Pennsylvania	12	3,348	15,999,842	68.71	10,994,254	44,214,472	4.02	7,836	1,775,307	63.42	1,125,971	$4,801,086	$4.26	12,120,225	49,015,558
Rhode Island	1	65	(2)	(2)	(2)	(2)	(2)							(2)	(2)
Tennessee	1	24	108,832	73.00	79,448	527,535	6.64	140						79,448	527,535
Utah	1	56	324,100	58.38	189,194	(1)	(1)	50	13,825	60.27	8,332	(1)	(1)	197,526	(1)
Virginia								1,312	290,676	56.87	165,317	783,512	4.74	165,317	783,512
Washington								58							
West Virginia	4	387	2,346,287	68.12	1,598,198	4,282,010	2.68	1,350	131,082	67.04	87,872	417,830	4.75	1,686,070	4,699,840
Wisconsin	2	195	(2)	(2)	(2)	(2)	(2)							(2)	(2)
Combined States			2,496,780	73.49	1,834,927	11,757,652	6.41							1,834,927	11,757,652
Undistributed						24,138,507	5.71					423,749	6.50		24,562,256
	88	13,010	61,215,899	70.05	42,882,313	206,457,873	4.81	10,934	2,297,785	62.86	1,444,328	6,426,177	4.45	44,326,641	212,884,050

(1) Included under "Undistributed."

(2) Included under "Combined States."

TABLE 10.—*Byproduct and beehive coke produced in the United States, 1918 and 1936–39, by States, in net tons*

[Exclusive of screenings or breeze]

State	1918	1936	1937	1938	1939
Byproduct:					
Alabama	2,634,451	3,089,622	4,259,771	3,378,044	3,854,505
Colorado	230,663	337,341	486,945	186,805	398,033
Connecticut		(1)	(1)	(1)	(1)
Illinois	2,285,610	2,082,516	2,998,663	1,734,511	1,884,240
Indiana	3,898,215	5,449,755	5,467,061	2,904,779	4,878,033
Kentucky	517,749	(1)	(1)	(1)	(1)
Maryland	474,368	1,217,039	1,513,651	1,105,262	1,578,973
Massachusetts	556,397	1,108,219	1,130,620	1,019,302	1,057,158
Michigan	(1)	2,293,653	2,283,518	1,742,787	2,430,688
Minnesota	784,065	521,518	704,631	540,447	497,079
Missouri	(1)	(1)	(1)	(1)	(1)
New Jersey	682,148	1,007,500	1,015,073	1,007,394	1,003,197
New York	1,069,587	4,835,921	4,946,964	3,945,358	4,468,437
Ohio	5,226,334	6,242,300	6,737,881	3,699,995	6,135,949
Pennsylvania	4,586,981	12,570,816	13,701,262	7,119,328	10,994,254
Rhode Island		(1)	(1)	(1)	(1)
Tennessee	124,469	83,305	89,451	76,123	79,448
Utah		124,346	149,659	132,513	189,194
Washington	30,129	28,368	14,656		
West Virginia	603,393	1,702,792	1,817,993	1,346,734	1,598,198
Wisconsin	(1)	(1)	(1)	(1)	(1)
Combined States	2,293,021	1,874,110	1,892,949	1,719,021	1,834,927
	25,997,580	44,569,121	49,210,748	31,658,403	42,882,313
Beehive:					
Alabama	1,717,721				
Colorado	758,784	61,293	64,222	54,721	56,836
Georgia	22,048				
Kentucky	301,036				
New Mexico	597,072				
Ohio	138,909				
Oklahoma	(1)				
Pennsylvania	22,136,664	1,213,294	2,559,048	482,105	1,125,971
Tennessee	302,637	3,567	14,982	5.500	
Utah	(1)	5,617	6,657	7,668	8,332
Virginia	1,234,256	191,331	240,425	133,905	165,317
Washington	93,659	312			
West Virginia	2,716,613	230,649	279,387	153,513	87,872
Combined States	461,393				
	30,480,792	1,706,063	3,164,721	837,412	1,444,328
Grand total	56,478,372	46,275.184	52,375,469	32,495,815	44,326,641

[1] Included under "Combined States."

TABLE 11.—*Byproduct and beehive coke produced in Pennsylvania, 1938–39, by districts*

[Number of plants and ovens includes those idle during the year]

District	Plants	Ovens	Coal used (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens	
						Total	Per ton
1938							
Byproduct:							
Eastern Pennsylvania [1]	5	734	2,176,790	69.45	1,511,857	$9,425,789	$6.23
Western Pennsylvania [2]	7	2,614	8,222,863	68.19	5,607,471	20,644,917	3.68
	12	3,348	10,399,653	68.46	7,119,328	30,070,706	4.22
Beehive:							
Allegheny Mountain and Allegheny Valley	2	242	38,777	55.59	21,556	114,462	5.31
Connellsville	20	2,971	167,366	63.73	106,669	399,034	3.74
Lower Connellsville	17	2,570	248,202	66.25	164,431	622,974	3.79
Upper Connellsville	5	728	65,003	63.73	41,424	186,942	4.51
Pittsburgh and other districts [3]	6	1,056	245,905	60.20	148,025	622,378	4.20
	50	7,567	765,253	63.00	482,105	1,945,790	4.04
Grand total	62	10,915	11,164,906	68.08	7,601,433	32,016,496	4.21
1939							
Byproduct:							
Eastern Pennsylvania [1]	5	734	2,628,745	70.31	1,848,390	11,422,918	6.18
Western Pennsylvania [2]	7	2,614	13,371,097	68.40	9,145,864	32,791,554	3.59
	12	3,348	15,999,842	68.71	10,994,254	44,214,472	4.02
Beehive:							
Allegheny Mountain and Allegheny Valley	2	242	43,886	51.27	22,502	123,311	5.48
Connellsville	27	3,186	685,777	65.61	449,967	1,855,956	4.12
Lower Connellsville	15	2,506	622,631	63.99	398,405	1,727,290	4.34
Upper Connellsville	5	728	47,685	65.86	31,407	122,849	3.91
Pittsburgh and other districts [3]	6	1,174	375,328	59.60	223,690	971,680	4.34
	55	7,836	1,775,307	63.42	1,125,971	4,801,086	4.26
Grand total	67	11,184	17,775,149	68.19	12,120,225	49,015,558	4.04

[1] Includes plants at Bethlehem, Chester, Philadelphia, Steelton, and Swedeland.
[2] Includes plants at Aliquippa, Clairton, Erie, Johnstown, Midland, Neville Island, and Pittsburgh.
[3] Includes Bedford and parts of Indiana and Westmoreland Counties.

TABLE 12.—*Byproduct coke produced in Ohio, 1938–39, by districts*

District	Plants	Ovens	Coal used (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens	
						Total	Per ton
1938							
Canton, Cleveland, and Massillon	5	595	1,160,421	70.86	822,248	$4,140,148	$5.04
Youngstown	3	602	1,347,949	69.38	935,207	4,196,309	4.49
Other districts [1]	7	665	2,701,283	71.91	1,942,540	10,077,351	5.19
	15	1,862	5,209,653	71.02	3,699,995	18,413,808	4.98
1939							
Canton, Cleveland, and Massillon	5	595	2,356,096	70.90	1,670,575	7,889,660	4.72
Youngstown	3	602	2,466,038	70.49	1,738,227	7,339,136	4.22
Other districts [1]	7	665	3,809,255	71.59	2,727,147	13,274,128	4.87
	15	1,862	8,631,389	71.09	6,135,949	28,502,924	4.65

[1] Includes plants at Hamilton, Ironton, Lorain, Painesville, Portsmouth, Toledo, and Warren.

NUMBER AND TYPE OF OVENS

In the byproduct branch of the coke industry 286 new byproduct ovens were completed and put into operation during 1939; of these, 20 were in Illinois, 140 in Indiana, and 126 in Michigan. At the close of the year no ovens were reported under construction, and none had been abandoned; the number in existence at the 88 plants totaled about 13,010.

Beehive coke ovens have been dismantled steadily during the past 3 decades and in 1937 were exceeded in number by byproduct ovens for the first time. In 1910 there were 100,362 beehive ovens; in 1920, 75,298; and in 1930, 23,907. In 1939, only 10,934 remained. Byproduct ovens rose during the same period from 4,078 in 1910 to 10,881 in 1920, to 12,831 in 1930, and 13,010 in 1939, the net change during the past 9 years being slight. There is of course no basis of comparison between a byproduct and a beehive oven with respect to operating capacity, but the figures show the changing trend of coking practices.

The 76 beehive coke plants in existence at the close of 1939 comprised 10,934 ovens. Fifty-eight plants with a total of 8,857 ovens were active. The survey, inaugurated in 1938, covering the average number of ovens active during each month, was continued, and showed a high of 6,408 in November and a low of 990 in April. The average for the year was 2,711 ovens compared with 1,846 in 1938.

TABLE 13.—*Coke ovens completed and abandoned in the United States, 1938–39, and total number in existence at end of year, by States*

State	Plants in existence Dec. 31	Ovens						
		In existence Dec. 31		New		Abandoned during year	Under construction Dec. 31	
		Number	Capacity per day (net tons of coke)	Number	Capacity per day (net tons of coke)		Number	Capacity per day (net tons of coke)
1938								
Byproduct:								
Alabama	8	1,254	14,654					
Colorado	1	189	2,916	41	710	1		
Connecticut	1	61	(1)					
Illinois	8	896	12,352				20	186
Indiana	5	1,588	21,413			19		
Kentucky	1	120	(1)	12	(1)			
Maryland	1	361	5,088					
Massachusetts	2	215	3,553					
Michigan	10	621	7,617	65	1,275	120	126	2,359
Minnesota	3	196	2,572					
Missouri	1	64	(1)					
New Jersey	2	244	2,793	5	(1)			
New York	8	978	14,750					
Ohio	15	1,862	25,397	[2] 84	[2] 1,440	61		
Pennsylvania	12	3,348	41,895					
Rhode Island	1	65	(1)					
Tennessee	1	24	473					
Utah	1	56	705					
West Virginia	4	387	5,383					
Wisconsin	2	195	(1)					
Undistributed			6,307		190			
	87	12,724	167,868	207	3,615	201	146	2,545
At merchant plants	41	3,417	42,487	17	190	19	20	186
At furnace plants	46	9,307	125,381	190	3,425	182	126	2,359

See footnotes at end of table.

TABLE 13.—*Coke ovens completed and abandoned in the United States, 1938–39, and total number in existence at end of year, by States*—Continued

State	Plants in existence Dec. 31	Ovens: In existence Dec. 31		Ovens: New		Ovens: Abandoned during year	Ovens: Under construction Dec. 31	
		Number	Capacity per day (net tons of coke)	Number	Capacity per day (net tons of coke)		Number	Capacity per day (net tons of coke)
1938—Continued								
Beehive:								
Colorado	2	188						
Pennsylvania	50	7,567				534		
Tennessee	2	140						
Utah	1	93				726		
Virginia	7	1,312	(3)					
Washington	1	58						
West Virginia	9	1,458				1		
	72	10,816				1,261		
1939								
Byproduct:								
Alabama	8	1,254	14,654					
Colorado	1	189	2,916					
Connecticut	1	61	(1)					
Illinois	9	916	12,547	20	195			
Indiana	5	1,728	23,557	140	2,120			
Kentucky	1	120	(1)					
Maryland	1	361	5,088					
Massachusetts	2	215	3,553					
Michigan	10	747	9,992	126	2,292			
Minnesota	3	196	2,572					
Missouri	1	64	(1)					
New Jersey	2	244	2,793					
New York	8	978	14,738					
Ohio	15	1,862	25,397					
Pennsylvania	12	3,348	41,917					
Rhode Island	1	65	(1)					
Tennessee	1	24	360					
Utah	1	56	705					
West Virginia	4	387	5,511					
Wisconsin	2	195	(1)					
Undistributed			6,179					
	88	13,010	172,479	286	4,607			
At merchant plants	42	3,437	42,581	20	195			
At furnace plants	46	9,573	129,898	266	4,412			
Beehive:								
Colorado	2	188						
Pennsylvania	55	7,836		244	(3)	310	4	(3)
Tennessee	2	140						
Utah	1	50				43		
Virginia	7	1,312	(3)					
Washington	1	58						
West Virginia	8	1,350				100		
	76	10,934		244	(3)	453	4	(3)

[1] Included under "Undistributed."
[2] Includes 69 new ovens, 1,150 tons capacity, replacing 61 old ovens reported as abandoned.
[3] Data not available.

TABLE 14.—*Beehive ovens active in the United States in 1939, by months*

Month	Number	Month	Number	Month	Number
January	1,642	May	1,239	September	3,076
February	1,725	June	1,418	October	5,909
March	1,541	July	1,223	November	6,408
April	990	August	1,307	December	6,048

TABLE 15.—*Byproduct ovens of each type in the United States at end of 1938 and 1939, by States*

State	Koppers [1]	Semet-Solvay	Wilputte	Cambria	Roberts Morrissey	American Foundation	All others [2]	Total
1938								
Alabama	774	420	60					1,254
Colorado	189							189
Connecticut	61							61
Illinois	662	120	88				26	896
Indiana	1,167	161	260					1,588
Kentucky		120						120
Maryland	361							361
Massachusetts	160		55					215
Michigan	253	281					87	621
Minnesota	196							196
Missouri	56						8	64
New Jersey	244							244
New York	743	180				55		978
Ohio	1,569	293						1,862
Pennsylvania	3,018	88	97	120	25			3,348
Rhode Island	65							65
Tennessee		24						24
Utah	56							56
West Virginia	316		71					387
Wisconsin	115	80						195
	10,005	1,767	631	120	25	55	121	12,724
At merchant plants	1,924	1,046	246		25	55	121	3,417
At furnace plants	8,081	721	385	120				9,307
1939								
Alabama	774	420	60					1,254
Colorado	189							189
Connecticut	61							61
Illinois	662	120	88				46	916
Indiana	1,167	161	400					1,728
Kentucky		120						120
Maryland	361							361
Massachusetts	160		55					215
Michigan	314	346					87	747
Minnesota	196							196
Missouri	56						8	64
New Jersey	244							244
New York	743	180				55		978
Ohio	1,569	293						1,862
Pennsylvania	3,018	88	97	120	25			3,348
Rhode Island	65							65
Tennessee		24						24
Utah	56							56
West Virginia	316		71					387
Wisconsin	115	80						195
	10,066	1,832	771	120	25	55	141	13,010
At merchant plants	1,924	1,046	246		25	55	141	3,437
At furnace plants	8,142	786	525	120				9,573

[1] Includes the Koppers-Becker type.
[2] Includes 26 Curran-Knowles, 27 Parker-Russell, 60 Improved Equipment Co., and 8 Piette ovens in 1938 and 46 Curran-Knowles, 27 Parker-Russell, 60 Improved Equipment Co., and 8 Piette ovens in 1939.

CAPACITY OF BYPRODUCT OVENS

The reported maximum capacity of the byproduct ovens in existence is seldom attained, for various practical reasons that may be due to operating, economic, or labor conditions. It has been stated that the efficient life of a coke oven is limited to 20 years, as radiation losses after that period are high; other claims have been made that ovens built 25 years ago still can operate efficiently. Had it not been for the depression years much replacement building probably would have been done. The closing of ovens over an extended period added to their life and made replacement unnecessary in many instances.

The maximum daily capacity of the 88 byproduct coke plants in existence December 31, 1939, was 172,479 tons compared with 167,868 tons for the 87 plants at the end of 1938. The daily capacity at the 42 merchant plants was 42,581 tons, an average of 1,014 tons per plant, while at the 46 furnace plants the capacity was 129,898 tons (2,824 tons per plant); the furnace plants as a rule carry larger batteries of ovens.

Production of byproduct coke in 1939 was 69 percent of the calculated capacity of all byproduct ovens compared with 51 percent in 1938 and 91 percent in the peak year 1929. Furnace plants operated at 68 percent of capacity, while merchant plants operated at 72 percent.

TABLE 16.—*Estimated annual potential production of coke and coal required for charge of byproduct coke ovens in the United States, 1938–39, when operated at different percentages of maximum capacity, in millions of net tons*

Percent of maximum capacity	1938				1939 [1]	
	Ovens completed Dec. 31		Including ovens under construction		Ovens completed Dec. 31	
	Coke	Coal [2]	Coke	Coal [2]	Coke	Coal [2]
100	61.3	87.6	62.2	88.9	63.0	90.0
90	55.2	78.8	56.0	80.0	56.7	81.0
85	52.1	74.5	52.9	75.6	53.6	76.5
75	46.0	65.7	46.7	66.7	47.3	67.5
50	30.7	43.8	31.1	44.5	31.5	45.0

[1] No ovens under construction at end of 1939.
[2] Coal for charge estimated on basis of 70-percent yield in coke.

TABLE 17.—*Relationship (percent) of production to maximum capacity at byproduct coke plants in the United States, 1929 and 1936–39, by months*

Month	1929	1936	1937	1938	1939	Month	1929	1936	1937	1938	1939
January	88.6	62.4	83.0	52.4	62.8	August	93.6	74.2	86.0	47.3	70.2
February	91.3	63.3	83.5	52.3	63.5	September	91.9	76.0	86.1	52.4	77.2
March	93.0	61.5	84.9	50.7	64.1	October	92.3	78.1	76.0	57.9	86.6
April	92.8	67.6	84.9	47.7	56.2	November	89.0	80.3	62.8	63.3	90.3
May	94.0	70.8	84.6	43.2	44.4	December	83.1	83.4	53.1	62.8	89.7
June	93.9	72.1	78.6	40.4	59.2						
July	93.0	71.5	83.2	41.3	64.4	The year	91.4	71.6	78.8	51.0	68.9

QUANTITY AND COST OF COAL CHARGED

Although the quantity of coal used in the manufacture of coke has fluctuated widely during the past decade, the proportion of the total output of bituminous coal carbonized each year has remained remarkably constant, ranging from 10.3 to 16.8 percent during the past 10 years. In 1939, coke ovens consumed 63,513,684 tons—about 16 percent of the total output of bituminous coal. Of this quantity, 61,215,899 tons were used in byproduct ovens.

The cost of coal constitutes the chief item of expense in the manufacture of coke. In 1939 the cost of raw coal f. o. b. ovens ranged from $1.81 in Virginia, where all the coke is made in beehive ovens at the mines, to $5.49 in Minnesota, where the cost includes heavy freight charges from distant mines.

The average cost of coal in byproduct ovens in 1939 was $3.75 a ton, and the cost of the coal equivalent of 1 ton of merchantable coke was $5.36. The corresponding figures for beehive coke were $1.99 and $3.16, respectively.

TABLE 18.—*Coal consumed in coke ovens in the United States, 1937–39, by months in net tons*

Month	1937			1938			1939		
	Byproduct	Beehive	Total	Byproduct	Beehive	Total	Byproduct	Beehive	Total
January	6,198,700	426,600	6,625,300	3,946,400	184,400	4,130,800	4,785,200	127,400	4,912,600
February	5,679,900	458,500	6,138,400	3,560,700	164,700	3,725,400	4,377,200	116,800	4,494,000
March	6,387,000	556,800	6,943,800	3,818,100	153,200	3,971,300	4,890,000	113,200	5,003,200
April	6,183,800	480,800	6,664,600	3,477,500	117,600	3,595,100	4,143,400	32,700	4,176,100
May	6,368,500	509,700	6,878,200	3,255,500	92,000	3,347,500	3,407,500	40,900	3,448,400
June	5,729,200	430,500	6,159,700	2,948,600	81,500	3,030,100	4,392,300	85,400	4,477,700
July	6,217,200	441,700	6,658,900	3,104,000	68,700	3,172,700	4,782,900	76,300	4,859,200
August	6,425,800	401,100	6,826,900	3,555,600	78,900	3,634,500	5,214,200	72,700	5,286,900
September	6,220,700	392,800	6,613,500	3,792,600	87,700	3,880,300	5,556,700	123,900	5,680,600
October	5,664,800	351,600	6,016,400	4,386,700	99,700	4,486,400	6,446,900	421,200	6,868,100
November	4,527,000	264,000	4,791,000	4,650,100	109,100	4,759,200	6,503,500	570,500	7,074,000
December	3,972,800	212,700	4,185,500	4,770,500	122,400	4,892,900	6,716,100	516,800	7,232,900
	69,575,400	4,926,800	74,502,200	45,266,300	1,359,900	46,626,200	61,215,900	2,297,800	63,513,700

TABLE 19.—*Total quantity and value at ovens of coal used in manufacture of coke in the United States, 1938–39, by States*

State	Coal used (net tons)	Cost of coal		Coal per ton of coke	
		Total	Per ton of coal	Net tons	Cost
1938					
Byproduct plants:					
Alabama	4,762,433	$12,059,891	$2.53	1.41	$3.57
Colorado	279,691	(1)	(1)	1.50	(1)
Illinois	2,587,012	11,862,615	4.59	1.49	6.84
Indiana	4,131,092	20,246,011	4.90	1.42	6.96
Maryland	1,532,049	(1)	(1)	1.39	(1)
Massachusetts	1,447,392	(1)	(1)	1.42	(1)
Michigan	2,519,488	10,238,913	4.06	1.45	5.89
Minnesota	770,010	4,258,388	5.53	1.42	7.85
New Jersey	1,402,239	(1)	(1)	1.39	(1)
New York	5,546,010	26,098,012	4.71	1.41	6.64
Ohio	5,209,653	19,931,132	3.83	1.41	5.40
Pennsylvania	10,399,653	33,266,478	3.20	1.46	4.67
Tennessee	110,798	370,546	3.34	1.46	4.88
Utah	228,175	(1)	(1)	1.72	(1)
West Virginia	1,980,047	4,870,499	2.46	1.47	3.62
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	2,360,602	10,827,869	4.59	1.37	6.29
Undistributed		23,300,562	4.77		6.77
	45,266,344	177,330,916	3.92	1.43	5.61
At merchant plants	15,454,786	71,317,182	4.61	1.41	6.50
At furnace plants	29,811,558	106,013,734	3.56	1.44	5.13
Beehive plants:					
Colorado and Utah	99,839	334,242	3.35	1.60	5.36
Pennsylvania	765,253	1,496,472	1.96	1.59	3.12
Tennessee	10,000	18,300	1.83	1.82	3.33
Virginia	234,765	433,239	1.85	1.75	3.24
West Virginia	250,019	508,725	2.03	1.63	3.31
	1,359,876	2,790,978	2.05	1.62	3.32
1939					
Byproduct plants:					
Alabama	5,427,742	12,987,943	2.39	1.41	3.37
Colorado	602,787	(1)	(1)	1.51	(1)
Illinois	2,765,927	12,593,351	4.55	1.47	6.69
Indiana	6,942,767	32,468,533	4.68	1.42	6.65
Maryland	2,166,522	(1)	(1)	1.37	(1)
Massachusetts	1,494,835	(1)	(1)	1.41	(1)
Michigan	3,505,312	14,295,364	4.08	1.44	5.88
Minnesota	710,910	3,901,992	5.49	1.43	7.85
New Jersey	1,412,019	(1)	(1)	1.41	(1)
New York	6,279,848	28,956,540	4.61	1.41	6.50
Ohio	8,631,389	32,889,065	3.81	1.41	5.37
Pennsylvania	15,999,842	46,896,676	2.93	1.46	4.28
Tennessee	108,832	380,623	3.50	1.37	4.80
Utah	324,100	(1)	(1)	1.71	(1)
West Virginia	2,346,287	5,476,936	2.33	1.47	3.43
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	2,496,780	11,152,241	4.47	1.36	6.08
Undistributed		27,786,449	4.63		6.57
	61,215,899	229,785,713	3.75	1.43	5.36
At merchant plants	15,512,875	70,897,931	4.57	1.40	6.40
At furnace plants	45,703,024	158,887,782	3.48	1.44	5.01
Beehive plants:					
Colorado and Utah	100,720	335,017	3.33	1.55	5.16
Pennsylvania	1,775,307	3,475,476	1.96	1.58	3.10
Virginia	290,676	525,962	1.81	1.76	3.19
West Virginia	131,082	247,586	1.89	1.49	2.82
	2,297,785	4,584,041	1.99	1.59	3.16

[1] Included under "Undistributed."

TABLE 20.—*Average cost per net ton of coal charged into byproduct coke ovens in the United States, 1929 and 1936–39, by States*

State	1929	1936	1937	1938	1939
Alabama	$2.49	$2.24	$2.33	$2.53	$2.39
Illinois	4.29	4.43	4.62	4.59	4.55
Indiana	4.61	4.60	4.71	4.90	4.68
Massachusetts	4.70	4.98	[1]	[1]	[1]
Michigan	4.29	4.28	4.16	4.06	4.08
Minnesota	5.04	5.28	5.24	5.53	5.49
New York	4.22	4.45	4.55	4.71	4.61
Ohio	3.31	3.60	3.76	3.83	3.81
Pennsylvania	$2.73	$2.94	$2.98	$3.20	$2.93
Tennessee	3.02	3.35	3.42	3.34	3.50
Washington	5.26	4.81	4.87	----	----
West Virginia	2.41	2.37	2.54	2.46	2.33
United States average	3.50	3.69	3.74	3.92	3.75
Cost of coal per ton of coke	5.04	5.24	5.27	5.61	5.36

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

PREPARATION AND SOURCE OF COAL

The coal used for coking in Colorado and Tennessee, as well as in certain parts of Alabama, Illinois, New York, Ohio, Pennsylvania, and West Virginia, is washed before it is charged in the ovens. The washing sometimes is done by the operator at the mines and sometimes by the coke producer at the plant. For the country as a whole in 1939, 26 percent of the coal used in byproduct ovens and 21 percent of that in beehive ovens was washed before charging. In 1938, 30 percent of the coal for byproduct ovens and 31 percent of that for beehive ovens was washed.

TABLE 21.—*Washed and unwashed coal used in the manufacture of byproduct and beehive coke in the United States, 1938–39, by States in which used, in net tons*

State	Washed	Unwashed	Total
1938			
Byproduct plants:			
Alabama	4,632,422	130,011	4,762,433
Colorado	279,691	----	279,691
Illinois	509,938	2,077,074	2,587,012
Indiana	----	4,131,092	4,131,092
Maryland	----	1,532,049	1,532,049
Massachusetts	----	1,447,392	1,447,392
Michigan	----	2,519,488	2,519,488
Minnesota	----	770,010	770,010
New Jersey	----	1,402,239	1,402,239
New York	713,888	4,832,122	5,546,010
Ohio	897,596	4,312,057	5,209,653
Pennsylvania	5,825,378	4,574,275	10,399,653
Tennessee	110,798	----	110,798
Utah	----	228,175	228,175
West Virginia	535,006	1,445,041	1,980,047
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	18,269	2,342,333	2,360,602
	13,522,986	31,743,358	45,266,344
At merchant plants	1,199,778	14,255,008	15,454,786
At furnace plants	12,323,208	17,488,350	29,811,558
Beehive plants:			
Colorado	84,172	----	84,172
Pennsylvania	333,686	431,567	765,253
Tennessee	10,000	----	10,000
Utah	----	15,667	15,667
Virginia	----	234,765	234,765
West Virginia	----	250,019	250,019
	427,858	932,018	1,359,876

TABLE 21.—*Washed and unwashed coal used in the manufacture of byproduct and beehive coke in the United States, 1938–39, by States in which used, in net tons*—Continued

State	Washed	Unwashed	Total
1939			
Byproduct plants:			
Alabama	5,424,096	3,646	5,427,742
Colorado	602,787		602,787
Illinois	539,357	2,226,570	2,765,927
Indiana		6,942,767	6,942,767
Maryland		2,166,522	2,166,522
Massachusetts		1,494,835	1,494,835
Michigan		3,505,312	3,505,312
Minnesota		710,910	710,910
New Jersey		1,412,019	1,412,019
New York	779,873	5,499,975	6,279,848
Ohio	1,277,570	7,353,819	8,631,389
Pennsylvania	6,322,637	9,677,205	15,999,842
Tennessee	108,832		108,832
Utah		324,100	324,100
West Virginia	775,998	1,570,289	2,346,287
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	38,232	2,458,548	2,496,780
	15,869,382	45,346,517	61,215,899
At merchant plants	1,204,895	14,307,980	15,512,875
At furnace plants	14,664,487	31,038,537	45,703,024
Beehive plants:			
Colorado	86,895		86,895
Pennsylvania	382,297	1,393,010	1,775,307
Utah		13,825	13,825
Virginia		290,676	290,676
West Virginia	14,502	116,580	131,082
	483,694	1,814,091	2,297,785

Pennsylvania and West Virginia are the leading sources of coal used in byproduct coke manufacture. In 1938 each of these States supplied approximately 38 percent; in 1939 Pennsylvania led with 42 percent followed by West Virginia with 36 percent. Next in order of importance are Kentucky and Alabama with 10 and 9 percent, respectively, and Virginia with 2 percent. Colorado and Utah together furnished nearly a million tons of coal for that purpose in 1939, and smaller tonnages were obtained from Illinois, Ohio, and Tennessee.

TABLE 22.—*Coal used in manufacture of byproduct coke in the United States, 1938–39, by fields of origin, in net tons*

[Based upon detailed reports from each coke plant. The difference between these totals and those shown in tables 1, 9, 19, etc., is due to change in stock, loss of weight in handling, and the fact that these sometimes represent purchases during the year rather than actual consumption]

State and district where coal was produced	Total used	States where coal was consumed—in order of importance
1938		
Alabama	4,752,842	Alabama.
Colorado:		
Canon, Crested Butte, and Walsen	52,830	Colorado.
Trinidad	228,465	Do.
Illinois: Franklin County	106,667	Illinois.
Kentucky, Eastern:		
Elkhorn (including Hazard)	1,504,735	Indiana, Michigan, New York, New Jersey, Kentucky, Minnesota, Missouri, Ohio, Illinois, and Wisconsin.
Harlan	2,415,488	Indiana, Illinois, Ohio, Minnesota, and Michigan.
Kenova-Thacker [1]	1,160,615	Michigan, Ohio, Wisconsin, New York, West Virginia, and Missouri.
Miscellaneous	31,621	Missouri, Indiana, and Ohio.
Ohio	238	Ohio.
Pennsylvania:		
Central Pennsylvania:		
Medium-volatile	570,855	New York and Pennsylvania.
Low-volatile	736,966	Pennsylvania and New York.
Connellsville	7,681,177	Pennsylvania, Ohio, West Virginia, Illinois, Minnesota, Michigan, and New York.
Freeport	1,267,950	West Virginia, Ohio, New York, Pennsylvania, and Michigan.
Pittsburgh	6,375,832	Pennsylvania, New York, Ohio, Michigan, Illinois, Minnesota, and Wisconsin.
Somerset	266,965	Pennsylvania and West Virginia.
Westmoreland	468,591	Maryland, New York, and Pennsylvania.
Tennessee	79,695	Tennessee.
Utah: Carbon County	228,175	Utah.
Virginia: Southwestern [1] [2]	315,682	New Jersey, New York, Pennsylvania, and Massachusetts.
West Virginia: [2]		
Coal and Coke [3]	149,628	Pennsylvania, Minnesota, and New York.
Kanawha and Logan (including Coal River).	6,857,522	Massachusetts, Ohio, Illinois, New York, Indiana, New Jersey, Michigan, West Virginia, Pennsylvania, Wisconsin, Kentucky, Connecticut, Minnesota, Rhode Island, and Missouri.
New River, high-volatile	923,805	New York, New Jersey, Connecticut, Massachusetts, and Pennsylvania.
New River, low-volatile (including Winding Gulf).	1,539,972	New York, Massachusetts, New Jersey, Illinois, Rhode Island, West Virginia, Minnesota, Kentucky, and Missouri.
Northern	2,035,601	Maryland, Pennsylvania, Ohio, West Vriginia, and New York.
Pocahontas [2]	5,871,901	Indiana, Ohio, New York, Michigan, Illinois, Wisconsin, Maryland, Pennsylvania, Minnesota, Kentucky, Connecticut, Alabama, Missouri, Massachusetts, Tennessee, and West Virginia.
Webster-Gauley	209,537	Pennsylvania and Massachusetts.
Miscellaneous	10,316	Indiana.
	45,843,671	
1939		
Alabama	5,283,591	Alabama.
Colorado:		
Canon, Crested Butte, and Walsen	97,022	Colorado.
Trinidad	507,273	Do.
Illinois: Southern	124,491	Illinois and Missouri.
Kentucky, Eastern:		
Elkhorn (including Hazard)	1,516,089	Indiana, New York, New Jersey, Ohio, Michigan, Minnesota, Illinois, Wisconsin, and Kentucky.
Harlan	3,310,488	Indiana, Illinois, Ohio, Minnesota, Michigan, New York, and Wisconsin.
Kenova-Thacker [4]	1,406,177	Michigan, Ohio, Wisconsin, West Virginia, New York, and Missouri.
Miscellaneous	10,679	Missouri, Ohio, and Indiana.
Ohio	1,296	Ohio.

See footnotes at end of table.

TABLE 22.—*Coal used in manufacture of byproduct coke in the United States, 1938–39, by fields of origin, in net tons*—Continued

State and district where coal was produced	Total used	States where coal was consumed—in order of importance
1939—Continued		
Pennsylvania:		
Central Pennsylvania:		
Medium-volatile	523, 153	New York and Pennsylvania.
Low-volatile	1, 123, 597	Pennsylvania and New York.
Connellsville	13, 084, 727	Pennsylvania, Ohio, West Virginia, New York, Illinois, and Minnesota.
Freeport	1, 354, 891	West Virginia, Ohio, Michigan, New York, and Pennsylvania.
Pittsburgh	8, 675, 795	Pennsylvania, New York, Ohio, Michigan, Illinois, and Wisconsin.
Somerset	471, 923	Pennsylvania and West Virginia.
Westmoreland	485, 505	Maryland, New York, Minnesota, Ohio, and Wisconsin.
Miscellaneous	37, 000	Pennsylvania.
Tennessee	90, 902	Tennessee.
Utah: Carbon County	324, 100	Utah.
Virginia: Southwestern [1]	758, 998	Michigan, New Jersey, Ohio, Illinois, Minnesota, New York, and Pennsylvania.
West Virginia: [2 4]		
Coal and Coke [3]	199, 327	Pennsylvania, Minnesota, and New York.
Kanawha and Logan	7, 228, 279	Massachusetts, Ohio, Illinois, Indiana, New York, Kentucky, West Virginia, Michigan, New Jersey, Wisconsin, Pennsylvania, Connecticut, Rhode Island, Minnesota, and Missouri.
New River, high-volatile	1, 266, 674	New York, New Jersey, Connecticut, Massachusetts, Michigan, and Pennsylvania.
New River, low-volatile (including Winding Gulf).	2, 006, 606	New York, Massachusetts, New Jersey, Illinois, Maryland, Michigan, Missouri, Rhode Island, Pennsylvania, Kentucky, West Virginia, Minnesota, and Ohio.
Northern	3, 103, 359	Maryland, Pennsylvania, Ohio, Michigan, West Virginia, New York, and Massachusetts
Pocahontas [2]	8, 936, 553	Indiana, Ohio, New York, Michigan, Illinois, Maryland, Pennsylvania, Wisconsin, Minnesota, Kentucky, Connecticut, Massachusetts, Alabama, Tennessee, and West Virginia.
Webster-Gauley	133, 557	Pennsylvania.
	62, 062, 052	

[1] Coal from the extension of Thacker field in Virginia is included under Kenova-Thacker (Kentucky).
[2] Coal from the extension of the Pocahontas field in Virginia is included under Pocahontas (West Virginia).
[3] Includes coal from all Bituminous Coal Division field 24a-b-c except Webster-Gauley.
[4] Coal from the extension of Thacker field in West Virginia is included under Kenova-Thacker (Kentucky).

Table 23.—*Coal used in the manufacture of byproduct coke in the United States, 1938–39, by States where produced and consumed, and by merchant and furnace plants, in net tons*

State where coal was used	Coal produced in—										
	Alabama	Colorado	Illinois	Kentucky	Ohio	Pennsylvania	Tennessee	Utah	Virginia	West Virginia	Total
1938											
Alabama: Merchant plants	612,297									80,800	693,097
Furnace plants	4,140,545									7,104	4,147,649
Total Alabama	4,752,842									87,904	4,840,746
Colorado: Furnace plants		281,295									281,295
Illinois: Merchant plants			106,667	109,118		78,389				1,327,648	1,621,822
Furnace plants				388,343		407,660				121,341	917,344
Total Illinois			106,667	497,461		486,049				1,448,989	2,539,166
Indiana: Merchant plants										570,207	570,207
Furnace plants				2,101,029					172,272	1,401,076	3,674,377
Total Indiana				2,101,029					172,272	1,971,283	4,244,584
Maryland: Furnace plants						319,399				1,247,091	1,566,490
Massachusetts: Merchant plants									1,443	1,445,431	1,446,874
Michigan: Merchant plants				287,362		186,090			(1)	893,269	[2] 1,366,721
Furnace plants				785,608		28,717				210,820	1,025,145
Total Michigan				1,072,970		214,807			(1)	1,104,089	[2] 2,391,866
Minnesota: Merchant plants				54,195						357,394	411,589
Furnace plants				206,921		128,210				92,109	427,240
Total Minnesota				261,116		128,210				449,503	838,829
New Jersey: Merchant plants				71,630					159,726	1,148,941	1,380,297
New York: Merchant plants				235,712		1,354,427			224,550	1,538,827	3,353,516
Furnace plants						2,106,920				552,741	2,659,661
Total New York				235,712		3,461,347			224,550	2,091,568	6,013,177
Ohio: Merchant plants									(1)	723,719	[2] 723,719
Furnace plants				371,577	238	2,537,728				1,504,134	4,413,677
Total Ohio				371,577	238	2,537,728			(1)	2,227,853	[2] 5,137,396

Pennsylvania: Merchant plants						2,643			13,501	647,964	664,108
Furnace plants						8,771,131				955,581	9,726,712
Total Pennsylvania						8,773,774			13,501	1,603,545	10,390.820
Tennessee: Merchant plants							79,695		26,565		106,260
Utah: Furnace plants								228,175			228,175
West Virginia: Merchant plants						40,701				505,969	546,670
Furnace plants				6,009		1,388,052				4,895	1,398,956
Total West Virginia				6.009		1,428,753				510,864	1.945,626
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin: Merchant plants				268,409		18,269			3,105	2,062,384	2,352,167
Undistributed: Merchant plants									139,903		139,903
Grand total	4,752,842	281,295	106,667	4,885,913	238	17,368,336	79,695	228,175	741,065	17,399,445	45,843,671
Merchant plants	612,297		106,667	1,026,426		1,680,519	79,695		568,793	11,302,553	15,376,950
Furnace plants	4,140,545	281,295		3,859,487	238	15,687,817		228,175	172,272	6,096,892	30,466,721
1939											
Alabama: Merchant plants	451,022									58,114	509,136
Furnace plants	4,832,569									14,159	4,846,728
Total Alabama	5,283,591									72,273	5,355,864
Colorado: Furnace plants		604,295									604,295
Illinois: Merchant plants			123,248	36,192		94,312			7,490	1,257,842	1,519,084
Furnace plants				537,971		436,320				363,985	1,338,276
Total Illinois			123,248	574,163		530,632			7,490	1,621,827	2,857,360
Indiana: Merchant plants										628,706	628,706
Furnace plants				3,221,576					408,323	2,812,119	6,442,018
Total Indiana				3,221,576					408,323	3,440,825	7,070,724
Maryland: Furnace plants						268,677				2,038,667	2,307,344
Massachusetts: Merchant plants										1,496,908	1,496,908
Michigan: Merchant plants				92,161		175,385			(1)	815,507	[2] 1,083,053
Furnace plants				1,033,762		236,755			155,335	732,986	2,158,838
Total Michigan				1,125,923		412,140			155,335	1,548,493	[2] 3,241,891
Minnesota: Merchant plants				(1)		32,979			7,030	276,313	[2] 316,322
Furnace plants				166,999		22,000				75,927	264,926
Total Minnesota				166,999		54,979			7,030	352,240	[2] 581,248
New Jersey: Merchant plants				95,104					176,306	1,146,991	1,418,401

See footnotes at end of table.

TABLE 23.—*Coal used in the manufacture of byproduct coke in the United States, 1938–39, by States where produced and consumed, and by merchant and furnace plants, in net tons*—Continued

State where coal was used	Coal produced in—										
	Alabama	Colorado	Illinois	Kentucky	Ohio	Pennsylvania	Tennessee	Utah	Virginia	West Virginia	Total
1939—Continued											
New York: Merchant plants				264,771		1,559,456			140,441	1,590,850	3,555,518
Furnace plants						2,090,848				719,449	2,810,297
Total New York				264,771		3,650,304			140,441	2,310,299	6,365,815
Ohio: Merchant plants				(1)					(1)	715,460	[2] 715,460
Furnace plants				615,586	1,296	4,668,902				2,647,547	7,933,331
Total Ohio				615,586	1,296	4,668,902			(1)	3,363,007	[2] 8,648,791
Pennsylvania: Merchant plants						1,873			1,500	648,197	651,570
Furnace plants						14,476,704				1,200,677	15,677,381
Total Pennsylvania						14,478,577			1,500	1,848,874	16,328,951
Tennessee: Merchant plants							90,902		30,300		121,202
Utah: Furnace plants								324,100			324,100
West Virginia: Merchant plants						23,947				668,266	692,213
Furnace plants				13,464		1,630,201				24,265	1,667,930
Total West Virginia				13,464		1,654,148				692,531	2,360,143
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin: Merchant plants			1,243	89,010		38,232				2,367,964	2,496,449
Undistributed: Merchant plants				76,720					405,846		482,566
Grand total	5,283,591	604,295	124,491	6,243,316	1,296	25,756,591	90,902	324,100	1,332,571	22,300,899	62,062,052
Merchant plants	451,022		124,491	653,958		1,926,184	90,902		768,913	11,671,118	15,686,588
Furnace plants	4,832,569	604,295		5,589,358	1,296	23,830,407		324,100	563,658	10,629,781	46,375,464

[1] Included under "Undistributed."

[2] Excludes items included under "Undistributed."

YIELD OF COKE PER TON OF COAL

TABLE 24.—*Percentage yield of coke from coal in byproduct and beehive ovens in the United States, 1936–39, by States*

State	1936		1937		1938		1939	
	Byproduct	Beehive	Byproduct	Beehive	Byproduct	Beehive	Byproduct	Beehive
Alabama	69.66		72.37		70.93		71.01	
Colorado	66.68	65.25	67.36	55.71	66.79	65.01	66.03	65.41
Illinois	68.62		70.54		67.05		68.12	
Indiana	73.54		72.04		70.32		70.26	
Maryland	72.28		72.62		72.14		72.88	
Massachusetts	70.74		69.99		70.42		70.72	
Michigan	71.91		71.05		69.17		69.34	
Minnesota	69.22		70.27		70.19		69.92	
New Jersey	71.08		70.78		71.84		71.05	
New York	71.85		71.75		71.14		71.16	
Ohio	71.25		71.61		71.02		71.09	
Pennsylvania	68.39	64.56	68.83	65.50	68.46	63.00	68.71	63.42
Tennessee	68.95	51.80	69.00	53.89	68.70	55.00	73.00	
Utah	56.88	57.59	56.67	54.25	58.08	48.94	58.38	60.27
Virginia		57.96		58.33		57.04		56.87
Washington	60.38	62.28	56.11					
West Virginia	70.19	61.06	70.67	61.74	68.02	61.40	68.12	67.04
United States average	70.47	63.23	70.73	64.23	69.94	61.58	70.05	62.86

COKE BREEZE

TABLE 25.—*Coke breeze recovered at coke plants in the United States, 1938–39, by States*

State	Yield per ton of coal (percent)	Produced		Used by producer				Sold		Wasted (net tons)	On hand Dec. 31 (net tons)
				For steam raising		For other purposes, including water gas					
		Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value		
1938											
Byproduct plants:											
Alabama	4.61	219,586	$356,509	97,565	$138,124	25,843	$38,170	105,349	$193,957	8,130	35,355
Colorado	5.66	15,841	(1)	12,146	(1)			3,695	(1)		
Illinois	7.51	194,385	486,695	159,925	427,314	22,417	56,509	37,615	72,621		37,278
Indiana	6.13	253,296	601,982	123,522	274,159	75,241	150,003	35,254	128,188	90	35,522
Maryland	7.24	110,912	(1)	104,212	(1)	20,333	(1)	13,390	(1)		1,062
Massachusetts	8.27	119,704	(1)	79,685	(1)	6,325	(1)	29,504	(1)		7,164
Michigan	5.53	139,357	655,220	119,931	591,432	5,609	24,677	15,374	52,789		11,463
Minnesota	6.77	52,162	156,013	34,148	86,058	5,519	17,478	16,228	63,650		13,235
New Jersey	6.05	84,783	(1)	76,511	(1)			17,014	(1)		3,196
New York	4.77	264,467	745,357	177,675	479,113	51,581	162,010	43,703	122,197		45,307
Ohio	5.03	262,123	526,163	225,576	444,382	27,452	48,280	15,418	38,567		39,994
Pennsylvania	6.18	643,104	1,060,071	537,276	832,500	42,841	66,856	66,171	159,556		23,873
Tennessee	3.77	4,172	6,258	4,096	6,144			42	63		1,407
Utah	5.29	12,075	(1)			3,989	(1)	7.867	(1)		387
West Virginia	[2] 5.87	95,685	123,773	90,115	116,298	4,461	6,272	2,146	4,700		4,308
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	7.71	182,001	599,973	114,940	344,690	26,284	131,374	36,410	110,974		13,734
Undistributed			677,253		508,484		52,845		177,773		
	[2] 5.91	2,653,653	5,995,267	1,957,323	4,248,698	317,895	754,474	445,180	1,125,035	8,220	273,285
At merchant plants	[2] 6.61	998,925	2,753,917	688,324	1,857,648	87,122	297,555	246,495	667,503	90	137,209
At furnace plants	5.55	1,654,728	3,241,350	1,268,999	2,391,050	230,773	456,919	198,685	457,532	8,130	136.076
Beehive plants:											
Colorado and Utah	[2] 6.62	6,610	9,893					6,462	9,764	148	1,181
Pennsylvania	[2] 5.34	33,048	25,219			54	54	26,938	20,615	9,678	141
Virginia	[2] 4.52	6,258	18,336	122	533	22	97	5,793	16,767		341
West Virginia	[2] 3.37	295	82					270	60	50	112
	[2] 5.34	46,211	53,530	122	533	76	151	39,463	47,206	[3] 9,876	1,775

1939											
Byproduct plants:											
Alabama	4.81	260,956	421,086	142,756	199,846	10,202	13,464	124,101	226,701	----------	36,646
Colorado	5.96	35,947	(1)	29,229	(1)	----------	----------	6,718	(1)	----------	----------
Illinois	7.10	196,337	485,913	143,349	386,690	12,512	34,086	55,727	120,867	----------	37,258
Indiana	5.16	358,144	905,895	200,375	443,610	136,362	354,661	44,079	154,835	----------	32,925
Maryland	7.04	152,454	(1)	86,359	(1)	28,048	(1)	37	(1)	----------	43,303
Massachusetts	7.62	113,959	(1)	75,065	(1)	5,820	(1)	21,462	(1)	----------	18,776
Michigan	5.57	195,216	778,056	131,928	545,210	15,453	58,737	43,995	137,984	----------	8,666
Minnesota	6.09	43,292	129,757	30,864	79,675	5,287	16,865	16,552	60,780	----------	10,145
New Jersey	6.23	87,927	(1)	79,413	(1)	9,237	(1)	----------	----------	----------	2,473
New York	4.45	279,219	775,994	184,757	508,234	46,344	134,185	58,125	162,579	----------	48,382
Ohio	4.92	424,955	862,983	335,539	671,992	70,090	137,714	20,130	52,262	----------	54,268
Pennsylvania	5.83	933,427	1,573,102	797,742	1,288,869	57,437	91,027	78,636	195,189	----------	21,218
Tennessee	4.00	4,352	6,528	905	1,358	----------	----------	5,275	7,913	----------	287
Utah	5.42	17,551	(1)	3,403	(1)	5,394	(1)	7,631	(1)	----------	1,691
West Virginia	[2] 4.69	89,384	104,638	83,573	96,942	6,391	8,807	52	82	----------	2,664
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	6.46	161,254	479,365	129,800	384,239	----------	----------	29,855	90,484	----------	17,007
Undistributed	----------	----------	747,733	----------	502,162	----------	104,062	----------	55,067	----------	----------
	[2] 5.52	3,354,374	7,271,050	2,455,057	5,108,827	408,577	953,608	512,375	1,264,743	----------	335,709
At merchant plants	[2] 6.29	947,946	2,477,413	682,987	1,793,547	60,335	171,350	254,808	674,075	----------	130,789
At furnace plants	5.27	2,406,428	4,793,637	1,772,070	3,315,280	348,242	782,258	257,567	590,668	----------	204,920
Beehive plants:											
Colorado and Utah	[2] 4.78	4,810	5,871	----------	----------	----------	----------	4,810	5,871	----------	224
Pennsylvania	[2] 3.73	38,129	37,767	1,666	2,330	----------	----------	14,471	11,601	22,664	93
Virginia	[2] 3.65	6,390	17,978	132	525	100	448	6,480	17,914	30	134
West Virginia	[2] 2.65	2,214	554	----------	----------	----------	----------	220	55	1,994	----------
	[2] 3.73	51,543	62,170	1,798	2,855	100	448	25,981	35,441	[3] 24,688	451

[1] Included under "Undistributed." [2] Yield computed by dividing production of breeze at the few plants reporting by the quantity of coal charged at these plants.
[3] As reported; quantity produced but not used was undoubtedly greater. See Mineral Resources of the United States, 1922, part 2, pp. 726–727.

CONSUMPTION OF COKE

Allowing for imports and exports and for changes in producers' stocks the indicated consumption of coke in 1939 was 44,953,082 tons. Of this amount 31,422,272 tons (about 70 percent of the total) were, according to figures compiled by the American Iron and Steel Institute, consumed by blast furnaces in the manufacture of pig iron and ferro-alloys. The remainder—13,530,810 tons (30 percent)—was used in foundries, in smelting nonferrous metals, manufacturing water gas, miscellaneous other industrial uses, and domestic heating.

The noteworthy improvement in efficiency of fuel utilization in blast-furnace operations during recent years is shown clearly by the fact that the quantity of coking coal required to make 1 ton of pig iron dropped from an average of 3,247.5 pounds in 1913 to 2,547.3 in 1939.

TABLE 26.—*Coke consumed in manufacture of pig iron and for other purposes in the United States, 1913, 1918, and 1937–39, in net tons*

Year	Total production of coke	Imports	Exports	Net changes 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	33, 571, 349	65. 5	17, 700, 580	34. 5
1938	32, 495, 815	135, 240	486, 571	+1, 081, 267	31, 063, 217	19, 035, 270	61. 3	12, 027, 947	38. 7
1939	44, 326, 641	141, 911	589, 925	−1, 074, 455	44, 953, 082	31, 422, 272	69. 9	13, 530, 810	30. 1

[1] Production plus imports minus exports, plus or minus the decrease or increase, respectively, of the net changes in stocks.
[2] From Report of American Iron and Steel Institute. Figures include coke consumed in the manufacture of ferro-alloys.
[3] Data not available.

TABLE 27.—*Pounds of coke and coking coal consumed per net ton of pig iron made in the United States, 1913, 1918, and 1937–39*

Year	Pounds of coke per net ton of pig iron and ferro-alloys [1]	Percent yield of coke from coal	Calculated pounds coking coal per net ton of pig iron and ferro-alloys	Year	Pounds of coke per net ton of pig iron and ferro-alloys [1]	Percent yield of coke from coal	Calculated pounds coking coal per net ton of pig iron and ferro-alloys
1913	2, 172. 6	66. 9	3, 247. 5	1938	1, 801. 0	69. 7	2, 583. 9
1918	2, 120. 7	66. 4	3, 193. 8	1939	1, 778. 0	69. 8	2, 547. 3
1937	1, 830. 6	70. 3	2, 604. 0				

[1] From report of American Iron and Steel Institute; the consumption per ton of pig iron only, excluding the furnaces making ferro-alloys, was 2,172.6 in 1913, 2,120.7 in 1918, 1,806.7 in 1937, 1,774.6 in 1938, and 1,760.0 in 1939.

FURNACE, FOUNDRY, DOMESTIC, AND OTHER COKE

The terms "furnace coke" and "foundry coke," as used in the trade, refer to the size and grade of the coke as well as to the use for which it may be intended. Byproduct furnace coke ordinarily is run-of-oven coke from which the breeze and all small coke less than, say, three-fourths-inch diameter have been removed. Byproduct foundry coke ordinarily is a blocky coke of maximum size much greater than that of furnace coke, from which all sizes under 2½ to 3 inches are screened out. Coke of smaller size than furnace or foundry (exclusive, however, of breeze) often is called domestic coke. It may result from the screening of foundry or furnace coke, or, where the principal demand is for domestic coke, may be obtained by crushing the larger fragments. Other special sizes and grades may be prepared for special purposes. Thus, not all furnace coke finds its way to blast furnaces or all foundry coke to iron foundries proper, for either grade may be purchased by other classes of consumers.

Coke enters the domestic fuel market mainly under two conditions: (1) In or near areas of surplus metallurgical coke production and (2) in localities where the manufacture and distribution of large quantities of city gas result in the yield of correspondingly large quantities of coke. As this fuel is, on the average, not transported as far as coal, its consumption for domestic purposes tends to be localized in regions near the centers of production. In recent years the majority of the coke operators have reported that their plants are equipped to screen and size coke for domestic use.

TABLE 28.—*Byproduct coke produced and sold or used by producers in the United States, 1938–39, by States*

[Exclusive of screenings or breeze]

State	Produced		Used by producer in blast furnace [1]		Sold									
					Furnace [2]		Foundry		Domestic use		Industrial and other use (including water gas)[3]		Total	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
1938														
Alabama	3,378,044	$9,888,292	2,626,938	$6,643,545	(4)	(4)	(4)	(4)	130,551	$483,921	194,285	$771,861	589,766	$2,636,684
Colorado	186,805	(4)	161,931	(4)	-------	-------	6,197	(4)	857	(4)	20,508	(4)	27,562	(4)
Illinois	1,734,511	11,706,788	626,559	4,103,965	87,939	$439,963	113,217	$1,085,062	656,316	4,348,096	40,172	258,354	897,644	6,131,475
Indiana	2,904,779	18,278,201	2,451,423	15,332,499	(4)	(4)	126,767	1,141,738	287,724	1,508,486	(4)	(4)	426,374	2,733,001
Maryland	1,105,262	(4)	1,067,071	(4)	-------	-------	-------	-------	20,509	(4)	26,392	(4)	46,901	(4)
Massachusetts	1,019,302	(4)	80,151	(4)	72,638	(4)	25,519	(4)	794,622	(4)	43,911	(4)	936,690	(4)
Michigan	1,742,787	10,135,722	347,406	2,011,447	(4)	(4)	(4)	(4)	950,326	5,613,033	56,795	330,310	1,382,609	8,057,087
Minnesota	540,447	4,495,555	118,823	798,111	-------	-------	(4)	(4)	263,766	2,368,235	(4)	(4)	277,535	2,474,990
New Jersey	1,007,394	(4)	198,915	(4)	47,255	(4)	27,695	(4)	512,741	(4)	218,027	(4)	805,718	(4)
New York	3,945,358	23,529,138	1,299,798	7,416,092	886,709	4,904,072	(4)	(4)	1,420,604	8,984,465	(4)	(4)	2,470,353	15,088,964
Ohio	3,699,995	18,413,808	2,831,527	13,894,381	166,011	793,979	156,161	1,107,184	462,141	2,074,457	86,160	422,483	870,473	4,398,103
Pennsylvania	7,119,328	30,070,706	5,313,682	20,913,831	936,641	3,705,741	120,947	1,086,043	520,367	3,080,551	128,945	729,356	1,706,900	8,601,691
Tennessee	76,123	480,336	1,634	6,536	-------	-------	20,490	151,503	19,386	110,501	13,671	69,452	53,547	331,456
Utah	132,513	(4)	85,835	(4)	-------	-------	-------	-------	2,469	(4)	42,936	(4)	45,405	(4)
West Virginia	1,346,734	4,144,230	1,057,995	3,007,694	(4)	(4)	(4)	(4)	160,539	488,885	28,997	107,341	225,275	838,717
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	1,719,021	11,755,364	134,853	890,472	180,337	904,895	186,663	1,717,393	926,466	6,326,615	152,791	971,756	1,446,257	9,920,659
Undistributed	-------	20,580,899	-------	8,530,837	462,690	2,964,893	267,487	2,526,658	-------	8,613,693	134,672	3,092,063	-------	12,070,211
	31,658,403	163,479,039	18,404,541	83,549,410	2,840,220	13,713,543	1,051,143	8,815,581	7,129,384	44,000,938	1,188,262	6,752,976	12,209,009	73,283,038
At merchant plants	10,989,525	70,225,977	1,520,201	8,732,624	1,432,438	7,782,540	820,905	7,135,702	5,555,753	36,009,365	834,893	4,914,282	8,643,989	55,841,889
At furnace plants	20,668,878	93,253,062	16,884,340	74,816,786	1,407,782	5,931,003	230,238	1,679,879	1,573,631	7,991,573	353,369	1,838,694	3,565,020	17,441,149
1939														
Alabama	3,854,505	10,917,559	3,494,792	8,649,451	(4)	(4)	241,453	1,604,071	134,850	477,739	(4)	(4)	644,863	3,179,130
Colorado	398,033	(4)	356,808	(4)	-------	-------	6,499	(4)	903	(4)	24,110	(4)	31,512	(4)
Illinois	1,884,240	11,963,932	938,665	5,929,136	103,771	429,886	165,197	1,553,654	641,880	3,877,186	54,972	300,725	965,820	6,161,451
Indiana	4,878,033	28,532,944	4,441,303	25,829,576	(4)	(4)	195,024	1,715,986	339,819	1,605,682	(4)	(4)	581.846	3,593,572
Maryland	1,578,973	(4)	1,533,662	(4)	-------	-------	-------	-------	19,656	(4)	22,138	(4)	41,794	(4)
Massachusetts	1,057,158	(4)	175,386	(4)	16,745	(4)	38,165	(4)	793,868	(4)	34,831	(4)	883.609	(4)
Michigan	2,430,688	12,408,881	991,498	4,721,370	(4)	(4)	(4)	(4)	1,169,895	6,035,355	(4)	(4)	1,499.185	8,021,391
Minnesota	497,079	3,684,811	177,168	1,137,103	(4)	(4)	(4)	(4)	318,091	2,556,983	12,467	86,361	333,892	2,664,495
New Jersey	1,003,197	(4)	205,854	(4)	31,657	(4)	36,304	(4)	529,218	(4)	288,686	(4)	885,865	(4)

New York	4,468,437	25,526,646	1,655,793	9,356,720	1,290,023	6,462,230	(4)	(4)	1,450,777	9,043,546	(4)	(4)	2,922,874	16,758,044
Ohio	6,135,949	28,502,924	4,872,903	22,173,365	556,530	2,707,629	212,021	1,350,535	452,718	1,981,016	105,404	525,157	1,326,673	6,564,337
Pennsylvania	10,994,254	44,214,472	8,751,589	32,916,854	1,337,904	5,403,638	181,672	1,610,008	603,273	3,498,707	228,499	1,425,262	2,351,348	11,937,615
Tennessee	79,448	527,535	2,999	11,996	---------	---------	27,445	228,384	25,174	154,050	18,700	98,854	71,319	481,288
Utah	189,194	(4)	126,998	(4)	34	(4)	---------	---------	2,959	(4)	47,195	(4)	50,188	(4)
West Virginia	1,598,198	4,282,010	1,397,824	3,478,461	(4)	(4)	(4)	(4)	113,593	354,842	(4)	(4)	270,112	1,102,436
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	1,834,927	11,757,652	140,999	911,674	425,223	2,128,101	201,498	1,843,644	953,263	6,347,165	177,817	1,021,462	1,757,801	11,340,372
Undistributed	---------	24,138,507	---------	12,399,300	317,348	1,762,178	177,568	2,180,971	---------	8,579,401	491,864	5,037,901	---------	12,184,178
	42,882,313	206,457,873	29,264,241	127,515,006	4,079,235	18,893,662	1,482,846	12,087,253	7,549,937	44,511,672	1,506,683	8,495,722	14,618,701	83,988,309
At merchant plants	11,070,506	68,432,660	1,766,776	9,810,773	1,590,080	8,528,097	1,144,278	9,738,821	5,982,976	37,166,465	1,095,418	6,333,119	9,812,752	61,766,502
At furnace plants	31,811,807	138,025,213	27,497,465	117,704,233	2,489,155	10,365,565	338,568	2,348,432	1,566,961	7,345,207	411,265	2,162,603	4,805,949	22,221,807

[1] Includes coke used for other purposes than in blast furnaces as follows: To make producer or water gas—1938, 1,314,370 tons, valued at $7,418,916; 1939, 1,409,081 tons $7,693,450. For other purposes than in blast furnaces—1938, 401,066 tons, $2,069,263; 1939, 416,595 tons, $2,184,305.

[2] Includes coke sold as follows: To financially affiliated corporations—1938, 1,116,376 tons valued at $4,852,525; 1939, 2,063,898 tons, $8,682,688. For other purposes—1938, 773,336 tons, $4,668,821; 1939, 877,580 tons, $5,229,032. Merchant sales—1938, 950,508 tons, $4,192,197; 1939, 1,137,757 tons, $4,981,942.

[3] Includes coke sold for manufacture of water gas as follows: 1938, 397,563 tons valued at $2,537,307; 1939, 506,857 tons, $3,203,509.

[4] Included under "Undistributed."

TABLE 29.—*Beehive coke produced and sold or used by producers in the United States in 1939, by States*

State	Produced		Used by producer in blast furnace [1]		Sold			
					Furnace [2]		Foundry	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Colorado	56,836	(3)	56,296	(3)				
Pennsylvania	1,125,971	$4,801,086	164,341	$769,076	548,499	$2,368,692	143,248	$637,468
Utah	8,332	(3)					2,987	(3)
Virginia	165,317	783,512			67,920	304,316	31,229	(3)
West Virginia	87,872	417,830	183	(3)	38,482	172,056	21,890	131,886
Undistributed		423,749		372,653				179,915
	1,444,328	6,426,177	220,820	1,141,729	654,901	2,845,064	199,354	949,269

State	Sold—Continued					
	Domestic use		Industrial and other use (including water gas) [4]		Total	
	Net tons	Value	Net tons	Value	Net tons	Value
Colorado			335	(3)	335	(3)
Pennsylvania	86,402	$303,695	184,247	$716,604	962,396	$4,026,459
Utah	792	(3)	4,553	(3)	8,332	(3)
Virginia	410	(3)	64,555	311,256	164,114	777,965
West Virginia	600	(3)	23,614	(3)	84,586	402,188
Undistributed		7,440		124,126		50,842
	88,204	311,135	277,304	1,151,986	1,219,763	5,257,454

[1] Includes coke used for other purposes than in blast furnaces as follows: 1,124 net tons, valued at $4,626.
[2] Includes coke sold as follows: 196,956 net tons valued at $855,858 to financially affiliated corporations for blast furnace use; 16,260 tons, $79,349 for other purposes; and 441,685 tons, $1,909.857 as merchant sales.
[3] Iucluded under "Undistributed."
[4] Includes coke sold for manufacture of water gas as follows: 85,191 net tons valued at $315,429.

STOCKS OF COKE AND COKING COAL

The plotted monthly curve of producers' stocks of byproduct coke takes a typical shape as related to the corresponding monthly curves of byproduct-coke and pig-iron production for the 2 years 1938 and 1939. That is to say, as pig-iron and coke production increases stocks of coke decrease, and vice versa. (See fig. 1). On January 1, 1939, producers' stocks of byproduct coke had risen by 1,112,303 net tons (44 percent) over the January 1, 1938, figure to a total of 3,631,623 tons but by January 1, 1940, had fallen again by 1,061,933 tons to 2,569,690 tons, or nearly to the January 1, 1938, figure. Of the totals on January 1, 1939 and 1940, 72 percent (2,611,645 tons) and 75 percent (1,922,369 tons) were for domestic and general industrial use, respectively. Beehive plants as a rule carry but low stocks on hand, partly because of sporadic activity of the ovens during the year. At the close of 1939, 32,409 tons of coke were in inventory.

TABLE 30.—*Stocks of furnace, foundry, and domestic coke and of breeze in the United States on January 1, 1939–40, by States, in net tons*

State	Furnace	Foundry	Domestic and other	Total coke	Breeze
January 1, 1939					
Byproduct plants:					
Alabama	286, 902	32, 126	71, 111	390, 139	35, 355
Colorado	2, 311	237	57	2, 605	
Illinois	20, 617	3, 562	318, 542	342, 721	37, 278
Indiana	49, 342	1, 533	129, 471	180, 346	35, 522
Maryland	37, 328			37, 328	1, 062
Massachusetts	154		321, 034	321, 188	7, 164
Michigan	1, 631	106	130, 279	132, 016	11, 463
Minnesota	17, 534		266, 378	283, 912	13, 235
New Jersey			165, 319	165, 319	3, 196
New York	[1] 69, 357	(1)	394, 816	464, 173	45, 307
Ohio	172, 202	19, 031	97, 682	288, 915	39, 994
Pennsylvania	195, 637	15, 028	290, 507	501, 172	23, 873
Tennessee	22, 620	541	20, 401	43, 562	1, 407
Utah	851		1, 865	2, 716	387
West Virginia	54, 708	15, 675	51, 342	121, 725	4, 308
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	[1] 945	(1)	352, 841	353, 786	13, 734
	[1] 932, 139	[1] 87, 839	2, 611, 645	3, 631, 623	273, 285
At merchant plants	53, 714	71, 539	2, 195, 793	2, 321, 046	137, 209
At furnace plants	877, 930	16, 795	415, 852	1, 310, 577	136, 076
Beehive plants:					
Colorado	265			265	
Pennsylvania	3, 382	4, 681	28, 289	36, 352	141
Tennessee	1, 237	298		1, 535	
Utah		439	141	580	1, 181
Virginia	1, 845	1, 479		3, 324	341
West Virginia	499	1, 439	937	2, 875	112
	7, 228	8, 336	29, 367	44, 931	1, 775
January 1, 1940					
Byproduct plants:					
Alabama	59, 831	5, 952	22, 224	88, 007	36, 646
Colorado	11, 961	350	7	12, 318	
Illinois	7, 329	11, 696	280, 568	299, 593	37, 258
Indiana	81, 320	1, 898	76, 561	159, 779	32, 925
Maryland	36, 514			36, 514	43, 303
Massachusetts	265		223, 064	223, 329	18, 776
Michigan	[1] 6, 371	(1)	64, 400	70, 771	8, 666
Minnesota	8, 719		256, 163	264, 882	10, 145
New Jersey			78, 866	78, 866	2, 473
New York	[1] 26, 740	(1)	320, 001	346, 741	48, 382
Ohio	130, 663	10, 424	75, 459	216, 546	54, 268
Pennsylvania	180, 075	7, 192	204, 124	391, 391	21, 218
Tennessee	21, 470	443	25, 465	47, 378	287
Utah	9, 257		5, 286	14, 543	1, 691
West Virginia	19, 889	909	12, 096	32, 894	2, 664
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	468	7, 585	278, 085	286, 138	17, 007
	[1] 600, 872	[1] 46, 449	1, 922, 369	2, 569, 690	335, 709
At merchant plants	29, 531	40, 659	1, 594, 427	1, 664, 617	130, 789
At furnace plants	568, 019	9, 112	327, 942	905, 073	204, 920
Beehive plants:					
Colorado	470			470	
Pennsylvania	8, 897	4, 299	7, 468	20, 664	93
Utah		353	53	406	224
Virginia	4, 272	1, 969		6, 241	134
West Virginia	2, 763	1, 691	174	4, 628	
	16, 402	8, 312	7, 695	32, 409	451

[1] A small amount of foundry coke is included with the furnace.

TABLE 31.—*Summary of total stocks of coke on hand at all byproduct and beehive plants in the United States on Jan 1, 1929 and 1936–1940, in net tons*

	1929	1936	1937	1938	1939	1940
Byproduct plants:						
Furnace	750,318	697,699	282,144	610,840	931,644	597,550
Foundry	24,426	15,504	8,981	29,828	88,334	49,771
Domestic and other	1,018,205	2,070,544	1,408,350	1,878,652	2,611,645	1,922,369
	1,792,949	2,783,747	1,699,475	2,519,320	3,631,623	2,569,690
Beehive plants:						
Furnace	38,446	2,211	5,622	13,542	7,228	16,402
Foundry	8,020	11,146	8,508	13,264	8,336	8,312
Domestic and other	8,511	32,280	18,461	49,161	29,367	7,695
	54,977	45,637	32,591	75,967	44,931	32,409
Total:						
Furnace	788,764	699,910	287,766	624,382	938,872	613,952
Foundry	32,446	26,650	17,489	43,092	96,670	58,083
Domestic and other	1,026,716	2,102,824	1,426,811	1,927,813	2,641,012	1,930,064
	1,847,926	2,829,384	1,732,066	2,595,287	3,676,554	2,602,099

TABLE 32.—*Total stocks of coke at all furnace and nonfurnace byproduct plants in the United States on first of each month, 1938–39*

[Includes furnace, foundry, and domestic, but not breeze]

Month	Furnace plants		Other plants		Total	
	1938	1939	1938	1939	1938	1939
January	1,044,489	1,310,577	1,474,831	2,321,046	2,519,320	3,631,623
February	1,086,980	1,306,506	1,279,690	2,088,995	2,366,670	3,395,501
March	1,195,691	1,241,895	1,278,773	1,874,450	2,474,464	3,116,345
April	1,305,298	1,198,286	1,471,772	1,839,050	2,777,070	3,037,336
May	1,347,919	1,090,811	1,785,929	1,876,078	3,133,848	2,966,889
June	1,375,558	950,989	1,899,317	1,799,755	3,274,875	2,750,744
July	1,411,437	930,706	1,963,565	1,726,356	3,375,002	2,657,062
August	1,460,435	945,242	2,103,738	1,826,656	3,564,173	2,771,898
September	1,453,007	916,256	2,255,990	2,004,807	3,708,997	2,921,063
October	1,391,947	867,744	2,282,596	1,944,687	3,674,543	2,812,431
November	1,333,895	806,097	2,382,003	1,793,611	3,715,898	2,599,708
December	1,306,719	835,525	2,438,396	1,770,993	3,745,115	2,606,518

Stocks of bituminous coal closely follow fluctuations in the trend of monthly coke production. In 1939 the highest reserves of coking coal were built up in November; and at the end of May stocks were at the lowest level of the year. The low month in coke production was May 1939, and highest production was reached in December.

TABLE 33.—*Stocks of bituminous coal at byproduct coke plants in the United States at end of each month, 1936–39*

Month	1936	1937	1938	1939
January	4, 640, 021	8, 030, 871	6, 469, 457	7, 373, 871
February	3, 844, 535	8, 687, 389	5, 822, 943	7, 372, 654
March	3, 431, 228	9, 638, 317	5, 231, 300	7, 221, 632
April	3, 514, 922	8, 543, 774	4, 934, 840	4, 434, 124
May	4, 064, 263	8, 187, 883	4, 867, 332	2, 598, 470
June	4, 565, 229	7, 770, 256	4, 999, 856	3, 548, 326
July	5, 302, 189	7, 432, 741	5, 364, 442	4, 534, 922
August	5, 982, 093	7, 455, 932	5, 539, 623	5, 631, 984
September	6, 562, 018	7, 760, 533	5, 951, 617	6, 220, 015
October	7, 295, 700	8, 066, 938	6, 459, 196	7, 250, 436
November	8, 146, 434	8, 114, 094	7, 172, 900	8, 114, 807
December	8, 535, 318	7, 273, 403	7, 462, 163	7, 992, 848

VALUE AND PRICE

Reference has been made in previous chapters to the varying accounting practices of coke operators financially affiliated with iron and steel plants, by which the coke sometimes is charged to the furnace department at cost and sometimes at a price that includes a percentage of profit or at the prevailing market price.

According to trade-journal quotations published currently during 1939, prices on byproduct foundry coke advanced in four markets, decreased in six other markets, and remained stationary in New England. The increases ranged from 11 to 12 cents per ton, and decreases ranged from 13 cents at Birmingham and Indianapolis to 35 cents at Detroit. Connellsville prices, which have until recent years been regarded as basic reference prices for the entire industry, rose 16 cents for foundry coke and 23 cents for furnace coke.

Price cutting, long-time contracts, and other factors, however, materially affect the prices at which coke operators actually dispose of coke on the open market. According to sales data furnished by operators, average receipts for byproduct coke declined in 1939 from those of 1938 by as much as 27 cents for domestic coke; sales realizations for beehive coke varied from 1938, as follows: An increase of 22 cents for furnace, and a decrease of 15 cents for foundry and 11 cents for other industrial.

TABLE 34.—*Average receipts per net ton for coke sold in the United States, 1938–39, by States*

State	Byproduct				Beehive			
	Furnace [1]	Foundry	Domestic	Other industrial, including water gas	Furnace [1]	Foundry	Domestic	Other industrial, including water gas
1938								
Alabama	$2.53	$6.76	$3.71	$3.97	------	------	------	------
Colorado, Utah, and Wisconsin	------	10.07	7.37	7.75	------	(2)	(2)	(2)
Connecticut, Massachusetts, and Rhode Island	------	7.97	6.80	7.18	------	------	------	------
Illinois	5.00	9.58	6.63	6.43	------	------	------	------
Indiana	------	9.01	5.24	(2)	------	------	------	------
Kentucky, Michigan, and Missouri	5.02	8.36	5.64	5.60	------	------	------	------
Maryland and New Jersey	------	(2)	6.71	5.98	------	------	------	------
Minnesota	------	9.17	8.98	7.74	------	------	------	------
New York	5.02	(2)	6.32	(2)	------	------	------	------
Ohio	4.20	7.09	4.49	4.90	------	------	------	------
Pennsylvania	3.84	8.98	5.92	5.66	$3.85	$4.56	$3.49	$4.00
Tennessee	------	7.39	5.70	5.08	(2)	(2)	------	------
Virginia	------	------	------	------	4.40	(2)	(2)	4.93
West Virginia	4.32	7.77	3.05	3.70	(2)	6.15	(2)	4.04
Undistributed	------	9.38	------	6.18	4.20	5.35	4.44	6.15
Average	4.38	8.39	6.17	5.68	4.11	4.91	3.52	4.26
At merchant plants	4.72	8.69	6.48	5.89	------	------	------	------
At furnace plants	4.21	7.30	5.08	5.20	------	------	------	------
1939								
Alabama	(2)	6.64	3.54	4.05	------	------	------	------
Colorado, Utah, and Wisconsin	(2)	9.89	6.95	7.15	------	(2)	(2)	(2)
Connecticut, Massachusetts, and Rhode Island	------	7.80	6.72	7.02	------	------	------	------
Illinois	4.14	9.40	6.04	5.47	------	------	------	------
Indiana	(2)	8.80	4.73	(2)	------	------	------	------
Kentucky, Michigan, and Missouri	4.21	8.34	5.06	5.02	------	------	------	------
Maryland and New Jersey	------	(2)	6.53	6.13	------	------	------	------
Minnesota	(2)	8.36	8.04	6.93	------	------	------	------
New York	4.42	(2)	6.23	(2)	------	------	------	------
Ohio	4.84	6.37	4.38	4.98	------	------	------	------
Pennsylvania	3.95	8.86	5.80	6.24	4.32	4.45	3.51	3.89
Tennessee	------	8.32	6.12	5.29	------	------	------	------
Virginia	------	------	------	------	4.48	(2)	(2)	4.82
West Virginia	3.72	7.72	3.12	3.44	4.17	6.02	(2)	(2)
Undistributed	4.95	9.76	------	5.89	------	5.26	4.13	4.35
Average	4.27	8.15	5.90	5.64	4.33	4.76	3.53	4.15
At merchant plants	4.61	8.51	6.21	5.78	------	------	------	------
At furnace plants	4.17	6.94	4.69	5.26	------	------	------	------

[1] Includes coke sold to affiliated corporations and merchant sales. [2] Included under "Undistributed."

TABLE 35.—*Average monthly prices per net ton at ovens of spot or prompt Connellsville furnace and foundry coke, 1929 and 1936–39* [1]

Month	Furnace coke					Foundry coke				
	1929	1936	1937	1938	1939	1929	1936	1937	1938	1939
January	$2.75	$3.65	$4.00	$4.00	$3.75	$3.75	$4.25	$4.50	$5.00	$4.75
February	2.90	3.65	4.06	4.00	3.75	3.75	4.25	4.50	5.00	4.75
March	2.98	3.65	4.25	4.00	3.75	3.75	4.25	4.50	5.00	4.75
April	2.78	3.65	4.51	4.00	3.75	3.75	4.25	5.00	5.00	4.75
May	2.75	3.65	4.60	4.00	3.75	3.75	4.25	5.25	5.00	4.75
June	2.75	3.65	4.58	3.85	3.75	3.75	4.25	5.25	4.85	4.75
July	2.75	3.50	4.35	3.75	3.75	3.75	4.00	5.00	4.75	4.75
August	2.73	3.61	4.35	3.75	3.75	3.75	4.00	5.00	4.75	4.75
September	2.65	3.69	4.27	3.75	4.25	3.75	4.05	5.00	4.75	5.12
October	2.65	3.75	4.25	3.75	4.90	3.75	4.25	5.00	4.75	5.65
November	2.65	3.75	4.25	3.75	5.00	3.75	4.25	5.00	4.75	5.75
December	2.64	3.92	4.00	3.75	5.00	3.75	4.40	5.00	4.75	5.75
Average	2.75	3.68	4.29	3.86	4.09	3.75	4.20	4.92	4.86	5.02

[1] Iron Age.

TABLE 36.—*Average monthly prices per net ton of byproduct foundry coke, in 11 markets, 1935–39, as quoted by Steel*

	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
Birmingham, Ala. (at ovens):													
1935	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
1936	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50
1937	6.50	6.50	6.50	6.95	7.25	7.25	7.25	7.25	7.30	7.50	7.50	7.50	7.10
1938	7.50	7.50	7.50	7.50	7.50	7.50	7.00	7.00	7.00	7.00	7.00	7.00	7.25
1939	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	8.05	7.50	7.12
Buffalo, N. Y. (delivered at consumers' works): [1]													
1935	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
1936	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	9.15	10.50	10.50	8.14
1937	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50
1938	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50
1939	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	11.25	11.25	10.62
Chicago, Ill. (at ovens):													
1935	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	9.00	9.00	9.00	8.63
1936	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
1937	9.50	9.50	9.50	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.06
1938	10.25	10.25	10.25	10.25	10.25	10.25	10.10	9.75	9.75	9.75	9.75	9.75	10.03
1939	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.95	10.50	10.50	9.89
Cincinnati, Ohio (delivered at consumers' works):													
1935	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.15	9.00	9.50	9.50	9.50	9.31
1936	9.50	9.50	9.50	9.50	9.50	9.50	9.50	9.50	9.50	9.50	9.50	9.50	9.50
1937	9.70	9.75	9.75	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.31
1938	10.50	10.50	10.50	10.50	10.50	10.50	9.90	9.75	9.75	9.75	9.75	9.75	10.14
1939	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	10.50	10.50	9.88
Cleveland, Ohio (delivered at consumers' works):													
1935	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.75	9.75	9.75	9.38
1936	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.90	10.30	10.30	9.85
1937	10.30	10.30	10.30	10.80	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.05	10.81
1938	11.05	11.05	11.05	11.05	11.05	11.05	10.75	10.30	10.30	10.30	10.30	10.30	10.71
1939	10.30	10.30	10.30	10.30	10.30	10.30	10.30	10.30	10.30	10.30	11.05	11.05	10.42
Detroit, Mich. (delivered at consumers' works): [1]													
1935	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.90	9.00	9.00	8.62
1936	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.64	10.70	10.70	9.34
1937	10.50	10.70	10.70	10.89	11.10	11.10	11.10	11.10	11.10	11.10	11.10	11.10	10.97
1938	11.10	11.10	11.10	11.10	11.10	11.10	10.90	10.25	10.25	10.25	10.25	10.25	10.73
1939	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.25	11.00	11.00	10.38
Indianapolis, Ind. (delivered at consumers' works):													
1935	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75	9.15	9.40	9.40	8.89
1936	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40
1937	9.60	9.65	9.65	10.33	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.27
1938	10.50	10.50	10.50	10.50	10.50	10.50	10.00	10.00	10.00	10.00	10.00	10.00	10.25
1939	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.75	10.75	10.12
Newark, N. J. (delivered at consumers' works):													
1935	8.83	9.20	9.20	9.20	9.20	9.20	9.20	9.20	9.20	9.20	9.20	9.20	9.17
1936	9.60	9.70	9.70	9.70	9.70	9.70	9.70	9.70	9.70	10.20	10.20	10.20	9.82
1937	10.17	10.17	10.17	10.85	10.85	10.85	10.85	10.85	10.85	10.85	10.85	10.88	10.68
1938	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88
1939	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	11.25	11.38	11.38	10.99
New England (delivered at consumers' works):													
1935	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.40	11.50	11.50	11.12
1936	11.50	11.50	11.50	11.50	11.50	11.50	11.50	11.50	11.50	11.70	12.00	12.00	11.60
1937	12.00	12.00	12.00	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.38
1938	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50
1939	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50
Philadelphia, Pa. (delivered at consumers' works):													
1935	9.00	9.00	9.00	9.00	9.00	9.03	9.03	9.03	9.03	9.03	9.03	9.03	9.02
1936	9.38	9.38	9.38	9.38	9.38	9.38	9.38	9.38	9.38	9.88	9.88	9.88	9.50
1937	9.85	9.85	9.85	10.40	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.40
1938	10.62	10.63	10.63	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.64
1939	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.65	11.02	11.15	11.15	10.76
St. Louis, Mo. (delivered at consumers' works):													
1935	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.80	10.00	10.00	9.42
1936	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
1937	10.10	10.50	10.50	10.80	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	10.83
1938	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
1939	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.75	11.75	11.12

[1] Up to October 26, 1936, quotations are "at ovens."

SHIPMENTS BY RAIL

TABLE 37.—*Beehive coke loaded for shipment on originating railroads and waterways in the United States in 1939, by routes, as reported by coke producers*

Route	State	Net tons: By States	Net tons: Total	Percent of total
Railroads:				
Baltimore & Ohio	Pennsylvania	217,480	225,297	15.7
	West Virginia	7,817		
Chesapeake & Ohio	do	22,439	22,439	1.6
Denver & Rio Grande Western	Colorado	56,631	66,725	4.6
	Utah	10,094		
Huntingdon & Broad Top	Pennsylvania	300	300	(1)
Interstate	Virginia	146,480	146,480	10.2
Ligonier Valley	Pennsylvania	14,118	14,118	1.0
Louisville & Nashville	Virginia	350	350	(1)
Monongahela	Pennsylvania	315,340	315,340	22.0
New York Central	West Virginia	54,540	54,540	3.8
Norfolk & Western	Virginia	23,438	23,438	1.6
Pennsylvania	Pennsylvania	559,166	559,166	38.9
Pittsburgh & Lake Erie	do	3,888	3,888	0.3
Total railroad shipments		1,432,081	1,432,081	99.7
Waterway: Ohio River	Pennsylvania	4,592	4,592	0.3
Grand total		1,436,673	1,436,673	100.0

[1] Less than 0.1 percent.

EXPORTS AND IMPORTS [1]

Exports of coke from the United States totaled 589,925 net tons valued at $3,878,235 in 1939, an increase of 103,354 tons from the 1938 total of 486,571 tons. As usual, the principal export movement was to Canada, which received 495,389 tons (84 percent of the total), the bulk going through the gateways of Buffalo and Michigan. Outside of Canada the export market for American coke is small, although France took 45,901 tons in 1939, a vast increase over the 6,013 tons bought the year before. Between 5,000 and 10,000 tons were exported in 1939 to Cuba, to British West Indies, to Brazil, and to Japan.

TABLE 38.—*Coke exported from the United States, 1937–39, by customs districts*

District	1937		1938		1939	
	Net tons	Value	Net tons	Value	Net tons	Value
Buffalo	220,448	$1,406,897	222,484	$1,431,715	224,900	$1,358,559
Chicago	11,535	84,472	22,813	100,381		
Dakota	10,120	77,714	7,254	57,958	7,031	51,749
Duluth-Superior	3,697	32,144	3,214	27,745	3,171	25,639
Florida	3,750	76,125	4	53	409	4,041
Galveston			2,199	10,995		
Maine and New Hampshire	859	7,297	94	831	64	643
Maryland	3,829	20,989	1,993	13,025	1,379	16,972
Michigan	221,763	1,459,913	169,293	975,592	247,192	1,333,605
Mobile	13,847	100,470	7,127	109,810	8,202	135,756
New Orleans	3,092	35,152	2,461	21,244	8,989	103,103
New York	4,623	70,082	12,517	89,905	27,685	337,031
Ohio	12,051	72,877	20,974	110,857	11,050	61,053
Philadelphia	12,597	80,358	11,255	51,770	40,369	331,175
Rochester	1,107	6,364	40	394	573	2,048
St. Lawrence	2,257	25,200	1,440	16,590	1,049	11,774
San Francisco	36	746	40	839	1,324	30,940
Virginia	364	3,651	567	5,266	5,617	64,856
Other [1]	708	7,377	802	10,135	921	9,291
	526,683	3,567,828	486,571	3,035,105	589,925	3,878,235

[1] Includes values under $5,000.

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

Coke imports supply an insignificant part of the requirements of the country and are a factor in the home market in restricted localities only. In 1939, 141,911 tons were received in the United States, nearly all supplied by four countries—Canada, Belgium, the United Kingdom, and Germany—in order of importance.

TABLE 39.—*Coke exported from the United States, 1937–39, by countries*

Country	1937		1938		1939	
	Net tons	Value	Net tons	Value	Net tons	Value
North America:						
Canada	488,880	$3,185,966	461,310	$2,760,529	495,389	$2,848,584
Central America: Panama	153	3,693	100	1,162	100	2,329
Mexico	488	4,706	790	10,287	875	8,761
West Indies:						
Cuba	14,853	81,347	2,168	17,299	5,929	49,503
Trinidad and Tobago	3,198	27,483	213	2,223	6,523	67,642
Other	391	6,568	353	4,729	535	7,291
South America:						
Bolivia	-----	-----	445	6,638	133	1,177
Brazil	-----	-----	281	2,393	8,000	101,158
Chile	3,818	20,833	1,750	9,679	2,181	18,878
Peru	73	3,401	-----	-----	879	10,359
Other	42	837	214	3,279	547	9,037
Europe:						
Denmark	-----	-----	-----	-----	3,345	35,087
France	605	7,441	6,013	53,108	45,901	413,578
Germany	-----	-----	1,417	10,628	-----	-----
Italy	9,156	156,196	2,760	40,861	1,176	19,550
Netherlands	1,247	10,006	-----	-----	-----	-----
Norway	564	10,080	2,198	10,995	4,480	31,000
Switzerland	2,800	42,090	5,880	90,703	3,229	57,660
United Kingdom	336	5,866	679	10,592	844	15,742
Other	-----	-----	-----	-----	1	10
Asia:						
Japan	-----	-----	-----	-----	7,923	136,791
Philippine Islands	34	565	-----	-----	1,861	42,984
Other	45	750	-----	-----	73	1,099
Africa: Gold Coast	-----	-----	-----	-----	1	15
	526,683	3,567,828	486,571	3,035,105	589,925	3,878,235

TABLE 40.—*Coke imported for consumption in the United States, 1937–39, by customs districts*

District	1937		1938		1939	
	Net tons	Value	Net tons	Value	Net tons	Value
Buffalo	42,827	$650,182	24,527	$496,159	55,425	$956,814
Dakota	(1)	5	-----	-----	-----	-----
Hawaii	556	7,528	726	6,436	-----	-----
Los Angeles	40,826	183,274	23,752	130,187	11,392	64,458
Maine and New Hampshire	390	1,506	252	1,866	350	2,590
Massachusetts	37,738	169,021	19,852	76,212	10,976	43,871
Michigan	27	207	-----	-----	11	65
Montana and Idaho	28,833	157,051	28,902	162,154	26,688	148,183
New York	76,489	315,443	6,983	32,683	19,211	69,445
Oregon	3,340	11,528	2,259	14,085	1,156	6,418
Rhode Island	4,749	28,808	1,120	6,005	-----	-----
St. Lawrence	1,628	10,424	61	446	76	486
San Francisco	30,701	144,037	19,983	125,245	9,849	53,879
Vermont	360	2,690	260	1,910	278	1,775
Washington	17,900	97,798	6,563	40,758	6,499	39,188
	286,364	1,779,502	135,240	1,094,146	141,911	1,387,172

[1] Less than 1 ton.

TABLE 41.—*Coke imported for consumption in the United States, 1937–39, by countries*

Country	1937		1938		1939	
	Net tons	Value	Net tons	Value	Net tons	Value
Belgium	91,698	$401,516	35,772	$165,724	37,080	$152,606
Canada	83,033	882,061	58,065	691,611	85,818	1,129,337
Germany	57,322	239,457	21,907	108,327	4,321	26,126
Netherlands	20,517	90,063			10	80
United Kingdom	33,794	166,405	19,496	128,484	14,682	79,023
	286,364	1,779,502	135,240	1,094,146	141,911	1,387,172

WORLD PRODUCTION

With 14 of the 27 countries listed in the following world table involved in the European war, production figures for 1939 are few, and any world total would be meaningless. Of the 6 countries whose 1939 output is reported, only the Union of South Africa shows a consistently rising quantity during the past four years. Production in the U. S. S. R. dropped from 20,700,000 metric tons in 1938 to 16,670,000 metric tons in 1939, or a decrease of 19 percent.

TABLE 42.—*Coke produced in principal countries of the world, 1929 and 1936–39, in metric tons* [1]

[Compiled by M. T. Latus]

Country [2]	1929	1936	1937	1938	1939
Australia:					
New South Wales	471,813	907,537	955,030	1,153,670	(3)
Queensland	4,144	23,701	30,949	31,481	31,057
Belgium	6,192,960	5,252,360	6,083,910	4,894,980	5,176,650
Bulgaria		1,683	4,550	3,923	(3)
Canada	1,986,532	1,830,101	1,984,581	1,808,588	1,825,178
China (exports)	13,467	11,422	9,062	11,630	(3)
Czechoslovakia	3,170,629	1,955,515	3,279,864	[4] 2,367,000	(3)
France	9,080,127	7,101,380	7,900,000	7,785,000	(3)
Germany	39,421,033	35,832,617	40,920,357	43,511,082	(3)
Saar	2,423,000				
Great Britain [5]	13,637,421	13,972,181	15,171,482	13,031,396	(3)
Hungary	2,092	24,133	35,092	53,092	(3)
India, British [6]	843,504	1,840,362	1,900,413	1,738,178	(3)
Indochina	637	109	128	3,503	(3)
Italy	791,607	1,210,714	1,693,024	1,739,417	(3)
Mexico	493,777	(3)	(3)	(3)	(3)
Netherlands	2,402,566	3,053,451	3,364,885	3,158,065	(3)
New Caledonia				43,317	(3)
Peru	35,899		3,607		(3)
Poland	1,858,052	1,615,598	2,125,519	2,523,290	(3)
Rhodesia, Southern	100,001	20,115	56,029	49,987	(3)
Rumania		63,214	78,010	86,030	(3)
Spain	768,040	(3)	(3)	(3)	(3)
Straits Settlements	15,667	9,619	10,634	10,400	(3)
Sweden	103,778	112,497	121,630	112,107	(3)
Turkey		37,411	74,792	84,930	(3)
Union of South Africa	99,297	75,459	109,133	163,315	184,480
U. S. S. R.	4,700,000	19,883,000	20,000,000	20,700,000	16,670,000
United States	54,325,427	41,979,921	47,513,978	29,479,553	40,212,242
	142,941,000	[7] 137,000,000	[7] 153,000,000	[7] 135,000,000	(3)

[1] Gas-house coke is not included.
[2] In addition to countries listed above, coke is produced in Chosen and Japan, but data of production are not available.
[3] Data not available.
[4] Excluding Sudetenland since October.
[5] In Great Britain the production of gas-house coke (including breeze), not included above, is especially important and was as follows: 1936, 12,935,933 tons; 1937, 13,151,057 tons; 1938, 13,049,139 tons.
[6] Figures for 1929 represent "hard" and "soft" coke made at collieries only (73,616 tons of "hard" coke and 769,888 tons of "soft" coke). Data for other years shown represent total "hard" coke manufactured. In addition, the following quantities of "soft" coke were made at collieries: 1936, 932,534 tons; 1937, 850,581 tons; 1938, 921,479 tons.
[7] Exclusive of Mexico and Spain.

COKE-OVEN BYPRODUCTS

The statistics in the following tables are confined to the major products obtained in high-temperature byproduct ovens, which fall into five general groups, some of which are subdivided further. They are (1) gas, by far the most valuable byproduct, followed by (2) light oil and derivatives, (3) tar, (4) ammonia, and (5) miscellaneous products. In recent years an increasing number of operators have installed equipment at their plants for making tar derivatives on the premises. The sales value of such derivatives during 1938 and 1939 totaled $2,438,075 and $3,270,208, respectively, including phenol and sodium phenolate (except for phenol and tar acids produced at Clairton, Pa.), and the tar that went into the distilling of these products totaled 111,782,843 gallons, reported from 9 plants in 1939. Total sales values of all byproducts in 1938 and 1939 were $103,671,849 and $124,814,434. If to these amounts are added values for the tar used by the producer ($5,780,776 in 1938 and $10,081,205 in 1939) and the values of the breeze production ($5,995,267 in 1938; $7,271,050 in 1939), the ratio of the value of byproducts to the value of coke produced was 71 percent in 1938 and 69 percent in 1939.

Of particular interest at present is toluol, a light-oil derivative from coke-oven operations and tar refineries. The output in 1939 as a byproduct from coke operations was 19,767,200 gallons compared with 13,021,080 in 1938 and 20,896,724 in 1937. These figures do not include toluol obtained from tar refineries. Sales of toluol in 1939 totaled 20,484,568 gallons valued at $3,974,367—an average of $0.194 a gallon. At the beginning of 1940 the trade-journal quotation of $0.27 a gallon advanced 3 cents.

Statistics covering the production and sales of coke-oven byproducts during 1938 and 1939 are shown in the following tables:

TABLE 43.—*Byproducts obtained from coke-oven operations in the United States, 1938–39* [1]

[Exclusive of screenings or breeze]

Product	Production	Sales		
		Quantity	Value	
			Total	Average
1938				
Tar ... gallons	419,579,649	302,321,022	$14,904,501	$0.049
Ammonia:				
Sulfate ... pounds	873,863,077	916,619,707	10,712,947	.012
Ammonia liquor (NH content) ... do	40,725,570	41,452,920	1,330,304	.032
			12,043,251	
Sulfate equivalent of all forms ... do	1,036,765,357	1,082,431,387		
Gas:				
Used under boilers, etc ... M cubic feet	[2] 499,692,522	19,039,377	1,205,661	.063
Used in steel or affiliated plants ... do		143,598,923	14,813,680	.103
Distributed through city mains ... do		141,700,942	42,023,525	.297
Sold for industrial use ... do		18,671,749	2,322,117	.124
	[2] 499,692,522	323,010,991	60,364,983	.187

See footnotes at end of table.

TABLE 43.—*Byproducts obtained from coke-oven operations in the United States, 1938–39*—Continued

Product	Production	Sales: Quantity	Sales: Value: Total	Sales: Value: Average
1938—Continued				
Light oil and derivatives:				
Crude light oil .... gallons	[3] 123, 559, 610	9, 558, 969	$805, 807	$0.084
Benzol, crude and refined .... do	17, 744, 657	17, 175, 742	2, 317, 420	.135
Motor benzol .... do	56, 349, 589	55, 675, 583	5, 373, 407	.097
Toluol, crude and refined .... do	13, 021, 080	12, 884, 734	2, 819, 431	.219
Solvent naphtha .... do	3, 706, 258	3, 462, 836	633, 330	.183
Xylol .... do	2, 900, 243	2, 732, 697	677, 311	.248
Other light-oil products .... do	5, 450, 045	3, 617, 721	319, 777	.088
	[4] 99, 171, 872	105, 108, 282	12, 946, 483	.123
Naphthalene, crude and refined .... pounds	24, 943, 014	25, 456, 400	437, 654	.017
Tar derivatives:				
Creosote oil, distillate as such .... gallons	12, 986, 940	9, 784, 554	1, 079, 392	.110
Creosote oil in coal-tar solution .... do	773, 669	120, 679	21, 722	.180
Pitch of tar .... net tons	187, 989	3, 595	38, 701	10.765
Other tar derivatives	....	....	1, 243, 363	....
Phenol .... gallons	107, 778	98, 373	41, 986	.427
Sodium phenolate .... do	180, 347	181, 360	12, 911	.071
Other products [5]	....	....	536, 902	....
Value of all byproducts sold	....	....	[6] 103, 671, 849	....
1939				
Tar .... gallons	554, 406, 216	344, 534, 382	16, 585, 734	.048
Ammonia:				
Sulfate .... pounds	1, 160, 548, 288	1, 153, 901, 833	13, 153, 642	.011
Ammonia liquor (NH_3 content) .... do	48, 264, 021	48, 034, 809	1, 480, 879	.031
	....	....	14, 634, 521	....
Sulfate equivalent of all forms .... do	1, 353, 604, 372	1, 346, 041, 069	....	....
Gas:				
Used under boilers, etc .... M cubic feet	[2] 675, 143, 201	28, 714, 866	1, 967, 142	.069
Used in steel or affiliated plants .... do		237, 890, 694	24, 301, 060	.102
Distributed through city mains .... do		144, 876, 573	42, 891, 370	.296
Sold for industrial use .... do		22, 229, 157	2, 716, 883	.122
	[2] 675, 143, 201	433, 711, 290	71, 876, 455	.166
Light-oil and derivatives:				
Crude light oil .... gallons	[3] 170, 963, 199	9, 383, 907	727, 765	.078
Benzol, crude and refined .... do	25, 305, 714	24, 621, 650	3, 248, 548	.132
Motor benzol .... do	79, 607, 150	75, 082, 362	6, 934, 550	.092
Toluol, crude and refined .... do	19, 767, 200	20, 484, 568	3, 974, 367	.194
Solvent naphtha .... do	4, 788, 836	4, 660, 311	794, 323	.170
Xylol .... do	4, 089, 090	4, 393, 400	1, 018, 589	.232
Other light-oil products .... do	6, 247, 201	4, 193, 125	336, 072	.080
	[4] 139, 805, 191	142, 819, 323	17, 034, 214	.119
Naphthalene, crude and refined .... pounds	48, 460, 171	46, 551, 432	727, 947	.016
Tar derivatives:				
Creosote oil, distillate as such .... gallons	18, 479, 962	13, 573, 393	1, 470, 608	.108
Creosote oil in coal-tar solution .... do	975, 887	....	....	....
Pitch of tar .... net tons	215, 414	2, 109	13, 905	6.593
Other tar derivatives	....	....	1, 734, 810	....
Phenol .... gallons	99, 365	71, 080	28, 949	.407
Sodium phenolate .... do	288, 974	286, 949	21, 936	.076
Other products [5]	....	....	685, 355	....
Value of all byproducts sold	....	....	[6] 124, 814, 434	....

[1] Includes products of tar distillation conducted by coke-oven operators under same corporate name, except, however, phenol and other tar acids produced at Clairton, Pa.
[2] Includes gas wasted and gas used for heating retorts.
[3] Refined on premises to make the derived products shown: 1938, 117,248,545 gallons; 1939, 163,947,167 gallons.
[4] Total gallons of derived products.
[5] Ammonia thiocyanate, asphalt paint, cyanogen sludge, calcium ferrocyanide, light carbolic oils, pyridine oil, sodium carbolate, sodium prussiate, spent soda solution, sulfur, and vented vapors.
[6] Exclusive of value of breeze, which was $5,995,267 in 1938 and $7,271,050 in 1939.

TABLE 44.—*Coal equivalent of byproducts of byproduct coking in the United States, 1913, 1914, 1918, and 1938–39*

Year	Quantity of byproducts				Rough equivalent in heating value (billion B. t. u.)					Coal equivalent	
	1	2	3	4	5	6	7	8	9	10	11
	Coke breeze (thousand net tons)	Surplus gas (billion cubic feet)	Tar produced (thousand gallons)	Light oil produced (thousand gallons)	Coke breeze (1×20)	Surplus gas (2×550)	Tar (3 × 0.150)	Light oil (4 ×0.130)	Total (5+6 +7+8)	Net tons 9÷0.0262)	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
1938	2,654	323	419,580	123,560	53,080	177,650	62,937	16,063	309,730	11,822,000	25.4
1939	3,354	434	554,406	170,963	67,080	238,700	83,161	22,225	411,166	15,693,000	24.7

COKE-OVEN GAS

TABLE 45.—*Coke-oven gas produced and sold in the United States, 1938–39, by States*

State	Active plants	Produced (M cubic feet)	Used in heating ovens (M cubic feet)	Surplus sold or used			Wasted (M cubic feet)
				M cubic feet	Value		
					Total	Average	
1938							
Alabama	7	54,132,681	23,313,720	28,274,030	$2,209,461	$0.078	2,544,931
Colorado	1	3,292,183	1,875,164	1,395,066	(1)	(1)	21,953
Illinois	8	26,392,799	6,018,934	20,279,580	4,523,593	.223	94,285
Indiana	5	44,366,419	18,208,118	25,504,616	5,993,085	.235	653,685
Maryland	1	15,430,937	6,494,580	8,936,357	(1)	(1)	
Massachusetts	2	16,279,971	3,723,645	12,512,352	(1)	(1)	43,974
Michigan	9	28,800,580	6,494,393	22,037,351	3,164,628	.144	268,836
Minnesota	3	8,903,220	3,633,599	5,257,022	1,438,536	.274	12,599
New Jersey	2	16,371,899	3,355,583	13,016,316	(1)	(1)	
New York	8	59,664,055	12,427,730	46,162,273	14,900,318	.323	1,074,052
Ohio	14	54,845,691	23,716,505	29,707,773	3,618,400	.122	1,421,413
Pennsylvania	12	118,591,838	47,981,230	70,155,151	9,026,204	.129	455,457
Tennessee	1	1,042,877	462,765	580,112	154,068	.266	
Utah	1	3,056,842	1,449,075	1,518,236	(1)	(1)	89,531
West Viriginia	4	22,374,452	6,047,801	16,313,901	1,370,531	.084	12,750
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	6	26,146,078	4,212,250	21,360,855	6,450,296	.302	572,973
Undistributed					7,515,863	.201	
	84	499,692,522	169,415,092	323,010,991	60,364,983	.187	7,266,439
At merchant plants	40	169,717,382	35,155,300	132,498,828	37,137,781	.280	2,063,254
At furnace plants	44	329,975,140	134,259,792	190,512,163	23,227,202	.122	5,203,185
1939							
Alabama	6	60,865,445	26,259,841	33,045,531	2,560,642	.077	1,560,073
Colorado	1	7,171,893	3,512,390	3,626,584	(1)	(1)	32,919
Illinois	9	27,821,287	6,635,165	20,640,374	4,740,237	.230	545,748
Indiana	5	74,992,074	29,833,498	43,530,778	8,314,922	.191	1,627,798
Maryland	1	20,722,806	8,483,222	12,239,584	(1)	(1)	
Massachusetts	2	16,873,695	3,975,145	12,862,883	(1)	(1)	35,667
Michigan	9	40,704,449	6,386,903	33,951,687	4,152,266	.122	365,859
Minnesota	3	8,619,175	3,183,412	5,423,516	1,461,090	.269	12,247
New Jersey	2	16,570,792	3,589,092	12,981,700	(1)	(1)	
New York	8	67,991,560	15,679,866	51,426,272	15,337,889	.298	885,422
Ohio	15	90,969,431	38,430,434	50,484,575	5,779,642	.114	2,054,422
Pennsylvania	11	181,809,635	71,978,547	109,162,063	12,919,071	.118	669,025
Tennessee	1	1,071,727	450,277	621,450	160,312	.258	
Utah	1	4,364,810	1,880,847	2,239,994	(1)	(1)	243,969
West Viriginia	4	26,265,390	7,187,371	19,046,273	1,670,165	.088	31,746
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	6	28,329,032	5,398,046	22,428,026	6,542,010	.292	502,960
Undistributed					8,238,209	.187	
	84	675,143,201	232,864,056	433,711,290	71,876,455	.166	8,567,855
At merchant plants	39	172,077,078	36,004,338	134,485,966	37,717,223	.280	1,586,774
At furnace plants	45	503,066,123	196,859,718	299,225,324	34,159,232	.114	6,981,081

[1] Included under "Undistributed."

TABLE 46.—*Disposition of surplus coke-oven gas in the United States, 1938–39, by States*

State	Used by producer					
	Under boilers			In steel or other affiliated plants		
	M cubic feet	Value		M cubic feet	Value	
		Total	Average		Total	Average
1938						
Alabama	7,124,974	$363,498	$0.051	16,410,937	$1,238,121	$0.075
Colorado	------	------	------	1,395,066	[1]	[1]
Illinois	195,868	19,778	.101	1,752,254	254,657	.145
Indiana	1,104,360	92,902	.084	17,256,100	2,319,179	.134
Maryland	------	------	------	3,503,821	[1]	[1]
Massachusetts	13,494	[1]	[1]	------	------	------
Michigan	1,061,300	53,065	.050	12,202,760	1,826,549	.150
Minnesota	7,694	891	.116	1,162,053	168,851	.145
New Jersey	------	------	------	------	------	------
New York	1,386,398	93,604	.068	9,025,740	1,109,154	.123
Ohio	2,524,148	232,687	.092	19,403,205	1,901,776	.098
Pennsylvania	3,462,080	200,874	.058	47,283,281	4,300,922	.091
Tennessee	114,470	4,006	.035	------	------	------
Utah	836,118	[1]	[1]	20,195	[1]	[1]
West Virginia	526,180	25,587	.049	14,183,511	1,078,329	.076
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	682,293	70,914	.104	------	------	------
Undistributed	------	47,855	.056	------	616,142	.125
	19,039,377	1,205,661	.063	143,598,923	14,813,680	.103
At merchant plants	5,994,451	455,706	.076	5,312,043	452,145	.085
At furnace plants	13,044,926	749,955	.057	138,286,880	14,361,535	.104
1939						
Alabama	6,298,948	244,856	.039	21,596,775	1,716,123	.079
Colorado	------	------	------	3,626,584	[1]	[1]
Illinois	617,125	49,643	.080	2,074,026	265,701	.128
Indiana	3,660,242	327,045	.089	31,977,597	4,168,691	.130
Maryland	------	------	------	6,531,192	[1]	[1]
Massachusetts	13,479	[1]	[1]	2,047	[1]	[1]
Michigan	3,999,774	392,465	.098	22,212,620	2,552,950	.115
Minnesota	7,197	772	.107	1,303,909	193,965	.149
New Jersey	------	------	------	------	------	------
New York	2,087,238	138,863	.067	12,306,754	1,450,555	.118
Ohio	2,996,306	280,908	.094	38,281,890	3,735,941	.098
Pennsylvania	6,463,999	388,209	.060	80,757,946	7,579,899	.094
Tennessee	92,590	3,241	.035	------	------	------
Utah	1,469,753	[1]	[1]	31,347	[1]	[1]
West Virginia	172,642	8,975	.052	17,188,007	1,386,236	.081
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	835,573	53,655	.064	------	------	------
Undistributed	------	78,510	.053	------	1,250,999	.123
	28,714,866	1,967,142	.069	237,890,694	24,301,060	.102
At merchant plants	5,958,426	417,313	.070	6,416,013	566,038	.088
At furnace plants	22,756,440	1,549,829	.068	231,474,681	23,735,022	.103

[1] Included under "Undistributed."

TABLE 46.—*Disposition of surplus coke-oven gas in the United States, 1938–39, by States*—Continued

State	Sold					
	Distributed through city mains			Sold for industrial purposes		
	M cubic feet	Value		M cubic feet	Value	
		Total	Average		Total	Average
1938—Continued						
Alabama	3,700,366	$511,907	$0.138	1,037,753	$95,935	$0.092
Colorado	----------	----------	----------	----------	----------	----------
Illinois	18,304,603	4,246,432	.232	26,855	2,726	.102
Indiana	5,709,291	3,144,945	.551	1,434,865	436,059	.304
Maryland	5,432,536	[1]	[1]	----------	----------	----------
Massachusetts	12,467,724	[1]	[1]	31,134	[1]	[1]
Michigan	3,559,471	864,295	.243	5,213,820	420,719	.081
Minnesota	4,087,275	1,268,794	.310	----------	----------	----------
New Jersey	13,016,316	[1]	[1]	----------	----------	----------
New York	34,109,008	13,404,910	.393	1,641,127	292,650	.178
Ohio	5,173,698	1,192,269	.230	2,606,722	291,668	.112
Pennsylvania	16,513,689	4,253,110	.258	2,896,101	271,298	.094
Tennessee	465,642	150,062	.322	----------	----------	----------
Utah	524,965	[1]	[1]	136,958	[1]	[1]
West Virginia	----------	----------	----------	1,604,210	266,615	.166
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	18,636,358	6,152,335	.330	2,042,204	227,047	.111
Undistributed	----------	6,834,466	.217	----------	17,400	.104
	141,700,942	42,023,525	.297	18,671,749	2,322,117	.124
At merchant plants	107,016,255	34,404,089	.321	14,176,079	1,825,841	.129
At furnace plants	34,684,687	7,619,436	.220	4,495,670	496,276	.110
1939—Continued						
Alabama	4,430,055	533,580	.120	719,753	66,083	.092
Colorado	----------	----------	----------	----------	----------	----------
Illinois	17,554,864	4,386,825	.250	394,359	38,068	.097
Indiana	6,080,129	3,284,366	.540	1,812,810	534,820	.295
Maryland	5,708,392	[1]	[1]	----------	----------	----------
Massachusetts	12,814,242	[1]	[1]	33,115	[1]	[1]
Michigan	3,437,471	827,631	.241	4,301,822	379,220	.088
Minnesota	4,112,410	1,266,353	.308	----------	----------	----------
New Jersey	12,981,700	[1]	[1]	----------	----------	----------
New York	35,369,561	13,519,838	.382	1,662,719	228,633	.138
Ohio	6,113,841	1,423,622	.233	3,092,538	339,171	.110
Pennsylvania	16,584,194	4,441,151	.268	5,355,924	509,812	.095
Tennessee	528,860	157,071	.297	----------	----------	----------
Utah	554,694	[1]	[1]	184,200	[1]	[1]
West Virginia	----------	----------	----------	1,685,624	274,954	.163
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	18,606,160	6,165,714	.331	2,986,293	322,641	.108
Undistributed	----------	6,885,219	.215	----------	23,481	.108
	144,876,573	42,891,370	.296	22,229,157	2,716,883	.122
At merchant plants	107,542,354	34,835,122	.324	14,569,173	1,898,750	.130
At furnace plants	37,334,219	8,056,248	.216	7,659,984	818,133	.107

[1] Included under "Undistributed."

TAR

TABLE 47.—*Coke-oven tar produced and sold in the United States, 1938–39, by States*

State	Produced [1] (gallons)		Sold				
	Total	Per ton of coal coked	For use as fuel [3] (gallons)	For refining into tar products (gallons)	Total sold (gallons)	Value	
						Total	Average
1938							
Alabama	42,748,599	8.98	5,193,994	27,570,561	32,764,555	$1,699,004	$0.052
Colorado	3,294,308	11.78		215,488	215,488	(4)	(4)
Illinois	22,411,913	8.66	4,786,358	17,942,615	22,728,973	1,094,335	.048
Indiana	28,742,105	6.96	2,564,116	14,281,866	16,845,982	928,460	.055
Maryland	12,861,568	8.40		12,536,415	12,536,415	(4)	(4)
Massachusetts	11,980,547	8.28	571,536	11,525,822	12,097,358	(4)	(4)
Michigan	22,375,650	8.88	694,288	20,571,149	21,265,437	959,235	.045
Minnesota	5,942,922	7.72		5,637,733	5,637,733	309,286	.055
New Jersey	10,983,131	7.83	3,278,149	7,925,727	11,203,876	(4)	(4)
New York	54,045,612	9.74	8,334,391	43,315,910	51,650,301	2,498,594	.048
Ohio	45,580,107	8.75	9,495,699	32,462,789	41,958,488	2,131,603	.051
Pennsylvania	113,151,706	10.88	2,931,117	26,356,910	29,288,027	1,300,083	.044
Tennessee	749,467	6.76		750,024	750,024	35,251	.047
Utah	2,619,366	11.48		2,506,818	2,506,818	(4)	(4)
West Virginia	23,759,175	12.00		22,332,113	22,332,113	1,098,249	.049
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	18,333,473	7.77		18,539,434	18,539,434	881,703	.048
Undistributed						1,968,698	.051
	419,579,649	9.27	37,849,648	264,471,374	302,321,022	14,904,501	.049
At merchant plants	133,922,293	8.67	9,872,971	122,818,171	132,691,142	6,384,802	.048
At furnace plants	285,657,356	9.58	27,976,677	141,653,203	169,629,880	8,519,699	.050
1939							
Alabama	46,869,260	8.64	9,902,390	18,025,540	27,927,930	1,446,341	.052
Colorado	6,576,129	10.91		218,615	218,615	(4)	(4)
Illinois	23,053,501	8.33	5,952,631	15,066,955	21,019,586	1,002,347	.048
Indiana	44,856,319	6.46	2,574,144	21,126,373	23,700,517	1,166,383	.049
Maryland	17,954,024	8.29		17,701,420	17,701,420	(4)	(4)
Massachusetts	12,646,193	8.46	637,413	11,998,797	12,636,210	(4)	(4)
Michigan	31,168,837	8.89	8,518,487	21,339,872	29,858,359	1,353,874	.045
Minnesota	6,158,582	8.66		5,946,203	5,946,203	317,974	.053
New Jersey	11,420,692	8.09	3,150,946	8,062,611	11,213,557	(4)	(4)
New York	60,145,449	9.58	10,250,106	44,511,837	54,761,943	2,643,459	.048
Ohio	73,781,686	8.55	15,213,762	42,712,362	57,926,124	2,901,568	.050
Pennsylvania	169,081,691	10.57	9,942,820	21,790,639	31,733,459	1,391,046	.044
Tennessee	788,864	7.25		779,643	779,643	36,643	.047
Utah	3,728,334	11.50	181	3,757,069	3,757,250	(4)	(4)
West Virginia	25,975,052	11.07		25,265,149	25,265,149	1,151,505	.046
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	20,201,603	8.09		20,088,417	20,088,417	983,416	.049
Undistributed						2,191,178	.048
	554,406,216	9.06	66,142,880	278,391,502	344,534,382	16,585,734	.048
At merchant plants	136,417,322	8.79	9,735,980	122,367,243	132,103,223	6,259,509	.047
At furnace plants	417,988,894	9.15	56,406,900	156,024,259	212,431,159	10,326,225	.049

[1] Includes 79,863,885 gallons of tar "refined at plant" in 1938 and 111,782,843 gallons in 1939.
[3] Includes the following sold: To affiliated corporations—1938, 130,913 gallons; 1939, 630,473 gallons. To other purchasers—1938, 37,718,735 gallons; 1939, 65,512,407 gallons.
[4] Included in "Undistributed."

TABLE 47.—*Coke-oven tar produced and sold in the United States, 1938–39, by States*—Continued

State	Used by producer[1] (gallons)			On hand Dec. 31 (gallons)
	As fuel under boilers	In open hearth or affiliated plants	Otherwise	
1938—Continued				
Alabama	117,932	10,624,119	138,219	3,576,413
Colorado		147,315	14,606	387,413
Illinois		16,943	12,265	2,367,097
Indiana		2,863,788	56,643	3,319,161
Maryland		28,195		1,461,873
Massachusetts				294,211
Michigan			3,960	3,415,613
Minnesota				676,359
New Jersey				667,332
New York			100	3,709,013
Ohio	187,017	1,228,766	308,120	3,549,963
Pennsylvania	467,000	8,864,469	5,781,443	12,466,314
Tennessee				19,401
Utah		1,150		216,373
West Virginia		1,388,108		520,855
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin			44,942	685,905
Undistributed				
	771,949	25,162,853	6,360,298	37,333,296
At merchant plants			47,055	7,403,905
At furnace plants	771,949	25,162,853	6,313,243	29,929,391
1939—Continued				
Alabama		17,664,450	92,434	4,760,859
Colorado		2,049,257	3,617	620,023
Illinois			169	4,406,448
Indiana		9,801,093	146,565	4,179,114
Maryland		6,793		1,707,684
Massachusetts				304,194
Michigan	983,500	651,934	8,270	3,113,223
Minnesota				888,738
New Jersey				874,467
New York		1,192,540	22,378	6,119,922
Ohio	799,418	11,322,890	594,190	5,158,560
Pennsylvania	2,873,945	42,467,152	5,295	10,769,542
Tennessee				28,622
Utah		650		186,807
West Virginia		207,082	1,000	1,022,676
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin			3,331	795,760
Undistributed				
	4,656,863	85,363,841	877,249	44,936,639
At merchant plants			26,709	9,969,047
At furnace plants	4,656,863	85,363,841	850,540	34,967,592

[1] Excludes 79,863,885 gallons of tar "refined at plant" in 1938 and 111,782,843 gallons in 1939 that cannot be shown by States without disclosing individual operations.

AMMONIA

TABLE 48.—*Ammonia produced at coke-oven plants in the United States and sold, 1938–39, by States*

State	Active plants	Sulfate equivalent of all forms (pounds)		Produced as—	
		Total	Per ton of coal coked	Sulfate (pounds)	Liquor (NH_3 content) (pounds)
1938					
Alabama	7	120,933,088	25.39	111,531,488	2,350,400
Colorado	1	6,935,000	24.80	6,935,000	
Illinois	7	57,367,037	23.13	40,516,913	4,212,531
Indiana	5	87,830,453	21.26	79,831,213	1,999,810
Maryland	1	31,211,440	20.37	31,211,440	
Massachusetts	2	34,252,268	23.66	30,724,960	881,827
Michigan	9	57,330,116	22.75	23,085,588	8,561,132
Minnesota	3	15,965,639	20.73	15,965,639	
New Jersey	2	27,228,843	19.42	27,228,843	
New York	8	128,028,778	23.08	105,537,390	5,622,847
Ohio	14	122,683,361	23.55	93,353,653	7,332,427
Pennsylvania	12	253,618,391	24.39	237,586,527	4,007,966
Tennessee	1	3,007,613	27.15	3,007,613	
Utah	1	6,384,974	27.98	6,384,974	
West Virginia	3	42,521,709	26.08	42,521,709	
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	5	41,466,647	21.47	18,449,127	5,756,630
Undistributed					
	81	1,036,765,357	23.36	873,863,077	40,725,570
At merchant plants	37	327,412,794	22.47	203,108,698	31,076,024
At furnace plants	44	709,352,563	23.79	670,754,379	9,649,546
1939					
Alabama	6	133,436,377	24.58	125,977,737	1,864,660
Colorado	1	14,232,800	23.61	14,232,800	
Illinois	7	55,871,447	21.14	39,758,927	4,028,130
Indiana	5	127,694,635	18.39	116,621,203	2,768,358
Maryland	1	48,126,547	22.21	48,126,547	
Massachusetts	2	34,306,064	22.95	30,286,760	1,004,826
Michigan	9	73,705,126	21.03	28,457,486	11,311,910
Minnesota	3	15,887,708	22.35	15,887,708	
New Jersey	2	29,620,771	20.98	29,620,771	
New York	8	140,357,716	22.35	117,054,904	5,825,703
Ohio	15	192,178,308	22.27	153,907,344	9,567,741
Pennsylvania	11	378,404,833	23.65	364,074,677	3,582,539
Tennessee	1	2,835,006	26.05	2,835,006	
Utah	1	8,612,058	26.57	8,612,058	
West Virginia	3	46,946,124	24.61	46,946,124	
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	5	51,388,852	20.83	18,148,236	8,310,154
Undistributed					
	80	1,353,604,372	22.33	1,160,548,288	48,264,021
At merchant plants	35	332,644,271	22.29	203,599,275	32,261,249
At furnace plants	45	1,020,960,101	22.34	956,949,013	16,002,772

TABLE 48.—*Ammonia produced at coke-oven plants in the United States and sold, 1938-39, by States*—Continued

State	Sold as— Sulfate Pounds	Sulfate Value	Liquor (NH_3 content) Pounds	Liquor (NH_3 content) Value
1938—Continued				
Alabama	130,185,239	$1,625,010	2,486,490	$84,087
Colorado	9,464,827	(1)		
Illinois	47,744,142	481,922	4,287,715	(1)
Indiana	93,876,155	1,098,397	2,056,548	54,915
Maryland	33,325,390	(1)		
Massachusetts	29,600,380	(1)	881,074	(1)
Michigan	28,499,778	373,889	8,981,858	268,014
Minnesota	16,179,321	171,702		
New Jersey	28,653,395	(1)		
New York	108,293,453	1,281,744	5,560,271	178,989
Ohio	93,147,572	1,075,648	7,441,415	258,143
Pennsylvania	224,985,740	2,465,624	4,084,353	148,026
Tennessee	4,083,600	53,946		
Utah	6,223,165	(1)		
West Virginia	40,927,118	482,371		
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	21,430,432	263,859	5,673,196	167,165
Undistributed		1,338,835		170,965
	916,619,707	10,712,947	41,452,920	1,330,304
At merchant plants	220,046,874	2,634,587	31,571,479	1,002,809
At furnace plants	696,572,833	8,078,360	9,881,441	327,495
1939—Continued				
Alabama	124,387,618	1,537,643	1,810,089	60,783
Colorado	9,907,686	(1)		
Illinois	32,651,753	342,259	4,039,180	(1)
Indiana	117,470,487	1,272,189	2,645,513	75,971
Maryland	49,567,691	(1)		
Massachusetts	30,854,980	(1)	1,000,794	(1)
Michigan	28,710,408	277,500	11,369,266	264,307
Minnesota	17,947,079	189,062		
New Jersey	29,045,660	(1)		
New York	118,889,070	1,409,880	5,812,278	207,382
Ohio	149,571,584	1,692,664	9,544,326	323,083
Pennsylvania	366,372,413	4,024,338	3,558,348	128,589
Tennessee	2,989,500	35,874		
Utah	10,355,685	(1)		
West Virginia	46,676,719	553,032		
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	18,503,500	223,872	8,255,015	250,494
Undistributed		1,595,329		170,270
	1,153,901,833	13,153,642	48,034,809	1,480,879
At merchant plants	200,216,061	2,313,495	32,202,538	1,027,510
At furnace plants	953,685,772	10,840,147	15,832,271	453,369

1 Included under "Undistributed."

LIGHT OIL AND ITS DERIVATIVES

TABLE 49.—*Crude light oil produced at coke-oven plants in the United States and derived products obtained and sold, 1938–39, by States*

State	Active plants	Produced (gallons)		Refined on premises (gallons)	Derived products obtained and sold		
		Total	Per ton of coal coked		Produced (gallons)	Sold [1] (gallons)	Value [1]
1938							
Alabama	7	14, 583, 352	3. 06	14, 257, 422	12, 388, 307	11, 771, 038	$1, 322, 970
Colorado	1	952, 313	3. 40	960, 082	750, 693	675, 915	(2)
Illinois	5	5, 442, 431	2. 46	1, 765, 950	1, 422, 046	1, 492, 643	207, 354
Indiana	4	10, 321, 347	2. 80	10, 842, 068	9, 063, 236	8, 486, 672	1, 180, 445
Maryland	1	4, 644, 712	3. 03	4, 661, 672	3, 871, 645	3, 781, 915	(2)
Michigan	4	6, 500, 213	2. 94	4, 223, 996	3, 806, 010	3, 836, 091	447, 773
New York	7	12, 609, 098	2. 64	19, 481, 911	16, 163, 973	15, 553, 582	2, 226, 043
Ohio	14	15, 309, 633	2. 94	13, 274, 301	10, 922, 955	10, 628, 751	1, 388, 846
Pennsylvania	10	33, 350, 074	3. 52	32, 957, 066	27, 706, 005	26, 244, 892	2, 972, 206
Tennessee	1	260, 637	2. 35	256, 944	200, 600	205, 818	25, 173
Utah	1	961, 445	4. 21	964, 840	703, 778	701, 843	(2)
West Virginia	4	6, 864, 799	3. 47	6, 833, 182	5, 836, 381	5, 697, 890	853, 384
Connecticut, Kentucky, Massachusetts, Minnesota, Missouri, New Jersey, and Wisconsin	7	11, 759, 556	2. 39	6, 769, 111	6, 336, 243	6, 472, 263	956, 519
Undistributed							559, 963
	66	123, 559, 610	2. 99	117, 248, 545	99, 171, 872	95, 549, 313	12, 140, 676
At merchant plants	25	30, 380, 658	2. 49	24, 999, 437	21, 625, 957	21, 440, 715	3, 109, 074
At furnace plants	41	93, 178, 952	3. 19	92, 249, 108	77, 545, 915	74, 108, 598	9, 031, 602
1939							
Alabama	6	16, 287, 270	3. 00	16, 231, 054	14, 029, 044	13, 567, 774	1, 546, 260
Colorado	1	2, 034, 917	3. 38	2, 012, 251	1, 596, 217	1, 410, 753	(2)
Illinois	5	6, 091, 171	2. 55	1, 922, 013	1, 515, 744	1, 420, 658	194, 562
Indiana	4	16, 847, 246	2. 59	17, 745, 926	16, 127, 640	15, 849, 451	1, 995, 638
Maryland	1	7, 174, 031	3. 31	7, 174, 031	6, 013, 942	5, 988, 302	(2)
Michigan	4	9, 446, 308	2. 95	7, 401, 533	6, 558, 330	3, 417, 003	461, 781
New York	7	14, 051, 684	2. 55	21, 002, 798	17, 576, 292	17, 500, 173	2, 462, 650
Ohio	15	25, 183, 749	2. 92	22, 379, 189	18, 650, 345	18, 022, 004	2, 222, 550
Pennsylvania	9	51, 853, 145	3. 44	51, 116, 312	42, 878, 665	41, 851, 493	4, 707, 133
Tennessee	1	266, 023	2. 44	267, 875	216, 142	209, 778	24, 964
Utah	1	1, 342, 700	4. 14	1, 352, 030	1, 037, 461	1, 042, 067	(2)
West Virginia	4	8, 106, 539	3. 46	8, 073, 908	6, 945, 723	6, 692, 847	948, 194
Connecticut, Kentucky, Massachusetts, Minnesota, Missouri, New Jersey, and Wisconsin	7	12, 278, 416,	2. 45	7, 268, 247	6, 659, 646	6, 463, 113	822, 314
Undistributed							920, 403
	65	170, 963, 199	2. 99	163, 947, 167	139, 805, 191	133, 435, 416	16, 306, 449
At merchant plants	23	30, 279, 965	2. 48	25, 905, 491	22, 323, 665	22, 363, 499	3, 034, 641
At furnace plants	42	140, 683, 234	3. 12	138, 041, 676	117, 481, 526	111, 071, 917	13, 271, 808

[1] Excludes 9,558,969 gallons valued at $805,807 of crude oil sold as such in 1938 and 9,383,907 gallons, $727,765 in 1939.
[2] Included under "Undistributed."

NAPHTHALENE

TABLE 50.—*Crude and refined naphthalene sold by byproduct-coke operators in the United States, 1935–39*

Year	Pounds	Value		Receipts per ton of coke (cents)
		Total	Average receipts per pound (cents)	
1935	13,214,108	$167,632	1.3	.5
1936	34,946,890	570,295	1.6	1.3
1937	60,315,581	1,182,992	2.0	2.4
1938	25,456,400	437,654	1.7	1.4
1939	46,551,432	727,947	1.6	1.7

BYPRODUCT COKE OVENS OWNED BY CITY-GAS COMPANIES (PUBLIC UTILITY PLANTS)

Adaptation of byproduct coke ovens to the needs of city-gas manufacture has led a number of gas companies to install batteries of byproduct ovens to supplement or even to replace their coal or water-gas plants. From the point of view of ownership and accounting, these installations are part of the gas utility system, and the Bureau of the Census therefore groups them with the manufactured-gas industry under the title "The Gas and Coke Industries."

From other points of view, however, these installations belong to the byproduct coke industry. The coke produced is superior to gas-house coke. In practical operation of a byproduct coke plant the fact that the gas may be distributed through city mains has less consequence than the fact that the coke must be marketed for foundry, furnace, or household use. Considered with reference to oven design and the technique of manufacture, and still more with reference to the supply and demand for coke, these ovens should be included with other byproduct coke plants; they are so included in the statistics published by the Bureau of Mines.

These differences in classification are followed by the Bureau of the Census and the Bureau of Mines after consultation with leaders of the gas and coke industries, and the two offices have collaborated in the collection and analysis of the statistics.

The following table presents salient features of the byproduct coke industry separated with respect to plants owned by city-gas companies and those not so owned.

That the public utility plants have been increasing in number and volume of output is evidenced by the fact that the number rose from 9 in 1918 to 21 in 1929. In the latter year the coke produced from the 21 active plants amounted to 3,232,307 tons, or 6 percent of the total output of byproduct coke. In 1939, with only 17 plants active, the coke output was 3,159,129 tons, or 7 percent of national byproduct production.

TABLE 51.—*Production of coke, breeze, gas, and byproducts at byproduct coke plants owned by city gas companies (public utilities) and included by Bureau of the Census in manufactured-gas industry, and at all other byproduct coke plants, 1938–39*

Product	1938			1939		
	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities)[1]	Total	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities)[1]	Total
Number of active plants	66	18	84	67	17	84
Coke:						
Production ... net tons	28,430,014	3,228,389	31,658,403	39,723,184	3,159,129	42,882,313
Value	$142,501,302	$20,977,737	$163,479,039	$186,275,463	$20,182,410	$206,457,873
Average	$5.01	$6.50	$5.16	$4.69	$6.39	$4.81
Screenings or breeze:						
Production ... net tons	2,355,317	298,336	2,653,653	3,098,018	256,356	3,354,374
Sales ... do	421,504	23,676	445,180	470,586	41,789	512,375
Value	$1,066,519	$58,516	$1,125,035	$1,159,829	$104,914	$1,264,743
Average	$2.53	$2.47	$2.53	$2.46	$2.51	$2.47
Coal charged into ovens:						
Quantity ... net tons	40,654,801	4,611,543	45,266,344	56,697,045	4,518,854	61,215,899
Coke:						
Used by producer:						
Quantity ... net tons	17,701,093	703,448	18,404,541	28,527,680	736,561	29,264,241
Value	$79,114,103	$4,435,307	$83,549,410	$122,872,502	$4,642,504	$127,515,006
Sales:						
Quantity ... net tons	9,934,102	2,274,907	12,209,009	12,107,076	2,511,625	14,618,701
Value	$58,386,977	$14,896,061	$73,283,038	$67,877,767	$16,110,542	$83,988,309
Byproducts:						
Gas:						
Production ... M cubic feet	446,157,227	53,535,295	499,692,522	622,399,116	52,744,085	675,143,201
Sales of surplus:						
Used under boilers:						
Quantity ... M cubic feet	19,024,471	14,906	19,039,377	28,696,140	18,726	28,714,866
Value	$1,203,972	$1,689	$1,205,661	$1,963,902	$3,240	$1,967,142
Used in steel or affiliated plants:						
Quantity ... M cubic feet	143,581,124	17,799	143,598,923	237,875,390	15,304	237,890,694
Value	$14,808,600	$5,080	$14,813,680	$24,296,469	$4,591	$24,301,060
Distributed through city mains:						
Quantity ... M cubic feet	94,885,014	46,815,928	141,700,942	98,015,739	46,860,834	144,876,573
Value	$23,406,848	$18,616,677	$42,023,525	$24,024,630	$18,866,740	$42,891,370
Sold for industrial use:						
Quantity ... M cubic feet	16,631,150	2,040,599	18,671,749	20,327,643	1,901,514	22,229,157
Value	$1,675,194	$646,923	$2,322,117	$2,107,883	$609,000	$2,716,883
Tar:						
Production ... gallons	374,660,061	44,919,588	419,579,649	509,885,368	44,520,848	554,406,216
Sales:						
Quantity ... do	257,646,294	44,674,728	302,321,022	300,488,889	44,045,493	344,534,382
Value	$12,805,834	$2,098,667	$14,904,501	$14,545,104	$2,040,630	$16,585,734
Average	$0.050	$0.047	$0.049	$0.048	$0.046	$0.048
Ammonia:						
Production (NH_3 equivalent of all forms) ... pounds	235,178,959	24,012,380	259,191,339	314,838,954	23,562,139	338,401,093
Liquor (NH_3 content):						
Production ... pounds	36,986,054	3,739,516	40,725,570	45,094,454	3,169,567	48,264,021
Sales ... do	37,717,784	3,735,136	41,452,920	44,915,616	3,119,193	48,034,809
Value	$1,259,717	$70,587	$1,330,304	$1,431,624	$49,255	$1,480,879
Sulfate:						
Production ... pounds	792,771,623	81,091,454	873,863,077	1,078,978,000	81,570,288	1,160,548,288
Sales ... do	826,102,787	90,516,920	916,619,707	1,075,488,293	78,413,540	1,153,901,833
Value	$9,701,695	$1,011,252	$10,712,947	$12,269,765	$883,877	$13,153,642
Crude light oil:						
Production ... gallons	119,226,736	4,332,874	123,559,610	167,279,063	3,684,136	170,963,199
Sales ... do	6,187,242	3,371,727	9,558,969	6,525,552	2,858,355	9,383,907
Value	$516,725	$289,082	$805,807	$510,753	$217,012	$727,765
Light oil derivatives:						
Production ... gallons	98,423,768	748,104	99,171,872	139,218,163	587,028	139,805,191
Sales ... do	94,791,190	758,123	95,549,313	132,831,952	603,464	133,435,416
Value	$12,031,361	$109,315	$12,140,676	$16,217,241	$89,208	$16,306,449
Naphthalene, crude and refined:						
Production ... pounds	24,338,427	604,587	24,943,014	47,763,810	696,361	48,460,171
Sales ... do	24,848,013	608,387	25,456,400	45,850,071	701,361	46,551,432
Value	$430,385	$7,269	$437,654	$720,216	$7,731	$727,947
All other products, value	$2,825,690	$149,287	$2,974,977	$3,848,597	$106,966	$3,955,563

[1] Includes all byproduct ovens built by city gas companies, some of which are operated in conjunction with coal, oil, and water gas plants. Does not include independent byproduct plants, which may sell gas to public utility companies for distribution.

FUEL BRIQUETS AND PACKAGED FUEL [1]

By G. S. Goodman

SUMMARY OUTLINE

The domestic production of fuel briquets in the past 33 years has risen from 66,524 net tons in 1907 (the first year of record) to 1,107,720 [2] net tons in 1939; the potential annual capacity of the 31 fuel-briquet and 103 packaged-fuel plants active in 1939 is three times this amount.

Compared with the production of Germany and France—the most important fuel-briquetting countries of the world, producing 56 million and 8 million net tons, respectively, in 1938—the United States production seems small. Conditions that favor the successful operation of briquetting plants in Germany are the abundant supplies of brown coal, which can be briquetted without a binder to make a product that finds a ready domestic market.

The gradual development of the briquetting industry in the United States is significant because it reveals definite progress in utilization for domestic heating of the enormous stocks of slack and culm produced in mining operations and also that accumulated at the large Lake dock distribution centers. These coal fines were formerly wasted or sold at less than actual cost. The current trend of thought toward conservation of our National resources has directed attention [3] to the vast deposits [4] of low-rank bituminous and subbituminous coals and lignite in the United States, and to the rapidly diminishing known reserves of petroleum—which in the past 20 years has become such an important source of fuel and of energy.[5] Because of its convenience, fuel oil has replaced coal in the heating of many homes, but raw coal and coal processed into briquets remain cheaper and therefore are likely to continue as the chief fuels.

[1] Directories of fuel-briquetting and packaged-fuel plants operating in 1939 and names of manufacturers of equipment will be furnished on request by the Coal Economics Division, Bureau of Mines, Washington, D. C.

Data on the principal expenses in the manufacture of fuel briquets may be obtained from the Bureau of the Census, which collects and publishes such data in alternate years.

Briquets made from charcoal, wood wastes, and fruit pits are not included in the Bureau of Mines review.

[2] Includes 215,507 net tons of packaged fuel (treated separately in this report).

[3] Fieldner, A. C., Tryon, F. G., and Yancey, C. F., Energy Resources and National Policy, Nat. Resources Committee, Pt. III, sec. III, Conservation in Use, H. Doc. 160, 76th Cong., 1st sess., 1939, p. 376.

[4] Hendricks, T. A., Coal Reserves (with map showing coal fields of the United States): Reprint from Energy Resources and National Policy, 1939, Nat. Resources Committee, pp. 281–286.

[5] Tryon, F. G., and Simons, K. E., Relative Rate of Growth of Coal, Oil, and Water Power, 1889–1937: Bureau of Mines Minerals Yearbook, 1938, pp. 701–705.

Briquets are made in this country mostly from high-quality, low-volatile bituminous screenings or slack; of the lower-grade fuels, lignite has been used successfully, particularly by one briquetting company in North Dakota since 1929.

The production of packaged fuel in the past 5 years has risen from 25,244 tons in 1935 (first canvass made by the Bureau of Mines) to 215,507 tons in 1939, an eightfold increase in tonnage over 1935 and 34 percent over 1938. In 1937 it became a million-dollar industry, and in 1939 it rose to nearly 2 million.

Technologic developments.—Fieldner [6] states that public policy in the conservation of fuels should center on stimulation of research and wide dissemination of technological improvements. He [7] summarizes recent experimental work on fuel briquetting as follows:

> Experimental work in the United States showed that a binder of sodium silicate for anthracite culm, if modified by the addition of silicic acid gel, gave much greater resistance to disintegration by water.[8] Some Alabama lignites were successfully briquetted experimentally without a binder by preheating to 900° F., adding 8 percent water, and pressing at 13,500 pounds per square inch for 30 seconds.[9] Not all Alabama lignites could be so treated with like results, but with modification of the preheating and pressing treatments they gave satisfactory results. In Germany one of the large briquet plants, at the Hohenzollern mine at Beuthen, Upper Silesia, by using the Fohr-Kleinschmidt process, has reduced the amount of pitch required, eliminated cancer among the workmen, and made stronger briquets. Soft molten pitch instead of the powdered hard pitch previously used is atomized and sprayed under a pressure of 20 atmospheres on the coal, which has been preheated to 50° to 60° C.[10] At another plant an automatic apparatus for continuously recording the moisture content of coal for briquetting was installed; this is measured by means of variations in the capacity of an electrical condenser.[11] The principal factors affecting the mechanical strength and stability of brown-coal briquets and modern methods of manufacture are receiving special attention in Germany in view of the use of such carbonized briquets for the production of synthesis gas used in the manufacture of liquid fuels by the Fischer-Tropsch method.[12] Differences in the capillary networks of different coals have been found to influence the strengths of the briquets.[13] The nature of the capillary network is determined by vapor-pressure measurements. Trials of compounds of calcium, magnesium, barium, etc., mixed with coal in briquets for the purpose of fixing sulfur and preventing its emission during combustion showed that barium oxide was the best fixing agent.[14] The Canadian Department of Mines has published a comprehensive review of fuel briquetting which includes history, processes, binders, and the results of experimental work.[15]

The General Assembly of Illinois appropriated $85,000 in 1937 to demonstrate the feasibility of the Piersol [16] process of making smokeless

[6] Fieldner, A. C., Tryon, F. G., and Yancey, C. F., Energy Resources and National Policy: Nat. Resources Committee, Pt. III, sec. III, Conservation in Use; H. Doc. 160, 76th Cong., 1st sess., 1939, pp. 376–377.

[7] Fieldner, A. C., Developments in Coal Research and Technology in 1937 and 1938: Bureau of Mines Tech. Paper 613, 1940, pp. 29–30.

[8] Snell, F. D., and Kimball, C. S., Briquetting Coal with Sodium Silicate: Ind. Eng. Chem., vol. 29, 1937, pp. 724–726.

[9] Basore, C. A., Fuel Briquets from Alabama Lignite by Destructive Distillation at Low Temperatures and Briquetting the Residue without a Binder: Alabama Polytech. Inst., Eng. Exp. Sta. Bull. 8, 1937, 23 pp.; Chem. Abs., vol. 32, 1938, col. 1900.

[10] Brennstoff-Chemie (Improvements in Briquetting Bituminous Coal by the Fohr-Kleinschmidt Process): Vol. 18, 1937. pp. 75–76.

[11] Velten, O (Moisture Recorder for Briquet Coal): Braunkohle, vol. 36, 1937, pp. 535–569.

[12] Fritzsche, A. (Modern Methods for the Manufacture of Stable Brown-coal Briquets): Braunkohle, vol. 36, 1937, pp. 643–658, 665–676.

[13] Agde, G., and Vetter, K. E. (Influence of the Capillary Network of Crude Brown Coal on Its Briquetting Properties): Braunkohle, vol. 37, 1938, pp. 421–427; Chem. Abs., vol. 32, 1938, col. 9443.

[14] Yamada, K., and Sawamura, T., Fixation of Sulfur in Briquets: Jour. Fuel Soc. Japan, vol. 16, 1937, pp. 1309–1326; vol. 17, 1938, pp. 15–17; Chem. Abs., vol. 32, 1938, cols. 3123, 8107.

[15] Strong, R. A., Swartzman, E., and Burrough, E. J., Fuel Briquetting: Canada Dept. Mines and Resources, Mines and Geol. Branch, No. 775, 1937, 100 pp.

Knight, J. L., What Factors Are Important in Briquetting?: Coal Age, vol. 43, September 1938, pp. 34–35.

[16] Piersol, R. J., Briquetting Illinois Coals Without a Binder by Compression and by Impact: Illinois State Geol. Survey Rept. of Investigations 31, 1933, 70 pp.; Briquetting Illinois Coals Without a Binder by Impact: Illinois State Geol. Survey Rept. of Investigations 37, 1935, 75 pp.; Smokeless Briquets Impacted Without Binder from Partially Volatilized Illinois Coals: Illinois State Geol. Survey Rept. of Investigations 41, 1936, 30 pp.

briquets on a commercial scale from Illinois coals. A further appropriation of $95,000 was allotted for an applied research laboratory. The laboratory is expected to be completed by September 1940, and demonstrations of briquetting by the Piersol process are scheduled immediately thereafter. Comments on these proposed experiments have appeared in the various trade journals.[17]

A new type of briquet for heating orchards has been patented under the name of "Briquette Frost Fighter;" [18] this is unique in that the "briquette" is manufactured complete with container and kindling charge, making it immediately available in emergencies. Another advantage claimed is elimination of refilling—as the entire container, except the metal cover, is consumed, thus eliminating the necessity of refilling and considerably reducing labor costs. It is understood that plans are already under way for the construction of a plant for making these briquets on the Pacific coast.

Smoke tests [19] of packaged fuel made from high-volatile bituminous screenings from various sources are said to indicate a considerable reduction in smoke. Some of these experiments have been made with the thought of furnishing an answer to the smoke problem of St. Louis and other cities.

FUEL BRIQUETS

The salient statistics of the fuel-briquetting industry from 1935 to 1939 are summarized in the following table. Similar data for earlier years are to be found in annual issues of Mineral Resources and Minerals Yearbook, which include chapters on briquetting, beginning with 1907.

Salient statistics of the fuel-briquet industry in the United States, 1935–39

[Data regarding packaged fuel are given separately at end of this chapter]

Year	Production: Eastern States	Production: Central States	Production: Pacific Coast States	Production: Total	Imports	Exports[1]	Consumption[2]	Value of production (thousands of dollars)	Plants in operation	Average output per plant (thousands of net tons)	Average value per net ton, f. o. b. plant: Eastern States	Central States	Pacific Coast States
	Thousands of net tons												
1935	310	485	66	861	17	(1)	[1] 878	5,476	29	30	$4.48	$7.16	$9.29
1936	351	702	72	1,125	20	(1)	[1] 1,145	7,043	32	35	4.19	6.95	9.64
1937	271	636	89	996	7	25	978	6,394	31	32	4.19	7.01	8.94
1938	251	546	74	871	14	17	868	5,702	35	25	4.34	7.18	9.38
1939	243	574	75	892	1	13	880	5,802	31	29	4.23	7.15	8.96

[1] Exports not reported separately by Bureau of Foreign and Domestic Commerce prior to 1937.
[2] Production plus imports minus exports.

Production.—The production of fuel briquets in 1939 showed a total increase in tonnage of 2 percent for the entire country, principally in the Central States, where the production was 5 percent greater than in 1938 although there were fewer plants operating in 1939 in this region. This increase is notable when it is realized that 1939 temperatures averaged above normal yearly everywhere in the

[17] Mining and Metallurgy, January 1940, p. 35.
Beck, C. V., Smoke Abatement and Its Pitfalls: Coal Heat, vol. 37, No. 3, March 1940, pp. 8–10.
Business Week, Coal Mustn't Smoke: April 20, 1940, p. 49.
[18] Lamkin, William Lester, Portable Heater: U. S. Patent 2,165,390, July 11, 1939.
[19] Mitten, Ray F., Reducing Smoke by Means of Packaged Fuel: Coal Heat, vol. 37, No. 4, April 1940, p. 34; Can Smoke and Soot be Reduced when Bituminous Coals Are Hand-fired?: Mim. rept., 6 pp.

United States. Of the 16 States producing fuel briquets in 1939, all but 4 showed increases in production despite the fact that 4 less plants were operating than in the preceding year.

Reports received by the Bureau also indicate that several plants expect to start operations in 1940 or 1941.

A few fuel-briquet operators, making pillow and cube briquets, are selling part or all of their product in bags or cartons as an experiment; some 6,000 tons was so marketed in 1939. One operator re-

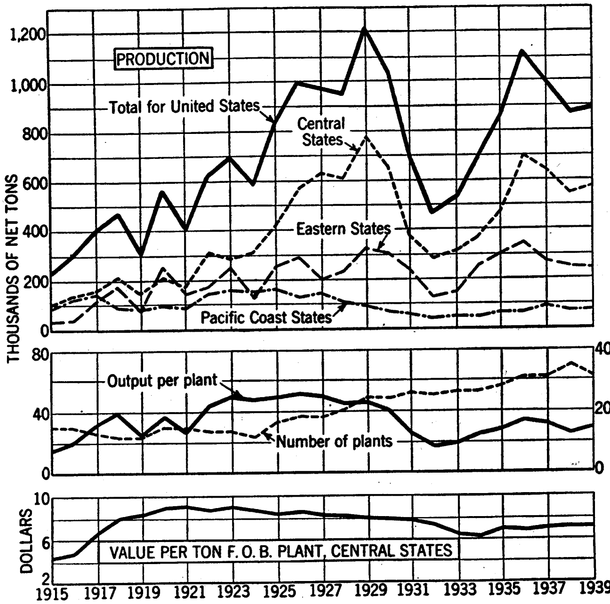

FIGURE 1.—Production of fuel briquets, number of plants in operation, and average value per ton, f. o. b. plant (Central States), 1915–39.

ported that his experiment in bagging briquets had not proved successful, owing to deterioration of the bags by mildew.

Fuel briquets produced in the United States, 1938–39

	1938			1939				
	Plants	Net tons	Value	Plants	Net tons	Value	Percent of change in— Tonnage	Percent of change in— Value
Eastern States	4	251,443	$1,090,055	4	243,429	$1,028,852	−3.2	−5.6
Central States	25	545,848	3,917,936	21	574,108	4,103,496	+5.2	+4.7
Pacific Coast States	6	73,969	693,899	6	74,676	669,318	+1.0	−3.5
	[1] 35	871,260	5,701,890	[1] 31	892,213	5,801,666	+2.4	+1.7

[1] 1938: 10 plants in Wisconsin; 3 each in Minnesota, North Dakota, and Washington; 2 each in California, Michigan, Nebraska, and West Virginia; and 1 each in Arkansas, Illinois, Massachusetts, Missouri, Ohio, Oregon, Pennsylvania, and Wyoming; 1939: 10 plants in Wisconsin; 3 in Washington; 2 each in California, Minnesota, Nebraska, and West Virginia; and 1 each in Arkansas, Illinois, Massachusetts, Michigan, Missouri, North Dakota, Ohio, Oregon, Pennsylvania, and Wyoming.

Wisconsin again produced about half of the annual output; the 10 plants in this State, 1 in Pennsylvania, and 2 in West Virginia produced 76 percent of the total tonnage of the country.

Fuel briquets produced in Wisconsin, 1934–39

Year	Plants	Net tons	Value	Year	Plants	Net tons	Value
1934	5	329,942	$2,174,168	1937	10	507,462	$3,639,183
1935	6	410,715	2,986,847	1938	10	422,281	3,085,873
1936	9	588,163	4,178,981	1939	10	430,554	3,158,859

In Washington 3 plants produced a total of 20,067 tons valued at $153,202. Output for each of the other 14 States producing briquets in 1939 cannot be published, as to do so would reveal operations of individual companies. However, in relative order of importance the States producing more than 20,000 tons in 1939 are Wisconsin, West Virginia, Pennsylvania, Oregon, Missouri, North Dakota, Minnesota, and Washington.

Monthly production of fuel briquets in the United States, 1937–39, in net tons

Month	1937	1938	1939	Month	1937	1938	1939
January	140,969	141,397	113,698	August	43,389	51,098	57,267
February	92,816	79,414	99,195	September	87,153	78,128	78,012
March	47,872	36,556	58,840	October	128,266	87,446	113,315
April	36,541	28,806	34,001	November	113,809	99,651	89,465
May	71,077	49,599	51,384	December	135,894	120,351	83,579
June	57,936	61,531	71,273				
July	40,208	37,283	42,184		995,930	871,260	892,213

January and October were the months of highest production in 1939, but the output did not fluctuate as markedly from month to month as in former years. Production in October normally is high in anticipation of winter demand; the marked decreases in November and December are directly traceable to the abnormally warm winter weather, particularly in the north-central sections, where departures from normal were as high as 13.7°. Of the 31 active plants, 18 operated every month in the year, 10 between 8 and 11 months, and 3 less than 5 months.

Value.—The sales realizations on briquets in the scattered producing centers in a given year vary considerably. An average value per ton for the entire industry therefore is of doubtful significance because of the different conditions under which briquets are manufactured in various parts of the country. The most important factors that influence the value per ton at any plant are probably cost of raw materials and prices of competing fuels. Hence, the general trend of fuel-briquet prices [20] from year to year is indicated best in this review by the average values in the Eastern, Central, and Pacific Coast States, as shown in the last three columns of the foregoing table of salient statistics.

These figures are not the prices paid by the consumers. Some plants are distant from the markets they serve, and to the value at

[20] Retail fuel-briquet prices for certain cities are issued by the Retail Price Division, Bureau of Labor Statistics, Department of Labor, Washington, D. C., in their releases entitled "Retail Fuel Prices by Cities."

the plant must be added transportation charges and the margin of the wholesaler or retailer, sometimes both.

The total value of fuel briquets manufactured in 1939 was $5,801,666 f. o. b. plant, an increase of $99,776 or 2 percent compared with 1938.

In the eastern part of the country the average value of $4.23 per ton is relatively low because the entire output comes from plants in the low-volatile bituminous fields of West Virginia and in the anthracite region of Pennsylvania, where the freight charges are not an important item in the cost of the raw fuel. In the Central States most of the raw fuel comes from the Lake docks, and the average value of $7.15 per ton reflects the freight charges. In the Pacific Coast States, where carbon residue from the manufacture of oil gas forms the greater part of the raw fuel used, the average value dropped from $9.38 in 1938 to $8.96 in 1939.

Number of plants.—Thirty-one plants reported commercial production in 1939; of these, one (in Michigan) reported for the first time. A plant in Minnesota, idle for several years, resumed operations in December. Three plants—one in Texas (in experimental operation in 1939), one in Minnesota, and one in North Dakota—expect to start commercial operations in the near future.

Fifteen plants were idle in 1939; 9 of these were also idle in 1938. Five went out of business in 1939, although one was active part of the year.

Size of plants.—The following table classifies the plants according to actual production as well as actual capacity; however, a better indication of the size of the plants is gained from their capacity, even though the latter is affected by seasonal variations in production.

The total annual capacity of the 31 active plants operating in 1939, as reported by the operators, is 3,161,000 net tons, well over three times the 1939 production of 892,213 tons.

Although fewer plants operated in 1939, the output of the individual plants generally increased. Eighteen plants, which operated every month in the year, produced 765,330 tons or 86 percent of the total production.

Classification of briquetting plants in the United States, 1938–39, by size of output and annual capacity

Output (net tons)	Plants		Annual capacity (net tons)	Plants	
	1938	1939		1938	1939
Less than 2,000	11	6	Less than 5,000	3	2
2,000 and less than 5,000	4	2	5,000 and less than 10,000	5	3
5,000 and less than 10,000	5	6	10,000 and less than 25,000	8	6
10,000 and less than 25,000	5	8	25,000 and less than 100,000	12	13
25,000 and less than 100,000	8	6	100,000 and less than 200,000	2	2
100,000 and over	2	3	200,000 and less than 400,000	3	3
			400,000 and over	2	2
	35	31		35	31

Raw fuels.—The briquetting process is now applied to a wide variety of raw fuels ranging from North Dakota lignite (after carbonization at low temperature) to Pennsylvania anthracite, petroleum coke, and the carbon residues of oil gas and natural gas.

In the Eastern States low-volatile bituminous slack and Pennsylvania anthracite fines are the raw fuels used in briquet manufacture. Plants in the Central States use virtually all the fuels, their selection depending on their availability to the point of manufacture.

In the Pacific Coast States petroleum coke and the carbon residues from the manufacture of oil gas and from the pyrolysis of natural gas are the raw fuels now used. In previous years considerable bituminous coal was used in this region, particularly by the Pacific Coast Coal Co. of Seattle, Wash., which had been engaged in briquet manufacture from 1914 till May 1939, when it closed its plant permanently. The operations of this plant at one time reached an annual tonnage of over 100,000 tons.

The decrease in briquetting operations in the Pacific Northwest during the past 20 years may be attributed to changing conditions in the fuel market owing to the consumer trend toward cheaper grades of coal, to the introduction of coal stokers and oil burners, and to competition with new types of briquets made from oil and gas residues.

Ten operators reported washing a total of 359,605 net tons of Pennsylvania anthracite and bituminous coal before making it into briquets.

One large plant in Wisconsin reported making two kinds of briquets—one of Pennsylvania anthracite exclusively and the other a mixture of low-volatile bituminous and Pennsylvania anthracite. Another operator in Nebraska also makes two kinds—one of petroleum coke and the other of semianthracite.

Classification of fuel-briquetting plants in the United States in 1939, by kinds of raw fuel used

Kind of raw fuel used:	Plants
Anthracite or semianthracite fines exclusively	5
Mixture of anthracite and bituminous	5
Bituminous:	
Low-volatile	12
High-volatile	2
Semicoke (lignite char)	1
Mixture of petroleum coke with semianthracite	1
Residual carbon from pyrolysis of natural gas	1
Residual carbon from manufacture of oil gas	2
Petroleum coke	4
	[1] 31

[1] Two plants made two kinds of briquets; hence the sum of these items exceeds the total number of plants.

Raw fuels used in making fuel briquets in the United States, 1938–39

	Net tons		Percent of total	
	1938	1939	1938	1939
Anthracite and semianthracite culm and fine sizes	200,347	196,758	23.9	23.5
Bituminous and subbituminous slack	505,917	503,431	60.5	60.2
Residual carbons from oil-gas manufacture and natural-gas pyrolysis; petroleum coke; and semicoke (lignite char)	130,143	136,213	15.6	16.3
	836,407	836,402	100.0	100.0

The success of a briquetting plant depends largely on its location with relation to the source of the raw-fuel supply and to the consuming market for the finished product, freight rates, cost of raw fuel, and prices of competing fuels to the consumer. In 1939 the plants drawing upon the nearby Lake docks for their raw fuel produced about 450,000 tons or about half of the total output; those near coal mines, about 280,000 tons; and those near petroleum refineries and gas plants, about 100,000 tons.

Binders and recarbonization.—Asphaltic pitch continues to be the preferred binder in the briquetting of coal and petroleum coke. Two plants briquetting the carbon residue from the manufacture of oil gas and one plant using low-volatile bituminous coal used no binder. The percentage of binder by weight ranged from less than 5 to more than 9 percent; the majority of plants used 5 to 7 percent.

Partial recarbonization to drive off smoke caused by the binder was reported by one operator using Pennsylvania anthracite as raw fuel.

Classification of briquetting plants in the United States in 1939, by type and percent of binder used

Type of binder	Plants	Ratio of binder to raw fuel (by weight)	Plants
Asphaltic pitch	22	Less than 5 percent	4
Mixed pitches	2	5 and less than 7 percent	17
Petroleum asphalt	2	7 and less than 9 percent	4
Asphalt and starch	1	9 percent and over	3
Starch	1	No binder	[1] 3
No binder	[1] 3		
	31		31

[1] Two plants use residual carbon from manufacture of oil gas, and one uses bituminous coal as raw fuel.

Weight and shape.—In 1939 all but 2.2 percent of the total production was made in pillow-shape and cylindrically briquets weighing less than 5 ounces.

Pillow-shape briquets seem to be the most popular in the United States; 24 of the 31 active plants made briquets of this type. Of the other plants, three made large cubes, two cylindrical briquets, one 3 types—pillow, cube, and cylindrical; and one both pillow and cube.

Prevailing weight of briquets produced in the United States in 1939

Weight (ounces)	Plants	Production: Net tons	Production: Percent of total	Weight (ounces)	Plants	Production: Net tons	Production: Percent of total
Less than 2	4	55,254	6.2	5 and under 6	1	19,568	2.2
2 and under 3	12	496,773	55.7	6 and under 10	1		
3 and under 4	5	220,225	24.7	10 and under 16	--------		
4 and under 5	6	100,393	11.2	16 and under 25	4		
					[1] 31	892,213	100.0

[1] 4 plants made briquets of more than 1 size; hence the sum of the items exceeds the number of active plants.

Distribution.—In 1939 fuel briquets were shipped into 38 States, Alaska, the District of Columbia, and Canada. Wisconsin was the largest consumer of fuel briquets in 1939; other States consuming more than 50,000 tons in 1939 were, in order of importance: Minnesota, North Dakota, South Dakota, and Michigan.

Fuel briquets of domestic manufacture consumed in the United States and exported to Canada, 1938–39, in net tons

Shipped into—	1938	1939	Shipped into—	1938	1939
Alaska	28	70	New Hampshire	1,798	1,794
Arkansas		147	New Jersey	1,025	992
California	7,551	12,829	New York	26,804	22,807
Connecticut	1,218	1,467	North Carolina	8,706	9,373
Delaware	163	249	North Dakota	56,728	60,475
District of Columbia	418	651	Ohio	27,637	27,791
Florida	492	368	Oklahoma		135
Georgia	28	123	Oregon	36,189	32,606
Idaho	1,340		Pennsylvania	11,015	10,706
Illinois	30,914	28,139	Rhode Island	4,792	4,305
Indiana	11,985	14,175	South Carolina	16,654	1,827
Iowa	23,618	22,580	South Dakota	35,542	56,961
Kansas	4,212	4,888	Texas		155
Kentucky	2,571	3,416	Vermont	330	290
Maine	786	3,810	Virginia	13,553	13,965
Maryland	2,602	2,442	Washington	21,210	25,048
Massachusetts	28,971	34,615	West Virginia	299	192
Michigan	59,827	54,051	Wisconsin	187,407	198,084
Minnesota	195,222	189,421	Wyoming	1,500	1,455
Missouri	7,961	9,341	Canada [1]	17,031	14,132
Montana		34			
Nebraska	19,272	24,476		867,399	890,385

[1] As reported by the operators to the Bureau of Mines; official figures on imports and exports are given in following tables.

Imports and exports.—Imports of fuel briquets have ceased since the beginning of the war in September 1939. One shipment of 1,344 net tons, valued at $5,572, from Belgium to Massachusetts, was received in February. Exports dropped in 1939 to 12,756 net tons valued at $97,725—all but 201 tons destined for Canada.

Briquets (coal and coke) and other composition coals for fuels imported for consumption in the United States, 1935–39

Year	Net tons	Value	Year	Net tons	Value
1935	16,779	$73,992	1938	13,814	$67,366
1936	20,350	80,210	1939	1,344	5,752
1937	6,674	28,549			

Briquets (coal and coke) exported from the United States, 1938–39, by countries and customs districts

Country	1938		1939		Customs district	1938		1939	
	Net tons	Value	Net tons	Value		Net tons	Value	Net tons	Value
Asia			1	$12	Arizona			22	$313
Bermuda			1	13	Buffalo	11,832	$87,170	8,600	65,158
Canada	16,690	$123,278	12,375	94,852	Dakota	(1)	10	36	640
Chile			28	574	Duluth and Superior	79	699	222	1,632
Mexico	2	31	24	338	Maine and New Hampshire	30	246		
Netherland West Indies			34	438	Michigan	941	4,511	589	3,752
Peru			112	1,485	New York	1	38	177	2,535
Venezuela			1	13	St. Lawrence	3,482	27,662	2,770	22,204
					San Diego	2	31	2	25
					Washington	325	2,942	158	1,466
	16,692	123,309	12,576	97,725		16,692	123,309	12,576	97,725

[1] Less than 1 ton.

World production.—Owing to the war, official data for 1938 and 1939 are less complete than usual; such revisions as are possible will be made in forthcoming issues of this series.

The world production of fuel briquets in 1938 reached a high of about 65 million metric tons, of which about 51 million were produced by Germany, about 7.5 million by France, 1.7 million by Belgium, 1.3 million by The Netherlands, and about 1 million by the United States.

United States production, as compared with world production of fuel briquets, has risen from less than 0.50 percent in 1913 to nearly 1.5 percent in 1938.

World production of fuel briquets, 1935–39, by countries, in metric tons

[Compiled by M. T. Latus]

Country [1]	1935	1936	1937	1938	1939
Algeria	73,200	60,885	68,682	(2)	(2)
Australia: Victoria [3]	292,866	363,340	396,760	420,704	(2)
Belgium	1,368,610	1,559,890	1,849,280	1,712,280	[4] 1,525,790
Bulgaria	43,015	41,802	47,106	85,770	(2)
Czechoslovakia:					
Coal	408,539	414,896	459,680	(2)	(2)
Lignite	188,466	189,304	264,482	(2)	(2)
Eire (Irish Free State)	(2)	2,745	10,725	20,501	(2)
France	7,998,500	8,518,480	8,321,000	7,475,000	(2)
Germany:					
Coal	5,567,508	6,044,310	6,785,537	6,897,245	(2)
Lignite	32,837,070	36,074,489	41,951,141	44,007,268	(2)
Hungary	334,766	317,916	373,519	441,081	(2)
Indochina	71,118	104,644	132,225	131,558	(2)
Italy	38,710	46,533	58,860	51,047	(2)
Netherlands:					
Coal	1,087,349	1,119,585	1,277,305	1,262,716	1,269,000
Lignite	31,352	31,190	49,539	60,543	68,000
Netherland India	46,263	56,347	55,349	82,123	(2)
New Zealand	10,669	21,445	31,582	29,947	(2)
Poland	192,288	167,416	209,347	222,531	(2)
Portugal	[5] 170	[5] 850	7,772	19,865	(2)
Rumania	239,033	220,461	262,330	245,568	(2)
Spain	814,316	(2)	(2)	(2)	(2)
Tunisia	58,696	79,138	82,805	86,478	(2)
Turkey	(2)	(2)	14,761	37,285	(2)
United Kingdom	870,786	725,234	826,600	507,415	(2)
United States [6]	803,717	1,080,814	1,035,970	936,402	1,004,902
Yugoslavia	18,365	13,350	61,323	100,945	(2)
Total [7]	53,395,372	57,255,064	64,633,680	64,834,272	(2)

[1] In addition to the countries listed, briquets are produced in Canada and New Caledonia, but data of output are not available.
[2] Data not available.
[3] Data for year ended Mar. 31 of year stated.
[4] Incomplete figures.
[5] From domestic coal only.
[6] Includes packaged fuel as follows: 1935, 22,901 tons; 1936, 60,261 tons; 1937, 132,482 tons; 1938, 146,012 tons; 1939, 195,504 tons.
[7] Totals incomplete, representing sum of figures given in table only.

PACKAGED FUEL [21]

Packaged fuel consists of 3- to 4-inch cubes (usually six to a package), wrapped tightly in heavy paper and sealed with gummed tape. It is made from various types of high-quality coal or coke screenings, usually mixed with a neutral binder. The majority of packaged-fuel manufacturers use shipped-in coal from the mines or Lake docks; some, however, use the accumulated screenings in coal dealers' yards and others both shipped-in and "yard" screenings.

This fuel has achieved popularity because of its cleanliness and convenience in handling and its appeal to the purchaser, who finds it

[21] For results of research and technologic developments in the fuel-briquetting and packaged-fuel industries see Technologic Developments, in first section of this report.

especially adapted to the home equipped with stoves or central heating. The success of the industry is due in no small degree to the close cooperation between the machine manufacturers and the operators.

At the request of the American Institute of Mining and Metallurgical Engineers, Ray F. Mitten,[22] of the C. M. Eberling Co., Cleveland, Ohio, reviewed briefly the packaged-fuel industry before members of the Coal Division of the Institute at its February (1940) meeting in New York City.

This industry, which began in 1932, has been canvassed by the Bureau of Mines each year since 1935. The results of these canvasses are included in the chapters on Fuel Briquets and Packaged Fuel in the Minerals Yearbooks since 1936.

The first canvass, covering 1935, revealed 25 packaged-fuel plants, which produced 25,244 net tons. The canvass for 1939 showed 103 plants in operation, with a production of 215,507 net tons valued at $1,866,751. This represents an eightfold increase in tonnage over 1935 and a 34-percent increase over 1938. The production in 1939 probably would have been even greater if it had not been for the abnormally mild winter of that year. These plants were reported to be equipped to produce an annual output of 700,000 tons.

The National Association of Packaged Fuel Manufacturers, whose membership is open to owners of all kinds of packaged-fuel equipment,[23] held several meetings in June and August 1939 in Chicago, Ill. The association plans to compile and disseminate information on technical methods and costs of manufacture of packaged fuel, general publicity, group and national advertising to broaden the field and further stimulate sales. In July 1939 the association issued a new organ called "Sales-Merchandizing Bulletin" and is pursuing an energetic program for the handling of trade problems. Late in 1939 it introduced a thermostat control, the "Packaged Fuel Comfort Regulator," for users of packaged fuel; this is being distributed by several members of the association.

Processes.—The Eberling process,[24] introduced about 5 years ago for the briquetting and wrapping of slack or screenings with a starch binder and further described in previous reports of this series, was used by 85 operations in 1939. This type of briquet is adapted primarily for local consumption. The processes used by the other operations are described briefly in the following paragraphs.

The Johnson Coal Cubing Co.,[25] of Detroit, Mich., uses a process and equipment of its own design, producing cubes bearing the trade-mark "Koal Pak," eight to a package, wrapped in heavy paper; in 1939 it also produced pillow-shape fuel briquets in bulk known as "Black Knight Fire Quets."

In the Glenn Smith process,[26] used in the manufacture of both bulk briquets and packaged fuel, the heated mixture of raw fuel and liquid binder is poured into molds under very high pressure. The resulting cubes are cooled on a conveyor that feeds them to the wrapping machine; this automatically wraps and labels the packages (eight

[22] Mitten, Ray F., The Development of the Packaged-fuel Industry: Presented before the American Institute of Mining and Metallurgical Engineers, New York meeting, February 14, 1940. (Mimeographed copies available upon application to Mr. Mitten.)

[23] Saward's Journal, August 19, 1939, vol. 22, No. 20, p. 307.

[24] Packaged Fuel by the Eberling Process: 1938 catalog issued by C. M. Eberling, 6002 Ellen Avenue, Cleveland, Ohio.

[25] Black Diamond, vol. 102, No. 7, April 8, 1939, p. 23.

[26] Black Diamond, vol. 100, No. 6, March 12, 1938, p. 60.

cubes to each package). Packaged-fuel operators using this process in 1939 sold part of their product unwrapped. A similar installation, completely automatic throughout, was completed in 1939 for the Cleveland Cliffs Iron Co. at Green Bay, Wis.; [27] commercial operations are scheduled for January 1940. This process also is used by four fuel-briquet companies in the Central States.

The Leemon process [28] was introduced commercially in 1939 by 13 packaged-fuel operators in Michigan, Wisconsin, and Ohio. Equipped with a mixture of slack and volatile binder, the machine produces under tremendous pressure 3- to 4-inch cubes, which are wrapped six to a package, averaging 190 to 200 packages to the net ton.

Production and value.—The 103 plants, most of them in the Central States, produced 215,507 net tons of packaged fuel in 1939. Michigan again led in tonnage, the number of plants in operation increasing from 21 in 1938 to 41 in 1939. Ohio, Wisconsin, and Minnesota followed in order.

Packaged fuel produced in the United States, 1938–39, by States

[The plants and production in this table are not included in the preceding fuel-briquet tables]

State	1938			1939		
	Plants	Net tons	Value	Plants	Net tons	Value
Central States:						
Idaho	1	(1)	(1)	1	(1)	(1)
Illinois	5	4,133	$42,555	5	3,998	$40,487
Indiana	5	12,060	87,667	5	12,234	99,909
Iowa	2	(1)	(1)	2	(1)	(1)
Michigan	21	60,676	509,779	41	86,903	716,851
Minnesota	6	14,304	162,746	8	22,763	250,397
Missouri				1	(1)	(1)
Nebraska	1	(1)	(1)	1	(1)	(1)
Ohio	17	31,522	256,489	19	45,646	369,692
Wisconsin	9	24,662	210,473	12	28,637	241,946
Undistributed [2]		4,959	49,880		6,732	64,201
Total Central States	67	152,316	1,319,589	95	206,913	1,783,483
Eastern and Pacific Coast States	[3] 9	8,636	85,664	[4] 8	8,594	83,268
Total United States	76	160,952	1,405,253	103	215,507	1,866,751

[1] Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.
[2] Includes States entered as "(1)" above.
[3] Maine 2, Pennsylvania 1, Virginia 4, Oregon 1, and Washington 1.
[4] Maine 2, Pennsylvania 1, Virginia 4, and Washington 1.

The peak season of production is from October through April. In 1939 March and July, respectively, were the high and low months of production. In making comparisons between spring and fall production in 1939, one should remember that 13 new plants began operations in the fall.

Monthly production of packaged fuel in the United States, 1938–39, in net tons

Month	1938	1939	Month	1938	1939
January	22,095	27,722	August	2,252	4,605
February	17,124	28,047	September	13,198	14,743
March	15,710	28,532	October	19,671	26,280
April	13,673	25,621	November	23,271	25,524
May	7,074	5,417	December	25,323	26,981
June	789	1,180			
July	772	855		160,952	215,507

[27] Retail Coalman, vol. 76, No. 1, January 1940, pp. 14–15; Black Diamond, vol. 104, No. 3, February 10, 1940, pp. 14–15.
[28] Black Diamond, vol. 102, No. 12, June 17, 1939, p. 15.

Number of plants.—There were 103 active packaged-fuel operations in 1939, of which 29 reported for the first time; 13 of the new operations started in the fall of the year. All but one of the new plants are in the Central States. Several of the smaller operators reported using their plants only to utilize accumulated yard screenings and to take up labor slack.

Eleven plants were idle in 1939 (eight of these were also idle in 1938). Nine companies—all in the Central States—went out of business in 1939; of these, seven sold their equipment to new entrants in this field and one is experimenting in research work on binders.

Five additional plants were under construction in 1939 and expect to start commercial operations in 1940.

Size of plants.—Eighty-five plants produced less than 3,000 tons each during the year. A number of plants, however, produced a considerably larger tonnage, the Johnson Coal Cubing Co., of Detroit, Mich., leading with the highest recorded production since 1937.

Reports submitted on individual capacities indicate that the 103 active plants were equipped to produce about 700,000 tons if operated at full capacity throughout the year.

Classification of packaged-fuel plants in the United States, 1938–39, by size of output and annual capacity

Output (net tons)	Plants		Annual capacity (net tons)	Plants	
	1938	1939		1938	1939
Less than 500	17	[1] 28	2,000 and less than 5,000	38	58
500 and less than 1,000	14	18	5,000 and less than 10,000	26	31
1,000 and less than 3,000	30	39	10,000 and less than 15,000	6	5
3,000 and less than 5,000	10	10	15,000 and less than 25,000	2	5
5,000 and less than 10,000	3	6	25,000 and less than 40,000	3	3
10,000 and less than 25,000	1	1	40,000 and less than 60,000		
25,000 and over	1	1	60,000 and over	1	1
	76	103		76	103

[1] Thirteen of these are new plants, which started operations in the fall of 1939.

Raw fuels.—Low-volatile bituminous slack (194,023 net tons) was the principal raw fuel used by 93 operators; 18,018 tons of petroleum coke, high-volatile bituminous, Oklahoma semianthracite, and Pennsylvania anthracite were used by the other operators, several reporting the use of mixtures of these various fuels.

The use of shipped-in slack from the mines and Lake docks by the majority of the operators appears to be definitely established, its exclusive use being reported by 60 operators; however, 26 plants used both shipped-in slack and yard screenings; and 17 plants utilized only yard screenings.

Binders.—Cornstarches, averaging about 15 pounds per ton of packaged fuel produced, are the principal binders. Eight plants reported the use of cement, asphalt, or glue; one, starch and cement; and one, starch and asphalt.

Several operators indicated an interest in obtaining more effective and cheaper binders.

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PEAT

By Joseph A. Corgan and A. L. Richardson

SUMMARY OUTLINE

The total production of peat in the United States in 1939, as reported by producers to the Bureau of Mines, was 55,483 short tons valued at $362,066—a substantial increase over 1938, when 45,933 tons valued at $286,127 were produced. Imports of peat moss in 1939 amounted to 78,611 short tons valued at $1,204,883, an increase over 1938 of approximately 13 percent in quantity and 11 percent in value. No exports were reported. Thus, the total quantity available for domestic consumption in 1939 (domestic production plus imports) was 134,094 tons, a gain of 18,652 tons compared with 1938. In this country peat is used primarily for soil improvement. As in past years, producers reporting in 1939 showed no record of the use of peat as fuel.

Every effort has been made to cover all commercial operations. A list showing the names and addresses of operators who reported production in 1939 to the Bureau of Mines has been prepared and will be furnished upon request to those who may be interested.

Reserves.—The known peat reserves in the United States are extensive. The total, calculated as air-dried peat, has been estimated to be 13,827,000,000 short tons,[1] centered chiefly in the Great Lakes region, in New England, and in the Atlantic and Pacific Coast States. Three of the Great Lakes States—Minnesota, Wisconsin, and Michigan—together contain 75 percent of the reserves, while 14 percent of the country's total is in Florida. In the Pacific Coast region, California contains most of the known deposits.

About half of the States in the Union contain some peat reserves. All are not workable and vary in composition and characteristics. Taken together, however, they constitute an important asset to the natural resources of the country.

Production.—Commercial production of peat in 1939 was reported by 39 producers, in 15 States. As the following table indicates, the total output was 55,483 short tons valued at $362,066—an increase over 1938 of 21 percent in quantity and 27 percent in value. The average per-ton value, at the plant, in 1939 was $6.53, while in 1938 it was $6.23. The trend of peat production and value from 1908 to 1939 is shown graphically in figure 1.

[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.

Peat produced in the United States, 1935–39

Year	Short tons	Value	Year	Short tons	Value
1935	37,060	$199,377	1938	45,933	$286,127
1936	46,126	266,883	1939	55,483	362,066
1937	51,223	305,156			

The producing States, in order of output, were: New York, New Jersey, Michigan, California, Connecticut, Florida, Iowa, Ohio, Maine, Colorado, Minnesota, Washington, Pennsylvania, Massachusetts, and New Hampshire.

Peat humus comprised 51 percent of the total production; reed or sedge peat, 38 percent; and peat moss and other, 11 percent. Peat humus was produced in 10 States, reed or sedge peat in 7 States, and peat moss in 6 States.

One plant reported production of kiln-dried peat, 1 of air-dried peat, 8 of cultivated peat, 28 of shredded peat, and 17 of raw peat.

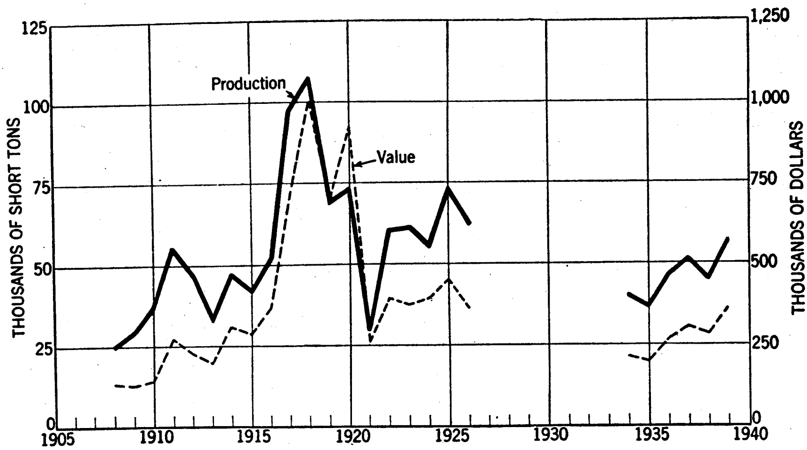

FIGURE 1.—Quantity and value of peat production, 1908–39. No data are available for the period 1927–33.

Uses.—The principal use of peat in the United States is for improving soil. Of the sales in 1939, 90 percent (41,964 tons) was used for this purpose. Two percent of the sales went for mixed fertilizers and 8 percent for other uses, such as improving lawns and golf courses, and in nurseries and greenhouses. Peat also is used as litter for barns; as packing material for plants, eggs, shrubs, vegetables, fruits, and fragile articles; and as an insulating material. No sales of peat for fuel were reported. In European countries, especially in Eire, peat is used extensively for fuel and power purposes, owing to lack of a plentiful supply of other fuels. In this country, with its ample supplies of higher-grade fuels available at reasonable cost, peat has been unable to compete successfully in the fuel market.

United States Government specifications.—There is a great difference in the kinds of peat, both in character and value, for specific uses. In purchasing its peat requirements, the Federal Government has certain specifications that must be met. These are shown below: [2]

Peat.—Reed muck or sedge muck (peat humus); dark brown to black; granulated; uniform in composition and size; slightly acid to slightly alkaline in reaction (pH 5.0 to 7.5); free of lumps; low in ash content (8 to 15 percent); low in content of woody material, and mineral matter such as sulfur and iron; water-absorbing capacity ranging from 100 to 350 percent; water content not to exceed 60 percent by weight on oven-dried basis; moisture content in excess of 60 percent may be accepted, but settlement will be made on basis of weights corrected to 60 percent moisture content.

Reed peat or sedge peat; brown; raw, shredded or granulated; low ash content (5 to 10 percent); low in mineral material such as iron and sulfur; low in content of woody material; water-absorbing capacity ranging from 350 to 800 percent; water content not to exceed 50 percent by weight on oven-dried basis; if satisfactory in other respects, moisture content in excess of 50 percent may be accepted, but settlement will be made on basis of weights corrected to 50 percent moisture content: Acid grade; reaction may vary from 4.5 to 5.5 pH; slightly acid to slightly alkaline grade, reaction may vary from 5.5 to 7.5 pH.

Imports.[3]—The quantity of peat moss imported in 1939 was 78,611 tons, an increase over 1938 but 10 percent less than the record year 1937, when 86,871 tons was imported. Germany, as for many years in the past, was the chief source of imports, supplying 28,127 tons (36 percent of the total). It should be noted, however, that in 1936 and 1937 Germany contributed 60 and 61 percent, respectively, of our total peat imports. The Netherlands was next in order of importance, with 17,824 tons, a gain of 166 percent over 1938. Sweden and Canada were third and fourth.

Peat moss was imported into Continental United States through 27 customs districts, indicating the wide distribution of its use in this country. The New York district received 25 percent of the total imports.

For the first time in several recent years, the average per-ton value of imported peat moss has declined from the preceding year. It was $15.33 in 1939 compared with $15.72 in 1938, evidently owing to the decrease in imports of German peat, whose reported value is comparatively high, and the increase in supplies from the Netherlands, which are lower in value. The average value varies considerably with the country of origin.

Peat moss imported for consumption in the United States, 1935–39

Year	Short tons	Value	Year	Short tons	Value
1935	54,547	$677,513	1938	69,509	$1,092,942
1936	75,066	955,807	1939	78,611	1,204,883
1937	86,871	1,219,127			

[2] Procurement Division, General Schedule of Supplies, Agricultural Implements and Materials (Class 70), for the period Nov. 1, 1939, to Oct. 31, 1940, prepared under direction of the Secretary of the Treasury, Washington, D. C., p. 5.

[3] Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Peat moss imported for consumption in the United States, 1938–39, by countries

Country	1938		1939	
	Short tons	Value	Short tons	Value
Canada	3, 989	$91, 167	6, 922	$147, 342
Denmark	1, 239	17, 293	2, 396	44, 971
Estonia	1, 486	26, 514	1, 424	28, 566
Finland	77	1, 659	153	2, 949
Germany [1]	36, 381	525, 564	28, 127	389, 597
India, British			110	873
Latvia	1, 604	34, 166	1, 701	33, 820
Mexico			15	564
Netherlands	6, 709	65, 968	17, 824	185, 828
Newfoundland and Labrador			1	27
Norway	744	13, 325	625	16, 262
Poland and Danzig [1]	222	3, 145	764	11, 436
Sweden	15, 127	282, 284	17, 247	322, 285
U. S. S. R.[1]	1, 433	25, 455	517	9, 593
United Kingdom	498	6, 402	785	10, 770
	69, 509	1, 092, 942	78, 611	1, 204, 883

[1] For statistical purposes, trade with Danzig and that part of Poland occupied by Germany has been included with Germany and trade with that part of Poland occupied by U. S. S. R. has been included with U. S. S. R., after Nov. 16, 1939.

World production.—The following table would seem to indicate that the world production of peat is increasing. Several countries show a material increase since 1936. Complete data regarding world production of peat are difficult to obtain. Some countries evidently do not have information on quantities produced. The data in this table are the latest available and may be of interest to those concerned with world production of peat.

World production of peat, 1936–38, by countries

[Compiled by M. T. Latus]

Country [1]		1936	1937	1938
Canada (fuel)	metric tons	1, 217	434	454
Eire [2]	do	(3)	3, 646, 603	(3)
Estonia	do	106, 659	169, 779	185, 600
Finland	bales	231, 661	294, 913	(3)
Do	cubic meters	8, 201	7, 653	(3)
Do	metric tons	18, 249	21, 560	(3)
France	do	17, 050	(3)	(3)
Italy	do	3, 194	3, 385	(3)
Latvia:				
Litter	cubic meters	46, 127	97, 718	90, 369
Waste	do	15, 876	22, 484	14, 901
Insulation	do	1, 604	2, 455	2, 440
Lithuania	metric tons	124, 000	142, 000	180, 000
Netherlands	do	(3)	(3)	800, 000
Sweden:				
Fuel	do	30, 743	34, 277	25, 711
Litter, baled	do	109, 349	115, 034	99, 998
Litter and "mull," unbaled	cubic meters	37, 067	38, 511	36, 578
"Mull" baled	metric tons	35, 916	32, 767	31, 959
Switzerland	do	7, 000	8, 000	10, 000
U. S. S. R	do	[4] 22, 286, 000	23, 822, 000	26, 460, 700
United States	do	41, 845	46, 468	41, 669

[1] In addition to the countries listed Argentina, Austria, Germany, Hungary, Norway, and Poland produce peat, but data of production are not available.
[2] About 60 percent of the farmsteads in the country depend entirely on peat fuel, the annual consumption of which is estimated at 6 to 8 million tons. About 50,000 tons of peat-moss litter and peat mull are manufactured annually in Eire, and some 10,000 tons of air-dried turf are used annually for power purposes. (The Mineral Position of the British Empire, London, 1937, p. 30.)
[3] Data not available. [4] Estimated.

CRUDE PETROLEUM AND PETROLEUM PRODUCTS[1]

By A. G. White, G. R. Hopkins, and H. A. Breakey

SUMMARY OUTLINE

World production of crude petroleum increased to 2,077 million barrels in 1939, a gain of 89 million barrels compared to 1938 and 38 million above the previous peak, attained in 1937.

The domestic petroleum industry improved in all its principal branches during 1939. Production of crude petroleum increased by 50 million barrels, but the relative position of the United States remained virtually unchanged at 61 percent of the world total. However, owing to a decrease of some 37 million barrels in domestic crude stocks, the available supply of domestic crude oil was relatively greater than the production figures would indicate.

The principal changes in world production in 1939 outside of the United States were an increase of 18 million barrels in Venezuela, a 4-million-barrel gain in Netherland India, and an increase of 8 million barrels in Soviet Russia. Production in Rumania continued to decline and was 15 million barrels less in 1939 than in 1935. Production in Mexico increased by over 4 million barrels, although it was still substantially below the 1937 level. The completion of new pipe lines in Colombia and eastern Venezuela promises to increase the production of these countries substantially in 1940.

The tremendous expansion in world oil production since 1914–18 has materially altered the character and sources of world supply. Russia and Rumania are still the chief producers in Europe, but other available sources have expanded. In 1914 war requirements had to be met mainly from the United States and Mexico, with the newly developed Persian fields furnishing minor amounts. Today Venezuela, Colombia, Trinidad, Iran (Persia), Iraq, Bahrein Island, and Saudi Arabia offer greatly augmented supplies.

[1] Data for 1939 are preliminary; detailed statistics with final revisions will be released later.

The opening of the European war in September 1939 had less effect on the oil industry of the United States than was anticipated. Industrial operations in the last quarter were stimulated by a rush of domestic orders to anticipate any war inflation in costs and prices, and this situation was evidenced by a very active fuel-oil market. The comparatively small decrease in total exports in 1939 was due primarily to reductions in crude exports earlier in the year. Possibly the most significant factor was that large foreign war demands did not materialize as many had anticipated and that refinery operations proved to be too optimistic and resulted in a large excess production of gasoline in the last quarter, although additions to fuel-oil stocks proved inadequate.

Operations during the first quarter of 1940 have, however, clarified the complexity of the changes in world oil consumption and in the sources of world oil supply in relation to our foreign trade in oil. World consumption of oil products has expanded so universally that much of the increase in war demands apparently may be met by restrictions of civilian consumption. Furthermore, important markets were cut off by blockade, and consumption in many neutral countries was reduced by scarcity of tankers and by a severalfold rise in tanker rates that increased the delivered cost of oil 2 to 3 cents per gallon. Legislative restrictions affecting credit and movement of American registry ships into the war zones have tended to divert the demand for oil to Caribbean sources, where new production in both Venezuela and Colombia has become available. As a result of these varied influences, our total oil exports were over 9 million barrels (23 percent) less in the first quarter of 1940 than in the same period of 1939.

The trend of domestic demand in the first quarter of 1940 also is significant in interpreting oil-industry operations during 1939. The lack of balance in the last quarter between refinery production and yields of gasoline and distillate fuel oils on the one hand and demand on the other resulted in an increase of over 11 million barrels for the year in gasoline inventories. This situation was accentuated further by unusually cold weather in the first quarter of 1940. All sources of heating-oil supply were strained to the utmost, including larger runs to stills, and on March 31, 1940, total inventories of finished and unfinished gasoline reached the all-time peak of 103.7 million barrels—16.6 million barrels above the level of the previous year. The proper seasonal balance between production of gasoline and heating oil and stocks has become one of the most acute problems of the industry and probably was the most important disturbing factor in 1939, a record year in the total demand for oil products.

The total demand for all oils in 1939—1,418 million barrels—set a new record some 87 million barrels above that in 1938 and 75 million above the previous high in 1937. Total exports—189 million barrels—were 5 million barrels less than in 1938 but still 16 million above 1937. The major factor in 1939 was the 8-percent increase in the domestic demand for all oils, which rose to 1,229 million barrels—92 million barrels greater than in 1938 and 59 million above the previous peak in 1937.

Total demand for all oils 1930–39

[Millions of barrels]

Year	Domestic demand	Exports	Total demand	Year	Domestic demand	Exports	Total demand
1930	926.4	156.5	1,082.9	1935	983.7	129.0	1,112.7
1931	903.2	124.4	1,027.6	1936	1,092.7	132.0	1,224.7
1932	835.5	103.3	938.8	1937	1,169.7	172.8	1,342.5
1933	868.5	106.7	975.2	1938	1,137.1	193.7	1,330.8
1934	920.2	114.5	1,034.7	1939 [1]	1,228.8	189.0	1,417.8

[1] Subject to revision.

Total stocks of all oils were reduced by over 42 million barrels—from 567 million at the close of 1938 to 525 million at the end of 1939. The major factor in this decline was the reduction of about 34 million barrels in refinable domestic crude stocks, caused primarily by a 2-week curtailment in State production allowables for the first half of August in the more important States east of California that had proration laws.

The total stocks of all oils probably were close to an economic minimum at the end of the year, although stocks of specific products were out of balance in some districts. A large excess of fuel-oil stocks, accumulated in 1938, remained unliquidated in California, while such stocks were relatively low east of California. Stocks of finished and unfinished gasoline generally were considered excessive and increased by over 11 million barrels during the year. Of this increase, 3 million were accumulated in California and over 8 million in districts east of California.

Salient statistics of crude petroleum, refined products, and natural gasoline, 1935–39

	1935	1936	1937	1938	1939 [1]
Crude petroleum:					
Domestic production ... thousands of barrels [2]	996,596	1,099,687	1,279,160	1,214,355	1,264,256
World production ... do	1,654,951	1,804,925	2,041,715	1,987,723	2,076,772
United States proportion of world production ... percent	60	61	63	61	61
Imports [3] ... thousands of barrels [2]	32,239	32,327	27,484	26,412	33,095
Exports [4] ... do	51,430	50,313	67,234	77,254	72,073
Stocks, end of period:					
Refinable crude ... do	[5] 314,855	[5] 288,579	[5] 306,826 [6] 305,091	274,958	238,910
California heavy crude ... do	(7)	(7)	14,505	16,467	13,330
Runs to stills ... do	965,790	1,068,570	1,183,440	1,165,015	1,237,840
Total value of domestic production at wells ... thousands of dollars	961,440	1,199,820	1,513,340	1,373,060	[8] 1,265,000
Average price per barrel at wells	$0.97	$1.09	$1.18	$1.13	[8] $1.00
Total producing oil wells in the United States, Dec. 31	340,990	349,450	363,030	369,640	(7)
Total oil wells completed in the United States during year	15,108	17,800	22,143	18,433	17,485
Refined products:					
Imports ... thousands of barrels [2]	20,396	24,777	29,673	27,896	25,804
Exports [4] ... do	77,557	81,681	105,600	116,474	116,909
Stocks, end of period ... do	[5] 223,361	[5] 226,595	[5] 253,413 [6] 239,632	259,665	256,249
Output of motor fuel ... do	468,021	516,266	571,727	569,162	607,941
Yield of gasoline ... percent	44.2	44.1	43.9	44.3	44.9
Completed refineries, end of year	632	572	551	538	(7)
Daily crude-oil capacity of refineries ... thousands of barrels [2, 9]	4,117	4,295	4,351	4,509	(7)
Average tank-wagon price (excluding tax) of gasoline in 50 United States cities ... cents per gallon [9]	12.02	12.63	[10] 10.53	[10] 10.43	[10] 9.58
Natural gasoline:					
Production ... thousands of barrels [2]	39,333	42,770	49,177	51,347	49,896
Stocks, end of period ... do	3,698	4,055	4,758	4,830	4,421

[1] Subject to revision. [2] 42 gallons. [3] As reported to the Bureau of Mines.
[4] Bureau of Foreign and Domestic Commerce; exports include shipments to Alaska, Hawaii, and Puerto Rico.
[5] California heavy crude and fuel oil included under refined products.
[6] For comparison with succeeding year. [7] Figures not available. [8] Estimated.
[9] American Petroleum Institute. [10] Dealer's net; comparable tank-wagon prices no longer available.

The domestic production of crude petroleum in 1939—1,264 million barrels—was supplemented by the importation of 33 million barrels of foreign crude and a reduction of 38 million barrels in the stocks of all crude oils. The resultant figure shows a total demand for all crude oils of 1,335 million barrels, comprising 72 million for export and 1,263 million for domestic requirements. As 5 million barrels less crude were exported in 1939 than in 1938, the increase in domestic demand was about 70 million barrels. The total demand for California crude oil being 228 million barrels—12 million less than in 1938—the increase in the demand for crude produced east of California and imported was 77 million barrels. The outstanding domestic factor, as regards sources of supply, was an increase of 66 million barrels in the demand for Illinois crude, or from a total demand of 23 million in 1938 to 89 million in 1939.

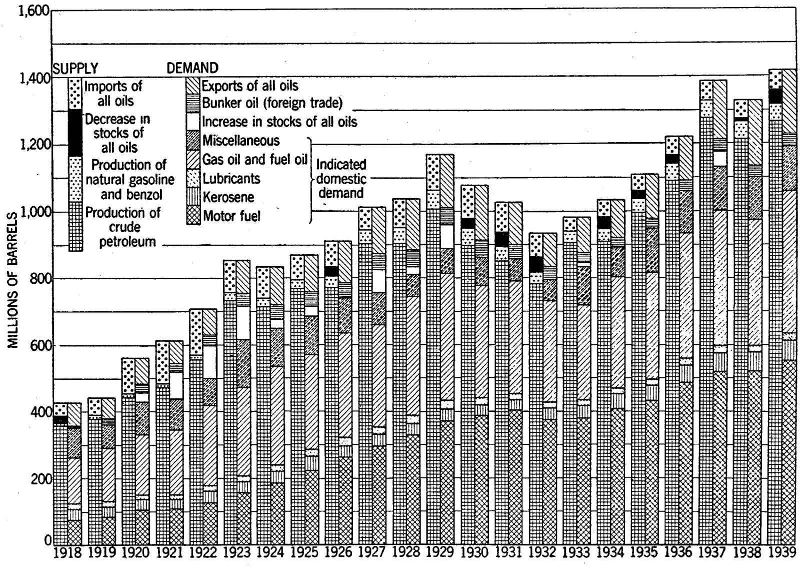

FIGURE 1.—Supply and demand of all oils, 1918–39

The total demand for motor fuel reached a new peak of 597 million barrels in 1939, an increase of 24 million barrels (4 percent). As exports declined by 5.5 million barrels, the increase in domestic demand was 29.5 million barrels (5 percent).

The total demand for distillate-fuel oils in 1939 increased to a new record of 171 million barrels. Exports increased over 2 million barrels and domestic demand by 22 million barrels. The domestic demand figure includes about 6 million barrels of transfers from crude oil and the net change in terminal stocks east of California, for which no corresponding data were available in 1938. With data for both years on the old basis, an increase of about 11 percent in domestic demand is indicated.

The total demand for residual fuel oils, including transfers from crude, increased from about 310 million barrels in 1938 to over 338 million in 1939. As exports decreased slightly, all of the gain was in domestic demand and amounted to about 29 million barrels (9 percent).

The total demand for kerosene rose from approximately 64 million barrels in 1938 to 69 million in 1939, a gain of almost 8 percent. The relative increase in exports was somewhat greater than in domestic demand. The growing demand for kerosene can be attributed largely to its uses for range oil and tractor fuel.

The total demand for lubricants increased by 16 percent, indicating a recovery from the decline in 1938 and an actual increase in demand over 1937. The export market was very strong, with an increase of about 28 percent over the previous year.

The variation in the relative rate of increase in demand for the several major products created a problem in the adjustment of refinery operations, with the net result of high gasoline inventories and low fuel-oil stocks at the end of the year.

The long-term trends in supply and demand are shown in figure 1.

Supply and demand of all oils in 1939, by months

[Including wax, coke, and asphalt in thousands of barrels]

	1939 [1]													1938 (total)
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
New supply:														
Domestic production:														
Crude petroleum	102,490	93,475	106,768	105,510	110,541	104,607	110,937	80,865	108,168	114,198	111,887	114,810	1,264,256	1,214,355
Natural gasoline	4,264	3,747	4,232	4,232	4,280	4,095	4,175	3,400	4,132	4,481	4,388	4,470	49,896	51,347
Benzol	185	170	192	162	130	174	191	210	225	259	267	275	2,440	1,764
Total production	106,939	97,392	111,192	109,904	114,951	108,876	115,303	84,475	112,525	118,938	116,542	119,555	1,316,592	1,267,466
Imports: [2]														
Crude petroleum	1,868	1,598	1,630	2,932	3,928	3,664	2,934	2,898	3,084	3,099	3,132	2,328	33,095	26,412
Refined products	1,657	1,821	2,229	1,841	2,659	2,609	2,637	2,785	1,771	2,205	1,833	1,757	25,804	27,896
Total new supply, all oils	110,464	100,811	115,051	114,677	121,538	115,149	120,874	90,158	117,380	124,242	121,507	123,640	1,375,491	1,321,774
Change in stocks, all oils	−990	−1,128	−1,696	+4,580	+1,156	−1,108	+3,588	−35,546	−7,343	−2,641	−1,294	+146	−42,276	−9,077
Demand:														
Total demand	111,454	101,939	116,747	110,097	120,382	116,257	117,286	125,704	124,723	126,883	122,801	123,494	1,417,767	1,330,851
Exports: [2]														
Crude petroleum	4,477	4,810	4,966	6,222	8,643	5,831	7,304	5,969	6,925	6.947	5,323	4,656	72,073	77,254
Refined products	8,494	7,335	10,849	9,243	12,128	10,834	9,622	11,429	10,797	9,805	7,816	8,557	116,909	116,474
Domestic demand:														
Motor fuel	37,767	34,595	42,520	43,977	49,547	49,812	50,508	53,828	49,347	49,687	47,275	43,694	552,557	523,003
Kerosene	5,980	5,901	5,201	5,042	4,368	3,570	3,710	4,436	4,638	5,019	6,023	6,613	60,501	56,360
Gas oil and distillate fuels [3]	16,963	14,767	13,923	10,856	7,523	7,187	6,938	8,157	10,010	10,908	14,417	17,168	138,817	117,449
Residual fuel oils [3]	28,443	25,589	28,436	24,472	25,047	23,923	23,442	25,407	26,966	28,323	29,453	31,436	320,937	291,833
Lubricants	1,609	1,653	1,987	1,770	2,132	1,902	1,982	1,963	2,207	2,656	1,927	1,825	23,613	21,233
Wax	74	97	73	52	102	70	62	73	116	144	142	158	1,163	995
Coke	530	605	646	394	587	578	454	844	433	793	628	618	7,110	5,589
Asphalt	1,061	833	1,269	1,840	2,714	2,834	3,048	3,532	3,326	2,986	2,022	1,413	26,878	24,155
Road oil	173	180	228	267	695	1,210	1,585	1,576	1,072	577	212	71	7,846	7,847
Still gas (production)	5,081	4,629	5,376	5,386	5,798	5,768	5,920	5,925	5,609	5,970	5,756	5,761	66,979	65,890
Miscellaneous	173	153	187	181	214	205	182	211	171	173	167	206	2,223	1,776
Losses and crude as fuel	629	792	1,086	395	884	2,533	2,529	2,354	3,106	2,895	1,640	1,318	20,161	20,993
Total domestic demand	98,483	89,794	100,932	94,632	99,611	99,592	100,360	108,306	107,001	110,131	109,662	110,281	1,228,785	1,137,123

Stocks:														
Refinable crude petroleum in U. S.	272,346	273,416	276,355	278,565	278,087	273,314	270,570	238,479	234,555	230,854	234,027	238,910	238,910	274,958 [4] 273,560
Heavy crude petroleum in Calif.	16,356	16,360	15,814	15,198	14,492	14,207	14,375	14,253	14,085	14,070	13,664	13,330	13,330	16,467
Natural gasoline	4,647	4,708	4,721	5,484	6,212	6,749	7,123	6,624	5,891	5,140	4,579	4,421	4,421	4,830
Refined products [3]	272,707	270,444	266,342	268,565	270,177	273,590	279,380	276,546	274,028	275,854	272,354	268,109	268,109	259,665 [4] 272,189
Total, all oils	566,056	564,928	563,232	567,812	568,968	567,860	571,448	535,902	528,559	525,918	524,624	524,770	524,770	555,920 [4] 567,046

[1] Subject to revision. [2] Imports of crude petroleum as reported to Bureau of Mines; all other imports and exports from Bureau of Foreign and Domestic Commerce.
[3] For figures to compare with 1938 see pages 1014 and 1016, respectively. [4] For comparison with 1939.

RESERVES

The proved oil reserves of the United States as of January 1, 1940, were estimated at 18,483 million barrels in a report prepared by the Committee on Petroleum Reserves of the American Petroleum Institute. This estimate may be subject to later revision. It presents only the quantity of crude oil that may be extracted by present known methods from fields completely developed or drilled or explored thoroughly enough to permit reasonably accurate calculations. The following table shows the previous estimates of reserves by this committee, the data for January 1, 1935, 1937, 1938, and 1939, being final and those for 1940 preliminary.

Estimates of proved oil reserves in the United States on January 1, 1935 and 1937–40, by States [1]

[Millions of barrels]

State	1935 [2]	1937 [2]	1938 [2]	1939 [2]	1940 [3]
Eastern States:					
Illinois	37	28	59	432	382
Indiana	5	3	7	6	14
Kentucky	50	39	38	49	44
Michigan	64	63	46	74	51
New York	75	66	45	40	35
Ohio	40	32	30	33	32
Pennsylvania	340	307	218	200	183
West Virginia	40	32	28	50	46
	651	570	471	884	787
Central and Southern States:					
Arkansas	103	87	171	332	320
Kansas	390	590	607	763	726
Louisiana	513	657	1,049	1,180	1,173
New Mexico	451	581	739	703	687
Oklahoma	1,235	1,384	1,311	1,206	1,063
Texas	6,643	8,343	9,692	10,180	9,768
	9,335	11,642	13,569	14,364	13,737
Mountain States:					
Colorado	16	19	19	22	20
Montana	102	115	109	99	94
Wyoming	267	260	280	327	306
	385	394	408	448	420
Pacific Coast States: California	3,261	3,251	3,303	3,710	3,532
Other States					7
Total United States	13,632	15,857	17,751	19,406	18,483

[1] From reports of Committee on Petroleum Reserves, American Petroleum Institute.
[2] Final revised estimates of the amount of crude oil which may be extracted by present methods from fields completely developed or sufficiently explored to permit reasonably accurate calculations.
[3] Subject to revision.

Other estimates of reserves published by trade journals or made by individuals have been considerably above or below these estimates. The main factor of importance, however, is that the rapidly growing demand for oil products tends to offset the increase in reserves, in terms of years' supply. The known reserves of oil are smaller than for any of our other major sources of fuel and power, and future domestic supply depends more on the extent of new exploration and the rate of discovery.

LEGISLATION AND PRORATION

Several developments of national importance in the legislative field occurred during 1939. Michigan passed a proration law and joined the compact, which had included Texas, Oklahoma, Illinois (not properly registered), Kansas, New Mexico, and Colorado. Mississippi has had oil-conservation laws for a number of years, but on September 25, 1939, it issued its first proration order, which covered the Tinsley field.

State allowables and Bureau of Mines estimates of market demand,[1] compared with actual production [2] in the United States, in 1939

[Daily averages, in thousands of barrels]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Texas:												
State allowable [3]	1,346	1,322	1,380	1,464	1,430	1,336	1,408	753	1,414	1,410	1,434	1,447
Bureau of Mines estimate	1,333	1,298	1,364	1,413	1,406	1,427	1,427	1,428	1,408	1,445	1,444	1,438
Actual production	1,314	1,298	1,353	1,424	1,403	1,313	1,377	810	1,401	1,408	1,418	1,415
California:												
State allowable [4]	605	605	602	577	578	595	595	598	598	598	599	599
Bureau of Mines estimate	588	580	588	592	583	595	595	595	596	595	596	595
Actual production	622	622	622	614	615	607	607	611	615	616	613	613
Oklahoma:												
State allowable [5]	428	428	428	428	428	428	428	428	385	424	429	438
Bureau of Mines estimate	500	483	473	473	456	450	456	448	429	424	429	438
Actual production	450	474	477	469	478	475	450	237	420	440	450	450
Louisiana:												
State allowable [6]	251	255	254	258	264	263	264	242	235	259	259	255
Bureau of Mines estimate	242	247	260	262	262	265	265	259	256	260	259	255
Actual production	259	266	259	270	267	268	270	177	243	268	273	268
Kansas:												
State allowable [7]	154	154	157	157	170	166	166	164	166	171	171	168
Bureau of Mines estimate	154	149	150	153	160	174	160	169	166	171	169	168
Actual production	159	152	177	174	173	174	177	102	169	176	188	176
New Mexico:												
State allowable [8]	101	104	115	114	117	117	116	111	100	114	111	110
Bureau of Mines estimate	96	100	110	115	116	117	116	111	109	114	111	110
Actual production	99	98	106	105	107	107	109	56	101	114	114	112
Arkansas:												
State allowable [9]	51	53	53	53	55	58	58	65	65	66	69	69
Bureau of Mines estimate	49	48	50	53	53	55	54	52	51	56	57	56
Actual production	51	53	54	51	55	59	61	46	63	64	69	69
Other States:												
Bureau of Mines estimate	309	315	345	373	389	408	440	460	496	525	555	560
Actual production	352	375	396	410	468	484	528	570	594	598	605	601
United States:												
Bureau of Mines estimate	3,271	3,220	3,340	3,434	3,425	3,491	3,513	3,522	3,511	3,590	3,620	3,620
Actual production	3,306	3,338	3,444	3,517	3,566	3,487	3,579	2,609	3,606	3,684	3,730	3,704

[1] Beginning November 1936, the State figures have been estimates of demand rather than required production as formerly; hence in comparing the demand data with actual production due regard should be given to changes in stocks by States of origin. (Changes in stocks and demand are given elsewhere in this chapter.)

[2] Comparisons of actual production with State allowables are complicated further by variations in the method of applying pipe-line deductions for B. S. and water. Thus it is believed that the allowables in Texas and California are on a 100-percent basis, in Oklahoma and Kansas on a 97-percent basis, in New Mexico on a 98-percent basis, and in Louisiana on a 99-percent basis. The bases used in reporting production to the Bureau of Mines are not definitely known, but indications are that the average for the United States is about 99 percent.

[3] Railroad Commission of Texas.

[4] Central Committee of California Oil Producers.

[5] Corporation Commission of Oklahoma. State allowable figures as shown do not include production permitted in accordance with "underage" and other special provisions of State orders.

[6] Department of Conservation, Louisiana. State allowable figures shown do not include production permitted under special orders of said Department.

[7] State Corporation Commission of Kansas.

[8] Oil Conservation Commission of New Mexico. State allowable figures as shown do not include production permitted in accordance with "underage" and other special provisions of State orders.

[9] Oil and Gas Commission.

Hearings on the oil industry before the Temporary National Economic Committee and before the Cole Committee of Congress, pursuant to H. Res. 290 and H. R. 7372, were held in 1939. A reciprocal trade agreement with Venezuela became operative late in the year. Under this treaty an import quota (5 percent of crude runs of preceding year) was assigned at half of the regular excise taxes.

The Bureau of Mines forecasts of demand by States were issued monthly throughout the year. As indicated in the table, actual production averaged about the same as the estimates of demand. The Bureau estimate of domestic demand for motor fuel in 1939 was about 0.25 percent too low, but because of the collapse of exports to Europe the estimate of total demand was about 0.5 percent too high.

EMPLOYMENT AND LABOR PRODUCTIVITY

Lower prices, less drilling, and a smaller output were the primary factors leading to a decrease in the average number of oil-field workers from 121,371 in 1937 to 117,570 in 1938. These figures include part-time workers, who averaged 12,321 and 10,120, respectively, in the 2 years.

Most of the States had fewer workers in 1938 than in 1937, Illinois and Louisiana being the chief exceptions.

The total man-hours worked was 237,857,000 compared with 239,834,000 in 1937. Estimating part-time hours as 800 for 1938, the average number of hours per week for full-time workers increased from 40.5 in 1937 to 40.8 in 1938. The labor-productivity average was influenced by the decreased production and fell from 5.33 barrels per man-hour in 1937 to 5.11 barrels in 1938.

Employment at wells, crude petroleum produced, and average output per man in the United States, 1937–38, by States [1]

State	Average number of workers		Crude petroleum production (thousands of barrels)		Labor productivity (barrels per man-hour)	
	1937	1938	1937	1938	1937	1938
Arkansas	1,940	1,980	11,764	18,180	2.79	4.49
California	19,640	18,800	238,521	249,749	6.68	6.51
Colorado	110	130	1,605	1,412	7.20	5.08
Illinois	1,920	3,090	7,499	24,075	1.65	3.19
Indiana	230	240	844	995	1.91	2.19
Kansas	9,470	8,520	70,761	60,064	3.81	3.52
Kentucky	1,425	1,530	5,484	5,821	1.92	1.73
Louisiana	7,640	7,890	90,924	95,208	6.50	6.12
Michigan	1,705	1,640	16,628	18,745	4.67	4.97
Montana	590	510	5,805	4,946	4.94	5.53
New Mexico	1,190	1,280	38,854	35,759	16.07	13.52
New York	1,703	1,600	5,478	5,045	1.40	1.23
Ohio	2,350	2,190	3,559	3,298	.81	.86
Oklahoma	23,100	21,250	228,839	174,994	4.91	4.19
Pennsylvania	7,420	7,050	19,189	17,426	1.34	1.17
Texas	35,600	34,950	510,318	475,850	7.24	6.86
West Virginia	3,220	2,990	3,845	3,684	.68	.63
Wyoming	2,100	1,850	19,166	19,022	3.92	4.87
Other States [2]	18	80	77	82	2.41	.48
Total United States	121,371	117,570	1,279,160	1,214,355	5.33	5.11

[1] Figures for 1939 not yet available. [2] Mississippi, Missouri, Nebraska, Tennessee, and Utah.

CRUDE PETROLEUM

SUPPLY AND DEMAND

The increased domestic demand for refined products in 1939 not only absorbed the 50-million-barrel gain in production but caused a larger withdrawal from crude-oil stocks. The total demand for 1939 was 1,335,138,000 barrels or 5 percent above 1938. Virtually all of the gain went into the consumption of domestic crude at refineries as exports, transfers, other fuel, and losses showed minor decreases. Imports of foreign crude made a material relative gain, but the proportion to the total demand was less than 3 percent.

Supply of and demand for crude petroleum, 1935–39

[Thousands of barrels]

	1935	1936	1937	1938	1939 [1]
Production	996, 596	1, 099, 687	1, 279, 160	1, 214, 355	1, 264, 256
Imports [2]	32, 239	32, 327	27, 484	26, 412	33, 095
Changes in stocks [3]	−22, 399	−26, 276	+18, 247	−28, 913	−37, 787
Total demand	1, 051, 234	1, 158, 290	1, 288, 397	1, 269, 680	1, 335, 138
Runs to stills:					
Domestic	933, 659	1, 034, 637	1, 157, 444	1, 138, 828	1, 204, 350
Foreign	32, 131	33, 933	25, 996	26, 187	33, 490
Exports	51, 430	50, 313	67, 234	77, 254	72, 073
Transfers to fuel-oil stocks [4]	13, 067	15, 732	17, 423	10, 660	[5] 8, 832
Consumed as fuel on producing properties [6]	1, 338	1, 664	1, 308	1, 452	1, 452
Consumed as fuel in operation of pipe lines [6]	1, 931	2, 138	2, 178	1, 930	2, 125
Other fuel and losses	17, 678	19, 873	16, 814	13, 369	12, 816
Total demand	1, 051, 234	1, 158, 290	1, 288, 397	1, 269, 680	1, 335, 138

[1] Subject to revision. [2] As reported to the Bureau of Mines.
[3] Exclusive of changes in stocks of heavy crude in California, 1935–37. [4] California only, 1935–38.
[5] Includes 2,298,000 barrels used for industrial purposes east of California, 616,000 barrels transferred to gas oil, etc., in California, and 5,918,000 barrels transferred to residual fuel oil in California.
[6] East of California.

PRODUCTION

As indicated in figure 2, the general trend of crude-oil production in 1939 was upward; the daily average in January was 3,306,000 barrels and in December 3,704,000 barrels. The upward trend was

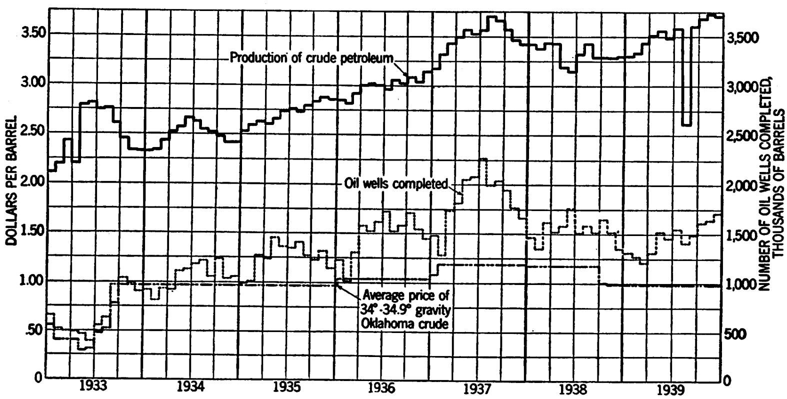

FIGURE 2.—Daily average production of crude petroleum, total number of oil wells completed, and average price per barrel of a selected grade of Oklahoma crude petroleum, 1933–39, by months.

not uninterrupted, as there was a marked slump in June (when the number of shut-down days in Texas was increased to 8) and in August, when most of the important producing States instituted a 15-day shut-down. The leading factor in the general upward trend of output in 1939 was the gain of more than 200,000 barrels in the daily average for Illinois.

About half the producing districts increased in output in 1939 over 1938. The most notable gain was that for the Illinois-Southwest Indiana district. The Gulf Coast region continued to reach new high levels. The most important decline in 1939 was in California.

Production of crude petroleum in the United States in 1939, by districts, States, and months

[Thousands of barrels]

District and State	1939 [1]													1938 (total)
	January	February	March	April	May	June	July	August	September	October	November	December	Total	
DISTRICT														
Pennsylvania Grade	2,118	1,981	2,261	2,195	2,417	2,276	2,207	2,316	2,225	2,426	2,367	2,386	27,175	27,316
Other Appalachian (including Kentucky)	638	490	564	532	624	626	622	667	540	569	594	568	7,034	7,415
Lima-Northeastern Indiana-Michigan	1,676	1,579	1,810	1,862	1,993	2,017	2,115	2,157	1,938	2,067	2,088	2,099	23,401	19,352
Illinois-Southwestern Indiana	4,503	4,601	5,437	5,473	6,924	7,171	8,850	9,986	10,582	10,779	10,442	10,977	95,725	25,046
North Louisiana and Arkansas	3,838	3,578	3,939	3,796	3,957	3,922	4,070	3,056	3,872	4,113	4,203	4,309	46,653	46,758
West Texas and Southeastern New Mexico	9,557	8,571	10,025	9,717	10,162	9,551	10,673	5,958	10,402	10,901	10,534	10,744	116,795	108,114
East Texas	12,205	10,682	12,389	13,407	13,447	11,712	12,413	6,251	12,353	14,022	13,313	13,275	145,469	152,116
Oklahoma, Kansas, North Texas, etc	30,512	27,979	32,256	31,572	32,519	30,920	31,601	17,645	29,597	30,768	30,804	31,466	357,639	370,533
Gulf Coast	16,137	14,715	16,564	16,259	16,836	15,726	16,988	11,341	15,621	16,768	16,546	17,408	190,909	182,217
Rocky Mountain	2,032	1,880	2,239	2,293	2,588	2,465	2,595	2,554	2,575	2,686	2,614	2,581	29,102	25,739
California	19,274	17,419	19,284	18,404	19,074	18,221	18,803	18,934	18,463	19,099	18,382	18,997	224,354	249,749
Total United States	102,490	93,475	106,768	105,510	110,541	104,607	110,937	80,865	108,168	114,198	111,887	114,810	1,264,256	1,214,355
STATE														
Arkansas	1,593	1,483	1,679	1,526	1,719	1,764	1,881	1,419	1,874	1,993	2,071	2,141	21,143	18,180
California	19,274	17,419	19,284	18,404	19,074	18,221	18,803	18,934	18,463	19,099	18,382	18,997	224,354	249,749
Colorado	103	82	90	124	132	122	126	127	127	141	107	110	1,391	1,412
Illinois	4,446	4,542	5,380	5,415	6,849	7,083	8,737	9,852	10,443	10,601	10,222	10,732	94,302	24,075
Indiana	57	59	59	60	77	90	115	136	141	180	222	247	1,443	995
Kansas	4,931	4,250	5,489	5,221	5,359	5,218	5,488	3,156	5,056	5,456	5,652	5,447	60,723	60,064
Kentucky	520	380	437	418	494	503	503	539	423	443	472	449	5,581	5,821
Louisiana	8,014	7,456	8,037	8,086	8,267	8,035	8,382	5,499	7,277	8,308	8,197	8,311	93,869	95,208
Michigan	1,630	1,530	1,757	1,811	1,935	1,962	2,063	2,105	1,894	2,016	2,045	2,051	22,799	18,745
Montana	435	386	449	479	508	505	517	526	504	561	540	551	5,961	4,946
New Mexico	3,062	2,744	3,277	3,142	3,318	3,204	3,363	1,747	3,034	3,537	3,427	3,468	37,323	35,759
New York	402	363	418	406	439	435	416	441	434	448	453	443	5,098	5,045
Ohio	252	236	274	255	288	272	269	266	247	276	260	261	3,156	3,298
Oklahoma	13,951	13,265	14,777	14,069	14,811	14,241	13,960	7,343	12,586	13,634	13,502	13,933	160,072	174,994
Pennsylvania	1,346	1,255	1,432	1,406	1,553	1,432	1,400	1,474	1,409	1,565	1,532	1,533	17,337	17,426
Texas	40,726	36,351	41,936	42,732	43,484	39,381	42,700	25,109	42,033	43,657	42,545	43,873	484,527	475,850
West Virginia	279	282	312	288	320	309	288	310	290	309	282	311	3,580	3,684
Wyoming	1,463	1,387	1,675	1,662	1,908	1,823	1,920	1,876	1,921	1,951	1,938	1,893	21,417	19,022
Other States [2]	6	5	6	6	6	7	6	6	12	23	38	59	180	82
Total United States: 1939	102,490	93,475	106,768	105,510	110,541	104,607	110,937	80,865	108,168	114,198	111,887	114,810	1,264,256	....
1938	106,152	94,733	106,679	102,975	98,829	94,472	102,914	106,363	98,516	101,793	98,482	102,447	....	1,214,355
Daily average 1939	3,306	3,338	3,444	3,517	3,566	3,487	3,579	2,609	3,606	3,684	3,730	3,704	3,464	3,327

[1] Subject to revision. [2] Mississippi, Missouri, Tennessee, and Utah.

Petroleum produced in the United States, 1935–39, and 1859–1939 total, by States[1]

[Thousands of barrels]

	1935	1936	1937	1938	1939[2]	1859–1939 (total)
Arkansas	11,008	10,469	11,764	18,180	21,143	480,547
California	207,832	214,773	238,521	249,749	224,354	5,346,197
Colorado	1,560	1,650	1,605	1,412	1,391	38,257
Illinois	4,322	4,475	7,499	24,075	94,302	551,415
Indiana	777	822	844	995	1,443	125,864
Kansas	54,843	58,317	70,761	60,064	60,723	[3]1,054,814
Kentucky	5,258	5,633	5,484	5,821	5,581	[4]161,933
Louisiana	50,330	80,491	90,924	95,208	93,869	956,628
Michigan	15,776	11,928	16,628	18,745	22,799	[5]124,690
Montana	4,603	5,868	5,805	4,946	5,961	76,765
New Mexico	20,483	27,223	38,854	35,759	37,323	[6]235,316
New York	4,236	4,663	5,478	5,045	5,098	[7]113,778
Ohio	4,082	3,847	3,559	3,298	3,156	585,218
Oklahoma	185,288	206,555	228,839	174,994	160,072	[3]4,650,118
Pennsylvania	15,810	17,070	19,189	17,426	17,337	[7]979,670
Texas	392,666	427,411	510,318	475,850	484,527	6,087,597
West Virginia	3,902	3,847	3,845	3,684	3,580	407,326
Wyoming	13,755	14,582	19,166	19,022	21,417	475,230
Other States[8]	65	63	77	82	180	1,135
Total United States	996,596	1,099,687	1,279,160	1,214,355	1,264,256	22,452,498
Value at wells:						
Total (thousands of dollars)	961,440	1,199,820	1,513,340	1,373,060	1,265,000	26,728,469
Average per barrel	$0.96	$1.09	$1.18	$1.13	$1.00	$1.19

[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 1925–39 production only; earlier years included under "Other States."
[6] Figures represent 1924–39 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, 1900–1919; Mississippi, 1933–35, 1939; Missouri, 1889–1911, 1913–16, 1919–23, 1932–39; New Mexico, 1913, 1919–23; Tennessee, 1916–39; Utah, 1907–11, 1920, 1924–39.

The percentage of total crude petroleum produced by each of the three leading States—Texas, California, and Oklahoma—dropped in 1939, and the three States combined contributed 68.7 percent of the total, which was 5.5 percent below the combined percentage for 1938; it is noteworthy that Illinois' share rose in the same proportion, or from 2.0 percent in 1938 to 7.5 percent in 1939. Michigan and Arkansas were the only other States that made an appreciable gain in percentage.

The relative rank of the producing States is shown graphically in figure 3.

Percentage of total crude petroleum produced in the United States, 1931–39, by principal States

State	1931	1932	1933	1934	1935	1936	1937	1938	1939[1]
Texas	39.1	39.8	44.5	42.0	39.4	38.9	39.9	39.2	38.3
California	22.2	22.7	19.0	19.2	20.9	19.5	18.6	20.6	17.7
Oklahoma	21.2	19.5	20.1	19.9	18.6	18.8	17.9	14.4	12.7
Total, 3 States	82.5	82.0	83.6	81.1	78.9	77.2	76.4	74.2	68.7
Louisiana	2.6	2.8	2.8	3.6	5.0	7.3	7.1	7.8	7.4
Kansas	4.4	4.4	4.6	5.1	5.5	5.3	5.5	5.0	4.8
New Mexico	1.8	1.6	1.6	1.9	2.1	2.5	3.1	2.9	2.9
Illinois	.6	.6	.5	.5	.4	.4	.6	2.0	7.5
Michigan	.4	.9	.9	1.2	1.5	1.1	1.3	1.5	1.8
Arkansas	1.7	1.5	1.3	1.1	1.1	.9	.9	1.5	1.7
Pennsylvania	1.4	1.6	1.4	1.6	1.6	1.6	1.5	1.4	1.4
All other	4.6	4.6	3.3	3.9	3.9	3.7	3.6	3.7	3.8
Total United States	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Subject to revision.

The East Texas field easily retained first place both in production in 1939 and in total output since discovery. The Oklahoma City field, which ranked second in 1938, fell to third in 1939, being displaced by the Salem (Ill.) field.

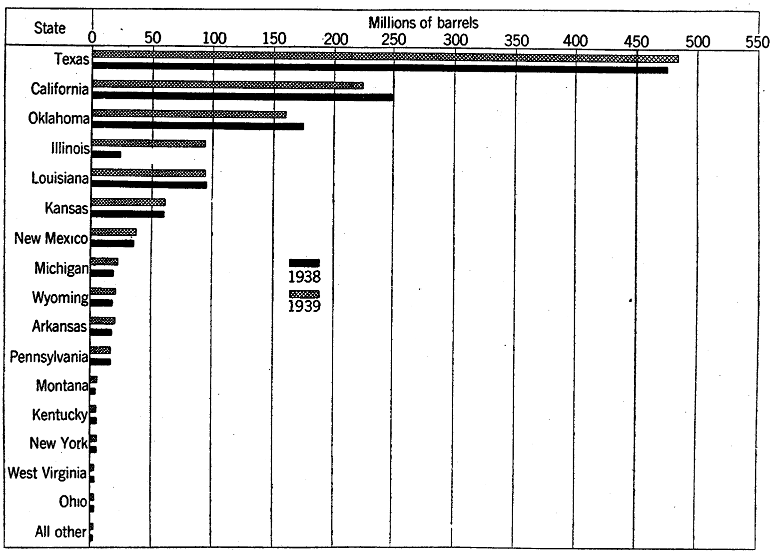

FIGURE 3.—Production of crude petroleum, 1938–39, by States.

Production of crude petroleum in leading fields in the United States, 1938–39,[1] *with total production since discovery*

[Thousands of barrels]

Field	State	1938	1939	Total since discovery
East Texas [2]	Texas	152,100	[3] 145,500	1,431,000
Midway-Sunset	California	22,900	18,900	877,000
Seminole	Oklahoma	[4] 28,100	30,700	820,000
Long Beach	California	20,600	17,000	638,000
Oklahoma City [2]	Oklahoma	40,900	[3] 37,600	488,000
Santa Fe Springs	California	12,600	10,100	458,000
Bradford-Allegany	Pennsylvania-New York	18,500	18,100	421,000
Smackover	Arkansas	6,500	7,100	410,000
Coalinga	California	3,900	5,700	361,000
Cushing-Shamrock	Oklahoma	3,800	3,400	339,000
Yates [2]	Texas	7,400	[3] 7,900	335,000
Augusta-Eldorado	Kansas	5,700	5,100	294,000
Salt Creek [2]	Wyoming	5,700	[3] 5,300	288,000
Huntington Beach	California	11,900	10,000	281,000
Wilmington	do	34,200	31,100	233,000
Kettleman Hills	do	25,600	19,600	222,000
Crane-Upton	Texas	[4] 10,300	9,900	164,000
Gray County	do	10,900	10,900	158,000
Caddo [2]	Louisiana	2,700	[3] 2,700	152,000
Conroe	Texas	11,600	9,200	107,000
Rodessa	Arkansas-Louisiana-Texas	27,500	20,400	103,000
Hobbs	New Mexico	5,000	4,400	97,000
Fitts	Oklahoma	16,700	9,200	84,000
Salem	Illinois	2,600	50,200	53,000
Eunice	New Mexico	9,000	7,900	41,000
Monument	do	9,500	8,200	32,000
Louden	Illinois	1,800	18,400	20,000

[1] Oil and Gas Journal, except as noted. [2] Bureau of Mines. [3] Subject to revision. [4] Revised figures.

The production of Pennsylvania Grade oil dropped again in 1939, but the decrease was much less than in the previous year. Of the four States yielding this type of crude oil, only New York increased its output in 1939. The average price of Pennsylvania Grade oil increased about 15 cents per barrel in 1939, but the higher postings came just too late to prevent output from declining to 27,175,000 barrels in 1939 from 27,316,000 in 1938.

Pennsylvania Grade crude oil produced, 1930–39, by States

[Thousands of barrels]

State	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939[1]
New York	3,647	3,363	3,508	3,181	3,804	4,236	4,663	5,478	5,045	5,098
Pennsylvania	12,786	11,876	12,396	12,607	14,462	15,794	17,053	19,173	17,407	17,318
West Virginia	5,068	4,470	3,875	3,815	4,095	3,901	3,846	3,844	3,684	3,580
Central and eastern Ohio	2,742	2,184	1,741	1,594	1,597	1,547	1,510	1,367	1,180	1,179
	24,243	21,893	21,520	21,197	23,958	25,478	27,072	29,862	27,316	27,175

[1] Subject to revision.

Arkansas.—The Magnolia field of Columbia County, discovered in 1938, proved to be of major importance and yielded about 3,600,000 barrels in 1939 compared with 68,000 barrels in 1938. This gain was the principal factor in the rise in State production from 18,180,000 barrels in 1938 to 21,143,000 in 1939. The number of oil wells completed decreased from 204 in 1938 to 183 in 1939; furthermore, the average initial production of the oil wells declined materially.

Attempts to find new Smackover lime fields similar to Magnolia were continued, and two commercial discoveries were made—Dorcheat, the deepest (nearly 9,000 feet) producing field in the State, and Big Creek, a distillate field. Lewisville, the only other discovery worth noting, was a small Glen Rose field.

The Arkansas Oil and Gas Commission was established early in 1939, replacing the Arkansas Conservation Board. The commission has concentrated on proration plans in several of the newest fields, with acreage and bottom-hole pressure the dominant factors in the allocation formulas.

Production of crude petroleum in Arkansas, 1934–38, by districts [1]

[Thousands of barrels]

Year	Buckner	Champagnolle	El Dorado	Irma	Magnolia	Rodessa	Schuler	Smackover	Urbana	Village	Other	Total
1934		486	991	300				7,916	826		663	11,182
1935		872	862	391				7,368	793		722	11,008
1936		900	811	383				7,126	651		598	10,469
1937	21	522	747	433		1,252	1,153	6,751	446		439	11,764
1938	340	452	709	578	68	2,317	6,359	6,406	422	119	410	18,180

[1] Figures by districts for 1939 not yet available.

California.—In 1939 production decreased in California for the first time since 1933. Although exports were materially lower, the domestic demand for all oils rose roughly 11 percent, hence a 30-million-barrel increase in stocks of all oils for 1938 was transformed into a withdrawal of several million barrels in 1939. The daily average production of crude oil in 1939 was 615,000 barrels compared with the proration "objective" of 600,000 barrels. However, as the trend in stocks indicated, efforts at curtailment were much more successful in 1939 than in 1938. The voters defeated a bill that would have established compulsory regulation.

Drilling declined nearly 15 percent from 1938, and 852 oil wells were completed compared with 993 in 1938. The successful completions in 1939 had the high average initial production of 909 barrels compared with an average of 927 barrels in 1938.

Production in all three producing districts—Valley, Coastal, and Basin—was lower in 1939 than in 1938. In the San Joaquin Valley the Canal and Coalinga fields were about the only ones where output increased in 1939. The important Kettleman Hills field slipped in production from 25,609,000 barrels in 1938 to 19,568,000 in 1939, but again ranked second to the Wilmington field in production. In the Coastal district, Ventura Avenue had an important extension, and the output was slightly above that in 1938. In the Los Angeles Basin the only important increase was in the Montebello field, where drilling was active on the edge of the structure.

New reserves discovered declined materially from 1938, but exploration was far from barren of results, as four new fields were discovered—South Mountain View (Arvin), Palima, and Strand, in Kern County; and Northeast Coalinga, in Fresno County.

Production of crude petroleum in California, 1935–39, by districts [1]

[Thousands of barrels]

District	1935	1936	1937	1938	1939
San Joaquin Valley:					
Belridge	3,629	4,648	6,332	5,312	4,781
Canal			31	849	1,855
Coalinga	7,249	6,067	5,759	3,898	5,731
Edison	979	2,023	1,577	1,102	838
Elk Hills	3,216	3,194	3,787	3,887	3,830
Fruitvale	1,848	2,903	3,246	3,078	2,377
Greeley			527	1,164	811
Kern River	4,518	5,163	5,639	4,590	4,133
Kettleman Hills	27,607	29,287	29,132	25,609	19,568
Lost Hills	1,762	1,347	1,414	1,297	1,222
McKittrick	1,394	777	1,308	1,289	1,326
Midway-Sunset	20,240	21,482	26,485	22,875	18,960
Mountain View	9,229	9,713	6,843	4,033	2,983
Mount Poso	5,540	6,747	6,677	6,235	4,314
Rio Bravo			128	1,945	2,875
Round Mountain	2,327	3,955	4,835	5,474	3,528
Ten Section			932	2,473	3,247
Other San Joaquin Valley	153	321	120	285	1,678
Total San Joaquin Valley	89,691	97,627	104,772	95,395	84,057
Coastal district:					
Capitan	522	571	918	1,067	876
Elwood	4,560	4,479	3,203	2,247	1,545
Rincon	670	754	1,058	1,395	1,238
San Miguelito	296	580	1,147	1,044	952
Santa Maria	1,531	1,668	3,893	6,128	6,305
Ventura Avenue	10,979	12,610	12,685	12,926	12,935
Other Coastal	2,653	2,239	2,113	2,089	2,449
Total Coastal	21,211	22,901	25,017	26,896	26,300

[1] American Petroleum Institute.

Production of crude petroleum in California, 1935–39, by districts—Continued

District	1935	1936	1937	1938	1939
Los Angeles Basin:					
Brea Olinda	3,612	2,961	2,659	2,125	2,063
Coyote	4,540	3,944	4,269	4,354	4,013
Dominguez	7,916	9,712	9,839	9,756	7,131
El Segundo		149	3,632	3,872	1,168
Huntington Beach	15,133	13,247	13,255	11,917	9,983
Inglewood	4,477	4,547	5,530	5,337	4,605
Long Beach	26,563	24,994	21,872	20,599	17,004
Montebello	2,287	3,205	3,167	4,147	7,455
Playa del Rey	5,696	4,644	3,181	2,305	1,801
Richfield	2,804	2,443	3,158	3,333	3,134
Rosecrans	993	804	1,259	3,732	4,459
Santa Fe Springs	16,159	16,460	15,745	12,630	10,050
Seal Beach	3,381	3,463	3,416	3,198	2,641
Torrance	2,498	2,860	2,833	5,203	6,418
Wilmington			14,186	34,168	31,100
Other Los Angeles Basin	871	812	731	782	972
Total Los Angeles Basin	96,930	94,245	108,732	127,458	113,997
Total California	207,832	214,773	238,521	249,749	224,354

Colorado.—Production in Colorado fell from 1,412,000 barrels in 1938 to 1,391,000 in 1939—a small decline compared to that in 1938. Drilling continued at a low ebb, and only seven oil wells were completed, the same number as in 1938. No new fields were discovered, but deeper sand production (in the Dakota) was found in the Fort Collins field.

Production of crude petroleum in Colorado, 1934–38, by districts [1]

[Thousands of barrels]

Year	Florence [2]	Fort Collins [3]	Greasewood	Iles	Moffat	Price	Rangely	Tow Creek	Total
1934	83	186	37	529	173		[4] 60	71	1,139
1935	72	145	22	1,067	150		[4] 36	68	1,560
1936	73	119	19	1,176	161		[5] 37	65	1,650
1937	57	90	6	1,040	149	173	[6] 33	57	1,605
1938	64	109	10	819	126	185	[5] 43	56	1,412

[1] Figures by districts for 1939 not yet available. [2] Includes Canon City. [3] Includes Wellington.
[4] Includes Berthoud, Boulder, and Walden. [5] Includes Berthoud and Boulder. [6] Includes Berthoud.

Illinois.—Production in Illinois continued to rise sensationally during 1939; in 1938 it trebled, but in 1939 it nearly quadrupled. The output was 94,302,000 barrels compared with 24,075,000 in 1938. Daily average production established new records in every month except October and November.

The Salem pool (Marion County) became second only to the East Texas field as a producer in 1939. Its output was about 50 million barrels in 1939, or more than half the State total. The Louden field (Fayette County) was second with about 18,000,000 barrels.

In every month of 1939, 200 to 300 oil wells were completed in Illinois, the total for the year being 2,943 compared with 1,806 in 1938. The average initial production per well per day rose from 271 barrels in 1938 to 285 in 1939.

About two dozen new fields were discovered in Illinois during 1939. These were quite well scattered over the south half of the State, several extending the oil-producing basin much farther than had been thought possible from the standpoint of geology. One of these was the Junction pool in Gallatin County. Some of the new discoveries were in the extreme eastern edge of the State in "old" territory—for example, Griffin and Keensburg in Wabash County. In addition to new fields, important discoveries of new zones and extensions were being made continually. Most important of these was the finding of "deep" production in the Devonian formation in the Salem field late in November. Devonian production was largely responsible for the gains in output in the first quarter of 1940, although the formation "does not hold up well."

Production of crude petroleum in Illinois, 1935–39, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1935	324	297	372	340	384	360	380	382	373	393	371	346	4,322
1936	325	294	396	347	389	383	407	385	391	398	368	392	4,475
1937	368	343	410	386	416	463	530	747	849	912	990	1,085	7,499
1938	1,128	1,108	1,336	1,393	1,450	1,478	1,704	2,083	2,558	2,773	3,072	3,992	24,075
1939 [1]	4,446	4,542	5,380	5,415	6,849	7,083	8,737	9,852	10,443	10,601	10,222	10,732	94,302

[1] Subject to revision.

Indiana.—The successful developments in Illinois and Michigan have caused a great revival of interest in the oil and gas possibilities of Indiana. In 1939, 176 oil wells were brought in compared with 46 in 1938. The production rose from 995,000 barrels in 1938 to 1,443,000 in 1939, the highest total since 1911. The Griffin field (Gibson and Posey Counties) discovered late in 1938, was the most active region in 1939. The New Harmony field (Posey County) was the most promising new discovery.

Kansas.—In 1939 the demand for Kansas crude oil continued to be influenced adversely by the expansion in Illinois, although not to the extent generally predicted. In any event drilling fell again, and 977 oil wells were brought in compared with 1,108 in 1938. Production in 1939 was 60,723,000 barrels, slightly higher than in 1938 but about 10 million barrels below the record of 1937.

In 1939, as usual, numerous discoveries were made in Kansas; the number of new fields ranges from 20 to 40, depending on whether some of the new areas are connected to older fields later. The Hittle, Bemis, Silica, and Trapp pools were among the most active in drilling in 1939. Silica and Trapp are reported to rank second and third, respectively, to Eldorado in point of proved acreage.

Three new counties—Norton, Phillips, and Sherman—were added to the producing column in 1939; Northeast Kansas shared in the Forest City basin drilling activity, but Nebraska achieved the most tangible result—a small oil well near Falls City.

Production of crude petroleum in Kansas, 1935–39, by counties [1]

[Thousands of barrels]

County	1935	1936	1937	1938	1939
Barton	738	1,195	3,519	3,490	3,490
Butler:					
Eldorado district	3,920	3,508	3,340	3,023	2,710
Other districts	2,792	2,656	2,649	2,668	2,354
Cowley	1,154	1,804	1,973	2,318	3,264
Ellis	167	758	2,629	3,116	3,468
Ellsworth	2,596	3,014	2,121	1,248	1,124
Greenwood-Woodson	4,089	4,001	4,007	3,834	3,578
Harvey	2,916	1,592	1,559	1,081	981
McPherson:					
Graber district	191	442	1,233	1,082	965
Ritz Canton district	2,974	2,346	1,872	1,650	1,753
Voshell district	1,670	1,104	931	765	574
Other districts	750	572	415	343	437
Reno	7,584	5,985	6,812	4,287	3,958
Rice	8,069	11,427	15,487	10,629	10,516
Russell	4,146	7,074	11,379	9,446	9,822
Sedgwick	2,973	2,002	1,545	1,418	1,247
Sumner	2,077	3,231	2,342	1,698	1,495
Other counties	4,558	4,373	5,345	6,038	7,427
	53,364	57,084	69,158	58,134	59,163

[1] Oil and Gas Journal.

Kentucky.—Lower prices and Illinois competition had adverse effects on developments in western Kentucky, where most of the output is produced, and the total production fell from 5,821,000 barrels in 1938 to 5,581,000 in 1939. Only 275 oil wells were completed in 1939 compared with 484 in 1938. The eastern part of the State witnessed a revival of interest; production increased owing to repressuring, and many thousands of acres were leased, chiefly on prospects for deeper production.

Louisiana.—Production in Louisiana declined in 1939, largely because the decrease for the Rodessa field was not matched by gains in the coastal district. The output for the year was 93,869,000 barrels compared with 95,208,000 in 1938.

The output in the northern fields in 1939 was 25,403,000 barrels, about 3 million barrels less than in 1938. All of the decrease was at Rodessa, which was quiet after active years in 1937 and 1938. The Cotton Valley and Cross Lake fields were the only ones to show substantial gains over production in 1938. Cross Lake, the only important discovery during 1938, yielded 1,875,000 barels in 1939, but the output was dropping rapidly as the year closed. Drilling fell sharply in 1939 and total initial production even more. No new fields were found in the northern district in 1939, and virtually all deep test wells, particularly the deepest (11,419 feet)—that at Pine Island (Caddo)—were disappointing.

The coastal district continued to set new production records; in 1939 the output was 68,466,000 barrels compared with 66,630,000 in 1938.

A dozen or more new fields were discovered in the Louisiana Gulf coast in 1939, in addition to numerous extensions. The Eola field, Avoyelles Parish, was the most interesting of the new discoveries. The Ville Platte and University fields were extended and made rapid gains in output. The Jennings field retained its top rank, although its production slumped rapidly in the latter half of the year.

Production of crude petroleum in Louisiana, 1934–38, by districts [1]

[Thousands of barrels]

District	1934	1935	1936	1937	1938
Gulf Coast:					
Black Bayou	422	564	1,087	1,313	1,285
Bosco	1,036	6,355	4,661	3,020	2,085
Caillou Island	1,748	3,288	5,504	6,402	6,249
Cameron Meadows	419	1,046	1,848	1,490	1,279
Charenton			17	236	1,085
Choctaw	324	276	346	440	442
Darrow	(2)	263	526	717	1,015
Dog Lake		(2)	227	674	518
English Bayou		713	2,511	2,871	2,176
Gibson				453	984
Gillis	(2)	1,492	3,262	2,217	973
Gueydan	110	82	58	99	189
Hackberry	1,911	2,580	3,125	4,592	3,728
Iowa	5,300	7,363	6,626	6,383	5,641
Jeanerette		(2)	985	2,277	2,485
Jennings	444	686	754	2,996	7,537
Lafitte		635	2,709	4,136	5,862
Lake Barre	1,894	2,792	2,532	1,368	657
Leeville	4,487	[3] 5,388	4,679	2,629	1,867
Lockport	714	655	474	528	378
New Iberia		(3)	2,191	6,231	5,339
Port Barre	937	1,250	797	600	612
Roanoke	241	1,631	2,282	1,890	1,339
Sulphur	1,256	944	1,793	1,414	1,244
Sweet Lake	385	403	350	294	307
Tepetate		(2)	1,456	2,158	1,985
Valentine				968	1,691
Ville Platte				3	850
Vinton	1,168	906	650	470	472
White Castle	191	196	336	490	593
Other Gulf Coast	807	1,268	1,788	2,682	5,763
Total Gulf Coast	23,794	40,776	53,574	62,041	66,630
Northern:					
Caddo	2,200	2,630	2,554	2,353	2,659
Cotton Valley	290	233	207	1,151	3,527
Haynesville	1,379	1,266	1,216	1,143	1,107
Homer	980	977	950	932	952
Lisbon				2,490	3,368
Rodessa		1,364	19,220	18,050	13,443
Urania	1,077	1,062	1,060	1,085	1,003
Zwolle	1,675	626	393	266	752
Other Northern	1,474	1,396	1,317	1,413	1,767
Total Northern	9,075	9,554	26,917	28,883	28,578
Total Louisiana	32,869	50,330	80,491	90,924	95,208

[1] Figures by districts for 1939 not yet available.
[2] Included under "Other Gulf Coast."
[3] Leeville includes New Iberia.

Michigan.—Production in Michigan reached a new peak of 22,799,000 barrels in 1939 compared with the previous record of 18,745,000 barrels in 1938. Prices improved materially, with the result that drilling increased; 813 oil wells were completed in 1939 compared with 566 in 1938. The most active fields were Walker, Kent County, and Bloomingdale, Van Buren County. The Freeman-Redding (Temple) field in Clare County assumed the rank of the leading field, displacing Buckeye.

In spite of active wildcatting, few discoveries were made; the two most promising were the Bangor field in Van Buren County and the Wyoming Park field in Kent County. New reserves discovered increased over 1938 but did not equal production, hence net reserves declined.

A new conservation law was passed, and the first order thereunder became effective June 1. Under this law new wells are prorated, but as the wells generally decline rapidly actual curtailment is limited to the newest fields.

Production of crude petroleum in Michigan, 1934–38, by districts [1]

[Thousands of barrels]

Year	Buckeye	Clayton	Crystal	Mount Pleasant	Muskegon	Porter	Sherman	Vernon	West Branch	Yost-Jasper	Other districts	Total
1934	-------	-------	-------	1,513	159	7,168	-------	907	--------	276	580	10,603
1935	-------	-------	3,605	1,130	102	8,317	-------	633	524	875	590	15,776
1936	10	58	2,449	880	93	4,620	32	469	772	1,625	920	11,928
1937	6,428	1,030	573	801	77	2,707	1,532	388	862	1,158	1,072	16,628
1938	7,385	1,071	238	583	60	1,798	1,152	256	758	833	4,611	18,745

[1] Figures by districts for 1939 not yet available. Data from Department of Conservation, Michigan.

Mississippi.—Mississippi, which produced a few thousand barrels of low-grade oil from the edge of the Jackson gas field some years ago, really entered the ranks of the oil-producing States in 1939 with discovery of the Tinsley field, Yazoo County. By the close of the year nine oil wells had been brought in, and interest in the area was at a high pitch. The output for 1939 was 107,000 barrels.

Missouri.—Interest in Missouri, particularly in the northwest corner, was stimulated by the discovery of oil near Falls City, Nebr., but the production, all from the stripper area south of Kansas City, remained several thousand barrels monthly.

Montana.—Although the producing branch of the industry in Montana appeared to have had a very successful year in 1939, with the output increasing about a million barrels, no new discoveries of importance were made, and reserves declined. The output was 5,961,000 barrels (second only to 1926) compared with 4,946,000 in 1938. There were 114 oil wells completed, compared with 69 in 1938. Most of the 1939 completions were in or near the Cut Bank field, which was extended several times.

Production of crude petroleum in Montana, 1934–38, by districts [1]

[Thousands of barrels]

Year	Border	Cat Creek	Cut Bank	Dry Creek	Elk Basin	Kevin-Sunburst	Lake Basin	Pondera	Other districts	Total
1934	70	236	1,204	(2)	16	1,628	16	363	70	3,603
1935	40	311	2,321	(2)	11	1,371	(2)	441	108	4,603
1936	43	258	3,332	214	12	1,543	(2)	433	33	5,868
1937	41	227	3,332	102	12	1,634	(2)	418	39	5,805
1938	23	211	2,809	365	8	1,290	18	210	12	4,946

[1] Figures by districts for 1939 not yet available. [2] Included under "Other districts."

Nebraska.—Leasing activity in the Forest City Basin in the extreme southeast corner of Nebraska yielded a discovery well near Falls City, rated at 130 barrels daily. The well decreased rapidly in output but produced about 2,000 barrels before the close of the year.

New Mexico.—Although production in New Mexico increased from 35,759,000 barrels in 1938 to 37,323,000 in 1939, it failed to attain the peak of 38,854,000 barrels achieved in 1937. The Eunice and Monument fields (Lea County) continued to be the leading producing areas. A gain for the Vacuum field was an important factor in the rise in total output in 1939 over 1938. Several new fields were discovered; of these the Loco Hills field, Eddy County, was the most promising. The light-oil area in the northwest corner of the State was quiet, with little activity outside the Rattlesnake field.

Production of crude petroleum in New Mexico, 1934–38, by districts [1]

[Thousands of barrels]

Year	Artesia	Hobbs	Hogback	Lea [2]	Rattlesnake [3]	Total
1934	898	12,628	76	2,962	300	16,864
1935	867	11,276	69	7,970	301	20,483
1936	1,056	9,169	84	16,592	322	27,223
1937	2,000	7,300	71	29,166	317	38,854
1938	2,216	5,304	70	27,882	287	35,759

[1] Figures by districts for 1939 not yet available.
[2] Includes Cooper, Eunice, Jal, Monument, and other pools in Lea County.
[3] Includes Aztec and Table Mesa in 1934–35; Aztec, Bloomfield, Red Mountain, and Table Mesa in 1936; Aztec, Bloomfield, Hospah, and Table Mesa in 1937; Aztec, Bloomfield, and Table Mesa in 1938.

New York.—Drilling increased in New York following the price advances of 1939, and the output rose to 5,098,000 barrels from 5,045,000 in 1938. The price of Bradford crude rose in six steps from $1.68 per barrel on January 1 to $2.50 on December 1; this substantial gain, occasioned largely by the increased demand for lubricants, gave the producers great encouragement for successful operations in 1940.

Ohio.—Nothing occurred in Ohio in 1939 to arrest the receding production, which fell from 3,298,000 barrels in 1938 to 3,156,000 in 1939. The number of oil wells completed increased from 189 in 1938 to 216 in 1939, but the total initial production dropped. During 1939 a bill was passed legalizing water-flooding in Ohio. The first horizontal well was drilled in Ohio in 1939.

Oklahoma.—Further losses of markets to Illinois and falling potentials featured the general picture in Oklahoma in 1939. The output was 160,072,000 barrels compared with 174,994,000 in 1938.

In an effort to maintain reserves, drilling was speeded in 1939, and 1,045 oil wells were brought in compared with 986 in 1938; however, the total initial production was less than in 1938, and the percentage of dry holes increased. Active areas in drilling were Creek County and the Cement and Sac and Fox fields.

The performance in the Seminole district was about the only encouraging feature of production in Oklahoma. The output in that district in 1939 was 30,700,000 barrels compared with 28,073,000 in 1938 and 30,704,000 in 1937. Most of the credit for the showing belongs to the St. Louis-Pearson field. Production of Oklahoma City, the leading field of the State, declined from 40,905,000 barrels in 1938 to 37,554,000 in 1939. Production at Fitts showed another drastic decline—from 16,655,000 barrels in 1938 to 9,120,000 in 1939.

Big wells continued to be completed in the Ramsey field, which produced about 1,500,000 barrels in 1939 compared with about 500,000 in 1938.

About a score of new pools were opened in Oklahoma in 1939, but most of them were on "pimples" passed over in previous years. The Hobart field (Kiowa County) probably was the most important discovery. A well was drilled to 14,582 feet in Washita County but was a failure after experiencing mechanical difficulties. Interest in the extreme southern and northwestern parts of the State was quite active as the year closed.

Production of crude petroleum in Oklahoma, 1935–39, by districts [1]

[Thousands of barrels]

District	1935	1936	1937	1938	1939
Allen	2,897	3,076	2,511	2,475	2,289
Billings	77	204	2,349	2,108	2,178
Bristow	3,329	3,186	2,790	2,389	2,403
Burbank	3,102	2,827	2,871	2,814	2,689
Cleveland County		543	3,896	1,778	1,013
Crescent	2,003	2,301	3,851	1,687	983
Cushing-Shamrock	4,738	4,129	3,908	3,848	3,446
Edmond	1,478	4,370	5,884	2,030	1,675
Fish	3,422	3,114	2,077	1,224	1,376
Fitts	6,901	19,908	30,977	16,655	9,120
Healdton	3,397	3,436	3,654	3,401	3,236
Keokuk-South Keokuk	852	2,113	2,979	1,713	1,176
Lucien	3,744	4,542	5,047	3,524	3,017
Nowata County	2,414	3,179	3,450	4,390	4,348
Oklahoma City	53,386	51,232	54,776	38,796	35,728
Okmulgee County	1,796	1,692	1,752	1,753	1,477
Olympic		2,711	4,315	1,889	1,034
Osage (outside Burbank-South Burbank)	9,113	8,293	7,626	6,438	6,063
Ramsey				528	1,489
Seminole field:					
Bowlegs	3,845	4,335	4,178	3,200	2,678
Carr City	2,003	2,216	1,973	1,294	922
Earlsboro	7,414	6,601	5,596	3,751	3,590
Little River	5,587	5,068	4,222	3,040	2,865
St. Louis-Pearson	8,365	8,543	7,528	7,766	11,303
Seminole City	4,062	3,810	3,428	2,842	2,618
Other Seminole districts	3,347	4,150	3,779	6,180	6,724
Total Seminole field	34,623	34,723	30,704	28,073	30,700
Sholem-Alechem-Tatums	3,160	2,561	3,129	1,691	1,553
South Burbank	4,217	5,390	5,579	3,938	3,150
Tulsa	1,432	1,308	1,721	1,513	1,073
Other districts	36,516	36,043	37,261	34,652	32,198
Total Oklahoma	182,597	200,881	223,107	169,307	153,414

[1] Oil and Gas Journal.

Pennsylvania.—Higher posted prices revived production in Pennsylvania during the last quarter of 1939, but the total output for the year failed by a small margin to equal that of 1938—17,426,000 and 17,337,000 barrels in 1938 and 1939, respectively. Fewer oil wells were completed in 1939, but the total initial production increased, probably owing to the addition of a number of exceptional wells in the Music Mountain pool of the Bradford field.

Tennessee.—No important discoveries were made in Tennessee in 1939, and production continued to be around 3,000 barrels monthly.

Texas.—The Saturday and Sunday shut-downs instituted by the Texas Railroad Commission in 1938 were continued into 1939. In addition, most of the fields were shut in during the latter half of August. In spite of this curtailment, production in every important area of the State except East Texas increased during 1939, and the total for the State rose from 475,850,000 barrels in 1938 to 484,527,000 in 1939.

No new discoveries were made in the Texas Panhandle in 1939, and fewer wells were drilled; but the potential of the wells increased, and the output rose from 23,556,000 barrels in 1938 to 24,165,000 in 1939.

The North Texas district experienced another satisfactory year in 1939. Production increased to about 40,000,000 barrels from about 37,000,000 in 1938 and reserves were augmented by the discovery of a score or more new pools. Fewer wells were drilled in 1939, mostly because the drilling program in the K-M-A field reached its peak in 1938. The Hull-Silk field, a 1938 discovery, lived up to expectations and became an important producer in 1939. Clay, Cooke, and Montague Counties led in new discoveries in 1939.

In the North-Central Texas district, sometimes called West-Central Texas but included in North Texas by the Bureau of Mines, wildcatting was active, and a dozen or more new productive spots were found. Most of the drilling was on the Palo Pinto lime trend in Jones and Shackelford Counties. The Griffin and Guitar pools (Jones County) were active; in the latter a deeper lime zone—the Hope—was discovered.

Production in the West Texas district recovered from its slump in 1938 and established a new record of 79,793,000 barrels in 1939. The gain of 1939 over 1938 was related closely to the State's allowable program, as drilling declined again. Ector County continued to lead in drilling, but Yoakum County showed the largest gain over 1938.

The number of new discoveries was again small in West Texas, and only two deserved special mention—the Apco pool (the first Ordovician discovery of Pecos County) and Cedar Lake, Gaines County. A deeper lime zone was found in the North Cowden pool, which opened a large area for similar exploration.

Production in the East Texas field proper decreased from 152,116,000 barrels in 1938 to 145,469,000 in 1939; it would have been about the same, except for the 2-week shut-down in August. Drilling continued to decrease rapidly in the East Texas field, and only 365 oil wells were brought into production during 1939 compared with 1,599 in 1938. Abandonments began to exceed new completions in 1939, but the number of producing wells increased from 25,700 on January 1 to 26,000 on December 31. The average bottom-hole pressure dropped from 1,110 pounds the first of the year to about 1,060 at the close.

Production in the other fields of the East Texas district fell from nearly 33,000,000 barrels in 1938 to about 31,000,000 in 1939. In 1939 the Talco and Rodessa (Texas portion) fields produced nearly 10 million barrels each, followed by Van with 5 to 6 million barrels New discoveries in 1939 were few and of little apparent consequence.

The Central Texas district, including chiefly the fault-line pools, passed another year of declining production and there were no important discoveries. The output was about 11,700,000 barrels—approximately 1 million barrels less than in 1938.

Production in the South Texas (Laredo) district showed another slight decrease; the total for 1939 was about 29,400,000 barrels compared with 29,597,000 in 1938.

Routine drilling declined in 1939, but interest in the area continued high and several dozen new discoveries were made. The chief activity was along the Frio-Vicksburg trend in Jim Wells, Brooks, Hidalgo, and Starr Counties and along the Cockfield trend in Duval County. Prominent new fields were Reynolds, Ben Bolt, Chiltipin, Muralla, Sejita, and Southland. The new Adami field of Webb County was active in drilling. Two deep Wilcox tests were drilled during the year, and whereas both had mechanical troubles and were plugged back, they showed considerable promise.

Although in 1939 the Texas coastal district had a comparatively poor year from the standpoint of new fields and reserves, production rose to a new high point of 122,443,000 barrels from 115,587,000 in 1938. Nearly as many oil wells were completed in 1939 as in 1938—1,663 against 1,728—but the average daily initial production of the 1939 completions was only 256 barrels compared with 518 in 1938.

About 15 new fields were discovered in the Texas Gulf Coast field during 1939, several of which were distillate producers. The most promising of the new fields were Anchor (Angleton), Brazoria County, and Caplen, Galveston County. Important new sand discoveries were made in the Ace and Thompsons fields; and the West Ranch field in Jackson County, discovered in 1938, was greatly extended.

Conroe easily retained its rank as the leading field of the district, though its output fell from 11,606,000 barrels in 1938 to about 9,200,000 in 1939.

Production of crude petroleum in Texas, 1934–38,[1] by districts

[Thousands of barrels]

District	1934	1935	1936	1937	1938
Gulf Coast:					
Anahuac	----------	358	2,606	4,318	2,887
Barbers Hill	6,820	6,765	5,461	4,366	3,413
Batson	246	588	638	630	597
Boling	209	182	348	545	540
Conroe	17,761	15,276	15,229	15,191	11,606
Dickinson	(2)	280	719	1,432	2,227
Esperson	452	395	630	601	496
Flour Bluff	----------	----------	93	1,607	1,736
Frindswood	----------	----------	----------	88	1,078
Goose Creek	1,203	1,069	1,038	860	596
Greta	3,936	4,769	5,481	6,635	4,190
Hankamer	378	565	779	576	450
Hardin	----------	----------	135	241	1,621
Hastings	----------	689	2,408	5,835	6,940
Heyser	----------	----------	120	1,515	3,051
High Island	2,747	2,513	2,069	1,183	900
Hull	3,453	2,311	1,950	2,492	2,899
Humble	1,188	1,230	1,163	1,217	1,202
Luby	----------	----------	----------	80	1,578
Manvel	1,020	2,467	3,014	3,458	3,222
Markham	389	459	540	612	594
Mykawa	133	705	1,161	632	511
Old Ocean	(2)	104	159	447	1,782
Orange	289	263	250	248	483
Pierce Junction	1,196	1,093	1,298	1,243	1,117
Placedo	----------	143	1,393	3,082	3,088
Plymouth	----------	650	3,400	5,056	4,467
Raccoon Bend	1,489	1,681	1,922	2,002	1,206
Refugio	1,489	1,641	3,228	2,307	2,093
Saxet-Saxet Heights	775	1,336	7,245	15,763	13,130
Segno	----------	----------	----------	472	708
Silsbee	----------	----------	6	464	605
Sourlake	484	602	561	569	441
Spindletop	1,052	962	858	912	837
Sugarland	2,183	2,098	1,715	1,322	1,222
Thompsons	4,245	4,123	3,523	4,147	3,998
Tomball	990	1,899	2,611	3,060	2,635
West Columbia	1,038	857	773	825	1,600
Withers	----------	----------	229	570	[illegible] 925
Other Gulf Coast	4,990	6,841	12,235	18,099	22,916
Total Gulf Coast	60,155	64,914	86.988	114,702	115,587

[1] Figures by districts for 1939 not yet available.
[2] Included under "Other Gulf Coast."

Production of crude petroleum in Texas, 1934–38, by districts—Continued

District	1934	1935	1936	1937	1938
East Texas:					
East Texas proper [3]	181,540	176,859	167,512	170,673	152,116
Cayuga	589	1,333	2,137	3,195	3,191
Long Lake	(4)	(4)	374	549	721
Rodessa		12	3,144	12,626	11,373
Sulphur Bluff				1,627	1,653
Talco			1,344	9,720	9,593
Van	14,621	14,062	12,508	11,346	5,630
Other East Texas	311	813	726	589	611
Total East Texas	197,061	193,079	187,745	210,325	184,888
Central Texas:					
Darst Creek	3,374	3,298	3,201	2,802	2,816
Luling	2,187	2,055	2,154	2,260	2,497
Lytton Springs	557	341	328	120	1,057
Mexia [5]	1,947	1,902	1,847	1,678	1,635
Salt Flat (Bruner)	1,637	1,495	1,448	1,586	1,419
Other Central Texas	2,334	4,356	4,896	5,125	3,263
Total Central Texas	12,036	13,447	13,874	13,571	12,687
North Texas [6]	31,558	31,098	33,041	37,580	36,823
Panhandle [7]	20,280	21,369	22,357	27,617	23,556
South Texas [8]	10,154	13,342	21,367	30,780	29,597
West Texas:					
Andrews	217	628	857	1,318	1,309
Big Lake	4,476	3,610	2,859	2,648	2,381
Chalk-Roberts [9]	6,563	8,163	9,345	8,663	8,030
Crane-Upton	6,145	6,384	7,843	10,078	9,938
Ector	2,625	3,591	5,759	10,121	14,817
Fisher	1,633	1,954	1,640	1,164	1,208
Hendricks	7,612	7,670	9,801	15,411	13,361
Ward County	3,479	5,883	8,992	12,561	8,878
Yates	15,991	15,935	13,414	11,388	8,590
Other West Texas	1,531	1,599	1,529	2,391	4,200
Total West Texas	50,272	55,417	62,039	75,743	72,712
Total Texas	381,516	392,666	427,411	510,318	475,850

[3] Joiner, Kilgore, Lathrop, and other pools in Cherokee, Gregg, Rusk, Smith, and Upshur Counties.
[4] Included under "Other East Texas."
[5] Includes other fields in Falls, Freestone, Limestone, and Navarro Counties.
[6] Includes the districts in and between Wilbarger, Wichita, Clay, Montague, and Cooke Counties on the north and Runnels, Coleman, Brown, and Comanche Counties on the south.
[7] Carson, Gray, Hutchinson, Moore, Potter, and Wheeler Counties.
[8] Includes fields in Duval, Hidalgo, Jim Hogg, Jim Wells, Starr, Webb, and Zapata Counties.
[9] Includes Westbrook and other fields in Glasscock, Howard, and Mitchell Counties.

Utah.—No wells were drilled in Utah in 1939, and the production of oil continued negligible.

West Virginia.—Despite a slight decline in number of oil wells completed in 1939, the total initial production increased; however, this was not enough to compensate for the natural decrease in the output of the many old wells, and it dropped from 3,684,000 barrels in 1938 to 3,580,000 in 1939.

Wyoming.—Deeper drilling and extensions in the Lance Creek field increased the output from 4,846,000 barrels in 1938 to about 6,700,000 in 1939. This was about the proportion by which the State production increased—from 19,022,000 barrels in 1938 to 21,417,000 in 1939. The reliable Salt Creek field was displaced by Lance Creek as the leading producer for the first time in about a score of years, but its production of 5,331,000 barrels was creditable considering its age.

Drilling in 1939 proceeded at about the same pace as in 1938, 99 and 95 oil wells having been completed in the respective years. Exploratory drilling was not especially successful; no new fields were found, and deeper sands at Lance Creek and Wertz were the only important discoveries.

Production of crude petroleum in Wyoming, 1933–38, by districts [1]

[Thousands of barrels]

Year	Big Muddy	Byron	Elk Basin	Frannie	Garland	Grass Creek	Hamilton Dome-Warm Springs	La Barge	Lance Creek	Lander-Dallas-Derby Dome	Lost Soldier-Ferris
1933	650	(2)	203	85	[2] 181	274	254	349	41	330	632
1934	634	(2)	177	615	[2] 364	356	322	488	128	316	605
1935	570	(2)	133	114	[2] 784	727	470	493	735	334	563
1936	522	(2)	159	310	[2] 318	559	426	471	1,892	330	471
1937	484	404	104	358	844	654	437	423	4,247	329	511
1938	441	533	94	419	303	513	346	395	4,846	306	1,037

Year	Medicine Bow	Oregon Basin	Osage	Poison Spider-South Casper	Quealy	Rock Creek	Salt Creek	Other districts	Total
1933	----------	252	241	167	----------	464	7,009	95	11,227
1934	----------	880	289	177	----------	540	6,520	145	12,556
1935	----------	1,638	174	131	----------	544	6,257	88	13,755
1936	167	1,733	143	206	----------	622	6,070	183	14,582
1937	1,344	1,407	261	230	268	748	5,874	239	19,166
1938	1,040	1,648	116	196	271	640	5,705	173	19,022

[1] Figures by districts for 1939 not yet available.

[2] Garland includes Byron.

WELLS

In consequence of the price recession of October 1938 drilling entered 1939 at a much lower level than prevailed the first of 1938. The drilling rate accelerated gradually in 1939, so that by the end of

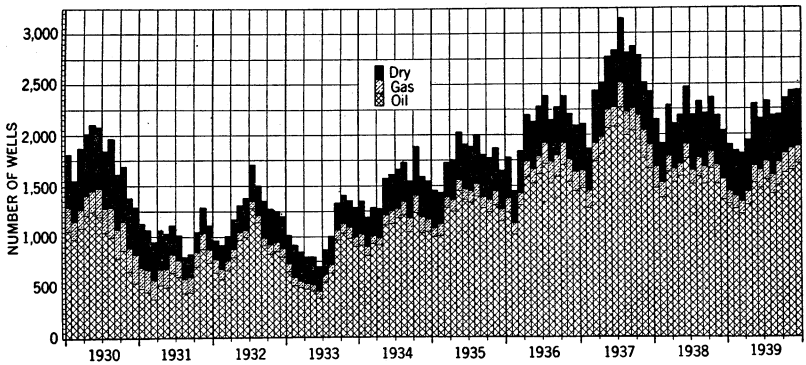

FIGURE 4.—Wells drilled, 1930–39, by months.

the year it was running ahead of 1938. However, the number of oil wells completed decreased 5 percent—from 18,433 in 1938 to 17,485 in 1939. The percentage of failures (dry holes) again increased materially—from 22.8 percent in 1938 to 24.6 in 1939 (see fig. 4); this trend is largely a result of the decline in drilling in the East Texas field, where less than 2 percent of the holes drilled since discovery to the end of 1939 (26,355) have been failures.

There were 369,640 producing wells in the United States on December 31, 1938; this was 6,610 more than were producing at the beginning of the year. Allowing for somewhat more than the usual percentage of abandonments on account of the lower prices, there probably were somewhat less than 375,000 producing oil wells at the end of 1939. However, the average daily production per well, which declined materially in 1938, rose to 9.3 barrels from 9.1 in 1938.

Wells drilled for oil and gas in the United States, 1938–39, by months [1]

Wells	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
													Number	Percent
1938 [2]														
Oil	1,474	1,355	1,620	1,524	1,585	1,753	1,503	1,581	1,514	1,657	1,513	1,354	18,433	69.7
Gas	209	168	173	129	127	154	145	180	156	168	179	197	[3] 1,985	7.5
Dry	464	391	506	452	479	572	547	566	542	543	494	487	6,043	22.8
	2,147	1,914	2,299	2,105	2,191	2,479	2,195	2,327	2,212	2,368	2,186	2,038	26,461	100.0
1939														
Oil	1,311	1,263	1,204	1,302	1,520	1,467	1,550	1,411	1,498	1,610	1,641	1,708	17,485	67.5
Gas	135	133	137	133	168	180	183	183	219	195	215	165	[3] 2,046	7.9
Dry	447	444	473	505	614	505	595	592	481	551	583	567	6,357	24.6
	1,893	1,840	1,814	1,940	2,302	2,152	2,328	2,186	2,198	2,356	2,439	2,440	25,888	100.0

[1] Oil and Gas Journal. Water-intake wells not included. [2] Revised figures.
[3] Total by months does not agree with total by States published elsewhere in the Yearbook, as latter has been revised on basis of annual data from State officials.

Because of rapid decline in drilling in the East Texas field, the Bradford-Allegany district became the leader in completions in 1939. Completions in Wichita County, one of the leaders in 1938, dropped nearly 50 percent in 1939. Increases in field activity in the Central States (Illinois, Michigan, and Indiana) were leading developments during 1939.

Wells drilled in the United States and estimated average daily initial oil production per well, 1938–39, by States and districts [1]

State and district	1938 [2]					1939				
	Oil		Gas	Dry	Total	Oil		Gas	Dry	Total
	Number	Average initial (barrels)				Number	Average initial (barrels)			
Arkansas	204	683	3	44	251	183	483	6	65	254
California [3]	993	927	7	265	1,265	852	909	15	251	1,118
Colorado	7	135	1	10	18	7	128	1	17	25
Illinois	1,806	271	23	408	2,237	2,943	285	18	621	3,582
Indiana	46	37	43	69	158	176	156	44	156	376
Kansas	1,108	581	200	402	1,710	977	432	150	309	1,436
Kentucky	484	89	91	314	889	275	54	110	312	697
Louisiana:										
Gulf Coast	329	388	10	186	525	582	317	11	242	835
Northern	361	465	116	145	622	289	236	87	161	537
Total, Louisiana	690	429	126	331	1,147	871	290	98	403	1,372
Michigan	566	451	28	406	1,000	813	534	52	527	1,392
Montana	69	78	21	27	117	114	85	26	37	177
New Mexico	494	370	19	67	580	525	385	18	63	606
Ohio	189	23	433	288	910	216	16	497	319	1,032
Oklahoma	986	218	160	545	1,691	1,045	197	151	603	1,799
Pennsylvania and New York	1,690	5	166	95	1,951	1,586	25	200	148	1,934
Texas:										
Gulf Coast	1,728	378	66	322	2,116	1,663	256	105	300	2,068
East Texas proper	1,599	1,282	1	45	1,645	365	1,167	------	20	385
West Texas	1,788	877	16	241	2,045	1,703	860	4	163	1,870
Rest of State	3,777	332	258	1,969	6,004	2,952	348	205	1,845	5,002
Total, Texas	8,892	618	341	2,577	11,810	6,683	500	314	2,328	9,325
West Virginia	114	13	484	126	724	110	18	419	90	619
Wyoming	95	480	19	43	157	99	874	10	41	150
Other States	------	-------	71	26	97	10	573	16	67	93
Total, United States	18,433	474	[4] 2,236	6,043	26,712	17,485	386	[4] 2,145	6,357	25,987

[1] Oil and Gas Journal, except California. [2] Revised figures. [3] American Petroleum Institute.
[4] Total by States does not agree with total by months published elsewhere in the Yearbook, as former has been revised upon basis of annual data from State officials.

Producing oil wells in the United States and average production per day in 1938, by States and districts [1]

State and district	Producing oil wells: Approximate number, Dec. 31	Average production per well per day (barrels)	State and district	Producing oil wells: Approximate number, Dec. 31	Average production per well per day (barrels)
Arkansas	2,800	18.2	Ohio	27,000	0.3
California [2]	13,930	50.0	Oklahoma	54,400	8.7
Colorado	200	19.3	Pennsylvania	81,500	.6
Illinois	15,800	4.4	Texas:		
Indiana	1,260	2.2	Gulf Coast	9,500	36.5
Kansas	20,900	7.7	East Texas proper	25,700	16.7
Kentucky	13,900	1.2	West Texas	9,300	23.5
Louisiana:			Rest of State	41,100	9.4
Gulf Coast	1,400	145.5	Total, Texas	85,600	16.0
Northern	3,500	23.9	West Virginia	17,700	.6
Total, Louisiana	4,900	57.6	Wyoming	3,300	15.7
Michigan	2,140	26.2	Other States [3]	140	1.7
Montana	1,620	8.4	Total wells	369,640	9.1
New Mexico	2,400	45.4			
New York	20,150	.7			

[1] Figures for 1939 not yet available. [2] American Petroleum Institute. [3] Missouri, Tennessee, and Utah.

Drilling activity in leading districts of the United States, 1938–39 [1]

District	State	Completions 1938	Completions 1939	District	State	Completions 1938	Completions 1939
Archer County	Texas	215	347	Gibson County	Indiana	5	115
Bradford-Allegany	Pa.-New York.	1,480	1,404	Kent County [2]	Michigan	5	326
Caddo	Louisiana	134	265	Lea County	New Mexico	469	413
Charenton	do	38	89	Marion County	Illinois	693	1,245
Columbia County	Arkansas	120	103	Montebello	California	33	130
Creek County	Oklahoma	135	206	Pottawatomie County	Oklahoma	174	267
Daviess County	Kentucky	145	181	Rice County	Kansas	167	203
East Texas	Texas	1,645	385	Russell County	do	201	237
Ector County	do	638	489	Van Buren County [2]	Michigan	133	375
Eddy County	New Mexico	70	163	Wichita County	Texas	1,033	524
Fairbanks	Texas	129	144	Wilmington	California	263	174
Fayette County	Illinois	518	960	Yoakum County	Texas	161	354

[1] Oil and Gas Journal, except Michigan. [2] Department of Conservation, Michigan.

STOCKS

Crude-oil stocks increased moderately in the first 4 or 5 months of 1939, followed by material reductions in June and July; however, these were small compared with that in August in consequence of the 2-week shut-down. Thus stocks of refinable grades decreased about 32,000,000 barrels or from 270,570,000 barrels on July 31 to 238,479,000 on August 31. The net change over the remaining 4 months was unimportant. Virtually all the 35-million barrel reduction in refinable grades in 1939 was in pipe-line and tank-farm stocks, as producers' stocks gained slightly and refinery stocks showed a relatively minor decline. Stocks of heavy crude in California, kept separate from statistics of refinable grades to maintain comparisons, were reduced by about 3 million barrels in 1939, or from 16,467,000 barrels on January 1 to 13,330,000 on December 31.

Stocks of crude petroleum, natural gasoline, and refined products in the United States at end of year, 1935–39

[Thousands of barrels]

	1935	1936	1937	1938	1939 [1]
Crude petroleum (refinable):					
At refineries	[2] 47,533	46,846	51,041	51,551	49,215
Pipe line and tank farm	[2] 256,793	230,499	244,545 [3] 243,552	211,931 [3] 211,138	178,546
Producers	10,529	11,234	11,240	11,476 [3] 10,871	11,149
Total refinable	314,855	288,579	306,826 [3] 305,833	274,958 [3] 273,560	238,910
California heavy crude [4]	(4)	(4)	14,505	16,467	13,330
Total crude petroleum	314,855	288,579	306,826 [3] 320,338	291,425 [3] 290,027	252,240
Natural gasoline	3,698	4,055	4,758	4,830	4,421
Refined products [5]	223,361	226,595	253,413 [3] 239,901	259,665 [3] 259,613	256,249
Grand total	541,914	519,229	564,997	555,920 [3] 554,470	512,910

[1] Subject to revision. [2] Revised figures. [3] For comparison with succeeding year.
[4] California heavy crude included under refined products as residual fuel oil from 1923 to end of 1937.
[5] Includes also equivalents for wax, coke, and asphalt in barrels.

An important factor in the rise of Pennsylvania Grade prices was a drop of just over a million barrels (about 20 percent) in stocks of that crude. The data on stocks of crude oil by States of origin for 1939 show that most of the figures trended downward; in fact, a gain of about 5,500,000 barrels of Illinois crude was the chief exception. The most important decreases were about 20 million barrels in stocks of Texas crude and nearly 10 million of Oklahoma crude.

New lows in days' supply for recent years were set continuously in 1939 as demand increased and stocks were reduced. The low point of 64 days' supply for all crudes, including California heavy, was reached on September 30.

Stocks of refinable crude petroleum [1] *in the United States in 1939, by States of location and origin and by months* [2]

[Thousands of barrels]

State	Jan. 1	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
LOCATION													
Arkansas	2,447	2,373	2,220	2,279	2,343	2,332	2,099	2,025	1,783	1,884	1,826	1,896	1,907
California	36,271	36,818	38,182	39,193	39,515	39,819	38,804	38,204	37,886	37,104	35,374	34,976	35,298
Illinois	11,752	12,130	12,068	11,918	12,195	12,720	13,303	13,612	14,026	13,881	13,824	13,123	12,983
Indiana	3,190	3,300	2,875	3,192	3,144	3,105	3,156	3,172	3,449	3,312	2,917	3,209	3,698
Kansas	7,936	7,757	7,370	7,373	7,617	7,545	7,394	7,805	6,807	7,210	7,701	8,549	9,091
Louisiana and Alabama	11,622	12,047	12,609	12,686	12,051	12,511	12,616	12,590	9,435	9,404	7,988	8,548	9,295
Maryland [3]	2,347	2,369	2,480	2,636	2,298	1,972	2,702	2,588	2,329	2,261	1,908	2,424	2,683
Michigan and Kentucky	2,320	2,515	2,593	2,611	2,676	2,719	2,781	2,609	2,556	2,407	2,715	2,645	2,861
Missouri [4]	4,462	4,416	4,620	4,544	4,459	4,417	4,320	4,526	4,620	4,682	4,410	4,225	4,367
Montana and Colorado	2,064	1,912	1,906	1,955	2,063	2,089	2,057	2,042	1,908	1,797	1,765	1,763	1,868
New Jersey	5,842	6,620	6,469	5,923	5,456	6,426	6,160	5,799	5,429	4,913	5,470	5,414	5,208
New Mexico	1,238	1,292	1,202	1,160	1,142	1,067	1,045	1,104	897	1,152	1,169	1,108	1,453
New York	1,149	1,350	1,219	1,064	1,061	1,066	1,079	1,129	1,130	1,143	1,262	1,367	1,106
Ohio	8,095	7,963	7,964	8,116	8,480	8,600	8,237	8,359	8,301	8,700	8,915	8,327	8,292
Oklahoma	53,506	52,917	52,717	54,668	54,240	54,555	54,811	54,146	47,130	44,714	44,165	44,467	44,436
Pennsylvania	6,630	6,423	6,226	6,080	6,655	6,933	6,939	7,155	6,930	6,569	6,754	6,395	6,580
Texas	92,403	89,666	90,414	91,073	93,543	91,058	87,156	85,057	65,770	65,903	65,384	68,419	70,683
West Virginia	2,338	2,335	2,246	2,219	2,283	2,224	2,311	2,318	2,347	2,267	2,269	2,150	2,053
Wyoming [5]	17,948	18,143	18,036	17,665	17,344	16,929	16,344	16,330	15,746	15,252	15,038	15,022	15,048
Total United States	273,560	272,346	273,416	276,355	278,565	278,087	273,314	270,570	238,479	234,555	230,854	234,027	238,910
ORIGIN													
Arkansas	3,089	3,180	3,054	3,157	3,217	3,377	3,309	3,404	2,966	2,885	2,555	2,874	2,846
California	36,400	36,927	38,323	39,383	39,699	39,878	38,902	38,427	38,072	37,372	35,533	35,129	35,478
Illinois and Indiana	11,403	12,126	12,696	12,705	13,183	13,982	14,573	15,203	16,299	16,584	17,041	16,341	16,932
Kansas	6,861	7,075	6,752	7,339	7,537	7,218	6,310	6,170	5,259	5,083	5,605	6,381	6,831
Louisiana	13,806	13,745	14,579	14,378	14,386	13,770	14,032	14,068	10,853	10,342	9,825	10,208	10,826
Michigan and Kentucky	2,377	2,595	2,772	2,836	2,892	2,963	3,012	2,911	3,115	2,966	3,071	2,594	2,501
Montana and Colorado	1,909	1,666	1,625	1,652	1,753	1,859	1,815	1,777	1,700	1,584	1,647	1,636	1,721
New Mexico	7,358	6,619	6,556	6,473	6,149	6,360	6,059	5,489	4,150	5,022	5,586	6,006	5,841
Ohio	756	666	784	689	656	693	740	485	592	673	686	667	670
Oklahoma	70,073	68,986	67,757	69,162	69,282	69,370	69,553	70,290	63,484	62,068	60,097	59,886	60,493
Pennsylvania, New York, and West Virginia	5,422	5,439	5,336	5,255	5,365	5,344	5,501	5,487	5,212	4,935	4,798	4,634	4,433
Texas	91,565	90,442	90,476	91,455	92,346	91,667	88,774	86,590	67,252	66,375	66,265	68,729	71,450
Wyoming	19,020	19,429	19,408	19,061	18,628	18,193	17,747	17,595	17,018	16,566	16,092	16,032	16,073
Foreign	3,521	3,451	3,298	2,810	3,472	3,413	2,987	2,674	2,507	2,100	2,053	2,910	2,815
Total United States	273,560	272,346	273,416	276,355	278,565	278,087	273,314	270,570	238,479	234,555	230,854	234,027	238,910

[1] Excludes stocks of California heavy crude. [2] Subject to revision. [3] Includes Delaware, Georgia, Massachusetts, Rhode Island, South Carolina, Tennessee, and Virginia.
[4] Includes Iowa and Nebraska pipe-line. [5] Includes South Dakota, Utah, and Nebraska refinery.

Stocks of refinable crude petroleum [1] in the United States in 1939, by districts and months [2]

[Thousands of barrels]

District	Jan. 1	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
At refineries, by fields of origin:													
Appalachian:													
Pennsylvania Grade	765	903	869	768	781	661	751	762	645	556	571	524	448
Other Appalachian (including Kentucky)	496	488	435	440	426	399	502	501	512	423	389	417	498
Lima-Northeastern Indiana-Michigan	515	504	622	694	741	675	799	874	1,164	1,061	1,174	824	640
Illinois-Southwestern Indiana	659	775	979	860	1,140	1,265	1,466	1,620	1,741	1,904	2,072	1,900	2,436
North Louisiana and Arkansas	2,244	2,094	2,464	2,910	3,148	3,146	2,969	2,833	2,054	1,958	1,643	2,013	2,039
West Texas and Southeastern New Mexico	3,800	5,056	5,196	4,881	4,122	4,369	4,317	4,523	3,974	4,153	4,945	4,738	4,590
East Texas	3,061	3,882	3,696	3,667	3,719	4,197	4,300	3,906	2,874	2,683	3,017	3,786	3,834
Oklahoma, Kansas, North Texas, etc.	14,130	14,133	12,975	12,587	11,875	11,387	11,614	11,269	10,290	10,858	10,250	11,662	11,302
Gulf Coast	10,000	9,383	9,488	9,785	8,989	9,040	9,740	10,652	9,691	8,057	8,767	8,715	9,287
Rocky Mountain	2,030	1,871	1,755	1,752	1,767	1,893	2,018	2,203	1,989	2,028	2,041	1,938	2,144
California	10,330	9,844	11,036	11,612	11,495	11,254	10,393	10,593	10,641	10,095	9,751	9,734	9,182
Foreign	3,521	3,451	3,298	2,810	3,472	3,413	2,987	2,674	2,507	2,100	2,053	2,910	2,815
Total at refineries	51,551	52,384	52,813	52,766	51,675	51,699	51,856	52,410	48,082	45,876	46,673	49,161	49,215
Pipe-line and tank-farm stocks, by fields of origin:													
Appalachian:													
Pennsylvania Grade	4,678	4,500	4,446	4,459	4,556	4,696	4,714	4,560	4,436	4,263	4,096	3,990	3,871
Other Appalachian (including Kentucky)	726	750	863	782	777	836	798	844	866	895	1,088	904	812
Lima-Northeastern Indiana-Michigan	880	1,055	1,142	1,129	1,122	1,223	1,124	837	796	876	737	746	842
Illinois-Southwestern Indiana	10,484	11,071	11,427	11,545	11,728	12,392	12,805	13,263	14,221	14,353	14,617	14,092	14,135
North Louisiana and Arkansas	5,521	5,809	5,872	5,565	5,552	5,497	5,634	5,411	4,487	4,338	3,995	3,979	3,877
West Texas and Southeastern New Mexico	19,757	18,578	17,902	17,811	17,389	17,544	16,933	16,927	12,796	14,370	14,344	14,997	15,843
East Texas	15,698	15,289	16,215	16,821	17,991	17,017	15,619	14,681	8,923	9,922	9,731	10,237	10,849
Oklahoma, Kansas, North Texas, etc.	93,921	90,380	89,780	92,323	93,391	93,623	92,186	90,149	78,842	74,920	73,090	73,460	75,224
Gulf Coast	17,776	18,356	18,840	18,890	20,012	19,318	18,088	18,341	13,814	13,896	13,655	14,022	15,133
Rocky Mountain	18,478	18,806	18,834	18,600	18,228	17,688	17,098	16,728	16,363	15,727	15,304	15,310	15,217
California	23,219	23,900	24,109	24,509	24,939	25,195	25,137	24,206	23,803	23,628	22,051	21,769	22,743
Total pipe-line and tank-farm	211,138	208,494	209,430	212,434	215,685	215,029	210,136	205,947	179,347	177,188	172,708	173,506	178,546
Producers' stocks	10,871	11,468	11,173	11,155	11,205	11,359	11,322	12,213	11,050	11,491	11,473	11,360	11,149
Total United States: 1939	273,560	272,346	273,416	276,355	278,565	278,087	273,314	270,570	238,479	234,555	230,854	234,027	238,910
1938 [3]	305,833	306,937	307,076	310,125	307,999	299,668	293,304	289,324	286,270	282,756	277,422	273,770	274,958

[1] Excludes stocks of California heavy crude; for 1939 figures see p. 947. [2] Subject to revision.
[3] Revisions of preliminary figures for 1938 (Minerals Yearbook, 1939, p. 957) are as follows (thousands of barrels): Pipe-line stocks, Jan. 31, N. Louisiana and Arkansas, 6041, and producers' stocks, Jan. 1, 11,240, Jan. 31, 12,124; Feb. 28, 12,453; Mar. 31, 13,220; Apr. 30, 11,777; May 31, 11,822; June 30, 11,957; July 31, 11,853; Aug. 31, 11,690; Sept. 30, 11,434; Oct. 31, 11,873; Nov. 30, 12,045; Dec. 31, 11,476.

CONSUMPTION AND DISTRIBUTION

Runs to stills.—Crude run to stills in 1939 totaled 1,238 million barrels, an increase of 73 million over 1938 and 54 million above the previous record figure of 1937. Foreign crude runs were 7 million barrels greater in 1939 than in 1938 but represented less than 3 percent of the total.

The outstanding change in refinery operations by districts was the further increase in runs in the Texas Gulf Coast and Illinois-Indiana districts. Crude runs in the Texas Gulf Coast district have risen from 282 million barrels in 1937 to 308 million in 1938 and 334 million in 1939. These increases represent a continuation of long-term trends that favor refining in the Gulf ports as convenient points for distribution of finished products via water to East Coast markets and for export. Crude runs in the Illinois-Indiana district were 164 million barrels in 1937, declined to 163 million in 1938, and rose to almost 192 million in 1939. The growth of refining in this district illustrates the advantage of the pipe-line movement of crude over rail movements of finished products to the important markets of the North Central States and has been stimulated further by the rapidly expanding production of crude in Illinois.

Crude runs of 192 million barrels in the East Coast district during 1939 were substantially above 1938 but not as large as in 1937. In the California district runs of 199 million barrels represented an additional small decline. Compared to 1938 there were minor changes in the amount of crude run in the Oklahoma-Kansas-Missouri district and in the Texas Inland district, but in both instances runs remained substantially below the 1937 level.

The increase in crude runs to stills in 1939 can be ascribed to improvement in domestic demand, as exports of refined products were substantially the same as in 1938. A small decrease of about 4 million barrels in total stocks of refined oils indicated that refinery operations as a whole closely approximated market demand for the year. Excess inventories for particular products represented the failure to liquidate previous accumulations or lack of balance in refinery yields.

Runs to stills of crude petroleum in the United States in 1939,[1] by districts and months

[Thousands of barrels]

District	January	February	March	April	May	June	July	August	September	October	November	December	Total
East Coast:													
Domestic	13, 460	12, 323	13, 484	13, 040	12, 140	12, 584	14, 154	14, 416	13, 521	14, 637	14, 536	14, 978	163, 273
Foreign	1, 719	1, 476	1, 924	2, 064	3, 687	3, 573	2, 678	2, 561	2, 899	2, 532	1, 913	2, 082	29, 108
Total East Coast	15, 179	13, 799	15, 408	15, 104	15, 827	16, 157	16, 832	16, 977	16, 420	17, 169	16, 449	17, 060	192, 381
Appalachian	3, 310	3, 131	3, 476	3, 265	3, 382	3, 460	3, 713	3, 853	3, 835	3, 857	4, 223	4, 262	43, 767
Indiana, Illinois, Kentucky, etc	14, 370	13, 544	14, 919	14, 818	15, 908	15, 675	15, 990	16, 030	16, 431	17, 842	18, 259	17, 848	191, 634
Oklahoma, Kansas, and Missouri	8, 977	8, 080	8, 559	9, 497	10, 226	9, 917	9, 724	9, 704	9, 538	9, 647	9, 228	9, 312	112, 409
Texas Inland	5, 529	5, 091	5, 181	5, 424	5, 658	5, 655	6, 085	5, 414	5, 197	5, 563	5, 322	5, 313	65, 432
Texas Gulf Coast:													
Domestic	27, 585	23, 581	27, 275	27, 106	29, 011	28, 038	28, 696	28, 920	27, 634	28, 713	26, 181	27, 241	329, 981
Foreign	199	250	147	145	253	419	529	400	507	494	225	252	3, 820
Total Texas Gulf Coast	27, 784	23, 831	27, 422	27, 251	29, 264	28, 457	29, 225	29, 320	28, 141	29, 207	26, 406	27, 493	333, 801
Louisiana Gulf Coast:													
Domestic	3, 861	3, 211	3, 985	4, 021	4, 211	3, 977	4, 357	4, 300	3, 943	4, 745	3, 838	3, 588	48, 037
Foreign	20	23	34	55	36	66	----------	61	77	61	96	33	562
Total Louisiana Gulf Coast	3, 881	3, 234	4, 019	4, 076	4, 247	4, 043	4, 357	4, 361	4, 020	4, 806	3, 934	3, 621	48, 599
Arkansas and Louisiana Inland	2, 094	1, 565	2, 004	1, 949	2, 039	2, 065	2, 003	2, 255	2, 148	2, 370	2, 166	2, 199	24, 857
Rocky Mountain	2, 112	1, 807	2, 012	2, 022	2, 259	2, 228	2, 268	2, 567	2, 437	2, 263	2, 273	2, 058	26, 306
California	16, 378	13, 715	15, 917	15, 897	16, 945	17, 030	16, 702	17, 151	17, 338	18, 256	16, 656	16, 669	198, 654
Total domestic	97, 676	86, 048	96, 812	97, 039	101, 779	100, 629	103, 692	104, 610	102, 022	107, 893	102, 682	103, 468	1, 204, 350
Total foreign	1, 938	1, 749	2, 105	2, 264	3, 976	4, 058	3, 207	3, 022	3, 483	3, 087	2, 234	2, 367	33, 490
Total United States	99, 614	87, 797	98, 917	99, 303	105, 755	104, 687	106, 899	107, 632	105, 505	110, 980	104, 916	105, 835	1, 237, 840
Daily average	3, 213	3, 136	3, 191	3, 310	3, 411	3, 490	3, 448	3, 472	3, 517	3, 580	3, 497	3, 414	3, 391

[1] Subject to revision.

Distribution.—Receipts of domestic and foreign crude petroleum at refineries in the United States totaled 1,167 million barrels in 1938 and 1,237 million in 1939. In 1939, receipts of foreign crude were 33 million barrels (less than 3 percent of the total); interstate receipts of domestic crude were 450 million barrels (36 percent of the total); and intrastate receipts were 754 million barrels (61 percent of the total). The interstate movement of crude declined further in relative importance in 1939, and the intrastate movement increased. The relative importance of the increase in intrastate deliveries in Illinois, Texas, Louisiana, and Michigan was offset to a considerable extent by a slight actual decrease in California and by the total increase in runs in districts receiving their supply mainly by interstate movement.

Refinery receipts of crude in 1939, by methods of transportation, indicated that 73 percent of the total was delivered by pipe lines, 24 percent by boat, and 3 percent by tank car and truck. These data show only fractional variations from the 1938 figures. The most important boat movement of crude is from Gulf ports to the East coast. These shipments increased from 151 million barrels in 1938 to 158 million in 1939.

Receipts of crude petroleum at refineries in the United States, 1935–39, by methods of transportation

[Millions of barrels]

	1935	1936	1937	1938	1939 [1]
By boat:					
Intrastate	55.4	68.6	78.5	74.1	72.7
Interstate	164.9	184.9	201.8	182.8	188.6
Foreign	32.2	32.3	27.5	26.4	33.1
Total by boat	252.5	285.8	307.8	283.3	294.4
By pipe lines:					
Intrastate	466.2	517.3	569.6	600.1	651.3
Interstate	220.9	247.2	276.7	254.3	250.5
Total by pipe lines	687.1	764.5	846.3	854.4	901.8
By tank car and truck:					
Intrastate	15.7	14.6	28.2	21.9	29.5
Interstate	9.7	7.6	8.5	7.8	10.9
Total by tank car and truck	25.4	22.2	36.7	29.7	40.4
Grand total	965.0	1,072.5	1,190.8	1,167.4	1,236.6

[1] Subject to revision.

The total demand for domestic crude in 1939 was 1,301 million barrels, an increase of 58 million over 1938. The amount of domestic crude run to stills rose to over 1,204 million barrels in 1939, an increase of 65 million.

The total market demand for crude by States of origin is computed from production and changes in stocks of State origin. This demand includes deliveries to domestic refineries, crude transferred to fuel oils, losses, and exports.

The most important changes in total market demand by States of origin in 1939 compared to 1938 were an increase of 66 million barrels in the demand for Illinois crude, a recession of 26 million barrels in the demand for Oklahoma crude, an increase of 15 million in the demand for Texas crude, and a drop of 12 million barrels in the demand for California crude. The increase in the demand for Louisiana crude was 3 million barrels, for Michigan crude 4 million, for Kansas crude 1 million, and for Wyoming crude 1 million. The demand for New Mexico crude was about the same.

Distribution of crude petroleum in the United States in 1939,[1] *by States*

[Thousands of barrels]

	Production	Imports	Refinery receipts							Runs to stills	Exports	Transfers to fuel
			Illinois	Kansas	Louisiana	New Mexico	Oklahoma	Texas	Other			
Arkansas	21,143								10,680	10,696	526	60
California	224,354								197,455	[2] 198,654	21,661	6,534
Colorado	1,391					6			2,552	2,563		32
Georgia [3]		1,367				90		25	450	1,679		
Illinois	94,302		[4] 37,408	3,717	230	5,064	8,853	1,966	613	[4] 57,651	9,365	422
Indiana	1,443		8,233	18,116		2,730	39,240	4,104	3,086	75,536		
Kansas	60,723			34,007			12,844	8		46,913		187
Kentucky [5]	5,618		4,239						6,250	10,359		
Louisiana:												
Gulf	68,466	549			28,675		668	[6] 14,098	[7] 4,269	[6, 7] 48,599	4,538	859
Inland	25,403				7,125			4,545	2,468	14,161		168
Maryland		2,981			2,266	598	480	5,855	330	12,614		
Massachusetts [8]		2,070			318	17		11,849		13,984		
Michigan	22,799		2,269				1,555		15,180	18,711		232
Missouri	(9)		78	796			2,610	11	3,815	7,319		
Montana	5,961								7,010	7,090	252	74
New Jersey		8,826	1,184		7,417	6,832	4,831	38,835	4,673	72,896		
New Mexico	37,323					1,452		395		1,848	693	72
New York:												
East		3,257						6,172		9,328		
West	5,098		2,741				841		4,562	8,316		
Ohio:												
East	2,576		9,953				671		2,724	13,377		
West	580		12,091		5		11,063	527	5,881	29,377		
Oklahoma	160,072			3,826			53,789	592		58,177	4,002	340
Pennsylvania:												
East		10,352			6,654	4,848	6,842	53,325	234	81,880		
West	17,337		85				1,962		16,789	18,837		
Texas:												
Gulf	122,443	3,693			36,772	14,337	16,310	260,041	1,665	333,801	31,036	1,514
Inland	362,084				615	2,188	1,449	60,800	412	65,432		1,656
Utah	(9)					8		102	2,675	2,804		
West Virginia	3,580		289				583		2,365	3,237		
Wyoming	21,417								[10] 12,236	[10] 12,001		259
Other	[11] 143											
U. S. total	1,264,256	33,095	78,570	60,462	90,077	38,170	164,591	463,250	308,374	1,237,840	72,073	12,409

[1] Subject to revision. [2] Includes Washington. [3] Includes Delaware, South Carolina, and Virginia. [4] Includes Minnesota. [5] Includes Tennessee. [6] Includes Alabama. [7] Includes Mississippi. [8] Includes Rhode Island. [9] Included in "Other." [10] Includes Idaho, Nebraska, and South Dakota. [11] Includes Mississippi, Missouri, and Utah.

Data on receipts of crude petroleum at refineries represent the principal bases for determining the trends of distribution of the market demand by States of origin. In 1939 Texas, Oklahoma, California, Louisiana, Illinois, Kansas, and New Mexico supplied about 91 percent of the total refinery receipts of domestic crude, or approximately the same percentage as in 1938. As the relative standing of these seven States as a whole remained the same, the principal factor of interest was the competitive change in individual position.

The total demand for California crude fell from 240 million barrels in 1938 to 228 million in 1939. California crude is primarily refined in California or exported, as shipments to Eastern States totaled only about 1 million barrels in both 1938 and 1939. The 12-million-barrel decrease in the demand for California crude in 1939 represented a reduction of 6 million barrels in exports, of 2 million in the amount run to stills, and of 4 million in crude transfers to fuel and losses.

The total demand for Texas crude was about 505 million barrels in 1939, almost 15 million barrels more than in 1938 but only 3 million greater than in 1937. All of the increase in demand in 1939 can be attributed to deliveries to intrastate refineries, as exports were less and deliveries to refineries in other States declined by 4 million barrels. Deliveries to the East Coast district totaled 116 million barrels—a gain of 4 million—while shipments to Louisiana fell to 18 million—a loss of 6 million barrels.

The total demand for Louisiana crude was 97 million barrels in 1939, a gain of less than 3 million over 1938. Intrastate deliveries increased by 6 million barrels, but there was a decrease in shipments of crude to other States, mainly the Texas Gulf district. Total deliveries to the East Coast district remained the same at about 17 million barrels.

The total demand for New Mexico crude was about 39 million barrels, essentially the same as in 1938. The major part of the production was marketed in other States, as intrastate deliveries were less than 2 million barrels. Shipments to the East Coast district totaled 12 million barrels in 1939, an increase of about 2 million that was offset by a reduction in shipments to the Illinois-Indiana district.

The total demand for Illinois crude increased from 23 million barrels in 1938 to 89 million in 1939, a rise of 66 million barrels. Intrastate deliveries to refineries increased by 29 million barrels—from 8 million in 1938 to 37 million in 1939. Deliveries to refineries in other States rose from 12 million in 1938 to 41 million in 1939, a gain of 29 million. Interstate deliveries represented an increase of 8 million barrels to refineries in Indiana, of 12 million to Ohio, of 3 million to western New York, of 2 million to Kentucky, and of 2 million to Michigan. Pipe-line shipments to East Coast refineries totaled over 1 million barrels and will increase materially in 1940. Exports to Canada gained about 8 million barrels, replacing Oklahoma crude in the movement across the northern border. A considerable part of the increased demand for Illinois crude was due to the cheaper transportation costs from fields close to refinery centers and to a greater relative increase in total refinery operations in the Illinois-Indiana district.

The total demand for Oklahoma crude dropped from 195 million barrels in 1938 to 169 million in 1939, a decline of 26 million. The major part of this decrease was in interstate and export movements, as intrastate deliveries declined by only 1 million barrels. The major changes in deliveries to refineries in other States were a decline of 12 million barrels in Illinois, of 6 million in Ohio, of 2 million in Indiana, and of 2 million in Michigan. On the other hand, deliveries to the Gulf Coast district increased 3 million barrels and to the East Coast district 2 million.

The total demand for Kansas crude was 61 million barrels in 1939, an increase of about 1 million. Intrastate deliveries were about the same, at 34 million barrels. The interstate market is restricted primarily to Indiana, Illinois, Oklahoma, and Missouri. Combined deliveries to Indiana and Illinois amounted to 22 million barrels in 1939, a decline of 1 million, while total shipments to Oklahoma and Missouri increased by almost 2 million barrels.

The demand for Wyoming crude increased by about 1 million barrels (largely in pipe-line shipments to Missouri and Indiana) to a total of 24 million. Deliveries to refineries in Wyoming and other Mountain States remained about the same. The total demand for Michigan crude rose from less than 19 million barrels in 1938 to about 23 million in 1939, most of this increase being in deliveries to refineries within the State. The demand for Arkansas crude increased by over 2 million barrels in 1939 to a total of 21 million. About half of this crude was delivered to refineries in the State.

PRICES AND VALUE

The average value of crude petroleum at wells receded in 1939, although most postings remained unchanged throughout the year. The average in 1938 was $1.13, whereas that in 1939 is estimated at $1.00. The final figure for 1939 may be several cents lower, as under-

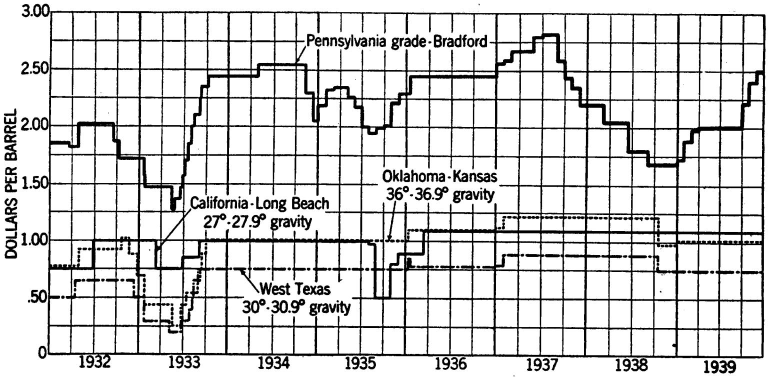

FIGURE 5.—Posted prices of selected grades of crude petroleum, 1932–39, by months.

selling was reported rife in Illinois and a few other States. This underselling weakened some quotations, which were restored after the August shut-down. The only active price was that for Pennsylvania Grade, which advanced from $1.68 on January 1 to $2.50 on December 31, in six steps; it rose 25 cents more on January 1, 1940.

Details of price changes for selected grades of crude petroleum are presented in the tables that follow and in figure 5.

Average monthly prices per barrel for selected grades of crude petroleum at wells in 1939

Month	Pennsylvania Grade: Bradford	Pennsylvania Grade: Southwest Pennsylvania	Illinois Basin	Oklahoma-Kansas 36°-36.9°	Panhandle, Tex. (Carson and Hutchinson Counties, 35°-35.9°)	West Texas 30°-30.9°	East Texas	Gulf-Coast Grade, 30°-30.9°	California (Long Beach 27°-27.9°)
January	$1.72	$1.37	$1.15	$1.02	$0.81	$0.75	$1.10	$1.08	$1.10
February	1.88	1.53	1.15	1.02	.81	.75	1.10	1.08	1.10
March	1.98	1.63	1.15	1.02	.81	.75	1.10	1.08	1.10
April	2.00	1.65	1.15	1.02	.81	.75	1.10	1.08	1.10
May	2.00	1.65	1.15	1.02	.81	.75	1.10	1.08	1.10
June	2.00	1.65	1.07	1.02	.81	.75	1.10	1.08	1.10
July	2.00	1.65	1.05	1.02	.81	.75	1.10	1.08	1.10
August	2.00	1.65	1.05	1.02	.81	.75	1.10	1.08	1.10
September	2.00	1.65	1.05	1.02	.81	.75	1.10	1.08	1.10
October	2.21	1.86	1.05	1.02	.81	.75	1.10	1.08	1.10
November	2.40	2.05	1.05	1.02	.81	.75	1.10	1.08	1.10
December	2.50	2.15	1.05	1.02	.81	.75	1.10	1.08	1.10
Average for year	2.06	1.71	1.09	1.02	.81	.75	1.10	1.08	1.10

Posted price per barrel of petroleum at wells in 1939, 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.[2]	Western Kentucky [3]	Illinois Basin [4]	Midland, Mich.[5]	Oklahoma-Kansas [6]: 34°-34.9°	Oklahoma-Kansas [6]: 36°-36.9°
Jan. 1	$1.68	$1.34	$0.97	$1.10	$1.15	$0.925	$0.98	$1.02
Jan. 21	1.80	1.43						
Jan. 24			1.02					
Feb. 1	1.88	1.53						
Mar. 6	2.00	1.65						
Apr. 17						.975		
June 8				1.00	1.05			
Oct. 6	2.25	1.90						
Oct. 9						1.02		
Nov. 1	2.40	2.05						
Nov. 4			1.12					
Dec. 1	2.50	2.15						
	2.06	1.71	1.03	1.04	1.09	.97	.98	1.02

Date	Panhandle, Texas (Carson and Hutchinson Counties, 35°-35.9°)[7]	West Texas 30°-30.9 [7]	Hobbs, N. Mex.[7]	Southwest Texas, Duval County, 22°-22.9° [7]	Van, Texas, 34°-34.9° [5]	East Texas [7]	Gulf Coast: Conroe, Tex.[8]	Gulf Coast: 30°-30.9° [7]	Gulf Coast: 20°-20.9° [7]
Jan. 1	$0.81	$0.75	$0.75	$0.83	$0.93	$1.10	$1.27	$1.08	$0.82
	.81	.75	.75	.83	.93	1.10	1.27	1.08	.82

Date	Rodessa, La., 36°-36.9° [9]	Smackover, Ark.[9]	Salt Creek, Wyo., 36°-36.9° [6]	Kevin-Sunburst, Mont.[4]	California [10]: Kettleman Hills, 38°-38.9°	California [10]: Long Beach, 27°-27.9°	California [10]: Midway-Sunset, 19°-19.9°	California [10]: Santa Fe Springs, 33°-33.9°
Jan. 1	$0.97	$0.73	$1.02	$1.20	$1.39	$1.10	$0.74	$1.20
Aug. 14	.77	.60						
Aug. 30	.97	.73						
	.96	.72	1.02	1.20	1.39	1.10	.74	1.20

[1] The Tide-Water Pipe Co., Ltd. [2] The Joseph Seep Purchasing Agency.
[3] Fordsville Gathering Line until May 1; Owensboro Ashland Co., May 1 to Dec. 31.
[4] The Ohio Oil Co. [5] The Pure Oil Co.
[6] Stanolind Oil & Gas Co. [7] Humble Oil & Refining Co. [8] The Texas Co.
[9] Standard Oil Co. of Louisiana. [10] Standard Oil Co. of California.

Value of crude petroleum at wells in the United States, 1937–38, by States [1]

State	1937		1938	
	Total (thousands of dollars)	Average per barrel	Total (thousands of dollars)	Average per barrel
Arkansas	11,400	$0.97	16,900	$0.93
California	242,100	1.02	257,250	1.03
Colorado	1,800	1.12	1,540	1.09
Illinois	9,970	1.33	30,100	1.25
Indiana	1,140	1.35	1,260	1.27
Kansas	88,100	1.25	72,100	1.20
Kentucky	7,680	1.40	7,570	1.30
Louisiana:				
Gulf Coast	75,800	1.22	77,100	1.16
Northern	34,500	1.19	33,000	1.15
Total Louisiana	110,300	1.21	110,100	1.16
Michigan	21,950	1.32	19,300	1.03
Montana	7,300	1.26	5,190	1.05
New Mexico	36,600	.94	33,250	.93
New York	14,140	2.58	9,550	1.89
Ohio	5,820	1.64	3,860	1.17
Oklahoma	283,500	1.24	209,500	1.20
Pennsylvania	49,300	2.57	32,760	1.88
Texas:				
Gulf Coast	139,600	1.22	137,250	1.19
East Texas proper	223,700	1.31	194,700	1.28
West Texas	71,800	.95	65,500	.90
Rest of State	159,400	1.07	141,700	1.05
Total Texas	594,500	1.16	539,150	1.13
West Virginia	8,800	2.29	5,600	1.52
Wyoming	18,860	.98	18,000	.95
Other States [2]	80	1.04	80	.98
Total United States	1,513,340	1.18	1,373,060	1.13

[1] Figures for 1939 not yet available. [2] Missouri, Tennessee, and Utah.

ROYALTIES ON INDIAN AND FEDERAL LANDS

Minerals Yearbook, 1938 (p. 853), presented data up to 1937 on royalty receipts, bonuses, etc., concerning Indian and Federal lands. Minerals Yearbook, 1939 (p. 966), gave similar data for 1938. Corresponding information for 1939 is as follows: Acreage of leases on Indian lands for the fiscal year 1939, 59,360; bonuses from sale of these leases, $170,215; royalty from production of oil and gas, $3,938,056; and advance royalty and annual rentals, $535,245. For the calendar year 1939, the production of crude petroleum on Government lands was 42,331,057 barrels, of which 5,093,276 barrels (valued at $5,168,248) was royalty.

REFINED PRODUCTS

Crude oil run to stills increased from 1,165 million barrels in 1938 to 1,238 million in 1939, but production of natural gasoline fell from 51,347,000 barrels to 49,896,000. In response to increased activity in the steel industry, benzol production recovered from 1,764,000 barrels in 1938 to 2,440,000 in 1939.

The new record of 552,557,000 barrels for domestic motor-fuel demand is 5.7 percent higher than the 1938 demand. Gas-oil and distillate fuel-oil consumption at 131,935,000 barrels (old basis) was 12 percent above the 1938 demand, while that for residual fuel oil at 321,228,000 barrels (old basis) was 10 percent higher. The demand was also higher for kerosene, lubricants, wax, coke, asphalt, road oil, and still gas.

Comparative analyses of statistics for the major refined products, 1935–39

[Thousands of barrels, except as otherwise indicated]

	1935	1936	1937	1938	1939 [1]
Motor fuel:					
Production	468,021	516,266	571,727	569,162	607,941
Imports	----------	78	144	79	118
Exports	30,613	28,646	38,306	50,109	44,559
Stocks, end of period	54,345	60,437	74,650	70,779	82,865
Domestic demand	434,810	481,606	519,352	523,003	552,557
Kerosene:					
Production	55,813	56,082	65,308	64,580	68,521
Exports	6,651	6,936	8,886	7,504	8,243
Stocks, end of period	7,915	5,633	7,083	7,799	7,576
Domestic demand	47,646	51,428	54,972	56,360	60,501
Gas oil and distillate fuel oils:					
Production	100,235	125,906	146,706	151,774	161,670
Transfers [2]	(3)	(3)	(3)	623	6,491
Imports	15	182	17	----------	171
Exports	16,249	20,448	30,129	29,641	32,021
Stocks, end of period	19,930	22,813	22,566	27,873 [4] 36,224	33,718
Domestic demand	86,028	102,757	116,841	117,449	[5] 138,817
Residual fuel oils:					
Production	259,826	287,968	312,064	294,890	306,896
Transfers [2]	13,067	15,732	17,423	10,037	5,918
Imports	16,115	18,801	22,114	21,065	15,932
Exports	12,699	14,435	15,304	17,920	17,490
Stocks, end of period	[6] 84,054	[6] 84,236	[6] 95,019 [7] 81,507	97,746 [4] 101,971	92,290
Domestic demand	280,695	307,884	325,514	291,833	[5] 320,937
Lubricants:					
Production	27,853	30,927	35,321	30,826	35,036
Imports	1	4	7	7	----------
Exports	8,499	8,691	10,975	9,417	11,981
Stocks, end of period	7,025	6,942 [8] 6,482	7,512	7,695	7,142
Domestic demand	19,661	22,323	23,323	21,233	23,613
Wax (thousands of pounds):					
Production	450,240	472,920	521,640	435,400	464,520
Imports	19,557	16,669	36,929	28,927	39,912
Exports	229,905	187,342	231,723	201,447	232,664
Stocks, end of period	114,675	115,434	144,992	129,340	75,648
Domestic demand	261,353	301,488	297,288	278,532	325,460
Coke (thousands of short tons):					
Production	1,458.0	1,378.2	1,306.6	1,602.2	1,666.4
Exports	133.5	124.6	164.3	155.6	285.8
Stocks, end of period	388.9	389.4	378.6	707.5	666.0
Domestic demand	1,340.7	1,253.1	1,153.1	1,117.7	1,422.1
Asphalt (thousands of short tons):					
Production	3,115.1	3,868.8	4,182.0	4,341.4	4,954.4
Imports	54.0	21.6	34.1	33.2	44.2
Exports	232.8	211.4	45.5	49.9	42.6
Stocks, end of period	429.7	364.2	557.4	490.4	550.0
Domestic demand	2,845.8	3,744.5	3,977.4	4,391.7	4,887.0
Road oil:					
Production	6,030	7,398	8,087	7,543	7,868
Stocks, end of period	732	851	984	680	702
Domestic demand	5,962	7,279	7,954	7,847	7,846
Other finished products:					
Production	1,888	2,148	2,382	1,921	2,359
Imports	150	----------	----------	----------	----------
Exports	76	71	101	112	123
Stocks, end of period	220	198	230	263	276
Domestic demand	1,973	2,099	2,249	1,776	2,223

[1] Subject to revision.
[2] Net transfers from crude oil to fuel oil; California only, 1935–38; in 1939 all transfers east of California included in gas oil, etc.
[3] Figures not available.
[4] Includes terminal stocks; compares with succeeding years.
[5] On new basis; see p. 1011.
[6] California heavy crude included.
[7] For comparison with succeeding year; California heavy crude included in crude-oil stocks.
[8] For comparison with succeeding years.

The total refinery output of gasoline in 1939—of about 596 million barrels—included about 261 million barrels of straight-run gasoline, 295 million of cracked gasoline, and 40 million of natural gasoline.

The yield of gasoline again increased comprising 44.9 percent of the crude oil run to stills in 1939 compared with 44.3 percent in 1938. The yield of gas oil and distillate fuel oil remained virtually the same as in 1938 at 13.1 percent, while the yield of residual fuel oil declined further from 25.3 percent in 1938 to 24.8 in 1939. (See fig. 6.)

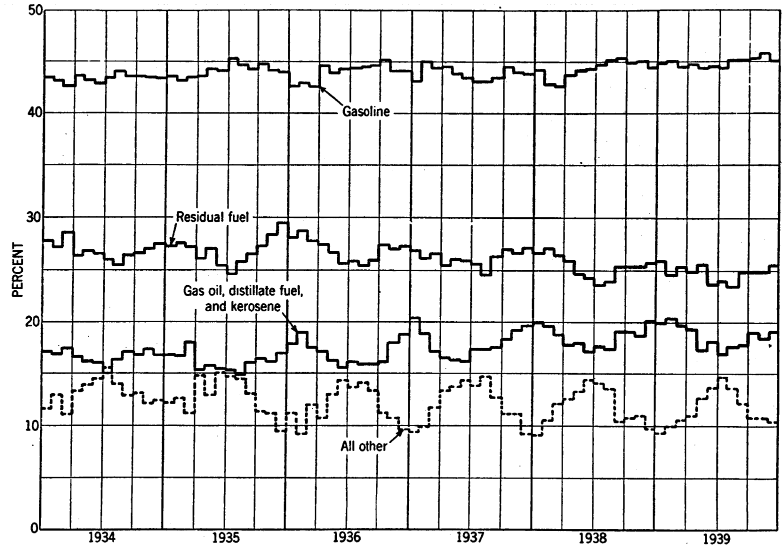

FIGURE 6.—Yields of principal petroleum products from crude oil run to stills, 1934–39, by months.

Runs to stills and production at refineries of the various refined products, 1935–39

[Thousands of barrels, except as otherwise indicated]

	1935	1936	1937	1938	1939 [1]
Input:					
Crude petroleum:					
Domestic	933, 659	1, 034, 637	1, 157, 444	1, 138, 828	1, 204, 350
Foreign	32, 131	33, 933	25, 996	26, 187	33, 490
Total crude petroleum	965, 790	1, 068, 570	1, 183, 440	1, 165, 015	1, 237, 840
Natural gasoline	31, 025	33, 817	39, 381	39, 961	40, 320
Total input	996, 815	1, 102, 387	1, 222, 821	1, 204, 976	1, 278, 160
Output:					
Gasoline	457, 842	504, 811	559, 141	556, 012	595, 925
Kerosene	55, 813	56, 082	65, 308	64, 580	68, 521
Gas oil and distillate fuel oils	100, 235	125, 906	146, 706	151, 774	161, 670
Residua fuel oils	259, 826	287, 968	312, 064	294, 890	306, 896
Lubricants	27, 853	30, 927	35, 321	30, 826	35, 036
Wax	1, 608	1, 689	1, 863	1, 555	1, 659
Coke	7, 290	6, 891	6, 533	8, 011	8, 332
Asphalt	17, 133	21, 278	23, 001	23, 878	27, 248
Still gas	51, 184	57, 046	64, 218	65, 890	66, 979
Wax thousands of pounds	450, 240	472, 920	521, 640	435, 400	464, 520
Coke thousands of short tons	1, 458. 0	1, 378. 2	1, 306. 6	1, 602. 2	1, 666. 4
Asphalt do	3, 115. 1	3, 868. 8	4, 182. 0	4, 341. 4	4, 954. 4
Still gas millions of cubic feet	197, 220	226, 466	241, 981	250, 382	254, 520
Road oil	6, 030	7, 398	8, 087	7, 543	7, 868
Other finished products	1, 888	2, 148	2, 382	1, 921	2, 359
Crude gasoline (net)	1, 032	486	[2] 128	[2] 1, 616	[2] 167
Other unfinished oils (net)	[2] 2, 412	[2] 8, 962	[2] 7, 931	[2] 4, 530	[2] 11, 511
Shortage	11, 493	8, 719	6, 256	4, 242	7, 345
Total output	996, 815	1, 102, 387	1, 222, 821	1, 204, 976	1, 278, 160

[1] Subject to revision.
[2] Negative quantity; represents net excess of unfinished oils rerun over unfinished oils produced.

Runs to stills and production at refineries in the United States of the various refined products, 1938–39, by months

[Thousands of barrels, except as otherwise indicated]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1938													
Input:													
Crude petroleum [1]	97,900	88,179	95,885	95,675	99,238	93,880	99,856	101,352	96,990	100,787	97,309	97,964	1,165,015
Natural gasoline [2]	3,557	2,728	3,233	2,856	2,799	2,635	2,935	2,950	3,329	4,432	4,222	4,285	39,961
Total input	101,457	90,907	99,118	98,531	102,037	96,515	102,791	104,302	100,319	105,219	101,531	102,249	1,204,976
Crude oil charged to cracking stills [3]	12,645	11,632	12,312	11,128	12,523	10,916	12,075	12,582	11,392	13,377	12,256	12,919	145,757
Other oils charged to cracking stills	43,944	38,824	42,576	43,642	45,881	45,571	48,009	48,660	46,860	46,792	44,674	44,961	540,394
Output:													
Gasoline	46,811	40,495	44,175	44,667	46,581	44,247	47,607	48,662	47,312	49,677	47,998	47,780	556,012
Kerosene	5,638	5,167	5,798	5,445	5,649	5,235	4,889	4,933	5,348	5,320	5,419	5,739	64,580
Gas oil and distillate fuel oils	13,876	12,144	12,294	11,577	12,160	10,784	12,688	12,691	13,074	13,820	12,793	13,873	151,774
Residual fuel oil	26,148	23,935	25,269	24,748	24,456	22,760	23,542	24,230	24,551	25,477	24,573	25,201	294,890
Lubricants	2,785	2,468	2,697	2,530	2,595	2,378	2,631	2,576	2,615	2,632	2,535	2,384	30,826
Wax	149	124	142	113	127	135	108	114	130	150	134	129	1,555
Coke	631	610	570	635	689	685	688	742	554	734	764	709	8,011
Asphalt	1,163	1,043	1,544	1,819	2,403	2,412	2,604	2,817	2,475	2,499	1,755	1,344	23,878
Still gas	5,227	4,718	5,191	5,363	5,832	5,677	6,020	6,043	5,577	5,646	5,373	5,223	65,890
Wax...thousands of pounds	41,720	34,720	39,760	31,640	35,560	37,800	30,240	31,920	36,400	42,000	37,520	36,120	435,400
Coke...thousands of short tons	126.2	122.0	114.0	127.0	137.8	137.0	137.6	148.4	110.8	146.8	152.8	141.8	1,602.2
Asphalt...do	211.5	189.6	280.7	330.7	436.9	438.5	473.4	512.2	450.0	454.4	319.1	244.4	4,341.4
Still gas...millions of cubic feet	19,863	17,928	19,726	20,379	22,162	21,573	22,876	22,963	21,193	21,455	20,417	19,847	250,382
Road oil	162	155	229	429	667	1,214	1,385	1,427	958	554	195	168	7,543
Other finished products	150	157	201	167	187	160	160	142	137	152	143	165	1,921
Crude gasoline (net)	[4] 462	504	7	69	[4] 151	[4] 354	[4] 352	[4] 245	[4] 440	[4] 188	[4] 283	279	[4] 1,616
Other unfinished oils (net)	[4] 1,184	[4] 711	631	435	378	729	377	[4] 269	[4] 2,235	[4] 1,775	[4] 28	[4] 878	[4] 4,530
Shortage	363	98	370	534	464	453	444	439	263	521	160	133	4,242
Total output	101,457	90,907	99,118	98,531	102,037	96,515	102,791	104,302	100,319	105,219	101,531	102,249	1,204,976

1939 [5]													
Input:													
Crude petroleum [1]	99, 614	87, 797	98, 917	99, 303	105, 755	104, 687	106, 899	107, 632	105, 505	110, 980	104, 916	105, 835	1, 237, 840
Natural gasoline [2]	3, 637	3, 229	3, 243	2, 983	2, 646	2, 682	2, 909	3, 092	3, 237	4, 358	4, 286	4, 018	40, 320
Total input	103, 251	91, 026	102, 160	102, 286	108, 401	107, 369	109, 808	110, 724	108, 742	115, 338	109, 202	109, 853	1, 278, 160
Crude oil charged to cracking stills [3]	13, 561	11, 988	13, 266	12, 525	12, 432	10, 885	10, 506	10, 898	9, 786	10, 286	10, 072	11, 140	137, 345
Other oils charged to cracking stills [6]	44, 899	40, 464	45, 081	44, 663	47, 406	49, 784	50, 461	----------	----------	----------	----------	----------	322, 758
Output:													
Gasoline	48, 308	42, 721	47, 186	47, 426	49, 620	49, 274	50, 439	51, 643	50, 770	54, 592	52, 322	51, 624	595, 925
Kerosene	5, 702	5, 174	5, 900	5, 813	5, 909	5, 439	5, 390	5, 783	5, 806	6, 141	5, 642	5, 822	68, 521
Gas oil and distillate fuel oils	14, 122	12, 709	13, 539	13, 301	12, 353	13, 530	12, 688	13, 246	12, 975	15, 017	13, 757	14, 433	161, 670
Residual fuel oil	25, 813	21, 564	25, 040	24, 750	27, 022	24, 836	25, 644	25, 299	26, 302	27, 594	26, 088	26, 944	306, 896
Lubricants	2, 527	2, 522	2, 664	2, 672	2, 856	2, 800	2, 755	3, 056	2, 854	3, 575	3, 277	3, 478	35, 036
Wax	126	119	160	125	123	141	103	111	144	161	173	173	1, 659
Coke	630	586	640	710	661	711	726	716	554	826	796	776	8, 332
Asphalt	1, 344	1, 041	1, 695	2, 062	2, 628	2, 672	2, 802	3, 175	3, 027	2, 980	2, 152	1, 670	27, 248
Still gas	5, 081	4, 629	5, 376	5, 386	5, 798	5, 768	5, 920	5, 925	5, 609	5, 970	5, 756	5, 761	66, 979
Wax ... thousands of pounds	35, 280	33, 320	44, 800	35, 000	34, 440	39, 480	28, 840	31, 080	40, 320	45, 080	48, 440	48, 440	464, 520
Coke ... thousands of short tons	126. 0	117. 2	128. 0	142. 0	132. 2	142. 2	145. 2	143. 2	110. 8	165. 2	159. 2	155. 2	1, 666. 4
Asphalt ... do	244. 4	189. 3	308. 2	374. 9	477. 8	485. 8	509. 4	577. 3	550. 4	541. 8	391. 4	303. 7	4, 954. 4
Still gas ... millions of cubic feet	19, 308	17, 590	20, 429	20, 467	22, 032	21, 918	22, 496	22, 515	21, 314	22, 686	21, 873	21, 892	254, 520
Road oil	323	173	312	408	866	1, 183	1, 478	1, 476	878	501	151	119	7, 868
Other finished products	165	174	168	238	241	192	195	212	218	164	198	194	2, 359
Crude gasoline (net)	112	181	132	24	[4] 50	35	126	[4] 132	[4] 393	[4] 291	[4] 32	393	[4] 167
Other unfinished oils (net)	[4] 1, 155	[4] 996	1, 011	[4] 996	[4] 219	9	499	[4] 518	[4] 1, 071	[4] 2, 654	[4] 1, 520	[4] 1, 879	[4] 11, 511
Shortage	377	429	359	415	593	779	1, 043	732	1, 069	762	442	345	7, 345
Total output	103, 251	91, 026	102, 160	102, 286	108, 401	107, 369	109, 808	110, 724	108, 742	115, 338	109, 202	109, 853	1, 278, 160

[1] Detail by districts and months in section on "Consumption and distribution of crude petroleum."
[2] Includes 1,349,000 barrels run through pipe lines in California in 1938 and 1,147,000 barrels in 1939.
[3] Included above in crude-petroleum input. [4] Negative quantity; represents net excess rerun over production.
[5] Subject to revision. [6] Not available after July 1939.

Runs to stills and production at refineries in the United States of the various refined products, 1938–39, by districts

[Thousands of barrels, except as otherwise indicated]

	East Coast	Appalachian	Indiana, Illinois, Kentucky, etc.	Oklahoma, Kansas, and Missouri	Texas Inland	Texas Gulf Coast	Louisiana Gulf Coast	Arkansas and Louisiana Inland	Rocky Mountain	California	United States
1938											
Input:											
Crude petroleum [1]	180,606	39,180	163,140	111,143	66,923	307,906	46,903	24,089	24,791	200,334	1,165,015
Natural gasoline [2]	1,198	269	4,488	5,772	6,625	6,063	382	737	803	13,624	39,961
Total input	181,804	39,449	167,628	116,915	73,548	313,969	47,285	24,826	25,594	213,958	1,204,976
Crude oil charged to cracking stills [3]	22,843	5,268	19,188	2,814	2,169	76,446	7,975	1,563	1,960	5,531	145,757
Other oils charged to cracking stills	87,540	13,629	97,667	58,468	32,793	117,494	22,199	6,669	9,566	94,368	540,393
Output:											
Gasoline	73,547	19,380	95,511	65,719	42,764	139,663	17,206	10,775	13,919	77,528	556,012
Kerosene	9,208	2,769	7,096	6,960	2,985	22,357	6,037	2,139	810	4,219	64,580
Gas oil and distillate fuel oils	28,559	2,446	17,397	11,163	4,217	47,529	7,450	2,341	1,689	28,983	151,774
Residual fuel oils	50,803	4,725	23,319	19,101	15,871	73,774	10,643	5,697	4,916	86,041	294,890
Lubricants	7,613	5,763	2,609	2,962	213	7,628	1,097	452	205	2,284	30,826
Wax	702	296	113	110	7	215	70	1	41	----------	1,555
Coke	19	100	4,889	1,068	507	705	303	6	329	85	8,011
Asphalt	9,303	623	3,331	1,878	1,077	1,156	1,264	1,064	863	3,319	23,878
Still gas	7,988	2,187	12,244	6,495	3,959	20,959	2,290	1,512	1,347	6,909	65,890
Wax, thousands of pounds	196,560	82,880	31,640	30,800	1,960	60,200	19,600	280	11,480	----------	435,400
Coke, thousands of short tons	3.8	20.0	977.8	213.6	101.4	141.0	60.6	1.2	65.8	17.0	1602.2
Asphalt, do	1691.5	113.2	605.7	341.4	195.8	210.1	229.8	193.5	157.0	603.4	4341.4
Still gas, millions of cubic feet	30,354	8,311	46,527	24,681	15,044	79,644	8,702	5,746	5,119	26,254	250,382
Road oil	907	140	1,714	703	2	233	171	75	1,114	2,484	7,543
Other finished products	790	170	295	120	58	104	47	1	97	239	1,921
Crude gasoline (net)	[4] 94	[4] 8	[4] 952	386	[4] 83	[4] 590	[4] 372	[4] 6	2	101	[4] 1,616
Other unfinished oils (net)	[4] 6,978	[4] 45	258	[4] 986	853	543	463	687	78	597	[4] 4,530
Shortage	[5] 563	903	[5] 196	1,236	1,118	[4] 307	616	82	184	1,169	4,242
Total output	181,804	39,449	167,628	116,915	73,548	313,969	47,285	24,826	25,594	213,958	1,204,976

1939 [6]											
Input:											
Crude petroleum [1]	192,381	43,767	191,634	112,409	65,432	333,801	48,599	24,857	26,306	198,654	1,237,840
Natural gasoline [2]	2,140	297	4,516	5,112	6,189	6,115	330	533	711	14,377	40,320
Total input	194,521	44,064	196,150	117,521	71,621	339,916	48,929	25,390	27,017	213,031	1,278,160
Crude oil charged to cracking stills [3] [7]	18,353	5,198	22,392	2,250	3,812	70,602	4,591	2,146	2,151	5,850	137,345
Output:											
Gasoline	78,625	21,805	109,447	65,494	43,156	153,475	18,399	10,684	15,066	79,774	595,925
Kerosene	9,120	2,847	8,476	7,073	2,977	23,224	6,898	2,470	782	4,654	68,521
Gas oil and distillate fuel oils	30,638	2,868	18,963	10,813	2,903	54,362	7,706	1,585	1,809	30,023	161,670
Residual fuel oils	55,392	5,415	28,962	19,011	14,769	78,391	12,076	6,170	5,728	80,982	306,896
Lubricants	9,055	6,128	3,111	3,100	221	8,454	1,504	538	180	2,745	35,036
Wax	678	347	136	114	10	254	80		40		1,659
Coke	34	116	4,600	924	510	901	2		308	937	8,332
Asphalt	10,130	782	5,330	1,949	905	1,599	1,429	988	362	3,774	27,248
Still gas	10,214	2,289	13,769	5,883	3,412	20,446	2,244	525	1,291	6,906	66,979
Wax .... thousands of pounds	189,840	97,160	38,080	31,920	2,800	71,120	22,400		11,200		464,520
Coke .... thousands of short tons	6.8	23.2	920.0	184.8	102.0	180.2	.4		61.6	187.4	1,666.4
Asphalt .... do	1,841.9	142.2	969.2	354.3	164.6	290.9	259.8	179.5	65.8	686.2	4,954.4
Still gas .... millions of cubic feet	38,814	8,698	52,321	22,354	12,966	77,694	8,528	1,997	4,906	26,242	254,520
Road oil	370	123	2,206	1,006	286	125	1	471	819	2,461	7,868
Other finished products	823	233	556	129	82	147	103	1	74	211	2,359
Crude gasoline (net)	223	118	[4] 19	174	22	[4] 352	[4] 12	17	[4] 19	[4] 319	[4] 167
Other unfinished oils (net)	[4] 9,345	14	914	[4] 750	622	[4] 1,522	[4] 1,971	888	[4] 156	[4] 205	[4] 11,511
Shortage	[5] 1,436	979	[5] 301	2,601	1,746	412	470	1,053	733	1,088	7,345
Total output	194,521	44,064	196,150	117,521	71,621	339,916	48,929	25,390	27,017	213,031	1,278,160

[1] Detail by districts and months in section on "Consumption and distribution of crude petroleum."
[2] Includes 1,349,000 barrels run through pipe lines in California in 1938 and 1,147,000 barrels in 1939.
[3] Included above in crude petroleum input.
[4] Negative quantity; represents net excess rerun over production. [5] Negative quantity (overage). [6] Subject to revision.
[7] Data on "other" oils charged to cracking stills not available after July 1939.

Heating-oil requirements jumped the demand for distillate fuel oil 11 percent above that for 1938, and high-capacity industry and transportation operations raised the demand for residual fuel 9 percent compared with an increase of only 4 percent in total motor-fuel demand. The lack of adjustment between yields and the relative demand for products, particularly in the last quarter of 1939, resulted in an abnormal increase in gasoline stocks, which stood at 82,865,000 barrels (including unfinished) at the end of 1939 compared

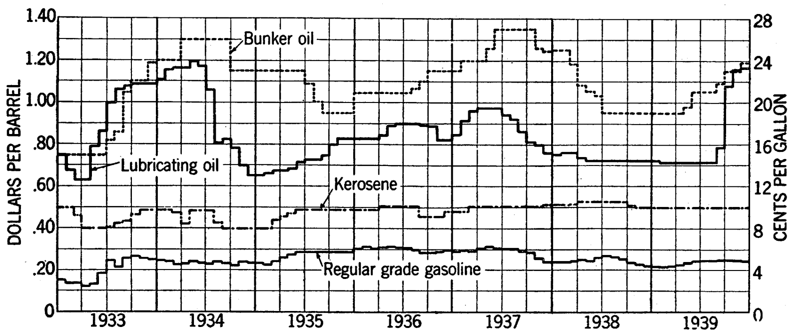

FIGURE 7.—Prices of refined petroleum products, 1933–39, by months.

with 71,680,000 barrels at the end of 1938. This is equivalent to a 60-day supply on December 31, 1939, and a 54-day supply on December 31, 1938.

As indicated in figure 7, prices moved from weakness to strength during the year; in spite of the large inventories, those for gasoline were higher at the close of the year than at the end of 1938, although the average for the year was lower. Lubricating-oil prices were high, many having gained over 100 percent during the year, while Pennsylvania-wax prices almost tripled. Although the average 1939 price for fuel oils in general was lower than the 1938 average, most grades were selling higher at the end of the year than at the beginning.

Stocks of refined products in the United States, 1938–39, by months

[Thousands of barrels, except as otherwise indicated]

	Jan. 1	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
1938													
Gasoline	69,892	79,114	85,018	85,035	82,684	80,987	73,725	70,224	64,599	63,163	63,542	64,083	65,949
Kerosene	7,083	6,523	5,986	6,093	6,394	7,627	9,202	10,112	10,149	10,497	9,949	9,676	7,799
Gas oil and distilltae fuel oil (refinery)	22,566	21,543	19,885	18,882	19,972	22,385	24,699	26,620	28,841	30,860	33,017	32,069	27,873
Residual fuel oils (refinery)	81,507	83,902	85,753	86,920	90,893	93,753	95,690	99,363	100,431	102,831	103,423	101,569	97,746
Lubricants	7,512	8,006	8,363	8,210	8,290	8,255	8,114	8,194	7,969	7,605	7,718	7,817	7,695
Wax	518	520	532	537	517	503	494	485	479	461	461	471	462
Coke	1,893	1,948	2,094	2,342	2,611	2,808	2,872	3,049	3,253	3,113	3,269	3,392	3,537
Asphalt	3,066	3,268	3,412	3,482	3,650	3,909	3,681	3,483	3,115	2,591	2,455	2,528	2,697
Wax, thousands of pounds	144,992	145,629	148,823	150,465	144,626	140,826	138,260	135,911	134,103	129,018	128,926	131,772	129,340
Coke, thousands of short tons	378.6	389.5	418.8	468.5	522.3	561.6	574.3	609.8	650.6	622.6	653.8	678.4	707.5
Asphalt, do	557.4	594.2	620.4	633.2	663.7	710.7	669.3	633.2	566.4	471.1	446.3	459.6	490.4
Road oil	984	894	850	955	1,155	1,164	1,130	1,075	966	827	686	660	680
Other finished products	230	230	250	299	296	326	319	295	274	265	265	260	263
Crude gasoline	7,098	6,759	7,262	7,285	7,375	7,160	6,806	6,508	6,363	5,923	5,735	5,452	5,731
Other unfinished oils	37,552	36,621	36,432	37,344	38,051	38,781	39,792	40,661	41,601	40,001	38,816	39,461	39,233
	239,901	249,328	255,837	257,384	261,888	267,658	266,524	270,069	268,040	268,137	269,336	267,438	259,665
1939 [1]													
Gasoline	65,949	73,847	79,691	81,189	81,623	78,342	74,395	71,824	66,448	65,498	68,116	71,619	77,301
Kerosene	7,799	6,711	5,452	5,605	5,663	6,551	7,949	8,855	9,361	9,952	9,967	9,019	7,576
Gas oil and distillate fuel oil:													
Refinery	27,873	24,650	21,731	20,115	21,058	22,088	25,659	27,581	29,282	30,018	30,951	30,179	26,374
Bulk terminal	8,351	7,650	6,996	5,784	5,413	5,725	6,218	7,759	8,344	8,120	9,142	7,709	7,344
Residual fuel oils:													
Refinery	97,746	95,548	92,594	89,768	90,411	92,485	93,322	96,305	95,897	95,051	94,757	91,466	87,774
Bulk terminal	4,225	4,163	3,691	3,326	3,660	4,259	5,083	4,859	5,464	5,012	5,164	5,230	4,516
Lubricants	7,695	7,762	7,951	7,800	7,886	7,630	7,427	7,179	7,069	6,704	6,639	6,799	7,142
Wax	462	459	420	420	426	407	399	390	386	320	290	291	270
Coke	3,537	3,585	3,525	3,470	3,670	3,580	3,550	3,665	3,410	3,340	3,260	3,235	3,330
Asphalt	2,645	2,926	3,146	3,575	3,784	3,696	3,531	3,278	2,912	2,612	2,596	2,733	3,025
Wax, thousands of pounds	129,340	128,627	117,711	117,537	119,301	113,925	111,604	109,322	108,173	89,584	81,147	81,369	75,648
Coke, thouasnds of short tons	707.5	717.0	705.0	694.0	734.0	716.0	710.0	733.0	682.0	668.0	652.0	647.0	636.0
Asphalt, do	480.9	532.0	572.0	650.0	688.0	672.0	642.0	596.0	529.5	475.0	472.0	497.0	550.0
Road oil	680	830	823	907	1,048	1,219	1,192	1,085	985	791	715	654	702
Other finished products	263	250	263	235	283	301	280	285	282	315	289	302	276
Crude gasoline	5,731	5,619	5,800	5,932	5,908	5,858	5,893	6,019	5,887	5,494	5,203	5,171	5,564
Other unfinished oils	39,233	38,707	38,361	38,216	37,732	38,036	38,692	40,296	40,819	40,801	38,765	37,947	36,915
Total [2]	272,189	272,707	270,444	266,342	268,565	270,177	273,590	279,380	276,546	274,028	275,854	272,354	268,109
Total [3]	259,613	260,894	259,757	257,232	259,492	260,193	262,289	266,762	262,738	260,896	261,548	259,415	256,249

[1] Subject to revision. [2] Includes bulk-terminal stocks of fuel oil not available prior to 1939. [3] For comparison with 1938.

Summary of percentage yields of refined products in the United States, 1932–39

[Computed on total crude runs to stills]

Product	1932	1933	1934	1935	1936	1937	1938	1939 [1]
Finished products:								
Gasoline [2]	44.7	43.7	43.4	44.2	44.1	43.9	44.3	44.9
Kerosene	5.3	5.7	6.0	5.8	5.2	5.5	5.5	5.5
Gas oil and distillate fuel oils	8.5	9.2	10.6	10.4	11.8	12.4	13.0	13.1
Residual fuel oils	27.5	27.6	26.8	26.9	27.0	26.4	25.3	24.8
Lubricants	2.7	2.8	2.9	2.9	2.9	3.0	2.6	2.8
Wax	.2	.2	.2	.2	.2	.2	.1	.1
Coke	1.1	.9	.7	.7	.6	.6	.7	.7
Asphalt	1.7	1.5	1.8	1.8	2.0	1.9	2.1	2.2
Road oil	.8	.6	.7	.6	.7	.7	.6	.6
Still gas	5.0	5.2	5.0	5.3	5.3	5.4	5.7	5.4
Other	.2	.2	.2	.2	.2	.2	.2	.2
Unfinished products:								
Gasoline	[3].2	.5	[3].3	.1	(4)	(3 4)	[3].1	(3 4)
Other			.2	[3].3	[3].8	[3].7	[3].4	[3].9
Shortage	2.5	1.9	1.8	1.2	.8	.5	.4	.6
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Subject to revision.
[2] Based upon total gasoline production less natural gasoline used.
[3] Negative percentage; represents excess percentage rerun over percentage produced.
[4] Less than 0.1 percent.

Refinery capacity including that of refineries under construction, was 4,650,805 barrels a day on January 1, 1939 (16,634 barrels more than on January 1, 1938), even though the number of refineries had dropped from 561 to 545.

The number of shut-down plants decreased from 120 to 103, but their capacity increased from 380,955 to 574,770 barrels a day, leaving the capacity of 3,933,785 barrels for the operating plants 36,411 barrels less than in 1938. The new Illinois plants, some of which were moved from Texas, and the new "pot-still" plants in Montana were largely responsible for this. The number of operating refineries in the Rocky Mountain district increased from 73 to 85, the greatest of any district, yet their daily capacity was 1,000 barrels less than in 1938, while the growth from 49 to 56 operating refineries in the Indiana-Illinois district raised the capacity only 11,000 barrels. In contrast with this, the Texas Gulf Coast district, with two additional plants operating, had an increased capacity of 64,000 barrels.

The operating ratio, or the proportion of crude runs to capacity, was 82 percent compared with 78 in 1938 and 83 percent in 1937.

Although more than half the capacity being built at the beginning of the year was for replacement, much of the construction during the year represented additions of newer-type refining equipment, such as catalytic polymerization units, catalytic cracking plants, and alkylation plants. However many refiners, particularly in the Midwest, have been postponing such additions because rapid developments in these processes made some plants obsolete soon after they were put in operation.

The principal advances in refinery technology during 1939 were expansion in catalytic cracking and in catalytic polymerization and progress in catalytic cracking and alkylation.

A number of catalytic cracking plants were put in operation during 1939, and some of the operators are claiming to produce a better grade of motor fuel than they formerly marketed. Likewise, a number of new catalytic polymerization units were installed during 1939.

Summary of refinery capacity in the United States, January 1, 1935–39 [1]

Year	Number				Capacity (barrels per day)			
	Operating	Shut down	Building	Total	Operating	Shut down	Building	Total
1935	435	196	7	638	3,614,749	443,751	13,900	4,072,400
1936	422	210	15	647	3,749,835	367,212	46,899	4,163,946
1937	423	149	11	583	3,966,616	328,265	81,200	4,376,081
1938	431	120	10	561	[2] 3,970,196	[2] 380,955	[2] 283,020	4,634,171
1939	435	103	7	545	3,933,785	574,770	142,250	4,650,805

[1] For data on 1914–34 see Minerals Yearbook, 1938, p. 863.
[2] New basis; for complete information see Bureau of Mines Information Circular 7034.

Alkylation is a development akin to polymerization. Whereas polymerization unites 2 molecules of the paraffin series to produce 1 unsaturated molecule, which must be hydrogenated to obtain isooctane, alkylation unites 1 molecule of the paraffin series with 1 molecule of the olefin series to produce 1 saturated molecule of isooctane. Both processes are being used almost entirely for the production of high-octane aviation fuel.

The sulfuric-acid alkylation process, in which isooctane is produced by using sulfuric acid as a catalyst at low temperature and pressure, was the principal development in alkylation in 1939.[2] In addition to this a process was announced for producing neohexane by thermal alkylation,[3] although this process was not in commercial operation during the year.

Although isooctane has a knock rating of 100 octane compared with a 95-octane rating for neohexane, the boiling range is so high—225°–263° F.—that it is necessary to blend it with other motor fuels, usually isopentane and a high-octane straight-run gasoline. This blend, when treated with 3 cc. of etraethyl lead per gallon, will produce a 100-octane aviation fuel. Although thermally cracked gasoline produces a high-octane motor fuel its knock rating is improved but little by the addition of lead, and for that reason selected straight-run gasoline is used in the blend.

The boiling range of neohexane is only 120°–122° F.; it can be blended with isooctane and isopentane, and with the addition of tetraethyl lead it produces an aviation fuel with an octane rating considerably above 100.

High-octane fuel is important in military aircraft because of the greater power it gives and the smaller engine needed per unit of power as the compression ratio increases. One hundred-octane fuel, which is now required for all new Army and Navy airplanes, gives an increase of 20 to 30 percent in power over that of 87-octane fuel and adds the advantages of quicker take-off, more rapid climbing, greater cruising radius, and increased speed.

[2] Anglo-Iranian Oil Co., Ltd., Humble Oil & Refining Co., Shell Development Co., Standard Oil Development Co., and Texas Co., High-octane Aviation Fuel by the Sulfuric Acid Alkylation Process: Am. Petrol. Inst. 20th ann. meeting, Chicago, Ill., November 13–17, 1939; pub. in Oil and Gas Jour., vol. 38, No. 27, 1939, p. 104.

[3] Oberfell, G. G., and Frey, F. E., Thermal Alkylation and Neohexane: Am. Petrol. Inst. 20th ann. meeting, Chicago, Ill., November 13–17, 1939; pub. in Oil and Gas Jour., vol. 38, No. 28, 1939, p. 50, and No. 29, p. 70.

The principal source of charging stock for both polymerization and alkylation is gas from the cracking stills, although some is obtained from natural gas; thus, the gasoline made by these processes creates a net addition to the output of gasoline without any additional consumption of crude oil. Furthermore, the gasoline so produced is superior as fuel to that obtained by other methods.

Other progress in refinery technology includes improved methods for desulfurization and cyclization.

The presence of sulfur in gasoline not only gives it a lower knock rating but also makes it less susceptible to tetraethyl lead. A number of recent developments have contributed to the facility and reduced the expense of extracting sulfur from gasoline.

Cyclization, or aromatization of straight-run gasolines, converts straight-chain paraffins into benzol, toluol, and xylols. These products have an octane rating of over 100 and can raise the quality of motor fuel, although they cannot at present be used as aviation fuel.[4]

MOTOR FUEL

Demand.—The domestic demand for motor fuel in 1939 was 552,557,000 barrels, a 5.7-percent increase over the 1938 record of

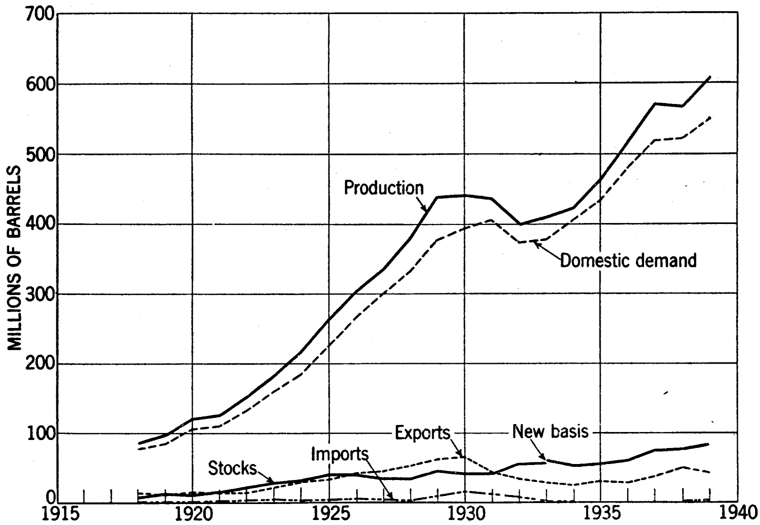

FIGURE 8.—Trends in production, domestic demand, exports, imports, and stocks of motor fuel, 1918–39.

523,003,000 barrels. Exports, however, declined from 50,109,000 barrels in 1938 to 44,559,000 in 1939, making the total demand 597,116,000 barrels, a 4-percent increase over the 1938 demand. (See fig. 8.)

[4] Egloff, Gustav, Gasoline Grading Laws Will Penalize Motorists: Am. Petrol. Inst. 20th ann. meeting, Chicago, Ill., Nov. 14, 1939; abs. in Nat. Petrol. News, vol. 31, No. 39, 1939, p. 21.

Comparative analyses of statistics for motor fuel in 1939,[1] by months

[Thousands of barrels]

	1939													1938 (total)
	January	February	March	April	May	June	July	August	September	October	November	December	Total	
Production	49, 120	43, 409	48, 367	48, 837	51, 384	50, 861	51, 896	52, 161	51, 890	54, 974	52, 691	52, 351	607, 941	569, 162
Daily average	1, 585	1, 550	1, 560	1, 628	1, 658	1, 695	1, 674	1, 683	1, 730	1, 773	1, 756	1, 689	1, 666	1, 559
Imports	----	----	----	----	----	----	----	----	6	23	86	3	118	79
Exports	3, 638	2, 909	4, 336	3, 663	4, 390	4, 459	3, 585	4, 208	4, 232	3, 443	2, 560	3, 136	44, 559	50, 109
Daily average	117	104	140	122	142	149	116	136	137	111	85	101	122	137
Stocks, end of period	78, 494	84, 399	85, 910	87, 107	84, 554	81, 144	78, 947	73, 072	71, 389	73, 256	76, 198	81, 722	81, 722	70, 779
Domestic demand	37, 767	34, 595	42, 520	43, 977	49, 547	49, 812	50, 508	53, 828	49, 347	49, 687	47, 275	43, 694	552, 557	523, 003
Daily average	1, 218	1, 236	1, 372	1, 466	1, 598	1, 660	1, 629	1, 736	1, 645	1, 603	1, 576	1, 409	1, 514	1, 433

[1] Subject to revision.

Domestic demand for motor fuel per motor vehicle in use, 1937–39

	1937	1938	1939 [1]
Domestic demand for motor fuel..............thousands of barrels..	519,352	[2] 523,003	552,558
Motor vehicles in use July 1..............number..	[2] 27,570,100	[2] 28,168,500	28,607,400
Motor-fuel demand per motor vehicle in use:			
Actual..............barrels..	18.84	[2] 18.57	19.32
Based on 1924–31 trend [3]..............do....	[2] 21.15	[2] 21.86	22.57
Deviation from trend..............do....	[2] −2.31	[2] −3.29	−3.25
Production and trade [4]..............index numbers..	91	77	86

[1] Subject to revision. [2] Revised figures.
[3] Least squares straight-line trend based on 1924–31 data. Depression years have been omitted because they are not normal.
[4] Federal Reserve Bank of New York; computed normal=100.

Distribution of domestic motor-fuel demand, 1936–39

[Thousands of barrels]

	1936	1937	1938	1939 [1]
Passenger cars:				
Highway	150,896	161,302	161,821	171,204
City	170,128	182,614	186,459	195,659
Total passenger cars	321,024	343,916	348,280	366,863
Trucks:				
Highway	35,462	39,723	40,757	43,120
City	57,643	63,084	61,136	66,293
Total trucks	93,105	102,807	101,893	109,413
Busses	14,500	15,500	15,300	15,500
Total automotive demand [2]	428,629	462,223	465,473	491,776
Other demand	52,977	57,129	57,530	60,781
Grand total	481,606	519,352	523,003	552,557

[1] Subject to revision. [2] 89 percent of total motor-fuel demand.

The 11-percent recession in exports for the year 1939 may be ascribed chiefly to the European war; during the last quarter alone exports were 33 percent less than in the corresponding quarter in 1938 compared with a 3-percent loss for the first 9 months of the year. This decrease was unexpected, as many persons had predicted that the immense demand for aviation gasoline and gasoline for powering the mechanized units of the armies would create a large draft on American sources. However, gasoline-rationing policies for neutral countries as well as belligerents, the small amount of actual fighting, the large supplies of gasoline and oil that the warring countries had been accumulating during recent years, and the tremendous risk of ocean transportation cut deeply into United States exports of petroleum and its products during the last quarter of 1939. More detailed information on exports and imports is given in another section of this chapter.

There were 3,140,000 new motor-vehicle registrations in 1939, according to R. L. Polk & Co., compared with 2,256,000 in 1938 and 4,100,000 in 1937. Preliminary estimates of cars in use on July 1, as shown in the accompanying table, indicate an increase of approximately 420,900 vehicles and a total of 28,607,400. Gasoline consumption per motor vehicle in use responded to improved business conditions by rising from 18.57 barrels in 1938 to 19.32 in 1939.

The effect of weather on motor-fuel demand was discussed in another publication of the Bureau,[5] which also included the gasoline-temperature index; this index is calculated by weighting the departures of temperature from normal for the various sections of the country (as reported in the Monthly Weather Review) by the quantity of gasoline consumed in the individual sections. The gasoline-temperature indexes for 1939 and the estimated influence of weather upon motor-fuel demand are given below.

Gasoline-temperature index and estimated influence of weather on motor-fuel demand in 1939, by months

Month	Gasoline-temperature index [1]	Influence on motor-fuel demand (thousands of barrels)	Month	Gasoline-temperature index [1]	Influence on motor-fuel demand (thousands of barrels)
January	4.1	996	September	3.2	646
February	1.9	46	October	1.8	−3
March	1.5	−169	November	.0	−482
April	−.7	−414	December	3.4	732
May	2.5	384			
June	1.8	−4	Average index	1.9	
July	1.0	−355	Total influence		1,542
August	2.1	165			

[1] In degrees departure from 46-year normal.

Although temperatures have averaged 1 degree above normal for the past 12 years, it can be seen from the table that the weather in 1939 was even milder. It is estimated that motor-fuel demand was 1,542,000 barrels greater because of the favorable weather.

Production.—Motor-fuel production in 1939 of 607,941,000 barrels was 38,779,000 barrels more than that in 1938—569,162,000 barrels. The 1939 production comprised 260,463,000 barrels of straight-run gasoline, 295,142,000 barrels of cracked gasoline, 2,440,000 barrels of benzol, and 49,896,000 barrels of natural gasoline, the latter being made up of about 40 million barrels of blended natural and about 10 million barrels of unblended natural. The ratio of straight-run gasoline to total motor-fuel production continued its downward trend, falling from 43.1 percent in 1938 to 42.8 in 1939, while that of cracked gasoline followed its rising trend, increasing from 47.5 percent in 1938 to 48.6 in 1939. The ratio of natural gasoline declined from 9.0 percent in 1938 to 8.2 in 1939.

[5] Breakey, Herbert A., Trends and Seasonal Factors Influencing Domestic Motor-fuel Demand: Bureau of Mines Econ. Paper 21, 1940, 65 pp.

Production of gasoline in the United States in 1939,[1] *by methods of manufacture, districts, and months*

[Thousands of barrels]

Method and district	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Straight run:													
East Coast	2,347	2,040	2,190	2,278	2,308	2,185	2,439	2,889	2,428	2,788	2,974	2,604	29,470
Appalachian	728	706	789	652	683	710	777	850	791	887	990	928	9,491
Indiana, Illinois, Kentucky, etc	3,581	3,320	3,726	3,645	3,861	3,867	3,711	3,982	4,075	4,406	4,287	4,185	46,646
Oklahoma, Kansas, and Missouri	2,698	2,485	2,670	2,862	3,073	2,951	2,852	2,767	2,779	2,859	2,778	2,743	33,517
Texas Inland	1,706	1,608	1,709	1,818	1,886	1,889	2,016	1,507	1,591	1,374	1,220	1,201	19,525
Texas Gulf Coast	5,025	4,083	4,600	4,830	5,585	5,365	5,325	5,039	4,994	5,481	4,944	5,239	60,510
Louisiana Gulf Coast	755	623	776	885	980	691	773	821	811	919	701	706	9,441
Arkansas and Louisiana Inland	620	434	544	520	492	557	478	544	500	579	594	583	6,445
Rocky Mountain	646	552	644	613	655	597	636	761	699	700	652	608	7,763
California	3,019	2,604	3,015	2,819	3,244	2,970	3,495	3,211	3,165	3,618	3,275	3,220	37,655
Total straight run	21,125	18,455	20,663	20,922	22,767	21,782	22,502	22,371	21,833	23,611	22,415	22,017	260,463
Percent yield	21.2	21.0	20.9	21.1	21.5	20.8	21.1	20.8	20.7	21.3	21.4	20.8	21.0
Cracked:													
East Coast	3,760	3,401	3,798	3,702	3,787	3,939	4,323	4,035	4,119	4,282	3,748	4,121	47,015
Appalachian	930	873	830	969	997	985	1,069	1,061	958	1,117	1,097	1,131	12,017
Indiana, Illinois, Kentucky, etc	4,356	4,093	4,279	4,424	4,554	4,919	5,040	5,030	5,215	5,412	5,665	5,298	58,285
Oklahoma, Kansas, and Missouri	2,101	1,907	1,973	2,183	2,348	2,316	2,248	2,410	2,401	2,418	2,208	2,352	26,865
Texas Inland	1,373	1,186	1,201	1,251	1,366	1,405	1,377	1,551	1,626	1,666	1,699	1,741	17,442
Texas Gulf Coast	7,221	6,060	7,311	7,226	7,383	7,316	7,304	7,982	7,368	7,746	7,089	6,844	86,850
Louisiana Gulf Coast	568	572	691	714	751	750	812	848	760	723	766	673	8,628
Arkansas and Louisiana Inland	310	224	242	285	339	318	319	335	278	328	358	370	3,706
Rocky Mountain	519	423	521	484	578	554	549	600	614	566	644	540	6,592
California	2,408	2,298	2,434	2,283	2,104	2,308	1,987	2,328	2,361	2,365	2,347	2,519	27,742
Total cracked	23,546	21,037	23,280	23,521	24,207	24,810	25,028	26,180	25,700	26,623	25,621	25,589	295,142
Percent yield	23.6	24.0	23.5	23.7	22.9	23.7	23.4	24.3	24.4	24.0	24.4	24.2	23.9
Total production including natural gasoline:													
East Coast	6,278	5,583	6,124	6,102	6,225	6,270	6,964	7,100	6,748	7,290	6,988	6,953	78,625
Appalachian	1,681	1,597	1,657	1,639	1,694	1,713	1,863	1,927	1,773	2,037	2,123	2,101	21,805
Indiana, Illinois, Kentucky, etc	8,306	7,710	8,315	8,338	8,778	9,113	9,106	9,305	9,737	10,341	10,467	9,931	109,447
Oklahoma, Kansas, and Missouri	5,257	4,777	5,021	5,382	5,788	5,631	5,465	5,591	5,583	5,823	5,515	5,661	65,494
Texas Inland	3,674	3,298	3,397	3,486	3,699	3,712	3,831	3,480	3,548	3,832	3,613	3,586	43,156
Texas Gulf Coast	12,799	10,611	12,311	12,708	13,268	12,916	12,927	13,457	12,847	14,106	12,764	12,761	153,475
Louisiana Gulf Coast	1,361	1,214	1,488	1,629	1,754	1,474	1,618	1,698	1,602	1,671	1,493	1,397	18,399
Arkansas and Louisiana Inland	963	697	828	837	862	913	846	918	821	975	1,015	1,009	10,684
Rocky Mountain	1,242	1,038	1,236	1,149	1,263	1,178	1,209	1,399	1,363	1,348	1,399	1,242	15,066
California	6,747	6,196	6,809	6,156	6,289	6,354	6,610	6,768	6,748	7,169	6,945	6,983	79,774
Total United States: 1939	48,308	42,721	47,186	47,426	49,620	49,274	50,439	51,643	50,770	[2] 54,592	[2] 52,322	[2] 51,624	[2] 595,925
1938	46,811	40,495	44,175	44,667	46,581	44,247	47,607	48,662	47,312	49,677	47,998	47,780	556,012

[1] Subject to revision. [2] Includes aviation gasoline (thousands of barrels): October 859, November 811, December 909.

Yields.—Gasoline produced from crude oil run to stills increased for the second consecutive year to establish a new record of 44.9 percent in 1939 compared with 44.3 percent in 1938. This increase probably is attributable in part to various new technologic improvements, including polymerization, alkylation, and catalytic cracking, discussed elsewhere in this chapter.

Most of these new processes utilize still gases as raw material; consequently the yield of still gas decreased from 5.7 percent in 1938 to 5.4 percent in 1939, whereas the yield of gasoline increased 0.6 percent. The remainder of the rise in gasoline yield (0.3 percent) probably was taken out of residual fuel-oil yield, which declined 0.5 percent.

Nearly all of the higher yield of gasoline was incident to the production of cracked gasoline, which increased from 23.2 percent in 1938 to 23.9 in 1939, while the yield of straight-run gasoline was virtually unchanged.

The yield of gasoline in 1939 did not experience the usual slump during the early part of the year, probably because the mild winter (see gasoline-temperature index) did not require the diversion of cracking stock to heating oil. Otherwise it conformed to the usual seasonal pattern, except that the summer sag was only slight, while the November yield (45.8 percent) established a new record.

One of the paradoxes of the industry is that in the autumn, when it is logical to expect a decline in the yield of gasoline because motor-fuel demand is decreasing rapidly and heating-oil demand is increasing, gasoline yield actually has reached its peak. During the warmer months of the year unfinished heavy oil is stored, and as cool weather approaches it is rerun, most of it probably being cracked to increase the winter supply of heating oil. The gasoline and heating oil resulting from such reruns constitute net additions to the products from the crude oil run to stills, but they are in no sense products of that particular oil. However, yields are computed on the basis of the ratio of the total products produced to quantity of crude oil run. Hence, when the actual yields of gasoline probably are declining in the fall, they appear to be increasing.

Net unfinished oil rerun during the last 4 months of 1939 amounted to 7,124,000 barrels—1.7 percent of crude-oil runs—compared with 229,000 barrels for the 4 preceding months.

Rerunning of imported unfinished oil also will cause yields to appear higher than they actually are. Imports of unfinished oils in 1939 totaled 9,193,000 barrels, 5,798,000 barrels of which were designated for domestic use.

Among the districts Inland Texas continued its upward trend, the output mounting to 56.5 percent in 1939 compared with 54.0 percent in 1938 and 51.2 percent in 1937. The yield of 45.1 percent for the Texas Gulf Coast district also was materially higher than its 1938 production of 43.4 percent.

Prices.—The average Group 3 refinery price per gallon of regular-grade gasoline for 1939 was 4.76 cents compared with 4.90 cents for 1938. After a gradual decline since 1936 it reached its lowest point early in February 1939—3.88 cents. From that point it improved until it met the usual seasonal weakness in the winter but kept considerably stronger than during the winter of 1938, in spite of the larger accumulation of stocks.

The 50-city average service-station price of regular-grade gasoline (ex-tax), as compiled by the American Petroleum Institute, dropped further in 1939 to an average of 13.30 cents from the 14.07-cent average for 1938. The general trend during the year, however, was upward. The lowest price was 13.04 cents on March 1, from which it rose to a high of 13.65 cents on October 1 and then relapsed to 13.51 cents on December 1. The prices for these 2 months were almost the same as during the same months in 1938, but the January 1, 1940, price of 13.53 cents was ⅓ cent higher than that at the beginning of 1939.

It is extremely difficult to determine service-station prices in States that have the dealer-marketing plan. As the dealer sells at whatever price will give him enough profit, posted prices often vary considerably throughout a city. Frequently discounts are given from the posted prices either generally or to selected customers.

The greatest change in price was at Cheyenne, Wyo., where the increase from January 1, 1939, to January 1, 1940, was 3.0 cents (12.0 to 15.0 cents ex-tax). The price change in Omaha, Nebr., ranked next, but in the opposite direction, falling from 13.0 to 10.5 cents from the beginning to the end of the year. The price in Salt Lake City, Utah, which dropped from 18.5 cents on January 1, 1938, to 15.0 on January 1, 1939, dropped another 3.5 cents to 11.5 cents by June 20, 1939. It recovered, however, to 14.5 cents on September 18 and was only 0.5 cent lower at the end of the year than at the beginning.

The highest prices prevailed in the Rocky Mountain area as usual, where the average increased from 15.85 cents per gallon (revised) at the beginning of the year to 16.66 cents at the end of the year. Boise, Idaho, after a short period of lower price, again recovered the distinction, along with Twin Falls, Idaho, of having the highest price—25.1 cents, including 6 cents for State and Federal taxes and 1 mill as a toll-bridge tax. Helena, Mont., with a price of 24.5 cents including 6 cents in taxes, was next highest at the end of the year. Bristol, Tenn., with a price of 23.75 cents including 8 cents in taxes, and Montgomery, Ala. with a price of 23.5 cents including 9 cents in Federal, State, county, and city taxes, were next highest.

Providence, R. I., supplanted Wichita, Kans., in attaining the distinction of having the lowest price at the end of the year; it was 14.0 cents a gallon compared with 14.6 cents at Wichita. Detroit, Mich., however, had a price of 13.9 cents for a few days in November. Motorists in the New England and North Atlantic States continued to enjoy the lowest prices for gasoline, although the average rose from 11.7 cents (revised) per gallon at the beginning of the year to 12.2 cents at the end of the year.

There were no price changes in the principal cities on the Pacific coast throughout the year, and the only price changes in important places in the California marketing area were in Spokane, Wash., where the price fell from 18.0 cents at the beginning of the year to 16.5 cents at the end of the year, and in Phoenix, Ariz., where the price dropped from 16.5 to 15.0 cents.

The 12-month average of the 50-city average dealer's net price of 9.58 cents was 0.46 cent lower than that for 1938. The average on January 1, 1940 (9.78 cents), was 0.22 cent higher than the January 1, 1939, average.

A State gasoline-tax increase from 4 to 5 cents for North Dakota in July was the first change in tax rates for 2 years, the average rate for the country having remained at 4.44 cents for 25 months. Excepting a 1-mill toll-bridge tax in Idaho there were no other changes in State taxes on gasoline, but an event heralded by the oil industry was the repeal in New Orleans, effective October 1, of the 2-cent city tax. Although a 5-cent State tax, a 2-cent Parish tax, and the 1-cent Federal tax remain, the distinction of having the highest gasoline tax in the country has passed from New Orleans to Mobile and Montgomery, Ala., and to Pensacola, Fla., each of which pays a total tax of 9 cents a gallon on its gasoline. Only Alabama, Missouri, New Mexico, and Wyoming have no restrictions on the levying of gasoline taxes by cities. A small number of selected cities in Florida and Nevada also are permitted to levy a gasoline tax.

Average monthly prices of gasoline, 1938–39, in cents per gallon

	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
1938													
67–69 octane at refineries in Oklahoma [1]	4.75	4.75	4.81	4.94	4.90	5.16	5.38	5.35	5.11	4.68	4.58	4.41	4.90
Dealer's net at 50 cities [2]	10.18	10.16	10.09	10.22	10.17	10.14	10.13	10.18	10.05	9.82	9.70	9.67	[3]10.04
Service-station at 50 cities (including State tax) [2]	18.73	18.72	18.69	18.67	18.62	18.66	18.60	18.64	18.46	18.20	18.13	17.96	18.51
1939													
67–69 octane at refineries in Oklahoma [1]	4.38	4.34	4.42	4.55	4.73	4.91	4.94	4.95	5.00	5.00	4.98	4.92	4.76
Dealer's net at 50 cities [2]	9.56	9.40	9.35	9.37	9.45	9.49	9.67	9.61	9.69	9.79	9.87	9.75	9.58
Service-station at 50 cities (including State tax) [2]	18.76	18.55	18.48	18.51	18.60	18.66	18.86	18.74	18.84	18.94	19.07	18.93	18.74

[1] National Petroleum News. [2] American Petroleum Institute. [3] Revised figures.

During 1939 one State (Missouri) and the District of Columbia had a tax rate of 2 cents, 10 States a tax rate of 3 cents, 17 States a tax rate of 4 cents, 10 States a tax rate of 5 cents, 1 State a tax rate of 5.1 cents, 5 States a tax rate of 6 cents, 1 State a tax rate of 6½ cents, and 3 States a tax rate of 7 cents.

In addition to the State taxes a Federal tax of 1 cent per gallon and numerous municipal and county taxes prevailed throughout the year.

Although there was no increase in octane number in the general price quotations for gasoline in 1939, the quality of gasoline, particularly during the last few months of the year, was generally improved, especially along the Atlantic coast.[6]

A dissatisfaction with octane rating as a means of describing the quality of gasoline, which has been developing for a number of years, reached the point during 1939 where many refiners have stopped mentioning octane in connection with their gasoline and instead emphasize quality to meet the needs of the individual driver. As the quality of the various gasolines depends on so many factors—such as the type of crude oils from which they were refined, the proportions of straight-run and cracked gasolines, the quantity of tetraethyl lead, and practical operating conditions under which the gasoline will be used—it is difficult to describe the relative quality of any gasoline by one number, as well as to devise a method for determining that number. Some gasolines have an advantage when the octane number is determined in one way, while others obtain a higher rating by a different method. There has been considerable confusion as to just what an octane number means, because, when making claims for their gasoline, refiners sometimes use that method by which their product receives the best rating, whether or not it is standard.

The method now known as the C. F. R. (Cooperative Fuel Research Committee) research method was the one first generally accepted for rating octane number. After practical tests had disclosed weaknesses in this method a new one—the C. F. R. motor method—was published as tentative in 1933, revised in 1934, 1936, 1937, 1938, and adopted as standard in 1939; it has been officially designated as D357–39, but is generally known as the A. S. T. M. method. At the same time the research method, which has been used as a check method for research purposes, was revised for adaption to the equipment used for the motor (D357–39) method. The motor method is at present most widespread throughout the world.[7]

The L–3 method is a compromise method used by the Ethyl Gasoline Corporation in dealing with its licensees. Although it is not standard and is official only between the corporation and its licensees, published price quotations at present usually are based upon ratings by this method.

Other methods of octane rating, generally used in connection with aviation fuel, include the United States Army Air Corps, the British Air Ministry, and the low-temperature methods, while a number of others for rating aviation fuel do not use octane number at all.

The near future probably will see some agreement upon octane rating, with consequent elimination of much of the confusion now existing, as well as even better grades of motor fuel than are being sold.

Aviation gasoline.—Late in 1939 the Bureau of Mines began to collect statistics on production and stocks of aviation gasoline. Data on exports of this grade of gasoline had been published by the Bureau of Foreign and Domestic Commerce since the first of 1939.

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[6] Miller, Walter, Petroleum Refining: Min. and Met., vol. 21, No. 397, January 1940, p. 51; also Lane, E. C., Cooperative Fuel Research Motor Gasoline-Survey, Summer 1939: Bureau of Mines Rept. of Investigation 3492, 1939, p. 2.

[7] Phillippovich, Alexander, Engine Fuel Testing and Proposals for Its Further Development: Nat. Petrol. News, vol. 31, No. 50, December 13, 1939, p. R–526.

The first report, a press release of December 21, 1939, gave total aviation-gasoline production in October 1939 as 859,000 barrels, of which 265,000 barrels was in California. The average octane was 84 (A. S. T. M.) and the average vapor pressure 6.6 pounds. The returns indicated that there were about 25 producing companies, with a monthly capacity for producing about 1,500,000 barrels of aviation gasoline. The next report (total given in Bureau of Mines Monthly Petroleum Statement for November 1939) showed that the indicated domestic demand for this grade of gasoline was 411,000 barrels compared with exports of 274,000 barrels. In December exports increased to 372,000 barrels, but domestic demand declined to 292,000.

Stocks.—The seasonal pattern for gasoline stocks in 1939 was just the opposite of that for 1938. During the early months of the year stocks were lower than in 1938, and during the middle of the year were comparable with them. During October, however, they began to rise rapidly, and by December 31 finished gasoline on hand had reached 77,301,000 barrels or 11,352,000 barrels more than on December 31, 1938. Unfinished stocks, however, declined from 5,731,000 barrels to 5,564,000 making a total of 82,865,000 barrels for finished and unfinished gasoline on December 31, 1939.

Finished stocks were higher in all districts at the end of 1939 than at the end of 1938. Those in the Texas Gulf Coast district increased the most, with a 41-percent gain from 9,626,000 to 13,609,000 barrels. While the generally higher stocks in excess of what might be required because of the greater gasoline demand are attributable largely to expanded runs to stills to meet heating-oil requirements, part of the stocks in Texas Gulf Coast district probably resulted from the lack of tankers to move both the gasoline and fuel oil to the East coast, where finished stocks were only 8 percent more at the end of 1939 than at the end of 1938.

Finished stocks in California increased from 13,192,000 barrels to 16,121,000 (22 percent). As California had stocks of all products adequate, under ordinary refinery operations, to meet the most optimistic demands, such inflation can be ascribed to maladjustment in refinery operation, considering that the increment in total motor-fuel demand for that area was only 4 percent.

Stocks of gasoline in the United States in 1939,[1] *by districts and months*

[Thousands of barrels]

District	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
Finished gasoline:												
Refinery:												
East Coast	5, 739	6, 895	7, 844	7, 358	7, 267	7, 031	6, 235	6, 260	6, 038	6, 213	6, 085	6, 618
Appalachian	1, 501	1, 811	1, 863	2, 003	1, 899	1, 637	1, 645	1, 385	1, 133	1, 150	1, 273	1, 634
Indiana, Illinois, Kentucky, etc	8, 671	10, 638	11, 334	10, 960	9, 172	8, 191	7, 218	6, 409	6, 145	6, 066	6, 006	7, 133
Oklahoma, Kansas, and Missouri	4, 647	5, 049	5, 015	5, 081	4, 778	4, 135	3, 601	2, 982	3, 131	3, 418	3, 661	4, 170
Texas Inland	2, 173	2, 297	2, 059	2, 012	1, 898	1, 793	1, 819	1, 665	1, 673	1, 713	2, 008	2, 148
Texas Gulf Coast	10, 800	11, 041	10, 037	11, 339	10, 739	9, 830	9, 484	8, 762	9, 780	9, 968	11, 915	13, 277
Louisiana Gulf Coast	1, 481	1, 682	1, 562	1, 574	1, 583	1, 426	1, 322	1, 153	1, 104	1, 481	1, 525	1, 438
Arkansas and Louisiana Inland	473	495	528	444	411	434	439	420	370	373	398	478
Rocky Mountain	1, 814	2, 079	2, 169	2, 099	2, 028	1, 803	1, 510	1, 301	1, 294	1, 243	1, 409	1, 524
California	12, 120	12, 582	13, 053	12, 302	12, 301	11, 692	10, 923	10, 709	10, 755	11, 891	12, 618	13, 500
Total United States	49, 419	54, 569	55, 464	55, 172	52, 076	47, 972	44, 196	41, 046	41, 423	[2] 43, 516	[2] 46, 898	[2] 51, 920
Bulk terminal and pipe line:												
East Coast	11, 957	12, 499	13, 708	13, 735	13, 902	13, 661	13, 923	12, 673	11, 590	11, 868	11, 194	11, 319
Appalachian	1, 786	1, 594	1, 550	1, 709	1, 716	1, 641	1, 806	1, 620	1, 283	1, 494	1, 804	1, 853
Indiana, Illinois, Kentucky, etc	4, 720	4, 287	3, 789	3, 856	3, 944	4, 556	5, 227	4, 735	5, 042	5, 401	5, 877	5, 874
Oklahoma, Kansas, and Missouri	2, 624	3, 268	2, 903	2, 944	2, 884	2, 868	2, 737	2, 628	2, 421	2, 193	2, 388	2, 581
Texas Inland	51	45	46	47	49	54	52	50	51	50	45	48
Texas Gulf Coast	365	245	227	229	293	346	285	270	310	280	311	332
Louisiana Gulf Coast	642	650	669	596	597	692	594	651	608	744	563	623
Arkansas and Louisiana Inland	141	132	152	243	139	165	146	147	73	116	144	130
California	2, 142	2, 402	2, 681	3, 092	2, 742	2, 440	2, 858	2, 628	2, 697	2, 454	2, 395	2, 621
Total United States	24, 428	25, 122	25, 725	26, 451	26, 266	26, 423	27, 628	25, 402	24, 075	24, 600	24, 721	25, 381
Unfinished gasoline:												
East Coast	983	1, 002	1, 087	1, 111	1, 077	1, 063	1, 122	1, 113	1, 025	987	811	931
Appalachian	232	226	259	269	255	240	248	236	299	292	296	357
Indiana, Illinois, Kentucky, etc	535	565	657	650	885	706	803	777	591	519	529	614
Oklahoma, Kansas, and Missouri	398	392	385	419	449	464	477	480	455	486	434	508
Texas Inland	242	263	246	256	227	217	217	230	195	230	256	298
Texas Gulf Coast	1, 330	1, 485	1, 526	1, 484	1, 317	1, 428	1, 591	1, 473	1, 349	1, 207	1, 323	1, 327
Louisiana Gulf Coast	362	405	451	366	334	340	312	281	276	350	354	379
Arkansas and Louisiana Inland	33	32	31	33	49	24	36	36	45	36	42	47
Rocky Mountain	95	96	102	110	106	100	91	89	82	77	71	71
California	1, 409	1, 334	1, 188	1, 210	1, 159	1, 311	1, 122	1, 172	1, 177	1, 019	1, 055	1, 032
Total United States	5, 619	5, 800	5, 932	5, 908	5, 858	5, 893	6, 019	5, 887	5, 494	5, 203	5, 171	5, 564
Total finished and unfinished gasoline stocks, United States:												
1939	79, 466	85, 491	87, 121	87, 531	84, 200	80, 288	77, 843	72, 335	70, 992	73, 319	76, 790	82, 865
1938	[3] 88, 845	[3] 92, 253	[3] 92, 277	[3] 89, 995	88, 147	80, 531	76, 732	70, 962	69, 086	69, 277	69, 535	71, 680

[1] Subject to revision. [2] Includes aviation gasoline (thousands of barrels): October 31, 2,400; November 30, 2,526; December 31, 2,771.
[3] Revised figures (thousands of barrels)—stocks of unfinished gasoline, Louisiana Gulf January 31, 555; February 28, 414; March 31, 498; April 30, 516.

The smallest additions to inventories were in the Rocky Mountain and Inland Louisiana-Arkansas districts, where they amounted to 6 and 7 percent, respectively.

The table of days' supply of gasoline shows that stocks increased relatively as well as actually. At the end of the year they amounted to 56.2 days of finished gasoline compared with 49.4 days at the end of 1938.

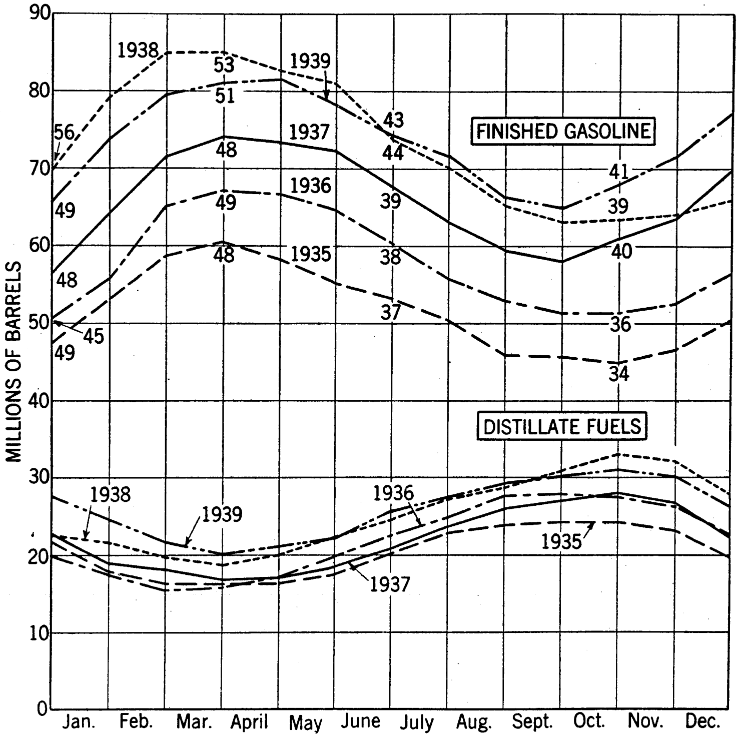

FIGURE 9.—Stocks of finished gasoline and distillate fuels, 1935–39, by months.

Days' supply of motor fuel on hand in the United States at end of month, 1937–39 [1]

Month	1937			1938 [2]			1939 [3]		
	Finished gasoline	Natural gasoline	Total motor fuel	Finished gasoline	Natural gasoline	Total motor fuel	Finished gasoline	Natural gasoline	Total motor fuel
January	52.0	3.2	55.2	61.7	3.8	65.5	55.1	3.5	58.6
February	51.5	3.1	54.6	58.6	3.5	62.1	52.7	3.1	55.8
March	48.2	3.1	51.3	53.2	3.5	56.7	51.1	3.0	54.1
April	46.6	3.4	50.0	51.8	3.8	55.6	46.9	3.2	50.1
May	42.0	3.4	45.4	46.1	3.8	49.9	43.3	3.4	46.7
June	39.1	3.6	42.7	44.1	4.1	48.2	42.6	3.9	46.5
July	36.6	4.0	40.6	39.3	4.3	43.6	38.4	3.8	42.2
August	34.5	4.1	38.6	39.0	4.9	43.9	37.2	3.7	40.9
September	36.7	3.8	40.5	38.5	4.9	43.4	38.2	3.5	41.7
October	39.9	3.5	43.4	39.1	4.1	43.2	41.0	3.1	44.1
November	47.2	3.8	51.0	42.1	3.8	45.9	47.4	3.0	50.4
December	[2] 56.4	3.9	[2] 60.3	49.4	3.6	53.0	56.2	3.2	59.4

[1] Stocks divided by the daily average total demand (domestic demand plus exports) for succeeding month.
[2] Revised figures. [3] Subject to revision.

Seasonal variations in gasoline stocks in recent years appear in figure 9, which gives the quantity of finished gasoline stocks in millions of barrels for the last day of each month for December 1934 to December 1939, together with equivalent days' supply at certain periods.

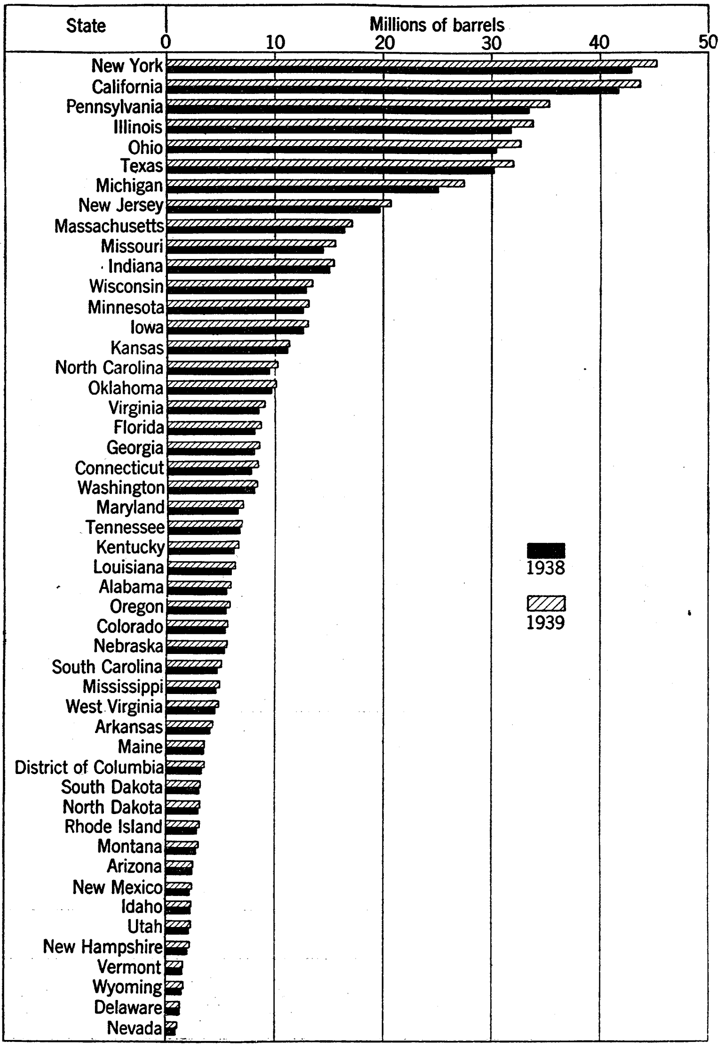

FIGURE 10—Gasoline consumption, 1938–39, by States.

The figures for days' supply on the chart represent the quantity of finished gasoline on hand at the end of a month divided by the total demand for the succeeding month.

Figure 9 also includes stocks of distillate fuels for the same period to stress the contrast in seasonal variations in stocks of the two products. It will be seen that at the end of 1939 there were 1½ million barrels less distillate fuel oil than at the end of 1938 to meet a 2,287,000-barrel (14-percent) increase in total demand for the succeeding month.

Production and consumption by States.—Texas ranked highest in gasoline production, furnishing 33 percent of the gasoline output. Other important States were: California, 13 percent; Pennsylvania, 8 percent; and Oklahoma and Illinois, 6 percent each.

The principal gasoline-consuming States maintained the same relative position in 1939 as for the past several years. (See fig. 10.) The 45,255,000 barrels (8.4 percent) consumed in New York, however, were only slightly more than the 43,760,000 barrels (8.1 percent) consumed in California. Pennsylvania followed with 6.5 percent and Illinois, Ohio, and Texas came next with 6 percent each.

Production and consumption of gasoline in the United States, 1937–39, by States

[Thousands of barrels]

State	1937		1938 [1]		1939 [2]	
	Production	Consumption [3]	Production	Consumption [3]	Production	Consumption [3]
Alabama	(4)	5,378	(4)	5,483	(4)	5,869
Arizona		2,473		2,441		2,550
Arkansas	3,006	3,908	3,028	4,040	3,452	4,332
California	79,967	41,853	77,528	41,722	[5] 79,774	43,760
Colorado	752	5,263	1,170	5,404	1,720	5,659
Connecticut		7,784		7,768		8,394
Delaware		1,302		1,328		1,391
District of Columbia		3,262		3,316		3,571
Florida		7,831		8,062		8,710
Georgia	[6] 5,332	7,899	[6] 4,990	8,066	[6] 4,646	8,531
Idaho		2,253	(7)	2,255	(7)	2,387
Illinois	26,407	30,794	28,309	31,703	[8] 33,538	33,803
Indiana	42,940	15,091	40,737	15,032	44,490	15,496
Iowa		11,807		12,574		13,103
Kansas	[9] 32,481	11,195	[9] 31,231	11,162	[9] 31,596	11,353
Kentucky	[10] 4,287	5,996	[10] 4,729	6,108	[10] 6,021	6,545
Louisiana	[4] 26,405	5,679	[4] 24,953	5,890	[4] 25,631	6,220
Maine		3,463		3,449		3,575
Maryland	(6)	6,433	(6)	6,475	(6)	6,945
Massachusetts	[11] 5,586	16,583	[11] 4,625	16,433	[11] 4,959	17,170
Michigan	5,672	26,443	6,822	25,094	7,932	27,455
Minnesota		12,140		12,613	(8)	13,111
Mississippi		4,519		4,616		4,988
Missouri	(9)	14,060	(9)	14,489	(9)	15,590
Montana	2,317	2,760	2,562	2,800	3,313	3,012
Nebraska	(12)	5,455	(7)	5,368	(7)	5,607
Nevada		890		920		1,045
New Hampshire		2,031		2,028		2,204
New Jersey	30,302	19,538	26,214	19,748	28,267	20,776
New Mexico	[13] 3,148	2,111	[13] 3,100	2,294	[13] 3,056	2,427
New York	5,833	43,228	5,515	42,910	6,355	45,255
North Carolina		9,272		9,546		10,229
North Dakota		2,899		3,031		3,137
Ohio	22,323	31,161	21,517	30,448	24,943	32,649
Oklahoma	37,095	9,284	34,488	9,732	33,898	10,159
Oregon		5,401		5,469		5,826
Pennsylvania	46,164	33,749	43,353	33,419	47,014	35,296
Rhode Island	(11)	2,913	(11)	2,881	(11)	3,092
South Carolina	(6)	4,480	(6)	4,656	(6)	5,055
South Dakota	(12)	2,708	(7)	3,080	(7)	3,174
Tennessee	(10)	6,355	(10)	6,687	(10)	6,875
Texas	170,279	29,054	182,427	30,247	196,631	31,926
Utah	(13)	2,169	(13)	2,213	(13)	2,375
Vermont		1,567		1,531		1,619
Virginia		8,158		8,457		9,098
Washington		7,964		8,057	(5)	8,320
West Virginia	1,598	4,672	1,627	4,533	1,712	4,879
Wisconsin		12,883		12,916		13,494
Wyoming	[12] 7,247	1,524	[7] 7,087	1,472	[7] 6,977	1,619
Total United States	559,141	505,635	556,012	509,966	595,925	539,656

[1] Revised figures. [2] Subject to revision. [3] American Petroleum Institute.
[4] Alabama included with Louisiana. [5] Washington included with California.
[6] Maryland and South Carolina included with Georgia.
[7] Idaho, Nebraska, and South Dakota included with Wyoming.
[8] Minnesota included with Illinois. [9] Missouri included with Kansas.
[10] Tennessee included with Kentucky. [11] Rhode Island included with Massachusetts.
[12] Nebraska and South Dakota included with Wyoming. [13] Utah included with New Mexico.

Distribution.—Motor fuel in the United States moves by pipe line, tanker, barge, tank car, and truck.

Pipe lines take the gasoline from refining centers and marine terminals to shipping points and consuming areas. The longest originates in Texas and transports Mid-Continent gasoline as far north and east as Minneapolis and Detroit. Others carry gasoline from Inland Texas and Louisiana to the Gulf coast, while a number of lines operate from the vicinity of New York City and Philadelphia as far west as Cleveland and as far north as Buffalo and Rochester, N. Y. One line runs from Providence, R. I., to Worcester, Mass., and thence to Hartford, Conn.

The quantity of motor fuel transported by pipe lines rose from 85,297,000 barrels in 1938 to 94,708,000 in 1939, an increase of 11 percent compared with the 6-percent increase in domestic demand.

Shipments of motor fuel by pipe lines in the United States in 1939, by months

[Thousands of barrels]

	1939													1938 (total)
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
Motor fuel turned into lines	7, 124	6, 442	7, 075	7, 578	8, 285	8, 658	8, 402	8, 722	7, 535	8, 379	8, 292	8, 631	95, 123	85, 592
Motor fuel delivered from lines	6, 723	5, 995	7, 345	7, 486	8, 469	8, 643	8, 594	8, 836	7, 640	8, 494	8, 111	8, 372	94, 708	85, 297
Shortage	22	[1] 1	24	23	15	27	19	33	42	33	19	6	262	330
Stocks in lines and working tanks, end of month	3, 706	4, 154	3, 860	3, 929	3, 730	3, 718	3, 507	3, 360	3, 213	3, 065	3, 227	3, 480	3, 480	3, 327

[1] Overage.

The tanker movement is almost entirely from the Gulf coast to the Atlantic coast, with a small amount moving from California. Boat shipments from the Gulf coast to the East coast, which include virtually all gasoline transportation between these points, rose from 105,036,000 barrels in 1938 to 114,633,000 in 1939. Tanker shipments from California to the East coast partly recovered from their slump to 2,965,000 barrels in 1938 by rising to 3,665,000 in 1939.

Tanker rates from the Gulf to North Atlantic ports, which were as low as 14.5 cents per barrel several times during the year, began rising rapidly during the fall and stood at 60 cents per barrel at the end of the year.

Except for a movement along the coast of the Gulf of Mexico, shipments by barge are principally up the Mississippi River and its tributaries, where domestic transportation of gasoline (without adjustment for duplications) rose from 46,060,000 barrels in 1937 to 51,808,000 in 1938.[8]

Tank cars are necessary for inland movement where pipe lines are not available, while tank trucks, although used to some extent in long hauls, function principally in short-haul distribution.

[8] Chief of Engineers, U. S. Army, Annual Report: Pt. 2, table 38, 1938, p. 43, 1939, p. 45.

KEROSENE AND RANGE OIL[9]

Refinery statistics for kerosene in 1939 compared with 1938 reveal gains in the indicated domestic demand as well as in exports; these increased markets were supplied by a greater production, supplemented by a nominal draft on stocks. The higher production of 68,521,000 barrels of kerosene in 1939 compared with 64,580,000 barrels in 1938 was due to the larger runs to stills, as the kerosene yield remained at 5.5 percent or the same level as in 1938. The domestic demand for kerosene increased 7 percent—from 56,360,000 barrels in 1938 to 60,501,000—the largest increment in the domestic market in several years. The improved demand for kerosene in 1939 was confined largely to the first half of the year; it slackened noticeably in the third and fourth quarters, as indicated by actual losses in July, October, and December 1939 compared with the corresponding months of 1938.

Comparative analyses of statistics for kerosene the in United States, 1938–39, by months and districts

	Production (thousands of barrels)		Yield (percent)		Domestic demand (thousands of barrels)		Stocks (thousands of barrels)	
	1938	1939[1]	1938	1939[1]	1938	1939[1]	1938	1939[1]
By months:								
January	5,638	5,702	5.8	5.7	5,361	5,980	6,523	6,711
February	5,167	5,174	5.8	5.9	5,017	5,901	5,986	5,452
March	5,798	5,900	6.0	6.0	5,150	5,201	6,093	5,605
April	5,445	5,813	5.7	5.9	4,333	5,042	6,394	5,663
May	5,649	5,909	5.7	5.6	3,637	4,368	7,627	6,551
June	5,235	5,439	5.6	5.2	3,257	3,570	9,202	7,949
July	4,889	5,390	4.9	5.0	3,760	3,710	10,112	8,855
August	4,933	5,783	4.9	5.4	4,292	4,436	10,149	9,361
September	5,348	5,806	5.5	5.5	4,187	4,638	10,497	9,952
October	5,320	6,141	5.3	5.5	5,185	5,019	9,949	9,967
November	5,419	5,642	5.6	5.4	5,368	6,023	9,676	9,019
December	5,739	5,822	5.9	5.5	6,813	6,613	7,799	7,576
Total United States	64,580	68,521	5.5	5.5	56,360	60,501	7,799	7,576
By districts:								
East Coast	9,208	9,120	5.1	4.7	(2)	(2)	1,356	1,318
Appalachian	2,769	2,847	7.1	6.5			184	297
Indiana, Illinois, Kentucky, etc.	7,096	8,476	4.3	4.4			702	1,089
Oklahoma, Kansas, and Missouri	6,960	7,073	6.3	6.3			743	686
Texas Inland	2,985	2,977	4.5	4.6			189	149
Texas Gulf Coast	22,357	23,224	7.3	7.0			2,722	1,917
Louisiana Gulf Coast	6,037	6,898	12.9	14.2			527	773
Arkansas and Louisiana Inland	2,139	2,470	8.9	9.9			192	184
Rocky Mountain	810	782	3.3	3.0			79	105
California	4,219	4,654	2.1	2.3			1,105	1,058
Total United States	64,580	68,521	5.5	5.5	56,360	60,501	7,799	7,576

[1] Subject to revision. [2] Figures not available.

Year-end stocks of kerosene for 1939—7,576,000 barrels—are below the 1938 final inventory—7,799,000 barrels. The decline in stored kerosene during 1939 contrasts with pronounced gains in stocks of 716,000 barrels in 1938 and 1,450,000 barrels in 1937. Kerosene held in storage at the end of 1939 represented 46 days' supply compared with 51 days' supply at the end of 1938 and 47 days' supply at the end of 1937. Kerosene stocks held in the Texas Gulf Coast refinery district declined by 805,000 barrels to a year-end total of 1,917,000 barrels during 1939, while noticeable increases of 387,000 and 246,000 barrels are indicated in the Indiana-Illinois and Louisiana Gulf districts, respectively. The Indiana-Illinois district moved from fifth

[9] By A. T. Coumbe, Petroleum Economics Division, Bureau of Mines.

to third place in importance as a kerosene storage area in 1939, supplanting California, which dropped to fourth place.

Exports of kerosene increased from 7,504,000 barrels in 1938 to 8,243,000 in 1939, a gain of 10 percent; this expansion is in contrast to a decline of 16 percent in the 1938 overseas demand compared with the 1937 total. Netherlands, Sweden, Brazil, the Philippine Islands, and China, including Hong Kong and Kwantung, all important markets for American kerosene, required increased quantities in 1939 compared with 1938, while kerosene exports to the Netherland West Indies and the United Kingdom in 1939 were below the 1938 totals.

Sales of kerosene in the United States 1937–38, by regions, States, and uses

[Thousands of barrels]

Region and State	Sold as range oil		Tractor fuel		All other uses		Total	
	1937	1938	1937	1938	1937	1938	1937	1938
Pacific Coast:								
California	[1] 65	86			[1] 1,305	1,206	1,370	1,292
Oregon	(1)	10		4	[1] 64	59	64	73
Washington	(1)	11			[1] 90	124	90	135
Arizona	[1] 3	6			[1] 72	82	75	88
Nevada	(1)	1			[1] 12	10	[1] 12	11
Rocky Mountain:								
Idaho	4	2	14	14	8	7	26	23
Montana	4	7	57	52	45	41	106	100
Wyoming	2	4	17	18	17	14	36	36
Utah	21	20	8	9	10	12	39	41
Colorado	17	22	73	69	47	50	137	141
New Mexico	17	23	25	29	44	44	86	96
North Central:								
North Dakota	28	36	164	167	33	47	225	250
South Dakota	61	74	147	124	77	69	285	267
Minnesota	111	150	264	255	478	457	853	862
Nebraska	93	97	252	196	114	159	459	452
Iowa	101	125	285	302	686	670	1,072	1,097
Wisconsin	124	143	207	187	534	522	865	852
Illinois	465	612	347	328	1,553	1,482	2,365	2,422
Indiana	75	107	136	127	1,054	1,068	1,265	1,302
Michigan	141	192	129	117	692	685	962	994
Ohio	224	270	169	181	753	823	1,146	1,274
Kentucky	19	34	28	31	441	486	488	551
Tennessee	106	101	96	89	461	426	663	616
South Central:								
Missouri	232	263	154	136	705	687	1,091	1,086
Kansas	181	154	280	206	235	271	696	631
Texas	206	242	378	314	1,265	1,365	1,849	1,921
Oklahoma	104	111	154	148	531	464	789	723
Arkansas	183	197	69	80	455	411	707	688
Louisiana	203	175	46	35	629	649	878	859
Mississippi	80	51	92	126	312	311	484	488
Alabama	67	82	37	26	456	344	560	452
New England:								
Maine	1,014	1,087	5	1	68	42	1,087	1,130
New Hampshire	703	701			54	37	757	738
Vermont	474	448	1	1	41	77	516	526
Massachusetts	9,369	9,629	14		319	452	9,702	10,081
Rhode Island	2,036	2,076			100	79	2,136	2,155
Connecticut	2,858	3,068	5	1	210	128	3,073	3,197
Middle Atlantic:								
New York	5,417	5,528	125	128	1,117	1,092	6,659	6,748
New Jersey	2,526	2,647	35	31	1,261	1,190	3,822	3,868
Pennsylvania	562	571	127	141	1,294	1,361	1,983	2,073
Delaware	76	86	4		22	52	102	138
Maryland	439	435	27	26	488	529	954	990
District of Columbia	49	51	3	1	84	76	136	128
South Atlantic:								
Virginia	212	170	15	7	532	560	759	737
West Virginia	41	37	8	4	149	147	198	188
North Carolina	308	329	75	88	634	641	1,017	1,058
South Carolina	65	96	32	33	426	437	523	566
Georgia	191	145	52	31	390	442	633	618
Florida	235	293	95	92	418	423	748	808
Total United States	[1] 29,512	30,805	4,251	3,955	[1] 20,785	20,810	[1] 54,548	55,570

[1] Revised figures.

The annual survey of the Bureau covering distribution of kerosene by principal uses showed total sales of 55,570,000 barrels in 1938 compared with 54,548,000 in 1937. Kerosene deliveries in 1938 were reported as follows: Range oil 30,805,000 barrels, comparable with 29,512,000 in 1937; tractor fuel 3,955,000 barrels in 1938, a slight decline from the 1937 total of 4,251,000 barrels; and all other uses, 20,810,000 barrels in 1938 and 20,785,000 in 1937. The growing market for range oil absorbs an ever-increasing proportion of kerosene deliveries each year and made up 55.4 percent of the total in 1938 compared with 54.1 percent in 1937 and 53.1 percent in 1936. Furthermore, the available kerosene does not entirely satisfy the market for range fuel, and the distributors make up the difference with No. 1 fuel oil; 2,902,000 barrels of the latter product were delivered as range oil in 1938 and 2,747,000 barrels in 1937. The total demand for range oil, including both kerosene and No. 1 fuel oil, was reported as 33,707,000 barrels in 1938 compared with 32,259,000 barrels in 1937.

The upward trend of recent years in refinery kerosene prices, as measured by the quotations for 41°–43° gravity water-white grade in Oklahoma, was reversed in 1939, and the average for the year declined to 3.97 cents per gallon compared with 4.19 cents in 1938. The average monthly price of 4.09 cents per gallon for December 1938 dropped to 4.06 cents in January 1939 and remained at that quotation until May, when the average decreased further to 4.05 cents per gallon. Summer prices for Oklahoma kerosene trended downward until they reached an average of 3.88 cents per gallon in September and remained at that point until the middle of December 1939, when a slight increase brought the average to 3.91 cents per gallon for the final month of the year.

The tank-wagon price of kerosene, as represented by the quotations at Chicago, dropped from an average of 10.31 cents per gallon in 1938 to 10 cents per gallon in 1939. A price of 10 cents a gallon, effective October 8, 1938, remained unchanged at that level throughout all of 1939.

Sales of range oil in the United States, 1936–38, by States [1]

[Thousands of barrels]

State	1936	1937	1938	
			Total	Percent of total
Massachusetts	8,219	9,645	9,959	29.5
New York	4,811	5,817	5,951	17.7
Connecticut	2,511	2,972	3,191	9.4
New Jersey	2,210	2,722	2,854	8.5
Rhode Island	1,744	2,079	2,127	6.3
Maine	981	1,108	1,174	3.5
Illinois	595	762	977	2.9
New Hampshire	639	708	701	2.1
Pennsylvania	538	639	641	1.9
Vermont	411	480	448	1.3
Maryland	357	443	437	1.3
North Carolina	268	312	331	1.0
Florida	224	271	325	1.0
Missouri	269	294	306	.9
Other States	3,515	[2] 4,007	4,285	12.7
Total United States	27,292	32,259	33,707	100.0

[1] Figures for 1939 by States not yet available.
[2] Revised figures.

FUEL OILS [10]

The domestic market for fuel oils recovered from its 1938 losses and reached a new all-time high in 1939. Exports of fuel oils in 1939 continued the upward trend of recent years and established a record for the second consecutive year, while imports declined noticeably in 1939 compared with 1938. Fuel-oil stocks at the end of 1939 were considerably below comparable quantities held on December 31, 1938.

Salient statistics of fuel oils in the United States, 1938–39

[Thousands of barrels]

	1938			1939 [1]		
	Gas oil and distillate fuel oils	Residual fuel oils	Total	Gas oil and distillate fuel oils	Residual fuel oils	Total
Stocks at beginning of year:						
Refinery	22,566	81,507	104,073	27,873	97,746	125,619
Bulk terminal	(2)	(2)	(2)	8,351	4,225	12,576
Production	151,774	294,890	[3] 446,664	161,670	306,896	[3] 468,566
Transfers from crude oil to fuel oil	[4] 623	[4] 10,037	[4] 10,660	[5] 6,491	[6] 5,918	12,409
Imports:						
Bonded		18,390	18,390		14,972	14,972
Duty paid		2,675	2,675	171	960	1,131
Exports	29,641	17,920	47,561	32,021	17,490	49,511
Stocks at end of year:						
Refinery	27,873	97,746	125,619	26,374	87,774	114,148
Bulk terminal	8,351	4,225	12,576	7,344	4,516	11,860
Indicated domestic demand:						
Class I railroads, purchases [7]	(2)	(2)	57,758	(2)	(2)	62,235
Public utility power plants [8]	(2)	(2)	13,077	(2)	(2)	17,331
Bunker oil, foreign trade	(2)	(2)	34,849	(2)	(2)	35,841
All other demands	(2)	(2)	303,598	(2)	(2)	[9] 344,347
	117,449	291,833	409,282	[10] 138,817	[11] 320,937	459,754

[1] Subject to revision. [2] Figures not available.
[3] Includes production by cracking: 1938, 252,252,000; 1939, 260,441,000.
[4] California only. [5] Includes 616,000 barrels in California.
[6] All in California—no transfers to residual fuel oil east of California.
[7] Interstate Commerce Commission; total includes Diesel fuel.
[8] Federal Power Commission. [9] 337,756,000 on old basis, comparable with 1938.
[10] 131,935,000 on old basis, comparable with 1938.
[11] 321,228,000 on old basis, comparable with 1938.

There are two sets of refinery statistics for fuel oils in 1939, one on the old basis comparable with 1938, and one on a new basis, which considers transfers of light grades of crude petroleum to the gas-oil and distillate fuel-oil account in refinery districts east of California and changes in bulk-terminal stocks, also in refinery districts east of California. Bulk-terminal stocks of fuel oil in California have been included in refinery stocks since 1924. The crude petroleum transferred to distillate fuel oil has previously been part of the fuel-and-loss item of the crude-oil account. The transfer of 5,875,000 barrels of crude oil to the distillate fuel-oil total on the new basis reduces "fuel and losses" under crude oil by that quantity and increases the indicated domestic demand for distillate fuel oils by the same amount. Furthermore, the changes in bulk-terminal stocks of distillate fuel oils in refinery districts east of California in 1939 adds an additional 1,007,000 barrels (the net reduction in these stocks in 1939) to the indicated domestic demand for distillate fuel oils. Bulk-terminal stocks of residual fuel oil held east of California increased by 291,000 barrels in

[10] By A. T. Coumbe, Petroleum Economics Division, Bureau of Mines.

1939, therefore the indicated domestic demand for residual fuel oil is reduced by the same quantity on the new basis. The following table, in thousands of barrels, shows the transition from the old to the new basis in 1939 and the crude-oil and fuel-oil items involved in the change.

Domestic demand for fuel oil on old and new bases, 1938–39.

	1938	1939	
		Old basis	New basis
Gas oil and distillate fuel oil:			
Transfers in California	623	616	616
Transfers east of California [1]	(2)	(2)	5,875
Change in terminal stocks	(3)	(3)	−1,007
Domestic demand	117,449	131,935	138,817
Residual fuel oil:			
Transfers in California [1]	10,037	5,918	5,918
Change in terminal stocks	(2)	(3)	+291
Domestic demand	291,833	321,228	320,937
Crude oil:			
Losses and other crude used as fuel	[2] 16,751	18,691	12,816

[1] All transfers east of California classified as light fuel oil.
[2] Available only for lease and pipe-line fuel totaling 3,382,000 barrels in 1938 and 3,577,000 barrels in 1939. These amounts included as "Losses and crude used as fuel" in this table.
[3] Not available.

Generally improved economic conditions resulted in higher domestic requirements for fuel oils, and deliveries increased from 409,282,000 barrels in 1938 to 453,163,000 (459,754,000 on the new basis) in 1939, a gain of 11 percent. The domestic demand for distillate or light fuel oils, which changed little in 1938 over 1937, moved upward to a new high of 131,935,000 barrels (138,817,000 on the new basis) in 1939, an increase of 12 percent over the 1938 total of 117,449,000 barrels. A more active market for residual or heavy fuel oils, associated with higher industrial consumption, brought the domestic requirements to 321,228,000 barrels (320,937,000 on the new basis) in 1939, a 10-percent gain over the 291,833,000 barrels credited in 1938 and but little below the record demand of 325,514,000 barrels reported in 1937.

Sales of gas oil, and fuel oil [1] and of range oil 1934–38, by uses [2]

[Thousands of barrels]

Use	1934	1935	1936	1937	1938
Gas oil and fuel oil:					
Railroads	52,581	55,651	61,727	69,458	57,829
Ships' bunkers (including tankers)	69,262	74,581	80,324	84,990	74,266
Gas and electric power plants	23,143	23,647	26,799	26,510	27,567
Smelters and mines	2,682	2,448	3,768	[4] 74,798	60,038
Manufacturing industries	54,260	61,128	67,558		
Heating oils	60,822	76,853	99,257	[4] 116,617	118,323
Fuel oil (#1) sold as range oil	(3)	(3)	(3)	2,747	2,902
U. S. Navy, Army transports, etc	7,914	10,428	9,241	9,135	11,756
Oil-company fuel	47,404	48,116	46,021	42,924	43,517
Miscellaneous uses	12,253	13,133	13,714	[4] 14,624	11,652
Total United States	330,321	365,985	408,409	[4] 441,803	407,850
Exports and shipments to noncontiguous Territories	28,605	28,948	34,883	45,433	47,561
Total	358,926	394,933	443,292	[4] 487,236	455,411
Range oil	15,756	21,526	27,292	[4] 32,259	33,707

[1] Includes some crude oil burned as fuel. [2] Figures for 1939 not yet available. [3] Figures not available.
[4] Revised figures.

The market for distillate fuel oils was at the same level in the final quarter of 1938 as in the corresponding period of 1937; however, a review of light fuel-oil deliveries in 1939 by quarters shows a marked upward trend in demand. In the first two quarters of 1939, sales of distillate fuel oils were approximately 20 percent above the requirements in the first half of 1938. The market slumped sharply in the third quarter of 1939, yet the total for the period is 4 percent above that for the same months of 1938. There was some improvement as the heating season opened, and the final quarter of 1939 closed with a 7-percent gain compared with the year-end period of 1938. An expanding market for residual fuel oils, noticeable in the final quarter of 1938, gained momentum in the early months of the new year and reached gains as high as 13 percent in the second and third quarters of 1939 over similar periods of 1938. The year closed with a 7-percent rise in the fourth quarter of 1939 over the same quarter of 1938.

Preliminary statistics released by several Government agencies indicate a higher demand for fuel oils in 1939 compared with 1938. Bunker loadings of 35,841,000 barrels for vessels in foreign trade are 3 percent above the 1938 total, according to the Bureau of Foreign and Domestic Commerce, Department of Commerce, while reports of the Interstate Commerce Commission indicate fuel-oil and Diesel-fuel purchases of 62,235,000 barrels by class I railroads, a gain of 8 percent over 1938 requirements (57,758,000 barrels). Public utility electric-power plants bought 17,331,000 barrels of fuel oil in 1939, a total nearly a third greater than the 1938 purchases of 13,077,000 barrels, as revealed by figures compiled by the Federal Power Commission. If these known items are deducted from the indicated domestic demand of 453,163,000 barrels (459,754,000 barrels on the new basis) there remain 337,756,000 barrels to supply the various other fuel-oil markets, such as manufactured-gas plants, bunkers for coastwise vessels, oil fuel for mines, smelters, and manufacuring establishments, space heating, Government requirements for the Army and Navy, and oil-company fuel, a total comparable to 303,598,000 barrels for the same group of consumers in 1938. Final distribution of fuel-oil deliveries for 1939 will not be available until the annual survey of fuel-oil sales by distributors is completed; it is believed, however, that all principal use items will show a gain for the year.

Figure 11 shows graphically the fluctuations in fuel-oil sales by principal uses during 1929–38. The sales cover all grades of light and heavy fuel oils, including kerosene delivered as range oil.

Exports of fuel oils, including shipments to noncontiguous Territories of the United States, were of record volume in 1939 for the second consecutive year, when the overseas trade totaled 49,511,000 barrels, a gain of 4 percent over the 1938 quantity (47,561,000 barrels). Expansion in the fuel-oil export trade was confined to the distillate grades, which increased 8 percent from 29,641,000 barrels in 1938 to 32,021,000 in 1939. Exports of 17,490,000 barrels of residual fuel oils in 1939 show little change from the 1938 quantity—17,920,000 barrels.

Larger exports of distillate fuel oils in 1939 compared with 1938 are associated with increased takings by the United Kingdom, Netherlands, Sweden, Canada, Panama Canal Zone, Japan, and the Philippines. The larger light-fuel-oil purchases by the above-named countries were partly offset by smaller consignments in 1939 to Belgium, Denmark, Germany, and the Netherland West Indies. Japan re-

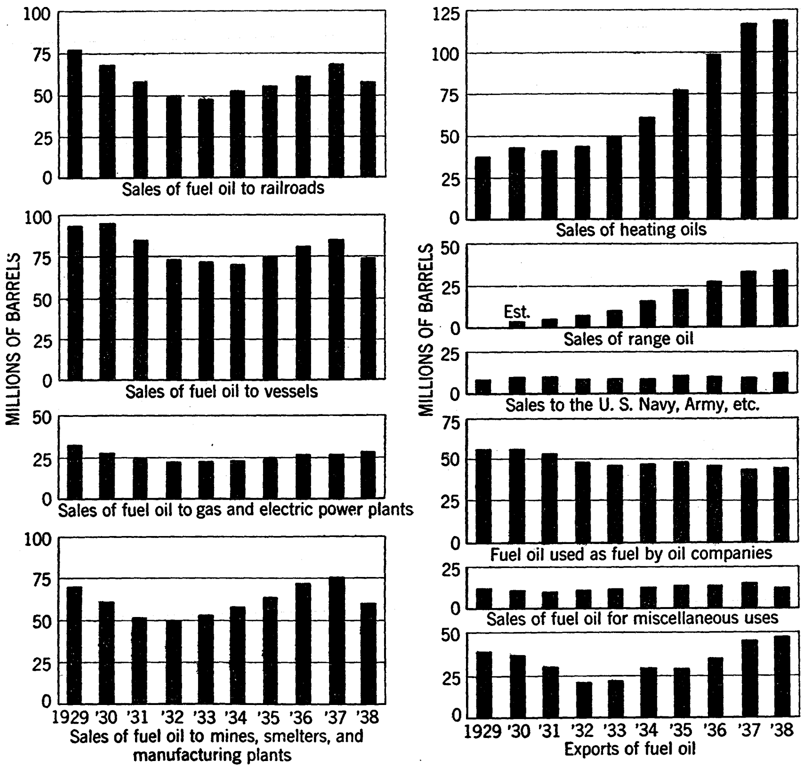

FIGURE 11.—Sales of fuel oils and range oil, 1929–38, by uses.

tained first place as the most important export customer for distillate fuel oils, receiving 6,020,000 barrels in 1939 compared with 5,297,000 in 1938.

Gains made in residual or heavy fuel oil exports in 1939 over 1938 to Italy, Spain, Japan, and the Philippines were wiped out by the smaller quantities required in 1939 by the United Kingdom, Netherlands, Canada, Cuba, Mexico, and Chile. Exports of residual fuel oil to Cuba had increased from 247,000 barrels in 1937 to 1,356,000 in 1938, and the larger share probably was intended for reexport; these declined to 322,000 barrels in 1939.

Comparative analyses of statistics for gas oil and distillate fuel oils in the United States, 1938–39, by months and districts

[Thousands of barrels]

	Production		Yield (percent)		Transfers			Imports		Exports		Domestic demand			Stocks		
					East of Calif.[2]	California											
	1938	1939[1]	1938	1939[1]	1939[1]	1938	1939[1]	1938	1939[1]	1938	1939[1]	1938	1939[1,3]	1939[1,4]	1938	1939[1,3]	1939[1,5]
By months:																	
January	13,876	14,122	14.2	14.2	535	------	13	------	44	2,257	1,675	12,642	15,727	16,963	21,543	24,650	32,300
February	12,144	12,709	13.8	14.5	401	------	88	------	127	2,151	2,131	11,651	13,712	14,767	19,885	21,731	28,727
March	12,294	13,539	12.8	13.7	407	------	73	------	------	2,810	2,924	10,487	12,304	13,923	18,882	20,115	25,899
April	11,577	13,301	12.1	13.4	438	------	34	------	------	2,687	2,345	7,800	10,047	10,856	19,972	21,058	26,471
May	12,160	12,353	12.3	11.7	478	94	38	------	------	2,561	4,004	7,280	7,357	7,523	22,385	22,088	27,813
June	10,784	13,530	11.5	12.9	482	101	78	------	------	2,980	2,839	5,591	7,198	7,187	24,699	25,659	31,877
July	12,688	12,688	12.7	11.9	467	55	103	------	------	2,896	2,857	7,926	8,012	6,938	26,620	27,581	35,340
August	12,691	13,246	12.5	12.3	513	110	45	------	------	2,614	3,361	7,966	8,229	8,157	28,841	29,282	37,626
September	13,074	12,975	13.5	12.3	515	28	47	------	------	2,428	3,015	8,655	9,271	10,010	30,860	30,018	38,138
October	13,820	15,017	13.7	13.5	565	117	37	------	------	1,574	2,756	10,206	11,365	10,908	33,017	30,951	40,093
November	12,793	13,757	13.1	13.1	551	80	20	------	------	2,270	2,116	11,551	12,433	14,417	32,069	30,179	37,888
December	13,873	14,433	14.2	13.6	523	38	40	------	------	2,413	1,998	15,694	16,280	17,168	27,873	26,374	33,718
Total United States	151,774	161,670	13.0	13.1	5,875	623	616	------	171	29,641	32,021	117,449	131,935	138,817	27,873	26,374	33,718
By districts:																	
East Coast	28,559	30,638	15.8	15.9	------	------	------	------	91	140	146				5,821	4,493	10,381
Appalachian	2,446	2,868	6.2	6.6	------	------	------	------	------	15	48				270	234	387
Ind., Ill., etc	17,397	18,963	10.7	9.9	655	------	------	------	------	4	5				3,427	3,681	4,372
Okla., Kans., etc	11,163	10,813	10.0	9.6	527	------	------	------	------	------	------				1,443	1,532	1,544
Tex. Inland	4,217	2,903	6.3	4.4	1,656	------	------	------	------	2,828	3,628	[6]	[6]	[6]	395	348	348
Tex. Gulf Coast	47,529	54,362	15.4	16.3	1,514	------	------	------	------	12,024	13,736				5,462	5,044	5,608
La. Gulf Coast	7,450	7,706	15.9	15.9	859	------	------	------	80	3,331	2,238				1,043	908	935
Ark. & La. Inland	2,341	1,585	9.7	6.4	228	------	------	------	------	------	------				268	194	203
Rocky Mountain	1,689	1,809	6.8	6.9	436	------	------	------	------	34	47				271	278	278
California	28,983	30,023	14.5	15.1	------	623	616	------	------	11,265	12,173				9,473	9,662	9,662
Total United States	151,774	161,670	13.0	13.1	5,875	623	616	------	171	29,641	32,021	117,449	131,935	138,817	27,873	26,374	33,718

[1] Subject to revision. [2] Not available prior to 1939. [3] For comparison with 1938.
[4] New basis including transfers east of California and changes in bulk-terminal stocks east of California.
[5] Includes bulk-terminal stocks east of California—bulk-terminal stocks in California included in refinery stocks since 1924.
[6] Not available.

Larger production of both distillate and residual fuel oils can be credited almost entirely to the running of more crude oil to stills in 1939 compared with 1938. The refinery throughput of crude petroleum increased from 1,165,015,000 barrels in 1938 to 1,237,-840,000 in 1939, a gain of over 6 percent, in contrast to a decline of nearly 2 percent in 1938 from 1937. The distillate fuel-oil output of 161,-670,000 barrels in 1939 is 6 percent above the 1938 yield—151,774,000 barrels. Only a small portion (about 1.2 million barrels) of the 9.9-million-barrel increase in production in 1939 over 1938 can be attributed to a change in the percentage of yield, as this factor varied only slightly, or from 13.0 percent in 1938 to 13.1 percent in 1939. Refiners, with a more active market for residual fuel oils, increased the production from 294,890,000 barrels in 1938 to 306,896,000 in 1939, or 4 percent, in contrast to a contracted output of over 5 percent in 1938 compared with 1937. The pressure for light heating oils in recent years explains in part the declining yield for residual fuel oils, which dropped to 24.8 percent in 1939 compared with 25.3 percent in 1938.

The California production of 30,023,000 barrels of distillate fuel oil during 1939 was about 4 percent over the 1938 quantity, while east of California the yield of 131,647,000 barrels of light fuel oil in 1939 was 7 percent above the 1938 output. In districts that make important quantities of light fuel oils, refineries in the Texas Gulf increased their production from 47,529,000 barrels in 1938 to 54,362,000 in 1939, a gain of 14 percent, while plants in the Indiana-Illinois and East Coast districts reported greater yields of distillate fuel oils by 9 and 7 percent, respectively, in 1939 compared with 1938. The output of light fuel oil declined in the Oklahoma-Kansas, Texas Inland, and Arkansas-Louisiana Inland refinery districts in 1939 over 1938. The output of residual fuel oils in California continued the downward trend of recent years and dropped from 86,041,000 barrels in 1938 to 80,982,000 in 1939, a loss of 6 percent. All refinery areas east of California turned out more heavy fuel oil in 1939 than in 1938 except the Oklahoma-Kansas and Texas Inland districts, where the declines were nominal. The production of residual fuel oil in the Indiana-Illinois district, where there was a great expansion in crude petroleum production and in refinery runs in 1939, increased from 23,319,000 barrels in 1938 to 28,962,000 in 1939, a gain of 24 percent. The yield of 55,392,000 barrels of heavy fuel oil in the East Coast area during 1939 represents an increase of 9 percent over the 1938 total, while a gain of 6 percent in the Texas Gulf Coast district to a total output of 78,391,000 barrels in 1939 places the latter area very near California in importance as a source of residual fuel oil.

Comparative analyses of statistics for residual fuel oil in the United States, 1938–39, by months and districts

[Thousands of barrels]

	Production		Yield (Percent)		Transfers in California		Imports		Exports		Domestic demand			Stocks		
	1938	1939 [1]	1938	1939 [1]	1938	1939 [1]	1938	1939 [1]	1938	1939 [1]	1938	1939 [1] [2]	1939 [1] [3]	1938	1939 [1] [2]	1939 [1] [4]
By months:																
January	26,148	25,813	26.7	25.9	1,230	792	1,635	957	869	1,379	25,749	28,381	28,443	83,902	95,548	99,711
February	23,935	21,564	27.1	24.6	1,285	540	1,454	984	911	925	23,912	25,117	25,589	85,753	92,594	96,285
March	25,269	25,040	26.4	25.3	1,047	915	1,971	1,337	1,521	2,047	25,599	28,071	28,436	86,920	89,768	93,094
April	24,748	24,750	25.9	24.9	843	871	2,016	1,316	1,473	1,488	22,161	24,806	24,472	90,893	90,411	94,071
May	24,456	27,022	24.6	25.6	752	448	1,598	2,104	1,690	1,854	22,256	25,646	25,047	93,753	92,485	96,744
June	22,760	24,836	24.2	23.7	714	497	2,223	1,935	1,613	1,684	22,147	24,747	23,923	95,690	93,322	98,405
July	23,542	25,644	23.6	24.0	775	188	1,616	1,513	1,790	1,144	20,470	23,218	23,442	99,363	96,305	101,164
August	24,230	25,299	23.9	23.5	552	195	1,605	1,723	1,723	1,613	23,596	26,012	25,407	100,431	95,897	101,361
September	24,551	26,302	25.3	24.9	638	315	1,932	675	1,680	1,624	23,041	26,514	26,966	102,831	95,051	100,063
October	25,477	27,594	25.3	24.9	765	351	1,617	1,532	1,643	1,296	25,624	28,475	28,323	103,423	94,757	99,921
November	24,573	26,088	25.3	24.9	814	244	1,561	1,012	1,270	1,116	27,532	29,519	29,453	101,569	91,466	96,696
December	25,201	26,944	25.7	25.5	622	562	1,837	844	1,737	1,320	29,746	30,722	31,436	97,746	87,774	92,290
Total United States	294,890	306,896	25.3	24.8	10,037	5,918	21,065	15,932	17,920	17,490	291,833	321,228	320,937	97,746	87,774	92,290
By districts:																
East Coast	50,803	55,392	28.1	28.8			19,489	15,869						7,413	3,930	7,976
Appalachian	4,725	5,415	12.1	12.4										568	494	494
Ind., Ill., etc.	23,319	28,962	14.3	15.1					169	58				4,025	2,964	3,020
Okla., Kans., etc.	19,101	19,011	17.2	16.9										3,527	2,733	2,733
Tex. Inland	15,871	14,769	23.7	22.6					741	1,931				2,113	2,301	2,301
Tex. Gulf Coast	73,774	78,391	24.0	23.5					6,716	3,857	(5)	(5)	(5)	6,978	6,462	6,579
La. Gulf Coast	10,643	12,076	22.7	24.8			1,576	61	268	193				1,162	916	1,213
Ark. & La. Inland	5,697	6,170	23.6	24.8										586	566	566
Rocky Mountain	4,916	5,728	19.8	21.8				2						619	515	515
California	86,041	80,982	42.9	40.8	10,037	5,918			10,026	11,451				70,755	66,893	66,893
Total United States	294,890	306,896	25.3	24.8	10,037	5,918	21,065	15,932	17,920	17,490	291,833	321,228	320,937	97,746	87,774	92,290

[1] Subject to revision. [2] For comparison with 1938.
[3] New basis including changes in bulk-terminal stocks east of California.
[4] Includes bulk-terminal stocks east of California, bulk-terminal stocks in California included in refinery stocks since 1924.
[5] Not available.

Transfers of non-gasoline-bearing crude oil to the residual fuel-oil account in California continued downward in 1939 for the second consecutive year, or from 10,037,000 barrels in 1938 to 5,918,000 in 1939. Virtually the same conditions, such as lack of active market demand, absence of price incentive, and ample heavy fuel-oil stocks, which governed these transfers in 1938, held in 1939. There was some improvement in the domestic demand for heavy fuel oil in the California marketing area, from 68 million barrels in 1938 to 76 million in 1939, but with ample refinery production and stocks of heavy fuel oil on hand, transfers of crude oil to the fuel-oil account were unnecessary during 1939 in the same volume as in recent years. Furthermore, there was also lack of inducement for transfers of crude from the price angle in 1939, although the quotation for heavy fuel oil moved upward from 80 cents to 87.5 cents per barrel in the 2 closing months of the year.

Although transfers of heavy crude oil to the residual fuel-oil account date back to 1932 in California, light crude used as fuel does not appear in refinery statistics of that area until 1938, when 623,000 barrels were transferred to the distillate fuel-oil supply, followed by a comparable total of 616,000 barrels in 1939. Distillate fuel-oil statistics for 1939 on a new basis include transfers of 5,875,000 barrels of crude oil used as fuel in refinery districts east of California, and the domestic demand of that area is increased correspondingly. The transfers of light crude oils east of California consist of the following items: 1,452,000 barrels used as fuel on leases, 2,125,000 barrels used by pipe lines, and 2,298,000 barrels consumed as industrial fuel.

Sales of gas oil and fuel oils [1] in the United States, 1934–38, by regions and States [2]

[Thousands of barrels]

Region and State	1934	1935	1936	1937 [3]	1938
Pacific Coast:					
Washington	8,485	8,976	9,331	11,352	9,241
Oregon	6,079	7,773	9,918	10,879	9,308
California	63,801	66,627	65,895	70,952	59,316
Arizona	729	2,545	2,585	3,994	2,838
Nevada	664	2,182	2,791	3,790	2,690
Rocky Mountain:					
Idaho	82	140	223	520	420
Montana	1,221	1,676	1,652	1,802	1,451
Wyoming	1,264	1,418	1,549	1,799	1,654
Utah	254	260	404	508	471
Colorado	400	464	581	644	636
New Mexico	753	835	715	561	502
North Central:					
North Dakota	199	269	294	416	442
South Dakota	353	474	536	613	777
Minnesota	2,796	2,986	4,093	5,184	4,974
Nebraska	1,152	1,315	1,743	1,955	1,982
Iowa	1,032	1,378	1,873	2,261	2,325
Wisconsin	2,415	2,992	4,022	4,823	4,748
Illinois	13,206	15,037	18,351	20,964	19,930
Indiana	6,199	6,935	7,450	7,905	7,824
Michigan	7,631	8,634	9,000	9,847	8,228
Ohio	5,393	5,826	7,173	8,030	7,105
Kentucky	749	815	799	973	840
Tennessee	500	328	387	593	557
South Central:					
Missouri	5,456	6,583	7,605	8,980	8,502
Kansas	6,693	7,394	7,764	7,364	6,687
Texas	38,368	39,382	41,841	43,231	37,672
Oklahoma	9,836	9,581	9,461	9,083	8,269
Arkansas	2,345	2,544	2,876	2,658	2,056
Louisiana	8,585	10,481	11,614	12,350	10,871
Mississippi	265	476	593	796	529
Alabama	1,174	1,294	1,545	1,889	2,113

[1] Includes some crude oil burned as fuel.
[2] Figures for 1939 not yet available.
[3] Revised to include 2,481,000 barrels of No. 1 fuel oil sold as range oil.

Sales of gas oil and fuel oils in the United States, 1934–38, by regions and States—Continued

Region and State	1934	1935	1936	1937	1938
New England:					
Maine	1,487	1,756	2,328	2,490	2,150
New Hampshire	885	1,176	1,363	1,513	1,431
Vermont	353	393	458	566	539
Massachusetts	14,394	17,187	18,829	21,798	21,362
Rhode Island	6,412	6,591	6,894	7,283	6,839
Connecticut	4,862	5,742	7,047	7,822	7,482
Middle Atlantic:					
New York	30,367	36,087	42,215	43,428	43,389
New Jersey	30,646	32,554	41,458	44,232	42,862
Pennsylvania	21,871	23,452	26,098	26,320	26,213
Delaware	865	914	1,335	1,666	1,400
Maryland	7,053	7,715	8,423	9,549	9,003
District of Columbia	1,190	1,509	1,911	2,108	2,137
South Atlantic:					
Virginia	1,808	2,575	3,420	3,638	4,824
West Virginia	576	919	840	807	912
North Carolina	334	402	504	591	699
South Carolina	549	509	591	679	757
Georgia	1,280	1,497	1,744	1,787	2,022
Florida	7,310	7,387	8,287	8,810	8,871
Total, United States	330,321	365,985	408,409	441,803	407,850

There has been an excise tax of 21 cents a barrel on imported crude petroleum, topped crude petroleum, residual fuel oil, and gas oil since June 21, 1932. A new reciprocal trade agreement signed with Venezuela and effective December 16, 1939, lowers the tax on the above petroleum products imported from that country to 10½ cents a barrel; however, the quantity imported at the lower rate in any 1 year is limited to 5 percent of the crude oil run to stills in American refineries in the previous year. Runs to stills were 1,237,840,000 barrels in 1939; consequently 61,892,000 barrels of crude and fuel oil can be imported in 1940 at the reduced tariff, but quantities exceeding this amount are subject to the usual tax of 21 cents a barrel. Other nations as well as Venezuela are allowed the benefit of the lower excise tax on our imports of crude and fuel oil; and allotments based upon their respective shares of this trade during the first 10 months of 1939 are approximately as follows: Venezuela, 72 percent; Netherlands and colonies, 20 percent; Colombia, 4 percent; and all other foreign countries, 4 percent.

At this time it is impossible to foresee the effect of the lower tariff on fuel oil—10½ cents per barrel—on the quantity brought into this country for domestic use. Imports of duty-paid residual fuel oil rose sharply in December 1939 and in January and February 1940, but it is uncertain whether this expansion was due to the lower rate of duty or to the unusually heavy winter demand and greatly depleted stocks in eastern refinery areas. Dwindling American exports are now forcing a larger portion of the fuel-oil production on local markets.

No distillate fuel oils were received from foreign sources in 1938; however, small quantities totaling 171,000 barrels were imported in January and February 1939. Imports of residual fuel oil decreased from 21,065,000 barrels in 1938 to 15,932,000 in 1939. Heavy fuel oil brought into the country under bond for ships' bunkers or for refining into products for reexport decreased from 18,390,000 barrels in 1938 to 14,972,000 in 1939, or 19 percent, while duty-paid fuel oils intended for domestic consumption dropped from 2,675,000 barrels in 1938 to 960,000 in 1939, or nearly two-thirds in volume. Most of the imported heavy fuel oil in 1939, as well as in 1938, was shipped from refineries in the Netherland West Indies and was entered in the New York customs district.

Data covering fuel oils held at bulk terminals for refinery districts east of California are not available before 1939, but beginning January 1, 1939, this information was reported and calculations of the indicated domestic demand for fuel oils on a new basis consider changes in bulk-terminal stocks as well as in refinery stocks. A net decline of 1,007,000 barrels in bulk-terminal stocks held east of California, plus a transfer of 5,875,000 barrels from crude oil to the fuel-oil account previously mentioned, increases the indicated domestic demand for distillate fuel oils in 1939 from 131,935,000 barrels, as originally reported, to 138,817,000 barrels on the present basis. Residual fuel oils stored at bulk terminals increased by 291,000 barrels during 1939; consequently the domestic demand for heavy grades in 1939 is decreased correspondingly or from 321,228,000 barrels on the old basis to a revised total of 320,937,000 barrels.

Increased domestic requirements and exports were instrumental in reducing refinery fuel-oil stocks by nearly 11.5 million barrels in 1939, or from 125,619,000 barrels held at the end of 1938 to 114,148,000 on December 31, 1939. Distillate fuel-oil inventories declined 1.5 million barrels (5 percent) during 1939, or from 27,873,000 barrels at the close of 1938 to 26,374,000 reported 1 year later. Residual fuel-oil stocks were drawn upon at a relatively greater rate in 1939 and were reduced by 10 percent (nearly 10 million barrels), or from 97,746,000 barrels in 1938 to 87,774,000 in 1939.

Monthly totals show that light fuel-oil stocks for January 1939—24,650,000 barrels—were higher by over 3 million barrels than in the first month of 1938. May 1939 stocks dipped below quantities reported in the same month of 1938, but after the heating-oil season the usual summer build-up raised the June-through-August 1939 inventories again above those in the same months of 1938. In the fall of 1939 the demand for heating oils forced stocks of light fuel oils down below the comparative totals reported for the final 4 months of 1938. Stocks of residual fuel oils in the first quarter of 1939 exceeded quantities in storage in the same period of 1938; but beginning in April 1939 heavy fuel-oil inventories were consistently liquidated, and the year's change netted a reduction of 9,972,000 barrels in stocks.

The great reduction in stocks of fuel oil was limited to refinery districts east of California, where inventories declined by 7.8 million barrels (17 percent) in 1939 compared with the quantities held at the end of 1938. Heavy fuel oils stored in eastern areas were reduced by 6.1 million barrels (nearly 23 percent) in 1939, while light grades declined 1.7 million barrels (over 9 percent). All eastern refinery districts reported diminished residual fuel-oil stocks in 1939 except

Texas Inland, where the increase was relatively small. The most pronounced decline in residual stocks in 1939 was reported for the East Coast, where heavy grades contracted nearly one-half or from 7,413,000 barrels in 1938 to 3,930,000 in 1939. The Indiana-Illinois, Oklahoma-Kansas, and Rocky Mountain refinery districts netted minor gains in light fuel-oil stocks during 1939, but all other eastern areas showed losses. As with residual grades, declines in stocks of distillate fuel oils were most outstanding in the East Coast, where year-end supplies in 1939 were about 23 percent below the comparable 1938 total. The California marketing area reported a 2-percent gain in stocks of light fuel oil during 1939, while residual fuel-oil inventories were reduced by 5 percent or from 70,755,000 barrels in 1938 to 66,893,000 at the end of 1939.

Shipments of heavy fuel oil from California to the Atlantic coast, revived in October 1938 after a lapse of about 4 years, continued throughout 1939, although California prices plus tanker rates did not seem to favor this traffic. West coast residual fuel oils reaching eastern markets totaled 2,289,000 barrels received in 1939 compared with 338,000 barrels in 1938. The movement of California light fuel oils to the East coast is unimportant; however, it increased from 321,000 barrels in 1938 to 633,000 in 1939.

Active demand and dwindling stocks in eastern markets during 1939 noticeably stimulated the shipments of fuel oils from the Gulf area to Atlantic ports, and this expanded trade held in spite of greatly increased tanker rates during the closing months of the year. The Gulf-to-Atlantic movement of light fuel oils increased from 29,187,000 barrels in 1938 to 34,701,000 in 1939, a gain of 19 percent, while the traffic in residual fuel oils over the same route in 1939 (65,446,000 barrels) is 15 percent above the 1938 total (56,987,000 barrels).

In sympathy with rapidly rising quotations by tankers entering the European war zone, Gulf coast to North Atlantic tanker rates increased severalfold from August to the close of 1939. The tanker rate per barrel for light fuel oils rose from a normal slack-season quotation of 17 cents in August 1939 to 34 cents by the end of September and then moved rapidly upward to an average of 65.5 cents by the end of December, a rate more than double the 30.5 cents quoted for December 1938. Tanker rates for heavy fuel oils in the same movement went from 17 cents per barrel in August to an average of 53 cents in December 1939 compared with 25.5 cents in December 1938.

The average price for crude petroleum dropped from $1.15 per barrel in 1938 to $1.00 in 1939; this lower value for crude oil was indicated in the average quotation for representative grades of fuel oils, which although in better demand show lower average prices for 1939 than for 1938. Light distillate fuel oils at Oklahoma refineries, Bunker C fuel oil in California, and Diesel oil for ships' bunkers in all marketing areas were at lower annual averages in 1939 than in 1938. The initial price of $0.95 per barrel, for Bunker C at New York, influenced by smaller stocks and rising tanker rates, turned upward in May to an annual average of $1.04 or to the same level as for 1938. Quotations for Bunker C at Gulf ports in 1939 averaged $0.83 per barrel or 2 cents above the 1938 price.

Monthly average prices of kerosene and fuel oil in the United States, 1938–39 [1]

	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
1938													
41°–43° gravity w. w. kerosene at refineries, Oklahoma cents per gallon	4.31	4.28	4.22	4.19	4.19	4.23	4.31	4.20	4.09	4.04	4.06	4.09	4.19
Kerosene, tank-wagon at Chicago cents per gallon	10.20	10.20	10.27	10.50	10.50	10.50	10.50	10.50	10.50	10.10	10.00	10.00	10.31
No. 1 straw distillate at refineries, Oklahoma cents per gallon	4.13	4.06	3.88	3.81	[2]	[2]	[2]	[2]	[2]	3.75	3.75	3.77	3.88
28°–30° gravity-zero distillate at refineries, Oklahoma cents per gallon	3.69	3.66	3.56	3.39	3.31	3.31	3.31	3.34	3.38	3.38	3.38	3.31	3.42
Bunker C for ships:													
New York dollars per barrel	1.25	1.25	1.18	1.08	1.05	1.03	.95	.95	.95	.95	.95	.95	1.04
Gulf coast do	.95	.95	.88	.81	.80	.78	.75	.75	.75	.75	.75	.75	.81
California do	.99	.99	.96	.95	.91	.89	.89	.84	.80	.80	.80	.80	.88
Diesel oil for ships:													
New York dollars per barrel	2.14	2.10	1.98	1.85	1.75	1.73	1.66	1.73	1.75	1.75	1.75	1.75	1.83
Gulf coast do	1.90	1.90	1.83	1.75	1.63	1.65	1.65	1.59	1.55	1.55	1.55	1.55	1.67
California do	1.64	1.64	1.64	1.64	1.58	1.54	1.54	1.54	1.54	1.54	1.54	1.45	1.57
1939													
41°–43° gravity w. w. kerosene at refineries, Oklahoma cents per gallon	4.06	4.06	4.06	4.06	4.05	4.00	3.96	3.89	3.88	3.88	3.88	3.91	3.97
Kerosene, tank-wagon at Chicago cents per gallon	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
No. 1 straw distillate at refineries, Oklahoma cents per gallon	3.63	3.53	3.50	3.50	3.50	3.38	3.38	3.33	3.25	3.25	3.39	3.44	3.42
28°–30° gravity-zero distillate at refineries, Oklahoma cents per gallon	3.30	3.06	3.03	3.00	2.93	2.88	2.88	2.94	3.06	3.06	3.10	[3]	---
Bunker C for ships:													
New York dollars per barrel	.95	.95	.95	.95	.98	1.05	1.05	1.05	1.09	1.15	1.15	1.19	1.04
Gulf coast do	.75	.75	.75	.75	.79	.83	.83	.81	.86	.95	.95	.95	.83
California do	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.84	.88	.81
Diesel oil for ships:													
New York dollars per barrel	1.75	1.68	1.65	1.65	1.66	1.68	1.68	1.68	1.70	1.86	1.90	1.96	1.74
Gulf coast do	1.55	1.48	1.45	1.45	1.45	1.45	1.45	1.45	1.51	1.70	1.70	1.70	1.53
California do	1.45	1.45	1.45	1.40	1.40	1.40	1.39	1.38	1.40	1.40	1.40	1.40	1.41

[1] National Petroleum News.
[2] Figures not quoted.
[3] Quotations discontinued Nov. 13.

Scarcity of Bunker C fuel oil on the Gulf and Atlantic coasts forced up the New York and Boston prices 10 cents a barrel in early May. Suppliers were slow in adopting the higher quotation, and it was well into June before the new price of $1.05 for North Atlantic points and of $0.80 to $0.85 per barrel for the Gulf area was in full effect. Uncertain supplies, some improvement in crude prices, oil-field shut-downs, and the unsettled conditions in Europe moved fuel-oil prices upward at Gulf ports late in August 1939, and a top quotation of $0.90 per barrel for Bunker C was general by the middle of September. Prices for heavy oil at North Atlantic supply points responded, and a price of $1.15 per barrel gradually became established. The price of Bunker C in the Gulf district increased again, and by the second week in October 1939 was quoted at an average of $0.95 per barrel; it remained at this level to the end of the year. Gulf to North Atlantic tanker rates, which advanced from 17 cents per barrel in August to about 55 cents in December 1939, were responsible for an increase from $1.15 to

$1.50 per barrel in Bunker C prices at New York during the closing week of the year. Bunker C at California seaboard points remained at $0.80 per barrel until early November 1939, when increased demand forced the price to $0.85–$0.90 per barrel by the end of the year.

Average retail prices for heating oils, as represented by quotations for No. 2 grade on the Chicago and New York markets, show net fractional advances in 1939 over 1938, according to data compiled by the Bureau of Labor Statistics, United States Department of Labor. The price of No. 2 heating oil in Chicago, which was 7.15 cents per gallon in December 1938, averaged 7.44 cents in the spring and summer months of 1939 and advanced to 7.62 cents for the quarter closed September 15. A lower average price of 7.47 cents per gallon for December 1939 represents only a slight net change for the year. The average retail price of No. 2 heating oil in New York dropped from 6.22 cents per gallon in March to 5.87 cents in June 1939. Some tightness in the supply, higher tanker rates, and better demand pushed the average price to 6.38 cents in September and to 6.69 cents in December 1939 compared with 6.60 cents in December 1938.

LUBRICANTS

Domestic demand for lubricants increased 11 percent, or from 21,233,000 barrels in 1938 to a new record of 23,613,000 in 1939. Exports increased 27 percent—from 9,417,000 to 11,981,000 barrels. These increases, amounting to 16 percent for the total demand, resulted in material advances in the prices of all lubricants, as well as Pennsylvania Grade crude oils. The increase in domestic demand is attributable largely to the expanded industrial activity in 1939, which carried the consumption of lubricants for industrial purposes well above the 1937 record.

The distribution of domestic demand for lubricants, by uses, has been revised on the basis of new studies by the American Petroleum Institute of the ratio of oil to gasoline consumption by automobiles.[11]

Estimates based upon the American Petroleum Institute study indicate that the types of lubricants used in 1939 were divided as follows:

Automotive consumption of lubricants in 1939 [1]

[Thousands of barrels]

Use	Passenger cars	Trucks	Busses
Crank case oil	7,650	2,036	219
Transmission oils	550	197	39
Total lubricating oils	8,200	2,233	258
Chassis greases	477	98	11
Total lubricants	8,677	2,331	269

[1] Subject to revision.

[11] American Petroleum Institute, Statistical Bulletin: Vol. 21, No. 7, February 7, 1940.

Domestic demand for lubricating oils, 1930–39 [1]

[Thousands of barrels]

Year	Automotive				Industrial	Total demand
	Passenger cars	Trucks	Busses	Total		
1930	9,708	2,192	216	12,116	9,473	21,589
1931	9,599	2,144	225	11,968	8,100	20,068
1932	8,340	1,839	220	10,399	6,215	16,614
1933	7,852	1,805	212	9,869	7,283	17,152
1934	7,995	1,922	227	10,144	8,280	18,424
1935	7,950	1,993	241	10,184	9,477	19,661
1936	8,297	2,165	254	10,716	11,607	22,323
1937	8,453	2,285	267	11,005	12,318	23,323
1938	8,152	2,168	259	10,579	10,654	21,233
1939	8,200	2,233	258	10,691	12,922	23,613

[1] 1930–38 revised; 1938 and 1939 subject to revision.

The production of lubricating oils rose from 30,826,000 barrels in 1938 to 35,036,000 in 1939, somewhat less than the 1937 figure of 35,321,000 barrels. The East Coast district produced 25.8, the Texas Gulf Coast district 24.1, and the Appalachian district 17.5 percent. The Louisiana Gulf Coast district is noteworthy because its 4.3 percent of total production is the highest reached so far in an upward trend that started from a 1.3-percent share in 1932.

Stocks of lubricating oils responded to the heavy demand by dropping from 7,695,000 barrels on December 31, 1938, to 7,142,000 on December 31, 1939. The decrease in stocks was striking in the Inland Texas and the Appalachian districts, where it was 67 and 36 percent, respectively, bringing lubricating-oil inventories to the lowest levels in a decade, while Texas Gulf Coast stocks fell 15 percent. Lubricating-oil stocks increased in the Oklahoma-Kansas, Louisiana Gulf Coast, Inland Louisiana-Arkansas, and California districts.

Comparative analyses of statistics for lubricants in the United States, 1938–39, by months and districts

	Production (thousands of barrels)		Yield (percent)		Domestic demand (thousands of barrels)		Stocks (thousands of barrels)	
	1938	1939 [1]	1938	1939 [1]	1938	1939 [1]	1938	1939 [1]
By months:								
January	2,785	2,527	2.8	2.5	1,471	1,609	8,006	7,762
February	2,468	2,522	2.8	2.9	1,305	1,653	8,363	7,951
March	2,697	2,664	2.8	2.7	2,195	1,987	8,210	7,800
April	2,530	2,672	2.6	2.7	1,587	1,770	8,290	7,886
May	2,595	2,856	2.6	2.7	1,723	2,132	8,255	7,630
June	2,378	2,800	2.5	2.7	1,605	1,902	8,114	7,427
July	2,631	2,755	2.6	2.6	1,844	1,982	8,194	7,179
August	2,576	3,056	2.5	2.8	2,002	1,963	7,969	7,069
September	2,615	2,854	2.7	2.7	2,127	2,207	7,605	6,704
October	2,632	3,575	2.6	3.2	1,805	2,656	7,718	6,639
November	2,535	3,277	2.6	3.1	1,738	1,927	7,817	6,799
December	2,384	3,478	2.4	3.3	1,831	1,825	7,695	7,142
Total United States	30,826	35,036	2.6	2.8	21,233	23,613	7,695	7,142
By districts:								
East Coast	7,613	9,055	4.2	4.7	([2])	([2])	2,230	2,237
Appalachian	5,763	6,128	14.7	14.0			910	579
Indiana, Illinois, Kentucky, etc.	2,609	3,111	1.6	1.6			577	529
Oklahoma, Kansas, and Missouri	2,962	3,100	2.7	2.8			565	602
Texas Inland	213	221	.3	.3			64	21
Texas Gulf Coast	7,628	8,454	2.5	2.5			1,810	1,545
Louisiana Gulf Coast	1,097	1,504	2.3	3.1			192	233
Arkansas and Louisiana Inland	452	538	1.9	2.2			44	62
Rocky Mountain	205	180	.8	.7			101	88
California	2,284	2,745	1.1	1.4			1,202	1,246
Total United States	30,826	35,036	2.6	2.8	21,233	23,613	7,695	7,142

[1] Subject to revision.

[2] Figures not available.

The skyrocketing of lubricating-oil prices was one of the sensational developments during 1939. Quotations for many Pennsylvania Grade oils advanced more than 100 percent in distinct contrast with their lethargy during 1938. The advance in prices of Mid-Continent grades, although not as large as in Pennsylvania, was material. The two grades quoted in the accompanying table rose 37 and 60 percent. The Gulf Coast oils benefited least, the range of their price advances being only between 17 and 24 percent. Nearly all these increases were attained during the latter part of the year, as prices remained dormant or even decreased until August.

Increased prices for lubricants were shown in prices for Pennsylvania Grade crude oil; Bradford crude, for example, rose more than a dollar—from $1.68 to $2.75 per barrel.

Average monthly refinery prices of five selected grades of lubricating oils, 1938–39, in cents per gallon [1]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1938													
Oklahoma:													
200 viscosity, No. 3 color, neutral	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.25	10.25	10.25	10.44
150–160 viscosity at 210°, bright stock, 10–25 pour test	15.10	15.25	15.25	14.75	14.50	14.50	14.50	14.50	14.50	14.50	14.50	14.50	14.70
Pennsylvania:													
200 viscosity, No. 3 color, neutral, 420–425 flash, 25 pour test	17.25	17.25	17.25	16.31	14.40	13.00	13.00	14.15	15.50	16.05	16.00	15.63	15.48
600 steam-refined, cylinder stock, filterable	8.25	8.75	8.88	9.00	9.00	9.00	8.44	8.25	8.25	8.05	8.00	8.00	8.49
Gulf Coast: 500 viscosity, No. 2½–3½ color, neutral	8.50	8.25	8.19	8.00	8.00	7.75	7.75	7.75	7.75	7.75	7.69	7.63	7.92
1939													
Oklahoma:													
200 viscosity, No. 3 color, neutral	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.13	10.59	13.25	14.00	14.00	11.14
150–160 viscosity at 210°, bright stock, 10–25 pour test	14.50	14.25	14.25	14.25	14.25	14.25	14.25	14.25	15.69	21.55	23.06	23.25	16.48
Pennsylvania:													
200 viscosity, No. 3 color, neutral 420–425 flash, 25 pour test	15.20	15.44	15.81	16.41	16.75	16.75	16.70	17.50	22.13	28.10	28.88	30.75	20.03
600 steam-refined, cylinder stock, filterable	8.05	8.38	8.88	9.00	9.00	9.00	8.50	8.50	12.13	15.60	16.38	17.25	10.89
Gulf Coast: 500 viscosity, No. 2½–3½ color, neutral	7.63	7.63	7.63	7.63	7.63	7.63	7.63	7.50	7.94	8.83	9.13	9.13	7.99

[1] National Petroleum News.

OTHER PRODUCTS

WAX

Domestic demand for wax rose 46,928,000 pounds, or from 278,532,000 pounds in 1938 to 325,460,000 in 1939—the greatest demand since 1933. Exports also increased 31,217,000 pounds to 232,664,000, while production increased only 29,120,000 pounds to 464,520,000; in consequence, stocks dropped from 129,340,000 pounds to 75,648,000, the lowest (except for 1933) in more than a decade.

Paraffin wax is one of the most widely used petroleum products; it is employed in numerous ways by cosmeticians and confectioners and has many functions in munitions plants. The largest quantities, however, are consumed in the manufacture of waxed paper, paper cartons, and candles. The practice of marketing milk and other products in waxed-paper cartons, which has seen rapid development recently, is one of the factors in the increased demand for wax.

Prices responded to the expanding demand and depleted stocks of wax; for Pennsylvania Grade crude scale wax these almost tripled during the year. Early in January the quotations for this wax were 2.32 cents per pound and in December had risen to 6.75 cents. The gain in price for fully refined wax on the Chicago market was not so great, being only 1.90 cents for most grades, although the 122°–124° rose from 4.00 to 6.10 cents.

Comparative analyses of statistics for wax in the United States, 1938–39, by months and districts

[Thousands of pounds]

	Production		Domestic demand		Stocks			
					Crude scale		Refined	
	1938	1939[1]	1938	1939[1]	1938	1939[1]	1938	1939[1]
By months:								
January	41, 720	35, 280	32, 148	20, 642	104, 462	87, 729	41, 167	40. 898
February	34, 720	33, 320	23, 130	27, 166	110, 562	79, 747	38, 261	37, 964
March	39, 760	44, 800	25, 272	20, 495	112, 123	79, 803	38, 342	37, 734
April	31, 640	35, 000	28, 339	14, 597	107, 903	80, 396	36, 723	38, 905
May	35, 560	34, 440	25, 755	28, 533	107, 540	77, 218	33, 286	36, 707
June	37, 800	39, 480	24, 132	19, 589	107, 611	81, 592	30, 649	30, 012
July	30, 240	28, 840	20, 743	16, 897	105, 492	78, 155	30, 419	31, 167
August	31, 920	31, 080	22, 619	20, 503	102, 690	77, 229	31, 413	30, 944
September	36, 400	40, 320	19, 303	32, 651	97, 775	67, 552	31, 243	22, 032
October	42, 000	45, 080	20, 163	40, 567	92, 900	61, 860	36, 026	19, 287
November	37, 520	48, 440	19, 865	39, 849	93, 618	60, 343	38, 154	21, 026
December	36, 120	48, 440	17, 063	43, 971	90, 251	56, 527	39, 089	19, 121
Total United States	435, 400	464, 520	278, 532	325, 460	90, 251	56, 527	39, 089	19, 121
By districts:								
East Coast	196, 560	189, 840			30, 790	22, 636	15, 447	6, 363
Appalachian	82, 880	97, 160			14, 975	14, 096	1, 824	872
Indiana, Illinois, Kentucky, etc	31, 640	38, 080			19, 076	8, 275	2, 674	1, 703
Oklahoma, Kansas, and Missouri	30, 800	31, 920	(2)	(2)	1, 649	2, 555	1, 261	1, 207
Texas Inland	1, 960	2, 800			260	207	-------	-------
Texas Gulf Coast	60, 200	71, 120			774	774	15, 489	5, 743
Louisiana Gulf Coast	19, 600	22, 400			642	871	1, 175	1, 986
Arkansas and Louisiana Inland	280	-------			-------	-------	-------	-------
Rocky Mountain	11, 480	11, 200			22, 085	7, 113	1, 219	1, 247
Total United States	435, 400	464, 520	278, 532	325, 460	90, 251	56, 527	39, 089	19, 121

[1] Subject to revision. [2] Figures not available.

Average monthly refinery price of 122° to 124° white crude scale wax at Pennsylvania refineries, 1935–39, in cents per pound [1]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
1935	3. 08	2. 83	2. 28	2. 13	2. 13	2. 13	2. 13	2. 00	2. 07	2. 13	2. 88	2. 33	2. 29
1936	2. 33	2. 40	2. 57	2. 58	2. 41	2. 34	2. 38	2. 39	2. 43	2. 43	2. 43	2. 45	2. 43
1937	2. 53	2. 65	2. 68	2. 69	2. 73	2. 88	2. 95	2. 96	2. 95	2. 98	2. 98	2. 91	2. 82
1938	2. 52	2. 13	2. 02	1. 93	1. 93	2. 17	2. 29	2. 37	2. 40	2. 39	2. 33	2. 32	2. 23
1939	2. 39	2. 49	2. 60	2. 73	2. 96	3. 00	2. 95	2. 88	3. 47	4. 95	6. 56	6. 75	3. 64

[1] National Petroleum News.

COKE

Domestic demand for petroleum coke totaled 1,422,100 short tons in 1939 compared with 1,117,700 in 1938. Exports established a record of 285,800 tons, which was 130,200 tons (84 percent) above the 1938 figure—155,600 tons. Somewhat more than half of the coke exports go to Canada, and Japan, France, and Norway come next in order of importance. By far the greatest proportion of the domestic coke demand is consumed as fuel, and the next largest proportion (probably 10 to 15 percent) is employed in the manufacture of carbon electrodes, brushes, and such products. The latter uses probably are more important for exported coke, except that going to Canada, where it is used mostly as fuel.

The most significant changes in production of coke occurred in the California and Louisiana Gulf Coast districts. The output in California, which was only 400 tons in 1937 and 17,000 in 1938, leaped to second place with 187,400 tons in 1939. Production in the Louisiana Gulf Coast district, after mounting from 16, 600 tons in 1937 to 60,600 in 1938, virtually disappeared in 1939, when it dropped to 400 tons. The Indiana-Illinois district still ranked first, contributing 55 percent of the national total, while the California, Oklahoma-Kansas, and Texas Gulf Coast districts came next, in close order.

Comparative analyses of statistics for petroleum coke in the United States, 1938–39, by months and districts

	Production (thousands of short tons)		Yield (percent)		Domestic demand (thousands of short tons)		Stocks (thousands of short tons)	
	1938	1939 [1]	1938	1939 [1]	1938	1939 [1]	1938	1939 [1]
By months:								
January	126.2	126.0	0.6	0.6	107.0	106.0	389.5	717.0
February	122.0	117.2	.7	.6	83.2	121.1	418.8	705.0
March	114.0	128.0	.6	.6	61.6	129.2	468.5	694.0
April	127.0	142.0	.7	.7	62.6	78.9	522.3	734.0
May	137.8	132.2	.7	.6	84.4	117.4	561.6	716.0
June	137.0	142.2	.7	.7	114.7	115.6	574.3	710.0
July	137.6	145.2	.7	.7	89.0	90.7	609.8	733.0
August	148.4	143.2	.7	.7	94.5	168.8	650.6	682.0
September	110.8	110.8	.6	.5	127.3	86.6	622.6	668.0
October	146.8	165.2	.7	.7	88.3	158.5	653.8	652.0
November	152.8	159.2	.8	.8	104.0	125.7	678.4	647.0
December	141.8	155.2	.7	.7	101.1	123.6	707.5	666.0
Total United States	1,602.2	1,666.4	.7	.7	1,117.7	1,422.1	707.5	666.0
By districts:								
East Coast	3.8	6.8	(2)	(2)			5.3	2.0
Appalachian	20.0	23.2	.2	.3			9.2	15.0
Indiana, Illinois, Kentucky, etc	977.8	920.0	3.0	2.4			407.4	191.0
Oklahoma, Kansas, and Missouri	213.6	184.8	1.0	.8			31.4	29.0
Texas Inland	101.4	102.0	.7	.8	(3)	(3)	93.2	80.0
Texas Gulf Coast	141.0	180.2	.2	.3			49.8	87.0
Louisiana Gulf Coast	60.6	.4	.6	(2)			30.4	7.0
Arkansas and Louisiana Inland	1.2	-------	(2)	(2)			-------	-------
Rocky Mountain	65.8	61.6	1.3	1.2			62.4	60.0
California	17.0	187.4	(2)	.5			18.4	195.0
Total United States	1,602.2	1,666.4	.7	.7	1,117.7	1,422.1	707.5	666.0

[1] Subject to revision. [2] Less than 0.1 percent. [3] Figures not available.

ASPHALT AND ROAD OIL

Domestic demand for asphalt was 4,887,000 tons in 1939, 495,300 tons greater than in 1938. Production (4,954,400 tons) was 613,000 tons more than in 1938, while stocks (550,000 tons) were 59,600 tons higher. Imports of 44,200 tons represented an 11,000-ton gain, while exports of 42,600 tons involved a 7,300-ton loss.

The 1939 domestic demand for road oil remained virtually the same as the 1938 demand at 7,846,000 barrels. The production of 7,868,000 barrels, however, was 325,000 barrels above that in 1938 and is shown in an increase in stocks from 680,000 to 702,000 barrels.

Detailed statistics on asphalt and road oil appear in the chapter on Asphalt and Related Bitumens.

STILL GAS

The production of still gas in 1939 was 254,520 million cubic feet, or 66,979,000 barrels. The increase of 4,138 million cubic feet over production in 1938 (250,382 million cubic feet) is the smallest since 1931 and probably can be attributed to the use of refinery gases as raw materials in the polymerization and alkylation processes.

Refineries used 233,791 million cubic feet of still gas for fuel in 1938, constituting 49.5 percent of the British thermal units supplied by all refinery fuels.

The Texas Gulf Coast district still leads in the production of still gas; the Indiana-Illinois and East Coast districts follow in order.

Production of still gas in the United States, 1937–39, by districts

District	1937		1938		1939 [1]	
	Millions of cubic feet	Equivalent in thousands of barrels	Millions of cubic feet	Equivalent in thousands of barrels	Millions of cubic feet	Equivalent in thousands of barrels
East Coast	31, 835	10, 339	30, 354	7, 988	38, 814	10, 214
Appalachian	8, 836	2, 301	8, 311	2, 187	8, 698	2, 289
Indiana, Illinois, Kentucky, etc	46, 710	12, 377	46, 527	12, 244	52, 321	13, 769
Oklahoma, Kansas, Missouri	26, 721	6, 968	24, 681	6, 495	22, 354	5, 883
Texas Inland	15, 990	3, 537	15, 044	3, 959	12, 966	3, 412
Texas Gulf Coast	70, 240	17, 893	79, 644	20, 959	77, 694	20, 446
Louisiana Gulf Coast	7, 413	1, 993	8, 702	2, 290	8, 528	2, 244
Arkansas and Louisana Inland	3, 894	899	5, 746	1, 512	1, 997	525
Rocky Mountain	5, 106	1, 344	5, 119	1, 347	4, 906	1, 291
California	25, 236	6, 567	26, 254	6, 909	26, 242	6, 906
Total United States	241, 981	64, 218	250, 382	65, 890	254, 520	66, 979

[1] Subject to revision.

MISCELLANEOUS PRODUCTS

The domestic demand for miscellaneous products recovered from its slump to 1,776,000 barrels in 1938 and increased to 2,223,000 barrels in 1939, approximately what it was in 1937. Exports rose from 112,000 barrels in 1938 to 123,000 in 1939, and production recovered to 2,359,000 barrels from the 1938 figure of 1,921,000.

The principal products in 1938 were liquefied petroleum gas (591,000 barrels), petrolatum (311,000 barrels), medicinal oil (172,000 barrels), and absorption oil (169,000 barrels). There are many other products that are much more important economically than quantitatively.

Production of miscellaneous oils in the United States, 1937–38, by districts and classes [1]

[Thousands of barrels]

District	Petrolatum	Absorption oil	Medicinal oil	Specialties	Liquefied petroleum gas	Other	Total
1937							
East Coast	147	18	130	12	388	73	768
Appalachian	200	9				39	248
Indiana, Illinois, Kentucky, etc.	37			14	140	207	398
Oklahoma, Kansas, and Missouri	32	74				46	152
Texas Inland		59			5	104	168
Texas Gulf Coast	12	2		25	37	220	296
Louisiana Gulf Coast					4	36	40
Arkansas and Louisiana Inland		1				9	10
Rocky Mountain	6	1		6	3	101	117
California		37	32	41		75	185
Total United States	434	201	162	98	577	910	2,382
1938							
East Coast	115	10	139	10	376	140	790
Appalachian	137	7		2		24	170
Indiana, Illinois, Kentucky, etc.	26			12	149	108	295
Oklahoma, Kansas, Missouri	25	64				31	120
Texas Inland		50			3	5	58
Texas Gulf Coast	7			32	48	17	104
Louisiana Gulf Coast					15	32	47
Arkansas and Louisiana Inland						1	1
Rocky Mountain	1	2		4		90	97
California		36	33	93		77	239
Total United States	311	169	172	153	591	525	1,921

[1] Figures for 1939 not yet available.

WORLD PRODUCTION [12]

The world production of crude petroleum resumed its upward trend, increasing 4 percent in 1939 over 1938. There was no change in the rank of the 10 leading countries. As the United States likewise increased its production 4 percent from 1938 to 1939, its share in the total output remained fixed at 61 percent in both 1938 and 1939.

North and South America together continued to supply more than three-fourths of the world total. Peru and Bolivia were the only exceptions to the general increase in petroleum production in the Western Hemisphere. In Venezuela larger yield in the Maracaibo fields, in Quiriquire, and in the newer fields of Temblador, Oficina, and Jusepin raised the national total 9 percent from 1938 to 1939. Greater output in Mexico, chiefly from Poza Rica, was due primarily to a 30-percent increase in the export market, principally for crude petroleum to be refined in the United States for export, in Italy, and in Germany. In Colombia the opening of the new pipe line from the Barco concession to Covenas in October 1939 permitted a small increase in the total crude production from 1938 to 1939. In Argentina both Government enterprise and private companies enlarged their output at Comodoro Rivadavia, at Plaza Huincul, and in Mendoza. In Canada continued increase in production in Alberta along the eastern front of the Rocky Mountains raised the petroleum production of the Dominion from 1938 to 1939.

Two countries in eastern Europe supplied 98 percent of the petroleum production of the Continent in 1938 and 96 percent in 1939. The U. S. S. R. increased its output 4 percent from 1938 to 1939 but fell 14 percent short of its quota for 1939 under the Third Five-year Plan. In Rumania production decreased 5 percent from 1938 to

[12] By A. H. Redfield, Petroleum Economics Division, Bureau of Mines.

1939 owing to the lower yield in the Dambovitza district and the reluctance of most major producers to engage in new drilling under the existing petroleum laws, the currency restrictions, and the prevailing political situation. Of the minor European producers, Germany was able to increase its petroleum production not only in its original area but also in the former Austria and to add to its 1939 output about 227,000 barrels from former Polish territory. The Hungarian petroleum production more than trebled, and Italian engineers succeeded in increasing the yield of the Albanian fields but not of Italy. The nations of northern and western Europe and of the Mediterranean area continued to depend on imports of crude and refined oils from the United States, from Latin America, from Rumania, from the Near East, and from the Netherland East Indies to meet their requirements.

Crude petroleum produced in principal countries of the world, 1935–39, in thousands of barrels

[Compiled by R. B. Miller]

Country	1935	1936	1937	1938	1939 [1]
North America:					
Canada	1,447	1,500	2,944	6,966	7,838
Mexico	40,241	41,028	46,690	38,279	42,779
Trinidad	11,671	13,237	15,503	17,737	19,270
United States	996,596	1,099,687	1,279,160	1,214,355	1,264,256
Other North America	47	62	33	78	84
Total North America	1,050,002	1,155,514	1,344,330	1,277,415	1,334,227
South America:					
Argentina	14,297	15,458	16,355	17,076	18,486
Bolivia	164	105	122	226	215
Colombia	17,598	18,756	20,599	21,582	22,037
Ecuador	1,732	1,942	2,161	2,246	2,313
Peru	17,067	17,593	17,457	15,839	13,508
Venezuela	148,254	154,794	186,230	188,174	205,956
Total South America	199,112	208,648	242,924	245,143	262,515
Europe:					
Albania	41	273	619	752	934
Czechoslovakia	133	127	123	130	120
France	541	503	502	513	500
Germany	2,996	3,115	3,176	3,861	4,487
Austria	44	50	221	383	693
Hungary			16	318	1,055
Italy	119	123	110	101	91
Poland	3,812	3,789	3,716	3,763	3,898
Rumania	61,310	63,659	52,452	48,366	45,996
U. S. S. R.[2]	182,386	186,206	193,241	204,956	212,500
Other Europe	2	1	4	9	9
Total Europe [2]	251,384	257,846	254,180	263,152	270,283
Asia:					
Bahrein Island	1,265	4,645	7,762	8,298	7,589
Burma	7,181	7,588	7,848	7,538	7,396
India, British	2,038	1,978	2,162	2,488	2,164
Iran (Persia)	57,273	62,718	77,804	78,372	78,151
Iraq	27,408	30,406	31,836	32,643	30,791
Japan (including Taiwan)	2,249	2,440	2,488	2,511	2,654
Netherland India	47,171	50,025	56,724	57,318	61,580
Sakhalin	2,545	3,212	3,656	[3] 3,821	[3] 4,000
Sarawak and Brunei	5,546	5,209	6,009	6,913	7,104
Saudi Arabia		20	65	495	3,855
Total Asia [4]	152,676	168,241	196,354	200,397	205,284
Africa:					
Egypt	1,301	1,278	1,196	1,581	4,415
Other Africa	4	4	22	27	27
Total Africa	1,305	1,282	1,218	1,608	4,442
Australia and New Zealand	5	5	4	4	4
Undistributed	4	4	4	4	17
Grand total	1,654,488	1,791,540	2,039,014	1,987,723	2,076,772

[1] Approximate production. Derived in part from World Petroleum, vol. 11, No. 2, February 1940, pp. 42–43.
[2] Includes fields in Russian Asia other than Sakhalin. [3] Approximate production.
[4] Exclusive of U. S. S. R. fields in Asia, other than Sakhalin, which are included with U. S. S. R. in Europe.

In Asia the petroleum production of Iran, controlled by a single enterprise, remained virtually static, while that of Iraq, equally closely controlled, declined 6 percent from 1938 to 1939 owing to disruption of tanker schedules by the outbreak of the war during the last 4 months of 1939. Increased output in Sumatra, in eastern Borneo, and in Ceram raised the production of the Netherland East Indies 5 percent, in spite of declines in Java and in the Tarakan heavy-oil field. The production of Burma and of British India, destined chiefly for consumption in peninsular India, was less in 1939 than in 1938. The opening of a pipe line and of a terminal at Ras Tanura on May 1, 1939, permitted the production of Saudi Arabia to rise sharply, while production on nearby Bahrein Island was reduced in 1939. Japanese wells in Japan proper and in Taiwan increased their output in 1939 over 1938 but made no significant contribution to the requirements of a predominantly importing country. The small indicated increase in the production of northern Sakhalin was due to the activity of the local Soviet "Trust" rather than to that of the Japanese concessionnaire.

Discovery of a new field at Ras Gharib nearly trebled the small production of Egypt but left the country still dependent on imports to meet its mineral-oil requirements.

FOREIGN TRADE [13]

Imports.—An 8-percent increase in the domestic demand for mineral oils in continental United States in 1939 over 1938 was duplicated by a corresponding 8-percent increase in imports of mineral oils, crude and refined, as well as in greater production of crude petroleum in the United States and larger withdrawals from stocks from 1938 to 1939. Imports constituted, however, only 4 percent of the total new supply of mineral oils in continental United States in 1939, as in 1938. Although the excise taxes on imported oils were halved by the Venezuelan Trade Agreement of November 6, 1939, and the reduction was generalized to other nations through the most-favored-nation clause, this reduction had no appreciable effect on mineral-oil imports during 1939, as it did not become effective until December 16, 1939.

The increase was due principally to imports of crude petroleum, which were 25 percent larger in 1939 than in 1938. Eighty-four percent of these imports in 1939 were for direct consumption on payment of excise tax; of these, Venezuela supplied 90 percent. More crude was also imported, chiefly from Mexico, for refining in bond and export of the finished products.

More unfinished oils were imported in 1939 than in 1938, both for direct consumption in continental United States and in bond for refining and export of the finished products. The Netherlands West Indies supplied most of these products in 1939.

On the other hand, imports of residual fuel oil were 24 percent less in 1939 than in 1938. There was a marked decrease in receipts of fuel oil in bond in continental United States for the supplies of vessels. Imports of fuel oil into continental United States for direct consumption declined to insignificance in 1939. The Netherland West Indies furnished 97½ percent of the bonded fuel oil and 94 percent of the fuel oil for direct consumption in continental United States in 1939.

[13] By A. H. Redfield, Petroleum Economics Division, Bureau of Mines.

Mineral oils, crude and refined, imported into continental United States, 1938–39, by months [1]

[Thousands of barrels]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	For direct consumption	In bond
1938															
Crude petroleum	2,095	1,883	2,569	1,827	2,081	2,192	2,565	1,714	1,574	2,693	2,359	2,860	26,412	22,761	3,651
Refined products:															
Gasoline, finished									79				79		79
Gasoline, unfinished	95						54	100					249	100	149
Residual fuel oil	1,635	1,454	1,971	2,016	1,598	2,223	1,616	1,605	1,932	1,617	1,561	1,837	21,065	2,675	18,390
Lubricating oil				1	1		1	1		1	1	1	7	7	
Paraffin wax	10	8	9	9	19	12	10	10	6	6	1	3	103	103	
Asphalt	62	7	10	9	9	12	7	15	11	9	19	12	182	182	
Unfinished oils, other	281	521	297	293	288	282	492	1,209	635	590	673	650	6,211	4,088	2,123
	4,178	3,873	4,856	4,155	3,996	4,721	4,745	4,654	4,237	4,916	4,614	5,363	54,308	29,916	24,392
1939															
Crude petroleum	1,868	1,598	1,630	2,932	3,928	3,664	2,934	2,898	3,084	3,099	3,132	2,328	33,095	28,447	4,648
Refined products:															
Gasoline, finished									6	23	86	3	118	28	90
Gas oil and distillate fuel oils	44	127											171	44	127
Residual fuel oil	957	984	1,337	1,316	2,104	1,935	1,513	1,723	675	1,532	1,012	844	15,932	960	14,972
Lubricating oil			1		1		1	1		1			5		5
Paraffin wax	11	7	7	5	17	10	9	11	14	22	14	16	143	138	5
Asphalt	16	53	18	8	14	17	9	9	23	9	19	47	242	242	
Unfinished oils, other	629	650	866	512	523	647	1,105	1,041	1,053	618	702	847	9,193	5,798	3,395
	3,525	3,419	3,859	4,773	6,587	6,273	5,571	5,683	4,855	5,304	4,965	4,085	58,899	35,657	23,242

[1] Imports of crude as reported to the Bureau of Mines; imports of refined products compiled from data of the Bureau of Foreign and Domestic Commerce; figures may differ slightly from those used throughout other sections of this report.

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Crude petroleum imported into and exported from continental United States in 1939, by countries [1]

[Thousands of barrels]

	1939													1938 (total)
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
Imports:														
For direct consumption:														
Canada														1
Colombia					860	307							1,167	
Mexico					70	70	288	227	206	190	348	289	1,688	1,602
Saudi Arabia							1						1	
Trinidad and Tobago											61		61	
Venezuela	1,371	1,343	1,417	2,401	2,627	2,902	2,241	2,162	2,467	2,197	2,244	2,273	25,645	20,846
	1,371	1,343	1,417	2,401	3,557	3,279	2,530	2,389	2,673	2,387	2,653	2,562	28,562	22,449
Bonded for manufacture and export:														
Mexico	203	229	110	126	328	410	385	430	465	494	91	88	3,359	882
Venezuela	294	161	209	261	301	277	146	122	98	212	104		2,185	2,717
Total imports	1,868	1,733	1,736	2,788	4,186	3,966	3,061	2,941	3,236	3,093	2,848	2,650	34,106	26,048
Exports:														
North America:														
Canada	1,189	1,201	1,165	1,887	3,172	2,804	2,992	2,853	3,881	3,297	2,383	1,297	28,121	24,845
Cuba	140	116	43	152	72	79	152	1	159	80	73	74	1,141	905
Mexico	4	5	9	5	8	11	7	7	142	12	12	68	290	143
South America:														
Argentina	87	194	191	226	437	104	446	161	108	69	102		2,125	1,504
Brazil			84					89					173	1
Europe:														
Belgium	46		70				79			84			279	349
Czechoslovakia														71
Denmark	36		32	40		48	33		22				211	94
France	1,085	1,186	1,254	1,884	2,051	793	1,622	1,214	842	875	742	1,407	14,955	16,743
Germany			104	82	156	74							416	1,287
Italy	652	520	330	312	708	378	308	586	211	344	212	424	4,985	6,751
Netherlands	19	51		60	62		43	41					276	326
Sweden	74	86	52	84	50	144		65	71	13			639	930
Switzerland														280
United Kingdom	40		24	127	82		68		96		65	58	560	89

Asia:														
China			89										89	166
Japan	990	1,360	1,351	1,362	1,754	1,028	1,468	570	1,381	1,934	1,636	1,252	16,086	21,272
Kwantung	100	91	168		90	190				90	89		818	917
Thailand (Siam)						78	78					76	232	
Africa: Union of South Africa								84					84	217
Other countries	15			1	1	100		298	11	149	9		584	364
Noncontiguous Territories	3						9		1				13	
Total exports	4,480	4,810	4,966	6,222	8,643	5,831	7,305	5,969	6,925	6,947	5,323	4,656	72,077	77,254
Net exports	2,612	3,077	3,230	3,434	4,457	1,865	4,244	3,028	3,689	3,854	2,475	2,006	37,971	51,206

[1] Bureau of Foreign and Domestic Commerce; figures may differ slightly from those used throughout other sections of this report.

Exports.—Continental United States continued to be a net exporter of mineral oils. Exports and shipments of mineral oils to noncontiguous Territories in 1939 were more than three times as large as imports. They constituted 13 percent of the total demand for mineral oils in 1939 compared with 15 percent in 1938. Although imports obtained from neighboring countries of North and South America consisted almost entirely of crude and semirefined oils for processing and bunker oil for supplies of vessels, exports included both crude petroleum to be refined in other countries and refined oils shipped for consumption to all parts of the world.

The outbreak of the war in Europe on September 1, 1939, had little appreciable effect on the petroleum export trade of continental United States, as a whole, although individual products were variously affected. The expected increase in demand, based upon analogy to the World War of 1914–18, failed to materialize; the defensive type of warfare waged by both sides after the brief Polish campaign did not call for the large quantities of gasoline and fuel oil required in a comparable period of the last war, and the drastic restrictions imposed on civilian consumption of mineral oils not only in belligerent but also in nonbelligerent countries kept down the total demand and conserved supplies for military and naval purposes. In fact, exports and territorial shipments of mineral oils from continental United States were 2 percent lower in 1939 than in 1938. The decrease occurred principally during the first 8 months of 1939, before the outbreak of the war. During the last 4 months of 1939 outward shipments changed little from their level during the corresponding months of 1938 and 1937.

Exports of crude petroleum were 7 percent lower in 1939 than in 1938. The decrease occurred during the first 8 months of 1939; during the last 4 months of the year the exports of crude were 4 percent larger than in the corresponding period of 1938. In contrast to the general trend, exports to Canada were 5 percent larger during the first 8 months of 1939 and 30 percent larger during the last 4 months of 1939 than in the corresponding periods of 1938. But France, which had maintained its 1938 level of imports of American crude during the first 8 months of 1938, reduced its receipts 31 percent during the last 4 months in comparison with the corresponding period of 1938. Japan, lacking dollar exchange for purchases of American crude, curtailed its purchases 45 percent during the first 8 months of 1939 in comparison with the first 8 months of 1938 but increased its purchases 59 percent during the last 4 months of 1939. Italy took less American crude throughout the year, replacing it in part with petroleum from Mexico, Venezuela, and Albania. Germany, because of exchange difficulties, bought less crude petroleum from the United States and substituted, at least in part, crude obtained from Mexico on a barter basis and from the Netherland West Indies through clearing agreements.

Mineral oils, crude and refined, shipped from continental United States and including shipments to noncontiguous Territories, 1938–39, by months [1]

[Thousands of barrels]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1938													
Crude petroleum	5,953	5,321	6,121	7,549	7,791	7,424	7,250	7,003	5,577	6,780	5,602	4,883	77,254
Refined products:													
Motor fuel [2]	3,090	3,929	3,562	4,474	4,576	4,284	4,190	4,829	3,528	4,526	3,698	5,423	50,109
Kerosene	837	687	541	811	779	403	219	604	813	683	324	803	7,504
Gas oil and distillate fuel oils	2,257	2,151	2,810	2,687	2,561	2,980	2,896	2,614	2,428	1,574	2,270	2,413	29,641
Residual fuel oil	869	911	1,521	1,473	1,690	1,613	1,790	1,723	1,680	1,643	1,270	1,737	17,920
Lubricating oils	820	806	655	864	908	914	708	800	852	715	699	676	9,417
Paraffin wax	42	38	55	41	68	70	52	49	86	84	54	80	719
Coke	41	48	14	53	70	48	66	65	58	136	121	58	778
Asphalt	17	34	28	24	22	16	23	11	27	24	18	30	274
Miscellaneous oils	13	5	15	4	14	10	7	5	15	3	4	17	112
Total refined	7,986	8,609	9,201	10,431	10,688	10,338	9,951	10,700	9,487	9,388	8,458	11,237	116,474
Total crude and refined	13,939	13,930	15,322	17,980	18,479	17,762	17,201	17,703	15,064	16,168	14,060	16,120	193,728
1939													
Crude petroleum	4,477	4,810	4,966	6,222	8,643	5,831	7,304	5,969	6,925	6,947	5,323	4,656	72,073
Refined products:													
Motor fuel [2]	3,638	2,909	4,336	3,663	4,390	4,459	3,585	4,208	4,232	3,443	2,560	3,136	44,559
Kerosene	810	532	546	713	653	471	774	841	577	1,107	567	652	8,243
Gas oil and distillate fuel oils	1,675	2,131	2,924	2,345	4,004	2,839	2,857	3,361	3,015	2,756	2,116	1,998	32,021
Residual fuel oil	1,379	925	2,047	1,488	1,854	1,684	1,144	1,613	1,624	1,296	1,116	1,320	17,490
Lubricating oils	851	680	829	816	981	1,101	1,022	1,204	1,012	985	1,190	1,310	11,981
Paraffin wax	66	68	94	72	57	89	59	53	108	69	44	52	831
Coke	52	41	49	116	164	163	157	127	191	113	193	63	1,429
Asphalt	18	41	15	21	16	20	16	18	24	19	12	12	232
Miscellaneous oils	5	8	9	9	9	8	8	4	14	17	18	14	123
Total refined	8,494	7,335	10,849	9,243	12,128	10,834	9,622	11,429	10,797	9,805	7,816	8,557	116,909
Total crude and refined	12,971	12,145	15,815	15,465	20,771	16,665	16,926	17,398	17,722	16,752	13,139	13,213	188,982

[1] Compiled from records of the Bureau of Foreign and Domestic Commerce; figures may differ slightly from those used throughout other sections of this report.
[2] Includes benzol and natural gasoline.

Europe remained the premier foreign market for American refined oils, taking 47 percent of the major liquid products exported from the United States in 1938 and 48 percent in 1939. Asiatic countries increased their share in the total trade from 16 percent in 1938 to 19 percent in 1939. On the other hand, the share of North American countries in the entire trade decreased from 20 percent in 1938 to 18 in 1939 and of South American countries from 5.3 percent in 1938 to 4.6 in 1939.

Decreased purchases by countries of northern and western Europe, notably the United Kingdom, France, Germany, and Belgium, were chiefly responsible for the 11-percent decline in exports and Territorial shipments of motor fuel from continental United States from 1938 to 1939. Less motor fuel was sold to Canada, Brazil, Japan, the U. S. S. R., the Union of South Africa, Australia, and New Zealand in 1939 than in 1938. The total included 4,111,000 barrels of natural gasoline and 4,234,000 barrels of aviation gasoline. The Netherland West Indies received 36 percent of the natural gasoline and 21 percent of the aviation gasoline for blending with gasoline produced in the refineries of Curaçao and Aruba and exported principally to Europe. Canada, the United Kingdom, France, Japan, and Italy took an additional 58 percent of the natural gasoline; and France, Japan, the United Kingdom, Italy, and Canada bought 50 percent of the aviation gasoline shipped from continental United States in 1939.

Gulf coast refineries of Texas and Louisiana furnished 61 percent and California refineries 25 percent of the motor fuel shipped from continental United States in 1939.

Major petroleum products shipped from continental United States, by countries of destination, and shipments to and exports from noncontiguous Territories, 1938–39 [1]

[Thousands of barrels, except wax, which is in thousands of pounds]

	Motor fuel [2]		Kerosene		Gas oil and fuel oil		Lubricating oil		Wax	
	1938	1939 [3]	1938	1939 [3]	1938	1939 [3]	1938	1939 [3]	1938	1939 [3]
Exports to foreign countries:										
North America:										
Canada	3,276	2,963	229	189	1,528	1,180	486	524	11,016	13,380
Cuba	778	534		1	1,473	390	37	55	2,414	2,939
Mexico	238	387	22	25	1,268	456	87	99	16,831	21,833
Netherland West Indies	4,852	5,126	1,209	561	5,111	4,843	12	19		1
Panama (including Canal Zone)	235	249	48	44	1,798	1,880	9	17	135	205
Other North America	284	465	128	224	446	684	65	68	6,312	7,596
	9,663	9,724	1,636	1,044	11,624	9,433	696	782	36,708	45,954
South America:										
Argentina	26	5					29	23	4,013	3,325
Brazil	1,460	1,280	401	415	482	180	243	302	1,860	2,840
Chile	216	246	28	9	2,546	2,184	59	90	3,770	4,885
Colombia	16	13		1	2	1	17	28	6,540	7,193
Other South America	174	110	29	11	195	185	109	123	9,805	12,245
	1,892	1,654	458	436	3,225	2,550	457	566	25,988	30,488
Europe:										
Belgium	1,383	1,273	51	10	1,151	1,098	799	975	15,271	12,105
Denmark	660	813	496	495	715	782	205	477	2,243	4,471
Finland	267	211	67	50	37	104	21	27	1,236	1,094
France	3,831	2,646	9		240	133	529	480	1,101	190
Germany	2,313	761	1	17	4,026	3,656	1,235	1,106	4,219	5,089

See footnotes at end of table.

Major petroleum products shipped from continental United States, by countries of destination, and shipments to and exports from noncontiguous Territories, 1938–39—Continued

	Motor fuel [2]		Kerosene		Gas oil and fuel oil		Lubricating oil		Wax	
	1938	1939	1938	1939	1938	1939	1938	1939	1938	1939
Exports to foreign countries—Continued.										
Europe—Continued.										
Ireland	177	195	20	63	16	32	6	7	2, 441	1, 544
Italy	432	320	------	14	1, 201	1, 553	306	483	22, 104	28, 838
Netherlands	2, 417	1, 670	696	991	3, 065	3, 089	192	362	5, 897	7, 904
Norway	263	360	104	188	414	663	33	80	1, 052	2, 729
Portugal	293	488	115	225	98	243	38	79	1, 761	2, 122
Spain	2, 095	2, 127	12	22	771	1, 691	106	377	2, 018	17, 239
Sweden	2, 390	3, 207	421	464	908	1, 498	159	268	7, 403	16, 705
United Kingdom	10, 031	9, 060	1, 555	1, 467	4, 044	4, 616	2, 459	2, 832	45, 232	39, 306
Other Europe	197	459	90	47	334	429	114	131	2, 632	2, 852
	26, 749	23, 590	3, 637	4, 053	17, 020	19, 587	6, 202	7, 684	114, 610	142, 188
Asia:										
India, British (including Burma)	87	33	12	81	51	40	323	443	1, 029	413
China, Hong Kong, and Kwantung	741	1, 150	337	534	619	1, 006	163	180	6, 558	6, 292
Japan	1, 484	1, 381	------	105	8, 327	9, 909	307	514	46	3
Philippine Islands	953	1, 228	509	578	1, 210	1, 374	79	129	528	498
U. S. S. R	1, 547	884	------	------	------	------	------	------	------	66
Other Asia	728	586	259	343	278	407	175	325	654	1, 290
	5, 540	5, 262	1, 117	1, 641	10, 485	12, 736	1, 047	1, 591	8, 815	8, 562
Africa:										
Union of South Africa	619	270	20	29	78	10	117	173	3, 401	2, 447
Other Africa	556	659	150	628	1, 129	1, 029	323	360	11, 175	2, 449
	1, 175	929	170	657	1, 207	1, 039	440	533	14, 576	4, 896
Oceania:										
Australia	2, 001	756	169	108	22	35	415	600	556	334
New Zealand	873	388	62	29	196	139	69	106	149	97
Other Oceania	65	50	12	26	54	71	2	3	------	------
	2, 939	1, 194	243	163	272	245	486	709	705	431
	47, 958	42, 353	7, 261	7, 994	43, 833	45, 590	9, 328	11, 865	201, 402	232, 519
Shipments to noncontiguous Territories:										
Alaska	225	240	8	9	1, 090	1, 259	17	19	5	8
Hawaii	1, 258	1, 240	147	142	2, 400	2, 449	49	66	9	54
Puerto Rico	697	846	108	129	261	235	25	31	28	80
Virgin Islands	21	19	4	3	4	5	1	2	3	------
Other	15	24	2	2	2	3	------	------	------	------
	2, 216	2, 369	269	285	3, 757	3, 951	92	118	45	142
Exports from noncontiguous Territories:										
Alaska	12	11	------	------	16	12	1	------	------	------
Puerto Rico	53	71	25	36	13	22	2	3	------	------
Virgin Islands	------	------	1	------	------	------	------	------	------	------
	65	82	26	36	29	34	3	3	------	------
Revisions [4]	------	[5] 81	------	------	------	4	------	1	------	3
Total shipments from United States	50, 109	44, 559	7, 504	8, 243	47, 561	49, 511	9, 417	11, 981	201, 447	232, 664

[1] Bureau of Foreign and Domestic Commerce. [2] Includes natural gasoline, naphtha, and benzol.
[3] Subject to revision. [4] By Bureau of Foreign and Domestic Commerce through March 20, 1940.
[5] Negative quantity.

More kerosene was exported to eastern Asia and to the smaller countries of northern and western Europe and to Africa in 1939 than in 1938. These increases offset the declines in shipments to the Netherland West Indies and to the United Kingdom and raised the total outward shipments of kerosene 10 percent in 1939 over 1938.

The growing use of the Diesel motors for ships, motortrucks, industrial machinery, and even airplanes is evidenced by the continued increase in exports and Territorial shipments of gas oil and distillate fuel, which were 8 percent larger in 1939 than in 1938. More gas oil and distillate fuel oil were shipped to Japan, to the United Kingdom, to the Netherlands, to the Canal Zone, to Canada, and to the Philippine Islands; less to the Netherland West Indies for reshipment chiefly to Europe; and less to Germany and to Belgium, especially after the outbreak of the war in September.

Outward shipments of residual fuel oil were slightly lower in 1939 than in 1938 but 14 percent higher than in 1937. Marked increases in exports to Japan, to Italy, to Spain, and to the Philippine Islands were offset by decreases in shipments to Cuba, Chile, Canada, Spanish Africa, Sweden, and the Netherlands.

The outbreak of the war in Europe dislocated the export trade in residual fuel oil. During the first 8 months of 1939 they were 5 percent higher than in the corresponding months of 1938; but in the last 4 months of 1939 they were 15 percent lower than in the corresponding period of 1938. The increase in foreign and Territorial shipments of lubricating oils from continental United States was general but was greatest in shipments to Europe (except to France and Germany). The outbreak of the war stimulated exports of lubricating oils; during the first 8 months of 1939 they exceeded the exports of the corresponding period of 1938 by 15 percent, but in the last 4 months of 1939 they were 53 percent larger than in the last 4 months of 1938.

Motor fuel exported and shipped to noncontiguous Territories from continental United States in 1939, by refinery districts and months [1]

[Thousands of barrels]

Refinery district	January	February	March	April	May	June
East Coast	63	156	57	65	156	120
Appalachian	10	11	12	6	12	129
Indiana, Illinois, Kentucky, etc	23	41	8	12	14	28
Texas Inland	319	211	285	154	540	200
Texas Gulf Coast	2,020	1,245	2,762	2,259	2,793	2,643
Louisiana Gulf Coast	283	98	142	174	181	201
Rocky Mountain	16	13	23	39	46	36
California	904	1,134	1,047	954	648	1,102
Total United States	3,638	2,909	4,336	3,663	4,390	4,459

Refinery district	July	August	September	October	November	December	Total
East Coast	394	294	157	151	251	197	2,061
Appalachian	10	56	77	119	76	79	597
Indiana, Illinois, Kentucky, etc	26	14	30	20	38	11	265
Texas Inland	117	104	190	132	300	164	2,716
Texas Gulf Coast	2,267	2,742	2,137	1,829	777	1,559	25,033
Louisiana Gulf Coast	106	79	233	158	272	365	2,292
Rocky Mountain	49	69	57	42	33	26	449
California	616	850	1,351	992	813	735	11,146
Total United States	3,585	4,208	4,232	3,443	2,560	3,136	44,559

[1] Compiled from data of Bureau of Foreign and Domestic Commerce as of March 20, 1940; figures may differ slightly from those used throughout other sections of this report.

Considerably more wax was shipped from continental United States in 1939 than in 1938. The increase was greatest in exports to Europe, especially to the Mediterranean countries and to the smaller nations of northern Europe bordering the North Sea and the Baltic. Canada and in general Latin America bought more paraffin wax from United States refineries in 1939 than in 1938. Decreased shipments to Africa and to the Far East were not adequate to offset the greater demand from Europe. Increased exports of paraffin wax from Burma and from the Netherlands East Indies would appear to explain the decrease of United States exports of wax to Africa and the Far East.

INTERCOASTAL SHIPMENTS [14]

Receipts of mineral oils, crude and refined, on the East coast from Gulf coast ports were nearly 10 percent larger in 1939 than in 1938. Crude petroleum was the largest single item in this movement, constituting 39 percent of the total shipments in 1939. In keeping with a 7-percent increase in 1939 over 1938 in runs to stills in East coast refineries, receipts of Gulf coast and Mid-Continent crude were 5 percent larger in 1939 than in 1938. They constituted 82 percent of the total runs of crude petroleum in 1939 compared with 83 percent in 1938. Receipts of refined oils from Gulf coast ports were 13 percent larger in 1939 than in 1938, in response to the improved demand in the marketing area of the East coast refineries.

Receipts of California mineral oils at East coast ports were larger in 1939 than in 1938; but they contributed relatively little to the supply of mineral oils in the East coast territory. The increases were chiefly in fuel oil, gas oil, and crude petroleum.

Mineral oils, crude and refined, shipped from Gulf coast to East coast ports of the United States, 1938–39 [1]

[Thousands of barrels]

	1939						
	January	February	March	April	May	June	July
Crude petroleum	14,184	11,743	12,847	11,818	12,785	12,991	13,772
Gasoline	8,164	7,409	10,026	8,807	10,674	10,535	10,518
Kerosene	2,601	2,349	1,821	1,622	1,683	1,174	1,191
Gas oil and distillate fuel oils	4,699	3,343	3,137	1,998	2,085	1,737	2,421
Residual fuel oils	6,346	5,415	5,763	4,239	5,285	4,414	4,742
Lubricating oils	502	351	492	446	564	552	588
Miscellaneous oils	35	15	81	66	50	68	39
	36,531	30,625	34,167	28,996	33,126	31,471	33,271

	1939—Continued						1938 (total)
	August	September	October	November	December	Total	
Crude petroleum	12,981	12,177	14,651	13,274	14,596	157,819	150,716
Gasoline	11,017	9,160	10,396	8,760	9,167	114,633	105,036
Kerosene	1,567	1,806	1,851	2,009	2,730	22,404	19,915
Gas oil and distillate fuel oils	2,233	2,319	2,992	3,228	4,509	34,701	29,187
Residual fuel oils	5,016	4,629	5,888	6,668	7,041	65,446	56,987
Lubricating oils	538	548	679	676	619	6,555	4,451
Miscellaneous oils	30	21	35	37	8	485	494
	33,382	30,660	36,492	34,652	38,670	402,043	366,786

[1] Petroleum Conservation Division, U. S. Department of the Interior.

[14] By A. H. Redfield, Petroleum Economics Division, Bureau of Mines.

Mineral oils, crude and refined, shipped from California to East coast ports of the United States, 1938-39

[Thousands of barrels]

	1939													1938 (total)
	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
Crude petroleum	-----	61	126	-----	62	61	199	131	217	-----	90	-----	947	923
Gasoline	129	67	245	629	385	611	236	291	309	191	243	329	3,665	2,965
Kerosene	-----	57	65	-----	-----	-----	-----	142	-----	62	-----	65	391	350
Gas oil and distillate fuel oils	230	-----	-----	-----	-----	-----	-----	-----	84	73	88	158	633	321
Residual fuel oils	63	264	124	271	226	351	61	300	209	211	140	69	2,289	338
Asphalt and road oils	-----	-----	75	66	140	-----	73	73	-----	-----	75	-----	502	491
Miscellaneous oils	6	1	5	2	5	5	7	-----	8	3	1	-----	43	33
	428	450	640	968	818	1,028	576	937	827	540	637	621	8,470	5,421

NATURAL GAS [1]

By F. S. LOTT AND G. R. HOPKINS [2]

SUMMARY OUTLINE

Marketed production of natural gas in the United States resumed its customary upward trend in 1939, after a temporary set-back in 1938. The estimated total was 2,437,200 million cubic feet, exceeding volume in 1938 by 6 percent and representing a new peak for the industry.

All types of demand except field use responded vigorously to improved business conditions, particularly in the Eastern States. In the last 4 months of 1939 abrupt expansion of operations in the steel and related industries, induced by the war in Europe, was responsible for conspicuous gains in the industrial use of gas in Pennsylvania, Ohio, and West Virginia. Western New York industrial plants were forced to reduce their consumption of natural gas because of inadequate supply.

Consumers in the United States used an estimated 2,434,154 million cubic feet (marketed production less net exports of 846 million cubic feet) in 1939 compared to 2,294,097 million in 1938. The average value at points of consumption, which had declined in 1938 to 21.8 cents per thousand cubic feet, is estimated to have increased to 22.2 cents in 1939. Higher average values are indicated for each of the three major classes of consumption, with industrial showing the greatest increase—from 9.4 cents in 1938 to 9.9 cents in 1939. Miscellaneous demand, the industrial component of greatest average value and economic significance, expanded most (13 percent) in 1939 and was the chief cause of the large gain in value of industrial gas. Domestic and commercial average values are estimated to have increased 0.2 cent each to 74.4 and 49.4 cents, respectively.

On the basis of the average values mentioned, the total value at points of consumption of natural gas consumed in the United States was $539,431,000 in 1939, an 8-percent increase over the 1938 total of

[1] Data for 1939 are preliminary; detailed statistics with final revisions will be released later.
[2] Tables compiled by H. Backus, Petroleum Economics Division, Bureau of Mines.

$500,550,000. The 1939 total was the greatest ever attained by the natural-gas industry. The total industrial value was slightly below its 1937 peak, but domestic and commercial sales were substantially above any previous levels, both in value and volume.

Salient statistics of natural gas in the United States, 1935–39

	1935	1936	1937	1938	1939[1]
Marketed production:					
California .... millions of cubic feet	284,109	320,406	329,769	315,168	320,000
Louisiana .... do	249,450	290,151	315,301	283,899	310,000
Oklahoma .... do	274,313	280,481	296,260	263.164	255,000
Texas .... do	642,366	734,561	854,561	882,473	945.000
West Virginia .... do	115,772	138,076	149,084	134,342	148,000
Other States .... do	350,585	404,127	462,645	416,516	459,200
Total production .... do	1,916,595	2,167,802	2,407,620	2,295,562	2,437,200
Exports:					
To Canada .... do	73	84	78	94	77
To Mexico .... do	6,727	7,352	4,790	1,743	3,100
Imports from Canada .... do	106	152	289	372	131
Consumption:					
Domestic .... do	313,498	343,346	371,844	367,772	388,000
Commercial .... do	100,187	111,623	117,390	114,296	122,000
Industrial:					
Field .... do	580,414	618,468	651,320	659,203	650,000
Carbon-black plants .... do	241,589	283,421	341,085	324,950	348,000
Petroleum refineries .... do	80,175	93,183	113,005	109,741	119,000
Electric public-utility power plants[2] millions of cubic feet	125,239	156,080	170,567	169,988	191,131
Portland-cement plants[3] .... do	26,752	36,923	40,450	37,336	40,233
Other industrial .... do	442,047	517,474	597,380	510,811	575,790
Total consumption .... do	1,909,901	2,160,518	2,403,041	2,294,097	2,434,154
Domestic .... percent of total	17	16	15	16	16
Commercial .... do	5	5	5	5	5
Industrial .... do	78	79	80	79	79
Number of consumers:					
Domestic .... thousands	7,391	8,017	8,348	8,634	[4]
Commercial .... do	613	657	680	704	[4]
Industrial[5] .... do	36	39	39	39	[4]
Number of producing gas wells	53,790	54,500	[6] 55,050	53,770	[4]
Value (at wells) of gas produced:					
Total .... thousands of dollars	110,402	119,193	123,457	113,571	121,750
Average per M cubic feet .... cents	5.8	5.5	5.1	4.9	5.0
Value (at points of consumption) of gas consumed:					
Domestic .... thousands of dollars	233,940	251,617	273,577	273,070	288,672
Commercial .... do	49,386	53,693	57,161	56,247	60,268
Industrial .... do	144,748	170,129	196,791	171,233	190,491
Total value .... do	428,074	475,439	527,529	500,550	539,431
Average per M cubic feet:					
Domestic .... cents	74.6	73.3	73.6	74.2	74.4
Commercial .... do	49.3	48.1	48.7	49.2	49.4
Industrial .... do	9.7	10.0	10.3	9.4	9.9
Domestic and commercial .... do	68.5	67.1	67.6	68.3	68.4
Domestic, commercial, and industrial .... cents	22.4	22.0	22.0	21.8	22.2
Treated for natural gasoline:					
Quantity .... millions of cubic feet	1,822,000	1,815,000	2,108,800	2,035,562	2,080,000
Percent of total consumption	95	84	88	89	85

[1] Subject to revision. [2] Federal Power Commission.
[3] Chapters on Cement in Minerals Yearbook and Statistical Appendix to Minerals Yearbook.
[4] Figures not yet available. [5] Exclusive of oil- and gas-field operators. [6] Revised figures.

Steady growth in domestic and commercial gas business has been accomplished by developing many market areas as the network of gas pipe lines extended into new territory. Construction was at very low ebb in 1938 but revived in 1939, when approximately 1,500 miles of line were laid. Large gas and utility holding companies built almost all of these lines; small organizations seldom are in a position to solve the many problems involved in carrying to successful completion a new gas pipe-line project of major proportions.

The most important movement of natural gas across the national boundaries is in export to Mexico; however, political considerations have caused it to dwindle rapidly since 1936. Little information is available regarding the extent of this movement in 1939, but it is estimated at approximately 3,100 million cubic feet, almost 80 percent less than the 1938 volume of 1,743 million. Exports to Canada were 77 million and imports 131 million cubic feet in 1939. The import movement ceased in June 1939.

As shown in figure 1, the average value of natural gas at the wells is estimated to have increased from 4.9 cents per thousand cubic feet in 1938 to 5.0 cents in 1939. The total indicated value of marketed production was $113,571,000 in 1938 and $121,750,000 in 1939. Although total value at the wells in 1939 was 25 percent larger than the depression low point in 1933 it was 23 percent smaller than the 1929 figure.

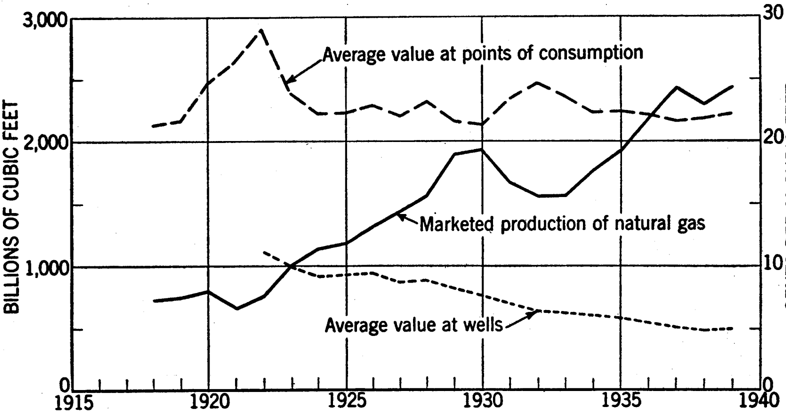

FIGURE 1.—Production and value of natural gas in the United States, 1918–39.

LEGISLATIVE AND LEGAL REVIEW

The Federal Power Commission has been active in a large number of proceedings initiated or pending in 1939 in connection with its administration of the 1938 Federal law to regulate interstate shipment of natural gas. Actions affecting gas rates have been brought by State regulatory bodies, municipalities, distributing companies, gas-producing companies, and the Power Commission on its own initiative. These actions deal with the sale or transmission of natural gas in at least 12 States, including most of the important producing areas.

On November 3, 1939, the Federal Power Commission adopted a ruling that prescribes a uniform system of accounts for natural-gas companies subject to the act; it became effective as of January 1, 1940. It requires the original cost of the plant to be stated within 2 years of the effective date, with the purpose of establishing this cost as a basis for calculating depletion, depreciation, and retirements.

Recent decisions of the Supreme Court of the United States indicate the probability of higher taxes on interstate gas operations. They have weakened the old, established doctrine which held that strictly interstate commerce was free from the burden of State taxes. Certain operations recognized as essential to and exclusively concerned with interstate transmission of natural gas are now taxable by States, provided duplication of taxes does not result.

Conservation laws applying to oil and gas production were enacted early in 1939 by the State legislatures of Arkansas and Michigan.

EMPLOYMENT AND PRODUCTIVITY

The average number of workers employed at gas wells declined 11 percent to 8,090 in 1938 from 9,073 in 1937. Curtailment of producing operations was widespread because of the generally reduced market demand for gas. Against the general trend, employment increased in New York, Illinois, New Mexico, and California, where new gas areas were expanding.

The total man-hours of labor required in gas-well production decreased less than the number employed (only 5 percent) in 1938 from 1937, especially in West Virginia, Pennsylvania, and Kansas, as many of the men laid off were part-time employees.

Average labor productivity increased 2 percent for the entire country chiefly because production of gas wells was better maintained in States with high productivity factors than in those where production per man-hour is small. As a group, the four States of highest productivity per man-hour—Louisiana, New Mexico, Texas, and Wyoming—increased their "dry"-gas production 44.4 billion cubic feet in 1938. Marked declines in output were common in the Eastern States, whose multitude of small wells require a large expense for labor per unit volume of gas produced.

In general, average annual employment at gas wells varies with the volume of gas produced but is characteristically more stable from year to year; hence the factor of labor productivity tends to increase with expanding production, and vice versa.

Employment at gas wells, natural gas produced from gas wells, and average output per man-hour in the United States, 1937–38, by States

State	Average number of workers		Total man-hours (thousands)		"Dry"-gas production (millions of cubic feet)		Labor productivity (thousands of cubic feet per man-hour)	
	1937	1938	1937	1938	1937	1938	1937	1938
Arkansas	35	30	73	60	5,700	5,300	78.1	88.3
California	18	23	36	51	[1] 10,000	13,000	[1] 277.8	254.9
Colorado	9	7	19	13	3,050	1,775	160.5	136.5
Illinois	9	12	15	22	30	150	2.0	6.8
Indiana	97	86	164	145	1,700	1,350	10.4	9.3
Kansas	566	480	1,062	1,050	57,000	54,000	53.7	51.4
Kentucky	400	375	775	780	55,500	46,000	71.6	59.0
Louisiana	230	200	411	365	290,000	260,000	705.6	712.3
Michigan	60	57	109	84	7,900	7,900	72.5	94.0
Montana	104	85	240	190	24,600	20,900	102.5	110.0
New Mexico	10	13	22	29	[1] 20,000	30,000	[1] 909.1	1,034.5
New York	530	625	989	1,155	21,900	40,910	22.1	35.4
Ohio	1,030	925	1,894	1,727	42,300	35,800	22.3	20.7
Oklahoma	530	420	965	852	112,000	76,000	116.1	89.2
Pennsylvania	2,220	1,955	4,413	4,133	[1] 118,000	80,000	[1] 26.7	19.3
Texas	450	420	837	884	650,000	715,000	776.6	808.8
West Virginia	2,700	2,300	5,100	4,750	[1] 152,500	136,000	[1] 29.9	28.6
Wyoming	35	30	55	50	23,000	22,400	418.2	448.0
Other States [2]	40	47	66	76	17,400	20,490	263.6	269.6
	9,073	8,090	17,245	16,416	[1] 1,612,580	1,566,975	[1] 93.5	95.5

[1] Revised figures.
[2] Mississippi, Missouri, North Dakota, South Dakota, Tennessee, Utah, and Washington.

GROSS PRODUCTION

Gross production of natural gas in the United States, as estimated in the accompanying table, increased slightly in 1938 over 1937, although the demand from established gas markets contracted 5 percent. The output of gas wells, which is habitually responsive to consumers' requirements, declined 3 percent (45.6 billion cubic feet). The volume of gas withdrawn from oil wells, however, was 4 percent larger (61.4 billion cubic feet) in 1938 than in 1937, causing an increase in the total production of gas. These changes suggest the contrasting economic and physical conditions that chart the separate courses of the two classes of gas-producing activity. The position of natural gas in oil production is incidental economically, under methods of operation still in common use, even where the gas output per barrel of oil produced is very high. However, much convincing evidence is now available of the great value of natural gas for increasing recovery of oil and reducing production expense and economic waste. This rapidly growing fund of knowledge may be expected to strengthen the sentiment among oil operators continually in favor of methods that retard the uneconomic dissipation of reservoir energies.

The practice of returning natural gas to oil sands for repressuring has expanded slowly. Fifteen States reported gas so used in 1938, an addition of 1 since 1937 and 4 since 1935. The volume of gas returned was the largest in 1938 of any year recorded, reflecting moderate growth in a number of States, notably in Texas. Reported repressuring in Oklahoma has declined over 50 percent since 1935, a trend in conformity with that of casing-head gas production in the State.

The storage of gas in depleted natural reservoirs has increased somewhat in recent years because this method of "delayed marketing" has been adopted in several eastern fields. Excess productive capacity was developed in several deep Oriskany-sand fields, and some of this gas was moved to storage points near important market areas to await periods of peak demand or eventual decline in productive capacity of the high-pressure fields.

Gross production and disposition of natural gas in the United States, 1937–38, by States, in millions of cubic feet

State	Estimated production [1]			Estimated disposition			
	From gas wells	From oil wells	Total	Marketed production	Repressuring	Stored in ground	Losses and wastage [2]
1937							
Arkansas	5,700	6,800	12,500	9,690	220	----------	2,590
California	[3] 10,000	[3] 413,000	[3] 423,000	329,769	34,120	1,589	[3] 57,522
Colorado	3,050	250	3,300	3,186	----------	----------	114
Illinois	30	1,170	1,200	1,040	----------	----------	160
Indiana	1,700	100	1,800	1,551	1	----------	248
Kansas	57,000	[3] 69,700	[3] 126,700	83,890	1,260	[4] 5,358	[3] 40,517
Kentucky	55,500	5,000	60,500	55,719	1,000	51	3,199
Louisiana	290,000	70,000	360,000	315,301	3,922	----------	40,777
Michigan	7,900	1,500	9,400	9,080	----------	----------	320
Mississippi	14,300	----------	14,300	13,348	----------	----------	952
Missouri	460	10	470	444	----------	----------	26
Montana	24,600	900	25,500	24,765	195	----------	540
New Mexico	[3] 20,000	[3] 92,000	[3] 112,000	46,337	1,087	----------	[3] 64,576
New York	21,900	100	22,000	21,325	----------	4	671
Ohio	42,300	3,200	45,500	42,783	6	[5] 5,010	1,183
Oklahoma	112,000	328,000	440,000	296,260	24,624	56	116,806
Pennsylvania	[3] 118,000	[3] 7,000	[3] 125,000	115,928	293	770	[3] 8,009

See footnotes at end of table.

Gross production and disposition of natural gas in the United States, 1937–38, by States, in millions of cubic feet—Continued

State	Estimated production [1]			Estimated disposition			
	From gas wells	From oil wells	Total	Marketed production	Repressuring	Stored in ground	Losses and wastage [2]
1937—Continued							
Texas	650,000	390,000	1,040,000	854,561	6,734		[3] 176,634
West Virginia	[3] 152,500	14,500	[3] 167,000	149,084	3,870	868	[3] 10,227
Wyoming	23,000	16,600	39,600	31,023	7,593		984
Other States [6]	2,640		2,640	2,536			104
	[3] 1,612,580	[3] 1,419,830	[3] 3,032,410	2,407,620	84,925	13,706	[3] 526,159
1938 [7]							
Arkansas	5,300	18,900	24,200	11,301	108		12,791
California	13,000	419,000	432,000	315,168	40,000	2,144	74,688
Colorado	1,775	225	2,000	1,904			96
Illinois	150	4,850	5,000	1,169	500		3,331
Indiana	1,350	150	1,500	1,299	6		195
Kansas	54,000	62,000	116,000	75,203	1,655	[8] 5,443	38,249
Kentucky	46,000	5,300	51,300	46,163	800	61	3,530
Louisiana	260,000	100,800	360,800	283,899	6,000		70,901
Michigan	7,900	2,700	10,600	10,165			435
Mississippi	14,300		14,300	13,656			644
Missouri	1,490	10	1,500	1,369			131
Montana	20,900	800	21,700	21,216	188		296
New Mexico	30,000	138,000	168,000	50,706	452		116,842
New York	40,910	90	41,000	39,402			1,539
Ohio	35,800	3,200	39,000	35,257	90	[9] 3,532	2,632
Oklahoma	76,000	254,000	330,000	263,164	18,656	822	45,578
Pennsylvania	80,000	6,200	86,200	76,547	563	[10] 2,360	7,741
Texas	715,000	435,000	1,150,000	882,473	20,000		244,757
West Virginia	136,000	14,000	150,000	134,342	3,360	619	8,962
Wyoming	22,400	16,000	38,400	26,678	9,173		2,549
Other States [6]	4,700		4,700	4,481			219
	1,566,975	1,481,225	3,048,200	2,295,562	101,551	14,981	636,106

[1] Marketed production plus quantities used in repressuring, stored in the ground, lost, and wasted (see footnote 2).
[2] Includes gas (mostly residue gas) blown to the air, shrinkage at natural-gasoline plants, and transportation losses but does not include direct waste on producing properties.
[3] Revised figures.
[4] Produced approximately as follows: 2,071 million cubic feet in Texas, 2,254 million in Oklahoma, 1,033 million in Kansas.
[5] Produced approximately as follows: 2,951 million cubic feet in West Virginia, 531 million in Kentucky, 1,528 million in Ohio.
[6] North Dakota (1938 only), South Dakota, Tennessee, Utah, and Washington. [7] Subject to revision.
[8] Produced approximately as follows: 2,770 million cubic feet in Texas, 1,780 million in Oklahoma, 893 million in Kansas.
[9] Produced approximately as follows: 1,981 million cubic feet in West Virginia, 530 million in Kentucky, 1,021 million in Ohio.
[10] Produced approximately as follows: 736 million cubic feet in West Virginia, 216 million in Kentucky, 59 million in New York, 1,349 million in Pennsylvania.

Losses and waste comprised 21 percent of estimated gross production in 1938, 17 percent in 1937, 15 percent in 1936, and 19 percent in 1935. The percentage increase in 1938 over 1937 is attributable in part to curtailment of gas-well production in 1938, but its principal cause is to be found in oil-production operations in several active areas where high gas-oil ratios are common. The most important of these were in New Mexico, Texas, California, Louisiana, and Arkansas.

MARKETED PRODUCTION

Marketed production of natural gas in the United States is estimated to have increased 6 percent in 1939 to 2,437 billion cubic feet, exceeding the 1937 peak. Expansion appears to have been general in almost all the leading producing States. Among States of secondary importance in gas output, sharp upward trends in natural-gas utilization have been evident for several years in Arkansas, Kansas, Kentucky, Michigan, Mississippi, Montana, New Mexico, New York, and Pennsylvania.

The dearth of available reserves may soon reverse the trend in Mississippi, New York, and Pennsylvania unless important new discoveries are promptly made. In the other States named and in all the States whose 1938 marketed production exceeded 100 billion cubic feet, known gas supplies appear adequate for a number of years.

Final 1938 data indicate that marketed production declined in most States. The only sharp increase occurred in New York through rapid withdrawal of gas from the recently developed Oriskany-sand fields.

The average price of gas at the wells declined to a new low of 4.9 cents per thousand cubic feet in 1938. Of 24 States reporting production in 1937 and 1938, however, 13 reported higher average values, 7 were lower, and 4 were unchanged. The average value at points of consumption of the gas produced dropped in 1938 to 21.8 cents, the lowest price in recent years.

Natural gas produced in the United States and delivered to consumers, 1934–38, by States, in millions of cubic feet

Year	Arkansas	California	Colorado	Illinois	Indiana	Kansas	Kentucky	Louisiana	Michigan	Mississippi	Montana	New Mexico
1934	7,024	268,122	2,633	1,868	1,802	46,909	33,124	225,713	2,789	8,245	14,971	24,075
1935	6,167	284,109	2,843	1,448	1,777	57,125	39,738	249,450	4,203	9,643	19,870	27,931
1936	8,500	320,406	3,687	865	2,241	69,178	43,903	290,151	7,167	11,821	23,003	33,928
1937	9,690	329,769	3,186	1,040	1,551	83,890	55,719	315,301	9,080	13,348	24,765	46,337
1938	11,301	315,168	1,904	1,169	1,299	75,203	46,163	283,899	10,165	13,656	21,216	50,706

Year	New York	Ohio	Oklahoma	Pennsylvania	Texas	West Virginia	Wyoming	Other States	Total	Value at points of consumption: Total (thousands of dollars)	Value at points of consumption: Average per M cubic feet (cents)
1934	6,278	50,330	254,457	86,238	602,976	109,161	23,148	858	1,770,721	395,378	22.3
1935	8,288	49,592	274,313	94,464	642,366	115,772	26,643	853	1,916,595	429,374	22.4
1936	12,431	46,994	280,481	110,362	734,561	138,076	29,322	725	2,167,802	476,813	22.0
1937	21,325	42,783	296,260	115,928	854,561	149,084	31,023	2,980	2,407,620	528,354	21.9
1938	39,402	35,257	263,164	76,547	882,473	134,342	26,678	5,850	2,295,562	500,698	21.8

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Natural gas produced and consumed in the United States in 1938, by States

State	Produced and delivered to consumers, including deliveries in other States						Consumed, including receipts from other States			
	Quantity		Estimated value at wells		Value at points of consumption		Quantity		Value at points of consumption	
	M cubic feet	Percent of total	Total	Average per M cubic feet (cents)	Total	Average per M cubic feet (cents)	M cubic feet	Percent of total	Total	Average per M cubic feet (cents)
Ala							14,796,000	0.6	$3,887,000	26.3
Ariz							12,660,000	.5	3,790,000	29.9
Ark	11,301,000	0.5	$451,000	4.0	$2,168,000	19.2	34,833,000	1.5	6,682,000	19.2
Calif	315,168,000	13.7	21,778,000	6.9	88,225,000	28.0	315,168,000	13.7	88,225,000	28.0
Colo	1,904,000	.1	70,000	3.7	464,000	24.4	19,212,000	.8	6,980,000	36.3
D. C							3,826,000	.2	2,785,000	72.8
Fla							1,469,000	.1	377,000	25.7
Ga							14,783,000	.6	5,737,000	38.8
Ill	1,169,000	(1)	49,000	4.2	616,000	52.7	66,500,000	2.9	36,979,000	55.6
Ind	1,299,000	.1	188,000	14.5	734,000	56.5	26,706,000	1.2	8,357,000	31.3
Iowa							20,109,000	.9	7,306,000	36.3
Kans	75,203,000	3.3	3,249,000	4.3	27,485,000	36.5	86,105,000	3.8	18,997,000	22.1
Ky	46,163,000	2.0	5,641,000	12.2	19,539,000	42.3	15,350,000	.7	6,811,000	44.4
La	283,899,000	12.4	9,681,000	3.4	47,991,000	16.9	162,260,000	7.1	19,904,000	12.3
Md							1,247,000	.1	877,000	70.3
Mich	10,165,000	.4	975,000	9.6	6,387,000	62.8	24,697,000	1.1	22,789,000	92.3
Minn							14,641,000	.6	7,013,000	47.9
Miss	13,656,000	.6	653,000	4.8	3,210,000	23.5	12,785,000	.6	3,482,000	27.2
Mo	1,369,000	.1	122,000	8.9	819,000	59.8	42,505,000	1.8	16,124,000	37.9
Mont	21,216,000	.9	883,000	4.2	6,132,000	28.9	[2] 18,225,000	.8	4,907,000	26.9
Nebr							17,539,000	.8	6,190,000	35.3
N. Mex	[3] 50,706,000	2.2	791,000	1.6	7,715,000	15.2	32,890,000	1.4	3,514,000	10.7
N. Y	[4] 39,402,000	1.7	5,713,000	14.5	19,419,000	49.3	47,950,000	2.1	20,283,000	42.3
N. Dak	71,000	(1)	2,100	3.0	27,000	38.0	1,533,000	.1	594,000	38.7
Ohio	35,257,000	1.5	5,916,000	16.8	17,550,000	49.8	108,013,000	4.7	53,860,000	49.9
Okla	263,164,000	11.5	5,237,000	2.0	27,391,000	10.4	244,443,000	10.7	20,132,000	8.2
Pa	[5] 76,547,000	3.3	13,947,000	18.2	29,544,000	38.6	96,285,000	4.2	40,959,000	42.5
S. Dak	10,000	(1)	1,000	10.0	3,000	30.0	5,354,000	.2	1,830,000	34.2
Tenn	6,000	(1)	600	10.0	2,000	33.3	14,047,000	.6	4,400,000	31.3
Tex	[6] 882,473,000	38.4	19,767,000	2.2	133,486,000	15.1	729,603,000	31.8	55,417,000	7.6
Utah	4,277,000	.2	147,000	3.4	937,000	21.9	11,699,000	.5	2,580,000	22.1
Va							615,000	(1)	608,000	98.9
Wash	117,000	(1)	9,300	7.9	91,000	77.8	117,000	(1)	91,000	77.8
W. Va	134,342,000	5.9	17,478,000	13.0	55,910,000	41.6	57,478,000	2.5	15,270,000	26.6
Wyo	26,678,000	1.2	822,000	3.1	4,853,000	18.2	18,654,000	.8	2,813,000	15.1
Total:										
1938	2,295,562,000	100.0	113,571,000	4.9	500,698,000	21.8	2,294,097,000	100.0	500,550,000	21.8
1937	2,407,620,000	100.0	123,457,000	5.1	528,354,000	21.9	2,403,041,000	100.0	527,529,000	22.0

[1] Less than 0.05 percent. [2] Includes 372,000 M cubic feet piped from Canada.
[3] Includes 832,000 M cubic feet piped to Mexico. [4] Includes 34,000 M cubic feet piped to Canada.
[5] Includes 60,000 M cubic feet piped to Canada. [6] Includes 911,000 M cubic feet piped to Mexico.

WELLS

During 1939, 2,145 gas wells were completed in the United States a 4-percent reduction from 1938, which in turn was 21 percent below 1937. Curtailment of drilling for gas was general in the Southwestern States, whose developed reserves greatly exceed current needs. Development increased, however, in all important Eastern States except West Virginia, where there was a material decline as drilling in the prolific Oriskany-sand fields passed its peak.

The number of producing gas wells in the country dropped from 55,050 on December 31, 1937, to 53,770 in 1938. The sum of this decline (1,280) and the 2,236 gas-well completions indicates that 3,516 gas wells were abandoned in 1938, a sharp increase over the total in any recent year. Abandonments exceeded completions in 13 States and were especially numerous in the old fields of Ohio, Pennsylvania, New York, Kansas, and West Virginia. The number of gas wells in

Michigan, Mississippi, Missouri, and Wyoming is comparatively small, but an unusually large percentage of them was abandoned in 1938.

Gas wells in the United States, 1937–39

State	Producing Dec. 31, 1937	Drilled during 1938 [1]	Producing Dec. 31, 1938	Drilled during 1939 [1]
Arkansas	190	3	190	6
California	60	7	70	15
Colorado	20	1	20	1
Illinois	70	23	80	18
Indiana	970	43	1,010	44
Kansas	2,500	200	2,290	150
Kentucky	[2] 2,510	91	[2] 2,340	110
Louisiana	1,600	126	1,560	98
Michigan	350	28	260	52
Mississippi	90	6	60	1
Missouri	150	60	120	15
Montana	380	21	350	26
New Mexico	70	19	70	18
New York	2,090	(3)	2,000	(3)
Ohio	6,340	433	6,200	497
Oklahoma	2,630	160	2,480	151
Pennsylvania	19,130	[3] 166	18,540	[3] 200
South Dakota, Utah, and Washington	30	5	30	------
Tennessee	(2)	------	(2)	------
Texas	[4] 2,940	341	3,160	314
West Virginia	12,800	484	12,840	419
Wyoming	130	19	100	10
	[4] 55,050	2,236	53,770	2,145

[1] From Oil and Gas Journal and State sources.
[2] Tennessee included with Kentucky.
[3] New York included with Pennsylvania.
[4] Revised figures.

In 1931 total gas wells in the United States reached a peak of 55,756, which has not been equaled since, although gas production has risen to new highs about 25 percent above the earlier record of 1930. Modern practices of wider spacing of wells and deeper drilling have increased the average recoverable gas per well and reduced the cost per unit volume of producing natural gas, despite rising costs of labor and material.

REVIEW OF FIELD DEVELOPMENTS, BY STATES

Arkansas.—Production of natural gas in Arkansas in 1939 declined 9 percent to 18,770 million cubic feet, according to records of the Arkansas Department of Revenue furnished by Geo. C. Branner, State geologist. Production in the old gas fields in the northwestern part of the State increased 12 percent over 1938 to 4,061 million cubic feet in response to greater industrial demand. In the southern fields, however, where most gas is produced with oil, gas withdrawals were 14,710 million, about 14 percent less than in 1938. The greatest decline—2,100 million cubic feet—occurred in Miller County coincident with a marked recession in production of oil from the Rodessa field. Production and waste of casinghead gas were no doubt reduced by administration of a comprehensive proration and conservation law, which was enacted by the Arkansas Legislature on February 20, 1939.

Some of the casinghead gas produced in the Village, Atlanta, and Schuler fields was provided with pipe-line outlets in 1939 and utilized for drilling and refinery fuel. As most of the gas from southern Arkansas fields is rather high in sulfur, its distribution for general use has been restricted in favor of the abundant supplies of "sweet" gas from northern Louisiana. An estimated 40 million cubic feet daily of gas capacity in southern Arkansas fields is awaiting markets.

Six gas-well completions were reported in 1939. Three of these, with a total capacity of 7,460,000 cubic feet, were in secs. 33 and 34, T. 10 N., R. 26 W., Franklin County. Sebastian County had one completion in sec. 16, T. 8 N., R. 29 W., which produced 1.5 million cubic feet initially from a total depth of 2,709 feet; and a shallow well (1,275 feet) in sec. 6, T. 9 N., R. 32 W., Crawford County, had a capacity of 250 thousand cubic feet. In southern Ouachita County the No. 1 Cook Estate, sec. 27, T. 15 S., R. 18 W., found an estimated 20 million cubic feet of gas in the Nacatoch sand at 1,588 feet; it is several miles west of the abandoned McDonald (Mt. Holly) field.

The Big Creek and Dorcheat fields, Columbia County, were discovered in 1939. They appear to have the general characteristics of "gas-condensate" fields and are substantial additions to available gas reserves. Extensions to several oil fields in 1939 increased further the available gas supplies. Three structures, which were tested in 1939 in Nevada, Ouachita, and Faulkner Counties, gave some indications of gas reserves of commercial value.

California.—Natural-gas production in California during 1939 was about 370 billion cubic feet, a small reduction from that of 1938. Information has been received from E. F. McNaughton, California Railroad Commission, and F. F. Doyle, Pacific Gas & Electric Co. Of the total production, 198 billion cubic feet were taken from San Joaquin Valley fields, 48 billion from Coastal fields, and 124 billion from the Los Angeles Basin. Twenty-six billion cubic feet came from the "dry"-gas fields, and the remainder was casinghead gas. "Dry"-gas production is becoming a more important factor in California operations. Almost 99 percent of all gas sold in the State is now natural gas, very little manufactured gas being delivered.

In the first half of 1939, 17,285 million cubic feet of gas were blown to the air, representing 9 percent of the total production during that period. State agencies are attempting to reduce this waste through cooperative action. Serious waste still occurs, however, in some fields of the Los Angeles Basin, where town-lot development and highly divided ownership are common. Losses in the Montebello field were approximately half those for the entire State.

Preliminary data indicate that gasoline plants processed 370 billion cubic feet of gas in 1939, 7 percent less than in 1938.

Fifteen gas wells were completed in 1939. Their location by fields, with total initial capacity, was as follows: Trico, 11 wells with 219 million cubic feet; Rio Vista, 1 with 20.3 million; Woodland (Yolo County), 1 with 14.1 million; Marysville Buttes, 1 with 20.9 million; and Eureka, 1 with 75 thousand. Producing gas wells in California totaled 63 at the end of 1938 and 70 on December 31, 1939.

Pipe-line deliveries of gas were begun in 1939 from the Trico and Marysville Buttes gas fields. Drilling at Trico was stimulated by its new market outlet.

Additional supplies of casinghead gas were developed in the new Paloma and Arvin fields, Kern County, and by extensions in the Coalinga, Fruitvale, Strand, Canal, Coles Levee, and Wasco fields in the San Joaquin Valley. In the Los Angeles Basin extensions were made to the Montebello, Rosecrans, and Aliso Canyon fields.

Sales of gas for domestic, commercial, and miscellaneous industrial use increased moderately in 1939. Sales to power plants for electric generation increased sharply from 9 billion cubic feet in 1938 to 22.5 billion in 1939.

Colorado.—The total production of gas in Colorado in 1939 was 1,719 million cubic feet, an increase of 16 percent over 1938, according to H. J. Duncan, supervisor, Federal Geological Survey, Casper, Wyo. Output was moderately higher from all fields except Berthoud, which fell 10 percent. The production by fields was as follows: Berthoud, 50,396,000 cubic feet; Craig, 4,659,000; Garcia, 57,500,000; Hiawatha, 1,517,693,000; Thornburg, 89,142,000.

No new gas wells were completed in 1939, the only drilling being the deepening of one well at Hiawatha and recompletion for 2 million cubic feet at 2,420 feet (old total depth, 2,232 feet).

About 3 million cubic feet of gas were wasted through leakage in the Hiawatha and Powder Wash (shut-in) fields and 32,500,000 at Garmesa (shut-in) owing to leakage at an old well that is being plugged. About 32,600,000 cubic feet of gas, produced with oil with a gas-oil ratio of 252 cubic feet per barrel, were wasted in the Wilson Creek oil field.

Illinois.—Gas was marketed from two Illinois fields in 1939—Russellville in Lawrence County and Ayers in Bond County. The source of information is a report by A. H. Bell and G. V. Cohee, Illinois Geological Survey.

Russellville produced 964 million cubic feet from 920 productive acres. The old Ayers field produced 13,600,000, making its total production since 1922, 180,600,000 cubic feet.

Large gas reserves were found by the Storms Heirs No. 1, completed in July 1939 in sec. 14, T. 6 S., R. 9 E., White County, as a gas well in the Waltersburg sand of the Chester series at a depth of 2,215 feet, with an open flow of 12,300,000 cubic feet. By March 5, 1940, 5 gas and 30 oil wells had been drilled in the Storms field, with an initial capacity ranging from 4 to 30 million cubic feet of gas per day. It is reported that 100 million cubic feet per day of gas from the oil wells are being burned in flares, only a small amount being used for field purposes.

It is estimated that an output of 250 million cubic feet of 1,600 B. t. u. gas per day was being produced early in 1940 in the Salem oil field, Marion County, from five different producing horizons and that approximately half the ultimate gas production from this field already has been withdrawn from the ground. About 1 million cubic feet per day are being injected in 11 input wells for repressuring, a small amount is used in field operations, and the remainder is wasted by burning in flares.

In the Louden field, Fayette County, a daily yield of approximately 30 million cubic feet of gas is being produced along with oil. In the north end of the field where there is a "gas cap," gas is passed through absorbers that extract 1.3 to 1.5 gallons of natural gasoline per thousand cubic feet. About 1 million cubic feet of gas per day are used for repressuring, 3 million for lease operations, and 3.5 million as fuel; the remaining 22.5 million are burned in flares.

In other new oil fields in Illinois small amounts of natural gas are produced and used on leases or burned in flares.

In late 1938 and early 1939, five shallow gas wells were completed in Hillyard Township near Plainview, Macoupin County. Their average depth is 440 feet in basal Pennsylvanian sandstone, and initial production ranged from 125,000 to 750,000 cubic feet of 806 B. t. u.

gas per day; there is no market outlet as yet. Three abandoned gas fields, which produced 1.2 billion cubic feet in all, are situated in Macoupin County.

Indiana.—Production of natural gas in Indiana decreased from 1,244 million cubic feet in 1938 to 875 million in 1939, according to a report from G. F. Fix, State gas supervisor. Part of the decline was due to depletion in old fields and part to the fact that Oaktown, the largest gas-producing field in the State, was shut in during most of the year. It produced only 92 million cubic feet in 1939 compared to 299 million in 1938.

Gas-well completions in 1939 totaled 44; five were in unproved or wildcat territory and 39 in old areas. Completions in the active fields were: Rockport, 13; Old Trenton, 6; Greensburg, 5; Shelburn-Graysville (Sullivan County), 5; and Alford, 4. The total initial capacity was 112 million cubic feet, including 100 million from the 13 wells in the new Rockport field, Spencer County.

Production at Rockport (discovered in the summer of 1939) is from the Palestine sandstone of Upper Chester age at an average depth of 900 feet. Well capacity has ranged from 3 to 15 million cubic feet, with a rock pressure of 390 pounds.

A new gas area was discovered in sec. 19, T. 6 S., R. 12 W., Posey County, by a well that made 2.2 million cubic feet from a Pennsylvanian sand lens at 368 feet, with a rock pressure of 200 pounds. Another interesting development was the discovery of gas in a new horizon (Eden or Cynthiana) at a depth of 473 feet in Wayne County.

Several million cubic feet of gas per day are being produced from new oil wells, chiefly in the Griffin oil field developed in 1939; this gas is not marketed.

A pipe-line outlet was provided for the Rockport gas in December 1939, but no production was marketed until 1940. Gas production in Indiana is expected to increase in 1940 because of this and other new developments. The current active search for new oil reserves increases the prospect of developing new gas supplies in the near future.

Kansas.—Gas production in Kansas increased substantially in 1939 over 1938 in response to heavier market demand. The fields of largest production, as recorded by the Kansas Corporation Commission, were as follows: Hugoton, 28,964.5 million cubic feet; Otis, 8,062.9 million; Burrton, 6,387.1 million (chiefly casinghead gas); Medicine Lodge, 6,380.6 million; Lyons, 2,838.7 million; and Cunningham, 2,453.1 million. The total accumulated production of the great Hugoton field through 1939 was 188,964 million cubic feet; of Otis, 44,426 million; of Medicine Lodge, 36,437 million; of Cunningham, 8,525 million; and of Lyons, 5,051 million.

A total of 96 new gas wells (68 in western Kansas and 28 in the eastern fields) was reported in 1939, according to R. P. Keroher, geologist, Kansas Geological Survey. The total reported daily initial capacity of new wells was 1,168,500 thousand cubic feet, including 69,500 thousand (5 per cent) in eastern Kansas. Seventy-three percent of the total new production was in two large fields in western Kansas—the Hugoton (with 202 million cubic feet) and the Cunningham-Cairo-Lunt-Gilcrist area (with 643 million). Twenty-two percent (254 million cubic feet) was distributed among pools in Barton, Barber, Harvey, McPherson, and Sherman Counties in descending importance.

Probably the most important addition to gas reserves was developed in the Cunningham field of Kingman and Pratt Counties, where active drilling in 1939 proved an estimated 100 billion cubic feet of new gas reserves from the Viola limestone. Twenty-eight wells in this area had a daily open-flow capacity of over 600 million cubic feet.

A gas discovery in the Kansas City-Lansing limestone, which usually does not produce dry gas, was made by the No. 1 Oeser well in sec. 17, T. 16 S., R. 11 W., Barton County, called the Prusa field. It was completed March 14, 1939, with an initial capacity of 11.6 million cubic feet. Another discovery was made in T. 8 S., R. 29 W., near Goodland in Sherman County, in the far northwestern portion of Kansas. Two wells were drilled, with a total daily capacity of about 100,000 cubic feet of gas from a depth of 1,100 feet; they are currently supplying gas to the town of Goodland. Other additions to known gas reserves were reported in Barber, Franklin, Greenwood, Jefferson, Johnson, and Woodson Counties. A wildcat in sec. 4, T. 10 S., R. 20 E., Jefferson County, found 8.5 million cubic feet of gas in the Bartlesville sand at 1,443 feet. The discovery is of particular interest because it opened the first production of apparent commercial value in the Kansas portion of the Forest City Basin.

Six wells were drilled in the Medicine Lodge gas field, Barber County, with open flows ranging from 2 to 25 million cubic feet. In the Hugoton field five wells were drilled in Stevens County, four in Haskell County, and two in Grant County, with an initial production of 2.5 to 39.5 million cubic feet per well. A large gas well (24.5 million cubic feet) was completed in the Albert pool, Barton County, and one (60 million cubic feet) in the nearby Otis area. New gas capacity of minor importance, principally associated with oil, was developed in 1939 in the Beaver, Kruckenburg, Ritz-Canton, Wherry, Hall, Gurney, Coralena, and Burrton fields.

Approximately 275 gas wells were plugged during 1939 compared to 320 in 1938.

A new carbon-black plant was under construction at Ryus as the year ended. It will use about 3 million cubic feet of gas daily from the Hugoton field in manufacturing high-grade carbon blacks.

Gas pipe-line construction in 1939 is discussed in the pipe-line section.

Kentucky.—Gas developments in Kentucky in 1939 were routine, according to information from C. D. Hunter, I. B. Browning, R. N. Thomas, and G. M. Stranghan of Ashland and R. E. Stouder of Louisville.

In eastern Kentucky about 50 gas wells were drilled, the most active counties being Floyd, Knott, Martin, and Pike. With excess reserves already developed in this area there has been little incentive to drill for gas. Heavy demand during the past winter, however, is expected to cause more active development during 1940. Repressuring is now playing an important role in production of the eastern oil fields.

An extensive leasing campaign is in progress in the eastern counties, involving several hundred thousand acres on all known structures. The intention is to seek production from deeper horizons, particularly from the top of the "Corniferous" down to the St. Peter sandstone.

Gas activity in western Kentucky was unimportant and probably on a reduced scale in 1939. Geologic information was obtained from several wells drilled in the deeper parts of the Western Coal Basin, making available for the first time accurate data on the Pennsylvanian and Devonian formations.

Louisiana.—Gas and "gas-condensate" well completions in northern Louisiana declined further in 1939, the total being 86 against 137 in 1938, according to data supplied by Cyril K. Moresi, State geologist. Of the new wells, 66, with a total capacity of 454 million cubic feet per day, produced dry gas; the remaining 20 produced condensate with gas. Drilling in the Cotton Valley and Rodessa fields fell sharply in 1939, and activity in the Monroe area declined slightly from 53 new wells in 1938 to 49 in 1939. Completions were reported from 13 fields in 1939 and from 10 in 1938.

Reports for 1939 covering south Louisiana for the first time indicate that 53 gas and high gas-oil ratio wells were completed; of these, 5 were dry gas wells. Six completions were in the Ville Platte field, 5 in North Tepetate, and 4 at Lake Arthur; the remainder were scattered through 24 other fields.

Gross reported production of natural gas in 1939 was 402,751 million cubic feet, a 12-percent increase over 1938 and the highest on record. Production at gas wells rose to 284,895 million cubic feet in 1939 from 259,946 million in 1938, and casinghead-gas output increased to 117,857 million cubic feet from 100,849 million the year before.

The northern fields produced 313,333 million cubic feet, including 273,933 million from gas wells. The output of the Monroe field in 1939 was 189,557 million cubic feet, 10 percent higher than in 1938. Rodessa gas wells produced 33,149 million, an increase of 25 percent over 1938. Cotton Valley and Sligo, the next largest producers, supplied slightly less gas than in 1938, with 18,816 million and 13,718 million cubic feet, respectively. Most of the casinghead gas from northern fields in 1939 came from Rodessa, which produced 27,101 million cubic feet, followed by Cotton Valley with 4,562 million and Shreveport with 2,836 million. Markets for northern Louisiana gas doubtless will be expanded somewhat by a new line to Jackson, Miss., built in 1939.

Gas production in the southern part of the State totaled 89,418 million cubic feet, including only 10,962 million from gas wells. Small amounts of gas are obtained from gas wells in many fields, the most important of which are Bosco (3,915 million cubic feet) and North Tepetate (2,393 million). The most important sources of casinghead gas in 1939, with volumes in millions of cubic feet, were: Ville Platte, 10,045; Tepetate, 9,799; English Bayou, 6,978; Lafitte, 5,784; Bancroft, 4,504; Roanoke, 4,157; Iowa, 3,937; Lake Long, 3,399; Jennings, 2,880; Bosco, 2,816; and Lake Arthur, 2,608. The output at Ville Platte for 1939 increased from 1,193 million cubic feet in 1938. Other fields showing important growth in output were Bancroft, Lake Arthur (south Roanoke), Lake Long, and English Bayou. In all, 82 south Louisiana fields reported casinghead-gas production in 1939, 12 more than in 1938.

Field development in northern fields ordinarily was limited to routine drilling, and no new discoveries were reported. In the coastal area, however, active exploration led to the finding of several new fields and many new pay zones in older fields, with potentially important gas reserves. The Perkins field, Calcasieu Parish, was a new gas discovery, and deeper sands productive of gas or gas-condensate were opened at North Tepetate, Baton Rouge, Ville Platte, Leeville, Lake Mongoulois, and Bateman Lake.

Michigan.—Production of natural gas in Michigan in 1939 was 10,137 million cubic feet, a 10-percent increase over 1938, as reported by F. R. Frye, petroleum engineer, Michigan Department of Conservation. The total included 1,147 million cubic feet of casinghead gas; the remainder was from gas wells.

Gas-well completions in 1939 totaled 56—about double the 1938 total of 27. Nineteen gas wells were abandoned during the year.

The principal new gas field discovered in 1939 was in Lincoln township (T. 18 N., R. 5 W.), Clare County. A considerable supply of gas was developed from an upper sand (Berea) in the Clayton oil field, Arenac County, at a depth of about 1,200 feet. New pipe lines were built to market gas from both these fields.

During development of the Wise oil field commercial amounts of gas were found in the Michigan Stray sand, and approximately 1,400 acres were considered proved at the end of 1939. Gas was discovered in the Berea sand at 1,100 feet in the Walker oil field near Grand Rapids.

In December 1939 a well in Wright township (T. 8 N., R. 13 W.), Ottawa County, found 3.5 million cubic feet of gas from the Berea sand. Two older wells in this area had shown about one-half million cubic feet of capacity. A wildcat in Monroe County produced 108 thousand cubic feet of gas from the Trenton limestone.

Projects are reported for marketing residue gas from two new gasoline plants. From the Walker oil field, Kent County, gas will go through 22 miles of 8-inch pipe to connect with an existing trunk line. Another line is contemplated from a gasoline plant in the Redding oil field, Clare County, to a chemical plant at Midland.

The Six Lakes field produced 4,868 million cubic feet of gas in 1939—almost 50 percent of the State total. The Austin field, with 800 million cubic feet, was the next largest producer, followed by New Haven, Home, and Broomfield.

Mississippi.—Production from the Jackson gas field, which continued to be the only commercial source of gas in Mississippi, in 1939 reached an all-time peak of 15,233 million cubic feet—almost 7 percent above the 1938 record. Data have been supplied by H. M. Morse, supervisor, State oil and gas board.

However, the field is approaching exhaustion, as is indicated by the rapid encroachment of salt water in the producing formation. The strong water drive sustains gas pressures as the size of the productive area diminishes. At the end of 1939 only 30 productive gas wells remained, in contrast to 60 and 90, 1 and 2 years before. Twenty of the remaining wells are producing salt water. One gas well and three dry holes were drilled on the Jackson structure in 1939.

In December 1939 a well was started in the old Amory gas field in an attempt to bring that area back into production. Wildcatting over a wide area of Mississippi was stimulated by discovery of oil in Yazoo County in September 1939.

Anticipating reduced gas supply from the Jackson field, an 18-inch line was laid from northern Louisiana fields to connect with the trunk gas line south of the city of Jackson.

Missouri.—Fifteen gas wells with a total daily initial open flow of 6,383,150 cubic feet were completed in Missouri in 1939, according to records prepared by Frank C. Greene, geologist, Missouri Geological Survey. This is a sharp reduction from 1938, when intensive development of a gas field was in progress in Jackson County. Completions, by counties, were as follows: Jackson, 6; Platte, 3; Cass, 2; Clay, 2; Bates and Clinton, 1 each.

One new gas pool was opened in Platte County but remained undeveloped at the end of the year. Wildcatting increased markedly in the northern half of the State. Drilling operations were begun in Bollinger, Butler, and Wayne Counties in the southeastern portion of the State, but no completions were reported.

Montana.—The natural-gas industry in Montana recovered somewhat in 1939 from the curtailed operations of 1938 but remained less active than in 1937, according to information supplied by H. J. Duncan, supervisor, Geological Survey, United States Department of the Interior, Casper, Wyo. Gas-well completions increased to 26 from the 1938 total of 21. The combined daily open-flow capacity of the new wells was 201,485,000 cubic feet, 65 percent more than the capacity developed in 1938 and a larger total than that of any recent year. Two gas wells of unusual size were drilled in the Cut Bank field and shut in. Spruce Oil Co. No. 1, in sec. 24, T. 37 N., R. 5 W., about 3 miles south of the international boundary, had an initial gaged production of 43 million cubic feet from the Sunburst sand at 2,552 to 2,601 feet and a shut-in pressure of 725 pounds. Glacier Production Co. No. 2, in sec. 35, T. 36 N., R. 6 W., 13 miles north of the town of Cut Bank, had an estimated daily capacity of 80 million cubic feet from the Sunburst sand at 2,905 to 2,959 feet. No new gas fields were discovered in 1939.

All gas production, except part of that from the Cedar Creek field, is used within the State. Importations from the Rogers Imperial well in Canada were 131,244,000 cubic feet in 1939 to June 1, when the importation permit expired and was not renewed. The rock pressure of the well had dropped below the pressure maintained in the trunk line from the Whitlash field to Great Falls. The only other gas piped into Montana is from the Wyoming side of the Elk Basin field, which supplied 1,609,848,000 cubic feet to the Billings region.

Gas withdrawals increased nearly 2 billion cubic feet in northwestern Montana owing to increased demand from beet-sugar refineries and copper smelters and a reduction of rates at Great Falls. In southern Montana withdrawals decreased about 45 million cubic feet, showing the influence of milder weather and curtailed industrial operations, which were partly offset by increased demand from electric power plants.

Wastage of gas is estimated at 65 million cubic feet from gas fields and 15 million from oil fields, exclusive of about 300 million lost from Glacier No. 2 well mentioned above, which blew wild for 4 days before being brought under control.

Source and distribution of natural gas in Montana in 1939 [1]

Field	Total production (M cubic feet)	Utilization: Domestic and commercial (M cubic feet)	Industrial: M cubic feet	Industrial: Consumer	Location of principal markets
Bowdoin	673, 059	504, 794	168, 265	Steam boilers	Glasgow, Malta, Fort Peck etc.
Bowes	628, 404	314, 202	314, 202	Sugar refinery	Havre and Chinook.
Box Elder	311, 671	233, 753	77, 918	do	Do.
Cedar Creek	7, 107, 335	2, 617, 335	2, 322, 165 2, 167, 835	Cement and sugar factories. Electric power plants	Miles City, Sydney, Glendive, Montana; Rapid City, S. Dak.; Bismarck Bowman, Williston, N. Dak., etc.
Cut Bank	9, 025, 820	3, 610, 328	5, 415, 492	Smelter and steam boilers.	Anaconda, Butte, Helena etc.
Dry Creek	911, 844	911, 844			Big Timber, Bozeman, Livingstone, etc.
Hardin	71, 475	71, 475			Hardin.
Kevin-Sunburst	2, 976, 039	1, 487, 515	1, 488, 524	Smelters, steam boilers.	Great Falls, Shelby, etc.
Whitlash	639, 360	415, 584	223, 776	do	Great Falls, etc.
	22, 345, 007	10, 166, 830	12, 178, 177		

[1] Data supplied by H. J. Duncan, supervisor, Geological Survey, U. S. Department of the Interior.

New Mexico.—Only 10 gas wells were completed in southeastern New Mexico fields during 1939 compared to 19 in 1938, and the total open-flow capacity was 52,072 thousand cubic feet, a decline of 80 percent from 1938, according to E. A. Hanson, supervisor, Geological Survey, United States Department of the Interior, Roswell, N. Mex. As is usual in this area, most gas wells were incidental to the development of oil-bearing formations.

One discovery was made in April in Eddy County by Smith No. 1, which produced 750 thousand cubic feet of gas from the Permian at a total depth of 2,436 feet.

Dry-gas production increased 11 percent in 1939 to 27,106 million cubic feet—26,356 million from Lea County and the remainder from Eddy County. The quantity of gas processed at gasoline plants declined slightly to 88,671 million cubic feet from 91,800 million in 1938. The use of gas lift in oil production increased consumption 20 percent in 1939 over 1938 to 3 billion cubic feet, and field consumption for fuel and miscellaneous purposes was 10 percent greater in 1939 (2,750 million cubic feet).

Slight drilling activity continued in the fields that produce carbon dioxide gas in Harding, Torrance, and Mora Counties. Completion of six wells was reported.

In the northwestern gas fields output increased 13 percent in 1939 to 2,577 million cubic feet owing to increased withdrawals from the Kutz Canyon field, which totaled 1,869 million cubic feet. The other two active fields produced in 1939 as follows: Ute Dome, 676 million, and Blanco, 32 million cubic feet. Three gas wells were completed at Kutz Canyon in 1939.

State records indicate that the total production of gas in New Mexico was 142.5 billion cubic feet in 1939 compared with 167.6 billion in 1938—the peak year. The most important producing fields in 1939 were Eunice (46.3 billion), Monument (26.4 billion), and Cooper (19.7 billion).

New York.—The initial production of gas wells in New York during 1939 dropped sharply compared with the previous year, according to information compiled by C. A. Hartnagel, assistant State geologist. Intensive drilling was conducted in the southern New York Oriskany-sandstone area, where existing gas pools were being depleted rapidly. A total of 56 wells was drilled, including 18 producers with a total initial capacity of 104,793,000 cubic feet.

Eight producers and two dry holes were completed in the Woodhull field, Steuben County, making 46 gas wells and 4 dry holes for this area. Four producers with a combined daily open flow of 39,000,000 cubic feet were drilled in the Beach Hill and State Line pools, Allegany County.

A wildcat well in Andover, Allegany County, came in with an initial daily production of 12 million cubic feet and a rock pressure of 2,000 pounds. This well is now making salt water, and three of the four wells being drilled near by will be abandoned. Six other Oriskany tests in Allegany County were failures.

In Cameron, Steuben County, a wildcat located 13,900,000 cubic feet of gas in the Oriskany, but eight wells drilled in the immediate vicinity were failures. Other productive wells in Steuben County included one each in the towns of Jasper (4,200,000), Troupsburg (1,400,000), and Tuscarora (115,000).

The most easterly Oriskany production in New York was discovered in Danby, Tomkins County, by a well that made 5,000,000 cubic feet daily and was followed by four dry holes in the area. Dry holes also were drilled in Baldwin and Erin, Chemung County.

The discouraging results of exploration and the depletion of present active fields are rapidly causing a local scarcity of gas reserves that may threaten the life and usefulness of certain existing gas lines. The use of gas for industrial purposes has been curtailed.

Ohio.—Drilling in Ohio in 1939 increased about 12 percent over that in 1938 and resulted in the completion of 501 gas wells—68 more than in 1938—as reported by J. E. Schaefer, geologist, East Ohio Gas Co. The average initial volume was 596,000 cubic feet per well in 1939 compared with 459,000 in 1938. The higher average was due to numerous completions in the Clinton (170) and Newburg (33) sands, whose average capacity was 1,071 and 1,367 thousand cubic feet per well, respectively.

Gas wells completed in the most active counties were: Licking, 67; Athens, 57; Noble, 52; Washington, 41; Cuyahoga, 26; Guernsey, 25; Meigs, 25; Knox, 24; Stark, 24; and Monroe, 22. In 1939 the combined initial open flow of all gas wells was 298,564,000 cubic feet—50 percent larger than in 1938 and 34 percent above 1937. The Clinton sand continued to be the dominant source of new gas, contributing 182,199,000 cubic feet of the total open-flow capacity in 1939. The Newburg sand had 45,098,000 cubic feet, the Berea sand 42,027,000 feet from 179 new wells, and shallow sands 26,977,000 feet from 105 wells. Small amounts of new gas were found in the Devonian shale (seven wells), Oriskany sand (four wells), and Trenton limestone (three wells).

Gas production in Ohio has followed a declining trend for many years. It seems probable, however, that in 1939 there was a moderate increase over the 1938 marketed production (35,257 million cubic feet).

Although most of the Clinton-sand wells were drilled as extensions to productive areas, one important new pool was developed in 1939 in the contiguous corners of Mary Ann, Newton, Newark, and Madison Townships, Licking County. The discovery well was completed on December 1, 1938, in Newark Township, with an open flow of one-half million cubic feet. Interest was greatly stimulated by a well on the Van Wey farm in south Mary Ann Township, which began producing at 6,500,000 cubic feet daily in February 1939, with a rock pressure of 725 pounds. In 1939, 48 gas wells, 1 oil well, and 11 dry holes were drilled in this pool in the Clinton sand. During the drilling campaign, six Newburg-sand gas wells also were completed.

The only important development in the shallow-sand fields of eastern Ohio was the Yoker Valley gas field in Wayne and Beaver Townships, Noble County. The discovery well was drilled late in 1938, and during 1939, 34 gas wells and 4 dry holes were completed in the Berea sand at a depth of 1,500 to 1,700 feet. The initial open-flow capacity in this pool averaged less than 1 million cubic feet, but some wells were making as high as 3½ million. Rock pressure was about 600 pounds.

Ten dry holes were drilled in 1939 in searching for a producing zone from the "Green Sand" of western Ohio, which lies 500 to 700 feet below the Trenton. These holes ranged from 1,443 to 2,513 feet in depth.

Oklahoma.—The total output of natural gas in Oklahoma declined further in 1939 from the peak attained in 1937, according to Oklahoma Tax Commission records. The production of 275 billion cubic feet during 1939 was 16 percent less than that of 1938. The output of gas wells was unchanged at 75 billion cubic feet, but casinghead-gas production dropped to 200 billion cubic feet from 252 billion in 1938, owing chiefly to continued depletion and reduction of reservoir pressures in the Oklahoma City, Fitts, and Edmond pools, which have been major sources of casinghead gas in recent years. The domestic and commercial use of gas increased moderately over 1938 in 1939.

In 1939, 151 gas wells were completed—about the same as in 1938. Their total daily open-flow capacity was about 857 million cubic feet. In addition, the completion of 69 combination oil and gas wells was reported, with a total gas capacity of 252 million cubic feet. Fifteen gas and combination wells in the Cement field, Caddo County, comprised about 25 percent of the new-gas potential for the entire State. Other fields in which important additions to gas-producing capacity were made were: Chickasha, Meridian, Kellyville, Carter-Hamilton, Jesse, Fitts, South Stroud, Lafoon North, Weleetka, Onapa, Cushing, and Seminole County. About 150 gas- or water-injection wells were drilled in connection with projects for secondary recovery of oil.

From the standpoint of new gas reserves, perhaps the most important development of 1939 was the opening of gas production from deeper sands in the Chickasha field, Grady County. On April 4, 1939, the No. 1 Smith well, in sec. 26, T. 5 N., R 8 W., was completed with an output of 13.2 million cubic feet of gas daily from a depth of 5,330 to 5,350 feet. The No. 4 Carlson, an old gas well in sec. 22, T. 5 N., R. 8 W., was deepened from 2,398 to 3,968 feet and completed with an open flow of 72 million cubic feet and a rock pressure of 1,880 pounds.

In sec. 8, T. 5 N., R. 10 E., Hughes County, new gas reserves were discovered by the No. 1 Shemwell, which found about 30 million cubic feet of gas in the Calvin sand at 4,505 to 4,525 feet, with a rock pressure of 1,650 pounds. A rank wildcat well in Kingfisher County—No. 1

Geis in sec. 15, T. 18 N., R. 9 W.—gaged 2.5 million cubic feet of gas daily, with about 12 barrels of condensate, from a depth of 7,365 feet, plugged back from 8,507 feet (total depth).

Tests of gas wells in the Oklahoma City field indicate that in October 1939 there were 101, with a total daily capacity of 422 million cubic feet from 8 different horizons. The most important formations were: Oswego-Prue, with 66 wells having 265 million cubic feet of potential capacity; Hoover, with 10 wells having 73 million; Layton, with 10 wells and 34 million; and Oolitic, with 7 wells and 20 million cubic feet.

At the year end a new carbon-black plant was under construction in the Fitts field, Pontotoc County. Initially it will burn 3 million cubic feet of stripped casinghead gas a day and may later be enlarged to handle 7 million.

Gas pipe-line construction in 1939 was limited to a few very small projects, the largest being a 10-inch line from the Doyle area in eastern Stevens County, which runs southeastward 11 miles to connect with a 12-inch main line, which carries gas southward into Texas.

Pennsylvania.—The most important gas development in Pennsylvania during 1939 was in the Oriskany-sand fields of Potter County, where 27 producing wells with a total daily open-flow volume of 365,410,000 cubic feet were completed. The capacity of these wells ranged from 175,000 to 50,000,000 cubic feet and the rock pressure from 230 to 2,235 pounds. Information is taken from a report by J. G. Montgomery, Jr., vice president, United Natural Gas Co. Two of the wells opened a new field near Brookland, but their small productive capacity (500,000 and 175,000 cubic feet) does not give great promise to the area. All other wells were in proved fields. Twenty-two dry holes were drilled; 11 wells were being drilled at the end of the year.

Dry holes as follows were drilled in the Oriskany sand: In Armstrong County, 1; Beaver County, 2; Butler County, 1; Clarion County, 1; and McKean County, 3. No new fields of commercial importance were discovered during 1939. A test of the Medina sand in Mercer County was dry and was abandoned at 5,485 feet.

The first output from the Oriskany in Fayette County was found by a well which produced 1,500,000 cubic feet from that formation and 747,000 from the cherty zone of the overlying Onondaga lime. Another well located 926,000 cubic feet of gas in this cherty zone and a third well was a failure through these horizons. The depth of the wells ranged from 7,115 to 7,826 feet. Two additional wells were being drilled at the end of the year.

Gas was discovered in the Bradford sand in Cowanshannock Township, Armstrong County, at a depth of 3,637 feet. Sixteen producing wells and 2 dry holes were drilled in 1939. The average open flow was 1,650,000 cubic feet and the original rock pressure 1,140 pounds. The total area of the pool is reported to be small.

The use of rotary equipment for drilling deep holes in Pennsylvania apparently has been abandoned by operators after experimental drilling by this method in 1938 and early 1939. After the last rotary hole was completed in 1939 the material was shipped away.

Oriskany production totaled about 30 billion cubic feet in Potter and Tioga Counties, a 5-billion increase over 1938, owing chiefly to larger output of the Sharon and State Line fields. A marked decrease in the production from these areas was experienced during the latter part of the year. To offset this decline, shallow-sand production was increased.

South Dakota.—A small production of gas (estimated at 8 million cubic feet) by the cities of Pierre and Fort Pierre, S. Dak., continued in 1939. According to a statement by E. P. Rothrock, State geologist, there were no important new gas developments. The possibility of increased gas production was indicated by a well drilled on a good structure near Pierre, which struck a considerable quantity of dry gas.

A sample of gas from an old well at the Lacy Post Office was tested in the laboratory of the Bureau of Mines, Amarillo (Tex.) helium plant and found to contain 0.02 percent helium.

Texas.—The gross production of natural gas in Texas during 1939 continued the upward trend that has persisted without interruption since 1932. According to records of the Texas Railroad Commission, 1,298 billion cubic feet of gas were produced, an 18-percent increase over 1938. Of this total, 872 billion were from gas wells and 426 billion from oil wells. The gas output of both types of wells has increased consistently in recent years, as suggested by the fact that casinghead gas equaled 32 percent of the total gas produced in 1936 and 33 percent in 1939. Increases in production over 1938 were: Casinghead gas, 7 percent; sour (high-sulfur) gas, 8 percent; and sweet gas, 32 percent.

Utilization of gas increased in all major classifications, but by far the greatest growth was that incident to repressuring and gas-lift operations, which rose from 44.3 billion in 1938 to 155.3 in 1939, or 251 percent. This was due chiefly to the phenomenal growth in throughput at recycling plants, which process natural gas and vapors at very high pressures and return stripped gas to the natural reservoirs. Data concerning them first were made available for January 1939, when 10 plants extracted liquid condensate from a daily average of 116,444,000 cubic feet of gas. In December, 22 plants reported an average gas volume of 470,442,000 cubic feet processed daily. About 90 percent of the volume withdrawn from the ground usually is forced back into the producing sand to maintain pressure. Several additional plants are under construction, and others are planned. A large number of high-pressure condensate reservoirs have been discovered and await exploitation in the South Texas, Gulf Coast, and East Texas districts, and new discoveries are being made, hence the rapid expansion of recycling promises to continue for a considerable time.

A total of 462 billion cubic feet of gas was delivered to gas pipe lines in Texas during 1939—13 percent more than in 1938. Carbon-black plants burned 317 billion cubic feet (9 percent over 1938), and plant fuel and lease operations required 171 billion (a 1-percent increase). Extraction loss of 51 billion cubic feet at gasoline plants also represented a 1-percent increase, and waste of gas through blowing to the air rose to 142 billion cubic feet—a 4-percent increase. The reported waste, which includes only tail gas from gasoline plants, is greatest in the South Texas, West Texas, and Gulf Coast districts. The volume of gas processed at gasoline plants was 870 billion cubic feet in 1939 and 821 billion in 1938. The Panhandle district furnished 64 percent of the 1939 total—525 billion.

Gas wells completed in Texas numbered 314 in 1939 and 341 in 1938. The most active districts again were Southwest Texas (87) and the Panhandle (81), despite reduced operations. Completion of 62 gas wells on the Gulf Coast in 1939 was a sharp gain over the 36 completed in 1938. Activity in other areas was changed little from 1938, except in West Texas, where only 4 new wells were reported in contrast to 16 in 1938.

From the standpoint of discoveries of new gas reserves, South Texas overshadowed other districts, with 8 new fields in as many counties and 13 new productive horizons in old fields. Graham No. 1, in Survey 572, Duval County, opened the Chiltipin field in June 1939, producing 10 million cubic feet of gas from the Pettus formation at 4,795 feet. Pettus production was discovered in Karnes County in December by No. 1 Newberry, which made 3 million cubic feet from a depth of 2,949 feet. Gas discoveries were completed in the Catahoula formation in Calhoun, Goliad, and Victoria Counties, the largest (that in Goliad County) having an initial capacity of 15.5 million cubic feet. Other new fields in Bee, Live Oak, and San Patricio Counties produced from the Vicksburg, Hockleyensis, and Frio sands, respectively.

The West Texas district reported a small discovery of gas by the Hopper No. 1 well in Taylor County. In Limestone County, East Texas district, Barron No. 1 was drilled to the Pettit zone, and at 5,611 feet the well flowed 13.7 million cubic feet of gas daily. A new area was opened in Shackelford County and one new "pay" horizon in Stephens County, West Central Texas. A new source of gas was developed in Young County, North Texas, from the Strawn formation, and in the Panhandle a new gas area producing from the Permian lime was opened by Freeman No. 1 in Sherman County. The Gulf Coast district reported a discovery in Matagorda County which produced gas from the Miocene at 4,143 feet and a large well completed at 6,520 feet from a new sand—the Yegua—in the Fairbanks field, Harris County, which showed an initial daily flow of 55 million cubic feet.

Utah.—Following an 89-percent increase in 1938, Utah gas production in 1939 rose an additional 11 percent to 4,180,000,000 cubic feet, according to data supplied by H. J. Duncan, supervisor, Geological Survey, Casper, Wyo. The output of the Clay Basin field was 4,133,000,000 cubic feet and of the Ashley Valley field 47,000,000. The Farnham dome produced 51,172,000 cubic feet of carbon dioxide, which was used in the manufacture of dry ice.

It is estimated that of the 11,938 million cubic feet of gas produced in the Baxter Basin-Clay Basin-Hiawatha areas near the Colorado-Utah-Wyoming border, 11,498 million were delivered to Utah markets.

No gas-well completions were reported in 1939.

Virginia.—In June 1939 natural gas was first supplied to consumers in the city of Bristol, on the Virginia-Tennessee line. Output is from four gas wells in a small field about 10 miles northwest of Bristol in Scott County, Va., and is the only commercial production of natural gas in the State.

Washington.—The Rattlesnake Hills field, Benton County continued during 1939 to produce the only natural gas in commercial quantities in Washington. Its output dropped 45 percent from 1938 to 67 million cubic feet valued at $53,563. Of this quantity, 7 percent was used in the field and the remainder sold to consumers.

The Shallow gas field, Whatcom County, produced a little gas from the Chuckanut formation, which was consumed locally. No gas wells were completed during 1939, and prospecting generally was less active than in 1938.

Carbon dioxide production from wells near Klickitat, Klickitat County, continued to increase. In 1939, 22 million cubic feet of this gas was used to produce 2,149,195 pounds of dry ice valued at $60,786.

This information was supplied by Sheldon L. Glover, of the Department of Conservation and Development, State of Washington.

West Virginia.—Gas-well completions in West Virginia declined in 1939 to 366 from the 1938 total of 504 as a result of the slowing of Oriskany-sand development in Kanawha County and a general decline in activity in other fields. Information is taken from a report by David B. Reger, consulting geologist, Morgantown, W. Va.

A total of 68 Oriskany-sand gas wells was completed in 1939; of these 55, with an initial daily open flow of 349 million cubic feet, were in Kanawha County; and 13, with an open flow of 86 million cubic feet, were in Jackson County. The proved areas in Kanawha County are approaching full development. Most of the completions in Jackson County are in Ripley and Washington districts and are northwestern outposts of the Elk-Poca pool of Kanawha County. One of the new wells (Parsons No. 1) in Ripley district is 15 miles north of this pool and may therefore open a new field. It was completed in the Oriskany sand for 328,000 cubic feet, with a rock pressure of 1,870 pounds and a total depth of 5,139 feet. Another well far removed from older production—the Currey No. 1 at the northern edge of Ravenswood district—showed an initial daily flow of 2,534-000 cubic feet in the Oriskany with a rock pressure of 1,900 pounds and a total depth of 4,707 feet. Two other wells completed near Ravenswood City seem to indicate another productive area. These scattered wells are expected to stimulate an extensive drilling campaign in the central and southern parts of Jackson County.

In Kanawha County, Oriskany-sand drilling was largely routine in proved territory. A number of wells started for this objective were completed in upper sands, chiefly the Salt Sand, Big Lime (Mississippian), and Devonian Brown Shale. The Maxton No. 2 in Poca district had a Big Lime open flow of 17.3 million cubic feet. About 50 active rigs were reported in the two counties at the end of the year.

Reger estimates that about 200 billion cubic feet of gas have been withdrawn from the three Oriskany fields of the Charleston area and that an approximately equal volume of gas remains to be produced, indicating a total recovery of about 6 million cubic feet per acre. Rock pressures in the Campbell-Davis Creek and Cooper Creek pools have declined to around 275 pounds, suggesting that compression plants soon may be required to maintain production against prevailing line pressures of 200 to 250 pounds.

Drilling outside Jackson and Kanawha Counties failed to discover additional production from the Oriskany sand. Testing of strata below the Oriskany resulted in two productive gas wells in the Newburg sand (Silurian) in Butler district, Wayne County. A well in Peytona district, Boone County, on the western slope of the Warfield anticline was drilled to 6,004 feet and found gas in the Big Lime (249,000 cubic feet), Newburg (99,000 cubic feet), and Clinton (Silurian) sand (70,000 cubic feet). This is the first Clinton-sand production recorded in West Virginia and may stimulate deep drilling over a large area.

Three new areas producing from the Devonian Brown Shale were opened in Cabell County, two in Putnam, and one in Wayne. The Villa Nova gas pool in Clay and Braxton Counties was developed into an important reserve in 1939. The discovery well, drilled in late 1938, was first thought to be producing from the Webster Springs sand. Later information indicates the productive sand is Edray, just above the Big Lime of the Greenbriar series. About 1,500 acres have been proved by 17 wells, 1,500 to 1,800 feet deep and with an average open flow of 1.1 million cubic feet. Limits of the pool are not defined, and 16 wells were being drilled at the end of 1939.

Gas wells were drilled in 27 counties in 1939, the most active areas with number of wells completed being: Boone, 12; Braxton, 11; Cabell, 30; Calhoun, 27; Clay, 24; Gilmer, 32; Jackson, 13; Kanawha, 73; Lincoln, 17; Ritchie, 27; Roane, 20; Wayne, 21; and Wetzel, 15. The total open-flow capacity of new gas wells was 602.4 million cubic feet, a sharp reduction from the 1938 aggregate. Production for the year is estimated as 147 billion cubic feet. Available gas reserves in the State probably were increased during 1939.

Four treating plants were built to remove sulfur and moisture from the gas being produced in the northern part of the Elk-Poca pool. They are designed to handle 110 million cubic feet of gas per day.

The laying of two small pipe lines was reported in Kanawha County.

Wyoming.—According to a report by H. J. Duncan, supervisor, Geological Survey, Casper, Wyo., gross gas production in Wyoming in 1939 was 37,779 million cubic feet, almost the same as in 1938, including estimated field use of 918 million cubic feet and waste of 740 million, in addition to metered gas. A total of 19,532 million cubic feet of metered gas was delivered to gas companies for distribution, 11,647 million being used in recycling and repressuring and 4,942 million in other field operations.

In repressuring and recycling the following quantities of gas were used, by fields: Salt Creek, 6,510 million cubic feet; Lance Creek, 3,171 million; Rock Creek, 1,928 million (including 1,427 million purchased from Big Medicine Bow); and LaBarge, 38 million.

Gas production from the most important fields in 1939 was as follows, in millions of cubic feet: Salt Creek, 9,590; Baxter Basin, North and South, 5,798; Lance Creek, 4,556; Big Sand Draw, 3,410; Big Medicine Bow, 3,156; Muskrat, 2,210; Little Buffalo Basin, 1,797; and Elk Basin, 1,610. Changes up or down from 1938 were minor. The largest increase—936 million—occurred at Lance Creek.

Gas processed in Wyoming in 1939 for extraction of natural gasoline totaled 18,027 million cubic feet, which included virtually all gas produced from the Salt Creek, Lance Creek, and Big Sand Draw fields and that of the Rock Creek field (501 million).

About 600 million cubic feet of gas were wasted in 1939 in the Lance Creek field owing to inadequate gathering facilities. These were improved after September 1939 and reduced waste to 500,000 cubic feet per day. In gas fields waste was negligible, except for 100 million lost at three wellheads during drilling.

Only 7 gas wells were reported as completed in 1939 compared to 14 in 1938. Six wells completed with a total initial capacity of 26,200,000 cubic feet were in old fields, and one was a new discovery with a capacity of 2,500,000. It was drilled on the Horne structure in sec. 22, T. 22 N., R. 78 W., and shut in for lack of pipe-line connection. Gas supplies in old fields were augmented by new wells in Big Sand Draw, Garland, Billy Creek, and Baxter Basin and by deepening wells at Elk Basin and Little Buffalo Basin. In the Muskrat field a new well was reported in December to have gaged

75 million cubic feet. The reserves of the Billy Creek field appear to be nearly exhausted, and as there is no other developed gas production in the northeast quarter of the State supplies for Buffalo and Sheridan probably will be piped from Big Sand Draw and Muskrat by means of an extension from Casper.

The Allen Lake-Laramie pipe line was extended 5.2 miles, with a 6-inch line to the Oil Springs field in secs. 2 and 3, T. 23 N., R. 79 W. (a 1938 discovery), from which production was begun in November. The Mahoney dome-Rawlings gas line was connected to the Bunker Hill field in secs. 29 and 32, T. 27 N., R. 89 W., with 10 miles of 6-inch and 2 miles of 4-inch welded line.

CONSUMPTION

The decline in natural-gas consumption to 2,294 billion cubic feet in 1938 from 2,403 billion in 1937 was caused by less demand from all classes of consumers except those in oil fields. The "other industrial" load fell most sharply and comprised 79 percent of the total decline.

Domestic consumption was 1 percent less in 1938 than in 1937, despite an increase in the number of consumers to 8,634 thousand from 8,348. Consumption per domestic meter declined 4 percent to 42,600 cubic feet in 1938, reversing an upward trend of the preceding 3 years.

The average value at points of consumption of all gas sold in 1938 was 21.8 cents per thousand cubic feet, 0.2 cent below the 1937 average. The sharp reduction in industrial-gas value more than offset the increase in average value of domestic and commercial gas.

Natural gas consumed in the United States, 1934–38

Year	Domestic and commercial consumption							
	Consumers (thousands) [1]			Billions of cubic feet			Average number of M cubic feet used per domestic and commercial consumer	Average value at points of consumption per M cubic feet (cents)
	Domestic	Commercial	Total	Domestic	Commercial	Total		
1934	6,984	582	7,566	288	91	379	50.2	68.6
1935	7,391	613	8,004	314	100	414	51.7	68.5
1936	8,017	657	8,674	343	112	455	52.5	67.1
1937	8,348	680	9,028	372	117	489	54.2	67.6
1938	8,634	704	9,338	368	114	482	51.6	68.3

Year	Industrial consumption								Total consumption	
	Billions of cubic feet							Average value at points of consumption per M cubic feet (cents)	Billions of cubic feet	Average value at points of consumption per M cubic feet (cents)
	Field	Carbon black	Petroleum refineries	Electric public utility power plants [2]	Portland cement plants [3]	Other industrial	Total industrial			
1934	555	230	80	128	27	366	1,386	9.7	1,765	22.3
1935	580	242	80	125	27	442	1,496	9.7	1,910	22.4
1936	619	283	93	156	37	518	1,706	10.0	2,161	22.0
1937	651	341	113	171	41	597	1,914	10.3	2,403	22.0
1938	659	325	110	170	37	511	1,812	9.4	2,294	21.8

[1] Includes consumers served with mixed gas. [2] Federal Power Commission.
[3] Chapters on Cement in Minerals Yearbook and Statistical Appendix to Minerals Yearbook.

Natural gas consumed in the United States, 1934–38, by States, in millions of cubic feet

State	1934	1935	1936	1937	1938
Alabama	7,932	10,563	16,630	16,593	14,796
Arizona	4,729	5,603	8,232	12,857	12,660
Arkansas	25,075	26,476	30,986	35,074	34,833
California	268,122	284,109	320,406	329,769	315,168
Colorado	16,449	17,233	19,713	20,816	19,212
District of Columbia	2,640	2,707	3,104	3,458	3,826
Florida	554	692	1,005	1,389	1,469
Georgia	5,357	8,082	11,575	13,893	14,783
Illinois	45,084	57,319	72,516	78,650	66,500
Indiana	12,864	15,613	18,564	23,551	26,706
Iowa	16,636	19,077	20,918	21,354	20,109
Kansas	65,599	72,806	82,025	96,822	86,105
Kentucky	14,106	15,826	18,159	18,154	15,350
Louisiana	137,413	151,934	166,485	174,153	162,260
Maryland	752	784	915	1,011	1,247
Michigan	2,789	4,203	11,142	24,112	24,697
Minnesota	7,125	10,579	11,918	13,111	14,641
Mississippi	7,219	8,765	11,368	13,327	12,785
Missouri	29,792	33,060	40,124	46,898	42,505
Montana [1]	12,444	16,832	19,894	21,594	18,225
Nebraska	12,789	14,310	16,780	17,263	17,539
New Mexico	15,625	18,419	19,814	28,056	32,890
New York	31,209	35,705	40,638	50,080	47,950
North Dakota	1,112	1,382	1,578	1,641	1,533
Ohio	94,998	105,896	121,381	125,133	108,013
Oklahoma	249,721	258,598	260,120	269,604	244,443
Pennsylvania	87,474	91,601	110,195	119,501	96,285
South Dakota	3,901	4,656	5,061	5,519	5,354
Tennessee	8,062	9,479	11,913	13,353	14,047
Texas	501,047	525,697	598,088	706,120	729,603
Utah	6,776	8,747	10,552	12,449	11,699
Virginia	292	343	447	550	615
Washington	104	138	141	143	117
West Virginia	52,353	53,763	57,978	65,395	57,478
Wyoming	16,844	18,904	20,153	21,648	18,654
Total United States	1,764,988	1,909,901	2,160,518	2,403,041	2,294,097

[1] Includes natural gas piped from Canada.

Treated for natural gasoline.—Gasoline plants processed an estimated 2,080 billion cubic feet of natural gas in 1939, 2 percent more than the 1938 total of 2,035,562 million. The recovery of gasoline, in gallons per thousand cubic feet of gas treated, is estimated to have declined about 4 percent in 1939 from the 1938 average of 1.06, chiefly because of reduced yields in Texas. The 1939 volume of gas treated equaled about 85 percent of total consumption of natural gas compared to 89 percent in 1938.

Although total 1938 throughput of gasoline plants was 3 percent less than in 1937, there were sharp increases in volume in Arkansas, New Mexico, and California. Important declines occurred in Louisiana, Oklahoma, and West Virginia.

Natural gas treated at natural-gasoline plants in the United States, 1934–38, by States, in millions of cubic feet

State	1934	1935	1936	1937	1938
Arkansas	3,250	3,371	2,955	4,031	21,377
California	325,629	310,016	372,118	381,568	398,187
Colorado	511	222	223	153	145
Illinois	1,512	1,076	971	1,027	1,110
Kansas	69,859	87,669	106,230	153,416	144,631
Kentucky	21,704	29,772	35,493	34,981	38,446
Louisiana	70,534	81,868	115,606	144,474	116,331
Michigan	410	1,755	1,419	1,381	1,395
Montana	4,114	6,382	8,238	9,062	7,126
New Mexico	11,904	11,786	29,489	61,625	97,830
New York	375	27	22	50	65
Ohio	25,100	29,622	33,103	33,625	28,488
Oklahoma	299,183	260,757	255,433	338,007	265,746
Pennsylvania	29,346	33,348	34,168	31,508	22,600
Texas	787,078	828,570	673,483	754,696	752,784
West Virginia	108,097	118,789	128,488	140,512	122,301
Wyoming	17,566	16,970	17,561	18,684	17,000
	1,776,172	1,822,000	1,815,000	2,108,800	2,035,562
Percent of total consumption	[1] 101	95	84	88	89

[1] Exceeds 100 percent, as part of the natural gas treated for natural gasoline is blown to the air and not ncluded in total consumption.

Domestic and commercial.—After the small decline in domestic consumption in 1938 the demand for natural gas for home use is estimated to have expanded over 5 percent in 1939 to 388 billion cubic feet. The average value at points of consumption was approximately 74.4 cents per thousand cubic feet, indicating that the total revenue from domestic customers was $288,672,000 in 1939 compared to $273,070,000 in 1938.

Commercial establishments consumed about 122 billion cubic feet of natural gas in 1939, a 7-percent increase over 1938. With the average value of commercial gas estimated at 49.4 cents per thousand cubic feet in 1939, the total sales value was $60,268,000.

In recent years commercial markets have been expanding more rapidly than domestic, doubtless as a result of intensive cultivation of this type of load by gas-utility organizations. Since 1933 domestic consumption has increased 37 percent, while commercial has grown 43 percent. Trends in rates for the two classes of consumption have been slightly more favorable to commercial customers.

Domestic and commercial consumption of natural gas in the United States in 1938, by States [1]

State	Domestic				Commercial				Total			
	Consumers	M cubic feet	Value at points of consumption		Consumers	M cubic feet	Value at points of consumption		Consumers	M cubic feet	Value at points of consumption	
			Total	Average (cents)			Total	Average (cents)			Total	Average (cents)
Alabama	27,710	1,231,000	$1,390,000	112.9	3,460	581,000	$321,000	55.2	31,170	1,812,000	$1,711,000	94.4
Arizona	27,790	876,000	1,264,000	144.3	2,950	706,000	419,000	59.3	30,740	1,582,000	1,683,000	106.4
Arkansas	65,860	5,002,000	2,782,000	55.6	11,520	3,282,000	1,119,000	34.1	77,380	8,284,000	3,901,000	47.1
California	1,541,220	69,141,000	55,595,000	80.4	89,850	15,959,000	8,494,000	53.2	1,631,070	85,100,000	64,089,000	75.3
Colorado	93,830	5,117,000	4,104,000	80.2	8,870	1,623,000	939,000	57.9	102,700	6,740,000	5,043,000	74.8
District of Columbia	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Florida	3,580	109,000	156,000	143.1	340	31,000	28,000	90.3	3,920	140,000	184,000	131.4
Georgia	76,320	3,663,000	3,417,000	93.3	6,350	1,975,000	764,000	38.7	82,670	5,638,000	4,181,000	74.2
Illinois	1,182,990	17,224,000	23,754,000	137.9	64,750	5,027,000	4,361,000	86.8	1,247,740	22,251,000	28,115,000	126.4
Indiana	124,200	2,566,000	3,068,000	119.6	6,470	431,000	429,000	99.5	130,670	2,997,000	3,497,000	116.7
Iowa	121,150	3,778,000	4,066,000	107.6	9,110	1,456,000	989,000	67.9	130,260	5,234,000	5,055,000	96.6
Kansas	202,920	14,469,000	8,955,000	61.9	23,880	9,068,000	2,918,000	32.2	226,800	23,537,000	11,873,000	50.4
Kentucky	161,410	8,009,000	4,516,000	56.4	17,100	1,980,000	990,000	50.0	178,510	9,989,000	5,506,000	55.1
Louisiana	168,120	7,945,000	5,675,000	71.4	21,010	4,344,000	1,780,000	41.0	189,130	12,289,000	7,455,000	60.7
Maryland	[2] 199,930	[2] 4,404,000	[2] 3,493,000	[2] 79.3	[2] 9,100	[2] 531,000	[2] 377,000	[2] 71.0	[2] 209,030	[2] 4,935,000	[2] 3,870,000	[2] 78.4
Michigan	522,230	15,227,000	17,516,000	115.0	23,190	2,042,000	2,188,000	107.1	545,420	17,269,000	19,704,000	114.1
Minnesota	141,800	4,119,000	4,433,000	107.6	7,640	1,302,000	810,000	62.2	149,440	5,421,000	5,243,000	96.7
Mississippi	37,980	2,629,000	1,800,000	68.5	6,830	1,946,000	631,000	32.4	44,810	4,575,000	2,431,000	53.1
Missouri	367,550	10,811,000	9,442,000	87.3	34,030	3,054,000	1,888,000	61.8	401,580	13,865,000	11,330,000	81.7
Montana	37,530	5,504,000	2,524,000	45.9	4,720	3,597,000	1,123,000	31.2	42,250	9,101,000	3,647,000	40.1
Nebraska	113,400	4,225,000	3,350,000	79.3	7,840	1,510,000	812,000	53.8	121,240	5,735,000	4,162,000	72.6
New Mexico	21,820	1,606,000	1,173,000	73.0	2,820	1,112,000	437,000	39.3	24,640	2,718,000	1,610,000	59.2
New York	398,460	14,882,000	12,314,000	82.7	33,260	2,814,000	2,123,000	75.4	431,720	17,696,000	14,437,000	81.6
North Dakota	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Ohio	1,160,250	55,911,000	33,725,000	60.3	112,370	11,509,000	6,452,000	56.1	1,272,620	67,420,000	40,177,000	59.6
Oklahoma	235,380	18,691,000	8,567,000	45.8	30,270	7,860,000	2,547,000	32.4	265,650	26,551,000	11,114,000	41.9
Pennsylvania	668,200	34,707,000	21,443,000	61.8	55,820	7,860,000	4,308,000	54.8	724,020	42,567,000	25,751,000	60.5
South Dakota	15,050	1,079,000	848,000	78.6	1,780	1,022,000	414,000	40.5	16,830	2,101,000	1,262,000	60.1
Tennessee	40,430	2,209,000	1,956,000	88.5	5,350	1,721,000	720,000	41.8	45,780	3,930,000	2,676,000	68.1
Texas	649,460	29,578,000	22,309,000	75.4	80,390	13,210,000	5,610,000	42.5	729,850	42,788,000	27,919,000	65.2
Utah	[3] 29,490	[3] 2,792,000	[3] 1,804,000	[3] 64.6	[3] 1,560	[3] 1,159,000	[3] 414,000	[3] 35.7	[3] 31,050	[3] 3,951,000	[3] 2,218,000	[3] 56.1
Virginia	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Washington	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
West Virginia	177,300	17,083,000	6,233,000	36.5	19,110	4,390,000	1,482,000	33.8	196,410	21,473,000	7,715,000	35.9
Wyoming	20,610	3,185,000	1,398,000	43.9	2,500	1,194,000	360,000	30.2	23,110	4,379,000	1,758,000	40.1
Total: 1938	8,633,970	367,772,000	273,070,000	74.2	704,240	114,296,000	56,247,000	49.2	9,338,210	482,068,000	329,317,000	68.3
1937	8,348,390	371,844,000	273,577,000	73.6	679,790	117,390,000	57,161,000	48.7	9,028,180	489,234,000	330,738,000	67.6

[1] Includes natural gas used with manufactured gas. [2] Maryland includes District of Columbia and Virginia. [3] Utah includes North Dakota and Washington.

Field.—Oil-field operations are thought to have consumed slightly less gas in 1939 than in 1938, the estimated total being 650 billion cubic feet—a decline of 9.2 billion from 1938. There was a substantial decrease in drilling in California and Texas and a small increase in Oklahoma. These three States report such great amounts of field gas that their activities largely control the trend for the United States. The field uses and handling of natural gas have become increasingly complex, particularly in high-pressure areas. As a result, the statistical treatment of these functions has grown more difficult. Problems have been introduced by expansion of such activities as pressure maintenance, repressuring, gas lift, and recycling that tend to enlarge the field use of gas substantially above the amounts used in routine drilling and pumping.

Carbon black.—Carbon-black plants burned 348 billion cubic feet of natural gas in 1939, an increase of 7 percent over 1938 and a new all-time high for this type of gas use. The previous peak (in 1937) was 341,085 million cubic feet.

Consumption of gas for carbon-black manufacture increased in Texas and Oklahoma-Kansas, offsetting the continued decline in Louisiana. No carbon black was manufactured in Wyoming in 1939, as the single plant in that State was closed permanently on February 23, 1938. New plants were constructed or definitely planned in Texas (Gulf Coast district), Oklahoma, and Kansas.

Petroleum refineries.—The quantity of natural gas employed as fuel at petroleum refineries is estimated to have increased 8 percent in 1939 to 119 billion cubic feet. Of the 19 States reporting this type of consumption in 1938, four (Colorado, Indiana, Michigan, and Tennessee) have been added to the list since 1935. In the same interval increased refinery consumption of gas was indicated in eight States, notably in Texas, California, and Louisiana. Important declines occurred in New York, Oklahoma, West Virginia, and Wyoming. In 1938 Texas used 40 percent and California 30 percent of the United States total of natural gas consumed at refineries.

Electric public utility power plants.—Greater output of electrical energy and dry weather in some localities in 1939 caused a 12-percent increase in consumption of natural gas by public utility power plants. The 1939 total was 191,131 million cubic feet compared to 169,988 million in 1938.

The accompanying table indicates that in 1938 power plants in 29 States utilized natural gas for at least part of their fuel requirements. As might be expected, the largest consumption usually is in States having abundant supplies of cheap gas. Indiana is perhaps the outstanding exception. In 1938 power plants in that State consumed 10,153 million cubic feet of natural gas, despite the relatively high gas rates.

Portland-cement plants.—Portland-cement production increased 16 percent in 1939, and consumption of natural gas in cement manufacture increased to 40,233 million cubic feet from 37,336 million in 1938. Consumption of gas usually follows the trend in cement production rather closely. However, over a period of years the increasing thermal efficiencies of modern equipment have tended to reduce the amount of fuel consumed per barrel of product.

Industrial consumption of natural gas in the United States in 1938, by States and uses

State	Field (drilling, pumping, and operating gasoline-recovery plants)		Manufacture of carbon black			Fuel at petroleum refineries, electric public utility power plants, portland-cement plants, and other industrial							Total industrial		
	M cubic feet (estimated)	Value at points of consumption (estimated)	M cubic feet	Value at points of consumption		M cubic feet					Value at points of consumption		M cubic feet	Value at points of consumption	
				Total	Average (cents)	Petroleum refineries	Electric public utility power plants	Portland-cement plants	Other industrial	Total	Total	Average (cents)		Total	Average (cents)
Alabama	-	-	-	-	-	-	1,222,000	(1)	[1] 11,762,000	12,984,000	$2,176,000	16.8	12,984,000	$2,176,000	16.8
Arizona	-	-	-	-	-	-	2,013,000	-	9,065,000	11,078,000	2,107,000	19.0	11,078,000	2,107,000	19.0
Arkansas	11,582,000	$896,000	-	-	-	3,585,000	1,770,000	(1)	[1] 9,612,000	14,967,000	1,885,000	12.6	26,549,000	2,781,000	10.5
California	132,223,000	8,952,000	-	-	-	32,624,000	9,111,000	(1)	[1] 56,110,000	97,845,000	15,184,000	15.5	230,068,000	24,136,000	10.5
Colorado	253,000	12,000	-	-	-	1,000	1,463,000	(1)	[1] 10,755,000	12,219,000	1,925,000	15.8	12,472,000	1,937,000	15.5
District of Columbia	-	-	-	-	-	-	-	-	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Florida	-	-	-	-	-	-	-	-	1,329,000	1,329,000	193,000	14.5	1,329,000	193,000	14.5
Georgia	-	-	-	-	-	-	4,400,000	-	4,745,000	9,145,000	1,556,000	17.0	9,145,000	1,556,000	17.0
Illinois	1,296,000	79,000	-	-	-	20,000	2,195,000	-	40,738,000	42,953,000	8,785,000	20.5	44,249,000	8,864,000	20.0
Indiana	148,000	15,000	-	-	-	569,000	10,153,000	-	12,839,000	23,561,000	4,845,000	20.6	23,709,000	4,860,000	20.5
Iowa	-	-	-	-	-	-	5,315,000	(1)	[1] 9,560,000	14,875,000	2,251,000	15.1	14,875,000	2,251,000	15.1
Kansas	16,464,000	1,179,000	(3)	(3)	(3)	2,937,000	15,463,000	5,832,000	[3] 21,872,000	[3] 46,104,000	[3] 5,945,000	[3] 12.9	62,568,000	7,124,000	11.4
Kentucky	1,444,000	183,000	-	-	-	-	-	-	3,917,000	3,917,000	1,122,000	28.6	5,361,000	1,305,000	24.3
Louisiana	41,254,000	2,164,000	24,143,000	$625,000	2.6	9,536,000	21,832,000	(1)	[1] 53,206,000	84,574,000	9,660,000	11.4	149,971,000	12,449,000	8.3
Maryland	-	-	-	-	-	-	-	-	[2] 753,000	[2] 753,000	[2] 400,000	[2] 53.1	[2] 753,000	[2] 400,000	[2] 53.1
Michigan	2,109,000	202,000	-	-	-	2,000	1,000	-	5,316,000	5,319,000	2,883,000	54.2	7,428,000	3,085,000	41.5
Minnesota	-	-	-	-	-	-	1,474,000	-	7,746,000	9,220,000	1,770,000	19.2	9,220,000	1,770,000	19.2
Mississippi	-	-	-	-	-	-	1,436,000	-	6,774,000	8,210,000	1,051,000	12.8	8,210,000	1,051,000	12.8
Missouri	301,000	27,000	-	-	-	-	10,464,000	(1)	[1] 17,875,000	28,339,000	4,767,000	16.8	28,640,000	4,794,000	16.7
Montana	898,000	52,000	-	-	-	383,000	696,000	-	7,147,000	8,226,000	1,208,000	14.7	9,124,000	1,260,000	13.8
Nebraska	-	-	-	-	-	-	3,963,000	(1)	[1] 7,841,000	11,804,000	2,028,000	17.2	11,804,000	2,028,000	17.2
New Mexico	19,475,000	383,000	-	-	-	103,000	3,852,000	-	6,742,000	10,697,000	1,521,000	14.2	30,172,000	1,904,000	6.3
New York	237,000	35,000	-	-	-	1,656,000	3,397,000	-	24,964,000	30,017,000	5,811,000	19.4	30,254,000	5,846,000	19.3
North Dakota	-	-	-	-	-	-	(4)	-	(4)	(4)	(4)	(4)	(4)	(4)	(4)
Ohio	1,004,000	189,000	-	-	-	21,000	3,812,000	-	35,756,000	39,589,000	13,494,000	34.1	40,593,000	13,683,000	33.7
Oklahoma	165,884,000	4,503,000	(3)	(3)	(3)	8,203,000	11,310,000	(1)	[1,3] 32,495,000	[3] 52,008,000	[3] 4,515,000	[3] 8.7	217,892,000	9,018,000	4.1
Pennsylvania	4,744,000	1,126,000	-	-	-	2,325,000	3,256,000	-	43,393,000	48,974,000	14,082,000	28.8	53,718,000	15,208,000	28.3
South Dakota	-	-	-	-	-	-	984,000	(1)	[1] 2,269,000	3,253,000	568,000	17.5	3,253,000	568,000	17.5
Tennessee	-	-	-	-	-	10,000	5,128,000	-	4,979,000	10,117,000	1,724,000	17.0	10,117,000	1,724,000	17.0
Texas	242,196,000	7,522,000	289,656,000	2,100,000	.7	43,764,000	44,116,000	9,743,000	57,340,000	154,963,000	17,876,000	11.5	686,815,000	27,498,000	4.0

Utah	48,000	5,000	----------	----------	----------	16,000	[4] 224,000	----------	[4] 9,110,000	[4] 9,350,000	[4] 1,042,000	[4] 11.1	[4] 9,398,000	[4] 1,047,000	[4] 11.1
Virginia	----------	----------	----------	----------	----------	----------	----------	----------	(2)	(2)	(2)	(2)	(2)	(2)	(2)
West Virginia	10,991,000	1,892,000	----------	----------	----------	448,000	83,000	----------	24,483,000	25,014,000	5,663,000	22.6	36,005,000	7,555,000	21.0
Wyoming	6,652,000	212,000	(3)	(3)	(3)	3,538,000	855,000	----------	[3] 3,230,000	[3] 7,623,000	[3] 843,000	[3] 11.1	14,275,000	1,055,000	7.4
Miscellaneous	----------	----------	11,151,000	167,000	1.5	----------	----------	21,761,000	----------	----------	----------	----------	----------	----------	----------
Total: 1938	659,203,000	29,628,000	324,950,000	2,892,000	0.9	109,741,000	169,988,000	37,336,000	510,811,000	827,876,000	138,713,000	16.8	1,812,029,000	171,233,000	9.4
1937	651,320,000	31,199,000	341,085,000	4,294,000	1.3	113,005,000	170,567,000	40,450,000	597,380,000	921,402,000	161,298,000	17.5	1,913,807,000	196,791,000	10.3

[1] Gas used at portland-cement plants included under "Miscellaneous" for United States total and under "Other industrial" for State total to avoid disclosing figures of individual operators.

[2] Maryland includes District of Columbia and Virginia.

[3] Gas used in manufacture of carbon black included under "Miscellaneous" for United States total and under "Other industrial" for State total to avoid disclosing figures of individual operators.

[4] Utah includes North Dakota.

Other industrial.—A higher rate of manufacturing operations caused increased demand for natural gas in industry in 1939. The outbreak of war in Europe on September 1 started a boom, particularly in steel and metal-working industries in eastern cities, that sharply expanded industrial gas markets in the region of the Ohio Valley. The total quantity of natural gas used by miscellaneous industries in 1939 is estimated to have been 575,790 million cubic feet, exceeding the comparable 1938 figure by 13 percent.

Among recent applications of natural gas to industrial processes may be mentioned the production of inert atmospheres from products of gas combustion. These inert gases are useful in the manufacture and storage of a number of materials, notably paints and varnish, to prevent or reduce oxidation. Gas has been widely adopted for melting type metal in the newspaper industry, replacing electricity as the source of heat. Gas-operated air-conditioning equipment, which is still in the development stage, appears to offer possibilities as a new type of natural-gas market.

The greatest potentialities for the future, however, are indicated by new chemical techniques and discoveries that will utilize natural gas as raw material. The manufacture of such bulk products as fabrics, a variety of plastics, and synthetic rubber is emerging on a commercial scale. Immediate construction of a plant in Louisiana with the capacity to produce 10,000 pounds per day of synthetic rubber has been announced.

A brief summary of the principal chemical methods employed in treating natural gas and the classes of products obtained has been published by the Bureau of Mines as Information Circular 7108, Utilization of Natural Gas for Chemical Products, by Harold M. Smith.

Mixed gas.—The amount of natural gas used as a blend with manufactured gas in 1938 was 55,825 million cubic feet, less than 1 percent below the 1937 total. Declines in most States indicated the reduced demand incident to unsatisfactory general business conditions. However, the sharp decline in Michigan (79 percent) was due chiefly to the transfer of all domestic and commercial meters (46,990 in 1937), which had been using mixed gas, to other types of gas service. Only a small industrial load remained. Mixed-gas sales in California, which were 338 million cubic feet in 1937, were eliminated in 1938 by a similar change.

In Ohio almost four times as much natural gas was sold with manufactured gas in 1938 as in 1937, apparently owing to the use of a larger proportion of natural gas in the mixed gas sold, with the effect of increasing the heating value per unit volume.

Average value at points of consumption of the natural gas used in mixed gas was 91.8 cents per thousand cubic feet in 1938 and 90.7 cents in 1937.

Consumption of natural gas used with manufactured gas in the United States in 1938, by States

State	Domestic		Commercial		Industrial (M cubic feet)	Total	
	Consumers	M cubic feet	Consumers	M cubic feet		M cubic feet	Value at points of consumption
District of Columbia	147,400	3,063,000	6,480	299,000	464,000	3,826,000	$2,785,000
Illinois	1,049,450	14,287,000	55,130	4,302,000	4,486,000	23,075,000	25,041,000
Indiana	29,440	388,000	1,220	69,000	32,000	489,000	546,000
Iowa	52,230	1,260,000	3,520	221,000	90,000	1,571,000	1,674,000
Kentucky	70,940	2,574,000	7,060	689,000	672,000	3,935,000	2,088,000
Maryland	16,900	373,000	320	9,000	14,000	396,000	350,000
Michigan					449,000	449,000	170,000
Minnesota	121,330	2,915,000	5,720	422,000	220,000	3,557,000	4,010,000
Missouri	223,650	2,538,000	10,400	306,000	195,000	3,039,000	3,083,000
Nebraska	54,340	683,000	360	37,000	82,000	802,000	498,000
New York	266,120	7,751,000	21,790	1,563,000	1,045,000	10,359,000	8,144,000
Ohio	151,330	1,560,000	15,250	511,000	376,000	2,447,000	1,480,000
Pennsylvania	54,110	1,443,000	1,790	144,000	107,000	1,694,000	1,187,000
Virginia	15,010	169,000	420	7,000	10,000	186,000	202,000
Total: 1938	2,252,250	39,004,000	129,460	8,579,000	8,242,000	55,825,000	51,258,000
1937	2,283,040	39,517,000	127,570	7,985,000	8,599,000	56,101,000	50,897,000

NEW MARKETS

Natural gas was brought in 1939 to more than 80 towns and cities, with a total population of over 250,000, that formerly had not enjoyed this service. The largest number of new markets was connected in Minnesota and Iowa adjacent to the new trunk line built from Sioux City, Iowa, to Minneapolis in 1939. In southern Minnesota about 20 communities with a total population of about 60,000 and in Iowa about 10 communities with population of about 25,000 were added. Several Michigan towns were first supplied in 1939, the largest being Ann Arbor, whose approximate population is 30,000.

Other communities of substantial size that began consuming natural gas in 1939 may be summarized as follows: In Ohio, 8 towns (population, 28,000); in Arizona, 7 towns (population, 19,000); in California, 10 towns (population, 22,000); in Illinois, 5 towns (population, 10,000); in Louisiana, 3 towns (population, 11,000); and in Tennessee-Virginia, the city of Bristol (population, 21,000). Smaller additions to domestic and commercial markets were reported in Indiana, Kansas, Mississippi, New Mexico, Oklahoma, Texas, and Wyoming. The new markets mentioned do not include extensions to distribution systems in communities served with natural gas before 1939. Important new industrial markets were acquired in Arizona, New Mexico, Texas, and California.

INTERSTATE SHIPMENTS

In 1938, for the first time since 1931, the total movement of natural gas in interstate commerce declined appreciably, falling to 636,626 million cubic feet from 687,428 million in 1937, or 7 percent.

Declines in interstate movements from producing States were general, and the most severe affected Oklahoma, Pennsylvania, and Louisiana. The outstanding exception was New York, whose shipments more than doubled—from 9,954 million in 1937 to 22,384 million in

1938. Virtually all this gas went into Pennsylvania. Slightly increased movements were reported from Indiana, Mississippi, Missouri, and Utah. Illinois and North Dakota were added to the interstate list in 1938. Marketed production exceeded consumption in 1938 in Texas by 153 billion cubic feet, in Louisiana by 122 billion, and in West Virginia by 77 billion, indicating that these three leading States supplied the major portion of the total interstate movement.

The States with the largest interstate receipts continued in 1938 to be Ohio, with 72.9 billion cubic feet, and Illinois, with 65.4 billion. There has been particularly rapid growth in recent years in shipments from Kentucky to West Virginia, Texas to Louisiana, and Texas to Michigan.

Interstate transportation of natural gas in 1938 [1]

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Colorado	Wyoming	Utah	1,456,000
		Wyoming	91,000
			1,547,000
Illinois		Indiana	101,000
Indiana		Illinois	42,000
		Kentucky	120,000
			162,000
Kansas		Colorado	457,000
	Missouri	Illinois	2,176,000
	do Illinois	Indiana	2,691,000
	Nebraska	Iowa	6,009,000
	do South Dakota	do	6,000
	Missouri Illinois Indiana	Michigan	4,842,000
	Nebraska Iowa	Minnesota	6,691,000
		Missouri	6,288,000
		Nebraska	8,498,000
	Nebraska Iowa	do	3,000
		Oklahoma	547,000
	Nebraska	South Dakota	887,000
			39,095,000
Kentucky	West Virginia Virginia Maryland	District of Columbia	3,826,000
	Indiana	Illinois	135,000
		Indiana	833,000
	West Virginia Virginia	Maryland	101,000
	West Virginia Virginia Maryland District of Columbia	do	397,000
		Ohio	1,586,000
	West Virginia	do	4,307,000
	do	Pennsylvania	10,196,000
	do Virginia Maryland	do	21,000
	West Virginia	Virginia	429,000
	do Virginia Maryland District of Columbia	do	186,000
		West Virginia	15,203,000
			37,220,000

[1] Includes exports to Canada and Mexico

Interstate transportation of natural gas in 1938—Continued

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Louisiana	Mississippi	Alabama	13,582,000
		Arkansas	23,028,000
	Mississippi, Alabama	Georgia	14,783,000
	Arkansas, Missouri	Illinois	15,168,000
		Mississippi	3,227,000
	Arkansas	do	2,164,000
	do	Missouri	10,987,000
	Arkansas, Mississippi	Tennessee	14,041,000
		Texas	41,284,000
			138,264,000
Mississippi		Alabama	1,214,000
	Alabama	Florida	1,469,000
		Louisiana	3,579,000
			6,262,000
Missouri		Illinois	140,000
	Illinois	Indiana	169,000
	do, Indiana	Michigan	306,000
			615,000
Montana		North Dakota	1,466,000
		South Dakota	3,314,000
	North Dakota	do	75,000
			4,855,000
New Mexico	Texas, New Mexico	Arizona	12,660,000
		Colorado	164,000
	Texas, New Mexico, Arizona	Mexico	832,000
		Texas	5,767,000
			19,423,000
New York		Canada	34,000
		Pennsylvania	22,350,000
			22,384,000
North Dakota		South Dakota	4,000
Ohio		Indiana	5,000
		West Virginia	141,000
			146,000
Oklahoma		Arkansas	504,000
	Kansas, Missouri	Illinois	89,000
	Kansas, Missouri, Illinois	Indiana	102,000
Oklahoma		Kansas	18,965,000
	Kansas, Missouri, Illinois, Indiana	Michigan	201,000
	Kansas	Missouri	7,908,000
	do	Nebraska	408,000
		Texas	1,173,000
			29,350,000
Pennsylvania	New York	Canada	60,000
		New York	30,932,000
		Ohio	52,000
	West Virginia	do	380,000
		West Virginia	1,845,000
			33,269,000

Interstate transportation of natural gas in 1938—Continued

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Texas	New Mexico	Colorado	18,210,000
	Oklahoma Kansas Missouri	Illinois	4,131,000
	Oklahoma Kansas Nebraska Iowa	do	43,551,000
	Oklahoma Kansas Missouri Illinois	Indiana	5,091,000
	Oklahoma Kansas Nebraska Iowa Illinois	do	16,577,000
	Oklahoma Kansas Nebraska	Iowa	14,087,000
	Oklahoma Kansas Nebraska South Dakota	do	7,000
	Oklahoma	Kansas	31,032,000
		Louisiana	13,046,000
		Mexico	911,000
	Oklahoma Kansas Missouri Illinois Indiana	Michigan	9,183,000
	Oklahoma Kansas Nebraska Iowa	Minnesota	7,950,000
	Oklahoma Kansas	Missouri	16.568,000
	Oklahoma Kansas	Nebraska	7,512,000
	Oklahoma Kansas Nebraska Iowa	do	4,000
		New Mexico	1,607,000
		Oklahoma	10,082,000
	Oklahoma Kansas Nebraska	South Dakota	1,064,000
	New Mexico Colorado	Wyoming	481,000
			201,094,000
Utah		do	93,000
West Virginia		Kentucky	6,287,000
		Maryland	749,000
		Ohio	64,266,000
	Kentucky	do	2,311,000
		Pennsylvania	20,440,000
			94,053,000
Wyoming		Colorado	24,000
		Montana	1,492,000
		Nebraska	1,114,000
		Utah	6,059,000
			8,689,000
			636,626,000

PIPE-LINE DEVELOPMENTS

Construction of pipe lines for transmitting natural gas revived sharply in 1939 from the unusually low level of 1938. About three times as many projects were completed in 1939, and their aggregate mileage exceeded 1,500 in contrast to less than 400 miles laid in 1938.

Except for a few small lines, all the construction was in States west of the Mississippi River.

The largest new line was of 16-inch pipe running from Sioux City, Iowa, to Minneapolis, Minn., a distance of about 240 miles; it will augment the supply of gas for Minneapolis-St. Paul and bring natural-gas service to towns in northwestern Iowa and south-central Minnesota. Another large line was laid from the Monroe field, La., eastward to connect with existing trunk lines near Jackson, Miss. It consists of 125 miles of 18-inch pipe and 50 miles of various sizes from 4-inch to 20-inch. The approaching depletion of the Jackson (Miss.) gas field made necessary a new source of gas supply to serve growing markets in Mississippi and States to the east.

A new line consisting of 73 miles of 8⅝-inch and 117 miles of 6⅝-inch pipe was laid from a main-line connection near Gage, N. Mex., to supply fuel to smelters at Miami and Globe, Ariz. Two loops—62 miles of 16-inch and 56 miles of 12¾-inch—were installed on the main line east of Gage, N. Mex., to provide the additional capacity required by the growing demand for gas in Arizona and adjacent territory.

In California a number of short additions to the gas-utility systems were reported, with a total length of a little over 100 miles, mostly of 8- and 10-inch pipe. New outlets for gas were provided for the Rio Bravo, Kettleman Hills, Sutter Buttes, and Delano fields. One of the new 8-inch lines brought gas to a pottery at Lincoln, Calif., and a line along the crest of the San Bernardino Mountains supplied 11 communities with natural-gas service for the first time.

Nine new gas lines were laid in Texas, none of which, however, was of major proportions. Their total length was about 250 miles. New lines were built to transport gas from the Spanish Camp, Page, Buffalo, Joaquin, Katy, and Wasson fields. Additional supplies of gas were piped to Beaumont and Houston for industrial use, and new lines brought gas to McNeil and Carlsbad, Tex., and several other small towns.

A few short lines were built in Louisiana, and one 50-mile, 6-inch line was run from the Joaquin (Tex.) gas field to Natchitoches, La. New connections were made with the Sibley, Sligo, and Lake Bastineau fields.

About 40 miles of 20-inch line were laid in Clay and Washington Counties, Kans., as a loop to increase the capacity of a main line. In addition, an 8-inch line 35 miles long was built from the Cunningham field to Hutchinson, Kans., and a small 10-mile line from the Wackerle gas field to Oswego, Kans. There was very little gas-line construction in Oklahoma in 1939. The largest of three projects consisted of 11 miles of 10-inch and 8-inch pipe running from the Doyle area in northeastern Stevens County southeastward to connect with a 12-inch trunk line 20 miles north of Healdton.

In Mississippi 32 miles of 18-inch line were installed, extending an existing system from the town of Onward to the new Tinsley oil field near Yazoo City. The chief demand for this gas is from drilling and oil-production operations.

Michigan was the most active of the Eastern States in gas pipe-line construction, three lines having been built as follows: 22 miles of 6-inch from the trunk line at Milan to Ann Arbor; 45 miles of 6-inch from the Arenac field to Midland; and 30 miles of 4½-inch from the Austin field to Claire. Two 24-inch loops with a total length of 16.2

miles were added to the Texas-Detroit line at points in Indiana. A line was laid in Illinois from Streator to Pontiac, a distance of 23 miles; and about 15 miles of 6- and 8-inch line were run from Lawrence County fields, Ill., eastward to connect with a trunk line in Indiana. Point Marion, Pa., obtained a new gas supply through a new 4½-inch line laid from the Wasson No. 1 gas well in West Union Township, 19 miles away.

Eight miles of 12-inch line were laid to replace old 8-inch pipe in the line from the Elk Basin field to Billings, Mont.; and in Wyoming, 11 miles of 8-inch were laid in the James Lake area, Carbon County.

At the end of 1939 several large loops were being added to the Texas-Detroit line involving a reported 140 miles of 22- and 24-inch pipe. A 75-mile, 8⅝-inch line was under construction from the Cotton Valley (La.) field northward to Hope and Okay, Ark., and in New Mexico a 31-mile extension of a line from Albuquerque to Belen and other towns was progressing.

NATURAL GASOLINE

AND LIQUEFIED PETROLEUM GASES[1]

By G. R. Hopkins

SUMMARY OUTLINE

NATURAL GASOLINE

The natural-gasoline industry appeared headed for another drab year in 1939 until the oil fields were shut down for 2 weeks during August. This shut-down, which affected all the important producing States except California and Illinois, caused production in 1939 to fall below that in 1938 but also entailed a scarcity of supplies sufficient to raise the price 1 cent or more per gallon. The market situation continued strong for several months, or long enough to insure a small profit for most companies; but price declines in December placed the industry in States east of California in an uncomfortable position, which grew worse during the first 4 months of 1940. Prices in California, however, have shown remarkable steadiness.

The proportion of natural gasoline in refinery gasoline, which increased in both 1937 and 1938, declined from 7.2 percent in 1938 to 6.8 in 1939. Although the shut-down brought about a net decrease in stocks of natural gasoline for 1939 the apathy in refinery demand quickly reversed this trend during the first quarter of 1940.

Owing principally to the war abroad, exports of natural gasoline fell about a third, or to 172,662,000 gallons in 1939. Direct sales to jobbers and retailers also decreased materially during the year.

No spectacular advances were made in established production methods in 1939, but use of the recycling process continued to expand rapidly, and much progress was made in producing high-octane gasoline from the lighter hydrocarbons. Most of this research was at refineries, but the natural-gasoline industry played an important role.

[1] Data for 1939 are preliminary; detailed statistics with final revisions will be released later.

Salient statistics of the natural-gasoline industry in the United States, 1935–39, in thousands of gallons

	1935	1936	1937	1938	1939 [1]	Percent of change in 1939 from 1938
Production:						
Appalachian	61,315	65,669	72,056	68,541	70,268	+2.5
Illinois, Kentucky, and Michigan	10,106	10,361	12,319	13,057	15,264	+16.9
Oklahoma City	120,127	128,783	166,188	141,516	103,608	−26.8
Seminole	97,599	115,557	121,839	122,144	120,259	−1.5
Texas Panhandle	276,602	218,703	230,405	249,968	242,020	−3.2
East Texas	78,210	140,091	185,313	188,117	188,260	+.1
Rocky Mountain	53,965	65,337	74,868	82,397	87,701	+6.4
Kettleman Hills	153,936	171,052	182,894	186,780	156,484	−16.2
Long Beach	83,653	89,366	84,297	92,675	86,745	−6.4
All other districts	716,473	791,421	935,255	1,011,379	1,025,023	+1.3
Total production	1,651,986	1,796,340	2,065,434	2,156,574	2,095,632	−2.8
Stocks:						
Total at plants, terminals, and refineries, Jan. 1	177,086	155,316	170,310	199,836	202,860	
Total at plants, terminals, and refineries, Dec. 31	155,316	170,310	199,836	202,860	185,682	−8.5
Net change	−21,770	+14,994	+29,526	+3,024	−17,178	
Total supply [2]	1,673,756	1,781,346	2,035,908	2,153,550	2,112,810	−1.9
Distribution:						
Used at refineries [3]	1,271,760	1,367,814	1,596,294	1,621,704	1,645,266	+1.5
Run through crude-oil pipe lines in California	31,290	52,500	57,708	56,658	48,174	−15.0
Exports	135,366	107,058	148,428	256,914	172,662	−32.8
Direct shipments to consumers	116,340	139,230	143,640	137,970	121,128	−12.2
Losses	119,000	114,744	89,838	80,304	125,580	+56.4
Total distribution	1,673,756	1,781,346	2,035,908	2,153,550	2,112,810	−1.9

[1] Subject to revision.
[2] Production plus or minus changes in stocks.
[3] Including quantities run through crude-oil pipe lines east of California.

PRICES AND MARKET CONDITIONS

Although natural-gasoline prices in 1939 were far below the 20-cent quotations of 20 years ago, there was some improvement over 1938. The price of a representative grade of natural gasoline (26–70 in Oklahoma) was just under 4 cents as the year opened and dropped to 2.50 cents in the slack months of April and May, but was 4.25 cents during most of September, October, and November, the months of heaviest consumption. The rapid decline of this quotation in December was disappointing, as it made prospects for 1940 discouraging.

Figure 1 shows that the average value of natural gasoline (estimated for 1939) remained below the refinery price of United States motor gasoline in Oklahoma, although the gap was not as wide as in 1938.

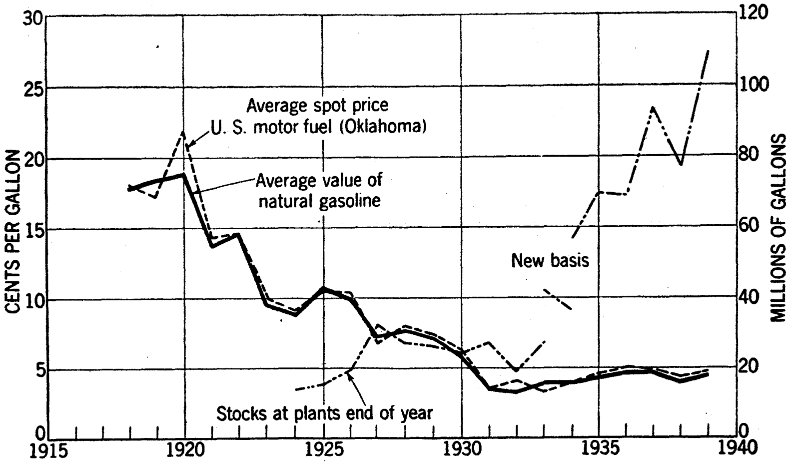

FIGURE 1.—Trends in average value of natural gasoline, spot price of gasoline, and stocks of natural gasoline, 1918–39.

Spot price of Oklahoma natural gasoline, grade 26–70, on specified dates in 1939, with monthly and yearly averages, in cents per gallon

[National Petroleum News]

Date	Cents	Date	Cents	Date	Cents
Jan. 1	3.75	May 1	[1] 2.50	Sept. 5	[2] 4.00
3	3.75	8	[1] 2.50	11	[2] 4.00
9	3.50	15	[1] 2.50	18	[1] 4.25
16	2.75–3.00	22	[1] 2.50	25	[1] 4.25
23	2.75	29	[1] 2.50	Average	4.13
30	2.75	Average	2.50	Oct. 2	[2] 4.25
Average	3.13	June 5	[1] 2.63–2.75	9	[1] 4.25
Feb. 6	2.50–2.75	12	[1] 2.75	16	[1] 4.25
13	2.50	19	[1] 2.75	23	[1] 4.25
20	2.50	26	[1] 2.75	30	[2] 4.25
27	2.50	Average	2.73	Average	4.25
Average	2.53	July 3	[1] 2.75	Nov. 6	[1] 4.25
Mar. 6	2.50–2.63	10	[1] 2.75	13	[2] 4.25
13	2.50–2.63	17	[2] 2.75	20	[1] 4.25
20	2.50–2.63	24	[2] 2.75	27	[1] 4.25
27	2.50–2.63	31	[2] 3.00	Average	4.25
Average	2.56	Average	2.80	Dec. 4	[1] 4.00
Apr. 3	[1] 2.50	Aug. 7	[2] 3.00	11	[1] 3.50
10	[1] 2.50–2.63	14	[2] 3.00	18	[2] 3.00–3.25
17	[1] 2.50	21	[2] 4.00	26	[1] 2.75
24	[1] 2.50	28	[2] 4.00	Average	3.34
Average	2.52	Average	3.50	Average, 1939	3.19
				1938	2.74

[1] Sales. [2] Quotations.

EMPLOYMENT AND PRODUCTIVITY

The average number of workers at natural-gasoline plants dropped from 9,429 in 1937 to 9,205 in 1938. Most of the decrease was in part-time workers, who averaged 595 in 1938 compared with 734 in 1937.

Man-hours for 1938 totaled 18,818,000, assuming 1,000 hours per year for each part-time worker. The hours per week for full-time workers accordingly declined from 41.3 in 1937 to 38.1 in 1938. Average productivity increased again as less efficient plants were weeded out; in 1938 the average was 114.6 gallons per man-hour compared with 106.6 in 1937.

Employment at natural-gasoline plants, natural gasoline produced, and average output per man-hour in the United States, 1937–38, by States [1]

State	Average number of workers		Natural-gasoline production (thousands of gallons)		Labor productivity (gallons per man hour)	
	1937	1938	1937	1938	1937	1938
Arkansas	90	90	11,285	25,648	62.7	139.4
California	1,720	1,800	623,894	660,890	183.8	186.8
Colorado	10	10	404	386	18.4	17.5
Illinois	46	55	2,567	2,436	24.2	18.7
Kansas	242	210	57,026	55,988	113.6	127.5
Kentucky	58	55	7,344	7,040	65.0	60.7
Louisiana	320	280	106,415	95,634	185.7	164.3
Michigan	19	20	2,408	3,581	57.3	81.4
Montana	9	10	2,296	1,768	88.3	61.0
New Mexico	120	135	38,253	49,596	154.9	179.7
Ohio	92	95	7,704	7,382	36.2	38.9
Oklahoma	2,660	2,520	492,290	468,499	88.8	90.3
Texas	3,125	3,070	615,281	685,920	94.7	106.9
West Virginia	520	500	50,379	50,398	46.6	52.0
New York and Pennsylvania	190	180	13,973	10,761	33.3	31.1
Wyoming and Utah	208	175	33,915	30,647	82.3	88.6
Total, United States	9,429	9,205	2,065,434	2,156,574	106.6	114.6

[1] Figures for 1939 not yet available.

PRODUCTION

Trends in total output.—As most natural gasoline is made from casinghead gas there is close relationship between its output and that of crude oil; however, in 1939, the production of crude petroleum increased 4 percent whereas the output of natural gasoline probably

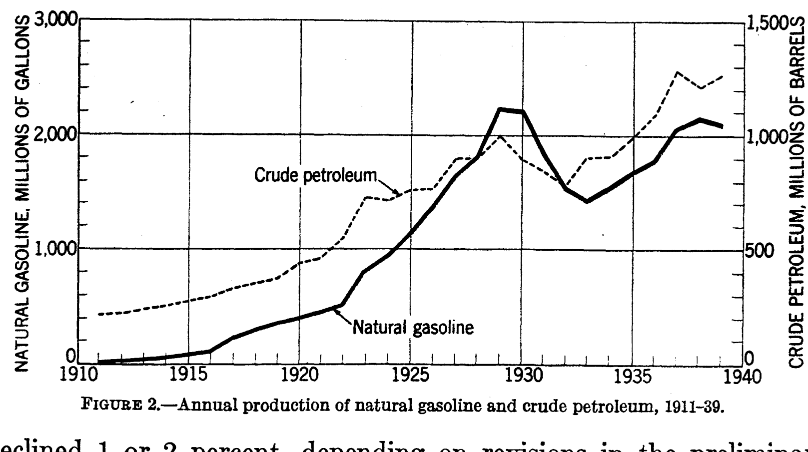

FIGURE 2.—Annual production of natural gasoline and crude petroleum, 1911–39.

declined 1 or 2 percent, depending on revisions in the preliminary figures. This discordant trend is due primarily to developments in Illinois, which were largely responsible for the gain in crude-oil production but which, as explained more fully elsewhere, were not conducive to a proportionate increase in the output of natural gasoline. (See fig. 2.)

Monthly production of natural gasoline in the United States, 1938–39, by fields, in millions of gallons

Field	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1938													
Appalachian	7.4	6.5	6.9	5.8	5.1	4.1	3.9	4.2	4.7	5.6	6.6	7.7	68.5
Illinois, Kentucky, and Michigan	1.1	1.0	1.0	.9	1.1	1.1	1.0	1.0	1.1	1.2	1.2	1.4	13.1
Oklahoma:													
Oklahoma City	13.8	11.8	13.9	12.0	12.6	11.5	11.2	11.0	10.5	12.3	10.9	10.0	141.5
Osage County	4.7	4.1	4.7	4.4	4.5	4.4	4.6	4.7	4.9	5.4	4.6	4.9	55.9
Seminole	10.9	10.3	10.9	10.6	10.4	9.2	9.2	10.3	10.3	10.7	9.6	9.7	122.1
Rest of State	13.2	11.9	13.0	12.2	12.5	11.6	12.1	11.8	11.9	12.8	12.8	13.2	149.0
Total, Oklahoma	42.6	38.1	42.5	39.2	40.0	36.7	37.1	37.8	37.6	41.2	37.9	37.8	468.5
Kansas	5.2	4.8	4.5	4.9	4.4	4.3	3.8	4.0	4.3	4.9	5.2	5.7	56.0
Texas:													
Gulf Coast	3.3	3.4	4.8	4.8	5.4	5.7	6.4	6.9	6.4	6.5	5.9	5.8	65.3
East Texas	15.1	13.6	16.4	15.9	15.4	15.7	18.5	17.6	14.8	16.0	14.5	14.6	188.1
North Texas	2.2	2.0	2.2	2.3	2.3	2.2	2.2	2.2	2.3	2.4	2.2	2.2	26.7
Panhandle	23.3	19.6	21.5	21.1	20.3	18.9	19.0	20.0	19.4	20.9	22.2	23.8	250.0
West-Central	6.3	5.6	6.4	6.0	5.9	5.8	6.2	6.2	5.8	6.4	6.4	6.4	73.4
Rest of State	5.8	5.7	6.7	6.7	6.7	6.7	7.6	7.9	7.2	7.5	6.8	7.1	82.4
Total, Texas	56.0	49.9	58.0	56.8	56.0	55.0	59.9	60.8	55.9	59.7	58.0	59.9	685.9
Louisiana	8.5	7.8	7.4	7.7	8.1	7.9	7.9	7.5	7.8	8.2	8.1	8.7	95.6
Arkansas	1.9	1.8	2.1	2.2	1.9	1.9	2.0	2.5	2.4	2.5	2.2	2.3	25.7
Rocky Mountain	6.4	5.9	6.4	6.2	6.9	6.7	7.1	7.1	7.0	7.9	7.4	7.4	82.4
California:													
Huntington Beach	3.6	3.3	3.7	3.5	3.7	3.6	3.7	3.7	3.4	3.5	3.4	3.5	42.6
Kettleman Hills	16.0	14.0	16.0	15.3	15.6	14.9	14.8	16.2	15.8	16.1	16.2	15.9	186.8
Long Beach	6.8	6.5	7.5	7.7	8.2	7.9	8.5	8.2	7.8	8.1	7.7	7.8	92.7
Santa Fe Springs	5.6	5.0	5.5	5.3	5.6	5.3	5.3	5.2	5.0	5.2	5.0	5.0	63.0
Ventura Avenue	5.6	5.0	4.8	4.8	5.0	4.9	4.7	4.8	4.8	5.3	5.4	5.5	60.6
Rest of State	19.0	17.4	19.0	18.5	18.2	17.3	17.2	18.1	17.4	18.0	17.6	17.5	215.2
Total, California	56.6	51.2	56.5	55.1	56.3	53.9	54.2	56.2	54.2	56.2	55.3	55.2	660.9
Total, United States	185.7	167.0	185.3	178.8	179.8	171.6	176.9	181.1	175.0	187.4	181.9	186.1	2,156.6
Daily average	6.0	6.0	6.0	6.0	5.8	5.7	5.7	5.8	5.8	6.0	6.1	6.0	5.9
1939 [1]													
Appalachian	7.5	6.8	7.0	6.0	5.0	3.7	3.7	4.0	4.5	6.2	7.6	8.3	70.3
Illinois, Kentucky, and Michigan	1.4	1.2	1.1	1.1	1.1	1.0	1.1	1.1	1.2	1.4	1.7	1.8	15.2
Oklahoma:													
Oklahoma City	9.6	8.1	9.4	9.1	9.2	9.2	8.5	5.8	7.9	9.3	8.6	8.9	103.6
Osage County	4.3	3.5	4.3	4.4	4.5	4.6	4.6	3.0	4.3	4.4	4.4	4.7	51.0
Seminole	10.0	8.9	10.4	10.8	11.5	11.0	10.8	7.0	9.7	10.3	9.8	10.1	120.3
Rest of State	14.7	12.9	14.3	13.6	14.1	13.2	13.5	9.5	12.6	14.1	13.6	13.8	159.9
Total, Oklahoma	38.6	33.4	38.4	37.9	39.3	38.0	37.4	25.3	34.5	38.1	36.4	37.5	434.8
Kansas	5.5	4.9	4.8	5.1	4.9	4.3	4.0	3.9	4.5	5.5	6.1	6.1	59.6
Texas:													
Gulf Coast	5.1	4.7	5.5	6.2	6.3	6.9	7.6	5.4	9.0	8.9	8.5	11.0	85.1
East Texas	14.4	12.9	15.2	17.0	17.7	17.1	18.4	9.4	16.7	18.4	16.0	15.1	188.3
North Texas	2.2	2.0	2.3	2.3	2.4	2.1	2.2	2.0	2.3	2.3	2.2	2.2	26.5
Panhandle	20.8	17.5	19.6	20.2	19.4	18.4	19.0	16.9	20.5	23.1	24.1	22.5	242.0
West-Central	5.9	5.1	5.9	5.7	5.2	5.2	5.3	4.6	5.3	5.7	5.6	5.4	64.9
Rest of State	7.1	6.2	7.3	8.4	8.7	8.7	9.1	5.4	9.0	9.4	8.9	9.7	97.9
Total, Texas	55.5	48.4	55.8	59.8	59.7	58.4	61.6	43.7	62.8	67.8	65.3	65.9	704.7
Louisiana	7.5	6.4	6.7	6.9	7.1	7.6	7.8	7.1	8.3	8.7	9.2	8.8	92.1
Arkansas	2.1	1.9	2.5	2.2	2.2	2.0	2.2	2.0	2.1	2.0	1.7	1.7	24.6
Rocky Mountain	7.0	6.2	7.6	7.5	8.0	7.9	7.9	5.4	7.4	8.2	7.4	7.2	87.7
California:													
Huntington Beach	3.2	2.8	3.0	2.9	3.1	2.7	2.8	2.8	2.7	2.8	2.6	2.7	34.1
Kettleman Hills	16.2	13.5	15.0	14.1	14.2	12.6	12.6	12.6	10.9	11.5	11.6	11.7	156.5
Long Beach	7.3	6.5	7.5	7.3	7.3	7.1	7.2	7.3	7.4	7.5	7.0	7.3	86.7
Santa Fe Springs	5.1	4.6	5.0	4.8	4.9	4.8	4.9	4.9	4.7	4.9	4.7	4.8	58.1
Ventura Avenue	5.1	4.8	5.3	4.8	5.0	5.1	5.1	5.1	5.0	5.6	5.5	5.6	62.0
Rest of State	17.1	16.0	18.0	17.3	18.0	16.8	17.1	17.6	17.5	18.0	17.5	18.3	209.2
Total, California	54.0	48.2	53.8	51.2	52.5	49.1	49.7	50.3	48.2	50.3	48.9	50.4	606.6
Total, United States	179.1	157.4	177.7	177.7	179.8	172.0	175.4	142.8	173.5	188.2	184.3	187.7	2,095.6
Daily average	5.8	5.6	5.7	5.9	5.8	5.7	5.7	4.6	5.8	6.1	6.1	6.1	5.7

[1] Subject to revision.

The monthly trend of production was fairly uniform over the first 7 months of 1939 but slumped drastically in August owing to the shutdown. An upward trend was discernible over the last 4 months.

California.—Production of natural gasoline in California decreased from 660,890,000 gallons in 1938 to 606,631,000 in 1939. This, the first decrease in output since 1933, reflects the downward trend in crude-oil production through proration rather than a declining gas supply.

The output of all the important fields or districts (except Ventura Avenue, in which new oil zones were opened), was less in 1939 than in the preceding year. Despite a 30-million gallon decrease in output, the Kettleman Hills field still ranks first among the producing fields; it produced slightly more than a fourth of the State total in 1939.

Louisiana.—With the decline of casinghead-gas production in the Rodessa field the output of natural gasoline continued to trend downward, although the decrease in 1939 was not as large as in 1938 because of the gain in production in the coastal district. The output in 1939 was 92,066,000 gallons compared with 95,634,000 in 1938 and with 106,415,000 in the peak year 1937.

Oklahoma.—The production of natural gasoline in Oklahoma during 1939 continued to fall more or less in consonance with the decline in crude-oil production. The output was 434,797,000 gallons compared with 468,499,000 gallons in 1938. As in the preceding year, production at Oklahoma City declined materially, Seminole held up remarkably well, and "Other districts" besides Osage County made the only gain.

Texas.—Production in Texas increased in 1939, the gain being relatively higher than in crude-oil production because of the increased use of recycling. The output reached a new record of 704,707,000 gallons compared with 685,920,000 in 1938. A year ago the statement was made that Texas probably would pass California as the leading producer of natural gasoline in 1939. Actually, final figures for 1938 show that Texas took first place in that year.

Natural gasoline produced in the United States, 1935–39, by States, in thousands of gallons

Year	Arkansas	California	Colorado	Illinois	Kansas	Kentucky	Louisiana	Michigan	Montana	New Mexico
1935	13,076	534,624	417	2,642	32,507	5,614	49,732	1,850	1,739	19,563
1936	11,957	593,416	451	2,337	37,775	6,009	72,687	2,015	2,071	28,921
1937	11,285	623,894	404	2,567	57,026	7,344	106,415	2,408	2,296	38,253
1938	25,648	660,890	386	2,436	55,988	7,040	95,634	3,581	1,768	49,596
1939 [1]	24,631	606,631	310	3,817	59,567	8,464	92,066	2,983	2,161	54,555

Year	New York	Ohio	Oklahoma	Pennsylvania	Texas	West Virginia	Wyoming	Total: Thousands of gallons	Total: Value at plant: Thousands of dollars	Total: Value at plant: Average per gallon (cents)
1935	27	6,232	379,913	12,623	516,748	42,433	32,246	1,651,986	70,940	4.3
1936	22	6,991	418,591	14,267	520,547	44,389	33,894	1,796,340	84,572	4.7
1937	33	7,704	492,290	13,940	615,281	50,379	[2] 33,915	2,065,434	97,125	4.7
1938	27	7,382	468,499	10,734	685,920	50,398	[2] 30,647	2,156,574	87,266	4.0
1939 [1]	34	7,444	434,797	12,178	704,707	50,612	[2] 30,675	2,095,632	94,300	4.5

[1] Subject to revision. [2] Includes Utah.

The output of the Texas Panhandle, the leading producing district of the country, declined slightly in 1939, but that of the East Texas field gained, passing Kettleman Hills as the second ranking field. However, the largest gains in Texas were in the Gulf Coast—the result of rapidly expanding recycling operations—and in "Other districts."

Other States.—Arkansas did not continue the substantial gain in output attained during 1938; in fact, output declined slightly in 1939. There was a material increase in Illinois although the general character of the gas production in the new fields of that State is not particularly attractive to plant operators. Kansas and New Mexico reached new peaks in production in 1939. West Virginia and Wyoming made slight gains, the former because of the Oriskany gas development, the latter as a consequence of the gain in crude-oil production.

Natural gasoline produced and natural gas treated in the United States in 1938, by States [1]

State	Number of operators [2]	Number of plants operating	Natural gasoline produced: Thousands of gallons	Value at plants: Thousands of dollars	Value at plants: Average per gallon (cents)	Natural gas treated: Millions of cubic feet	Natural gas treated: Average yield per M cubic feet (gallons)
Arkansas	7	8	25,648	905	3.5	21,377	1.20
California	36	96	660,890	41,085	6.2	398,187	1.66
Colorado	2	2	386	10	2.6	145	2.66
Illinois	20	51	2,436	124	5.1	1,110	2.19
Kansas	12	19	55,988	1,603	2.9	144,631	.39
Kentucky	6	7	7,040	364	5.2	38,446	.18
Louisiana	17	28	95,634	3,026	3.2	116,331	.82
Michigan	1	1	3,581	107	3.0	1,395	2.57
Montana	1	1	1,768	113	6.4	7,126	.25
New Mexico	5	6	49,596	1,415	2.9	97,830	.51
New York	1	1	27	2	7.4	65	.42
Ohio	7	12	7,382	377	5.1	28,488	.26
Oklahoma	57	137	468,499	14,373	3.1	265,746	1.76
Pennsylvania	58	95	10,734	526	4.9	22,600	.47
Texas	70	146	685,920	19,781	2.9	752,784	.91
West Virginia	24	79	50,398	2,063	4.1	122,301	.41
Wyoming	5	7	30,024	1,364	4.5	17,000	1.77
Utah			623	28	4.5		
Total, 1938	[2] 266	696	2,156,574	87,266	4.0	2,035,562	1.06
1937	[2] 249	696	2,065,434	97,125	4.7	2,108,800	.98

[1] Complete figures for 1939 not yet available.
[2] A producer operating in more than 1 State is counted only once.

CONSUMPTION AND MOVEMENTS

The indicated demand for natural gasoline in 1939 may reach 2,130,000,000 gallons, or about 1 percent below that in 1938. The refinery utilization probably will exceed 1,700,000,000 gallons. This represents about 80 percent of the total, or about the same proportion as in 1938. Exports and "direct" shipments declined in relative importance; this loss automatically raises the percentage for "Losses."

Distribution of natural gasoline in the United States, 1938–39, by months, in thousands of gallons

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1938													
Production	185,724	166,950	185,304	178,794	179,844	171,654	176,904	181,062	175,014	187,362	181,860	186,102	2,156,574
Decrease in all stocks										58,296	43,218	38,304	
	185,724	166,950	185,304	178,794	179,844	171,654	176,904	181,062	175,014	245,658	225,078	224,406	2,156,574
Used at refineries [1]	145,950	111,174	130,158	114,576	112,140	105,630	119,574	115,962	135,534	181,734	173,040	176,232	1,621,704
Run through pipe lines in California	3,444	3,402	5,628	5,376	5,418	5,040	3,696	7,938	4,284	4,410	4,284	3,738	56,658
Exports [2]	10,878	26,418	16,758	21,588	26,712	16,380	20,832	31,500	11,298	30,618	14,406	29,526	256,914
Direct shipments to consumers	12,096	11,928	13,020	10,206	11,130	11,508	9,702	10,164	12,054	12,600	12,684	10,878	137,970
Increase in stocks	8,106	2,772	21,588	27,216	15,498	16,926	27,846	17,136	5,754				3,024
Losses	5,250	11,256	−1,848	−168	8,946	16,170	−4,746	−1.638	6,090	16,296	20,664	4,032	80,304
	185,724	166,950	185,304	178,794	179,844	171,654	176,904	181,062	175,014	245,658	225,078	224,406	2,156,574
1939 [3]													
Production	179,088	157,374	177,744	177,744	179,760	171,990	175,350	142,800	173,544	188,202	184,296	187,740	2,095,632
Decrease in stocks	7,686							20,958	30,786	31,542	23,562	6,636	17,178
	186, 774	157,374	177,744	177,744	179,760	171,990	175,350	163,758	204,330	219,744	207,858	194,376	2,112,810
Used at refineries [1]	149,226	132,090	131,838	121,254	106,680	108,780	118,188	125,916	131,418	179,298	176,148	164,430	1,645,266
Run through pipe lines in California	3,528	3,528	4,368	4,032	4,452	3,864	3,990	3,948	4,536	3,738	3,864	4,326	48,174
Exports [2]	21,924	5,880	24,570	20,748	9,366	14,952	19,614	16,422	18,732	12,810	3,864	3,780	172,662
Direct shipments to consumers	9,240	8,904	12,138	9,996	10,962	9,450	10,122	8,694	9,660	11,214	11,130	9,618	121,128
Increase in stocks		2,562	546	32,046	30,576	22,554	15,708						
Losses	2,856	4,410	4,284	−10,332	17,724	12,390	7,728	8,778	39,984	12,684	12,852	12,222	125,580
	186,774	157,374	177,744	177,744	179,760	171,990	175,350	163,758	204,330	219,744	207,858	194,376	2,112,810

[1] Includes quantities run through pipe lines east of California.
[2] Figures compiled by the Bureau of Foreign and Domestic Commerce.
[3] Subject to revision.

Refinery utilization.—The proportion of natural gasoline in refinery gasoline, an important index as to whether natural gasoline is maintaining its relative importance, dropped to 6.8 percent in 1939 from 7.2 percent in 1938, bringing the percentage to about the level that prevailed during 1935 and 1936.

Blending of natural gasoline increased in 1939 in the East Coast, Appalachian, Indiana-Illinois, Texas Gulf Coast, and California districts, but of these only the first and last gained in the percentage of total refinery-gasoline production.

Percent of natural gasoline in refinery gasoline in the United States, 1935–39, by districts

Year	East Coast	Appalachian	Indiana, Illinois, Kentucky	Oklahoma, Kansas, Missouri	Texas Inland	Texas Gulf Coast	Louisiana Gulf Coast	Arkansas and Louisiana Inland	Rocky Mountain	California	Total
1935	2.0	1.6	4.1	10.1	12.5	2.7	1.8	5.7	7.9	16.1	6.7
1936	1.6	1.6	4.4	9.7	11.5	3.9	1.8	5.4	7.8	15.5	6.7
1937	1.9	1.8	4.3	8.5	13.1	5.3	4.6	6.5	6.1	15.7	7.0
1938	1.6	1.4	4.7	8.8	15.5	4.3	2.2	6.8	5.8	17.6	7.2
1939 [1]	2.7	1.4	4.1	7.8	14.3	4.0	1.8	5.0	4.7	18.0	6.8

[1] Subject to revision.

"Direct" sales.—The sale of low-pressure natural gasoline directly to consumers, attractive in theory, has proved generally uneconomic in practice, probably because of the difficulty of meeting certain motor-fuel specifications. Anyway, sales to jobbers and retailers dropped from 137,970,000 gallons in 1938 to 121,128,000 in 1939; however, this decline may be halted in 1940, as more complete reports on recycle plants may reduce "Losses" and raise direct shipments.

Texas led in total direct sales, although shipments from Oklahoma to Illinois constituted the largest single interstate movement. Direct sales from Louisiana made the largest relative increase in 1939.

Water-borne shipments.—Exports of natural gasoline, as reported to the Bureau of Foreign and Domestic Commerce and as used in this publication, dropped from 256,914,000 gallons in 1938 to 172,662,000 in 1939. Bureau of Mines export figures, formerly used in this publication, were 202,230,000 and 167,806,000 gallons, respectively. The largest export movement continued to be that to the Netherland West Indies, with exports to United Kingdom, Canada, and France following in that order. Japan took about 7,600,000 gallons, or less than half as much as in 1938. Germany took none, but exports of about 4,250,000 gallons to Italy represented a substantial rise over 1938. Although the war-risk situation apparently should have favored movement from the West coast, that movement declined more than 40 percent in 1939 (from 54,000,000 gallons in 1938 to 30,000,000 in 1939), whereas movement from points east of California was only about 30 percent less than in 1938.

Natural gasoline utilized at refineries in the United States, 1938–39, by districts and months, in thousands of gallons

District	January	February	March	April	May	June	July	August	September	October	November	December	Total
1938													
East Coast	5,754	3,654	4,620	2,520	1,932	2,772	2,310	3,360	5,712	5,544	5,628	6,510	50,316
Appalachian	1,176	966	798	672	714	756	924	1,092	966	966	1,092	1,176	11,298
Indiana, Illinois, Kentucky, etc.	15,414	12,348	14,658	12,348	13,104	11,970	14,448	12,474	18,060	20,748	23,352	19,572	188,496
Oklahoma, Kansas, and Missouri	21,882	19,614	21,966	15,036	15,162	15,540	16,464	17,598	24,444	28,560	24,318	21,840	242,424
Texas:													
Gulf Coast	29,064	12,768	17,430	20,496	17,976	15,540	19,278	17,808	14,364	27,720	29,274	32,928	254,646
Inland	23,226	24,276	22,092	20,748	22,470	21,462	20,034	19,950	21,084	26,460	29,400	27,048	278,250
Total, Texas	52,290	37,044	39,522	41,244	40,446	37,002	39,312	37,758	35,448	54,180	58,674	59,976	532,896
Louisiana-Arkansas:													
Louisiana Gulf Coast	2,142	1,764	2,310	1,554	1,008	630	714	1,008	1,302	840	1,470	1,302	16,044
Arkansas and Louisiana Inland	2,478	2,688	2,478	2,016	2,310	2,352	2,982	2,898	2,856	3,192	2,814	1,890	30,954
Total, Louisiana-Arkansas	4,620	4,452	4,788	3,570	3,318	2,982	3,696	3,906	4,158	4,032	4,284	3,192	46,998
Rocky Mountain	3,696	3,318	3,192	2,100	1,302	966	1,344	1,344	2,436	4,200	5,040	4,788	33,726
California	44,562	33,180	46,242	42,462	41,580	38,682	44,772	46,368	48,594	67,914	54,936	62,916	572,208
Total, United States	149,394	114,576	135,786	119,952	117,558	110,670	123,270	123,900	139,818	186,144	177,324	179,970	1,678,362
1939 [1]													
East Coast	7,182	5,964	5,712	5,124	5,460	6,132	8,484	7,392	8,442	9,240	11,172	9,576	89,880
Appalachian	966	756	1,596	756	588	756	714	672	1,008	1,386	1,512	1,764	12,474
Indiana, Illinois, Kentucky, etc.	15,498	12,474	13,020	11,298	15,246	13,734	14,910	12,306	18,774	21,966	21,630	18,816	189,672
Oklahoma, Kansas, and Missouri	19,236	16,170	15,876	14,154	15,414	15,288	15,330	17,388	16,926	22,932	22,218	23,772	214,704
Texas:													
Gulf Coast	23,226	19,656	16,800	27,384	12,600	9,870	12,516	18,312	20,370	36,918	30,702	28,476	256,830
Inland	24,990	21,168	20,454	17,514	18,774	17,556	18,396	17,724	13,902	33,264	29,148	27,048	259,938
Total, Texas	48,216	40,824	37,254	44,898	31,374	27,426	30,912	36,036	34,272	70,182	59,850	55,524	516,768
Louisiana-Arkansas:													
Louisiana Gulf Coast	1,596	798	882	1,260	966	1,386	1,386	1,218	1,302	1,218	1,092	756	13,860
Arkansas and Louisiana Inland	1,386	1,638	1,764	1,344	1,302	1,596	2,058	1,638	1,806	2,856	2,646	2,352	22,386
Total, Louisiana-Arkansas	2,982	2,436	2,646	2,604	2,268	2,982	3,444	2,856	3,108	4,074	3,738	3,108	36,246
Rocky Mountain	3,234	2,646	2,982	2,184	1,260	1,134	1,008	1,596	2,100	3,444	4,326	3,948	29,862
California	55,440	54,348	57,120	44,268	39,522	45,192	47,376	51,618	51,324	49,812	55,566	52,248	603,834
Total, United States	152,754	135,618	136,206	125,286	111,132	112,644	122,178	129,864	135,954	183,036	180,012	168,756	1,693,440

[1] Subject to revision.

Shipments of natural gasoline to jobbers, retailers, and refinery-owned bulk plants in the United States in 1939, by States, in thousands of gallons [1]

State from which natural gasoline was transported	State to which natural gasoline was transported							Total
	Texas	Oklahoma	Illinois	Ohio	Arkansas	Minnesota	Other States	
Texas	37,789	203	1,694	170		6,040	11,324	57,220
Oklahoma	508	14,020	12,537	167	120	2,092	7,080	36,524
West Virginia			98	6,470			18,249	24,817
Arkansas					11,426		1,194	12,620
Louisiana	3,277	900	8		208	62	7,554	12,009
Kansas		1,512	57			2,206	1,614	5,389
Other States			438	7,780			14,269	22,487
	41,574	16,635	14,832	14,587	11,754	10,400	61,284	171,066

[1] Subject to revision.

STOCKS

Unlike the situation in the gasoline industry, stocks of natural gasoline declined during 1939—from 202,860,000 gallons on January 1 to 185,682,000 on December 31. The monthly trend of stocks in 1939 followed the usual seasonal pattern, with sharp increases in the second quarter and material decreases in the last quarter. It is noteworthy that if there had been no shut-down of crude-oil production in August the usual increase in stocks probably would have occurred during that month, and stocks would have increased over the year.

The relationship of the trends of stocks and posted prices was quite close in 1939, particularly in August, when the shut-down caused a rise of 1 cent per gallon.

Stocks of natural gasoline in the United States, 1938–39, by months, in thousands of gallons

Date	At refineries				At plants and terminals				Total	
	California		Other States		Texas		Other States			
	1938	1939 [1]	1938	1939 [1]	1938	1939 [1]	1938	1939 [1]	1938	1939 [1]
Jan. 1	81,774	108,696	24,654	17,136	57,988	48,397	35,420	28,631	199,836	202,860
Jan. 31	86,604	102,942	20,874	16,044	61,233	46,306	39,231	29,882	207,942	195,174
Feb. 28	98,196	92,022	25,746	12,348	47,159	61,095	39,613	32,271	210,714	197,736
Mar. 31	103,362	83,958	28,518	17,262	59,625	58,597	40,797	38,465	232,302	198,282
Apr. 30	108,780	87,570	26,964	19,572	74,600	72,316	49,174	50,870	259,518	230,328
May 31	118,398	96,852	24,570	22,260	77,410	81,413	54,638	60,379	275,016	260,904
June 30	129,360	95,298	24,696	24,234	77,595	97,068	60,291	66,858	291,942	283,458
July 31	134,358	93,156	25,284	26,082	96,756	110,681	63,390	69,247	319,788	299,166
Aug. 31	136,752	88,200	27,090	26,712	110,698	106,680	62,384	56,616	336,924	278,208
Sept. 30	138,726	81,270	26,544	26,040	122,584	96,022	54,824	44,090	342,678	247,422
Oct. 31	123,732	73,416	23,268	22,932	98,278	82,896	39,104	36,636	284,382	215,880
Nov. 30	120,624	64,512	18,732	22,680	71,896	72,800	29,912	32,326	241,164	192,318
Dec. 31	108,696	59,136	17,136	17,430	48,397	78,492	28,631	30,624	202,860	185,682

[1] Subject to revision.

TECHNICAL DEVELOPMENTS

Recycling plants.—Facilities for the recovery of "condensate" from high-pressure reservoirs were expanded rapidly during 1939.

Better understanding of "retrograde condensation" and of the phase relations of the lighter hydrocarbons (under varying reservoir conditions) indicated the need for maintaining pressure during condensate-producing operations. It was found that there were material underground losses of the recoverable liquid fractions if reservoir pressures were allowed to fall below certain critical points. Hence recycling plants were developed to remove condensate by absorption and refrigeration at very high pressures (usually above 1,000 pounds) and to return the stripped gas to the reservoir to maintain its pressure.

In January 1939, 8 such plants were operating in Texas, recovering 2,235 barrels per day of condensate from an average of 116.4 million cubic feet of gas; in December 1939, 22 plants reported daily recovery of 6,612 barrels from a volume of 470.4 million cubic feet. About 90 percent of the volume of gas withdrawn from the producing sands was returned. The data above are based upon reports of the Railroad Commission of Texas.

As a large number of gas-condensate fields have been discovered and await exploitation, much additional expansion of recycling activities is in prospect.

There is great diversity in the manner of marketing condensate from the various plants. The principal factors that control the method of disposing of the product are situation of plants, specifications of the liquid produced, and facilities owned or available to plant owners. Some plants are equipped with stabilizing or fractionating units and produce a finished motor fuel that is sold wholesale or retail. Others sell raw condensate, which is mixed with crude oil or natural gasoline in pipelines or shipped by tank cars and trucks to refineries or natural-gasoline terminals.

Yields.—As predicted a year ago the average yield of natural gasoline increased in 1938, when it was 1.06 gallons per thousand cubic feet compared with 0.98 gallon in 1937. This increase was related to the gain in the relative importance of the East Texas field, a high-yield area. In 1939 the yield is expected to fall to about 1.00 gallon, as State figures for Texas indicate a sizable decrease, owing both to enlarged pipeline takings in the Panhandle and to the spread of recycling. Yields from recycling are relatively low, and probably the average is less than 0.75 gallon per thousand.

Production by processes.—In 1939 the number of compression plants again declined, and the number of absorption plants again increased, but the number of charcoal plants remained at 9. Production by the absorption process increased and by the other two processes decreased during 1939.

Trends in vapor pressures.—The weighted average vapor pressure of all shipments of natural gasoline, which had been dropping steadily, increased from 19.6 pounds in 1938 to 20.1 in 1939. This gain was all in refinery shipments, as the weighted average for "direct" shipments fell from 15.6 pounds in 1938 to 14.6 in 1939 and for exports from 17.2 pounds to 16.7.

Technical improvements.—The year 1939 probably witnessed as many activities in the chemistry of the lighter hydrocarbons as any previous 12 months. Although most of the work on alkalization, isomerization, and similar problems was done at refineries, the natural-gasoline industry is bound to play a large part in any program involving use of the fractions generally termed "liquefied petroleum gases" as the base for motor-fuel production.

Natural gasoline produced in the United States in 1938, by States and by methods of manufacture [1]

State	Number of plants operating			Production (thousands of gallons)		
	Compression	Absorption [2]	Charcoal	Compression	Absorption [2]	Charcoal
Arkansas		8			25,648	
California	2	94		2,200	658,690	
Colorado	1	1		176	210	
Illinois	51			2,436		
Kansas	4	15		2,058	53,930	
Kentucky	3	3	1	4	6,552	484
Louisiana	3	25		2,731	92,903	
Michigan		1			3,581	
Montana		1			1,768	
New Mexico		6			49,596	
New York	1			27		
Ohio	5	6	1	48	5,820	1,514
Oklahoma	34	103		47,752	420,747	
Pennsylvania	80	14	1	2,682	7,880	172
Texas	26	120		111,997	573,923	
West Virginia	51	22	6	10,456	35,281	4,661
Wyoming	3	4		26,331	3,693	
Utah					[3] 623	
Total: 1938	264	423	9	208,898	1,940,845	6,831
1937	277	410	9	228,419	1,828,421	8,594

[1] Figures for 1939 not yet available.
[2] Includes combination of absorption process with compression and charcoal processes.
[3] Drip gasoline.

LIQUEFIED PETROLEUM GASES [2]

The trend in sales of liquefied petroleum gases, which had showed some slackening in 1938, again turned sharply upward in 1939 with domestic sales totaling 223,580,000 gallons. The improved demand for liquefied petroleum gases in 1939 is indicated by the 35-percent gain over the 1938 total of 165,201,000 gallons, which in turn was 17 percent above domestic requirements in 1937. The expansion in the market in 1939 measures up to gains of 33 and 39 percent, respectively, in 1937 and 1936. All important uses of these gases showed marked advances in 1939 over 1938, with the exception of chemical manufacturing. Sales of "bottled gas," which makes it possible to employ modern kitchen equipment in rural districts beyond the city gas mains, rose over 50 percent in 1939. Gas companies, which use liquefied petroleum gases for enriching manufactured gas or for direct distribution through their mains, increased their purchases of these gases 37 percent in 1939. Industrial demand, which declined in 1938 compared with 1937, made an outstanding gain of 59 percent in 1939, as manufacturing activities again advanced. The spread in their use as motor fuel, especially in western areas, is evidenced by a 37-percent increase in deliveries for this purpose in 1939. The quantity of liquefied petroleum gases required for chemical manufacturing was reported as 20 percent below the 1938 total.

Exports of liquefied petroleum gases, which have fallen steadily since 1936, again turned upward in 1939, and the total—1,570,000 gallons—is approximately double the quantity in 1938. Distributors supplied a domestic and export demand of 225,100,000 gallons in 1939, a 36-percent gain over the 1938 total of 166,026,000 gallons.

[2] By A. T. Coumbe, Petroleum Economics Division, Bureau of Mines.

Sales of liquefied petroleum gases in the United States, 1933–39, in thousands of gallons

Year	Propane	Butane	Propane-butane mixtures	Pentane	Total
1933	15,835	19,056	3,226	814	38,931
1934	18,681	25,553	10,271	1,922	56,427
1935	26,814	34,084	13,493	2,464	76,855
1936	36,502	40,200	27,375	2,575	106,652
1937	46,474	45,399	46,694	2,833	141,400
1938	54,130	52,768	56,050	2,253	165,201
1939 [1]	79,323	71,351	69,020	3,886	223,580

[1] Subject to revision.

Sales of liquefied petroleum gases in the United States, 1938–39, by uses, by methods of transportation, and regional distribution, in thousands of gallons

	Propane	Butane	Propane-butane mixtures	Pentane	Total	Percent
1938						
By uses:						
Domestic	37,556	13,194	6,316	766	57,832	35.0
Gas manufacturing	1,491	8,270	1,538	8	11,307	6.8
Industrial fuel	14,316	23,405	1,404	16	39,141	23.7
Chemical manufacturing	347	43	30,496	1,413	32,299	19.6
Internal-combustion-engine fuel	380	5,025	16,296		21,701	13.1
All other uses	40	2,831		50	2,921	1.8
	54,130	52,768	56,050	2,253	165,201	100.0
Percent of total	32.8	31.9	33.9	1.4	100.0	100.0
By methods of transportation:						
Bulk	22,420	50,050	53,665	1,926	128,061	77.5
Cylinders and drums	31,710	2,718	2,385	327	37,140	22.5
	54,130	52,768	56,050	2,253	165,201	100.0
Regional distribution:						
Pacific Coast area	6,983	8,072	20,083		35,138	21.3
All other areas	47,147	44,696	35,967	2,253	130,063	78.7
	54,130	52,768	56,050	2,253	165,201	100.0
1939 [1]						
By uses:						
Domestic	52,533	17,881	16,093	1,023	87,530	39.2
Gas manufacturing	2,083	9,796	3,483	73	15,435	6.9
Industrial fuel	23,685	36,388	2,155	112	62,340	27.9
Chemical manufacturing	249	42	23,957	2,644	26,892	12.0
Internal-combustion-engine fuel	663	5,850	23,279		29,792	13.3
All other uses	110	1,394	53	34	1,591	.7
	79,323	71,351	69,020	3,886	223,580	100.0
Percent of total	35.5	31.9	30.9	1.7	100.0	100.0
By methods of transportation:						
Bulk	36,218	69,453	61,695	3,447	170,813	76.4
Cylinders	43,105	1,898	7,325	439	52,767	23.6
	79,323	71,351	69,020	3,886	223,580	100.0
Regional distribution:						
Pacific Coast area	7,891	12,916	27,690		48,497	21.7
All other areas	71,432	58,435	41,330	3,886	175,083	78.3
	79,323	71,351	69,020	3,886	223,580	100.0

[1] Subject to revision.

Domestic deliveries of liquefied petroleum gases in 1938 comprised approximately equal portions of propane, butane, and propane-butane mixtures; however, in 1939 (probably owing to the large increase in the demand for "bottled gas," which is predominantly propane) the proportion of total sales accredited to propane increased from 33 to about 36 percent, and there was a corresponding drop in propane-butane mixtures from 34 percent of total sales in 1938 to 31 percent in 1939. The proportion of pentane in domestic deliveries is comparatively small; however, the percentage gained slightly in 1939 over 1938.

Except for the larger sales of the relatively unimportant pentane, sales of propane made the greatest proportionate gain in 1939, increasing 47 percent, or from 54,130,000 gallons in 1938 to 79,323,000 in 1939. Deliveries of butane, reported as 71,351,000 gallons in 1939, were 35 percent above the 1938 total, while the demand for propane-butane mixtures was 23 percent above, rising from 56,050,000 gallons in 1938 to 69,020,000 in 1939. Sales of pentane, a petroleum gas of chief importance to chemical manufactures, increased greatly in 1939 to 3,886,000 gallons, a 72-percent gain over the quantity in 1938.

The rapid growth in demand for "bottled gas" is revealed in the constantly increasing proportion of total liquefied-petroleum-gas sales required for this trade. In 1937 about 29 percent of the total deliveries of liquefied petroleum gases was reported for domestic consumption; this share increased to 35 percent in 1938 and to over 39 percent of all requirements in 1939. Gas companies absorbed about 7 percent of deliveries in 1938 and 1939 compared with 8 percent in 1937. The use of these gases as industrial fuel declined from 31 percent of the total demand in 1937 to 24 percent in 1938 but, with increased manufacturing activities, rose to 28 percent in 1939. About 20 percent of the sales were credited to chemical plants in 1937 and 1938; however, this share dropped to 12 percent in 1939. Sales items for recent years show a slowly increasing proportion consumed as fuel for internal-combustion engines, a use that has increased from 12 percent of total deliveries in 1937 to over 13 percent in both 1938 and 1939.

The demand for propane increased from 54,130,000 gallons in 1938 to 79,323,000 in 1939. As in former years, the larger share of propane deliveries was reported for domestic or household use; deliveries for industrial fuel use ranked second. The proportion credited to domestic sales was 66 percent in 1939 compared to 69 percent of the total in 1938 and 65 percent in 1937. It is believed that the percentage sold for domestic use during 1938 was larger because of the slackened industrial fuel demand in that year. This shift likewise is shown in the percentages of total propane sales reported for industrial consumption in the corresponding years, as follows: 31 percent in 1937, 26 percent in 1938, and an increase to 30 percent of all propane sales in 1939.

The marketed production of butane increased from 52,768,000 gallons in 1938 to 71,351,000 in 1939. The larger part of marketed production of butane is consumed as an industrial fuel; however, the percentage of total sales reported under that classification dropped from 62 percent in 1937 to 44 percent in 1938 and then reverted to 51 percent in 1939, as manufacturing activities expanded. Twenty-five percent of the total butane deliveries was accredited to domestic consumption in 1938 and 1939, or about double the 1937 share employed for the same purpose. This upward trend is due largely to mounting consumption of butane as a household fuel in south central areas, where natural gas is not readily available. The percentage of the butane total sold to gas-manufacturing companies has decreased gradually from over 16 percent in 1937 to 14 percent in 1939.

Sales of propane-butane mixtures reported totaled 69,020,000 gallons in 1939 compared with 56,050,000 in 1938. In 1937 and 1938 slightly more than half of all deliveries of propane-butane mixtures were made to manufacturers of chemicals, but in 1939 this proportion declined to about one-third of the total. Liquefied petroleum gases used as motor fuel are predominantly a mixture of propane and butane. Propane-butane mixtures consumed as internal-combustion-engine fuel constitute about one-third of all such sales; however, the proportion declined to 29 percent in 1938 and then returned to 34 percent of the total demand during 1939. The domestic or "bottled-gas" market is taking a rapidly expanding share of total deliveries of propane-butane mixtures. The percentage of all sales of propane-butane mixtures credited to domestic use has increased from about 8 percent in 1937 to over 23 percent in 1939.

The demand for pentane increased from 2,253,000 gallons in 1938 to 3,886,000 in 1939. Most of the marketed production of pentane is used as solvents and raw material in the manufacture of chemicals, and the quantity diverted to this trade rose from 63 percent of all sales of pentane in 1938 to 68 percent in 1939.

The American Gas Association is the source of the following statistics covering the distribution of liquefied petroleum gases by manufactured-gas companies:

At the end of 1939, liquefied petroleum gas was being delivered through mains to consumers in 178 communities in 30 States by 82 companies supplying 49,800 customers.

Butane-air gas with heating value ranging from 520 to 1,000 B.t.u. per cu. ft. was supplied to 125 communities in 30 States by 72 companies. A mixture of undiluted butane and propane gas with a heating value of 2,800 to 3,000 B.t.u per cu. ft. was supplied to 12 communities in California by 5 companies. Undiluted propane gas with a heating value of 2,550 B.t.u. per cu. ft. was supplied to 41 communities in Maryland, Minnesota, New Jersey, North Dakota, Virginia, and Wisconsin by 6 companies.

The rapidly expanding household demand for liquefied petroleum gases is again indicated in the mounting percentage of shipments in cylinders and drums compared to corresponding losses in the share of bulk distribution. Gases handled in cylinders comprised 23.6 percent of the marketed production in 1939 compared to 22.5 percent in 1938 and 21.2 percent in 1937. It is noted from a second angle that 96.5 percent of all shipments in cylinders during 1939 were reported for domestic use compared to 95.4 percent of the 1938 total so shipped.

CARBON BLACK

By G. R. Hopkins and H. Backus

SUMMARY OUTLINE

Under the stimulus of the war and the recovery in rubber production the carbon-black industry reached record levels in all phases of

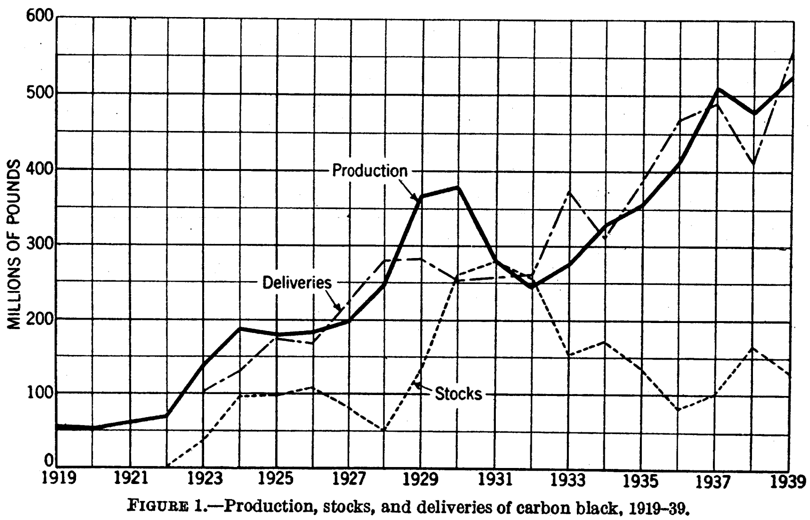

Figure 1.—Production, stocks, and deliveries of carbon black, 1919–39.

production and consumption in 1939. The output was 525,166,000 pounds, 10 percent more than in 1938, and sales totaled 560,533,000 pounds, 36 percent more than in 1938. The position of stocks improved considerably, but prices continued distressingly low. The domestic price rallied slightly, but the trend of export quotations continued downward. The average f. o. b. price rose from 2.41 cents per pound in 1938 to 2.45 cents in 1939—about enough to cover the increase in the average price of gas from 0.89 cent per thousand cubic feet in 1938 to 0.94 cent in 1939. Increases up to a quarter of a cent on domestic quotations on April 1, 1940, were heartening.

Figure 1 shows the sharp recovery in production and deliveries from the slump of 1938.

Salient statistics of carbon black produced from natural gas in the United States, 1935–39

	1935	1936	1937	1938	1939
Number of producers reporting	21	20	24	24	22
Number of plants	54	54	57	55	49
Quantity produced:					
By States and districts:					
Louisiana pounds	64,875,000	59,201,000	66,381,000	39,534,000	51,734,000
Texas:					
Panhandle district do	263,361,000	321,576,000	405,247,000	382,369,000	410,130,000
Rest of State do	[1] 24,513,000	12,330,000	15,821,000	34,735,000	43,044,000
Total Texas do	[1] 287,874,000	333,906,000	421,068,000	417,104,000	453,174,000
Other States do	(1)	18,238,000	23,157,000	20,401,000	20,258,000
Total United States do	352,749,000	411,345,000	510,606,000	477,039,000	525,166,000
By processes:					
Channel process do	316,284,000	366,876,000	444,427,000	441,284,000	464,588,000
Other processes [2] do	36,465,000	44,469,000	66,179,000	35,755,000	60,578,000
Stocks held by producers Dec. 31 pounds	136,086,000	79,582,000	100,497,000	166,159,000	130,792,000
Losses do	926,000	113,000	76,000	[3] 65,000	------------
Quantity sold:					
Domestic deliveries:					
To rubber companies do	213,708,000	278,018,000	269,584,000	217,231,000	316,621,000
To ink companies do	15,177,000	17,787,000	18,116,000	14,131,000	21,929,000
To paint companies do	6,550,000	6,914,000	6,159,000	4,229,000	6,382,000
For miscellaneous purposes do	9,916,000	10,299,000	11,503,000	7,883,000	11,773,000
Total domestic sold do	245,351,000	313,018,000	305,362,000	243,474,000	356,705,000
Export do	142,185,000	154,718,000	184,253,000	167,968,000	203,828,000
Total sold do	387,536,000	467,736,000	489,615,000	411,442,000	560,533,000
Value (at plants) of carbon black produced:					
Total	$13,755,000	$16,110,000	$17,389,000	$11,486,000	$12,857,000
Average per pound cents	3.90	3.92	3.41	2.41	2.45
Estimated quantity of natural gas used M cubic feet	241,589,000	283,421,000	341,085,000	324,950,000	347,270,000
Average yield of carbon black per M cubic feet pounds	1.46	1.45	1.50	1.47	1.51
Average value of natural gas used per M cubic feet cents	1.57	1.30	1.26	.89	.94

[1] Oklahoma and Wyoming included with "Texas: Rest of State."
[2] Lewis, roller, "Special," and thermatomic. [3] Gain.

PRODUCTION

By States.—Production in Louisiana, which declined so materially in 1938 as to foreshadow disappearance of the industry in a few years, scored a notable come-back in 1939, rising to 51,734,000 pounds compared with 39,534,000 in 1938. Production in Kansas and Oklahoma continued at about 20 million pounds. Texas production rose to a new peak of 453,174,000 pounds—9 percent (36,070,000 pounds) above 1938. In 1939 the output in the Panhandle was 410,130,000 pounds, equivalent to 91 percent of the State total compared with 92 percent in 1938. Wyoming, which has been a producer since the first statistics were collected in 1919, ceased to produce in 1939.

By months.—According to estimates based upon monthly figures of the National Gas Products Association, the monthly output of carbon black averaged just above 40 million pounds until the last quarter, when under the stimulus of the war it increased to nearly 50 million pounds.

Carbon black produced from natural gas in the United States, 1935–39, by States

Year	Production (thousands of pounds)				Average value per pound (cents)
	Louisiana	Texas	Other States	Total	
1935	64,875	[1] 287,874	(1)	352,749	3.90
1936	59,201	333,906	[2] 18,238	411,345	3.92
1937	66,381	421,068	[3] 23,157	510,606	3.41
1938	39,534	417,104	[3] 20,401	477,039	2.41
1939	51,734	453,174	[4] 20,258	525,166	2.45

[1] Oklahoma and Wyoming included with Texas.
[2] Oklahoma and Wyoming.
[3] Kansas, Oklahoma, and Wyoming.
[4] Kansas and Oklahoma.

Carbon black produced from natural gas in the United States in 1939, by States and by major producing districts

State and district	Producers reporting [1]	Number of plants	Production: Pounds	Value at plant: Total	Value at plant: Average cents	Natural gas used: M cubic feet	Average yield per M cubic feet (pounds)	Value: Total	Value: Average per M cubic feet (cents)
Kansas	1	1	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Louisiana: Monroe-Richland district (Morehouse and Ouachita Parishes)	6	7	51,734,000	$1,871,000	3.62	21,777,000	2.38	$631,000	2.90
Oklahoma	3	3	[2] 20,258,000	[2] 529,000	[2] 2.61	[2] 11,872,000	[2] 1.71	[2] 163,000	[2] 1.37
Texas:									
Panhandle district (Carson, Gray, Hutchinson, Moore, and Wheeler Counties)	18	31	410,130,000	9,492,000	2.31	287,880,000	1.42	2,324,000	.81
Rest of State (Nueces, Stephens, Ward, and Winkler Counties)	5	7	43,044,000	965,000	2.24	25,741,000	1.67	145,000	.56
Total, Texas	[1] 18	38	453,174,000	10,457,000	2.31	313,621,000	1.44	2,469,000	.79
Total United States	[1] 22	49	525,166,000	12,857,000	2.45	347,270,000	1.51	3,263,000	.94

[1] In counting the total number of producers a producer operating in more than 1 State, district, or county is counted only once.
[2] Kansas included with Oklahoma.

Carbon black produced from natural gas in the United States in 1939, by months, in pounds

Month	National Gas Products Association	Bureau of Mines [1]: Total	Bureau of Mines [1]: Daily average	Month	National Gas Products Association	Bureau of Mines [1]: Total	Bureau of Mines [1]: Daily average
January	37,313,345	41,593,147	1,341,714	August	35,948,558	40,070,166	1,292,586
February	34,124,815	38,074,535	1,359,805	September	40,028,362	44,639,110	1,487,970
March	39,729,197	44,324,010	1,429,807	October	42,450,401	47,317,457	1,526,370
April	38,329,668	42,748,512	1,424,950	November	42,294,448	47,159,907	1,571,997
May	40,317,963	44,954,210	1,450,136	December	43,254,022	48,262,755	1,556,863
June	37,396,775	41,698,181	1,389,939				
July	39,748,355	44,324,010	1,429,807		470,935,909	525,166,000	1,438,811

[1] Monthly figures obtained by allocating the Bureau's annual total proportionately to the association's monthly data.

Methods and yields.—Production by processes other than channel increased materially in 1939, nearly compensating for the loss in 1938. The output by "other" processes in 1939 amounted to 60,578,000 pounds, equivalent to 12 percent of the total, compared with 35,755,000 pounds comprising only 7 percent of the total in 1938.

The yield of carbon black rose from 1.47 pounds per thousand cubic feet in 1938 to a new peak of 1.51 pounds in 1939. This gain was due to the rise in relative importance of "other" processes, several of which give unusually high yields.

Despite the low price level, research in the fundamentals of carbon-black production and consumption continued, as it is quite generally recognized that the behavior of different blacks under varying conditions is a fertile field for experiment. One of the products of this research ("dustless" carbon black) increased steadily in popularity in 1939; it is doubtful if more than 10 percent of the present output is of the old nongranular type.

Number and capacity of plants.—New construction continued at a low ebb in 1939. About a half dozen plants were dismantled, and only two new ones were added to the operating list.

The total daily capacity of the operating plants, which remained virtually at a standstill in 1938, declined from about 1,736,000 pounds in 1938 to about 1,714,000 in 1939. The capacity in Texas increased about 30,000 pounds, but this was outweighed by a decline of about 70,000 pounds in Louisiana. The operating ratio, or the ratio of daily average production to average capacity, increased from 75 percent in 1938 to 84 percent in 1939.

Number and daily capacity of carbon-black plants operated in the United States, 1938–39, by counties or parishes

State	County or parish	Number of plants		Total daily capacity (pounds)	
		1938	1939	1938	1939
Kansas	Grant	1	1	(1)	(1)
Louisiana	Morehouse	2	1	23,850	12,000
	Ouachita	9	6	225,775	168,995
		11	7	249,625	180,995
Oklahoma	Beckham	1	1		
	Seminole	1	1	[1] 76,750	[1] 91,750
	Texas	------	1		
		2	3	[1] 76,750	[1] 91,750
Texas	Carson	[2] 1	[2] 1		
	Moore	6	6	413,700	411,500
	Wheeler	2	2		
	Gray	10	8	340,360	311,150
	Hutchinson	[2] 14	[2] 14	[2] 548,120	[2] 567,670
	Eastland	1	------		
	Nueces	------	1		
	Stephens	4	4	107,300	150,800
	Ward	1	1		
	Winkler	1	1		
		40	38	1,409,480	1,441,120
Wyoming	Niobrara	1	------	(1)	------
United States		55	49	1,735,855	1,713,865

[1] 1938: Kansas and Wyoming included with Oklahoma; 1939: Kansas included with Oklahoma.
[2] 1 plant, in both Carson and Hutchinson Counties, counted in Hutchinson County.

Producers.—The latest complete list of carbon-black producers (as of December 31, 1937) was given on page 967 of Minerals Yearbook, 1938. Changes in the list for 1938 were given on page 1073 of Minerals Yearbook, 1939. The changes in 1939 are as follows: The Southern Carbon Co. discontinued operations, and its three Louisiana plants at Fowler, Perryville, and Swartz were dismantled; the J. M. Huber Corporation closed its plants in Louisiana and Wyoming permanently; the Columbian Carbon Co. closed its plant at Pampa but opened one at Corpus Christi; and the General Atlas Carbon Co. began operations at its plant near Guymon, Okla.

DEMAND

Total deliveries.—Sales of carbon black in 1939 totaled 560,533,000 pounds—36 percent more than in 1938. Domestic sales in 1939 were

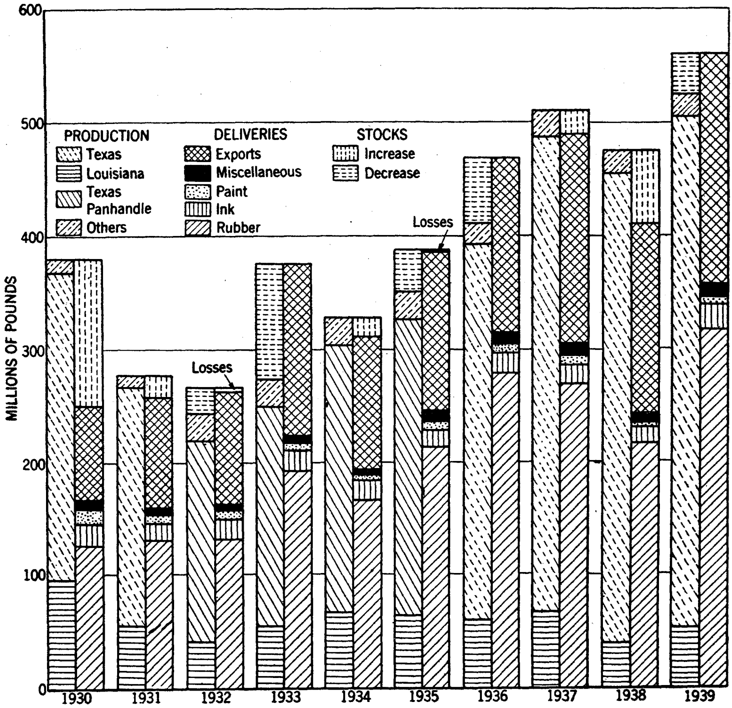

FIGURE 2.—Production and consumption of carbon black, 1930–39.

356,705,000 pounds and exports 203,828,000 pounds, both figures new records, with domestic deliveries showing the largest increase. (See fig. 2.)

Domestic consumption.—Domestic sales in 1939 (356,705,000 pounds) were 47 percent higher than in 1938 and 14 percent above the previous high of 1936. Reports from producers indicate that they were divided as follows: Rubber companies, 316,621,000 pounds (89 percent); ink companies, 21,929,000 pounds (6 percent); paint companies, 6,382,000 pounds (2 percent); and miscellaneous purposes, 11,773,000 pounds (3 percent). These data indicate that all four classes of consumption maintained their relative positions in 1939.

According to E. G. Holt, of the Bureau of Foreign and Domestic Commerce, who has again supplied data on rubber consumption, the total consumption of rubber in the United States reached the record-breaking total of 763,700 long tons, or 37 percent above the total of 558,800 tons consumed in 1938. Of the 1939 total, 592,000 tons was crude rubber, 170,000 tons reclaimed rubber, and 1,700 tons synthetic rubber. According to statistics of the Rubber Manufacturers Association 57,078,000 casings were produced in 1939 compared with the revised figure of 40,907,000 for 1938. Returns from the Federal excise tax on tires and tubes indicate that the total weight of casings sold in 1939 was 56 percent greater than in 1938. The production of camelpack for retreads has expanded rapidly in recent years and may have reached 50,000,000 pounds in 1939. This type of rubber utilizes more carbon black per pound of rubber than the average casing. As far as carbon-black consumption is concerned, these data indicate chiefly that an increase in the average size of casings outweighed a larger increase in the use of reclaimed (which uses relatively little carbon black) than in crude rubber.

The apparent world consumption of crude rubber was 1,090,000 long tons compared with the revised figure of 942,000 long tons in 1938. As the gain in consumption in the United States was somewhat larger than in the rest of the world, this country greatly strengthened its position as the leading rubber manufacturer.

The pick-up in business in 1939 was attended by a marked increase in advertising; consequently the apparent consumption of newsprint increased materially over 1938, though it fell far short of the 1937 total. According to data supplied by B. M. Frost, of the Bureau of Foreign and Domestic Commerce, the supply of newsprint available for domestic consumption in 1939 was 3,541,000 short tons compared with 3,089,100 in 1938. Sales of carbon black to ink companies increased 55 percent—from 14,131,000 pounds in 1938 to 21,929,000 in 1939. Possibly a higher percentage of carbon black is being used in inks, although probably further additions to manufacturers' stocks were made at the favorable prices.

Sales of carbon black to paint companies also rose materially—from 4,229,000 pounds in 1938 to 6,382,000 in 1939. According to E. C. Wood, of the Bureau of Foreign and Domestic Commerce, paint production in 1939 probably was about 15 percent higher than in 1938, with perhaps a much larger increase for black paints alone.

Sales of carbon black for miscellaneous purposes increased sharply; the 1939 total of 11,773,000 pounds was about 50 percent higher than in 1938 and slightly above the previous record (11,503,000 pounds) of 1937. No data are available as to which of the many miscellaneous uses expanded in 1939.

Exports and imports.[1]—Exports of carbon black passed the 200-million-pound mark for the first time in 1939, when the total was 203,828,000 pounds compared with 167,968,000 in 1938. Shipments to Germany declined in 1939, but this decrease was far outweighed by larger exports to British possessions.

The average export value continued to decline—4.36 cents per pound compared with 4.51 cents in 1938.

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

Exports of carbon black to the United Kingdom increased about 50 percent in 1939 to a total of 66,215,000 pounds. Exports to France (still second in importance) gained moderately in 1939, reaching 29,391,000 pounds, while those to Germany declined although the total (19,661,000 pounds) was third most important. There were notable increases in shipments to Brazil and China in 1939.

No particular trend was apparent in exports of carbon black by months, even after the war started. The highest monthly total was in April, the month of lowest exports in 1938. About 70 percent of the exports was shipped from the Galveston customs district, a slightly lower ratio than in 1938.

Carbon black exported from the United States, 1937–39, by countries

Country	1937		1938		1939	
	Pounds	Value	Pounds	Value	Pounds	Value
Argentina	3,115,630	$163,139	3,203,142	$151,669	4,234,248	$200,463
Australia	9,641,002	516,410	6,952,545	324,118	9,665,979	443,192
Belgium	5,164,255	234,743	5,459,202	250,475	4,656,082	212,169
Brazil	723,933	37,682	744,938	35,935	1,871,434	86,351
Canada	17,171,885	719,631	13,867,345	372,752	17,933,916	486,363
China	1,529,855	76,878	673,498	32,230	1,476,897	70,344
Czechoslovakia [1]	2,187,100	91,522	1,834,572	84,395	276,500	11,425
France	29,913,980	1,336,934	26,216,610	1,219,450	29,390,562	1,335,998
Germany [1]	27,441,114	1,172,649	23,646,635	1,076,568	19,660,805	857,907
India, British	1,002,210	44,198	949,455	44,340	2,703,106	123,530
Italy	6,956,079	300,972	9,764,699	440,881	8,260,281	375,258
Japan	11,929,498	619,790	9,172,849	443,483	10,617,734	482,538
Mexico	1,229,597	56,438	1,396,870	44,444	1,750,366	55,466
Netherland India	853,905	47,055	1,235,515	57,142	1,422,234	63,700
Netherlands	3,931,601	176,132	3,643,185	174,052	3,034,415	145,927
Norway	453,302	23,018	560,789	28,088	614,977	30,086
Poland and Danzig [1]	2,175,159	103,231	3,166,867	151,361	2,368,187	109,336
Spain	512,200	21,252	1,332,229	59,357	2,644,577	117,075
Sweden	1,549,753	86,637	2,714,415	130,083	4,425,409	213,870
Union of South Africa	3,155,311	128,449	1,792,986	75,375	4,322,092	188,958
United Kingdom	48,381,173	2,467,609	44,429,105	2,104,878	66,214,827	2,975,028
Yugoslavia	87,600	5,193	804,735	39,803	------------	------------
Other countries	5,146,740	270,521	4,406,130	239,004	6,283,189	303,682
	184,252,882	8,700,083	167,968,316	7,579,883	203,827,817	8,888,666

[1] For statistical purposes trade with the Sudeten area, as far as ascertainable, is included with Germany, while trade with the other Czechoslovak Provinces occupied by Germany, Hungary, and Poland has been included with these countries since March 18 or 19, 1939. After November 16, 1939, trade with Danzig and that part of Poland occupied by Germany has been included with Germany, and trade with that part of Poland occupied by the U. S. S. R. has been included with U. S. S. R.

Carbon black exported from the United States, 1938–39, by months and customs districts

Month	1938		1939		Customs district	1938		1939	
	Pounds	Value	Pounds	Value		Pounds	Value	Pounds	Value
Jan	14,869,135	$766,764	14,192,588	$612,887	Buffalo	89,711	$7,997	62,576	$8,065
Feb	11,083,662	493,070	19,370,600	847,358	Dakota	588,073	28,312	397,965	19,110
Mar	14,814,670	654,988	19,935,052	874,362	El Paso	1,344,900	38,617	1,649,717	48,882
Apr	10,904,372	459,564	21,043,569	935,012	Galveston	120,745,454	5,533,374	144,454,115	6,426,836
May	16,807,723	783,212	18,682,152	830,584	Los Angeles	349,312	14,496	1,074,945	40,332
June	12,861,809	553,249	14,185,130	620,797	Michigan	13,453,512	355,969	17,338,956	460,020
July	11,443,234	525,217	17,371,802	731,516	New Orleans	27,408,556	1,404,677	31,928,600	1,592,678
Aug	12,421,213	538,079	13,505,738	579,460	New York	112,410	36,746	303,278	26,888
Sept	13,355,141	607,181	18,831,339	851,138	Sabine	2,369,513	97,018	2,158,650	89,124
Oct	16,629,738	776,318	17,200,319	737,795	San Francisco	1,152,551	50,094	3,617,832	137,457
Nov	14,668,039	640,315	14,838,550	641,986	Vermont	192,555	4,488	269,240	7,285
Dec	18,109,580	781,926	14,670,978	625,771	Other districts	161,769	8,095	571,943	31,989
	167,968,316	7,579,883	203,827,817	8,888,666		167,968,316	7,579,883	203,827,817	8,888,666

Imports of "gas black and carbon black," as reported by the Bureau of Foreign and Domestic Commerce, totaled 6,901 pounds valued at $784 in 1939 compared with 390 pounds valued at $30 in 1938. Imports of acetylene black (all from Canada) nearly doubled in 1939, rising from 1,220,781 pounds valued at $127,889 in 1938 to 2,381,572 pounds valued at $248,332 in 1939.

STOCKS

The situation as to stocks of carbon black improved considerably during 1939; in place of a material increase, as in 1938, there was a moderate decline. Stocks on December 31, 1939 totaled 130,792,000 pounds, which was 35,367,000 pounds below stocks of January 1. In terms of quantity present stocks compare with those on hand during the early part of 1936 and in terms of days' supply, with those prevailing in the spring of 1937. Stocks in the form of finished rubber goods changed but slightly in 1939; stocks of casings held by manufacturers increased only from 8,451,000 on January 1, 1939, to 8,688,000 at the year end.

PRICES AND VALUES

In general, carbon-black prices in 1939 remained at the low levels reached in the early part of 1938. Although demand, both domestic and export, reached record levels, competitive conditions were such as to prevent any consistent advance.

The weighted average f. o. b. value at plants increased from 2.41 cents per pound in 1938 to 2.45 cents in 1939. This slight change is substantiated by the quotation for Zone A, the standard price in the industry, which has remained at 2.75 cents per pound since April 4, 1938.

In spite of the fact that exports expanded rapidly in the first 2 months of the war on a "seller's market," prices at the close of the year were slightly below those at the beginning. The average export value for 1939 was 4.36 cents per pound compared with 4.51 cents in 1938.

Quoted prices on various grades of carbon black, 1938–39, in cents per pound

[Oil, Paint, and Drug Reporter]

Date	Standard rubber, ink, and paint qualities (carlots)							Special grades for varnishes, lacquers, and enamels (cases delivered)						
	Zone [1]							Grade						
	A	B	C	D	E	F	G	1	2	3	4	5	6	7
1939:														
Jan. 1	2.75	3.10	3.19	3.25	3.41	3.75	3.00	3.75	8.50	13.00	27.50	40.00	60.00	110.00
Sept. 11											29.00			
Average:														
1939	2.75	3.10	3.19	3.25	3.41	3.75	3.00	3.75	8.50	13.00	28.00	40.00	60.00	110.00
1938	2.75	3.09	3.20	3.24	3.40	3.73	3.22	4.04	8.50	13.00	27.50	40.00	60.00	110.00

[1] Zone A: Gulf coast ports: Galveston, Houston, Port Arthur, New Orleans, etc.; for coastwise delivery in North America.
Zone B: Arkansas, Colorado, Kansas, part of Missouri, New Mexico, and Texas except coastal ports.
Zone C: Pacific coast.
Zone D: Illinois, Iowa, and Wisconsin.
Zone E: Florida, Georgia, Indiana, Kentucky, Michigan, Ohio, Tennessee, West Virginia, and parts of New York and Pennsylvania.
Zone F: Atlantic Seaboard States: Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, parts of Pennsylvania, Rhode Island, South Carolina, Vermont, and Virginia.
Zone G: Mexico.

HELIUM

By C. W. Seibel and H. S. Kennedy

SUMMARY OUTLINE

Operation of Amarillo plant.—During the fiscal year 1939 the Bureau of Mines helium plant near Amarillo, Tex., continued to operate on an intermittent schedule and produced 6,281,800 cubic feet of helium. The cumulative production is 90,541,000 cubic feet for the first 10 years of the plant's operation, from April 1929 to June 30, 1939. During the first half of the fiscal year ending June 30, 1940, an additional 3,906,000 cubic feet of helium was produced, making a total production of 94,447,000 cubic feet of helium to December 31, 1939.

Sales of residue natural gas from which the helium was extracted were 318,601,000 cubic feet valued at $16,727. The cumulative sales of such gas for the 10-year period of operation of the Amarillo helium plant total 4,684,149,000 cubic feet, for which $245,918 was received.

Cliffside gas field.—In the fiscal year 1939 a total of 383,062,000 cubic feet of helium-bearing natural gas was produced by the Bureau of Mines from the Government's Cliffside gas field to supply the Amarillo plant, giving a cumulative production from the field of 5,436,215,000 cubic feet.

During the year a deep test was made for oil in the Cliffside field, in which the Government owns all gas rights for 50,000 acres covering the entire geologic structure but does not own the oil rights. After drilling to a depth of more than 6,000 feet without finding oil, the company responsible for the work abandoned the test. Under the terms of a "working agreement" between the Government (as owner of the gas rights) and the owners of the oil rights, which was entered into when the Bureau of Mines purchased the gas rights in the land, the Bureau acquired the well with equipment and casing for a fraction of its cost. The casing was "gun-perforated" opposite the gas strata, and a gas well having an open-flow capacity of 12 million cubic feet per day was developed. This well, now known as Bureau of Mines Bush A-2, is about 3,500 feet deep and cased with heavy 10¾-inch casing. Its open-flow capacity and closed-in pressure (709 pounds per square inch) compare favorably with those of the best wells in the field, and it cost the Government considerably less than any other well in the field.

Purchase of additional properties.—An amendatory act authorizing the conservation, production, exploitation, and sale of helium gas, approved September 1, 1937 (50 Stat. 885), provided that

> the Secretary of the Interior is hereby directed, if possible under the terms hereof, to acquire by purchase all properties developed or constructed by private parties prior to the passage of this Act for helium production * * *.

Pursuant thereto, the helium properties of the Girdler Corporation of Louisville, Ky., were acquired November 3, 1938. These properties comprise helium-production plants at Dexter, Kans., and Thatcher, Colo., with related gas leases and wells to supply helium-bearing natural gas. Both plants had been in a stand-by condition for some time before the purchase and have been maintained in that condition by the Government because the Amarillo plant, completed in 1929, can now supply all Government and private demands for helium when operating at a fraction of its capacity. The purchase places all helium plants under the control of the Government.

Sales.—The act approved September 1, 1937, authorized the sale of helium to the public, and from the time it became effective until the close of the fiscal year ended June 30, 1938, 73,082 cubic feet of helium were sold and delivered to non-Government purchasers. The production for Government agencies in that period was 5,757,680 cubic feet.

During the fiscal year 1939, the first full year of operation under the act, the public took advantage of the opportunity and purchased 1,068,300 cubic feet of helium under 30 contracts with the Bureau. Of this quantity, 265,800 cubic feet were purchased for medical, 9,600 cubic feet for scientific, and 792,900 cubic feet for commercial purposes. In the same period various agencies of the Federal Government obtained 5,213,400 cubic feet of helium. All the helium was produced in the Amarillo plant.

Government uses.—The United States Army and Navy continue to be the largest users of helium. They employ it for inflating observation and meteorological balloons as well as dirigible lighter-than-air craft. The Navy also uses helium in diving operations. The use of large balloons that carry radio-sonde apparatus has increased the desirability, from the standpoint of safety, of using helium instead of explosive hydrogen in meteorological balloons, so the Weather Bureau is rapidly becoming a large user of helium. The National Bureau of Standards has procured helium from the Bureau of Mines for determination of specific heats and other scientific studies, and the Public Health Service uses helium in research on its medical applications.

In 1925 the Bureau of Mines, in cooperation with the Navy Department, experimented on the use of synthetic mixtures of oxygen and helium in deep-sea diving. The actual use of such mixtures in diving operations was given considerable publicity in connection with the raising of the submarine *Squalus*, and it has been stated that if helium had not been available the efforts to raise the submarine probably would have been ineffective.

Non-Government uses.—The present-day medical use of helium in the treatment of asthma and other respiratory diseases is an outgrowth of research on the use of helium in diving. Helium also is being employed in the administration of anesthetics. Other promising medical uses are being investigated by research workers.

Influenced by growing evidence of the efficacy of helium in medical applications, hospitals and physicians now use about 25 percent of all helium sold for non-Government purposes, and the demands are increasing. Helium also is being used to an increasing extent in technical research, as is indicated by sales of helium to educational and research institutions for scientific studies.

The largest non-Government user of helium in lighter-than-air craft has been the Goodyear Tire & Rubber Co., which maintains small passenger-carrying blimps, filled with helium produced in the Amarillo plant, at the New York and San Francisco Fairs, as well as several other points. These blimps give reserve pilots active training in airship operation.

Near the end of the fiscal year 1939 the Committee for Organization of the First Polish Flight into the Stratosphere purchased 220,000 cubic feet of helium for filling a stratosphere balloon, but the flight was prevented by the European War.

Laws or ordinances in some localities prohibit the use of hydrogen or any explosive gas in filling toy balloons. Helium is the only safe gas for such use, and some toy-balloon vendors have purchased helium in considerable quantities. Helium also is being used to some extent in "sky advertising"; by large balloons that hold approximately 1,000 cubic feet and carry advertising on their envelopes or on banners which they support.

Prices.—As the Government desires to encourage use of helium and to make it generally available for medical purposes, helium is sold at prices near the cost of production. The regulations governing sales of helium to private parties provide that, in accordance with a provision of the act requiring payment in advance, deposits made by purchasers of helium shall be based upon an estimated cost of production prepared by the Bureau of Mines and approved by the Secretary of the Interior. For the fiscal year 1939 the estimate was \$14.25 per thousand cubic feet. As helium is sold virtually at cost, the sales regulations require that, to protect the Government, purchasers of helium for medical and scientific use deposit 120 percent of the estimated cost of the helium, which now is \$17.10 per thousand cubic feet, and that purchasers of helium for commercial use deposit 134.4 percent of the estimated cost, now \$19.15 per thousand cubic feet.

At the end of each fiscal year the actual cost of producing helium is determined and approved as provided for in the regulations. In accordance with the act, the cost used as a basis for determining the price to be paid by non-Government users includes items for depreciation, depletion, and interest on certain investments, whereas the amounts paid by Government agencies are based upon operating costs only.

For the fiscal year 1939 the prices per thousand cubic feet charged non-Government purchasers of helium, as approved by the Secretary of the Interior, were \$12.80 for helium to be used for medical purposes, \$13.44 for helium for scientific use, and \$15.05 for helium for commercial use. After the total charges against the various purchasers of helium were determined, the surpluses to their credit were refunded.

The refunds for the fiscal year 1939 were \$4.30, \$3.66, and \$4.10 per thousand cubic feet, respectively, for helium sold for medical, scientific, and commercial uses. The price charged Government agencies was $11.47 per thousand cubic feet, irrespective of the use to which the helium was put.

The prices per thousand cubic feet charged non-Government users of helium for the fiscal years 1938 and 1939 are compared in the following table:

	1938	1939
Medical	$13. 471	$12. 80
Scientific	13. 471	13. 44
Commercial	15. 088	15. 05

The lower rate charged for helium for medical use is in accord with the Government's desire to make helium available to the public for medical use at the lowest practicable cost. There is no difference in the quality of the helium sold for the three classes of use, as it has a purity of about 98.2 percent, and the impurity is largely nitrogen.

Before the act approved September 1, 1937, was passed, helium obtained for private use from non-Government sources sometimes cost as much as $150 per thousand cubic feet, and even in quantities as large as a million cubic feet it sold for $75 per thousand cubic feet.

ASPHALT AND RELATED BITUMENS

By A. H. Redfield [1]

SUMMARY OUTLINE

To meet an 8-percent increase in total demand, domestic and foreign, for petroleum asphalt (including small quantities of imported lake asphalt and grahamite), petroleum refineries in the United States increased their output 10 percent from 1938 to 1939. In consequence, their inventories rose 12 percent from December 31, 1938, to December 31, 1939, in contrast to a 12-percent reduction during 1938. The entire increase in demand was on the domestic market, as exports of asphalt were slightly less in 1939 than in 1938. Imports both of petroleum asphalt and natural asphalt advanced from 1938 to 1939, but they constituted 1 percent of the total demand in 1939. Only 4 percent of the petroleum asphalt produced by refineries in the United States was sold to foreign countries in 1939.

Salient statistics of asphalt and related bitumens in the United States, 1938–39

	1938	1939
SUPPLY		
Native asphalt and related bitumens:		
Produced ... short tons	[1] 477,741	459,848
Imported (chiefly lake asphalt) ... do	23,645	26,586
Petroleum asphalt (excluding road oil):		
Produced at refineries ... do	4,506,876	4,954,400
Imported	9,786	47,261
Stocks, Jan. 1 ... do	557,446	490,408
Total supply ... do	[1] 5,575,494	5,978,503
DISTRIBUTION		
Native asphalt and related bitumens:		
Indicated domestic demand ... short tons	[1] 464,195	446,064
Exports (unmanufactured) ... do	13,546	13,784
Petroleum asphalt (excluding road oil):		
Indicated domestic demand (including lake asphalt) ... do	4,404,846	4,768,960
Exports ... do	202,499	199,695
Stocks, Dec. 31 ... do	490,408	550,000
Total distribution ... do	[1] 5,575,494	5,978,503

[1] Revised figures.

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

Salient statistics of asphalt and related bitumens in the United States, 1938-39—Continued

	1938	1939
VALUES		
Native asphalt and related bitumens:		
Sales	[1] $2,874,803	$3,066,844
Imports (chiefly lake asphalt)	378,209	362,559
Exports (unmanufactured)	543,509	577,031
Petroleum asphalt:		
Sales (excluding road oil) from—		
Domestic petroleum	25,948,928	28,172,396
Foreign petroleum	15,432,152	12,719,680
Total sales	41,381,080	40,892,076
Imports	38,883	189,052
Exports	3,030,162	3,097,799

[1] Revised figures.

NATIVE ASPHALT AND BITUMENS

Bituminous rock.—As a result of decreased demand east of the Mississippi River sales of bituminous rock by producers in the United States declined from 449,091 short tons (revised figure) in 1938 to 422,484 tons in 1939. The value of the rock asphalt sold decreased from $2,219,159 in 1938 (revised figure) to $2,007,810. Rock-asphalt operators in Kentucky and Alabama sold 215,142 tons valued at $1,379,138 in 1938 but only 175,602 tons valued at $1,214,476 in 1939. On the other hand, sales by operators in Texas, Oklahoma, and New Mexico advanced in quantity from 206,443 tons (revised figure) in 1938 to 221,497 tons in 1939 but declined in value from $727,032 in 1938 to $684,808 in 1939. Sales by producers in California and Kansas were lower in quantity and value in 1939 than in 1938, but sales in Missouri were slightly higher.

Gilsonite and wurtzilite.—Sales of gilsonite by producers in northeastern Utah increased from 28,574 short tons valued at $649,724 in 1938 to 37,289 tons valued at $1,053,192 in 1939. Demand for the better grades was good during the greater part of 1939; prices were firm; and the loss of sales to Germany during the last quarter of the year did not affect the general market for gilsonite.

Sales of wurtzilite totaled 76 tons valued at $5,920 in 1938 and 75 tons valued at $5,842 in 1939.

Sulfonated bitumen.—In 1939, as in 1938, a small quantity of natural sulfonated bitumen was produced in Box Elder County, Utah, near Ogden.

Exports.—Exports of natural asphalt, unmanufactured, changed little from 1938 to 1939. They amounted to 13,546 short tons valued at $543,509 in 1938 and 13,784 tons valued at $577,031 in 1939. Of the total exports Europe took 75 percent in 1938 and 74 percent in 1939; Canada 10 percent in 1938 and 8 percent in 1939; South America 2 percent in 1938 and 4 percent in 1939; and Asia, chiefly Japan, 10 percent in 1938 and 1939.

MANUFACTURED OR PETROLEUM ASPHALT

Production.—Petroleum refineries in the United States produced 10 percent more asphalt in 1939 than in 1938. The most marked gains were in the Indiana, Illinois, Kentucky, etc., district, in the East Coast district, and in the Texas Gulf Coast district. On the other hand, decreases were considerable in the Rocky Mountain, Arkansas, and Louisiana Inland, and Texas Inland districts. These decreases were not sufficient, however, to offset the increases east of the Mississippi River, in the Gulf Coast districts of Louisiana and Texas, and in California.

Stocks.—To meet an increase of 364,100 short tons in the indicated domestic demand for asphalt (offset to a slight extent by a decline of 2,800 tons in export demand), petroleum refineries in the United States enlarged their output of asphalt 447,500 tons in 1939, while imports of lake asphalt, grahamite, and petroleum asphalt rose 40,400 tons. Consequently, stocks of asphalt at refineries were 59,600 tons higher on December 31, 1939, than on December 31, 1938, compared to a drop of 67,000 tons during 1938. The principal advances in inventories were in the Illinois, Indiana, Kentucky, etc., district, in the Oklahoma, Kansas, and Missouri district, and in California. In contrast to the general increase, stocks were reduced considerably in the Texas Inland district and to some extent in the Rocky Mountain and East Coast districts during 1939.

Production, receipts, stocks, consumption, transfers and losses, and sales of asphalt (exclusive of road oil) at petroleum refineries in the United States in 1939, by districts, in short tons

District	Production	Receipts from other sources	Stocks		Consumption by companies, transfers, and losses	Sales	
			Dec. 31, 1938	Dec. 31, 1939		Domestic	Foreign
East Coast	1,841,900	56,900	134,100	129,000	26,100	1,840,300	37,500
Appalachian	142,200	--------	14,800	20,000	7,200	129,800	--------
Indiana, Illinois, Kentucky, etc	969,200	11,400	108,900	148,000	130,500	810,400	600
Oklahoma, Kansas, and Missouri	354,300	59,000	40,200	68,000	20,100	365,400	--------
Texas:							
Gulf Coast	290,900	--------	15,400	19,000	80,500	152,100	54,700
Inland	164,600	500	24,900	8,000	--------	182,000	--------
Total, Texas	455,500	500	40,300	27,000	80,500	334,100	54,700
Louisiana-Arkansas:							
Louisiana Gulf Coast	259,800	--------	34,100	35,000	14,200	234,200	10,500
Arkansas and Louisiana Inland	179,500	57,800	16,500	21,000	--------	232,800	--------
Total, Louisiana-Arkansas	439,300	57,800	50,600	56,000	14,200	467,000	10,500
Rocky Mountain	65,800	41,900	23,100	15,000	8,800	107,000	--------
California	686,200	--------	78,400	87,000	9,100	582,900	85,600
Total: 1939	4,954,400	227,500	490,400	550,000	296,500	4,636,900	188,900
1938	4,506,900	95,500	557,400	490,400	192,800	[1] 4,476,600	(1)

[1] Foreign included with domestic.

Sales.—Total sales of petroleum asphalt by refineries increased 8 percent in quantity but decreased 1 percent in value from 1938 to 1939. The average value at the refinery of asphalt sold in 1939 was $8.47 per short ton compared with $9.24 in 1938.

Of the total sales of petroleum asphalt in 1939, 26 percent was manufactured from foreign petroleum, imported chiefly from Venezuela and Mexico, compared with 32 percent in 1938. Although runs of foreign crude to stills rose from 26,187,000 barrels in 1938 to 33,490,000 in 1939, sales of asphalt made from foreign crude declined from 1,449,664 short tons in 1938 to 1,278,786 in 1939. Apparently more of the foreign crude was run to fuel oil in 1939 than in 1938. East Coast refineries sold 96 percent of the asphalt made from foreign crude in 1939 compared with 91 percent in 1938.

Sales of asphalt (exclusive of road oil) at petroleum refineries in the United States, 1938–39, by districts

District	1938		1939	
	Short tons	Value	Short tons	Value
East Coast	1,774,744	$18,840,860	1,877,834	$18,417,699
Appalachian	117,922	1,489,664	129,843	1,499,740
Indiana, Illinois, Kentucky, etc.	652,373	6,509,542	810,985	6,847,378
Oklahoma, Kansas, and Missouri	358,246	2,485,080	365,381	2,121,986
Texas:				
Gulf Coast	159,295	1,412,779	206,840	1,570,306
Inland	214,568	1,402,950	181,959	1,330,904
Total, Texas	373,863	2,815,729	388,799	2,901,210
Louisiana-Arkansas:				
Louisiana Gulf Coast	228,619	2,153,334	244,703	2,108,695
Arkansas and Louisiana Inland	226,677	1,553,073	232,818	1,459,166
Total, Louisiana-Arkansas	455,296	3,706,407	477,521	3,567,861
Rocky Mountain	166,140	1,486,292	106,960	810,493
California	578,043	4,047,506	668,508	4,725,709
Total	4,476,627	41,381,080	4,825,831	40,892,076

Average sales values of asphalt at the refineries decreased in nearly all districts from 1938 to 1939. The only exceptions were the Texas Inland, where the average sales value increased from $6.54 per short ton in 1938 to $7.31 in 1939, and the California, where the average sales value rose from $7.00 in 1938 to $7.07 in 1939. The general decline was ascribed to overproduction in California and the Texas Inland district of heavy crude that could be run cheaply to asphalt and sold at reduced prices. However, prices became firmer in the last quarter of 1939 as a result of continued improvement in demand.

Statistics of sales of asphalt by varieties in 1939 are not strictly comparable with the corresponding figures for 1938. The 1939 data refer only to sales to domestic consumers, while those for 1938 include export sales; however, as export sales amounted to only 4 percent of the total sales in both 1938 and 1939 the discrepancy is not great, and rough comparisons are possible. Statistics of sales to domestic consumers will give for 1939 and future years a more accurate picture of the type of demand in the major market for asphalt.

Asphalt and asphaltic material (exclusive of road oil) sold at petroleum refineries in the United States in 1939, by varieties

[Value f. o. b. refinery]

	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: [1]						
Asphalt for—						
Paving	794,324	$6,195,315	382,210	$3,776,412	1,176,534	$9,971,727
Roofing	603,834	4,827,630	203,478	2,020,147	807,312	6,847,777
Waterproofing	48,983	581,039	31,030	361,514	80,013	942,553
Blending with rubber	12,705	152,421	11,588	139,791	24,293	292,212
Briquetting	62,114	324,858	6	43	62,120	324,901
Mastic and mastic cake	1,453	12,367	3,210	32,363	4,663	44,730
Pipe coatings	19,283	191,565	2,401	30,330	21,684	221,895
Molding compounds	21,989	222,006	7,357	98,375	29,346	320,381
Miscellaneous uses	87,314	879,262	40,196	407,414	127,510	1,286,676
	1,651,999	13,386,463	681,476	6,866,389	2,333,475	20,252,852
Semisolid and liquid products of more than 200 penetration: [1]						
Flux for—						
Paving	112,188	759,702	83,614	779,399	195,802	1,539,101
Roofing	330,374	2,309,622	91,360	920,223	421,734	3,229,845
Waterproofing	4,130	51,386			4,130	51,386
Mastic	129	2,659	75	1,561	204	4,220
Cut-back asphalts:						
Rapid-curing	530,023	4,623,953	321,906	3,101,272	851,929	7,725,225
Medium-curing	561,611	4,055,738	41,306	388,565	602,917	4,444,303
Emulsified asphalts and fluxes	52,653	605,097	3,228	30,784	55,881	635,881
Paints, enamels, japans, and lacquers	24,095	409,200	13,484	214,413	37,579	623,613
Other liquid products	130,304	861,358	2,989	35,586	133,293	896,944
	1,745,507	13,678,715	557,962	5,471,803	2,303,469	19,150,518
Total to domestic consumers	3,397,506	27,065,178	1,239,438	12,338,192	4,636,944	39,403,370
Export sales	149,539	1,107,218	39,348	381,488	188,887	1,488,706
Total: 1939	3,547,045	28,172,396	1,278,786	12,719,680	4,825,831	40,892,076
1938	3,026,963	25,948,928	1,449,664	15,432,152	4,476,627	41,381,080

[1] DEFINITIONS

Paving asphalt.—Refined asphalt and asphaltic cement, fluxed and unfluxed, produced for direct use in the construction of sheet asphalt, asphaltic concrete, asphalt macadam, and asphalt block pavements, and also for use as joint filler, in brick, block, and monolithic pavements.

Roofing asphalt.—Asphalt and asphaltic cement used in saturating, coating, and cementing felt or other fabric and in the manufacture of asphalt shingles.

Waterproofing asphalt.—Asphalt and asphaltic cement used to waterproof and dampproof tunnels, foundations of buildings, retaining walls, bridges, culverts, etc., and for constructing built-up roofs.

Briquetting asphalt.—Asphalt and asphaltic cement used to bind coal dust or coke breeze into briquets.

Mastic and mastic cake.—Asphalt and asphaltic cement for laying foot pavements and floors, waterproofing bridges, lining reservoirs and tanks, capable of being poured and smoothed by hand troweling.

Pipe coatings.—Asphalt and asphaltic cement used to protect metal pipes from corrosion.

Molding compounds.—Asphalts used in the preparation of molded composition, such as battery boxes, electrical fittings, push buttons, knobs, handles, etc.

Miscellaneous uses.—Asphalt and asphaltic cement used as dips and in the manufacture of acid-resisting compounds, putty, saturated building paper, fiber board and floor coverings, and not included in the preceding definitions.

Flux.—Liquid asphaltic material used in softening native asphalt or solid petroleum asphalt for paving, roofing, waterproofing, and other purposes.

Cut-back asphalt.—Asphalt softened or liquefied by mixing with petroleum distillates.

Emulsified asphalt and fluxes.—Asphalts and fluxes emulsified with water for cold-patching, road laying, and other purposes.

Other liquid products.—Petroleum asphalt, exclusive of fuel oil used for heating purposes, not included in the preceding definitions.

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Highway construction absorbed three-fifths of all asphalt sold to domestic consumers in 1939 in the form of paving asphalt, paving flux, cut-back asphalts, and emulsions. In general, such statistics as are available indicate an increase in street and road construction in 1939 over 1938. According to the Engineering News-Record awards for street and road contracts exceeding $25,000 increased 1 percent in value (from $637,862,000 in 1938 to $643,771, 000 in 1939) and about 1 percent in volume, as construction costs changed little from 1938 to 1939. The total highway mileage constructed by State highway departments, according to the same journal, rose from 28,310 in 1938 to 30,428 in 1939. According to the American Association of State Highway Officials, the total mileage completed increased from 30,977 in 1938 to 31,628 in 1939. However, average employment for construction and maintenance of Federal and State highways, as reported to the Bureau of Public Roads, decreased from 273,055 in 1938 to 220,843 in 1939.

The increase in mileage of State highways built during 1939 reported by the Engineering News-Record was in bituminous types, untreated surfacing, and grading and draining operations. Asphaltic types (asphaltic concrete, asphaltic macadam, and low-cost bituminous mixtures) gained 7 percent from 1938 to 1939—they constituted 78 percent of the mileage of higher and intermediate types laid on State highways in 1938 and 85 percent in 1939.

No comprehensive statistics are available to show the proportions of the various types of surface laid on city and town streets. Apparently there was a small increase in the yardage of municipal street paving, especially in the larger cities, an important but little-recorded field of demand.

Awards of street and road contracts increased in the Middle Atlantic States, in the Ohio Valley and Great Lakes States, and in the States west of the Mississippi River and east of the Rocky Mountains, according to the Engineering News-Record. They decreased considerably in the Rocky Mountain and Pacific Coast States and New England and to a smaller extent in the Southeastern States.

Increased construction of lighter types of surface, both on State highways and secondary roads, as well as continued use of cut-back asphalts for soil stabilization and revetments, is indicated by a 4-percent gain in sales of cut-back asphalts from 1,392,997 tons in 1938 (includes export sales) to 1,454,846 in 1939 (domestic sales only). A considerable advance in sales by East Coast refineries and smaller increases in sales by refineries of the Appalachian, the Indiana, Illinois, Kentucky, etc., the Texas Gulf Coast and Texas Inland, and the Louisiana-Arkansas Inland districts offset declines in sales by the other districts west of the Mississippi River. The entire increase was in sales in medium-curing cut-backs—from 500,087 tons valued at $3,828,718 in 1938 to 602,917 valued at $4,444,303 in 1939, as sales of rapid-curing cut-backs declined from 892,910 tons valued at $9,129,262 in 1938 to 851,929 tons valued at $7,725,225 in 1939.

Petroleum refineries sold 56,953 tons (13,417,238 gallons) of asphalt emulsions valued at $678,779 in 1938 and 55,881 tons (13,164,691 gallons) valued at $635,881 in 1939. In addition, 43,928,186 gallons valued at $3,659,258 were sold in 1938 by major industrial companies that purchased asphalt from petroleum refineries and 49,826,902 gallons valued at $3,899,958 in 1939. Accordingly, total known sales of emulsified asphalts and fluxes advanced from 57,345,424 gallons valued at $4,338,037 in 1938 to 62,991,593 gallons valued at $4,535,839 in 1939.

Roofing manufacture furnished the second-largest demand for asphalt, absorbing 25 percent of the total sales in 1938 and 26 percent in 1939. Although shipments of prepared roofing and asphalt siding reported to the Bureau of the Census decreased slightly—from a total of 35,238,029 squares in 1938 to 34,823,305 in 1939—sales of roofing asphalt and roofing flux combined increased from 1,127,635 tons in 1938 to 1,229,046 in 1939. The 1939 figure, it may be noted, includes only domestic sales, whereas the figure for 1938 includes both domestic and export sales. The principal increases occurred in the East Coast district, the Indiana, Illinois, Kentucky, etc., district, and California.

DOMESTIC DEMAND

The indicated domestic demand for petroleum asphalt (including small quantities of imported lake asphalt and grahamite) was 8 percent greater in 1939 than in 1938, increasing from 367,071 short tons per month in 1938 to 397,413 in 1939.

In terms of the long-term trend the indicated demand was 30 percent above the expected demand for 1939, whereas it was 23 percent above the expected demand for 1938; that is, if the national demand had continued the average rate of growth it manifested from 1908 to 1936, it would have averaged 297,864 tons a month in 1938 and 306,533 in 1939. If these averages are used as a standard of comparison, the indicated demand of 367,071 tons a month in 1938 was 123 percent of the expected demand (297,864 tons), and the indicated demand of 397,413 tons a month in 1939 was 130 percent of the expected demand (306,533 tons).

The demand for asphalt is seasonal to a marked degree, reaching its maximum in August and its minimum in February. Normally, 65 percent of the indicated consumption of asphalt occurs in the 6 months from May 1 to October 31; from 1937 to 1939, 69 percent of the annual total apparently was consumed in these months. Consequently, to furnish an adequate standard of comparison the monthly trend values are multiplied by a "seasonal factor" for each month.

Relation of indicated asphalt demand in the United States to basic trend multiplied by seasonal factors, 1938–39, by months

Month	1938			1939		
	Trend multiplied by seasonal factors	Indicated monthly demand	Relation of indicated monthly demand to trend	Trend multiplied by seasonal factors	Indicated monthly demand	Relation of indicated monthly demand to trend
	Short tons	*Short tons*	*Percent*	*Short tons*	*Short tons*	*Percent*
January	174,310	229,001	131.4	179,401	198,502	110.6
February	159,983	153,342	95.9	164,655	146,917	89.2
March	205,139	254,351	124.0	211,130	230,991	109.4
April	281,243	297,329	105.7	289,457	317,551	109.7
May	345,999	398,654	115.2	356,104	483,030	135.6
June	385,228	475,112	123.3	396,478	499,270	125.9
July	396,368	478,289	120.7	407,943	546,799	134.0
August	411,856	581,820	141.2	423,885	629,709	148.6
September	395,950	541,739	136.8	407,154	594,823	146.1
October	387,730	489,368	126.2	399,053	528,534	132.4
November	248,091	310,373	125.1	255,336	351,431	137.6
December	182,471	195,468	107.1	187,800	241,403	128.5
	3,574,368	4,404,846	123.2	3,678,396	4,768,960	129.6

In the first quarter of 1939 the indicated demand averaged 104 percent of the long-time trend multiplied by seasonal factors compared with 118 percent in the first 3 months of 1938. In the second quarter of 1939 it rose to 125 percent of the expected demand for these months compared with 116 percent during the second quarter of 1938. From July to September 1939 the demand was highest, averaging 143 percent of the expected demand compared with 133 percent for the same months of 1938. In the last quarter of 1939 the indicated demand averaged 133 percent of the expected demand compared with 122 percent in the last 3 months of 1938.

DISTRIBUTION BY RAIL

The tonnage of asphalt (natural, byproduct, or petroleum) terminated by class I railroads in the United States rose from 4,295,232 short tons in 1938 to 4,826,245 in 1939, according to freight-commodity statistics compiled by the Interstate Commerce Commission. The increase was general, but more than nine-tenths of the gain occurred on railroads operating principally north of the Potomac and Ohio Rivers and east of Lake Michigan and the Illinois River.

Fifty-one percent of the asphalt (petroleum, lake, and natural-rock) terminated in the continental United States by land carriers and intraport vessels was delivered to consumers in the Northeastern district, lying north of the Potomac and Ohio Rivers and east of the Mississippi and Illinois Rivers. Railroads and minor carriers terminated 2,418,722 short tons of asphalt in this district in 1938 and 2,452,957 in 1939. In the Southeastern district, lying south of the Potomac and Ohio Rivers and east of the Mississippi and Pearl Rivers, land deliveries of asphalt rose from 663,802 tons in 1938 to 697,391 tons in 1939. In the Southwestern district, lying west of the Mississippi and Pearl Rivers and south of St. Louis, Kansas City, and Amarillo, asphalt deliveries by rail and truck increased from 372,610 tons in 1938 to 402,416 in 1939. In the North Central district, lying between the Great Lakes and the Rocky Mountain front, 677,478 tons were delivered in 1938 and 667,199 in 1939. In the Pacific-Rocky Mountain district, lying west of Great Falls, Cheyenne, Denver, Albuquerque, and El Paso, the tonnage of asphalt terminated dropped from 768,773 in 1938 to 596,053 in 1939.

Supply and distribution of asphalt (petroleum, lake, and natural rock), exclusive of road oil, in continental United States in 1939, by districts, in short tons

	Northeastern district	Southeastern district	Southwestern district	North Central district	Pacific-Rocky Mountain district
Produced within district	2,091,400	638,402	1,476,512		808,834
Imported	60,983	2,240	10,622		
Received by rail from—					
Northeastern district		45,000		460,000	
Southeastern district	493,061				
Southwestern district	46,264	479,116		160,000	60,000
Pacific-Rocky Mountain district	38,000		12,836	49,463	
Net receipts by water	371,951	40,781			
Withdrawn from stocks			59,100		
	3,101,659	1,205,539	1,559,070	669,463	868,834
Shipped by rail—					
Within district	2,352,957	617,391	302,416	667,199	536,053
To Northeastern district		493,061	46,264		38,000
To Southeastern district	45,000		479,116		
To Southwestern district					12,836
To North Central district	460,000		160,000		49,463
To Pacific-Rocky Mountain district			60,000		
Shipped by motortruck, minor railroads, and intraport	100,000	80,000	100,000		60,000
Net shipments by water			341,785		70,947
Exported	39,202	1,387	69,489	2,264	101,035
Added to stocks	104,500	13,700			500
	3,101,659	1,205,539	1,559,070	669,463	868,834

FOREIGN TRADE

Imports.—Imports of natural asphalt and bitumens into the United States rose in quantity from 23,645 short tons in 1938 to 26,586 tons in 1939, but declined in value from $378,209 in 1938 to $362,559 in 1939. Imports of lake asphalt from Trinidad increased from 19,396 tons valued at $205,038 in 1938 to 21,440 tons valued at $227,223 in 1939. Imports of grahamite from Cuba likewise increased—from 3,826 tons valued at $65,344 in 1938 to 4,676 tons valued at $83,734 in 1939.

Atlantic Coast ports (chiefly New York) received 23,188 tons of natural asphalt and bitumen and Gulf Coast ports (Mobile, New Orleans, and Galveston) 3,364 tons in 1939.

Imports of petroleum asphalt, including cut-backs, and road oil advanced from 9,786 short tons valued at $38,883 in 1938 to 47,261 tons valued at $189,052 in 1939. All the petroleum asphalt imported in 1939 came from the Netherland West Indies; 37,763 tons were received in the customs district of New York and 9,498 tons in the customs district of New Orleans.

Exports.—Exports of petroleum asphalt, manufactured and unmanufactured, were 1 percent less in 1939 than in 1938. The principal decreases were in shipments to Europe, especially the United

Kingdom, France, and Belgium. Less asphalt was exported to other North and South American countries (except Brazil) in 1939 than in 1938. On the other hand, more asphalt was exported to eastern Asia, especially Netherland India, British India, and French Indochina, to Africa (especially the Union of South Africa), and to Australia in 1939 than in 1938; however, these increases were insufficient to offset the decline in shipments to northwestern Europe.

Petroleum asphalt exported from the United States, 1937–39, by countries

Country	1937		1938		1939	
	Short tons	Value	Short tons	Value	Short tons	Value
North America:						
Canada	5,264	$105,585	11,565	$120,589	10,641	$149,309
Other North America	6,076	96,119	12,015	202,144	8,099	126,468
	11,340	201,704	23,580	322,733	18,740	275,777
South America:						
Argentina	268	6,361	451	9,400	121	3,760
Brazil	8,210	105,367	8,459	123,633	9,070	140,966
Other South America	2,209	35,820	6,951	131,892	2,413	58,864
	10,687	147,548	15,861	264,925	11,604	203,590
Europe:						
Belgium	1,751	24,018	2,924	38,928	1,327	17,684
Denmark	75	1,762	118	3,867	289	5,929
Finland	105	2,486	65	1,677	1,021	19,246
France	4,461	68,441	4,010	52,187	300	9,491
Germany	603	14,347	354	8,832	253	6,590
Italy	3,559	52,808	32	661	531	8,020
Netherlands	1,121	17,585	578	8,331	834	12,354
Spain			56	2,714	32	687
Sweden	950	16,049	738	12,151	2,241	34,620
United Kingdom	21,156	364,277	29,222	455,126	16,313	412,468
Other Europe	2,300	43,039	2,943	52,664	1,953	34,064
	36,081	604,812	41,040	637,138	25,094	561,153
Asia:						
British Malaya	16,776	221,882	9,508	174,017	8,338	135,458
Ceylon	6,593	86,264	3,453	49,504	2,794	35,689
China	7,956	123,054	2,153	31,699	2,400	34,322
Hong Kong	3,244	46,030	2,642	38,788	1,343	20,977
India, British, and Burma	24,736	353,923	10,427	149,979	16,162	227,575
Indochina, French	5,621	54,989	5,809	85,590	8,286	95,744
Japan	4,908	75,983	1,964	30,172	125	4,127
Netherland India	17,323	238,965	13,022	190,183	25,210	367,810
Philippine Islands	11,627	143,973	11,367	150,427	11,946	169,454
Other Asia	169	4,661	2,493	42,878	2,241	48,027
	98,953	1,349,724	62,838	943,237	78,845	1,139,183
Africa:						
British East Africa	306	4,725	1,616	27,026	2,724	43,291
Mozambique	6,985	124,046	5,391	96,465	4,209	68,598
Tunisia	19	437				
Union of South Africa	16,079	279,249	11,567	195,501	18,478	290,752
Other Africa	94	2,732	84	3,394	539	12,732
	23,483	411,189	18,658	322,386	25,950	415,373
Oceania:						
Australia	21,977	299,079	32,510	436,460	33,114	435,739
New Zealand	6,105	95,209	7,787	100,199	6,340	66,846
Other Oceania	131	1,862	225	3,084	8	138
	28,213	396,150	40,522	539,743	39,462	502,723
	208,757	3,111,127	202,499	3,030,162	199,695	3,097,799

ROAD OIL

Increased construction of oil-treated macadam, gravel, and sand-clay highways resulted in a gain of 5 percent in refinery sales of road oil—from 7,741,843 barrels in 1938 (revised figure) to 8,108,400 in 1939. As a result of lower prices, however, the value at the refineries of sales of road oil decreased 11 percent—from $9,464,114 (revised figure) in 1938 to $8,458,600 in 1939.

Increases occurred in the following districts: Indiana, Illinois, Kentucky, etc.; Oklahoma, Kansas, and Missouri; Texas; Louisiana-Arkansas; and California. Declines in the East Coast, Appalachian, and Rocky Mountain districts were inadequate to offset the general increase.

Of the road oil sold in 1939, only 293,100 barrels valued at $592,300 were made from foreign petroleum, imported chiefly from Venezuela and Mexico. Of the road oil made from foreign crude, 98 percent was sold by refineries of the East Coast district in 1939.

Road oil sold by petroleum refineries in the United States, 1938–39, by districts

District	1938		1939	
	Barrels	Value	Barrels	Value
East Coast	943,073	$1,544,169	881,900	$1,208,100
Appalachian	146,066	185,542	121,400	147,000
Indiana, Illinois, Kentucky, etc	1,751,411	2,390,213	2,102,600	2,142,800
Oklahoma, Kansas, and Missouri	919,151	841,264	987,400	735,300
Texas	241,694	363,008	369,200	574,300
Louisiana-Arkansas	[1] 143,257	[1] 193,828	190,600	181,100
Rocky Mountain	1,183,880	1,492,280	1,025,800	1,373,400
California	2,413,311	2,453,810	2,429,500	2,096,600
	[1] 7,741,843	[1] 9,464,114	8,108,400	8,458,600

[1] Revised figures.

Petroleum refineries in the United States reported the production of 7,868,000 barrels of road oil in 1939 compared with 7,788,000 barrels (revised figure) in 1938. The refinery output of road oil in 1939 was augmented by 1,222,700 barrels of other petroleum products, chiefly fuel oil, transferred to road-oil stocks compared with 722,100 barrels similarly transferred in 1938. Stocks of road oil and transferred oils rose 22,000 barrels in 1939 and 13,000 in 1938. Consumption of road oil at refineries in operations, transfers, losses, and adjustments were 960,300 barrels in 1939 compared with 755,257 in 1938.

Production, receipts, stocks, consumption, transfers and losses, and sales of road oil in the United States in 1939, in barrels

District	Production	Receipts from other sources	Stocks		Consumption by companies, transfers, and losses	Sales	
			Dec. 31, 1938	Dec. 31, 1939		Domestic	Foreign
East Coast	370,000	547,500	39,000	59,000	15,600	881,900	
Appalachian	123,000		4,000	5,000	600	121,400	
Indiana, Illinois, Kentucky, etc	2,206,000	19,100	12,000	26,000	108,500	2,102,600	
Oklahoma, Kansas, and Missouri	1,006,000	142,500	38,000	60,000	139,100	987,400	
Texas	411,000	267,100	8,000	43,000	273,900	357,200	12,000
Louisiana-Arkansas	472,000	3,700	42,000	34,000	293,100	190,600	
Rocky Mountain	819,000	228,300	244,000	136,000	129,500	1,025,800	
California	2,461,000	14,500	293,000	339,000		2,422,000	7,500
Total: 1939	7,868,000	1,222,700	680,000	702,000	960,300	8,088,900	19,500
1938 [1]	7,788,000	722,100	667,000	680,000	755,257	[2] 7,741,843	[2]

[1] Revised figures. [2] Foreign included with domestic.

The average value of road oil sold in the United States f. o. b. refinery fell from $1.22 (revised figure) in 1938 to $1.04 in 1939. The principal decreases were in the East Coast district (from $1.64 in 1938 to $1.37 in 1939); the Indiana, Illinois, Kentucky, etc., district (from $1.36 to $1.02); the Louisiana-Arkansas district (from $1.35 to $0.95) the Oklahoma-Kansas-Missouri district (from $0.92 to $0.74); and California (from $1.02 to $0.86). Gains in Texas (from $1.50 to $1.56) and the Rocky Mountain district (from $1.26 to $1.34) were too slight to check the general decline.

CEMENT

By Oliver Bowles and E. V. Balser

SUMMARY OUTLINE

Production of portland cement in the United States increased from 105,357,000 barrels (376 pounds) in 1938 to 122,259,154 in 1939, a 16-percent gain, according to final annual reports submitted by cement companies to the Bureau of Mines. Shipments increased from 106,324,127 barrels valued at $153,977,226 to 122,651,459 barrels valued at $180,893,208, a gain of 15 percent in quantity and 17 percent in value. The preliminary figures on production for 1939, published by the Bureau of Mines in January 1940, were 0.4 percent less and shipments 0.3 percent less than the final figures. There was a consistent gain in shipments each month of 1939 compared with the corresponding month of 1938.

The Federal Reserve Board annual index for cement production in 1939 was 82 compared with 95 for the durable-goods industries and 72 for the construction industries. Corresponding figures for 1938 were cement 70, durable-goods industries 65, and construction industries 64.

In 1939 portland cement was manufactured at 150 plants, and shipments were made from 150 plants compared with 149 producing and 151 shipping in 1938.

The average factory value was $1.47 a barrel in 1939 compared with $1.45 in 1938.

Shipments included 3,670,506 barrels of high-early-strength portland cement valued at $6,910,099 (an average of $1.88 a barrel) in 1939 compared with 3,385,523 barrels valued at $6,247,699 (an average of $1.85 a barrel) in 1938.

The quantity of natural, masonry (natural), and puzzolan cements produced increased 34 percent and shipments 29 percent compared with 1938. The value of shipments of these varieties gained 23 percent.

The preceding data show briefly the condition of the cement industry in the United States as a whole. The accompanying chart, figure 1, shows the percentage gains or losses in shipments from mills into each State in 1939 compared with the shipments in 1938. Unusually large gains generally indicate that demands were heavy for extensive reclamation or other projects and drastic declines reflect the completion of such projects.

The following tables present the outstanding features of the cement industry during recent years.

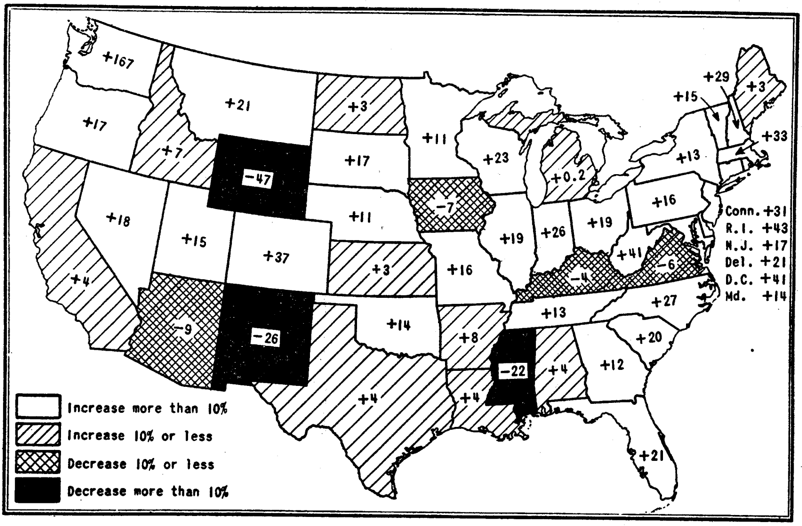

FIGURE 1.—Shipments of portland cement from mills into States in 1939 compared with 1938. The figures represent percent of change based upon preliminary figures for 1939.

Salient statistics of the cement industry in the United States, 1936–39

	1936	1937	1938	1939
Domestic production:				
Portland ......barrels..	112,649,782	116,174,708	105,357,000	122,259,154
Masonry, natural, and puzzolan (slag-lime) barrels..	1,819,488	1,900,643	[1] 1,820,795	2,439,110
Total production ......do....	114,469,270	118,075,351	[1] 107,177,795	124,698,264
Active plants:				
Portland	149	150	151	150
Masonry, natural, and puzzolan (slag-lime)	13	12	[1] 12	12
Domestic shipments:				
Portland ......barrels..	112,849,979	113,804,782	106,324,127	122,651,459
Value	$170,415,302	$168,835,208	$153,977,226	$180,893,208
Masonry, natural, and puzzolan (slag-lime) barrels..	1,760,993	1,873,400	[1] 1,867,949	2,405,135
Value	$2,362,396	$2,578,885	[1] $2,725,776	$3,361,724
Total shipments ......barrels..	114,610,972	115,678,182	[1] 108,192,076	125,056,594
Value	$172,777,698	$171,414,093	[1] $156,703,002	$184,254,932
Imports ......barrels..	1,658,902	1,803,932	1,727,411	1,913,853
Exports ......do....	334,673	378,554	558,226	1,146,339
Apparent consumption ......do....	115,935,201	117,103,560	[1] 109,361,261	125,824,108
Stocks at mills at end of year:				
Portland:				
Finished cement ......do....	22,568,685	[1] 24,913,245	[1] 23,992,939	23,600,634
Clinker ......do....	5,564,000	6,342,000	[1] 5,286,000	5,165,000
Masonry, natural, and puzzolan (slag-lime) barrels..	230,788	[1] 253,518	[1] 373,816	407,791

[1] Revised figures

Principal hydraulic cements produced and shipped in the United States, 1935–39

Year	Active plants	Production: Portland cement (barrels)	Masonry, natural, and puzzolan (slag-lime) cements: Active plants	Masonry, natural, and puzzolan (slag-lime) cements: Barrels	Total: Active plants	Total: Barrels
1935	150	76,741,570	13	1,006,064	163	77,747,634
1936	149	112,649,782	13	1,819,488	162	114,469,270
1937	150	116,174,708	12	1,900,643	162	118,075,351
1938	151	105,357,000	[1] 12	[1] 1,820,795	[1] 163	[1] 107,177,795
1939	150	122,259,154	12	2,439,110	162	124,698,264

Year	Shipments: Portland cement: Barrels	Portland cement: Value	Masonry, natural, and puzzolan (slag-lime) cements: Barrels	Masonry, natural, and puzzolan (slag-lime) cements: Value	Total: Barrels	Total: Value
1935	75,232,917	$113,372,182	1,011,411	$1,437,542	76,244,328	$114,809,724
1936	112,849,979	170,415,302	1,760,993	2,362,396	114,610,972	172,777,698
1937	113,804,782	168,835,208	1,873,400	2,578,885	115,678,182	171,414,093
1938	106,324,127	153,977,226	[1] 1,867,949	[1] 2,725,776	[1] 108,192,076	[1] 156,703,002
1939	122,651,459	180,893,208	2,405,135	3,361,724	125,056,594	184,254,932

[1] Revised figures.

PORTLAND CEMENT

PRODUCTION, SHIPMENTS, AND STOCKS

Although all portland cements had fairly constant and uniform properties some years ago, during recent years the varied demands of construction have led to the development of a variety of portland cements, each adapted to a particular use. These include high-early-strength, masonry, low-heat, and oil-well cements. All varieties are included in the general portland cement tables that follow, and the special types are discussed in more detail, with statistics wherever available, in a later section of this report. The special portland cements are not to be confused with certain other types, such as natural and slag-lime cements, that are quite distinct from portland cement and are covered in a separate section of this chapter.

The following tables present the principal statistics for portland cement. In the first, which relates to production, shipments, and stocks by States and districts, the term "active plant" is applied to a mill or group of mills situated at one place and operated by one company. If a company has establishments at different places, its mill or group of mills at each place is counted as one plant. The districts are groups of States related geographically and commercially.

The tables giving data by months, compiled from monthly reports of the producers, include figures of clinker or unground cement produced and in reserve at the mills awaiting manufacture into finished cement. Although the figures may differ slightly from those based upon annual reports of the producers, they reflect accurately seasonal fluctuations in the industry.

Portland cement produced, shipped, and in stock in the United States, 1938–39, by States and districts

	Active plants		Production			Shipments							Stock at mills (Dec. 31)		
			Barrels		Increase or decrease in 1939 (percent)	1938		1939		Average factory value per barrel		Increase or decrease in quantity in 1939 (per cent)	Barrels		Increase or decrease in 1939 (percent)
	1938	1939	1938	1939		Barrels	Value	Barrels	Value	1938	1939		1938	1939 [1]	
STATE															
Alabama	6	6	4, 627, 639	5, 038, 400	+9	4, 548, 079	$6, 114, 246	5, 042, 921	$6, 690, 765	$1. 34	$1. 33	+11	675, 520	670, 999	−0. 7
California	10	10	10, 513, 067	10, 990, 079	+5	10, 539, 010	15, 689, 210	11, 293, 989	15, 889, 395	1. 49	1. 41	+7	[2] 1, 480, 745	1, 176, 835	−21
Illinois	4	4	3, 959, 932	4, 648, 834	+17	4, 357, 119	5, 993, 644	4, 801, 292	7, 056, 746	1. 38	1. 47	+10	833, 017	680, 559	−18
Iowa	5	5	4, 726, 517	4, 718, 024	−. 2	4, 759, 390	7, 327. 048	4, 717, 295	7, 771, 503	1. 54	1. 65	−. 9	[2] 1, 541, 951	1, 542, 680	+. 04
Kansas	6	6	3, 264, 350	3, 739, 004	+15	3, 217, 497	4, 949, 018	3, 746, 370	5, 614, 112	1. 54	1. 50	+16	[2] 1, 083, 982	1, 076, 616	−. 7
Michigan	11	9	7, 159, 362	8, 218, 760	+15	7, 192, 511	8, 767, 859	8, 327, 479	10, 891, 978	1. 22	1. 31	+16	[2] 2, 067, 712	1, 958, 993	−5
Missouri	5	5	4, 491, 458	4, 785, 594	+7	4, 570, 389	6, 871, 120	4, 702, 259	7, 420, 013	1. 50	1. 58	+3	976, 873	1, 060, 208	+9
New York	10	10	5, 807, 731	6, 867, 614	+18	5, 720, 922	7, 893, 270	6, 853, 796	9, 866, 102	1. 38	1. 44	+20	[2] 1, 598, 172	1, 611, 990	+. 9
Ohio	9	9	5, 188, 477	5, 799, 726	+12	5. 258, 603	7, 094, 745	6, 140, 125	8, 233, 817	1. 35	1. 34	+17	[2] 1. 670. 082	1, 329, 683	−20
Pennsylvania	25	25	20, 868, 384	25, 105, 902	+20	21, 082, 966	28, 242, 913	24, 870, 343	34, 332, 649	1. 34	1. 38	+18	[2] 5, 417, 552	5, 653, 111	+4
Puerto Rico	----	1	----------	324, 243	------	----------	----------	347, 981	571, 397	-----	1. 64	------	[2] 24, 988	1, 250	−95
Tennessee	6	6	3, 318, 797	3, 537, 208	+7	3, 390, 871	5, 063, 628	3, 677, 116	5, 613, 477	1. 49	1. 53	+8	[2] 533, 386	393, 478	−26
Texas	10	10	6, 949, 164	7, 337, 246	+6	7, 116, 545	11, 885, 494	7, 207, 001	12, 152, 780	1. 67	1. 69	+1	[2] 780, 494	910, 739	+17
Other States [3]	44	44	24, 482, 122	31, 148, 520	+27	24, 570, 225	38, 085, 031	30, 923, 492	48, 788, 474	1. 55	1. 58	+26	[2] 5, 308, 465	5, 533, 493	+4
	151	150	105, 357, 000	122, 259, 154	+16	106, 324, 127	153, 977, 226	122, 651, 459	180, 893, 208	1. 45	1. 47	+15	[2] 23, 992, 939	23, 600, 634	−2
DISTRICT															
Eastern Pennsylvania, New Jersey, and Maryland	22	22	19, 895, 691	23, 650, 626	+19	19, 825, 160	26, 222, 912	23, 540, 428	32, 391, 372	1. 32	1. 38	+19	[2] 4, 583, 853	4, 694, 051	+2
New York and Maine	11	11	6, 245, 193	7, 315, 716	+17	6, 184. 521	8, 631, 618	7, 271, 793	10, 587, 487	1. 40	1. 46	+18	[2] 1, 707, 862	1, 751, 785	+3
Ohio, western Pennsylvania, and West Virginia	18	18	9, 374, 184	11, 339, 742	+21	9, 632, 020	13, 073, 949	11, 541, 643	15, 709, 189	1. 36	1. 36	+20	[2] 3, 142, 690	2, 940, 789	−6
Michigan	11	9	7, 159, 362	8, 218, 760	+15	7, 192, 511	8, 767, 859	8, 327. 479	10, 891, 978	1. 22	1. 31	+16	[2] 2, 067, 712	1, 958, 993	−5
Wisconsin, Illinois, Indiana, and Kentucky	11	11	9, 930, 734	12, 276, 018	+24	10, 760, 293	15, 454, 526	12, 099, 208	18, 150, 783	1. 44	1. 50	+12	[2] 2, 107, 696	2, 284, 506	+8
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	18	18	12, 026. 249	13, 349, 464	+11	12, 020, 082	17, 326, 540	13, 506, 584	19, 753, 173	1. 44	1. 46	+12	[2] 1, 812. 457	1, 655, 337	−9

Eastern Missouri, Iowa, Minnesota, and South Dakota	11	11	9,994,563	10,474,558	+5	10,190,025	15,572,640	10,338,021	16,730,452	1.53	1.62	+1	[2] 2,751,932	2,888,469	+5
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	12	12	7,602,704	8,038,885	+6	7,442,529	11,304,784	8,017,308	12,128,812	1.52	1.51	+8	[2] 2,111,105	2,132,682	+1
Texas	10	10	6,949,164	7,337,246	+6	7,116,545	11,885,494	7,207,001	12,152,780	1.67	1.69	+1	[2] 780,494	910,739	+17
Colorado, Montana, Utah, Wyoming, and Idaho	8	8	2,689,465	3,062,889	+14	2,705,161	5,365,567	3,078,540	5,865,025	1.98	1.91	+14	[2] 612,994	597,343	−3
California	10	10	10,513,067	10,990,079	+5	10,539,010	15,689,210	11,293,989	15,889,395	1.49	1.41	+7	[2] 1,480,745	1,176,835	−21
Oregon and Washington	9	9	2,976,624	5,880,928	+98	2,716,270	4,682,127	6,081,484	10,071,365	1.72	1.66	+124	808,411	607,855	−25
Puerto Rico		1		324,243				347,981	571,397		1.64		[2] 24,988	1,250	−95
	151	150	105,357,000	122,259,154	+16	106,324,127	153,977,226	122,651,459	180,893,208	1.45	1.47	+15	[2] 23,992,939	23,600,634	−2

[1] Subject to revision.
[2] Revised figures.
[3] Arkansas, Colorado, Florida, Georgia, Idaho, Indiana, Kentucky, Louisiana, Maine, Maryland, Minnesota, Montana, Nebraska, New Jersey, Oklahoma, Oregon, South Dakota, Utah, Virginia, Washington, West Virginia, Wisconsin, and Wyoming.

The accompanying table shows revised figures on stocks of finished portland cement on hand at the mills at the end of 1937.

Producers' stocks of finished portland cement on hand at mills in the United States on Dec. 31, 1937, by States and districts

State	Barrels [1]	District	Barrels [1]
Alabama	595,960	Eastern Pennsylvania, New Jersey, and Maryland	4,513,216
California	1,501,403	New York and Maine	1,647,202
Illinois	1,230,204	Ohio, western Pennsylvania, and West Virginia	3,390,989
Iowa	1,569,787	Michigan	2,110,930
Kansas	1,034,522	Wisconsin, Illinois, Indiana, and Kentucky	2,937,350
Michigan	2,110,930	Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	1,806,127
Missouri	1,055,804	Eastern Missouri, Iowa, Minnesota, and South Dakota	2,942,357
New York	1,511,375	Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	1,942,361
Ohio	1,735,666	Texas	947,883
Pennsylvania	5,627,033	Colorado, Montana, Utah, Wyoming, and Idaho	625,370
Tennessee	605,461	California	1,501,403
Texas	947,883	Oregon and Washington	548,057
Other States [2]	5,387,217		
	24,913,245		24,913,245

[1] Revised figures.
[2] Arkansas, Colorado, Florida, Georgia, Idaho, Indiana, Kentucky, Louisiana, Maine, Maryland, Minnesota, Montana, Nebraska, New Jersey, Oklahoma, Oregon, South Dakota, Utah, Virginia, Washington, West Virginia, Wisconsin, and Wyoming.

Summary of monthly estimates of portland cement produced, shipped, and in stock at mills in the United States in 1939, by districts, in thousands of barrels

District	January	February	March	April	May	June	July	August	September	October	November	December
PRODUCTION												
Eastern Pennsylvania, New Jersey, and Maryland	670	1,188	1,923	1,995	1,799	2,390	2,458	2,530	2,209	2,431	2,204	1,876
New York and Maine	100	192	361	681	637	810	844	857	853	826	631	517
Ohio, western Pennsylvania, and West Virginia	294	229	567	821	953	1,172	1,370	1,496	1,264	1,357	1,100	658
Michigan	365	250	258	559	798	953	1,018	917	887	796	738	680
Wisconsin, Illinois, Indiana, and Kentucky	670	656	796	681	1,157	1,258	1,300	1,267	1,295	1,151	1,049	928
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	822	903	1,143	1,058	1,134	1,094	1,289	1,097	1,227	1,269	1,235	1,094
Eastern Missouri, Iowa, Minnesota, and South Dakota	261	221	590	858	1,009	1,030	984	1,136	1,166	1,250	1,019	946
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	366	343	610	657	860	781	904	708	569	837	733	653
Texas	673	571	499	720	772	537	667	485	685	704	478	547
Colorado, Montana, Utah, Wyoming, and Idaho	107	61	105	208	364	353	358	317	283	311	334	267
California	761	678	913	906	1,092	1,023	840	959	968	1,023	931	916
Oregon and Washington	212	213	406	530	610	552	612	600	531	584	601	406
Puerto Rico	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
United States:												
1939	5,301	5,505	8,171	9,674	11,185	11,953	12,644	12,369	11,937	12,539	11,053	9,488
1938	4,534	3,916	5,879	7,983	10,361	10,535	10,968	11,007	10,559	11,556	10,184	8,066
SHIPMENTS												
Eastern Pennsylvania, New Jersey, and Maryland	956	973	1,641	1,956	2,601	2,527	2,316	2,393	2,320	2,343	2,115	1,416
New York and Maine	228	204	365	511	741	800	782	880	937	879	610	334
Ohio, western Pennsylvania, and West Virginia	399	351	690	762	1,247	1,185	1,236	1,493	1,320	1,291	948	551
Michigan	277	259	411	530	970	1,122	853	1,084	967	879	624	361
Wisconsin, Illinois, Indiana, and Kentucky	393	334	681	793	1,222	1,250	1,339	1,635	1,511	1,399	958	584
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	941	810	1,108	1,122	1,271	1,212	1,128	1,178	1,279	1,370	1,147	941
Eastern Missouri, Iowa, Minnesota, and South Dakota	315	236	569	748	1,086	1,142	1,113	1,323	1,440	1,165	784	417
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	466	342	601	673	851	822	726	806	826	816	636	451
Texas	628	545	697	665	686	644	535	582	585	568	554	518
Colorado, Montana, Utah, Wyoming, and Idaho	124	81	194	302	362	319	287	312	338	364	253	142

[1] Data not available.

Summary of monthly estimates of portland cement produced, shipped, and in stock at mills in the United States in 1939, by districts, in thousands of barrels—Continued

District	January	February	March	April	May	June	July	August	September	October	November	December
SHIPMENTS—continued												
California	809	722	986	985	1,047	992	886	1,070	961	1,070	960	840
Oregon and Washington	104	187	524	607	664	700	556	645	620	685	558	230
Puerto Rico	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
United States:												
1939	5,640	5,044	8,467	9,654	12,748	12,715	11,757	13,401	13,104	12,829	10,147	6,785
1938	4,390	4,575	7,259	8,691	9,752	10,943	10,164	11,823	11,716	12,357	8,573	6,290
STOCKS (END OF MONTH)												
Eastern Pennsylvania, New Jersey, and Maryland	4,297	4,512	4,791	4,832	4,026	3,889	4,031	4,168	4,057	4,145	4,231	4,695
New York and Maine	1,582	1,570	1,566	1,736	1,633	1,643	1,705	1,681	1,597	1,544	1,565	1,752
Ohio, western Pennsylvania, and West Virginia	3,032	2,909	2,787	2,843	2,549	2,536	2,660	2,663	2,607	2,673	2,824	2,904
Michigan	2,166	2,156	2,004	2,033	1,855	1,686	1,848	1,680	1,600	1,518	1,639	1,960
Wisconsin, Illinois, Indiana, and Kentucky	2,375	2,697	2,811	2,700	2,623	2,630	2,592	2,219	2,004	1,755	1,846	2,189
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	1,691	1,784	1,819	1,755	1,618	1,499	1,661	1,580	1,528	1,428	1,516	1,655
Eastern Missouri, Iowa, Minnesota, and South Dakota	2,698	2,683	2,709	2,819	2,742	2,631	2,502	2,315	2,040	2,125	2,360	2,888
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	2,012	2,032	2,041	2,024	2,033	1,992	2,169	2,072	1,815	1,835	1,931	2,133
Texas	826	852	655	709	795	688	820	722	822	958	882	911
Colorado, Montana, Utah, Wyoming, and Idaho	596	576	486	392	392	426	497	503	449	396	477	601
California	1,423	1,380	1,307	1,228	1,273	1,305	1,259	1,148	1,155	1,108	1,079	1,155
Oregon and Washington	913	941	810	766	712	564	617	575	486	385	429	605
Puerto Rico	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	1
United States:												
1939	23,611	24,092	23,786	23,837	22,251	21,489	22,361	21,326	20,160	19,870	20,779	23,449
1938	25,023	24,361	22,979	22,262	22,875	22,467	23,286	22,534	21,374	20,569	22,179	23,947

[1] Data not available.

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Summary of monthly estimates of clinker (unground portland cement) produced and in stock at mills in the United States in 1939, by districts, in thousands of barrels

District	January	February	March	April	May	June	July	August	September	October	November	December
PRODUCTION												
Eastern Pennsylvania, New Jersey, and Maryland	688	1,220	2,002	1,958	1,542	2,398	2,605	2,507	2,179	2,298	2,156	1,844
New York and Maine	44	221	412	699	540	844	845	830	842	832	643	519
Ohio, western Pennsylvania, and West Virginia	276	271	631	852	942	1,289	1,366	1,315	1,186	1,255	1,070	790
Michigan	411	291	333	495	817	892	926	884	853	867	787	693
Wisconsin, Illinois, Indiana, and Kentucky	683	776	963	912	951	1,159	1,224	1,249	1,201	1,082	1,174	1,027
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	871	924	1,197	1,082	985	1,104	1,335	1,172	1,216	1,192	1,155	1,080
Eastern Missouri, Iowa, Minnesota, and South Dakota	246	223	689	832	1,056	1,063	1,019	1,109	1,031	1,182	1,001	988
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	345	443	642	711	826	743	811	690	603	847	724	660
Texas	743	510	454	665	744	557	706	465	626	688	566	535
Colorado, Montana, Utah, Wyoming, and Idaho	105	39	100	176	371	375	347	339	309	343	359	243
California	797	735	904	941	1,037	1,039	1,055	1,044	992	1,042	897	904
Oregon and Washington	378	277	365	492	498	527	532	532	424	486	542	457
Puerto Rico	[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]
United States: 1939	5,587	5,930	8,692	9,815	10,309	11,990	12,771	12,136	11,462	12,114	11,074	9,740
1938	4,762	4,062	5,687	7,821	10,064	10,361	10,840	10,910	10,127	10,917	10,203	8,363
STOCKS (END OF MONTH)												
Eastern Pennsylvania, New Jersey, and Maryland	811	850	944	920	676	722	877	874	859	748	709	755
New York and Maine	204	235	289	313	223	266	275	258	255	269	289	292
Ohio, western Pennsylvania, and West Virginia	620	661	719	747	735	829	820	650	576	475	437	567
Michigan	310	351	426	383	403	341	251	214	182	243	275	281
Wisconsin, Illinois, Indiana, and Kentucky	299	418	586	802	609	507	418	383	287	210	322	415
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	478	494	548	557	409	425	472	550	538	465	387	377
Eastern Missouri, Iowa, Minnesota, and South Dakota	369	372	403	391	440	482	520	498	373	308	258	310
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	270	371	403	449	416	378	285	265	288	300	290	295
Texas	334	279	234	187	168	191	235	220	167	164	251	243
Colorado, Montana, Utah, Wyoming, and Idaho	114	91	87	55	66	83	74	97	123	155	181	159
California	1,010	1,052	1,022	1,044	969	977	1,175	1,254	1,242	1,244	1,205	1,193
Oregon and Washington	744	812	786	720	614	596	526	464	364	273	220	278
Puerto Rico	[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]
United States: 1939	5,563	5,986	6,447	6,568	5,728	5,797	5,928	5,727	5,254	4,854	4,824	5,165
1938	6,589	6,732	6,623	6,497	6,326	6,218	6,089	5,902	5,506	4,927	4,963	5,286

[1] Data not available.

Producers' stocks of portland cement on hand at the mills were 2 percent lower at the end of 1939 than at the end of 1938. The following table gives stocks on December 31 and the seasonal fluctuations in stocks from 1935 to 1939.

Producers' stocks of finished portland cement and clinker (unground cement) on hand at mills in the United States on Dec. 31 and monthly range, 1935–39

		Dec. 31 (barrels)	Monthly range			
			Low		High	
			Month	Barrels	Month	Barrels
1935	Cement	23,064,563	October	20,501,000	July	23,287,000
	Clinker	5,226,000	December	5,226,000	do	6,849,000
1936	Cement	22,568,685	October	18,079,000	February	22,971,000
	Clinker	5,564,000	September	4,838,000	March	5,625,000
1937	Cement	[1] 24,913,245	do	21,388,000	April	25,747,000
	Clinker	6,342,000	October	5,859,000	March	7,554,000
1938	Cement	[1] 23,992,939	do	20,569,000	January	25,023,000
	Clinker	[1] 5,286,000	do	4,927,000	February	6,732,000
1939	Cement	23,600,634	do	19,870,000	do	24,092,000
	Clinker	5,165,000	November	4,824,000	April	6,568,000

[1] Revised figures.

DOMESTIC CONSUMPTION

Apparent consumption (shipments plus imports minus exports) for a series of years is indicated in the table of salient statistics. The only available gage of consumption by States is the record of shipments into States by manufacturers; it is therefore merely approximate. Cement shipped to destinations within a State in which it is manufactured is of course added to that shipped from other States. Shipments into a State during any 1 year may not equal the consumption during that year but over a series of years should afford a fair index of consumption. The following table shows shipments into States in 1938 and 1939 and per capita consumption in each State.

The official figures for exports of cement differ from those reported by manufacturers in the following table, because cement forwarded from mills and destined to foreign countries and to Alaska, Hawaii, and Puerto Rico is reported by shippers as exported, whether or not it leaves the country during the calendar year, whereas the export figures of the Bureau of Foreign and Domestic Commerce record the cement that actually leaves the country during the period specified. The exports recorded by the Bureau of Foreign and Domestic Commerce include all hydraulic cement exported, whereas the figures supplied by producers relate to portland cement only.

The per capita consumption indicated in the table falls short of the total apparent consumption by the quantity of imports, which slightly affects certain States near the Canadian border and the seaboard.

Shipments of domestic portland cement from mills into States and per capita, 1938–39, in barrels [1]

State	1938		1939	
	Total	Per capita [1]	Total	Per capita [1]
Alabama	1, 310, 975	0. 45	1, 368, 138	0. 47
Arizona [2]	702, 045	1. 70	639, 754	1. 55
Arkansas	779, 153	. 38	841, 229	. 41
California	9, 216, 358	1. 50	9, 595, 856	1. 56
Colorado	856, 634	. 80	1, 170, 566	1. 09
Connecticut [2]	1, 365, 048	. 78	1, 787, 229	1. 03
Delaware [2]	298, 784	1. 14	356, 843	1. 37
District of Columbia [2]	1, 004, 861	1. 60	1, 423, 195	2. 27
Florida	1, 236, 370	. 74	1, 505, 807	. 90
Georgia	1, 323, 885	. 43	1, 484, 770	. 48
Idaho	382, 709	. 78	411, 488	. 83
Illinois	6, 432, 231	. 82	7, 664, 172	. 97
Indiana	2, 837, 462	. 82	3, 576, 555	1. 03
Iowa	3, 226, 718	1. 26	2, 994, 325	1. 17
Kansas	1, 645, 844	. 88	1, 689, 635	. 91
Kentucky	1, 984, 266	. 68	1, 908, 566	. 65
Louisiana	1, 908, 484	. 90	1, 978, 083	. 93
Maine	411, 716	. 48	416, 027	. 49
Maryland	1, 612, 035	. 96	1, 904, 453	1. 13
Massachusetts [2]	1, 958, 035	. 44	2, 606, 866	. 59
Michigan	5, 288, 904	1. 10	5, 338, 118	1. 11
Minnesota	2, 394, 117	. 90	2, 649, 925	1. 00
Mississippi [2]	2, 019, 522	1. 00	1, 582, 099	. 78
Missouri	2, 787, 556	. 70	3, 225, 022	. 81
Montana	391, 573	. 73	469, 511	. 87
Nebraska	1, 102, 230	. 81	1, 223, 654	. 90
Nevada [2]	127, 842	1. 27	153, 351	1. 52
New Hampshire [2]	289, 235	. 57	374, 609	. 73
New Jersey	3, 423, 585	. 79	4, 008, 134	. 92
New Mexico [2]	891, 119	2. 11	674, 335	1. 60
New York	10, 823, 514	. 84	12, 224, 290	. 94
North Carolina [2]	1, 648, 790	. 47	2, 095, 636	. 60
North Dakota [2]	279, 648	. 40	284, 346	. 40
Ohio	5, 265, 862	. 78	6, 308, 706	. 94
Oklahoma	1, 900, 253	. 75	2, 165, 556	. 85
Oregon	669, 471	. 65	795, 363	. 77
Pennsylvania	6, 068, 337	. 60	7, 052, 453	. 69
Puerto Rico	412, 354		690, 306	
Rhode Island [2]	371, 918	. 55	567, 057	. 83
South Carolina [2]	768, 781	. 41	934, 253	. 50
South Dakota	393, 566	. 57	461, 999	. 67
Tennessee	1, 969, 645	. 68	2, 212, 597	. 76
Texas	6, 271, 197	1. 02	6, 541, 321	1. 06
Utah	479, 141	. 92	551, 629	1. 06
Vermont [2]	221, 915	. 58	263, 515	. 69
Virginia	2, 307, 481	. 85	2, 162, 937	. 80
Washington	2, 237, 035	1. 35	5, 974, 458	3. 60
West Virginia	1, 021, 349	. 55	1, 394, 698	. 75
Wisconsin	2, 620, 103	. 90	3, 222, 499	1. 10
Wyoming	496, 988	2. 11	264, 887	1. 13
Unspecified	18, 539		148, 737	
	105, 455, 183	. 81	121, 339, 558	. 94
Exports reported by manufacturers but not included above [3]	868, 944		1, 311, 901	
Total shipped from cement plants	106, 324, 127		122, 651, 459	

[1] Per capita figures based on latest available estimates of population made by the Bureau of the Census.
[2] Non-cement-producing State. [3] Includes shipments to Alaska and Hawaii.

The following table of monthly shipments from portland-cement mills into States in 1939 is based upon monthly reports of producers. Although the totals may vary slightly from figures shown in tables based upon annual reports they reflect seasonal fluctuations with fair accuracy.

Portland cement shipped from mills into States in 1939, by months, in barrels

Shipped to—	January	February	March	April	May	June	July	August	September	October	November	December
Alabama	116,667	90,754	121,614	115,381	116,712	126,267	107,135	107,551	101,917	123,099	117,884	122,047
Arizona	60,567	31,824	51,170	45,944	43,652	49,600	27,819	36,033	54,763	87,323	80,631	69,365
Arkansas	77,885	49,052	75,756	68,967	76,513	85,180	80,217	65,295	57,894	64,367	80,028	59,210
California	720,910	665,113	876,346	879,336	930,026	875,390	761,412	853,202	750,932	856,975	757,191	722,181
Colorado	47,549	34,291	68,753	106,334	136,151	135,696	114,745	126,162	125,534	124,694	88,505	61,096
Connecticut	48,593	45,605	86,082	140,433	209,755	193,106	189,079	207,646	222,181	205,266	162,105	76,541
Delaware	9,562	15,561	22,524	24,940	31,418	28,778	46,025	54,564	45,477	30,553	27,142	19,245
District of Columbia	51,768	70,976	99,267	106,780	124,046	98,358	109,605	118,869	144,303	161,941	195,296	136,273
Florida	97,603	99,444	119,846	116,790	126,009	113,733	113,035	127,485	124,045	148,978	168,858	148,855
Georgia	106,390	84,430	118,346	126,393	129,051	118,568	123,990	124,411	143,039	166,143	132,782	107,108
Hawaii	14,041	15,230	34,447	24,112	26,329	22,709	15,897	37,035	31,678	12,905	14,222	20,817
Idaho	19,539	12,553	42,721	42,351	43,770	43,226	29,956	54,004	38,938	37,529	31,406	14,884
Illinois	248,190	194,337	430,605	500,305	726,186	834,385	853,117	985,126	970,879	872,654	652,047	397,501
Indiana	115,259	103,325	230,532	247,531	356,892	341,942	372,992	517,079	478,131	388,771	269,747	154,770
Iowa	52,123	35,052	119,813	194,352	344,923	360,248	367,529	436,576	480,912	361,086	169,768	71,271
Kansas	109,530	78,099	132,111	170,354	178,603	152,841	133,627	148,228	169,689	188,167	135,706	92,197
Kentucky	85,271	63,210	138,577	148,942	201,542	170,592	182,314	201,076	225,939	223,200	160,120	106,673
Louisiana	153,851	129,801	177,195	184,343	187,282	182,777	167,949	144,419	152,928	178,627	180,711	137,173
Maine	14,567	12,414	13,473	23,655	48,680	63,826	44,087	48,805	64,902	56,905	23,441	9,746
Maryland	78,092	98,600	150,079	163,744	199,261	182,464	189,210	198,571	152,252	155,248	155,182	119,489
Massachusetts	117,513	95,195	122,555	204,333	297,437	287,941	293,605	280,422	269,151	266,227	232,139	137,410
Michigan	175,644	160,428	262,658	356,307	631,065	698,750	516,009	698,516	594,014	598,050	415,082	232,474
Minnesota	48,326	37,023	114,433	180,303	326,794	368,154	294,968	329,657	378,948	314,799	172,991	82,589
Mississippi	105,256	77,099	138,530	148,267	154,827	150,875	156,385	138,622	149,836	154,279	121,079	85,168
Missouri	146,216	107,231	241,495	248,205	368,719	342,099	332,231	313,841	314,665	356,151	275,959	177,481
Montana	13,397	7,389	32,961	51,290	52,332	47,722	47,349	45,332	47,682	55,306	48,360	22,794
Nebraska	40,073	23,376	74,237	98,223	125,627	108,445	106,064	147,205	184,918	145,552	108,995	59,903
Nevada	7,381	6,190	13,306	12,733	18,237	15,274	15,214	14,867	13,289	12,216	13,941	6,259
New Hampshire	10,085	7,207	16,239	23,518	32,639	34,033	43,278	50,861	57,175	54,779	28,194	15,591
New Jersey	150,044	157,510	278,678	333,910	457,318	472,922	418,208	409,729	389,170	384,871	335,995	224,060
New Mexico	98,099	73,492	91,607	64,117	56,274	56,125	44,099	40,814	35,890	43,215	37,393	32,162
New York	444,726	423,704	830,155	1,009,618	1,351,923	1,376,473	1,241,294	1,352,060	1,277,707	1,229,216	995,132	687,817
North Carolina	110,841	114,633	138,597	179,349	202,068	205,141	206,413	216,707	208,597	208,952	179,420	119,240
North Dakota	5,514	2,599	16,249	24,138	46,205	43,474	38,449	30,076	33,922	28,377	13,966	4,859
Ohio	218,308	191,278	385,449	410,398	737,019	693,441	631,068	828,245	678,781	687,211	518,122	316,885
Oklahoma	154,530	121,925	198,814	204,646	207,254	200,982	167,676	214,356	192,481	203,614	161,384	142,282
Oregon	37,816	34,905	60,611	64,228	68,573	78,905	71,116	91,471	84,016	79,846	70,578	40,514
Pennsylvania	237,693	222,310	413,940	490,077	735,328	760,194	797,280	854,827	795,298	793,941	594,943	323,582
Puerto Rico	49,155	37,375	25,375	13,769	20,376	14,112	12,650	12,606	41,970	66,485	39,175	24,234
Rhode Island	15,514	13,866	26,236	52,520	68,761	69,287	50,767	74,401	55,137	55,751	42,115	27,076
South Carolina	79,227	69,800	96,175	87,001	95,551	84,617	75,389	75,840	70,883	61,865	58,478	77,227
South Dakota	10,514	9,063	25,719	43,348	58,514	50,489	48,438	54,349	76,385	39,027	27,349	19,113
Tennessee	168,426	121,653	177,629	161,822	218,045	180,132	178,156	216,431	231,086	247,510	181,149	128,864
Texas	533,973	476,811	603,203	590,104	625,014	615,645	510,188	548,481	543,249	520,723	487,845	483,172

Utah	19,751	11,934	37,388	60,818	73,309	58,065	46,850	57,260	55,376	50,376	51,371	26,133
Vermont	7,708	8,968	8,103	16,027	32,478	38,641	29,816	32,226	33,716	33,904	18,227	3,578
Virginia	119,509	114,051	185,543	194,651	222,892	197,791	189,057	218,568	235,908	202,871	159,517	110,838
Washington	75,498	159,653	458,949	568,238	614,045	646,907	549,920	665,618	670,091	766,266	591,809	207,060
West Virginia	60,818	51,539	90,756	84,386	143,271	132,552	133,313	177,985	172,799	169,651	100,170	58,336
Wisconsin	89,643	90,425	111,733	167,010	308,731	386,179	390,849	538,120	494,656	335,616	199,307	111,863
Wyoming	11,847	6,076	17,005	22,968	34,054	31,843	29,097	31,286	29,806	21,094	19,270	9,993
Unspecified	7,455	16,159	2,354	6,658	60,000	11,943	15,596	8,989	14,834	6,484	10,786	91
	5,598,457	4,980,538	8,405,939	9,603,967	12,681,481	12,638,839	11,710,532	13,361,905	12,967,769	12,638,656	9,913,013	6,645,090
Foreign countries	41,543	63,462	61,061	50,033	66,519	76,161	46,468	39,095	136,231	190,344	233,987	139,910
Total shipped from cement plants	5,640,000	5,044,000	8,467,000	9,654,000	12,748,000	12,715,000	11,757,000	13,401,000	13,104,000	12,829,000	10,147,000	6,785,000

USES

Portland cement is applied to a multitude of uses that may be grouped in a few general classes. The Bureau of Mines has no facilities for collecting statistics of consumption by uses; but engineers of the Portland Cement Association, who are in touch with construction throughout the country, have estimated the quantities of portland cement used in the principal groups of consuming industries.

Estimated distribution of portland cement in the United States in 1938, by uses [1]

Classification	Percent	Barrels
Paving: Roads, streets, and airports	24	25,210,000
Structural: Buildings (including multiple dwellings), bridges, and railroads	29	30,463,000
Conservation: Reclamation, water supply, and sewerage	17	17,857,000
Housing (1- and 2-family dwellings), and miscellaneous uses	20	21,009,000
Farm	10	10,504,000
	100	105,043,000

[1] Compiled by the Portland Cement Association, based upon limited available data. Not comparable with published distributions for previous years because of changes in classifications.

LOCAL SUPPLIES

The following table compares the shipments from mills within a State or group of States with the estimated consumption (State receipts of mill shipments) and indicates the surplus or deficiency in the supply of cement locally available. Consumption in the States that do not produce cement also is indicated in the table showing consumption per capita.

The surplus in the following table was distributed by years as follows: In 1938, to non-cement-producing States and Puerto Rico 12,359,897 barrels, foreign countries, Alaska, and Hawaii 868,944 barrels, and unspecified 18,539 barrels; in 1939, to non-cement-producing States 13,743,088 barrels, foreign countries, Alaska, and Hawaii 1,311,901 barrels, and unspecified 148,737 barrels.

Estimated surplus or deficiency in local supply of portland cement in cement-producing States, 1938–39, in barrels

State or division	1938			1939		
	Shipments from mills	Estimated consumption	Surplus or deficiency	Shipments from mills	Estimated consumption	Surplus or deficiency
Alabama	4,548,079	1,310,975	+3,237,104	5,042,921	1,368,138	+3,674,783
California	10,539,010	9,216,358	+1,322,652	11,293,989	9,595,856	+1,698,133
Illinois	4,357,119	6,432,231	−2,075,112	4,801,292	7,664,172	−2,862,880
Iowa	4,759,390	3,226,718	+1,532,672	4,717,295	2,994,325	+1,722,970
Kansas	3,217,497	1,645,844	+1,571,653	3,746,370	1,689,635	+2,056,735
Michigan	7,192,511	5,288,904	+1,903,607	8,327,479	5,338,118	+2,989,361
Missouri	4,570,389	2,787,556	+1,782,833	4,702,259	3,225,022	+1,477,237
Ohio	5,258,603	5,265,862	−7,259	6,140,125	6,308,706	−168,581
Pennsylvania	21,082,966	6,068,337	+15,014,629	24,870,343	7,052,453	+17,817,890
Puerto Rico				347,981	690,306	−342,325
Tennessee	3,390,871	1,969,645	+1,421,226	3,677,116	2,212,597	+1,464,519
Texas	7,116,545	6,271,197	+845,348	7,207,001	6,541,321	+665,680
Colorado, Montana, Utah, Wyoming, and Idaho	2,705,161	2,607,045	+98,116	3,078,540	2,868,081	+210,459
Oregon and Washington	2,716,270	2,906,506	−190,236	6,081,484	6,769,821	−688,337
Georgia, Kentucky, Virginia, Florida, and Louisiana	4,954,431	8,760,486	−3,806,055	5,570,611	9,040,163	−3,469,552
Indiana, Wisconsin, Minnesota, Nebraska, Oklahoma, South Dakota, and Arkansas	10,615,153	12,026,884	−1,411,731	11,703,257	14,141,417	−2,438,160
Maryland, New Jersey, and West Virginia	3,115,611	6,056,969	−2,941,358	4,071,603	7,307,285	−3,235,682
New York and Maine	6,184,521	11,235,230	−5,050,709	7,271,793	12,640,317	−5,368,524
	106,324,127	93,076,747	+13,247,380	122,651,459	107,447,733	+15,203,726

TRANSPORTATION

As charges for transportation and delivery are large items in the cost of cement to consumers the accompanying table, showing the quantities of portland cement shipped in 1934, 1936, and 1939 from mills by truck, railroad, and boat in bulk and in containers, is of interest. Detailed data as to mode of shipping were not reported in 1934 for 2,982,924 barrels—a little less than 4 percent of the total shipments; in 1936, the detailed data were lacking for 16,870,730 barrels—nearly 15 percent of the total shipments; in 1939, the detailed data are lacking for 5,681,405 barrels—a little less than 5 percent of the total shipments for the year.

The only comparable figures for earlier years are those for 1928, when reports of producers to the Bureau of Mines showed that of the total shipments 2.4 percent were in bulk and 97.6 percent in containers.

Of the plants furnishing detailed information on the methods used in shipping their output for 1934, 131, representing 32 States, reported shipments in bulk; for 1936, 130 plants, representing 33 States, and for 1939, 137 plants, representing 33 States, reported bulk shipments.

Shipments of portland cement from mills in the United States in 1934, 1936, and 1939, in bulk and in containers, by types of carriers

[Unit of measure, barrels of 376 pounds]

Type of carrier	In bulk		In containers				Mode of shipping not stated	Total shipments	
			In bags		In other containers[1]	Total in containers			
			Paper	Cloth					
1934	*Barrels*	*Percent*	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Percent*
Truck	[2] 452,116	3.0	2,081,301	2,306,663	166	4,388,130		4,840,246	6.4
Railroad	13,270,738	87.4	25,254,019	26,813,430	151,539	52,218,988		65,489,726	86.3
Boat	1,288,816	8.5	761,596	536,519	1,452	1,299,567		2,588,383	3.4
Not stated	171,793	1.1	192,714	321,616		514,330	2,296,801	[3] 2,982,924	3.9
	15,183,463	100.0	28,289,630	29,978,228	153,157	58,421,015	2,296,801	75,901,279	100.0
Percent of total shipments	20.0		37.3	39.5	0.2	77.0	3.0	100.0	
1936									
Truck	[2] 793,550	3.9	4,090,942	5,023,665		9,114,607		9,908,157	8.8
Railroad	17,071,517	84.3	36,728,613	30,107,645	4,006	66,840,264	725,809	84,637,590	75.0
Boat	165,820	.8	753,838	496,151	17,693	1,267,682		1,433,502	1.3
Not stated	2,226,828	11.0	2,937,472	3,615,491	9,743	6,562,706	8,081,196	[3] 16,870,730	14.9
	20,257,715	100.0	44,510,865	39,242,952	31,442	83,785,259	8,807,005	112,849,979	100.0
Percent of total shipments	18.0		39.4	34.8		74.2	7.8	100.0	
1939									
Truck	[2] 2,078,494	8.6	7,325,535	6,913,700	140,904	14,380,139		16,458,633	13.4
Railroad	21,255,557	87.9	43,327,220	33,360,063	34,220	76,721,503		97,977,060	79.9
Boat	600,446	2.5	1,302,465	631,450		1,933,915		2,534,361	2.1
Not stated	250,594	1.0	439,221	498,273		937,494	4,493,317	[3] 5,681,405	4.6
	24,185,091	100.0	52,394,441	41,403,486	175,124	93,973,051	4,493,317	122,651,459	100.0
Percent of total shipments	19.7		42.7	33.8	0.1	76.6	3.7	100.0	

[1] Includes steel drums and iron and wooden barrels.
[2] Includes cement used at mills by producers as follows: 1934, 32,200 barrels; 1936, 103,893 barrels; 1939, 132,238 barrels.
[3] Includes cement for which mode of shipping is not stated as follows: 1934, 2,296,801 barrels; 1936, 8,081,196 barrels; 1939, 4,493,317 barrels.

PRICES

The average selling price of portland cement, f. o. b. factories (excluding the price of containers and cash discounts), as reported to the Bureau of Mines, is stated on a preceding page in the table of shipments by States and districts during 1938 and 1939. The average factory value of portland cement may be higher in certain States than it would be if ordinary structural cement were the only kind considered. For these States the average includes certain special cements that command higher prices, including the white portland cement made in California and Pennsylvania and the high-early-strength portland cement now manufactured in many States. The average selling price per barrel, f. o. b. factory, of white portland cement in 1939 was $3.72; in 1938, $3.66. The average factory selling price of high-early-strength portland cement was $1.88 a barrel in 1939 and $1.85 a barrel in 1938. The sales value of other hydraulic cements is given later in this chapter.

The following table shows the average factory value of portland cement from 1935 through 1939.

Average factory value per barrel in bulk of portland cement in the United States, 1935–39

1935	$1. 51	1938	$1. 45
1936	1. 51	1939	1. 47
1937	1. 48		

PLANT CAPACITY

At the end of 1939 the capacity for producing finished portland cement of the 150 plants active and shipping in 1939 and the 9 plants inactive in 1939 but producing or shipping from stock on hand within the 7 previous years is shown in the following table, with similar figures for 1938. Figures for plant capacity are based upon manufacturers' reports, supplemented by a few estimates.

Portland-cement-manufacturing capacity of the United States, 1938–39, by commercial districts

District	Estimated capacity (barrels)		Percent of capacity utilized	
	1938	1939	1938	1939
Eastern Pennsylvania, New Jersey, and Maryland	50, 712, 000	49, 545, 000	39. 2	47. 7
New York and Maine	17, 124, 000	17, 199, 000	36. 5	42. 5
Ohio, western Pennsylvania, and West Virginia	28, 447, 000	28, 627, 000	33. 0	39. 6
Michigan	16, 605, 000	16, 605, 000	43. 1	49. 5
Wisconsin, Illinois, Indiana, and Kentucky	29, 046, 000	29, 046, 000	34. 2	42. 3
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	25, 755, 000	25, 778, 000	46. 7	51. 8
Eastern Missouri, Iowa, Minnesota, and South Dakota	22, 917, 000	22, 915, 000	43. 6	45. 7
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	17, 159, 000	16, 159, 000	44. 3	49. 7
Texas	12, 042, 000	12, 058, 000	57. 7	60. 8
Colorado, Montana, Utah, Wyoming, and Idaho	6, 125, 000	5, 765, 000	43. 9	53. 1
California	22, 820, 000	25, 280, 000	46. 1	43. 5
Oregon and Washington	6, 945, 000	7, 095, 000	42. 9	82. 9
Puerto Rico		350, 000		92. 6
	255, 697, 000	256, 422, 000	41. 2	47. 7

The following estimates, based upon the monthly reports of producers, of the relationship between the production of finished portland cement and the manufacturing capacity of the industry for each month in 1938 and 1939 and for the 12 months ended with each month indicate the seasonal changes in capacity utilized.

Ratio (percent) of finished portland cement produced to manufacturing capacity of the United States, 1938-39

Month	Monthly		12 months ended—		Month	Monthly		12 months ended—	
	1938	1939	1938	1939		1938	1939	1938	1939
January	20.7	24.2	44.5	41.3	July	50.2	57.8	40.8	44.9
February	19.8	26.9	43.7	41.9	August	50.4	56.5	40.4	45.5
March	26.9	37.3	42.7	42.8	September	49.9	56.4	40.2	46.0
April	37.7	45.7	41.8	43.4	October	52.9	57.3	40.2	46.4
May	47.4	51.1	41.3	43.7	November	48.2	52.2	40.6	46.7
June	49.8	56.4	41.0	44.3	December	36.9	42.9	41.0	46.8

The following table gives statistics of capacity, 1937–39, by the two general methods—the "wet" and the "dry"—used in manufacturing portland cement at plants in the United States.

Portland-cement-manufacturing capacity of the United States, 1937-39, by processes

Process	Estimated capacity						Percent of capacity utilized			Percent of total finished cement produced		
	Thousands of barrels			Percent of total								
	1937	1938	1939	1937	1938	1939	1937	1938	1939	1937	1938	1939
Wet	122,638	119,776	121,337	48.1	46.8	47.3	49.2	46.1	51.8	51.9	52.4	51.4
Dry	132,585	135,921	135,085	51.9	53.2	52.7	42.1	36.9	43.9	48.1	47.6	48.6
	255,223	255,697	256,422	100.0	100.0	100.0	45.5	41.2	47.7	100.0	100.0	100.0

RAW MATERIALS

In 1938—the latest year for which data on raw materials were collected—the producers reported that approximately 32,244,000 short tons (revised figure) of raw materials (exclusive of fuels and explosives) entered into the manufacture of 105,357,000 barrels (19,807,116 short tons) of portland cement in the United States, an average of about 612 pounds to a barrel of finished cement (376 pounds).

The totals were as follows: 26,193,000 tons (revised figure) of limestone and cement rock, 3,054,000 tons of clay and shale (including kaolin for the manufacture of white cement), 428,000 tons of blast-furnace slag, 618,000 tons of marl, 93,000 tons of iron ore, 663,000 tons of gypsum, and 1,195,000 tons of other materials, such as oystershells, sandstone, sand, cinders, fluorspar, diatomite, diatomaceous shale, fuller's earth, bentonite, silica, quartz, ashes, pyrite ore, and pyrite cinder. In cements like the puzzolan portlands, which require highly siliceous materials in their manufacture, the use of a wider variety of materials, such as diatomite, diatomaceous earth and shale, pumicite, and tufa, is being reported.

Gypsum and anhydrite.—About 3 percent by weight of gypsum (or gypsum and anhydrite mixtures) is added to the cement clinker at the time of grinding to retard the time of setting. Data[1] on the uses of gypsum show that 774,982 short tons of gypsum and anhydrite were employed as cement retarder in 1939. This represented 17 percent of the total crude-gypsum supply (domestic and imported) of the country.

NEW DEVELOPMENTS

New plants.—The Permanente Corporation (address, San Jose) has virtually completed its new 7,000-barrel-a-day wet-process plant near Los Altos, Santa Clara County, Calif. Production was begun in December 1939. The limestone used had been rejected by previous cement-plant investigators because of its high chert content, but this impurity is greatly reduced in the new plant by means of froth flotation. The entire output of this modern plant will be used in constructing the Shasta Dam, for which the company has been awarded a contract for 5,800,000 barrels. Addition of a third kiln to increase capacity to 9,000 barrels a day is contemplated.

The new wet-process plant of the Puerto Rico Cement Corporation near San Juan, Puerto Rico, began production in January 1939 and operated continuously throughout the year.

A new small pilot plant was built by the Carneva Portland Cement Co. at Carrara, Nev., in 1939. It is designed for manufacture of white cement, using marble and white clay as raw materials. If the pilot plant operates successfully and markets are adequate erection of a large mill is planned.

Plant rehabilitation.—The Universal Atlas Cement Co. has entirely rebuilt its Leeds (Ala.) plant, making it a modern wet-process operation. Special mention may be made of its Woodford remote-control rock-haulage system, Dorr thickeners for dewatering slurry, and air-quenching of clinker to facilitate grinding. The Lehigh Portland Cement Co. has virtually completed rehabilitation of its Alsen (N. Y.) plant at a reported expense of about $3,000,000.

The Louisville Cement Co., Speed, Ind., the Kosmos Portland Cement Co., Kosmosdale, Ky., and the Medusa Portland Cement Co., Wampum, Pa., have put in operation new, highly efficient dust-collecting systems. The last company sells the recovered dust for liming land. The Medusa Portland Cement Co. has added recuperators to conserve heat at its Dixon (Ill.) plant and has equipped its Silica (Ohio) clinker grinding mills with "electric ears." The Keystone Portland Cement Co., Bath, Pa., has put in new clinker coolers, and the Dewey Portland Cement Co., Davenport, Iowa, has adopted truck haulage for its raw materials.

The Lone Star Cement Corporation now operates direct-firing kilns at its Limedale (Ind.) plant. Instead of maintaining an independent coal-grinding plant and holding pulverized coal in storage, as in ordinary practice, coal ranging in size from slack to ¾ inch is fed by automatic control, as required, to bowl mills that pulverize it and feed it directly to the kilns.

Unburned magnesite brick are being used more and more in cement-kiln linings, in some instances in a layer between the magnesite lining and the shell. Their use in the burning zone is new.

[1] Details in chapter on Gypsum in this volume.

Flotation.—Since 1934 the Valley Forge Cement Co., West Conshohocken, Pa., has used froth flotation to improve the composition of its raw materials. An important modification of the method developed during 1939 was the employment of cationic reagents to concentrate and remove excess mica from the raw materials. Froth-flotation equipment has been added to the plant of the National Portland Cement Co., Brodhead, Pa.

Mineralizers and grinding aids.—The National Bureau of Standards has devoted much study to the use of mineralizers to facilitate clinkering and accelerate the rate of silicate formation, thus conserving fuel. Calcium fluoride (fluorspar) and magnesium fluosilicate were found to be effective and advantageous.

During the grinding of cement clinker to the extreme fineness now demanded, the fine particles tend to flocculate or draw together into masses or lumps that cushion the blows of balls or other grinding mediums and thus retard the rate of disintegration. To overcome this difficulty a way must be devised to counteract the electrical charge that makes the particles attract each other. The Dewey & Almy Chemical Co., Cambridge, Mass., has developed a dispersing agent known in the trade as TDA, a mixture of triethanolamine salts and highly purified soluble calcium salts of modified lignin sulfonic acid. Addition of 1 part in 3,000 is said to increase mill capacity 20 to 40 percent. The material also increases the strength and workability of the concrete. The cost of the dispersing agent is about 1½ cents per barrel of finished portland cement and 3 cents per barrel of high-early-strength cement.

Specifications.—To crystallize the trend toward special cements Committee C–1 of the American Society for Testing Materials has grouped cements under five general types, as follows: (1) Ordinary portland cement requiring no special qualities; (2) cement for use in concrete subject to moderate sulfate action and moderate freezing and thawing; (3) high-early-strength; (4) low-heat; (5) sulfate-resistant. The new or improved specifications covering these five types will, if adopted, tend to increase production costs, for they will demand careful preparation of raw materials with rigid supervision of insoluble material, free lime, and alkali. The tendency toward increasing fineness of finished cement also adds to the cost.

Electric eyes and ears.—Delicate instruments that measure light and sound are winning an important place in the cement industry. Fineness is measured with a turbidimeter that utilizes a beam of light transmitted through a kerosene suspension of the cement particles. Several companies use "electric ears" to control the feed of ball mills. The mills are noisiest when running with a light load. The volume of sound carried through a microphone is converted into electrical energy in a control box, and the mechanism is so adjusted that when the noise is loud the mill feed is increased automatically, while deadening of sound in turn reduces the feed. The latest adaptation of such devices is the "electric eye," which controls the fuel supply upon the basis of the intensity of light in the burning zone of the kiln.

New cements.—A new product known as "Sealithor" supersulfate cement developed in Belgium consists of a mixture of granulated blast-furnace slag, a small quantity of slaked lime, and a larger quantity of calcium sulfate. It contains 26 percent soluble silica, 45 percent calcium oxide, and 7 percent sulfur trioxide. Tests made under supervision of the Belgian Government show that the new cement is unusually impervious, that it hardens in sea water and expands slightly on setting, is a little stronger than portland cement, and is resistant to chemical attack.

A new type of plastic masonry cement ("Mortar-mix") is now on the market; dried clay replaces lime in this mixture.

Achievements.—The Margaret Hayden Rorke award for the highest achievement among American Trade Association executives was won in 1939 by the Portland Cement Association for its design of a "farm-to-market" light-traffic soil-cement road surface costing only $5,000 a mile.

New publication.—In 1939 the Bureau of Mines issued Information Circular 7102, The Cement Industry of Latin America, covering raw-material supplies, cement-plant equipment, present and prospective plant capacity, market situation, production, consumption, and imports for each country in South and Central America, Mexico, and the West Indies.

FUELS AND POWER

Fuels.—According to monthly reports of producers, supplemented by a few estimates by the Bureau of Mines, the following quantities of fuel were consumed at portland-cement plants in the United States (including Puerto Rico) in 1939 for making 121,620,000 barrels of clinker (unground cement) and 122,259,154 barrels of finished cement: Coal, 5,227,756 short tons; oil, 2,378,762 barrels (42 gallons); and natural gas, 40,233,089,789 cubic feet. Corresponding figures for 1938 are: Clinker produced, 104,117,000 barrels; and finished cement produced, 105,357,000 barrels. Fuels consumed were: Coal, 4,482,758 short tons (revised figure); oil, 1,927,584 barrels; and natural gas, 37,496,315,988 cubic feet (revised figure).

Electric power.—The accompanying table gives the electric energy produced at portland-cement plants and that purchased from power companies during 1938 and 1939. The cement industry generated 50 percent of its electric-power requirements in 1939 compared with 51 percent in 1938 and 53 percent in 1937.

Electrical energy used at portland-cement-producing plants, 1938–39, by processes, in kilowatt-hours

Process	Electrical energy used: Generated at portland-cement plants		Electrical energy used: Purchased		Electrical energy used: Total		Finished cement produced	Average electrical energy used per barrel of cement produced
	Active plants	Kilowatt-hours	Active plants	Kilowatt-hours	Kilowatt-hours	Percent	Barrels	Kilowatt-hours
1938								
Wet	36	483,474,071	74	767,024,235	1,250,498,306	51.8	55,229,268	22.6
Dry	37	749,733,662	50	416,182,260	1,165,915,922	48.2	50,127,732	23.3
	73	1,233,207,733	124	1,183,206,495	2,416,414,228	100.0	105,357,000	22.9
Percent of total electrical energy used		51.0		49.0	100.0			
1939								
Wet	32	526,914,528	72	891,020,665	1,417,935,193	51.0	62,894,829	22.5
Dry	35	859,576,415	51	503,548,018	1,363,124,433	49.0	59,364,325	23.0
	67	1,386,490,943	123	1,394,568,683	2,781,059,626	100.0	122,259,154	22.7
Percent of total electrical energy used		49.9		50.1	100.0			

SPECIAL PORTLAND CEMENTS

Although regular or standard portland cements have been improved greatly during recent years and are well-adapted for all ordinary uses, new conditions have arisen in industry that demand cements having special qualities, such as high early strength, unusual plasticity, low or moderate heat of setting, or high resistance to chemical action. Special types of portland cement are discussed in the following paragraphs.

White portland cement.—White cement has been manufactured for many years in Pennsylvania and since 1932 in California. It is simply a standard portland cement, the raw materials of which are unusually pure, with an especially low iron content. To avoid contamination and discoloration from fuel these cements are calcined with gas. They are produced at so few plants that the Bureau is not at liberty to publish figures of production separately.

Alumina cement.—A product known as alumina or high-alumina cement was first manufactured in France under the name "ciment fondu." Modifications of alumina cement have been made in the United States for many years under patent. The raw materials are bauxite and limestone or lime, which are completely fused in a furnace. The melted product is cooled rapidly and ground to fine powder. Production figures cannot be published separately.

High-early-strength cement.—For street work where traffic is heavy, construction work where one step must follow another rapidly, and similar uses a cement that attains adequate strength in 24 hours or less is much in demand. This has led to the development of special high-early-strength cements that are now manufactured in many States.

Masonry cement.—Cements suitable for masonry must be plastic and of low shrinkage.

In addition to "masonry portland" and "masonry natural" (discussed on a following page) producers also report masonry cements, hydraulic but not portland, that evidently are specially prepared from portland-cement clinker and other ingredients. Production of such cements, made at 35 plants in 1939, totaled 1,865,192 barrels and shipments 1,838,820 barrels valued at $2,473,127—an average of $1.34 a barrel. Corresponding data for 1938, representing the output of 32 plants, are: Production 1,246,263 barrels and shipments 1,225,960 barrels valued at $1,589,908—an average of $1.30 a barrel. To avoid duplication the above figures are not included in the portland-cement totals, because portland-cement clinker evidently is the principal constituent used.

Low and moderate heat-of-hardening portland cement.—Because of the enormous masses of concrete used in large dams, such as those in the Tennessee Valley and the Far West, a demand has arisen for cements that develop little heat in the process of setting. They include Tennessee Valley Authority Type B and other cements that must conform with Federal specifications.

Portland-puzzolan cement.—Portland-puzzolan cements, including those reported as "high-silica," are especially adapted for resistance to chemical attack, such as the reaction with salts contained in sea water. They are made by adding them to portland cement, pumicite, slag, or other materials that react with the calcium content of the cement.

Oil-well cement.—In the oil-producing States, particularly California, Texas, and Wyoming, special types of portland cement have been developed that are suitable for grouting wells.

Miscellaneous.—Other special portland cements include those suitable for resisting high temperatures.

The following table presents statistical data for recent years insofar as they are available. All figures given in this table except those for masonry cement are included in the general tables appearing earlier in this chapter.

Special portland cements produced and shipped in the United States, 1937–39, by kinds

Kind and year	Active plants	Production (barrels)	Shipments		
			Barrels	Value	
				Total	Average
High-early-strength:					
1937	64	4,192,959	3,845,314	$7,134,468	$1.86
1938	72	3,340,582	3,385,523	6,247,699	1.85
1939	79	3,751,331	3,670,506	6,910,099	1.88
Masonry or mortar:					
1937	10	257,385	273,144	362,807	1.33
1938	5	84,875	88,905	124,239	1.40
1939	3	(1)	(1)	(1)	(1)
Low and moderate heat:					
1937	29	3,169,593	3,511,674	5,008,217	1.43
1938	[2] 41	[2] 4,231,663	[2] 3,830,518	[2] 5,757,388	[2] 1.50
1939	47	5,603,200	5,789,202	8,295,307	1.43
Portland-puzzolan:					
1937	6	260,194	294,384	417,130	1.42
1938	6	159,745	149,142	229,441	1.54
1939	10	402,312	392,472	558,917	1.42
Oil-well:					
1937	[2] 10	342,316	313,064	652,960	2.09
1938	7	226,769	220,122	457,665	2.08
1939	12	372,057	371,218	703,647	1.90
Miscellaneous:					
1937	13	580,705	587,718	928,856	1.58
1938	16	608,777	589,663	965,970	1.64
1939	12	629,788	636,845	868,643	1.36

[1] Bureau of Mines not at liberty to publish figures separately. [2] Revised figures.

NATURAL, MASONRY (NATURAL), AND PUZZOLAN CEMENTS

The term "masonry cement" is used here to designate certain cements made by calcining argillaceous limestone at a comparatively low temperature and grinding the calcined material to a fine powder. This product is known as "natural" cement. Portland cements that are also used for masonry are discussed under the special portland cements on the previous page.

In addition to portland-puzzolan cements discussed on the previous page, another type known as slag-lime cement is now made at Birmingham and Graystone, Ala., by mixing granulated blast-furnace slag with hydrated lime and grinding them to a fine consistency. The mixture is not subsequently calcined.

Figures for production and shipments of special types of cement other than portland are presented in the following table.

Natural, masonry (natural), and puzzolan (slag-lime) cements produced, shipped, and in stock at mills in the United States, 1935–39

Year	Production		Shipments		Stock (Dec. 31)
	Active plants	Barrels (376 pounds)	Barrels (376 pounds)	Value	Barrels (376 pounds)
1935	13	1,006,064	1,011,411	$1,437,542	172,572
1936	13	1,819,488	1,760,993	2,362,396	230,788
1937	12	1,900,643	1,873,400	2,578,885	[1] 253,518
1938	[1] 12	[1] 1,820,795	[1] 1,867,949	[1] 2,725,776	[1] 373,816
1939	12	2,439,110	2,405,135	3,361,724	407,791

[1] Revised figures.

TRENDS IN EMPLOYMENT AND OUTPUT PER MAN [2]

In Minerals Yearbook, 1935 (pp. 891–905), trends in employment and output per man in the cement industry were traced from 1928 to 1933. It seems desirable at this time to add similar data for the succeeding 5 years and thus reveal significant trends over an 11-year period.

Total employment.—The Bureau of the Census biennially compiles data on employment at cement plants, but that organization obtains the figures for each year by averaging the monthly totals of employment, whereas Bureau of Mines data represent the total number employed, irrespective of how short a time some of them had worked. In other words, as pointed out in the earlier report, the Bureau of Mines figure is the total number of men actually employed in the cement industry, and the Bureau of the Census figure represents more closely the number of men to whom the industry might have provided full-time employment throughout the year.

It may be observed from the table that follows that the coverage of the study in the earlier years ranged from 87.3 to 89.1 percent, whereas for 1937 and 1938 it was 100 percent. The estimated total number of employees in 1928 was 35,100, and the number recorded in 1938 was 25,036.

Output per man.—Production in 1928 was 176,298,846 barrels, or 5,023 barrels per man; in 1938 it was 105,357,000, or 4,208 barrels per man. Production in this interval declined 40 percent, whereas employment dropped only 29 percent. Maintenance of a relatively larger number of employees for a given tonnage of production shows the results of the shorter week and the fewer hours per day of employment during 1938. In 1928 each employee averaged 324 days of work and was occupied 9.5 hours per day; in 1938 he worked only 256 days and averaged 7.5 hours per day. Although employees worked fewer days and shorter hours in 1938 than in 1928 the productivity per hour of labor increased considerably in 1938 compared with the earlier year. As may be noted in the accompanying table, production per man per hour in 1928 was 1.63 barrels; in 1938 it was 2.21 barrels. This 36-percent increase in output indicates improvements in equipment and increased efficiency of operation.

[2] Statistics on employment and output per man presented in this discussion were compiled by E. T. Shuey from records of the employment statistics section, Bureau of Mines.

Employment in the cement industry, finished cement produced at mills included in study, and average output per man in the United States, 1928–38

Year	Employment					Production			Percent of industry represented [1]
	Average number of men	Time employed				Finished portland cement (barrels)	Average per man (barrels)		
		Average number of days	Total man-shifts	Man-hours			Per shift	Per hour	
				Average per man per day	Total				
1928	31,295	324	10,137,187	9.5	96,541,428	157,121,800	15.50	1.63	89.1
1929	29,274	319	9,345,890	9.5	88,528,269	152,116,204	16.28	1.72	89.1
1930	27,775	308	8,562,897	9.2	78,771,352	140,771,728	16.44	1.79	87.3
1931	22,036	279	6,146,564	8.8	53,833,283	111,501,887	18.14	2.07	88.9
1932	17,440	231	4,020,861	8.4	33,799,409	67,449,096	16.77	2.00	87.9
1933	19,536	196	3,835,657	7.3	28,048,172	56,463,620	14.72	2.01	89.0
1934	23,496	237	5,561,630	6.8	37,819,085	77,747,765	13.98	2.06	100.0
1935	24,088	230	5,548,809	7.0	39,007,631	76,331,570	13.76	1.96	99.5
1936	25,406	272	6,917,074	7.3	50,688,870	111,238,300	16.08	2.19	98.7
1937	26,432	279	7,380,028	7.4	54,714,935	116,174,708	15.74	2.12	100.0
1938	25,036	256	6,398,178	7.5	47,729,779	105,357,000	16.47	2.21	100.0

[1] Calculated for each year by dividing the quantity of finished cement produced at mills included in study by the total production.

Mill employees.—At the average cement plant, mill employees outnumber quarry and crusher employees more than 4 to 1. In 1928 mill employees averaged 9.5 hours a day for 332 days and produced 1.98 barrels of finished cement per man-hour; in 1938 they averaged 7.4 hours a day for only 264 days but produced 2.71 barrels of cement per man-hour. Thus productivity per man per hour increased 37 percent during this 11-year period.

Mill employees in the cement industry, finished cement produced at mills included in study, and average output per man in the United States, 1928–38

Year	Employment—cement mill only					Production			Percent of industry represented [1]
	Average number of men	Time employed				Finished portland cement (barrels)	Average per man (barrels)		
		Average number of days	Total man-shifts	Man-hours			Per shift	Per hour	
				Average per man per day	Total				
1928	25,122	332	8,346,570	9.5	79,226,232	157,121,800	18.82	1.98	89.1
1929	23,755	328	7,791,270	9.4	73,405,571	152,116,204	19.52	2.07	89.1
1930	22,271	320	7,132,322	9.2	65,524,129	140,771,728	19.74	2.15	87.3
1931	17,309	294	5,086,328	8.7	44,502,808	111,387,566	21.90	2.50	88.8
1932	13,551	243	3,290,962	8.4	27,563,197	67,402,383	20.48	2.45	87.8
1933	15,075	206	3,103,654	7.3	22,592,150	56,454,620	18.19	2.50	88.9
1934	18,524	245	4,530,525	6.8	30,626,050	77,747,765	17.16	2.54	100.0
1935	19,077	238	4,546,467	7.0	31,891,278	76,186,064	16.76	2.39	99.3
1936	19,881	280	5,564,582	7.3	40,634,045	111,029,026	19.95	2.73	98.6
1937	20,925	289	6,041,237	7.4	44,553,173	116,174,708	19.23	2.61	100.0
1938	19,828	264	5,224,790	7.4	38,666,410	105,357,000	20.16	2.71	100.0

[1] Calculated for each year by dividing the quantity of finished cement produced at mills included in study by the total production.

Quarry and crusher employees.—Data in the accompanying table on quarry and crusher employees are not as complete for recent years as formerly because the tonnage of material handled has not been recorded. The table shows, for 1938 compared with 1929, a moderate decline in the number of men employed and a striking reduction in both the average number of days worked and the hours of employment per day.

Quarry and crusher employees in the cement industry, material (quarry rock and overburden) handled at quarries included in study, and average output of material per man in the United States, 1929–38

Year	Employment—quarry and crusher only					Material handled—quarry rock and overburden				Percent of industry represented [1]
	Average number of men	Time employed				Short tons	Percent of overburden included	Average per man (short tons)		
		Average number of days	Total man-shifts	Man-hours				Per shift	Per hour	
				Average per man per day	Total					
1929	5,123	281	1,441,964	9.6	13,779,252	44,113,986	15.3	30.59	3.20	78.1
1930	4,939	256	1,264,000	9.1	11,536,403	40,413,300	13.4	31.97	3.50	76.3
1931	4,141	225	929,924	8.8	8,221,384	32,991,564	10.0	35.48	4.01	82.1
1932	3,480	185	643,113	8.6	5,505,342	19,662,583	7.8	30.57	3.57	83.2
1933	3,954	165	651,458	7.4	4,827,640	16,741,818	7.5	25.70	3.47	83.7
1934	4,381	204	893,292	7.0	6,296,481	23,303,057	10.7	26.09	3.70	100.0
1935	4,470	197	879,253	7.1	6,248,681	(2)	(2)	(2)	(2)	99.5
1936	5,023	246	1,233,219	7.4	9,174,710	(2)	(2)	(2)	(2)	98.7
1937	4,980	242	1,203,867	7.6	9,169,763	(2)	(2)	(2)	(2)	90.0
1938	4,442	218	968,873	7.6	7,384,387	(2)	(2)	(2)	(2)	90.3

[1] Calculated for each year by dividing the quantity of finished cement produced at mills included in study by the total production.
[2] Figures not available.

Hours per day.—From 1928 to 1938 there was a striking decrease in the number of hours in the working day. In 1928 no cement plant maintained for any of its employees a working day of less than 8 hours; in 1938, 49.2 percent of them were in this classification. Those working 8 to 9 hours a day in 1928 comprised 42.2 percent and in 1938, 48.4 percent of the total. In 1928, 57.8 of the employees worked more than 9 hours a day, and in 1938 such workers comprised only 2.4 percent of the total.

Almost invariably the production per man-hour is higher where men work short shifts than where they work longer hours per day. For instance, in 1937 employees working less than 7 hours a day produced 2.3 barrels of cement an hour, while those employed between 11 and 12 hours a day produced only 1.1 barrels during each hour of labor. Factors other than length of the working day may, however, affect productivity per hour. In general, plants that maintain a short working day are more efficient than those that exact long hours, therefore the output per man-hour in the former group will be relatively high. Data at hand are inadequate to show a definite relationship

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between man-hour output and length of day; but, from the figures in the accompanying table, one would infer that a relatively high production per man-hour is to be expected when the working day is short.

Number of men employed in the cement industry in the United States and output per man-hour, 1933–38, classified according to hours of labor per day

Hours per day	1933			1934			1935		
	Men employed		Production per man-hour (barrels)	Men employed		Production per man-hour (barrels)	Men employed		Production per man-hour (barrels)
	Number	Percent of total		Number	Percent of total		Number	Percent of total	
Less than 6									
6 and less than 7	6,802	34.8	2.25	12,417	52.9	2.25	9,980	41.4	2.07
7 and less than 8	4,467	22.9	2.06	4,936	21.0	1.86	6,545	27.2	1.83
8 and less than 9	6,875	35.2	1.89	5,906	25.1	1.91	7,308	30.3	1.94
9 and less than 10	1,006	5.1	1.65				255	1.1	1.91
10 and less than 11	215	1.1	1.63						
11 and less than 12	171	.9	.83	237	1.0	.63			
	19,536	100.0	2.01	23,496	100.0	2.06	24,088	100.0	1.96

Hours per day	1936			1937			1938		
	Men employed		Production per man-hour (barrels)	Men employed		Production per man-hour (barrels)	Men employed		Production per man-hour (barrels)
	Number	Percent of total		Number	Percent of total		Number	Percent of total	
Less than 6				1,821	6.9	2.3	319	1.3	2.7
6 and less than 7	7,185	28.3	2.37	5,198	19.7	2.3	6,375	25.5	2.2
7 and less than 8	4,988	19.6	2.26	5,471	20.7	2.2	5,608	22.4	2.3
8 and less than 9	13,112	51.6	2.08	13,400	50.7	2.0	12,124	48.4	2.2
9 and less than 10	121	.5	2.98	162	.6	1.4	610	2.4	1.6
10 and less than 11									
11 and less than 12				384	1.4	1.1			
	25,406	100.0	2.19	26,436	100.0	2.1	25,036	100.0	2.2

District and State tables.—The following tables show a geographic break-down by districts and States of the statistical record of employment and productivity of labor in the cement industry. These data are primarily of interest in the study of regional relationships. The first table, covering employment in the cement industry as a whole, and the second, relating to mill employees, give data for 1934 to 1938, supplementing similar data for 1928 to 1933 on pages 897 to 902 of Minerals Yearbook, 1935. However, the third table, covering quarry and crusher employees, applies only to 1934, because data for quarry rock and overburden handled during the years since 1934 have not been recorded.

Employment in the cement industry, finished cement produced at mills included in study, and average output per man in the United States, 1934–38, by districts and by States

	Employment					Production			
	Average number of men	Time employed				Finished portland cement (barrels)	Average per man (barrels)		Percent of industry represented [1]
		Average number of days	Total man-shifts	Man-hours					
				Average per man per day	Total		Per shift	Per hour	
1934									
DISTRICT									
Eastern Pennsylvania, New Jersey, and Maryland	4,593	228	1,045,807	7.1	7,457,497	14,917,633	14.26	2.00	100.0
New York and Maine	1,822	229	417,592	6.9	2,876,679	5,015,615	12.01	1.74	100.0
Ohio, western Pennsylvania, and West Virginia	3,062	200	613,805	7.2	4,393,359	7,355,563	11.98	1.67	100.0
Michigan	1,578	184	290,544	7.5	2,165,712	4,103,902	14.12	1.89	100.0
Wisconsin, Illinois, Indiana, and Kentucky	2,302	270	622,574	6.3	3,898,082	9,079,458	14.58	2.33	100.0
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	2,143	255	547,447	6.6	3,619,690	7,560,020	13.81	2.09	100.0
Eastern Missouri, Iowa, Minnesota, and South Dakota	2,229	258	574,582	6.6	3,801,404	7,786,482	13.55	2.05	100.0
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	1,594	269	428,959	6.4	2,752,209	5,837,914	13.61	2.12	100.0
Texas	1,143	192	219,235	6.7	1,476,426	3,537,734	16.14	2.40	100.0
Colorado, Montana, Utah, Wyoming, and Idaho	590	244	144,185	6.4	923,704	2,181,218	15.13	2.36	100.0
California	1,769	302	534,887	6.7	3,567,241	8,721,854	16.31	2.44	100.0
Oregon and Washington	671	182	122,013	7.3	887,082	1,650,372	13.53	1.86	100.0
	23,496	237	5,561,630	6.8	37,819,085	77,747,765	13.98	2.06	100.0
STATE									
Alabama	540	282	152,548	6.5	990,743	2,208,279	14.48	2.23	100.0
California	1,769	302	534,887	6.8	3,567,241	8,721,854	16.31	2.44	100.0
Illinois	1,117	271	303,047	5.5	1,657,232	4,124,805	13.61	2.49	100.0
Iowa	1,050	247	259,124	6.6	1,705,421	3,180,546	12.27	1.86	100.0
Kansas	717	233	166,939	6.8	1,142,448	2,497,911	14.96	2.19	100.0
Michigan	1,578	184	290,544	7.5	2,165,712	4,103,902	14.12	1.89	100.0
Missouri	1,093	271	296,627	6.4	1,908,578	4,033,859	13.60	2.11	100.0
New York	1,646	233	383,844	6.9	2,631,196	4,760,609	12.40	1.81	100.0
Ohio	1,394	209	290,849	7.1	2,072,295	4,045,854	13.91	1.95	100.0
Pennsylvania	4,965	212	1,051,966	7.1	7,514,798	15,323,116	14.57	2.04	100.0
Tennessee	725	253	183,621	6.8	1,241,521	2,481,379	13.51	2.00	100.0
Texas	1,143	192	219,235	6.7	1,476,426	3,537,734	16.14	2.40	100.0
Other States [2]	5,759	248	1,428,399	6.8	9,745,474	18,727,917	13.11	1.92	100.0
	23,496	237	5,561,630	6.8	37,819,085	77,747,765	13.98	2.06	100.0

See footnotes at end of table.

Employment in the cement industry, finished cement produced at mills included in study, and average output per man in the United States, 1934–38, by districts and by States—Continued

	Employment					Production			
		Time employed					Average per man (barrels)		
				Man-hours					
	Average number of men	Average number of days	Total man-shifts	Average per man per day	Total	Finished portland cement (barrels)	Per shift	Per hour	Percent of industry represented
1935									
DISTRICT									
Eastern Pennsylvania, New Jersey, and Maryland	4,755	239	1,135,869	7.3	8,259,006	14,171,492	12.48	1.72	97.2
New York and Maine	1,662	191	318,083	6.8	2,178,688	4,582,936	14.41	2.10	100.0
Ohio, western Pennsylvania, and West Virginia	2,983	188	560,353	7.3	4,087,631	7,300,481	13.03	1.79	100.0
Michigan	1,522	212	322,942	7.6	2,458,362	4,578,966	14.18	1.86	100.0
Wisconsin, Illinois, Indiana, and Kentucky	2,300	262	603,636	6.8	4,080,649	8,204,274	13.59	2.01	100.0
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	2,379	223	531,243	7.3	3,897,567	7,656,504	14.41	1.96	100.0
Eastern Missouri, Iowa, Minnesota, and South Dakota	2,290	243	555,750	7.2	3,977,876	7,876,617	14.17	1.98	100.0
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	1,572	263	413,475	6.6	2,739,706	5,966,245	14.43	2.18	100.0
Texas	1,226	207	254,233	7.1	1,807,741	3,786,716	14.89	2.09	100.0
Colorado, Montana, Utah, Wyoming, and Idaho	684	262	179,315	6.1	1,088,912	2,336,204	13.03	2.15	100.0
California	1,668	307	512,534	6.4	3,286.235	7,974.201	15.56	2.43	100.0
Oregon and Washington	1,047	154	161,376	7.1	1,145,258	1,896,934	11.75	1.66	100.0
	24,088	230	5,548,809	7.0	39,007,631	76,331,570	13.76	1.96	99.5
STATE									
Alabama	632	266	168,399	7.4	1,241,338	2,493,291	14.81	2.01	100.0
California	1,668	307	512,534	6.4	3,286,235	7,974,201	15.56	2.43	100.0
Illinois	960	273	262,181	6.3	1,652,820	3,367,512	12.84	2.04	100.0
Iowa	1,117	218	244,060	7.9	1,921,793	3,519,558	14.42	1.83	100.0
Kansas	631	241	152,297	7.0	1,069,345	2,337,444	15.35	2.19	100.0
Michigan	1,522	212	322,942	7.6	2,458,362	4,578,966	14.18	1.86	100.0
Missouri	1,067	274	292,249	6.3	1,835,800	3,392,140	11.61	1.85	100.0
New York	1,493	193	288,508	6.8	1,970,964	4,285,458	14.85	2.17	100.0
Ohio	1,330	203	270,571	7.5	2,027,124	3,876,172	14.33	1.91	100.0
Pennsylvania	5,198	230	1,193,001	7.2	8,555,766	15,092,086	12.65	1.76	97.4
Tennessee	789	208	164,483	7.9	1,302,592	2,702,622	16.43	2.07	100.0
Texas	1,226	207	254,233	7.1	1,807,741	3,786,716	14.89	2.09	100.0
Other States [2]	6,455	221	1,423,351	6.9	9,877,751	18,925,404	13.30	1.92	100.0
	24,088	230	5,548,809	7.0	39,007,631	76,331,570	13.76	1.96	99.5
1936									
DISTRICT									
Eastern Pennsylvania, New Jersey, and Maryland	4,865	266	1,295,192	7.2	9,373,160	19,948,866	15.40	2.13	93.4
New York and Maine	1,677	227	379,998	7.5	2,835,100	6,111,232	16.08	2.16	100.0
Ohio, western Pennsylvania, and West Virginia	3,052	264	805,169	7.8	6,254,164	10,640,605	13.22	1.70	100.0
Michigan	1,673	275	460,116	8.0	3,678,199	7,673,324	16.68	2.09	100.0
Wisconsin, Illinois, Indiana, and Kentucky	2,702	290	783,768	6.9	5,396,929	11,794,731	15.05	2.19	100.0
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	2,562	265	678,250	7.4	5,052,765	10,077,981	14.86	1.99	100.0

See footnotes at end of table.

Employment in the cement industry, finished cement produced at mills included in study, and average output per man in the United States, 1934–38, by districts and by States—Continued

	Employment					Production			
		Time employed					Average per man (barrels)		
				Man-hours					
	Average number of men	Average number of days	Total man-shifts	Average per man per day	Total	Finished portland cement (barrels)	Per shift	Per hour	Percent of industry represented
1936—Continued									
DISTRICT—continued									
Eastern Missouri, Iowa, Minnesota, and South Dakota	2,425	277	672,750	7.2	4,816,399	10,514,858	15.63	2.18	100.0
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	1,623	307	498,277	7.1	3,523,931	8,218,730	16.49	2.33	100.0
Texas	1,251	259	327,135	7.4	2,421,657	5,839,983	17.85	2.41	100.0
Colorado, Montana, Utah, Wyoming, and Idaho	563	289	162,655	7.0	1,136,336	3,016,457	18.55	2.65	100.0
California	1,994	315	628,397	7.3	4,588,178	13,398,603	21.32	2.92	100.0
Oregon and Washington	1,019	221	225,367	7.2	1,612,052	4,002,930	17.76	2.48	100.0
	25,406	272	6,917,074	7.3	50,688,870	111,238,300	16.08	2.19	98.7
STATE									
Alabama	712	318	226,283	7.5	1,697,201	3,912,290	17.29	2.31	100.0
California	1,994	315	628,397	7.3	4,588,178	13,398,603	21.32	2.92	100.0
Illinois	1,228	296	363,613	6.4	2,326,838	4,807,434	13.22	2.07	100.0
Iowa	1,132	254	286,990	7.7	2,218,781	4,099,121	14.28	1.85	100.0
Kansas	694	299	207,209	7.4	1,528,707	3,560,321	17.18	2.33	100.0
Michigan	1,673	275	460,116	8.0	3,678,199	7,673,324	16.68	2.09	100.0
Missouri	1,150	297	342,079	6.5	2,240,189	4,954,851	14.48	2.21	100.0
New York	1,529	227	347,396	7.4	2,585,577	5,729,431	16.49	2.22	100.0
Ohio	1,471	264	388,247	7.7	2,988,726	5,370,456	13.83	1.80	100.0
Pennsylvania	5,130	266	1,363,673	7.2	9,876,319	21,459,207	15.74	2.17	93.8
Tennessee	826	221	182,519	7.8	1,424,664	3,013,666	16.51	2.12	100.0
Texas	1,251	259	327,135	7.4	2,421,657	5,839,983	17.85	2.41	100.0
Other States [2]	6,616	271	1,793,417	7.3	13,113,834	27,419,613	15.29	2.09	100.0
	25,406	272	6,917,074	7.3	50,688,870	111,238,300	16.08	2.19	98.7
1937									
DISTRICT									
Eastern Pennsylvania, New Jersey, and Maryland	5,138	278	1,426,778	7.4	10,557,973	21,195,678	14.86	2.01	100.0
New York and Maine	1,579	228	359,575	7.4	2,676,906	6,370,647	17.72	2.38	100.0
Ohio, western Pennsylvania, and West Virginia	3,184	257	819,778	7.7	6,275,891	10,787,616	13.16	1.72	100.0
Michigan	1,806	286	517,141	8.0	4,156,525	8,180,969	15.82	1.97	100.0
Wisconsin, Illinois, Indiana, and Kentucky	2,702	263	809,313	8.1	5,724,755	12,748,994	15.75	2.23	100.0
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	2,677	281	752,703	7.3	5,510,833	11,017,080	14.64	2.00	100.0
Eastern Missouri, Iowa, Minnesota, and South Dakota	2,441	284	694,444	7.3	5,074,534	10,675,595	15.37	2.10	100.0
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	1,694	310	525,274	7.3	3,857,301	8,651,217	16.47	2.24	100.0
Texas	1,349	284	383,140	7.5	2,857,378	6,906,453	18.03	2.42	100.0
Colorado, Montana, Utah, Wyoming, and Idaho	612	294	179,676	7.4	1,331,666	3,056,597	17.01	2.30	100.0
California	2,134	311	663,593	7.5	4,983,447	11,953,986	18.01	2.40	100.0
Oregon and Washington	1,116	223	248,613	6.9	1,707,726	4,629,876	18.62	2.71	100.0
	26,432	279	7,380,028	7.4	54,714,935	116,174,708	15.74	2.12	100.0

See footnotes at end of table.

Employment in the cement industry, finished cement produced at mills included in study, and average output per man in the United States, 1934–38, by districts and by States—Continued

	Employment					Production			Percent of industry represented
	Average number of men	Time employed				Finished portland cement (barrels)	Average per man (barrels)		
		Average number of days	Total man-shifts	Man-hours					
				Average per man per day	Total		Per shift	Per hour	
1937—Continued									
STATE									
Alabama	928	312	289, 149	6. 6	1, 908, 931	4, 415, 141	15. 27	2. 31	100. 0
California	2, 134	311	663, 593	7. 5	4, 983, 447	11, 953, 986	18. 01	2. 40	100. 0
Illinois	1, 225	301	368, 274	6. 6	2, 430, 539	5, 246, 102	14. 25	2. 16	100. 0
Iowa	1, 213	269	325, 895	7. 7	2, 518, 884	4, 706, 094	14. 44	1. 87	100. 0
Kansas	757	298	225, 424	7. 7	1, 737, 643	3, 696, 507	16. 40	2. 13	100. 0
Michigan	1, 806	286	517, 141	8. 0	4, 156, 525	8, 180, 969	15. 82	1. 97	100. 0
Missouri	1, 087	300	326, 133	6. 9	2, 256, 221	4, 756, 285	14. 58	2. 11	100. 0
New York	1, 435	227	325, 415	7. 4	2, 406, 177	5, 912, 772	18. 17	2. 46	100. 0
Ohio	1, 523	276	420, 437	7. 7	3, 234, 185	5, 699, 695	13. 56	1. 76	100. 0
Pennsylvania	5, 498	279	1, 532, 202	7. 2	11, 106, 884	23, 064, 465	15. 05	2. 08	100. 0
Tennessee	782	262	205, 044	7. 5	1, 544, 474	3, 081, 215	15. 03	1. 99	100. 0
Texas	1, 349	284	383, 140	7. 5	2, 857, 378	6, 906, 453	18. 03	2. 42	100. 0
Other States [2]	6, 695	269	1, 798, 181	7. 5	13, 573, 647	28, 555, 024	15. 88	2. 10	100. 0
	26, 432	279	7, 380, 028	7. 4	54, 714, 935	116, 174, 708	15. 74	2. 12	100. 0
1938									
DISTRICT									
Eastern Pennsylvania, New Jersey, and Maryland	5, 011	256	1, 284, 631	7. 3	9, 371, 264	19, 895, 691	15. 49	2. 12	100. 0
New York and Maine	1, 557	222	345, 461	8. 1	2, 802, 530	6, 245, 193	18. 08	2. 23	100. 0
Ohio, western Pennsylvania, and West Virginia	2, 904	217	630, 993	7. 7	4, 842, 987	9, 374, 184	14. 86	1. 94	100. 0
Michigan	1, 462	282	412, 057	8. 0	3, 284, 473	7, 159, 362	17. 37	2. 18	100. 0
Wisconsin, Illinois, Indiana, and Kentucky	2, 575	252	649, 394	7. 0	4, 524, 555	9, 930, 734	15. 29	2. 19	100. 0
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	2, 756	254	699, 503	7. 5	5, 269, 212	12, 026, 249	17. 19	2. 28	100. 0
Eastern Missouri, Iowa, Minnesota, and South Dakota	2, 432	272	660, 343	7. 2	4, 738, 607	9, 994, 563	15. 14	2. 11	100. 0
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	1, 652	283	467, 263	7. 4	3, 475, 800	7, 602, 704	16. 27	2. 19	100. 0
Texas	1, 372	266	364, 563	7. 6	2, 782, 132	6, 949, 164	19. 06	2. 50	100. 0
Colorado, Montana, Utah, Wyoming, and Idaho	655	259	169, 531	7. 0	1, 185, 451	2, 689, 465	15. 86	2. 27	100. 0
California	1, 721	313	539, 384	7. 7	4, 140, 796	10, 513, 067	19. 49	2. 54	100. 0
Oregon and Washington	939	186	175, 055	7. 5	1, 311, 972	2, 976, 624	17. 00	2. 27	100. 0
	25, 036	256	6, 398, 178	7. 5	47, 729, 779	105, 357, 000	16. 47	2. 21	100. 0
STATE									
Alabama	1, 036	248	256, 930	7. 3	1, 877, 401	4, 627, 639	18. 01	2. 46	100. 0
California	1, 721	313	539, 384	7. 7	4, 140, 796	10, 513, 067	19. 49	2. 54	100. 0
Illinois	1, 164	242	281, 756	6. 4	1, 806, 204	3, 959, 932	14. 05	2. 19	100. 0
Iowa	1, 204	269	323, 813	7. 5	2, 419, 684	4, 726, 517	14. 60	1. 95	100. 0
Kansas	812	257	208, 836	7. 9	1, 640, 363	3, 264, 350	15. 63	1. 99	100. 0
Michigan	1, 462	282	412, 057	8. 0	3, 284, 473	7, 159, 362	17. 37	2. 18	100. 0
Missouri	1, 086	282	305, 725	6. 9	2, 106, 749	4, 491, 458	14. 69	2. 13	100. 0
New York	1, 427	221	314, 703	8. 1	2, 545, 345	5, 807, 731	18. 45	2. 28	100. 0
Ohio	1, 430	251	358, 285	7. 7	2, 761, 709	5, 188, 477	14. 48	1. 88	100. 0
Pennsylvania	5, 301	244	1, 292, 396	7. 3	9, 417, 847	20, 868, 384	16. 15	2. 22	100. 0
Tennessee	715	235	168, 286	7. 9	1, 333, 206	3, 318, 797	19. 72	2. 49	100. 0
Texas	1, 372	339	364, 563	6. 0	2, 782, 132	6, 949, 164	19. 06	2. 50	100. 0
Other States [2]	6, 306	249	1, 571, 444	7. 4	11, 613, 870	24, 482, 122	15. 58	2. 11	100. 0
	25, 036	256	6, 398, 178	7. 5	47, 729, 779	105, 357, 000	16. 47	2. 21	100. 0

[1] Calculated for each year by dividing the quantity of finished cement produced at mills included in study by the total production.

[2] Arkansas, Colorado, Florida, Georgia, Idaho, Indiana, Kentucky, Louisiana, Maine, Maryland, Minnesota, Montana, Nebraska, New Jersey, Oklahoma, Oregon, South Dakota, Utah, Virginia, Washington, West Virginia, Wisconsin, and Wyoming.

Mill employees in the cement industry, finished cement produced at mills included in study, and average output per man in the United States, 1934–38, by districts and by States

	Employment—Cement mill only					Production			
	Average number of men	Time employed				Finished portland cement (barrels)	Average per man (barrels)		Per cent of industry represented
		Average number of days	Total man-shifts	Man-hours					
				Average per man per day	Total		Per shift	Per hour	
1934									
DISTRICT									
Eastern Pennsylvania, New Jersey, and Maryland	3,840	232	891,601	7.1	6,353,334	14,917,633	16.73	2.35	100.0
New York and Maine	1,469	242	356,171	6.9	2,443,764	5,015,615	14.08	2.05	100.0
Ohio, western Pennsylvania, and West Virginia	2,235	207	462,561	7.2	3,311,121	7,355,563	15.90	2.22	100.0
Michigan	1,348	188	253,471	7.2	1,834,144	4,103,902	16.19	2.24	100.0
Wisconsin, Illinois, Indiana, and Kentucky	1,846	278	513,403	6.3	3,217,083	9,079,458	17.68	2.82	100.0
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	1,535	273	418,569	6.5	2,719,302	7,560,020	18.06	2.78	100.0
Eastern Missouri, Iowa, Minnesota, and South Dakota	1,700	270	459,425	6.6	3,020,118	7,786,482	16.95	2.58	100.0
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	1,293	279	361,026	6.4	2,300,434	5,837,914	16.17	2.54	100.0
Texas	971	199	193,703	6.7	1,295,127	3,537,734	18.26	2.73	100.0
Colorado, Montana, Utah, Wyoming, and Idaho	453	244	110,649	6.5	715,017	2,181,218	19.71	3.05	100.0
California	1,321	312	412,106	6.6	2,708,661	8,721,854	21.16	3.22	100.0
Oregon and Washington	513	191	97,840	7.2	707,945	1,650,372	16.87	2.33	100.0
	18,524	245	4,530,525	6.8	30,626,050	77,747,765	17.16	2.54	100.0
STATE									
Alabama	402	299	119,997	6.5	782,589	2,208,279	18.40	2.82	100.0
California	1,321	312	412,106	6.6	2,708,661	8,721,854	21.16	3.22	100.0
Illinois	849	278	235,964	5.3	1,245,772	4,124,805	17.48	3.31	100.0
Iowa	818	246	201,461	6.5	1,318,326	3,180,546	15.79	2.41	100.0
Kansas	560	247	138,061	6.8	934,126	2,497,911	18.09	2.67	100.0
Michigan	1,348	188	253,471	7.2	1,834,144	4,103,902	16.19	2.24	100.0
Missouri	793	301	238,483	6.4	1,516,048	4,033,859	16.91	2.66	100.0
New York	1,310	248	324,769	6.8	2,215,034	4,760,609	14.66	2.15	100.0
Ohio	1,118	208	232,931	7.1	1,658,257	4,045,854	17.37	2.44	100.0
Pennsylvania	4,022	222	892,970	7.1	6,383,082	15,323,116	17.16	2.40	100.0
Tennessee	516	265	136,615	6.6	900,715	2,481,379	18.16	2.75	100.0
Texas	971	199	193,703	6.7	1,295,127	3,537,734	18.26	2.73	100.0
Other States [2]	4,496	256	1,149,994	6.8	7,834,169	18,727,917	16.29	2.39	100.0
	18,524	245	4,530,525	6.8	30,626,050	77,747,765	17.16	2.54	100.0
1935									
DISTRICT									
Eastern Pennsylvania, New Jersey, and Maryland	3,935	247	973,357	7.2	7,045,101	14,171,492	14.56	2.01	97.2
New York and Maine	1,356	200	271,126	6.8	1,830,679	4,582,936	16.90	2.50	100.0
Ohio, western Pennsylvania, and West Virginia	2,282	195	444,585	7.2	3,221,966	7,300,481	16.42	2.27	100.0
Michigan	1,378	210	289,780	7.6	2,213,228	4,578,966	15.80	2.07	100.0
Wisconsin, Illinois, Indiana, and Kentucky	1,901	273	519,560	6.8	3,544,785	8,204,274	15.79	2.31	100.0
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	1,637	241	394,389	7.2	2,850,749	7,656,504	19.41	2.69	100.0

See footnotes at end of table.

Mill employees in the cement industry, finished cement produced at mills included in study, and average output per man in the United States, 1934–38, by districts and by States—Continued

	Employment—cement mill only					Production			
	Average number of men	Time employed				Finished portland cement (barrels)	Average per man (barrels)		Percent of industry represented
		Average number of days	Total man-shifts	Man-hours					
				Average per man per day	Total		Per shift	Per hour	
1935—Continued									
DISTRICT—continued									
Eastern Missouri, Iowa, Minnesota, and South Dakota	1,790	252	450,229	7.2	3,245,309	7,876,617	17.49	2.43	100.0
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	1,273	272	346,330	6.6	2,293,512	5,966,245	17.23	2.60	100.0
Texas	1,005	214	215,281	7.2	1,545,401	3,786,716	17.59	2.45	100.0
Colorado, Montana, Utah, Wyoming, and Idaho	484	265	128,157	6.0	773,980	2,190,698	17.09	2.83	93.8
California	1,193	323	384,919	6.3	2,415,283	7,974,201	20.72	3.30	100.0
Oregon and Washington	843	153	128,754	7.1	911,285	1,896,934	14.73	2.08	100.0
	19,077	238	4,546,467	7.0	31,891,278	76,186,064	16.76	2.39	99.3
STATE									
Alabama	444	287	127,337	7.3	933,764	2,493,291	19.58	2.67	100.0
California	1,193	323	384,919	6.3	2,415,283	7,974,201	20.72	3.30	100.0
Illinois	753	290	218,011	6.3	1,377,964	3,367,512	15.45	2.44	100.0
Iowa	932	216	200,945	7.9	1,583,424	3,519,558	17.52	2.22	100.0
Kansas	507	251	127,301	6.9	882,183	2,337,444	18.36	2.65	100.0
Michigan	1,378	210	289,780	7.6	2,213,228	4,578,966	15.80	2.07	100.0
Missouri	733	311	227,767	6.3	1,442,932	3,392,140	14.89	2.35	100.0
New York	1,203	203	244,082	6.7	1,641,375	4,285,458	17.56	2.61	100.0
Ohio	1,037	207	214,946	7.6	1,636,213	3,876,172	18.03	2.37	100.0
Pennsylvania	4,325	239	1,032,495	7.1	7,331,011	15,092,086	14.62	2.06	97.4
Tennessee	545	218	118,894	7.9	937,557	2,702,622	22.73	2.88	100.0
Texas	1,005	214	215,281	7.2	1,545,401	3,786,716	17.59	2.45	100.0
Other States [2]	5,022	228	1,144,709	6.9	7,950,943	18,779,898	16.41	2.36	99.2
	19,077	238	4,546,467	7.0	31,891,278	76,186,064	16.76	2.39	99.3
1936									
DISTRICT									
Eastern Pennsylvania, New Jersey, and Maryland	3,999	270	1,078,556	7.2	7,769,712	19,948,866	18.50	2.57	93.4
New York and Maine	1,354	238	322,048	7.5	2,401,837	6,111,232	18.98	2.54	100.0
Ohio, western Pennsylvania, and West Virginia	2,216	270	598,051	7.7	4,602,837	10,640,605	17.79	2.31	100.0
Michigan	1,459	278	406,274	8.0	3,250,195	7,673,324	18.89	2.36	100.0
Wisconsin, Illinois, Indiana, and Kentucky	2,253	297	669,228	7.0	4,656,995	11,794,731	17.62	2.53	100.0
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	1,827	279	509,272	7.4	3,743,902	10,077,981	19.79	2.69	100.0
Eastern Missouri, Iowa, Minnesota, and South Dakota	1,866	295	549,683	7.1	3,922,614	10,514,858	19.13	2.68	100.0
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	1,273	315	401,262	7.1	2,842,990	8,218,730	20.48	2.89	100.0
Texas	966	263	254,393	7.3	1,855,211	5,839,983	22.96	3.15	100.0
Colorado, Montana, Utah, Wyoming, and Idaho	443	293	129,804	7.0	904,497	2,807,183	21.63	3.10	93.1
California	1,443	327	472,084	7.3	3,456,148	13,398,603	28.38	3.88	100.0
Oregon and Washington	782	222	173,927	7.1	1,227,107	4,002,930	23.02	3.26	100.0
	19,881	280	5,564,582	7.3	40,634,045	111,029,026	19.95	2.73	98.6

See footnotes at end of table.

Mill employees in the cement industry, finished cement produced at mills included in study, and average output per man in the United States, 1934–38, by districts and by States—Continued

	Employment—cement mill only					Production			Percent of industry represented
	Average number of men	Time employed				Finished portland cement (barrels)	Average per man (barrels)		
		Average number of days	Total man-shifts	Man-hours			Per shift	Per hour	
				Average per man per day	Total				
1936—Continued									
STATE									
Alabama	508	336	170, 539	7. 5	1, 282, 190	3, 912, 290	22. 94	3. 05	100. 0
California	1, 443	327	472, 084	7. 3	3, 456, 148	13, 398, 603	28. 38	3. 88	100. 0
Illinois	975	303	295, 455	6. 4	1, 902, 105	4, 807, 434	16. 27	2. 53	100. 0
Iowa	897	259	232, 603	7. 7	1, 792, 762	4, 099, 121	17. 62	2. 29	100. 0
Kansas	535	311	166, 528	7. 3	1, 223, 498	3, 560, 321	21. 38	2. 91	100. 0
Michigan	1, 459	278	406, 274	8. 0	3, 250, 195	7, 673, 324	18. 89	2. 36	100. 0
Missouri	832	133	270, 526	6. 5	1, 768, 493	4, 954, 851	18. 32	2. 80	100. 0
New York	1, 228	238	292, 438	7. 4	2, 177, 005	5, 729, 431	19. 59	2. 62	100. 0
Ohio	1, 170	274	320, 997	7. 7	2, 484, 449	5, 370, 456	16. 73	2. 16	100. 0
Pennsylvania	4, 214	272	1, 146, 893	7. 2	8, 230, 381	21, 459, 207	18. 71	2. 61	93. 8
Tennessee	592	233	138, 042	7. 8	1, 076, 047	3, 013, 666	21. 83	2. 80	100. 0
Texas	966	263	254, 393	7. 3	1, 855, 211	5, 839, 983	22. 96	3. 15	100. 0
Other States [2]	5, 062	276	1, 397, 810	7. 3	10, 135, 561	27, 210, 339	19. 47	2. 68	99. 2
	19, 881	280	5, 564, 582	7. 3	40, 634, 045	111, 029, 026	19. 95	2. 73	98. 6
1937									
DISTRICT									
Eastern Pennsylvania, New Jersey, and Maryland	4, 218	288	1, 207, 543	7. 3	8, 810, 466	21, 195, 678	17. 55	2. 41	100. 0
New York and Maine	1, 328	237	314, 214	7. 5	2, 353, 056	6, 370, 647	20. 27	2. 71	100. 0
Ohio, western Pennsylvania, and West Virginia	2, 293	268	614, 484	7. 6	4, 700, 318	10, 787, 616	17. 56	2. 30	100. 0
Michigan	1, 626	287	467, 239	8. 0	3, 737, 916	8, 180, 969	17. 51	2. 19	100. 0
Wisconsin, Illinois, Indiana, and Kentucky	2, 298	307	704, 740	7. 1	5, 007, 825	12, 748, 994	18. 09	2. 55	100. 0
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	1, 948	293	571, 624	7. 2	4, 131, 074	11, 017, 080	19. 27	2. 67	100. 0
Eastern Missouri, Iowa, Minnesota, and South Dakota	1, 900	303	576, 459	7. 3	4, 196, 029	10, 675, 595	18. 52	2. 54	100. 0
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	1, 325	315	417, 968	7. 3	3, 070, 443	8, 651, 217	20. 70	2. 82	100. 0
Texas	1, 043	291	303, 245	7. 4	2, 241, 419	6, 906, 453	22. 78	3. 08	100. 0
Colorado, Montana, Utah, Wyoming, and Idaho	477	299	142, 470	7. 4	1, 057, 166	3, 056, 597	21. 45	2. 89	100. 0
California	1, 592	327	520, 615	7. 5	3, 885, 784	11, 953, 986	22. 96	3. 08	100. 0
Oregon and Washington	877	229	200, 636	6. 8	1, 361, 677	4, 629, 876	23. 08	3. 40	100. 0
	20, 925	289	6, 041, 237	7. 4	44, 553, 173	116, 174, 708	19. 23	2. 61	100. 0
STATE									
Alabama	696	312	216, 874	6. 5	1, 400, 321	4, 415, 141	20. 36	3. 15	100. 0
California	1, 592	327	520, 615	7. 5	3, 885, 784	11, 953, 986	22. 96	3. 08	100. 0
Illinois	972	310	301, 774	6. 6	1, 992, 489	5, 246, 102	17. 38	2. 63	100. 0
Iowa	977	278	271, 554	7. 7	2, 082, 229	4, 706, 094	17. 33	2. 26	100. 0
Kansas	575	300	172, 341	7. 7	1, 335, 541	3, 696, 507	21. 45	2. 77	100. 0
Michigan	1, 626	287	467, 239	8. 0	3, 737, 916	8, 180, 969	17. 51	2. 19	100. 0
Missouri	795	334	265, 194	6. 9	1, 824, 549	4, 756, 285	17. 94	2. 61	100. 0
New York	1, 210	235	284, 006	7. 4	2, 110, 838	5, 912, 772	20. 82	2. 80	100. 0
Ohio	1, 187	285	338, 076	7. 7	2, 604, 574	5, 699, 695	16. 86	2. 19	100. 0
Pennsylvania	4, 416	291	1, 284, 222	7. 1	9, 158, 509	23, 064, 465	17. 96	2. 52	100. 0
Tennessee	579	279	161, 277	7. 4	1, 188, 642	3, 081, 215	19. 11	2. 59	100. 0
Texas	1, 043	291	303, 245	7. 4	2, 241, 419	6, 906, 453	22. 78	3. 08	100. 0
Other States [2]	5, 257	277	1, 454, 820	7. 6	10, 990, 362	28, 555, 024	19. 63	2. 60	100. 0
	20, 925	289	6, 041, 237	7. 4	44, 553, 173	116, 174, 708	19. 23	2. 61	100. 0

See footnotes at end of table.

Mill employees in the cement industry, finished cement produced at mills included in study, and average output per man in the United States, 1934–38, by districts and by States—Continued

	Employment—cement mill only					Production			Percent of industry represented[1]
	Average number of men	Time employed				Finished portland cement (barrels)	Average per man (barrels)		
		Average number of days	Total man-shifts	Man-hours			Per shift	Per hour	
				Average per man per day	Total				
1938									
DISTRICT									
Eastern Pennsylvania, New Jersey, and Maryland	4,146	263	1,089,552	7.2	7,876,195	19,895,691	18.26	2.53	100.0
New York and Maine	1,267	228	289,311	8.2	2,363,015	6,245,193	21.59	2.64	100.0
Ohio, western Pennsylvania, and West Virginia	2,123	222	471,080	7.6	3,596,661	9,374,184	19.90	2.61	100.0
Michigan	1,299	286	371,377	8.0	2,971,018	7,159,362	19.28	2.41	100.0
Wisconsin, Illinois, Indiana, and Kentucky	2,254	255	574,231	7.0	4,015,214	9,930,734	17.29	2.47	100.0
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	2,060	259	534,042	7.5	4,019,301	12,026,249	22.52	2.99	100.0
Eastern Missouri, Iowa, Minnesota, and South Dakota	1,880	286	537,023	7.1	3,824,762	9,994,563	18.61	2.61	100.0
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	1,301	293	381,730	7.5	2,844,247	7,602,704	19.92	2.67	100.0
Texas	1,053	274	288,867	7.7	2,229,376	6,949,164	24.06	3.12	100.0
Colorado, Montana, Utah, Wyoming, and Idaho	493	280	137,853	7.0	961,012	2,689,465	19.51	2.80	100.0
California	1,219	335	408,363	7.6	3,113,073	10,513,067	25.74	3.38	100.0
Oregon and Washington	733	193	141,361	7.4	1,052,536	2,976,624	21.06	2.83	100.0
	19,828	264	5,224,790	7.4	38,866,410	105,357,000	20.16	2.71	100.0
STATE									
Alabama	779	251	195,761	7.2	1,408,970	4,627,639	23.64	3.28	100.0
California	1,219	335	408,363	7.6	3,113,073	10,513,067	25.74	3.38	100.0
Illinois	983	246	241,654	6.4	1,544,133	3,959,932	16.39	2.56	100.0
Iowa	911	279	253,731	7.4	1,879,356	4,726,517	18.63	2.51	100.0
Kansas	652	262	171,005	7.8	1,340,168	3,264,350	19.09	2.44	100.0
Michigan	1,299	286	371,377	8.0	2,971,018	7,159,362	19.28	2.41	100.0
Missouri	838	308	258,141	6.8	1,766,273	4,491,458	17.40	2.54	100.0
New York	1,160	226	262,026	8.1	2,134,539	5,807,731	22.16	2.72	100.0
Ohio	1,134	255	289,047	7.7	2,223,730	5,188,477	17.95	2.33	100.0
Pennsylvania	4,311	254	1,092,926	7.2	7,885,430	20,868,384	19.09	2.65	100.0
Tennessee	548	235	128,741	7.8	1,009,886	3,318,797	25.78	3.29	100.0
Texas	1,053	274	288,867	7.7	2,229,376	6,949,164	24.06	3.12	100.0
Other States[2]	4,941	256	1,263,151	7.4	9,360,458	24,482,122	19.38	2.62	100.0
	19,828	264	5,224,790	7.4	38,866,410	105,357,000	20.16	2.71	100.0

[1] Calculated for each year by dividing the quantity of finished cement produced at mills included in study by the total production.
[2] Arkansas, Colorado, Florida, Georgia, Idaho, Indiana, Kentucky, Louisiana, Maine, Maryland, Minnesota, Montana, Nebraska, New Jersey, Oklahoma, Oregon, South Dakota, Utah, Virginia, Washington, West Virginia, Wisconsin, and Wyoming.

Quarry and crusher employees in the cement industry, material (quarry rock and overburden) handled at quarries included in study, and average output of material per man in the United States in 1934,[1] *by districts and by States*

	Employment—quarry and crusher only					Material handled—quarry rock and overburden				Percent of industry represented[2]
	Average number of men	Time employed				Short tons	Percent of overburden included	Average per man (short tons)		
		Average number of days	Total man-shifts	Man-hours				Per shift	Per hour	
				Average per man per day	Total					
DISTRICT										
Eastern Pennsylvania, New Jersey, and Maryland	702	213	149,284	7.2	1,072,880	4,530,078	3.9	30.35	4.22	100.0
New York and Maine	321	171	54,853	7.1	389,155	1,288,535	5.5	23.49	3.31	100.0
Ohio, western Pennsylvania, and West Virginia	776	181	140,572	7.3	1,020,117	2,891,911	22.1	20.57	2.83	100.0
Michigan	183	181	33,119	9.1	299,936	1,302,810	46.2	39.34	4.34	100.0
Wisconsin, Illinois, Indiana, and Kentucky	423	230	97,126	6.3	608,729	2,226,221	20.6	22.92	3.66	100.0
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	543	195	106,011	7.1	751,556	2,424,016	5.6	22.87	3.23	100.0
Eastern Missouri, Iowa, Minnesota, and South Dakota	477	224	106,697	6.8	722,066	2,463,026	12.2	23.08	3.41	100.0
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	262	216	56,551	6.8	383,499	1,820,742	.5	32.20	4.75	100.0
Texas	154	143	22,095	7.2	159,984	1,027,508	5.0	46.50	6.42	100.0
Colorado, Montana, Utah, Wyoming, and Idaho	70	194	13,575	6.6	89,360	655,343	-------	48.28	7.33	100.0
California	337	265	89,371	6.9	620,875	2,298,170	1.6	25.71	3.70	100.0
Oregon and Washington	133	181	24,038	7.4	178,324	374,697	.8	15.59	2.10	100.0
	4,381	204	893,292	7.0	6,296,481	23,303,057	10.7	26.09	3.70	100.0
STATE										
Alabama	131	233	30,577	6.4	195,727	663,150	-------	21.69	3.39	100.0
California	337	265	89,371	6.9	620,875	2,298,170	1.6	25.71	3.70	100.0
Illinois	235	234	55,038	6.2	339,190	1,298,278	29.8	23.59	3.83	100.0
Iowa	189	275	51,993	6.7	347,405	1,172,322	14.5	22.55	3.37	100.0
Kansas	136	168	22,890	7.5	172,397	690,418	1.3	30.16	4.00	100.0
Michigan	183	181	33,119	9.1	299,936	1,302,810	46.2	39.34	4.34	100.0
Missouri	300	194	58,144	6.8	392,530	1,321,164	9.8	22.72	3.37	100.0
New York	304	173	52,507	7.1	372,402	1,180,794	3.6	22.49	3.17	100.0
Ohio	267	207	55,326	7.1	393,302	1,107,704	9.7	20.02	2.82	100.0
Pennsylvania	850	172	145,994	7.3	1,059,048	4,829,948	14.5	33.08	4.56	100.0
Tennessee	174	207	35,955	7.3	263,453	786,701	4.2	21.88	2.99	100.0
Texas	154	143	22,095	7.2	159,984	1,027,508	5.0	46.50	6.42	100.0
Other States[3]	1,121	214	240,283	7.0	1,680,232	5,624,090	3.8	23.41	3.35	100.0
	4,381	204	893,292	7.0	6,296,481	23,303,057	10.7	26.09	3.70	100.0

[1] Comparable figures not available after 1934.
[2] Calculated by dividing the quantity of finished cement produced at mills included in study by the total production.
[3] Arkansas, Colorado, Florida, Georgia, Idaho, Indiana, Kentucky, Louisiana, Maine, Maryland, Minnesota, Montana, Nebraska, New Jersey, Oklahoma, Oregon, South Dakota, Utah, Virginia, Washington, West Virginia, Wisconsin, and Wyoming.

FOREIGN TRADE [3]

Imports.—The figures in the following table cover imports of hydraulic cements of all kinds. The values assigned are supposed to represent values in the foreign countries from which the materials are exported, including the cost of containers or coverings.

Hydraulic cement imported for consumption in the United States, 1935–39

Year	Barrels	Value	Year	Barrels	Value
1935	619,404	$615,866	1938	1,727,411	$1,436,730
1936	1,658,902	1,421,620	1939	1,913,853	1,860,543
1937	1,803,932	1,392,633			

The following table of imports by countries of origin and import districts includes all hydraulic cements except "white nonstaining portland cement," which was reported "imported for consumption" as follows: 1939, 22,883 barrels valued at $75,983, of which 11,029 barrels valued at $42,864 came from Denmark, 2,323 barrels valued at $7,405 from Belgium, 4,279 barrels valued at $7,686 from France, and 1,278 barrels valued at $4,413 from the United Kingdom; 1938, 12,227 barrels valued at $38,557, of which 277 barrels valued at $1,038 came from Denmark, 5,439 barrels valued at $17,466 from Belgium, 3,262 barrels valued at $6,394 from France, and 1,555 barrels valued at $5,892 from the United Kingdom.

Roman, portland, and other hydraulic cements imported for consumption in the United States, 1938–39, by countries and customs districts [1]

Country and district	1938		1939	
	Barrels	Value	Barrels	Value
COUNTRY				
Belgium	1,168,148	$852,233	1,041,292	$895,170
Canada	1,385	3,372	263	549
Denmark	279,317	281,551	466,553	484,044
France	5,053	4,465	13,334	12,431
Germany	78,365	92,268	126,354	170,598
Italy	645	2,769	2,088	8,874
Japan	71,574	61,351	52,528	44,121
Mexico	149	312	2,130	2,425
Netherlands	33,872	26,169	23,705	33,331
Norway	21,238	17,072	25,392	18,492
Poland and Danzig	30,062	23,121	78,919	53,490
United Kingdom	9,189	18,526	8,405	17,756
Yugoslavia	16,187	14,964	50,007	43,279
	1,715,184	1,398,173	1,890,970	1,784,560
CUSTOMS DISTRICT				
Connecticut	5,146	6,922	1,863	1,641
El Paso	149	312	615	882
Florida	344,238	281,414	365,071	373,214
Galveston	14,702	10,070	18,686	13,837
Georgia	44,131	31,060	30,891	28,445
Hawaii	71,573	61,351	52,378	44,029
Los Angeles	50	36	325	997
Maine and New Hampshire	1,383	3,368	228	464
Maryland	67,363	45,310	88,170	53,150
Massachusetts	115,449	103,660	72,171	80,461
Mobile	43,549	31,499	53,475	56,395
Montana and Idaho			5	21

[1] Excludes "white, nonstaining, and other special cements."

[3] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Roman, portland, and other hydraulic cements imported for consumption in the United States, 1938–39 by countries and customs districts—Continued

Country and district	1938		1939	
	Barrels	Value	Barrels	Value
CUSTOMS DISTRICT—continued				
New Orleans	8,020	$6,565	11,491	$8,421
New York	469,217	414,081	647,857	637,190
North Carolina	1,313	891	1,917	1,467
Oregon	9,750	6,811	12,575	8,974
Philadelphia	93,694	58,005	116,676	67,412
Puerto Rico	263,777	213,063	295,036	275,648
Rhode Island	13,939	9,047	27,891	38,518
Sabine	3,200	2,549	2,013	1,489
St. Lawrence	---	---	30	64
San Antonio	49,452	40,532	57,120	64,525
San Diego	1,787	1,234	---	---
San Francisco	1,993	1,268	150	92
South Carolina	53,406	38,455	10,915	9,837
Vermont	2	4	---	---
Virgin Islands	9,519	9,294	4,321	4,267
Washington	28,382	21,372	19,100	13,120
	1,715,184	1,398,173	1,890,970	1,784,560

Exports.—Although the United States is the major cement-producing country of the world its export trade is small. As indicated in the following table, exports in 1939 were larger than in any other recent year but still comprised less than 1 percent of total domestic shipments. The value of exports is the actual cost at United States ports as indicated by the shippers on the export declarations.

Hydraulic cement exported from the United States, 1935–39

Year	Barrels	Value	Percent of total shipments from mills
1935	416,099	$1,012,942	0.6
1936	334,673	886,560	.3
1937	378,554	1,044,161	.3
1938	558,226	1,294,883	.5
1939	1,146,339	2,352,693	.9

The following table shows exports by country of destination in 1938 and 1939.

Hydraulic cement exported from the United States, 1938–39, by countries

Country	1938		1939	
	Barrels	Value	Barrels	Value
North America:				
Bermuda	1,334	$2,316	10	$58
Canada	9,147	41,052	7,365	40,269
Central America:				
British Honduras	4,228	6,088	4,520	6,714
Costa Rica	1,309	2,886	26,195	45,585
Guatemala	142	257	3,630	7,220
Honduras	7,100	10,627	18,323	31,309
Nicaragua	1,837	3,154	3,470	6,261
Panama:				
Canal Zone	89,840	183,443	199,431	433,363
Republic of	4,407	12,883	66,763	121,814
Salvador	300	1,312	3,830	8,073

Hydraulic cement exported from the United States, 1938–39, by countries—Continued

Country	1938		1939	
	Barrels	Value	Barrels	Value
North America—Continued.				
Mexico	23,438	$68,350	29,444	$65,666
Newfoundland and Labrador	676	1,506	4,148	6,917
West Indies:				
British:				
Jamaica	260	752	115	516
Trinidad and Tobago	710	2,466	539	1,379
Other British	1,220	3,357	5,937	11,831
Cuba	12,309	52,407	17,579	76,385
Dominican Republic	2,128	6,609	37,274	67,407
French	10	11		
Haiti	3,027	4,415	51,204	84,350
Netherland	10,428	26,082	19,629	34,076
	173,850	429,973	499,406	1,049,193
South America:				
Argentina	35,181	149,505	22,756	96,047
Bolivia	175	881	280	1,261
Brazil	11,843	47,333	24,410	93,516
Chile	5,413	27,222	3,216	16,306
Colombia	20,635	55,817	23,046	68,456
Ecuador	503	2,172	11,372	25,665
Paraguay	75	368	212	914
Peru	3,675	16,667	7,238	27,559
Surinam	500	830	3,000	5,795
Uruguay	1,887	7,048	1,155	4,925
Venezuela	216,943	377,301	498,609	832,762
Other South America			500	760
	296,830	685,144	595,794	1,173,966
Europe:				
Belgium	874	3,899	396	1,727
Ireland	284	1,479		
Netherlands	458	2,279	222	1,061
Norway	64	456	120	652
Sweden	25	121	220	2,032
United Kingdom	5,964	24,007	4,230	15,246
Other Europe	105	763	65	318
	7,774	33,004	5,253	21,036
Asia:				
British Malaya	315	1,193	165	676
China	7	70	20	180
India, British	1,275	6,498	1,166	6,375
Iraq			532	2,415
Netherland India	20	103	480	2,011
Philippine Islands	70,327	104,538	30,213	52,722
Saudi Arabia	1,932	7,207	3,664	12,810
Other Asia	3,429	14,948	4,526	12,029
	77,305	134,557	40,766	89,218
Africa:				
Egypt	140	913	24	114
Liberia	6	62	2,754	6,989
Mozambique	48	197		
Union of South Africa	1,455	7,383	1,818	9,264
Other Africa	29	104		
	1,678	8,659	4,596	16,367
Oceania:				
British:				
Australia	499	2,178	462	2,600
New Zealand	285	1,351	55	291
Other	5	17	7	22
	789	3,546	524	2,913
	558,226	1,294,883	1,146,339	2,352,693

The following table shows shipments of cement to outlying Territories of the United States in 1938 and 1939.

Domestic hydraulic cement shipped to noncontiguous Territories of the United States, 1938–39

Territory	1938		1939	
	Barrels	Value	Barrels	Value
Alaska	40,982	$112,692	43,506	$115,056
American Samoa	3	6	7	31
Canton and Enderbury Islands	(1)	(1)	2,200	6,094
Guam	2	14		
Hawaii	321,578	710,573	328,381	725,301
Midway Island	28	88		
Puerto Rico	418,521	574,033	352,763	511,674
Virgin Islands	14,017	27,905	20,354	38,905
Wake Island	10	43		
	795,141	1,425,354	747,211	1,397,061

[1] Beginning January 1, 1939.

WORLD PRODUCTION

The following table of world production has been compiled by the Bureau of Mines from consular reports, official statistics, and trade literature. The figures are in metric tons (1 metric ton equals 2,204.622 pounds). The table shows the latest reported plant capacity and the production from 1935 to 1939, inclusive. Although figures for certain countries are still lacking the table presents a reasonably complete picture of the cement industry throughout the world. Figures on capacity are the best estimates that can be made from available data.

World production of cement, 1935–39, and latest reported plant capacity, by countries, in metric tons [1]

[Compiled by R. B. Miller]

Country	Latest reported plant capacity [2]	Production				
		1935	1936	1937	1938	1939
North America:						
Canada	2,390,000	553,679	784,103	975,231	876,193	909,875
Cuba	(3)	(3)	(3)	(3)	(3)	(4)
Guatemala	25,000	(3)	(3)	(3)	(3)	(4)
Mexico	529,000	251,651	285,978	344,693	373,712	(4)
United States:						
Continental	143,673,000	13,259,847	19,522,716	20,137,732	18,279,156	21,211,969
Puerto Rico	60,000					55,300
South America:						
Argentina	1,856,000	721,564	833,631	1,035,495	1,160,706	(4)
Bolivia	25,000	6,858	10,547	11,100	18,600	(4)
Brazil	830,000	366,261	485,064	571,462	617,896	(4)
Chile	(3)	284,885	248,424	313,110	363,987	447,992
Colombia	(3)	77,000	104,465	123,175	141,809	(4)
Ecuador	20,000	13,674	(3)	(3)	(3)	(4)
Peru	120,000	60,296	75,115	83,048	101,380	119,986
Uruguay	240,000	99,778	111,073	147,773	158,359	(4)
Venezuela	50,000	21,811	37,583	44,626	39,863	39,130

See footnotes at end of table.

World production of cement, 1935–39, and latest reported plant capacity, by countries, in metric tons—Continued

Country	Latest reported plant capacity	Production				
		1935	1936	1937	1938	1939
Europe:						
Albania	22,000	(3)	8,000	14,000	(3)	(4)
Belgium	4,000,000	2,200,000	2,350,000	3,008,016	3,054,144	2,551,756
Bulgaria	245,000	105,000	113,000	135,000	180,000	(4)
Czechoslovakia	2,300,000	958,000	1,050,000	1,360,000	(3)	(4)
Denmark	938,000	756,823	792,369	676,125	639,957	(4)
Estonia	(3)	37,990	50,611	65,931	79,740	(4)
Finland	640,000	269,315	332,557	410,371	475,152	(4)
France	[2] 10,578,000	4,403,800	4,638,400	4,254,800	(3)	(4)
Germany	[2] 17,000,000	8,807,000	11,689,000	12,605,000	15,600,000	(4)
Austria	1,000,000	371,000	369,000	430,000	650,000	(4)
Greece	450,000	273,000	276,850	290,000	308,000	(4)
Hungary	876,000	280,000	215,000	392,000	(3)	(4)
Italy	[2] 6,689,000	4,223,118	3,826,548	4,359,112	4,607,454	4,800,000
Latvia	170,000	72,013	100,213	117,591	154,621	164,601
Netherlands	(3)	360,000	401,000	441,000	456,000	541,000
Norway	358,000	263,127	300,658	320,481	331,600	(4)
Poland	1,850,000	842,604	1,048,270	1,289,108	1,719,452	(4)
Portugal	(3)	214,000	245,343	254,000	268,000	(4)
Rumania	1,200,000	382,000	376,000	456,311	(3)	(4)
Spain	2,600,000	[5] 1,355,000	[5] 600,000	[5] 650,000	[5] 570,000	1,000,000
Sweden	(3)	739,630	795,181	875,541	993,000	(4)
Switzerland	1,300,000	(3)	509,000	(3)	[5] 650,000	(4)
U. S. S. R.	[2] 6,000,000	4,470,000	5,845,000	5,459,000	5,696,000	(4)
United Kingdom	[2] 10,000,000	6,054,000	6,700,000	7,300,000	7,900,000	(4)
Yugoslavia	1,680,000	785,000	643,072	618,635	712,302	(4)
Asia:						
China	1,170,000	(3)	[6] 450,000	(3)	(3)	(4)
Manchuria	1,010,000	378,000	580,000	[6] 800,000	(3)	(4)
Chosen	1,600,000	460,000	567,000	665,000	(3)	(4)
Hong Kong	115,000	(3)	(3)	(3)	110,036	(4)
India, British	1,465,000	892,000	977,000	1,142,000	(3)	(4)
Indochina	300,000	107,000	149,230	234,638	266,366	(4)
Iran	125,000	(3)	(3)	(3)	(3)	(4)
Japan	[2] 13,100,000	5,876,803	6,232,206	6,703,328	(3)	(4)
Levant	(3)	100,000	120,000	180,459	162,245	169,285
Netherland India	235,000	140,000	136,000	(3)	(3)	170,000
Palestine	(3)	187,000	154,000	161,000	98,445	(4)
Philippine Islands	336,000	110,825	132,910	148,000	166,921	(4)
Syria	90,000	33,450	58,000	74,000	80,000	(4)
Thailand (Siam)	120,000	49,000	62,000	77,000	82,000	(4)
Turkey	350,000	131,175	137,086	214,794	267,568	274,742
Africa:						
Algeria	(3)	64,700	66,800	65,000	(3)	(4)
Belgian Congo	40,000	3,800	7,520	10,723	16,500	(4)
Egypt	700,000	378,780	335,000	330,000	375,763	(4)
Madagascar	70,000	4,000				(4)
Morocco, French	(3)	189,000	161,780	156,000	165,000	(4)
Mozambique	30,000	12,572	11,826	14,957	24,297	27,618
Tunisia	(3)	39,700	48,600	56,400	68,700	(4)
Union of South Africa	1,000,000	527,000	760,047	839,526	878,206	948,664
Oceania:						
Australia [7]	1,323,000	558,961	655,590	731,650	862,539	881,778
New Zealand [8]	(3)	124,414	153,705	176,000	(3)	(4)
	147,088,000	65,660,000	78,170,000	84,140,000	88,850,000	(4)

[1] Table includes all kinds of cement. Few data are available for Afghanistan, Burma, Eritrea, Ethiopia, Hong Kong, Luxemburg, and Taiwan, and they do not permit the establishment of production figures at this time, but estimates of production and capacity of these countries are included in the totals. The present plant capacity of China and war-affected Europe is in reality unknown owing to the destructive effects of military operations.

[2] Figures are approximate only and are subject to revision.

[3] Data not available, estimate included in total.

[4] Data not yet available.

[5] Shipments.

[6] Approximate production.

[7] 12 months ended June 30 of the year indicated.

[8] 12 months ended March 31 of the year indicated.

Canada.—According to the Dominion Bureau of Statistics sales of portland cement by Canadian producers increased 4 percent in quantity and 3 percent in value in 1939 compared with 1938. The same plants were in operation both years. The following table presents the principal statistics of the Canadian industry.

Salient statistics of the cement industry in Canada, 1938–39 [1]

	1938		1939	
	Barrels	Value	Barrels	Value
Output	5,558,047		5,721,447	
Sales:				
Quebec	2,730,320	$3,693,188	3,027,759	$4,035,294
Ontario	1,818,032	2,555,214	1,709,263	2,437,777
Manitoba	330,889	754,427	343,717	773,363
Alberta	304,373	611,790	377,846	744,357
British Columbia	335,488	626,731	272,679	520,420
Total sales	5,519,102	8,241,350	5,731,264	8,511,211
Stocks, Dec. 31	1,875,288		1,865,471	
Imports:				
Portland	48,497	105,326	16,622	58,316
Manufactures		6,650		14,968
Total imports		111,976		73,284
Exports	89,419	101,059	156,556	159,579
Apparent consumption	5,478,180		5,591,330	

[1] Dominion Bureau of Statistics.

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STONE

By Oliver Bowles and M. S. Jensen

SUMMARY OUTLINE

Sales of stone in 1939 attained an all-time record of more than 147,000,000 tons. Their value was the highest since 1930. Sales of crushed and dimension stone combined increased 18 percent in quantity and 14 percent in value over 1938. Sales of dimension stone (exclusive of slate) were 30 percent higher in quantity and 17 percent higher in value. For the crushed-stone industry the corresponding gains were 18 and 13 percent. The smaller proportional increase in value than in tonnage indicates a trend toward lower unit prices.

The present chapter follows the general plan of the chapter on Stone in Minerals Yearbook, 1939, data on dimension stone being separated from that on crushed stone, except in the introductory general tables.

The tables in this report give the quantities sold or used by producers and the values f. o. b. quarries and mills insofar as these figures are obtainable. Stone quarried and used by the producer is considered as sold and is included in the statistics of sales. The data, however, do not include stone made into abrasives (such as grindstones) or that used in making lime and cement. These materials are reported in terms of finished products in the Abrasive Materials, Lime, and Cement chapters of this volume. The following tables show total sales of stone by kinds, uses, and States.

Stone sold or used by producers in the United States, 1935–39, by kinds

[Quantities approximate]

Year	Granite		Basalt and related rocks (trap rock)		Marble		Limestone	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1935	6,013,990	$13,507,165	9,671,950	$9,315,040	132,450	$3,415,861	57,492,760	$50,668,765
1936	15,442,150	22,893,289	14,014,440	13,386,933	165,760	5,761,554	87,735,740	81,559,984
1937	9,265,830	20,192,882	13,581,460	12,508,276	207,760	5,456,191	94,577,270	90,901,877
1938	10,432,980	20,915,609	13,908,790	12,280,016	219,390	5,248,290	81,679,690	82,286,555
1939	12,041,360	22,495,983	16,091,250	14,164,016	228,080	6,688,662	100,846,090	94,817,481

Year	Sandstone		Other stone [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1935	3,009,790	$4,568,093	6,838,110	$6,349,573	83,159,050	$87,824,497
1936	6,254,290	9,717,105	7,804,040	8,207,114	131,416,420	141,525,979
1937	5,072,660	7,516,136	10,438,260	9,637,766	133,143,240	146,213,128
1938	6,314,430	8,066,200	12,283,660	10,458,376	124,838,940	139,255,046
1939	8,853,680	11,745,631	9,386,670	8,549,742	147,447,130	158,461,515

[1] Includes mica schist, conglomerate, argillite, various light-colored volcanic rocks, serpentine not used as marble, soapstone sold as dimension stone, and such other stone as cannot properly be classed in any main group.

Stone sold or used by producers in the United States, 1938–39, by uses

Use	1938		1939	
	Quantity	Value	Quantity	Value
Dimension stone:				
Building stone:				
Rough construction ... short tons	463,720	$905,536	652,500	$1,694,526
Cut stone, slabs, and mill blocks ... cubic feet	7,135,860	10,989,024	9,300,300	14,313,759
Approximate equivalent in short tons	541,870		700,510	
Rubble ... short tons	370,060	426,796	549,240	525,173
Monumental stone ... cubic feet	2,450,930	7,359,184	2,571,840	7,265,575
Approximate equivalent in short tons	201,680		211,400	
Paving blocks ... number	4,300,930	462,729	[1] 2,797,560	[1] 246,084
Approximate equivalent in short tons	38,220		[1] 25,580	
Curbing ... cubic feet	1,375,920	1,217,091	[2] 1,175,260	[2] 1,080,861
Approximate equivalent in short tons	109,170		[2] 94,290	
Flagging ... cubic feet	488,340	417,802	789,410	427,048
Approximate equivalent in short tons	41,400		64,840	
Total dimension stone (quantities approximate, in short tons)	1,766,120	21,778,162	2,298,360	25,553,026
Crushed and broken stone:				
Riprap ... short tons	6,210,520	6,995,418	5,811,740	5,851,732
Crushed stone ... do	94,763,050	88,767,221	103,891,020	93,958,275
Furnace flux (limestone and marble) ... do	9,702,860	6,943,429	17,287,790	12,632,243
Refractory stone [3] ... do	659,690	991,765	1,492,310	2,044,054
Agricultural (limestone) ... do	4,367,410	5,637,485	5,459,260	6,592,827
Other uses [4] ... do	7,369,290	8,141,566	11,206,650	11,829,358
Total crushed and broken stone ... do	123,072,820	117,476,884	145,148,770	132,908,489
Grand total (quantities approximate, in short tons)	124,838,940	139,255,046	147,447,130	158,461,515

[1] To avoid disclosing confidential information, sandstone paving blocks in 1939 are included under "Curbing."
[2] Includes sandstone paving blocks.
[3] Ganister (sandstone), mica schist, soapstone, and dolomite.
[4] Includes roofing granules as follows: 1938, 171,389 tons, $666,917; 1939, 158,924 tons, $743,034. There were also produced slate granultes used for roofing as follows: 1938, 258,930 tons valued at $2,220,306; 1939, 265,830 tons, $2,312,177.

Stone sold or used by noncommercial producers in the United States in 1939, by uses

[Included in total production]

Use	Short tons	Value	Use	Short tons	Value
Dimension stone:			Crushed and broken stone:		
Building stone	40,430	$110,668	Riprap	1,861,580	$2,345,029
Rubble	67,510	86,126	Crushed stone	44,374,750	42,878,689
Curbing	[1] 10,520	[1] 100,828	Agricultural (limestone)	487,500	513,508
Flagging	350	2,500	Other uses	2,701,560	2,479,821
Total dimension stone	118,810	300,122	Total crushed and broken	49,425,390	48,217,047
			Grand total	49,544,200	48,517,169

[1] Includes a small quantity of paving blocks.

Stone sold or used by producers in the United States, 1938–39, by States

State	1938		1939	
	Short tons (approximate)	Value	Short tons (approximate)	Value
Alabama	1,326,160	$1,809,379	1,855,990	$2,516,584
Alaska	189,090	204,232	([1])	([1])
Arizona	431,310	337,078	665,290	626,281
Arkansas	[2] 308,760	[2] 293,497	641,460	640,330
California	7,634,260	6,632,719	5,734,100	4,673,751
Colorado	897,270	1,051,333	900,460	1,040,579
Connecticut	1,529,730	1,731,707	1,816,650	2,077,366
Delaware	([1])	([1])	([1])	([1])
District of Columbia	([1])	([1])	----------	----------
Florida	[2] 1,349,160	[2] 1,223,438	[2] 1,444,100	[2] 1,462,730
Georgia	1,465,680	3,581,319	1,988,530	4,838,623
Hawaii	515,140	727,194	373,040	573,812
Idaho	1,047,980	795,896	1,863,350	1,238,735
Illinois	[2] 8,528,440	[2] 7,335,844	8,420,120	7,820,589
Indiana	[2] 3,782,410	[2] 6,486,996	[2] 4,338,690	[2] 7,469,659
Iowa	3,369,750	3,782,480	6,400,590	4,385,234
Kansas	[2] 3,676,230	[2] 4,958,723	3,406,640	4,550,560
Kentucky	[2] 3,361,600	[2] 2,987,494	4,802,280	4,480,098
Louisiana	([1])	([1])	([1])	([1])
Maine	192,250	1,161,535	[2] 205,280	[2] 1,228,930
Maryland	[2] 947,390	[2] 1,167,518	1,024,130	1,327,830
Massachusetts	[2] 2,188,820	[2] 3,865,042	2,543,730	4,459,797
Michigan	[2] 7,900,370	[2] 4,059,590	11,138,280	5,890,728
Minnesota	941,050	1,914,056	1,405,740	2,339,774
Mississippi	----------	----------	([1])	([1])
Missouri	3,332,480	4,458,781	[2] 3,958,470	[2] 4,589,986
Montana	1,364,680	1,717,417	1,266,220	1,714,718
Nebraska	[2] 510,240	[2] 780,664	427,580	660,732
Nevada	344,760	246,319	[2] 34,260	[2] 40,207
New Hampshire	53,790	444,537	105,390	437,342
New Jersey	2,583,220	2,678,766	2,806,020	3,036,516
New Mexico	[2] 698,350	[2] 438,284	[2] 287,190	[2] 164,924
New York	10,061,250	10,527,452	10,703,690	10,111,032
North Carolina	[2] 4,552,120	[2] 5,789,486	[2] 6,037,000	[2] 6,979,426
North Dakota	20,090	5,395	([1])	([1])
Ohio	[2] 9,888,730	[2] 8,970,552	[2] 11,133,560	[2] 10,140,272
Oklahoma	[2] 1,101,320	[2] 1,338,858	1,992,660	1,820,409
Oregon	[2] 2,355,970	[2] 2,025,335	2,225,610	1,682,175
Pennsylvania	12,134,290	13,045,423	[2] 15,743,790	[2] 16,906,854
Puerto Rico	[2] 239,610	[2] 247,896	849,610	531,867
Rhode Island	[2] 262,910	[2] 601,355	320,780	558,944
South Carolina	[2] 987,280	[2] 1,315,999	[2] 1,339,030	[2] 1,732,795
South Dakota	320,740	899,190	408,730	998,444
Tennessee	[2] 2,599,840	[2] 4,237,351	[2] 5,626,210	[2] 8,312,977
Texas	3,256,240	2,625,281	3,771,750	3,320,508
Utah	[2] 709,430	[2] 390,249	[2] 700,610	[2] 444,856
Vermont	264,480	3,148,950	232,770	3,412,005
Virginia	5,474,690	5,606,470	5,813,630	5,879,447
Washington	[2] 2,321,210	[2] 1,849,051	2,329,020	2,020,445
West Virginia	[2] 3,194,980	[2] 4,391,563	[2] 3,808,140	[2] 4,477,828
Wisconsin	3,097,230	3,880,935	3,182,780	3,564,045
Wyoming	252,170	346,018	690,860	668,069
Undistributed	1,273,990	1,140,399	683,320	612,702
	124,838,940	139,255,046	147,447,130	158,461,515

[1] Included under "Undistributed."

[2] To avoid disclosing confidential information certain State totals are incomplete, the figures not included being combined under "Undistributed."

DIMENSION STONE

The term "dimension stone" is applied to blocks or slabs of natural stone, of which most are cut to definite shapes and sizes. These products are quite distinct from crushed, broken, and pulverized stone, which comprise irregular fragments or grains sized chiefly by mechanical screening or air separation. Crushed and broken stone is covered in a later section of this chapter.

Dimension-stone producers fall in three main groups upon the basis of plant operation: (1) Those who quarry stone and sell it as rough blocks or slabs; (2) those who quarry stone and manufacture it into finished products; and (3) those who have no quarries but who buy their rough stock and manufacture it into finished products. The Bureau of Mines statistical canvass covers the first and second groups, but as the third group comprises manufacturers rather than quarrymen it is canvassed by the Bureau of the Census. Bureau of Mines statistics are compiled from reports of tonnages and values of original sales, hence they include some material sold as rough blocks and some sold as finished products.

Total sales of dimension stone in 1939 rose 30 percent in quantity and 19 percent in value over 1938. These figures include slate, but details of the slate industry are given in a separate chapter of this volume. All varieties of stone shared the advance except miscellaneous stone, which declined 26 percent in quantity although it gained 22 percent in value.

The following table of salient statistics includes final figures for both 1938 and 1939 and the percentage of change from 1938 for each type of stone by principal products.

Dimension stone sold or used by producers in the United States, 1938–39, by kinds and uses

Kind and use	1938	1939	
		Total	Percent of change
Granite:			
Building stone:			
Rough construction ... short tons	202,640	204,490	+0.9
Value	$343,984	$410,395	+19.3
Average per ton	$1.70	$2.01	+18.2
Cut stone, slabs, and mill blocks ... cubic feet	967,410	865,130	−10.6
Value	$2,460,649	$2,665,205	+8.3
Average per cubic foot	$2.54	$3.08	+21.3
Rubble ... short tons	108,220	197,050	+82.1
Value	$127,372	$226,675	+78.0
Monumental stone ... cubic feet	2,092,540	2,160,480	+3.2
Value	$5,650,996	$5,664,543	+.2
Average per cubic foot	$2.70	$2.62	−3.0
Paving blocks ... number	4,165,230	2,797,560	−32.8
Value	$452,542	$246,084	−45.6
Curbing ... cubic feet	894,970	725,590	−18.9
Value	$742,489	$624,651	−15.9
Total:			
Quantity ... approximate short tons	672,630	733,610	+9.1
Value	$9,778,032	$9,837,553	+.6
Basalt and related rocks (trap rock):			
Building stone:			
Rough construction ... short tons	7,970	10,960	+37.5
Value	$11,654	$14,619	+25.4
Average per ton	$1.46	$1.33	−8.9
Rubble ... short tons	13,880	90,360	+551.0
Value	$9,897	$38,405	+288.0
Total:			
Quantity ... short tons	21,850	101,320	+363.7
Value	$21,551	$53,024	+146.0

Dimension stone sold or used by producers in the United States, 1938–39, by kinds and uses—Continued

Kind and use	1938	1939	
		Total	Percent of change
Marble:			
Building stone (cut stone, slabs, and mill blocks)...cubic feet	687,290	1,046,830	+52.3
Value	$3,264,877	$4,704,047	+44.1
Average per cubic foot	$4.75	$4.49	−5.5
Monumental stone...cubic feet	358,390	411,360	+14.8
Value	$1,708,188	$1,601,032	−6.3
Average per cubic foot	$4.77	$3.89	−18.4
Total:			
Quantity...approximate short tons	89,000	123,740	+39.0
Value	$4,973,065	$6,305,079	+26.8
Limestone:			
Building stone:			
Rough construction...short tons	166,260	320,640	+92.9
Value	$316,772	$424,230	+33.9
Average per ton	$1.91	$1.32	−30.9
Cut stone, slabs, and mill blocks...cubic feet	5,077,950	6,857,380	+35.0
Value	$4,350,724	$5,978,450	+37.4
Average per cubic foot	$0.86	$0.87	+1.2
Rubble...short tons	155,370	221,060	+42.3
Value	$194,621	$189,597	−2.6
Flagging...cubic feet	95,880	168,480	+75.7
Value	$74,560	$85,565	+14.8
Total:			
Quantity...approximate short tons	704,080	1,060,670	+50.6
Value	$4,936,677	$6,677,842	+35.3
Sandstone:			
Building stone:			
Rough construction...short tons	64,290	65,610	+2.1
Value	$190,419	$190,940	+.3
Average per ton	$2.96	$2.91	−1.7
Cut stone, slabs, and mill blocks...cubic feet	332,530	530,960	+59.7
Value	$440,444	$966,057	+119.3
Average per cubic foot	$1.32	$1.82	+37.9
Rubble...short tons	10,990	10,380	−5.6
Value	$23,703	$15,245	−35.7
Paving blocks...number	135,700	(1)	
Value	$10,187	(1)	
Curbing...cubic feet	480,950	[2] 449,670	
Value	$474,602	[2] $456,210	
Flagging...cubic feet	372,050	593,180	+59.4
Value	$334,322	$327,743	−2.0
Total:			
Quantity...approximate short tons	166,120	195,560	+17.7
Value	$1,473,677	$1,956,195	+32.7
Miscellaneous stone: [3]			
Building stone...cubic feet	332,700	601,880	+80.9
Value	$515,037	$654,342	+27.0
Average per cubic foot	$1.55	$1.09	−29.7
Rubble...short tons	81,600	30,390	−62.8
Value	$71,203	$55,251	−22.4
Flagging...cubic feet	20,410	27,750	+36.0
Value	$8,920	$13,740	+54.0
Total:			
Quantity...approximate short tons	112,440	83,460	−25.8
Value	$595,160	$723,333	+21.5
Total, exclusive of slate:			
Quantity...approximate short tons	1,766,120	2,298,360	+30.1
Value	$21,778,162	$25,553,026	+17.3
Slate as dimension stone [4]...approximate short tons	143,690	179,600	+25.0
Value	$3,165,351	$4,101,125	+29.6
Total, including slate:			
Quantity...approximate short tons	1,909,810	2,477,960	+29.7
Value	$24,943,513	$29,654,151	+18.9

[1] To avoid disclosing confidential information, paving blocks in 1939 are included under "Curbing."
[2] Includes paving blocks.
[3] Includes soapstone, mica schist, volcanic rocks, argillite, and other varieties that cannot be classified in the principal groups.
[4] Details of production, by uses, are given in the chapter on Slate in this volume.

BUILDING STONE

The largest use of dimension stone is for building. The following table gives the quantity and value of each kind of stone used for construction in 1938 and 1939.

Building stone sold or used by producers in the United States in 1939, by kinds

Kind	Rough			
	Construction		Architectural	
	Cubic feet	Value	Cubic feet	Value
Granite	2,241,800	$410,395	273,140	$253,537
Basalt	127,910	14,619		
Marble			313,270	664,998
Limestone	3,872,640	424,230	3,367,550	1,426,020
Sandstone	836,130	190,940	291,110	360,572
Miscellaneous	601,880	654,342		
	7,680,360	1,694,526	4,245,070	2,705,127

Kind	Finished				Total	
	Sawed [1]		Cut [1]			
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
Granite	297,470	$932,540	294,520	$1,479,128	3,106,930	$3,075,600
Basalt					127,910	14,619
Marble	232,040	464,900	501,520	3,574,149	1,046,830	4,704,047
Limestone	1,430,700	925,250	2,059,130	3,627,180	10,730,020	6,402,680
Sandstone	121,000	153,332	118,850	452,153	1,367,090	1,156,997
Miscellaneous					601,880	654,342
	2,081,210	2,476,022	2,974,020	9,132,610	16,980,660	16,008,285

[1] For granite, sawed stone corresponds to dressed stone for construction work (walls, foundations, bridges) and cut stone to architectural stone for high-class buildings.

GRANITE

Sales of granite as dimension stone were 9 percent greater in quantity and 1 percent greater in value in 1939 than in 1938. The gains were chiefly in rough monumental and rubble. Both paving blocks and curbing showed large declines in 1939.

Granite (dimension stone) sold or used by producers in the United States in 1939, 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
Arkansas	1	(1)	(1)	------	------	------	------	------	------	------	------	------	------	------	------	------	------	(1)	(1)
California	13	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	14,410	$32,702	7,360	$27,924	------	------	(1)	(1)	3,080	$163,403
Colorado	9	(1)	(1)	(1)	(1)	------	------	------	------	1,680	2,417	1,760	5,251	------	------	------	------	480	9,238
Connecticut	7	310	$3,002	1,870	$4,752	(1)	(1)	6,720	$10,513	4,520	18,053	(1)	(1)	------	------	11,710	$15,304	10,450	126,626
Delaware	1	(1)	(1)	------	------	------	------	(1)	(1)	------	------	------	------	------	------	------	------	(1)	(1)
Georgia	21	16,240	15,471	------	------	(1)	(1)	25,430	18,617	550,680	701,870	68,600	219,556	(1)	(1)	67,490	84,584	105,750	1,166,207
Maine	17	22,700	75,128	47,420	40,010	151,070	$644,290	------	------	11,390	11,354	560	1,750	1,681,730	$179,176	5,940	6,596	55,810	958,295
Maryland	8	49,270	96,799	(1)	(1)	------	------	(1)	(1)	------	------	------	------	------	------	97,910	22,623	98,840	189,394
Massachusetts	23	35,100	63,813	44,970	65,908	218,590	595,237	42,640	51,607	31,920	72,635	(1)	(1)	(1)	(1)	353,700	352,693	135,470	1,320,730
Minnesota	25	4,190	2,333	54,430	48,507	19,500	90,351	------	------	173,410	203,722	46,320	281,674	------	------	------	------	26,570	626,587
Missouri	4	(1)	(1)	(1)	(1)	------	------	------	------	7,400	15,360	700	3,697	------	------	------	------	1,780	22,662
Montana	8	------	------	(1)	(1)	(1)	(1)	------	------	2,260	3,683	550	4,060	------	------	------	------	250	8,326
New Hampshire	10	7,330	18,451	6,740	7,080	56,210	324,007	2,730	7,693	5,850	10,494	1,550	7,318	------	------	6,640	9,103	16,420	384,146
New Jersey	1	(1)	(1)	------	------	------	------	(1)	(1)	------	------	------	------	------	------	------	------	(1)	(1)
New York	5	3,570	17,216	(1)	(1)	7,560	31,000	(1)	(1)	------	------	------	------	(1)	(1)	(1)	(1)	10,330	71,142
North Carolina	9	(1)	(1)	(1)	(1)	40,270	187,052	(1)	(1)	43,470	63,361	10,910	42,708	(1)	(1)	144,960	113,007	31,700	450,736
Oklahoma	9	(1)	(1)	(1)	(1)	------	------	------	------	16,960	45,914	14,520	126,582	------	------	(1)	(1)	3,610	173,296
Oregon	2	------	------	------	------	------	------	------	------	------	------	(1)	(1)	------	------	------	------	(1)	(1)
Pennsylvania	15	41,360	71,643	(1)	(1)	------	------	67,820	65,416	17,360	27,235	28,200	116,984	(1)	(1)	1,920	968	113,200	282,924
Rhode Island	5	------	------	(1)	(1)	------	------	(1)	(1)	39,020	137,941	(1)	(1)	------	------	------	------	5,200	167,543
South Carolina	3	------	------	(1)	(1)	------	------	(1)	(1)	(1)	(1)	(1)	(1)	------	------	(1)	(1)	12,700	229,462
South Dakota	6	------	------	17,500	12,144	16,260	91,560	------	------	61,110	33,449	57,020	425,947	------	------	------	------	12,300	563,100
Texas	6	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	11,710	17,455	(1)	(1)	------	------	------	------	3,980	40,929
Vermont	10	------	------	------	------	22,440	117,855	------	------	685,600	2,031,251	4,000	20,000	------	------	------	------	58,640	2,169,106
Virginia	2	(1)	(1)	(1)	(1)	------	------	------	------	(1)	(1)	------	------	(1)	(1)	(1)	(1)	(1)	(1)
Washington	4	------	------	------	------	------	------	(1)	(1)	(1)	(1)	2,850	26,946	------	------	------	------	940	28,368
Wisconsin	14	(1)	(1)	25,600	18,092	4,000	38,974	(1)	(1)	15,920	16,881	42,180	541,485	(1)	(1)	(1)	(1)	14,730	645,651
Undistributed	------	24,420	46,539	74,610	57,044	56,090	291,342	51,710	72,829	154,910	227,424	23,820	139,460	1,115,830	66,917	35,320	19,773	11,380	39,682
	238	204,490	410,395	273,140	253,537	591,990	2,411,668	197,050	226,675	1,849,580	3,673,201	310,900	1,991,342	2,797,560	246,084	725,590	624,651	733,610	9,837,553
Short tons (approximate)	------	(2)	------	21,560	------	48,820	------	------	------	150,800	------	25,600	------	25,580	------	59,710	------	------	------

[1] Included under "Undistributed."

[2] 2,241,800 cubic feet (approximate).

The following tables show sales of monumental granite in the Quincy (Mass.) and Barre (Vt.) centers.

Monumental granite sold by the quarrymen at Quincy, Mass., 1935–39 [1]

Year	Active plants	Cubic feet	Value	Year	Active plants	Cubic feet	Value
1935	3	63,450	$95,529	1938	3	33,360	$73,832
1936	3	46,570	85,013	1939	3	25,620	61,955
1937	3	36,020	80,248				

Quincy granite is sold also for construction, curbing, rubble, riprap, and crushed stone.

Monumental granite sold by the quarrymen in the Barre district, Vermont, 1935–39 [1]

Year	Cubic feet	Value	Year	Cubic feet	Value
1935	676,820	$1,844,006	1938	605,660	$1,849,607
1936	771,230	2,109,526	1939	684,310	2,029,801
1937	847,740	2,390,377			

[1] Barre granite is sold also for construction, paving blocks, and crushed stone.

Estimated output of monumental granite in the Barre district, Vermont, 1937–39

	1937	1938	1939
Total quarry output, rough stock.....cubic feet..	765,390	589,440	614,256
Shipped out of Barre district in rough.....do....	153,078	117,888	122,852
Manufactured in Barre district.....do....	612,312	471,552	491,404
Light stock consumed in district.....do....	478,369	294,720	307,128
Dark stock consumed in district.....do....	287,021	176,832	184,276
Number of cutters in district	1,550	1,550	1,550
Average daily wage	$8.00	$8.00	$8.50
Average number of days worked	230	220	220
Total pay roll for year	$2,852,000	$2,813,250	$2,898,500
Estimated overhead	1,426,000	1,406,625	1,449,250
Estimated value of light stock	1,554,699	1,176,987	1,247,714
Estimated value of dark stock	1,234,191	934,347	990,494
Estimated polishing cost	484,263	372,938	388,639
Output from saws	161,421	124,312	129,546
Total value of granite	7,712,574	6,828,459	7,104,143

[1] Through the kindness of the Granite Manufacturers' Association, Barre, figures covering the entire granite industry of the Barre district are given in this table to supplement figures of sales reported by quarrymen.

BASALT AND RELATED ROCKS (TRAP ROCK)

Because of its dark color, basalt is not used extensively for building. However, its use as rubble increased substantially in 1939. Some of these dark rocks are used for memorials, but such stones are classed commercially as black granites, therefore they are included with the figures for monumental granite.

Basalt and related rocks (trap rock) (dimension stone) sold or used by producers in the United States in 1939, by States and uses

State	Active plants	Building stone: Rough construction, Short tons	Building stone: Rough construction, Value	Building stone: Rubble, Short tons	Building stone: Rubble, Value	Total: Short tons	Total: Value
California	1			(1)	(1)	(1)	(1)
Connecticut	2	(1)	(1)			(1)	(1)
Hawaii	3			(1)	(1)	(1)	(1)
Idaho	1			(1)	(1)	(1)	(1)
Maryland	2	(1)	(1)	(1)	(1)	(1)	(1)
New Jersey	3	(1)	(1)	(1)	(1)	18,190	$9,926
Oregon	2	1,990	$6,385			1,990	6,385
Pennsylvania	1	(1)	(1)			(1)	(1)
Washington	2			(1)	(1)	(1)	(1)
Undistributed		8,970	8,234	90,360	$38,405	81,140	36,713
	17	[2] 10,960	14,619	90,360	38,405	101,320	53,024

[1] Included under "Undistributed." [2] 127,910 cubic feet, approximate.

MARBLE

Sales of marble in 1939 increased 39 percent in quantity and 27 percent in value over 1938. The greatest advances were in rough and finished exterior building marble. Much larger quantities of rough monumental stone were sold, but sales of finished memorial stone declined. The principal gains in value of sales were in Tennessee, Georgia, Missouri, Vermont, and Massachusetts.

Marble (dimension stone) sold by producers in the United States, 1938–39, by uses

Use	1938: Cubic feet	1938: Value	1939: Cubic feet	1939: Value
Building stone:				
Rough:				
Exterior	13,880	$24,424	179,520	$358,053
Interior	145,650	351,976	[1] 133,750	[1] 306,945
Finished:				
Exterior	258,030	1,183,841	412,130	1,945,441
Interior	269,730	1,704,636	321,430	2,093,608
Total exterior	271,910	1,208,265	591,650	2,303,494
Total interior	415,380	2,056,612	455,180	2,400,553
Total building stone	687,290	3,264,877	1,046,830	4,704,047
Monumental stone:				
Rough	69,850	85,181	192,110	241,828
Finished	288,540	1,623,007	219,250	1,359,204
Total monumental stone	358,390	1,708,188	411,360	1,601,032
Total building and monumental	1,045,680	4,973,065	1,458,190	6,305,079
Approximate short tons	89,000		123,740	

[1] Includes onyx for the manufacture of mantels, lamp bases, desk sets, clock cases, and novelties.

Marble (dimension stone) sold by producers in the United States in 1939, by States and uses

State	Active plants	Building[1]		Monumental		Total		
						Quantity		
		Cubic feet	Value	Cubic feet	Value	Cubic feet	Short tons (approximate)	Value
Alabama	3	37,320	$233,728	18,350	$133,979	55,670	4,770	$367,707
Arizona[2]	1	2,710	8,537			2,710	220	8,537
Arkansas	4	21,890	27,310	(3)	(3)	(3)	(3)	(3)
California	1	(3)	(3)			(3)	(3)	(3)
Colorado	1	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Georgia	1	165,540	677,747	264,830	787,213	430,370	36,590	1,464,960
Maryland	1	960	8,675	710	5,546	1,670	150	14,221
Massachusetts	2	11,550	24,478	6,220	50,565	17,770	1,510	75,043
Minnesota	1	4,600	22,500			4,600	340	22,500
Missouri	4	206,020	524,867	8,410	18,603	214,430	17,910	543,470
New York	2	(3)	(3)	(3)	(3)	(3)	(3)	(3)
North Carolina	1	1,010	7,250	6,100	49,238	7,110	610	56,488
Tennessee	8	436,770	2,518,861	3,300	17,763	440,070	37,460	2,536,624
Utah[2]	1	1,660	3,355			1,660	130	3,355
Vermont	6	131,010	530,215	97,540	508,136	228,550	19,480	1,038,351
Virginia	1	(3)	(3)			(3)	(3)	(3)
Undistributed		25,790	116,524	5,900	29,989	53,580	4,570	173,823
	38	1,046,830	4,704,047	411,360	1,601,032	1,458,190	123,740	6,305,079
Short tons (approximate)		88,740		35,000				

[1] Includes 10,540 cubic feet of serpentine marble (verde antique) valued at $119,797, which was sold as building and ornamental stone.
[2] Onyx rough blocks for the manufacture of mantels, lamp bases, desk sets, clock cases, and novelties.
[3] Included under "Undistributed."

LIMESTONE

Limestone is used more extensively than any other type of building stone in the United States, and Indiana supplied 77 percent of the total architectural limestone (rough and finished) sold in 1939. All branches of the limestone industry showed decisive gains in 1939 compared with 1938. Sales of rough architectural stone increased 37 percent and sales of cut stone 33 percent. The average price per cubic foot of cut and sawed stone was $1.30, which was 2 cents lower than in 1938. The total of all products sold in 1939 was 51 percent greater in quantity and 35 percent greater in value than in 1938.

Limestone (dimension stone) sold or used by producers in the United States in 1939, by States and uses

State	Active plants	Building: Rough: Construction: Short tons	Building: Rough: Construction: Value	Building: Rough: Architectural: Cubic feet	Building: Rough: Architectural: Value	Building: Finished (cut and sawed): Cubic feet	Building: Finished (cut and sawed): Value	Building: Rubble: Short tons	Building: Rubble: Value	Flagging: Cubic feet	Flagging: Value	Total: Short tons (approximate)	Total: Value
Alabama	2			(1)	(1)	(1)	(1)					(1)	(1)
California	8	1,720	$4,844					1,090	$876	5,000	$2,997	3,210	$8,717
Colorado	1			2,420	$4,832							190	4,832
Florida	4	(1)	(1)			(1)	(1)	(1)	(1)	(1)	(1)	7,200	114,873
Georgia	1	(1)	(1)									(1)	(1)
Illinois	10	164,400	191,979					2,080	2,884	21,650	12,234	170,520	207,097
Indiana	23	49,400	25,833	2,462,860	845,252	2,812,350	$3,255,209	(1)	(1)	(1)	(1)	432,040	4,127,310
Iowa	5	(1)	(1)					2,510	3,081	(1)	(1)	3,320	4,794
Kansas	11	(1)	(1)	32,310	7,802	(1)	(1)	46,330	56,144	(1)	(1)	76,190	146,563
Kentucky	9	4,160	3,601	(1)	(1)	(1)	(1)	6,540	2,808	(1)	(1)	11,010	10,108
Maryland	3	(1)	(1)	(1)	(1)			(1)	(1)	(1)	(1)	2,970	13,083
Michigan	2	(1)	(1)					(1)	(1)			(1)	(1)
Minnesota	7	6,030	17,143	(1)	(1)	46,100	130,000	2,980	4,313	(1)	(1)	19,570	201,451
Missouri	17	2,290	3,387			(1)	(1)	44,650	60,599	(1)	(1)	49,090	80,247
Montana	1			(1)	(1)							(1)	(1)
Nebraska	2	(1)	(1)									(1)	(1)
New York	8	7,530	8,169					1,780	1,579			9,310	9,748
Ohio	17	15,800	20,215					320	212	3,770	3,415	17,630	23,842
Oklahoma	1							(1)	(1)			(1)	(1)
Pennsylvania	12	5,640	7,702					4,750	4,012	4,100	653	10,730	12,367
Puerto Rico	1	(1)	(1)									(1)	(1)
South Dakota	1									(1)	(1)	(1)	(1)
Tennessee	2	(1)	(1)					(1)	(1)			(1)	(1)
Texas	4	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)	71,460	823,894
Vermont	1							(1)	(1)			(1)	(1)
Virginia	1	1,280	641									1,280	641
Wisconsin	17	16,520	54,458	225,000	164,701	72,330	85,589	9,230	18,557	74,750	19,205	55,520	342,510
Undistributed		45,870	86,258	644,960	403,433	559,050	1,081,632	98,800	34,532	59,210	47,061	119,430	545,765
	171	320,640	424,230	3,367,550	1,426,020	3,489,830	4,552,430	221,060	189,597	168,480	85,565	1,060,670	6,677,842
Short tons (approximate)		(2)		247,420		254,610				16,940			

[1] Included under "Undistributed."

[2] 3,872,640 cubic feet, approximate.

The following tables show detailed figures, by uses, for limestone produced near Bedford and Bloomington, Ind.; Carthage, Mo.; and Mankato and Kasota, Minn.

Limestone sold by producers in the Indiana oolitic-limestone district, 1935–39, by classes

Year	Construction					
	Rough block		Sawed and semifinished		Cut	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
1935	1, 585, 150	$423, 741	591, 850	$359, 942	587, 870	$963, 562
1936	2, 346, 380	698, 231	1, 028, 740	577, 368	1, 456, 190	1, 861, 947
1937	2, 152, 560	727, 425	957, 240	633, 350	1, 332, 330	2, 168, 229
1938	2, 090, 110	619, 602	914, 180	561, 767	1, 147, 620	2, 044, 216
1939	2, 462, 860	845, 252	1, 277, 730	784, 247	1, 534, 530	2, 470, 724

Year	Construction—Continued			Other uses		Total	
	Total						
	Cubic feet	Short tons (approximate)	Value	Short tons	Value	Short tons (approximate)	Value
1935	2, 764, 870	207, 000	$1, 747, 245	160, 000	$107, 000	367, 000	$1, 854, 245
1936	4, 831, 310	350, 270	3, 137, 546	178, 150	132, 898	528, 420	3, 270, 444
1937	4, 442, 130	322, 050	3, 529, 004	139, 250	68, 253	461, 300	3, 597, 257
1938	4, 151, 910	310, 000	3, 225, 585	41, 610	26, 595	351, 610	3, 252, 180
1939	5, 275, 120	383, 000	4, 100, 223	247, 680	117, 200	630, 680	4, 217, 423

Indiana limestone sold by mills in the district not operated by quarry companies and by mills of quarry companies from stock obtained at quarries other than their own, 1935–39, by classes

Year	Sawed and semifinished		Cut		Total	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
1935	59, 950	$23, 209	536, 680	$832, 412	596, 630	$855, 621
1936	461, 560	328, 015	1, 392, 150	1, 956, 641	1, 853, 710	2, 284, 656
1937	168, 340	93, 815	1, 142, 249	1, 931, 488	1, 310, 589	2, 025, 303
1938	110, 670	69, 896	1, 136, 410	1, 703, 254	1, 247, 080	1, 773, 150
1939:						
Mills not operated by quarry companies	38, 550	15, 221	994, 230	1, 613, 772	1, 032, 780	1, 628, 993
Mills of quarry companies from stock obtained at quarries other than their own	69, 810	35, 117	845, 290	1, 352, 758	915, 100	1, 387, 875
	108, 360	50, 338	1, 839, 520	2, 966, 530	1, 947, 880	3, 016, 868

Limestone and marble sold by producers in the Carthage district, Jasper County, Mo. 1935–39, 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
1935	71,930	$142,507	2,620	$9,246	74,550	6,220	$151,753	46,470	$66,211	52,690	$217,964
1936	116,970	296,653	5,500	10,998	122,470	10,220	307,651	69,370	109,028	79,590	416,679
1937	128,570	338,040	7,530	14,912	136,100	11,380	352,952	95,840	128,617	107,220	481,569
1938	113,940	300,936	8,450	18,831	122,390	10,220	319,767	65,560	118,349	75,780	438,116
1939	180,040	448,966	8,400	18,603	188,440	15,730	467,569	60,580	94,215	76,310	561,784

Limestone and marble sold by producers at Mankato and Kasota, Minn., 1935–39

Year	Building stone (rough and dressed)		Other uses		Total	
	Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
1935	83,020	$111,396	35,320	$21,530	41,410	$132,926
1936	157,130	332,699	51,090	54,163	68,570	386,862
1937	143,580	251,164	36,860	40,106	47,750	291,270
1938	123,780	199,997	(1)	(1)	[2] 9,990	[2] 199,997
1939	122,030	175,772	14,720	15,830	24,480	191,602

[1] Bureau of Mines not at liberty to publish figures. [2] Exclusive of "Other uses."

SANDSTONE

Sales of sandstone increased 18 percent in quantity and 33 percent in value in 1939 over 1938. Rubble and stone for rough construction showed little change, but sales of rough architectural stone increased more than fourfold. Dressed stone (sawed and cut) declined 11 percent in quantity but increased 52 percent in value. Sandstone paving stones have receded to such insignificance that a column for them is no longer carried in the table. Sales of sandstone flagging increased considerably in quantity, but the unit value was much lower than in 1938.

Sales of bluestone shown in the second table have declined greatly, particularly in Pennsylvania.

Sandstone (dimension stone) sold or used by producers in the United States in 1939, by States and uses

State	Number of plants	Building										Curbing		Flagging		Total	
		Rough				Dressed				Rubble							
		Construction		Architectural		Sawed		Cut									
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons (approximate)	Value
Arizona	1	(1)	(1)							(1)	(1)			(1)	(1)	(1)	(1)
California	7	1,540	$5,596							1,460	$1,821			23,940	$10,375	4,970	$17,792
Colorado	3	(1)	(1)							(1)	(1)			(1)	(1)	2,750	14,108
Connecticut	2	(1)	(1)	(1)	(1)											(1)	(1)
Idaho	1									(1)	(1)					(1)	(1)
Indiana	1	(1)	(1)											(1)	(1)	(1)	(1)
Kansas	1									(1)	(1)			(1)	(1)	(1)	(1)
Maryland	6	29,480	30,485											45,750	16,034	33,140	46,519
Massachusetts	1			(1)	(1)	(1)	(1)	(1)	(1)					(1)	(1)	(1)	(1)
Minnesota	1	(1)	(1)													(1)	(1)
New Jersey	1	(1)	(1)													(1)	(1)
New York	22	3,510	13,480	4,120	$4,210	(1)	(1)	(1)	(1)	1,480	2,580	[2] 183,150	[2] $192,486	41,490	23,040	25,350	292,564
North Carolina	2	(1)	(1)											(1)	(1)	(1)	(1)
Ohio	8	7,060	76,635	258,960	324,960	109,650	$120,327	64,430	$182,606	470	1,810	242,300	239,822	302,000	112,805	78,390	1,058,965
Pennsylvania	22	11,200	20,693							5,090	5,141	24,220	23,902	85,780	88,470	25,360	138,206
Tennessee	3	(1)	(1)							(1)	(1)			31,720	51,748	5,410	70,630
Virginia	8	2,770	3,608											28,240	5,675	4,970	9,283
Washington	2	2,750	5,500					36,440	187,374					4,500	5,082	6,080	197,956
Wisconsin	1	620	2,500	7,030	7,032											1,180	9,532
Wyoming	1			(1)	(1)											(1)	(1)
Undistributed		6,680	32,443	21,000	24,370	11,350	33,005	17,980	82,173	1,880	3,893			29,760	14,514	7,960	100,640
	94	65,610	190,940	291,110	360,572	121,000	153,332	118,850	452,153	10,380	15,245	449,670	456,210	593,180	327,743	195,560	1,956,195
Short otns (approximate)		(3)		21,340		8,910		9,110				34,580		45,630			

[1] Included under "Undistributed."

[2] Includes a small quantity of paving blocks.

[3] 836,130 cubic feet, approximate.

Bluestone (dimension stone) sold or used by producers in the United States (all from New York and Pennsylvania) in 1939, by uses [1]

State	Building		Curbing		Flagging		Total		
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Short tons (approximate)	Value
New York	20,850	$60,059	119,020	$148,121	39,570	$20,365	179,440	15,170	$228,545
Pennsylvania	(2)	(2)	[2] 9,220	[2] 8,902	65,780	81,958	75,000	6,340	90,860
	20,850	60,059	128,240	157,023	105,350	102,323	254,440	21,510	319,405

[1] Included in figures for sandstone.
[2] A small amount of rough blocks included under curbing.

MISCELLANEOUS STONE

The following table gives data on certain types of dimension stone not included in the major groups already discussed. The principal varieties are mica schist, argillite, various light-color volcanic rocks, soapstone, and greenstone.

Miscellaneous varieties of stone (dimension stone) sold or used by producers in the United States in 1939, by States and uses

State	Active plants	Building				Flagging		Total	
		Rough and dressed		Rubble					
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Arizona	1	(1)	(1)					(1)	(1)
California	6	1,300	$4,226	(1)	(1)	(1)	(1)	1,920	$5,023
Florida	1			(1)	(1)			(1)	(1)
Georgia	3	300	500			1,280	$6,625	1,580	7,125
Maryland	5	4,880	13,658	3,250	$5,154	350	1,746	8,480	20,558
New Jersey	2	(1)	(1)	(1)	(1)			(1)	(1)
New York	1	(1)	(1)					(1)	(1)
Ohio	1	(1)	(1)					(1)	(1)
Pennsylvania	9	35,060	45,130					35,060	45,130
Puerto Rico	1	(1)	(1)					(1)	(1)
Virginia	2	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Washington	1			(1)	(1)			(1)	(1)
Undistributed		9,260	590,828	27,140	50,097	640	5,369	36,420	645,497
	33	[2] 50,800	654,342	30,390	55,251	[2] 2,270	13,740	83,460	723,333

[1] Included under "Undistributed."
[2] Building stone, approximately 601,880 cubic feet; flagging, approximately 27,750 cubic feet.

TRENDS IN THE USE OF BUILDING AND MEMORIAL STONE

Despite the moderate decline during 1939 in nonresidential building, where stone finds its chief market, all branches of the building-stone industry made encouraging gains, as indicated in figures 1 and 2. Sales of building marble made the most substantial gain, attaining the highest value since 1933. The value of sandstone sales in 1939 was higher than in any year since 1931, and sales of limestone reached the same value as in 1933. Granite recovered its loss of 1938, the value of sales in 1939 being about the same as in 1937. This substantial upward trend in the use of natural stone indicates wider recognition of its endurance, dignity, substantiality, fire resistance, and low

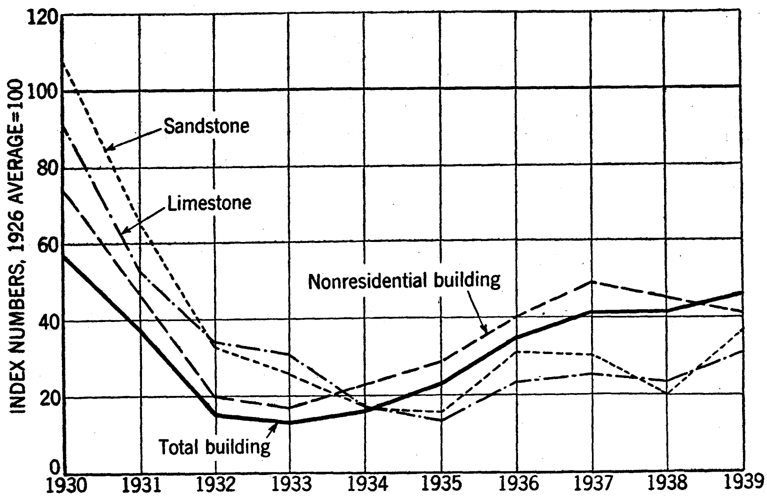

FIGURE 1.—Sales value of limestone and sandstone compared with total building and nonresidential building, 1930–39. To facilitate comparison, unlike units have been reduced to percentages of the 1926 value. Stone figures include rough and dressed stone; building contracts are from F. W. Dodge Corporation.

maintenance expense. Further gains are to be expected if nonresidential building experiences an upward trend.

Sales of memorial granite in 1939 were slightly higher both in quantity and value than in 1938. Sales of memorial marble increased in quantity but declined in value.

NEW DEVELOPMENTS

Prof. George W. Bain, of Amherst College, Amherst, Mass., has developed a new technique for determining the lasting qualities of marbles, for assisting fabricators in obtaining maximum translucence and weather resistance and for studying the effects of fabricating methods on marble endurance and appearance. These studies are based upon knowledge of crystallographic orientation of marble grains, size of intergranular spaces, index of irregularity, and other physical phenomena. They illustrate how a skilled geologist, chemist, and physicist may help in the solution of problems relating to utilization and fabrication, not only of marble but of many industrial minerals.

The Shawnee Stone Co., a producer of building limestone near Bloomington, Ind., is employing wire saws successfully in its quarries. Several other companies in the district are considering the use of this equipment.

The Georgia Marble Co. has changed from open-pit to underground operation at one of its quarries. The floor of the new drift will

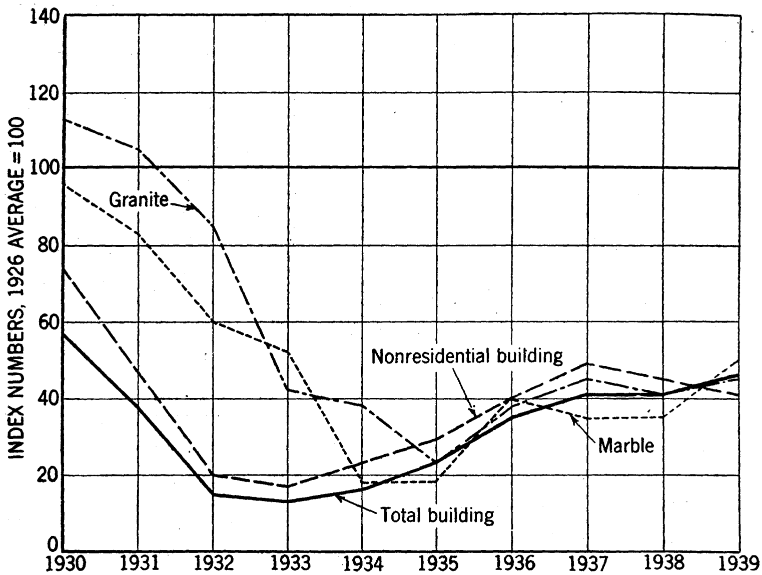

FIGURE 2.—Sales value of building marble and granite compared with total building and nonresidential building, 1930–39. To facilitate comparison, unlike units have been reduced to percentages of the 1926 value. Stone figures include rough and dressed stone; building contracts are from F. W. Dodge Corporation.

parallel the color banding, thus improving the pattern of the finished product and conserving stone. Markets for building marble in the South have improved, but demands for monuments have declined.

CRUSHED AND BROKEN STONE

More than 145,000,000 tons of crushed and broken stone were sold in 1939, exclusive of that used for making cement and lime. Sales increased 18 percent in quantity and 13 percent in value in 1939 compared with 1938. The largest proportional gains were in metallurgical and refractory stone.

The following table of salient statistics shows the quantity and value of crushed and broken stone sold during 1938 and 1939, by uses. Detailed data on asphaltic stone and slate granules and flour are given in the chapters of this volume on Asphalt and Slate.

Crushed and broken stone sold or used by producers in the United States, 1938–39, by principal uses

Use	1938			1939		
	Short tons	Value: Total	Value: Average	Short tons	Value: Total	Value: Average
Concrete and road metal	88,787,080	$84,212,446	$0.95	96,894,220	$88,988,217	$0.92
Railroad ballast	5,975,970	4,554,775	.76	6,996,800	4,970,058	.71
Metallurgical	9,702,860	6,943,429	.72	17,287,790	12,632,243	.73
Alkali works	3,634,050	1,743,173	.48	4,655,960	2,100,535	.45
Riprap	6,210,520	6,995,418	1.13	5,811,740	5,851,732	1.01
Agricultural	4,367,410	5,637,485	1.29	5,459,260	6,592,827	1.21
Refractory (ganister, mica schist, dolomite, soapstone)	659,690	991,765	1.50	1,492,310	2,044,054	1.37
Asphalt filler	288,590	789,587	2.74	265,710	676,978	2.55
Calcium carbide works	246,010	137,522	.56	274,890	233,085	.85
Sugar factories	619,910	878,028	1.42	621,730	853,235	1.37
Glass factories	170,560	290,297	1.70	240,840	394,727	1.64
Paper mills	223,450	373,207	1.67	302,620	488,079	1.61
Other uses	2,186,720	3,929,752	1.80	4,844,900	7,082,719	1.46
	123,072,820	117,476,884	.95	145,148,770	132,908,489	.92
Portland cement (including "cement rock")[1] Natural cement ("cement rock")[1]	[2] 26,193,000	(3)		30,463,000	(3)	
Lime[4]	6,694,000	(3)		8,509,000	(3)	
Total stone	[2] 155,960,000	(3)		184,121,000	(3)	
Asphaltic stone	[2] 449,091	[2] 2,219,159	4.94	422,484	2,007,810	4.75
Slate granules and flour	349,000	2,489,962	7.14	351,780	2,581,089	7.34

[1] Value reported as cement in chapter on Cement.
[2] Revised figures.
[3] No value available for stone used in manufacture of cement and lime.
[4] Value reported as lime in chapter on Lime.

The following tables show the tonnage and value of stone used for concrete aggregate, road construction, and railroad ballast for a series of years and by States for 1939.

Concrete and road metal and railroad ballast sold or used by producers in the United States, 1935–39

Year	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1935	49,487,510	$44,888,513	5,267,010	$4,011,469	54,754,520	$48,899,982
1936	79,336,740	76,095,094	7,934,080	6,022,693	87,270,820	82,117,787
1937	80,271,900	76,972,465	8,160,670	5,852,143	88,432,570	82,824,608
1938	88,787,080	84,212,446	5,975,970	4,554,775	94,763,050	88,767,221
1939	96,894,220	88,988,217	6,996,800	4,970,058	103,891,020	93,958,275

Concrete and road metal and railroad ballast sold or used by producers in the United States in 1939, by States

State	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	477,270	$389,198	—	—	477,270	$389,198
Alaska	([1])	([1])	—	—	([1])	([1])
Arizona	589,780	563,836	1,160	$577	590,940	564,413
Arkansas	[2] 229,990	[2] 239,371	[2] 6,690	[2] 4,486	572,460	505,191
California	4,295,210	2,785,444	[2] 237,280	[2] 113,149	[2] 4,532,490	[2] 2,898,593
Colorado	523,050	595,728	([1])	([1])	[2] 523,050	[2] 595,728
Connecticut	[2] 1,508,740	[2] 1,524,691	150,180	126,755	[2] 1,658,920	[2] 1,651,446
Delaware	([1])	([1])	—	—	([1])	([1])
Florida	1,186,410	1,087,955	([1])	([1])	[2] 1,186,410	[2] 1,087,955
Georgia	[2] 1,514,970	[2] 1,734,511	128,560	64,600	[2] 1,643,530	[2] 1,799,111
Hawaii	362,360	566,952	([1])	([1])	[2] 362,360	[2] 566,952
Idaho	1,582,850	1,109,691	—	—	1,582,850	1,109,691
Illinois	6,215,150	5,728,042	239,220	161,044	6,454,370	5,889,086
Indiana	3,087,540	2,732,149	81,350	61,827	3,168,890	2,793,976
Iowa	5,847,660	3,899,875	79,860	46,010	5,927,520	3,945,885
Kansas	[2] 2,913,280	[2] 3,969,512	122,410	63,537	[2] 3,035,690	[2] 4,033,049
Kentucky	[2] 3,488,020	[2] 3,434,494	522,330	258,654	[2] 4,010,350	[2] 3,693,148
Louisiana	97,410	49,048	—	—	97,410	49,048
Maine	62,070	79,880	—	—	62,070	79,880
Maryland	[2] 720,600	[2] 817,795	61,460	61,465	[2] 782,060	[2] 879,260
Massachusetts	[2] 1,808,200	[2] 2,121,356	157,380	138,152	[2] 1,965,580	[2] 2,259,508
Michigan	[2] 1,988,710	[2] 917,588	97,760	63,837	[2] 2,086,470	[2] 981,425
Minnesota	1,216,470	1,292,146	—	—	1,216,470	1,292,146
Missouri	[2] 3,031,100	[2] 3,079,376	11,870	13,069	[2] 3,042,970	[2] 3,092,445
Montana	482,230	307,615	—	—	482,230	307,615
Nebraska	[2] 262,250	[2] 339,124	—	—	[2] 262,250	[2] 339,124
Nevada	50,260	58,102	([1])	([1])	[2] 50,260	[2] 58,102
New Hampshire	[2] 21,250	[2] 27,903	—	—	[2] 21,250	[2] 27,903
New Jersey	2,384,250	2,376,189	[2] 96,560	[2] 86,503	[2] 2,480,810	[2] 2,462,692
New Mexico	[2] 174,020	[2] 112,181	([1])	([1])	290,880	171,771
New York	[2] 7,008,130	[2] 6,498,603	611,670	426,094	[2] 7,619,800	[2] 6,924,697
North Carolina	5,456,570	6,029,262	493,790	394,639	5,950,360	6,423,901
North Dakota	3,880	8,239	—	—	3,880	8,239
Ohio	6,412,890	5,347,487	690,130	504,223	7,103,020	5,851,710
Oklahoma	[2] 1,581,410	[2] 1,417,943	210,270	112,840	[2] 1,791,680	[2] 1,530,783
Oregon	2,128,090	1,582,558	—	—	2,128,090	1,582,558
Pennsylvania	5,635,340	5,728,289	671,690	604,709	6,307,030	6,332,998
Puerto Rico	846,990	529,901	([1])	([1])	[2] 846,990	[2] 529,901
Rhode Island	304,020	364,741	—	—	304,020	364,741
South Carolina	940,670	1,155,539	342,880	300,917	1,283,550	1,456,456
South Dakota	251,240	321,595	—	—	251,240	321,595
Tennessee	[2] 4,477,480	[2] 4,607,107	438,400	319,680	[2] 4,915,880	[2] 4,926,787
Texas	3,161,570	1,952,409	216,680	128,881	3,378,250	2,081,290
Utah	584,530	303,661	—	—	584,530	303,661
Vermont	[2] 79,380	[2] 107,243	—	—	[2] 79,380	[2] 107,243
Virginia	3,789,560	3,348,901	[2] 413,490	[2] 315,307	[2] 4,203,050	[2] 3,664,208
Washington	[2] 1,567,540	[2] 1,118,048	160	174	[2] 1,567,700	[2] 1,118,222
West Virginia	1,968,960	2,987,829	281,600	202,003	2,250,560	3,189,832
Wisconsin	2,492,830	1,711,615	20,440	16,353	2,513,270	1,727,968
Wyoming	273,470	191,549	([1])	([1])	[2] 273,470	[2] 191,549
Undistributed	1,808,570	1,735,946	611,530	380,573	1,967,460	1,795,595
	96,894,220	88,988,217	6,996,800	4,970,058	103,891,020	93,958,275

[1] Included under "Undistributed."
[2] To avoid disclosing confidential information certain totals are somewhat incomplete, the figures not included being combined under "Undistributed."

Commercial and noncommercial operations.—The following table shows production of crushed stone for concrete and road metal and railroad ballast during recent years by Government agencies of various kinds contrasted with that by commercial enterprises. Production by Government agencies increased 29 percent in 1939 compared with 1938, whereas commercial production decreased 1 percent.

Concrete and road metal and railroad ballast sold or used by commercial and noncommercial operators in the United States, 1935–39

[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
1935	38,090,660	$0.90	−11.9	69.6	16,663,860	$0.87	−3.7	30.4	54,754,520	−9.6
1936	57,494,430	.93	+50.9	65.9	29,776,390	.95	+78.7	34.1	87,270,820	+59.4
1937	62,315,350	.88	+8.4	70.5	26,117,220	1.06	−12.3	29.5	88,432,570	+1.3
1938	60,254,170	.88	−3.3	63.6	34,508,880	1.04	+32.1	36.4	94,763,050	+7.2
1939	59,516,270	.86	−1.2	57.3	44,374,750	.97	+28.6	42.7	103,891,020	+9.6

Methods of transportation.—The following table shows the quantities of concrete and road metal conveyed by each of the principal methods of transportation during 1938 and 1939.

Concrete and road metal sold or used by commercial producers in the United States, 1938–39, by methods of transportation [1]

Method of transportation	1938		1939	
	Short tons	Percent of total	Short tons	Percent of total
Truck	32,779,040	60.4	33,495,870	63.8
Rail	12,032,490	22.2	11,712,330	22.3
Waterway	5,398,770	9.9	4,886,820	9.3
Unspecified	4,067,900	7.5	2,424,450	4.6
	54,278,200	100.0	52,519,470	100.0

[1] For practical purposes the entire output of noncommercial operations commonly is moved by truck. Including noncommercial production, crushed stone for concrete and road metal moved as follows: 1938: Truck 76 percent, rail 13 percent, waterway 6 percent, and unspecified 5 percent; 1939: Truck 80 percent, rail 12 percent, waterway 5 percent, and unspecified 3 percent.

GRANITE

Sales of crushed and broken granite rose 16 percent in quantity and 14 percent in value in 1939 compared with 1938. The principal gain was in stone used for concrete aggregate and highway construction. Sales of both riprap and railroad ballast declined, reversing the trend of 1938.

Noncommercial production, which is a substantial part of the total, is reported by city, county, and State governments, highway commissions, or other Government agencies. From the reports submitted it is impossible to determine the number of plants that supply materials. For instance, the report of a Federal agency such as the W. P. A. may include the output of one or two large plants or 25 to 50 small portable plants. Because the number of individual operations supplying noncommercial crushed stone cannot be determined with any degree of accuracy, the columns indicating the number of active plants, which have appeared in past years in the granite and other tables covering the crushed-stone industry, have been omitted in this report.

Granite (crushed and broken stone) sold or used by producers in the United States in 1939, by States and uses

State	Riprap		Crushed stone: Concrete and road metal		Crushed stone: Railroad ballast		Other uses		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			(1)	(1)					(1)	(1)
Arizona			145,520	$134,543					145,520	$134,543
California	107,600	$75,029	469,300	399,549	73,820	$38,198	9,820	$2,800	660,540	515,576
Colorado	3,900	3,000	100,350	67,220					104,250	70,220
Connecticut	(1)	(1)					(1)	(1)	(1)	(1)
Delaware	(1)	(1)	(1)	(1)					(1)	(1)
Georgia	67,350	90,205	1,253,010	1,487,679	128,560	64,600	27,990	69,598	1,476,910	1,712,082
Idaho			58,780	28,770					58,780	28,770
Maine	4,940	7,361	41,610	53,276					46,550	60,637
Maryland	(1)	(1)	48,510	65,263	(1)	(1)	(1)	(1)	95,810	122,776
Massachusetts	(1)	(1)	384,780	638,483			(1)	(1)	390,440	641,561
Minnesota	5,190	2,715	30,960	35,161			5,980	15,570	42,130	53,446
Missouri	1,200	851							1,200	851
Montana	582,850	1,230,066	14,850	9,900					597,700	1,239,966
New Hampshire	(1)	(1)	21,250	27,903			(1)	(1)	74,930	33,681
New Jersey			(1)	(1)	(1)	(1)			(1)	(1)
New York	102,410	79,792	694,810	558,907	15,320	12,259	3,760	5,106	816,300	656,064
North Carolina	6,590	6,464	3,568,410	4,070,434	493,790	394,639	17,900	11,028	4,086,690	4,482,565
Oklahoma			9,890	7,435					9,890	7,435
Pennsylvania			204,590	247,327			6,280	10,333	210,870	257,660
Rhode Island	(1)	(1)	(1)	(1)					(1)	(1)
South Carolina	4,230	4,843	788,960	964,468	342,880	300,917	11,230	4,493	1,147,300	1,274,721
South Dakota	(1)	(1)	63,340	64,921			(1)	(1)	107,610	99,770
Tennessee			72,730	89,318					72,730	89,318
Texas	(1)	(1)							(1)	(1)
Utah			(1)	(1)					(1)	(1)
Vermont			6,500	10,600					6,500	10,600
Virginia			537,950	507,777	(1)	(1)	(1)	(1)	724,540	610,456
Washington	(1)	(1)	31,560	24,966			(1)	(1)	49,090	88,347
Wisconsin	(1)	(1)	2,490	3,515			(1)	(1)	64,520	84,156
Wyoming			(1)	(1)			(1)	(1)	(1)	(1)
Undistributed	197,850	227,147	262,800	313,820	150,550	109,388	122,810	80,793	316,950	383,229
	1,084,110	1,727,473	8,812,950	9,811,235	1,204,920	920,001	205,770	199,721	11,307,750	12,658,430

[1] Included under "Undistributed."

BASALT AND RELATED ROCKS (TRAP ROCK)

Basalt, gabbro, diorite, and other dark igneous rocks, known commercially as trap rock, are used widely for highway construction and concrete aggregate. Sales of crushed and broken trap rock increased 15 percent in both tonnage and value in 1939 compared with 1938, with gains for all major uses. Sales of riprap in the major producing States fluctuate greatly, as they depend chiefly on special reclamation and other projects. Prices per ton at the quarry were virtually the same in 1939 as in 1938.

Basalt and related rocks (trap rock) (crushed and broken stone) sold or used by producers in the United States in 1939, by States and uses

State	Riprap		Crushed stone				Other uses		Total	
			Concrete and road metal		Railroad ballast					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Arizona	--------	--------	(1)	(1)	--------	--------	--------	--------	(1)	(1)
California	163,420	$191,063	388,560	$343,963	4,510	$3,812	2,700	$1,500	559,190	$540,338
Colorado	(1)	(1)	(1)	(1)	--------	--------	--------	--------	(1)	(1)
Connecticut	55,910	44,335	1,508,740	1,524,691	150,180	126,755	--------	--------	1,714,830	1,695,781
Hawaii	(1)	(1)	362,360	566,952	(1)	(1)	(1)	(1)	371,020	570,856
Idaho	211,760	85,780	1,458,290	1,041,764	--------	--------	--------	--------	1,670,050	1,127,544
Maine	(1)	(1)	14,320	15,290	--------	--------	(1)	(1)	14,470	15,467
Maryland	(1)	(1)	167,920	209,859	(1)	(1)	--------	--------	226,130	268,882
Massachusetts	233,060	165,064	1,196,890	1,134,846	157,380	138,152	5,380	1,882	1,592,710	1,439,944
Michigan	--------	--------	109,530	113,511	--------	--------	--------	--------	109,530	113,511
Minnesota	(1)	(1)	(1)	(1)	--------	--------	(1)	(1)	(1)	(1)
Montana	(1)	(1)	(1)	(1)	--------	--------	--------	--------	273,200	212,169
New Jersey	165,930	174,966	2,196,100	2,169,909	96,560	86,503	--------	--------	2,458,590	2,431,378
New Mexico	--------	--------	(1)	(1)	--------	--------	--------	--------	(1)	(1)
New York	--------	--------	(1)	(1)	(1)	(1)	--------	--------	1,134,570	995,110
North Carolina	--------	--------	86,890	104,245	--------	--------	--------	--------	86,890	104,245
Oregon	57,580	37,903	2,082,180	1,538,993	--------	--------	--------	--------	2,139,760	1,576,896
Pennsylvania	(1)	(1)	654,970	540,146	195,040	154,233	(1)	(1)	851,820	695,687
Rhode Island	--------	--------	(1)	(1)	--------	--------	--------	--------	(1)	(1)
Texas	--------	--------	(1)	(1)	(1)	(1)	--------	--------	(1)	(1)
Virginia	--------	--------	228,990	227,865	--------	--------	--------	--------	228,990	227,865
Washington	524,460	321,971	1,535,980	1,093,082	160	174	--------	--------	2,060,600	1,415,227
Wisconsin	(1)	(1)	(1)	(1)	--------	--------	--------	--------	(1)	(1)
Wyoming	--------	--------	(1)	(1)	--------	--------	--------	--------	(1)	(1)
Undistributed	88,510	98,422	1,740,790	1,693,381	141,580	157,172	3,300	2,808	497,580	680,092
	1,500,630	1,119,504	13,732,510	12,318,497	745,410	666,801	11,380	6,190	15,989,930	14,110,992

[1] Included under "Undistributed."

MARBLE

Manufacturers of marble products find outlets for their waste material in virtually the same fields as those in which limestone is utilized. The great variation in unit value that appears in the accompanying table is due to the diversity in use. Waste blocks may be sold for riprap at only a few cents a ton or may be pulverized to an extremely fine powder and sold for special uses at several dollars a ton.

Marble (crushed and broken stone) sold by producers in the United States in 1939, by States [1]

State	Active plants	Short tons	Value	State	Active plants	Short tons	Value
Arkansas	1	600	$3,000	Texas	3	13,080	$100,744
Georgia	1	23,030	23,025	Utah	1	5,170	31,443
Maryland	1	3,390	33,648	Other States [2]	12	28,470	132,544
Massachusetts	1	6,790	3,853				
Missouri	2	9,900	12,544				
Tennessee	5	13,910	42,782		27	104,340	383,583

[1] Includes stone used for artificial stone, crushed stone, flux, poultry grit, riprap, stucco, terrazzo, whiting substitute, and uses not specified.
[2] Alabama, California, New York, Virginia, and Washington.

LIMESTONE

Limestone comprised 69 percent of all crushed and broken stone sold in 1939 (excluding that used for making cement and lime). It is employed more extensively than other rocks because it can be quarried and crushed at moderate cost, is available to a multitude of markets, and is essential to many chemical and manufacturing industries. The following tables show production by States and uses in 1939 and sales for miscellaneous industrial uses in 1938 and 1939.

Limestone (crushed and broken stone) sold or used by producers in the United States in 1939, by States and uses

State	Riprap		Fluxing stone		Crushed stone: Concrete and road metal		Crushed stone: Railroad ballast		Agriculture		Other		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(1)	(1)	1,121,700	$933,429	382,550	$296,728	--------	--------	(1)	(1)	26,870	$143,351	1,701,200	$1,509,485
Arizona	(1)	(1)	(1)	(1)	63,230	70,938	--------	--------	--------	--------	--------	--------	105,800	98,925
Arkansas	(1)	(1)	--------	--------	165,880	175,894	6,690	$4,486	27,710	$48,523	(1)	(1)	217,690	262,529
California	(1)	(1)	28,850	54,153	49,280	32,483	--------	--------	(1)	(1)	243,540	553,578	322,470	641,695
Colorado	--------	--------	227,750	124,923	--------	--------	--------	--------	--------	--------	52,970	80,669	280,720	205,592
Connecticut	--------	--------	(1)	(1)	(1)	(1)	--------	--------	42,340	142,631	11,900	47,114	58,500	200,412
Florida	(1)	(1)	--------	--------	1,144,090	998,742	(1)	(1)	41,450	111,351	(1)	(1)	1,394,580	1,258,644
Georgia	--------	--------	(1)	(1)	261,960	246,832	--------	--------	17,280	26,702	(1)	(1)	342,100	462,349
Hawaii	--------	--------	--------	--------	--------	--------	--------	--------	(1)	(1)	--------	--------	(1)	(1)
Idaho	--------	--------	--------	--------	46,490	33,237	--------	--------	--------	--------	13,160	26,301	59,650	59,538
Illinois	115,160	$104,099	317,790	311,580	5,965,470	5,409,074	239,220	161,044	1,239,410	1,072,336	109,410	223,934	7,986,460	7,282,067
Indiana	155,800	82,498	86,160	45,586	3,036,460	2,692,773	81,350	61,827	359,230	313,069	136,070	107,020	3,855,070	3,302,773
Iowa	219,440	139,136	(1)	(1)	5,835,740	3,888,734	79,860	46,010	214,620	186,431	(1)	(1)	6,385,350	4,369,299
Kansas	216,330	273,902	--------	--------	2,673,730	3,578,077	122,410	63,537	18,320	14,989	50,360	69,616	3,081,150	4,000,121
Kentucky	97,260	93,704	--------	--------	3,488,020	3,434,494	522,330	258,654	430,670	397,134	14,720	38,223	4,553,000	4,222,209
Louisiana	--------	--------	--------	--------	(1)	(1)	--------	--------	--------	--------	(1)	(1)	(1)	(1)
Maine	--------	--------	(1)	(1)	(1)	(1)	--------	--------	(1)	(1)	(1)	(1)	88,450	194,531
Maryland	--------	--------	(1)	(1)	481,080	514,684	(1)	(1)	18,300	32,603	9,320	12,104	513,700	565,791
Massachusetts	(1)	(1)	(1)	(1)	--------	--------	--------	--------	112,130	388,983	28,780	102,403	155,890	513,859
Michigan	(1)	(1)	5,388,360	2,998,602	1,851,120	782,471	97,760	63,837	(1)	(1)	3,286,810	1,540,200	10,882,350	5,539,316
Minnesota	53,410	77,683	(1)	(1)	1,157,710	1,242,220	--------	--------	(1)	(1)	22,090	54,728	1,263,230	1,407,589
Mississippi	--------	--------	--------	--------	--------	--------	--------	--------	(1)	(1)	--------	--------	(1)	(1)
Missouri	317,770	261,237	31,360	34,559	3,008,900	3,059,476	11,870	13,069	252,840	246,231	197,190	279,115	3,819,930	3,893,687
Montana	--------	--------	(1)	(1)	(1)	(1)	--------	--------	--------	--------	53,430	70,933	184,960	153,045
Nebraska	125,010	174,968	--------	--------	262,250	339,124	--------	--------	(1)	(1)	(1)	(1)	423,040	655,000
Nevada	--------	--------	(1)	(1)	(1)	(1)	--------	--------	--------	--------	(1)	(1)	(1)	(1)
New Jersey	(1)	(1)	(1)	(1)	48,420	60,528	--------	--------	(1)	(1)	(1)	(1)	167,610	413,243
New Mexico	(1)	(1)	--------	--------	40,070	59,431	(1)	(1)	--------	--------	--------	--------	153,240	112,174
New York	284,070	298,957	5,020	5,153	5,847,080	5,396,898	487,550	302,486	219,220	438,542	1,348,130	979,073	8,191,070	7,421,109
North Carolina	--------	--------	--------	--------	215,090	232,012	--------	--------	3,050	4,620	--------	--------	218,140	236,632
North Dakota	--------	--------	--------	--------	(1)	(1)	--------	--------	--------	--------	--------	--------	(1)	(1)
Ohio	203,980	136,368	2,753,240	1,757,519	6,231,750	5,187,234	690,130	504,223	470,770	479,638	430,440	572,720	10,780,310	8,637,702
Oklahoma	90,420	68,936	--------	--------	1,499,860	1,374,950	210,270	112,840	3,200	4,002	10,790	19,893	1,814,540	1,580,621
Oregon	--------	--------	--------	--------	--------	--------	--------	--------	(1)	(1)	(1)	(1)	24,310	46,983
Pennsylvania	2,640	2,259	5,264,170	4,648,927	3,885,990	4,006,475	275,840	257,269	390,910	927,930	1,127,790	1,587,059	10,947,340	11,429,919

Puerto Rico					(1)	(1)	(1)	(1)							135,570	137,762
Rhode Island			(1)	(1)					(1)	(1)	(1)	(1)	(1)	(1)
South Carolina					(1)	(1)			(1)	(1)			179,030	228,612
South Dakota	(1)	(1)			(1)	(1)							56,310	58,667
Tennessee	85,320	108,822	17,010	18,030	4,355,570	4,469,053	438,400	319,680	396,650	365,033	27,860	85,607	5,320,810	5,366,225
Texas	28,090	18,653	(1)	(1)	2,704,010	1,714,961	165,390	90,492	(1)	(1)	245,330	229,503	3,168,350	2,073,611
Utah			(1)	(1)	378,280	204,089					(1)	(1)	489,250	301,256
Vermont					72,880	96,643			(1)	(1)	(1)	(1)	120,910	158,205
Virginia	2,780	2,601	470,650	463,912	2,272,350	1,983,022	385,680	294,028	434,920	507,803	485,290	403,223	4,051,670	3,654,589
Washington			(1)	(1)					(1)	(1)	104,260	201,645	129,660	227,942
West Virginia	(1)	(1)	1,221,660	967,745	1,008,890	1,342,150	281,600	202,003	(1)	(1)	247,430	233,029	2,850,170	2,841,330
Wisconsin	50,400	42,722	26,660	23,461	2,358,290	1,555,169	20,440	16,353	191,390	187,955	31,220	48,994	2,678,400	1,874,654
Wyoming	(1)	(1)	(1)	(1)	9,370	4,285	(1)	(1)			132,540	193,406	196,210	247,708
Undistributed	190,110	153,332	311,180	231,359	502,810	482,483	272,330	153,002	574,850	696,321	675,120	1,094,352	437,230	292,239
	2,237,990	2,039,877	17,271,560	12,618,938	61,304,670	54,965,364	4,389,120	2,924,840	5,459,260	6,592,827	9,122,820	8,997,793	99,785,420	88,139,639

[1] Included under "Undistributed."

Limestone (crushed and broken stone) sold or used by producers in the United States for miscellaneous uses, 1938–39

Use	1938		1939	
	Short tons	Value	Short tons	Value
Alkali works	3,634,050	$1,743,173	4,655,960	$2,100,535
Calcium carbide works	246,010	137,522	274,890	233,085
Coal-mine dusting	50,890	178,263	68,260	180,123
Filler (not whiting substitute):				
Asphalt	288,590	789,587	265,710	676,978
Fertilizer	121,130	202,189	116,080	185,844
Other	61,970	245,356	84,910	330,359
Filter beds	142,050	127,586	105,850	81,277
Glass factories	170,560	290,297	240,840	394,727
Limestone sand	229,890	180,863	270,430	183,035
Magnesia works (dolomite)	62,540	99,684	89,390	147,129
Mineral food	65,570	226,844	68,580	267,269
Mineral (rock) wool	86,400	85,378	123,720	102,670
Paper mills	223,450	373,207	302,620	488,079
Poultry grit	31,260	153,789	39,010	180,529
Refractory (dead-burned dolomite)	263,930	274,624	824,930	713,991
Road base	205,840	117,882	524,240	445,040
Stucco, terrazzo, and artificial stone	23,360	146,828	33,820	179,321
Sugar factories	619,910	878,028	621,730	853,235
Whiting substitute [1]	145,170	671,842	175,460	948,528
Other uses [2]	80,350	89,447	183,400	225,636
Use unspecified	27,480	60,615	52,990	80,403
	6,780,400	7,073,004	9,122,820	8,997,793

[1] Includes stone for filler for graphite, calcimine, linoleum, paint, pigments, pottery, putty, regrinding, rubber, sealing wax, soap, and tile.
[2] Includes stone for acetic acid, acid neutralization, bird gravel, chemicals (unspecified), concrete blocks and pipes, dye works, explosives, fill, fireplace stone, foundry facings, roofing gravel, spalls, and waste rock.

Sales of dolomite (calcium-magnesium carbonate) and its primary product of calcination, dolomitic lime, for certain special uses, are covered in the following table:

Dolomite and dolomitic lime sold or used by producers in the United States for specified purposes, 1938–39

	1938	1939
Dolomite for—		
Basic magnesium carbonate:		
Short tons	62,540	89,390
Value	$99,684	$147,129
Dead-burned dolomite or refractory stone:		
Short tons	263,930	824,930
Value	$274,624	$713,991
Dolomitic lime for—		
Refractory (dead-burned dolomite):		
Short tons	366,626	671,561
Value	$3,095,355	$5,447,554
Paper mills:		
Short tons	42,000	41,000
Value	$288,000	$267,000
Total (calculated as raw stone) short tons	1,144,000	2,339,000

Limestone is quarried not only for use raw but also for manufacture into cement and lime. The large and important industries manufacturing these products are covered in separate chapters of this volume. It is of interest, however, to show in one table the total tonnage of limestone used for all purposes.

Limestone sold or used for all purposes in the United States, 1937–39, in short tons

Use	1937	1938	1939
Limestone (as given in this report) (approximate)	94,577,000	[1] 81,680,000	100,846,000
Portland cement (including "cement rock") [2]			
Natural cement ("cement rock") [2]	29,547,000	[1] 26,193,000	30,463,000
Lime [3]	8,250,000	6,694,000	8,509,000
	132,374,000	[1] 114,567,000	139,818,000

[1] Revised figures. [2] Value reported as cement in chapter on Cement.
[3] Value reported as lime in chapter on Lime.

SANDSTONE

The sandstone industry, which made substantial gains in 1938, continued its upward trend in 1939. Production was 41 percent greater in quantity and 48 percent greater in value than in 1938. A gain of 70 percent in sales of refractory stone (ganister) indicates the increased activity of steel plants. Sales of riprap, which are subject to extreme fluctuations, declined greatly, but sales for all other major uses made large gains. The average sales value at the quarry for all crushed sandstone was 6 cents a ton higher in 1939 than in 1938.

Sandstone (crushed and broken stone) sold or used by producers in the United States in 1939, by States and uses

State	Refractory stone (ganister)		Riprap		Crushed stone				Other uses		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	(1)	(1)	(1)	(1)	(1)	(1)					102,180	$103,892
Arizona			(1)	(1)	(1)	(1)					(1)	(1)
Arkansas					64,110	$63,477					64,110	63,477
California	(1)	(1)	21,260	$19,944	430,990	424,775	(1)	(1)	(1)	(1)	577,210	544,951
Colorado	12,960	$20,224	(1)	(1)	(1)	(1)					162,020	154,138
Georgia					(1)	(1)					(1)	(1)
Idaho					(1)	(1)					(1)	(1)
Illinois	480	3,600	12,980	8,857	223,100	288,897					236,560	301,354
Indiana			500	200	51,080	39,376					51,580	39,576
Iowa					11,920	11,141					11,920	11,141
Kansas			(1)	(1)	239,550	391,435			(1)	(1)	241,050	392,859
Kentucky	(1)	(1)			(1)	(1)					238,270	247,781
Maryland					(1)	(1)					(1)	(1)
Massachusetts					(1)	(1)					(1)	(1)
Michigan					(1)	(1)					(1)	(1)
Minnesota			(1)	(1)	(1)	(1)					(1)	(1)
Missouri					(1)	(1)					(1)	(1)
Montana	(1)	(1)	(1)	(1)							(1)	(1)
Nebraska					(1)	(1)					(1)	(1)
New York	5,700	7,750	4,600	9,294	277,240	358,599					287,540	375,643
North Carolina			25,590	25,591	1,245,350	1,252,725					1,270,940	1,278,316
Ohio	31,650	222,018	42,900	32,807	181,140	160,253			1,540	$4,685	257,230	419,763
Oklahoma			10,360	5,396	71,660	35,558					82,020	40,954
Oregon			(1)	(1)	(1)	(1)					(1)	(1)
Pennsylvania	406,750	659,906	5,990	13,312	465,630	486,155	200,810	$193,207	1,570,500	1,256,400	2,649,680	2,608,980
South Dakota			80,870	55,070	105,120	143,042					185,990	198,112
Tennessee	(1)	(1)			(1)	(1)					126,710	158,662
Texas			(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
Utah	5,920	11,836			77,420	28,790					83,340	40,626
Vermont			(1)	(1)	(1)	(1)					(1)	(1)
Virginia					291,300	284,100	27,810	21,279	9,910	1,982	329,020	307,361
Washington			600	480							600	480
West Virginia	(1)	(1)			(1)	(1)					957,970	1,636,498
Wisconsin	(1)	(1)			6,390	11,350			(1)	(1)	241,640	464,827
Wyoming			(1)	(1)	(1)	(1)					(1)	(1)
Undistributed	183,120	263,997	122,400	61,863	1,887,570	2,532,157	7,830	6,409	235,520	371,499	500,540	400,045
	646,580	1,189,331	328,050	232,814	5,629,570	6,511,830	236,450	220,895	1,817,470	1,634,566	8,658,120	9,789,436

[1] Included under "Undistributed."

MISCELLANEOUS STONE

Stone other than the five principal varieties already discussed includes light-color volcanic rocks, schists, boulders from river beds, serpentine, and flint. The following table shows sales of stone of these types by uses in 1939. Total sales declined 24 percent in quantity and 21 percent in value compared with 1938.

Miscellaneous varieties of stone (crushed and broken stone) sold or used by producers in the United States in 1939, by States and uses

State	Riprap		Crushed stone				Other uses		Total	
			Concrete and road metal		Railroad ballast					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alaska			(1)	(1)					(1)	(1)
Arizona			82,250	$60,255	1,160	$577			83,410	$60,832
Arkansas	(1)	(1)	(1)	(1)	(1)	(1)			352,760	276,617
California	461,000	$540,672	2,957,080	1,584,674	158,950	71,139	21,010	$28,321	3,598,040	2,224,806
Colorado	(1)	(1)	137,530	119,690	(1)	(1)	(1)	(1)	161,670	136,162
Florida			42,320	89,213					42,320	89,213
Idaho			(1)	(1)					(1)	(1)
Illinois			26,580	30,071					26,580	30,071
Kansas			(1)	(1)					(1)	(1)
Louisiana			(1)	(1)					(1)	(1)
Maine			(1)	(1)					(1)	(1)
Maryland			23,090	27,989			1,280	321	24,370	28,310
Massachusetts	26,500	38,000	226,530	348,027					253,030	386,027
Michigan	(1)	(1)	28,060	21,606			(1)	(1)	140,920	225,342
Minnesota			(1)	(1)					(1)	(1)
Missouri	(1)	(1)	22,200	19,900			(1)	(1)	58,660	36,525
Montana			146,240	60,118					146,240	60,118
Nevada	(1)	(1)	(1)	(1)	(1)	(1)			34,260	40,207
New Hampshire			(1)	(1)			(1)	(1)	14,040	19,515
New Jersey			(1)	(1)			(1)	(1)	82,320	81,066
New Mexico			133,950	52,750					133,950	52,750
New York	(1)	(1)	189,000	184,199	(1)	(1)	(1)	(1)	221,140	199,237
North Carolina	1,200	598	340,830	369,846					342,030	370,444
North Dakota			(1)	(1)					(1)	(1)
Oklahoma			(1)	(1)					(1)	(1)
Oregon	(1)	(1)	(1)	(1)					30,480	23,417

[1] Included under "Undistributed."

Miscellaneous varieties of stone (crushed and broken stone) sold or used by producers in the United States in 1939, by States and uses—Con.

State	Riprap		Crushed stone				Other uses		Total	
			Concrete and road metal		Railroad ballast					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Pennsylvania	150	$225	424,160	$448,186			475,420	$987,570	899,730	$1,435,981
Puerto Rico			(1)	(1)					(1)	(1)
Rhode Island	(1)	(1)	(1)	(1)					177,490	241,236
South Carolina			(1)	(1)					(1)	(1)
South Dakota	(1)	(1)	(1)	(1)			(1)	(1)	(1)	(1)
Tennessee			49,180	48,736					49,180	48,736
Texas	310	300	423,730	196,009	40,340	$30,175			464,380	226,484
Utah			(1)	(1)			(1)	(1)	122,720	68,176
Virginia			458,970	346,137			(1)	(1)	(1)	(1)
Washington	(1)	(1)	(1)	(1)			(1)	(1)	60,980	45,828
West Virginia			(1)	(1)					(1)	(1)
Wisconsin	(1)	(1)	(1)	(1)					(1)	(1)
Wyoming			129,650	93,854			224,240	220,000	353,890	313,854
Undistributed	171,800	152,269	1,573,170	1,280,031	220,450	135,630	84,880	239,321	1,428,620	1,105,455
	660,960	732,064	7,414,520	5,381,291	420,900	237,521	806,830	1,475,533	9,303,210	7,826,409

[1] Included under "Undistributed."

MARKETS

As indicated in figure 3, sales of crushed stone used as concrete aggregate or in road construction made gains in 1939 commensurate with the marked increase in portland-cement shipments; however, as in 1938, the gain was of no advantage to the commercial producers whose sales declined more than 700,000 tons from 1938. The increase was due to an advance of nearly 10,000,000 tons in production by noncommercial agencies. In view of the moderate gain in total build-

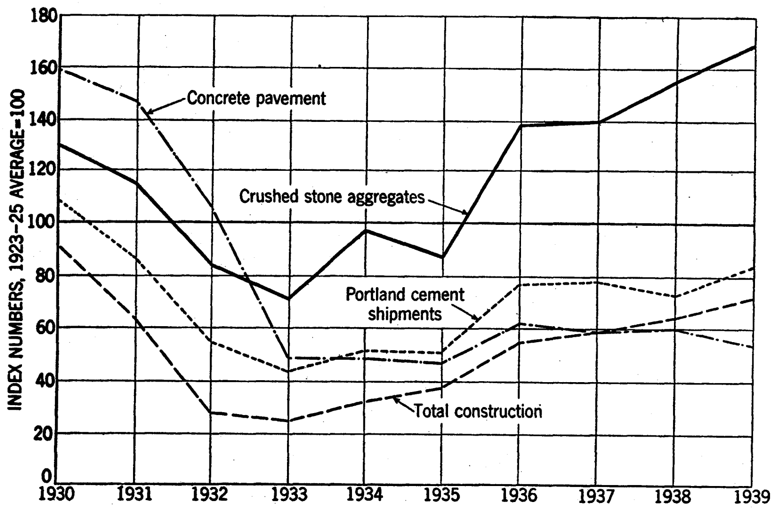

FIGURE 3.—Sales of crushed-stone aggregates (tons) compared with total construction, portland-cement shipments, and contracts for concrete pavements 1930–39. Data are plotted as index numbers with the 1923–25 average as 100. Figures on concrete pavements compiled by Portland Cement Association and on construction contracts by F. W. Dodge Corporation.

ing and the decline in concrete-pavement construction, the disproportionate gain in output of aggregates probably is due to their wide use in secondary roads.

Sales of limestone for use as a flux in blast furnaces producing pig iron rose decidedly in 1939 in consonance with increased furnace activity. Sales of dolomite and ganister for use as refractories in steel furnaces made a much greater proportional gain than sales of steel ingots. The abnormal demand probably was due to the relining of furnaces that were formerly inactive to meet the growing demands of the steel trade. Figure 4 shows the close relationship between sales of fluxing stone and refractories and the output of iron and steel mills.

NEW DEVELOPMENTS

An important contribution to the literature on crushed stone was published in 1939.[1] According to this report the annual production per man employed jumped from 1,200 tons in 1913 to 2,800 tons in 1936.

Further simplification of aggregate specifications (Simplified Practice Recommendation R163–36) involves consolidation of the two original groups of sizes into one, eliminating 12 sizes. Closer tolerances have been fixed for the lower limits of each size, and one size has been added to meet the need for fine seal surface treatment at

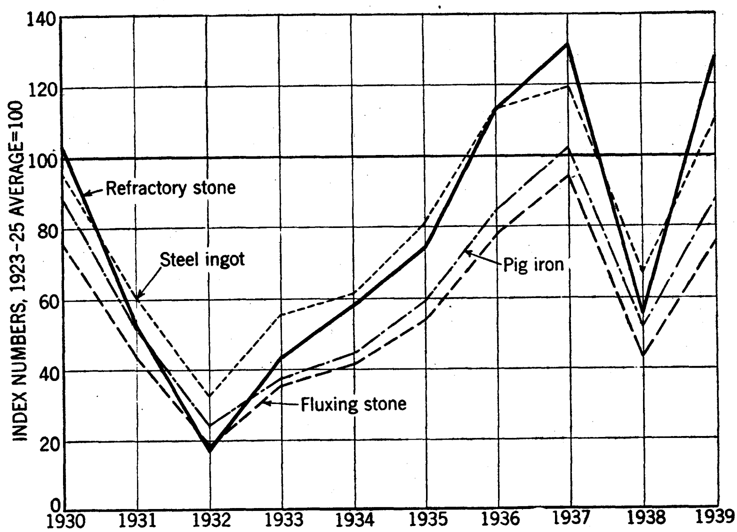

FIGURE 4.—Sales of fluxing stone and refractory stone (tons) compared with production of steel ingot and pig iron, 1930–39. All data are plotted as index numbers, with the 1923–25 average as 100. Statistics of steel-ingot and pig-iron production compiled by American Iron and Steel Institute.

airports. Producers of crushed stone, gravel, and slag have accorded this revision (R163–39) the required degree of acceptance. Another trend in specifications is to combine two diverse sizes of concrete aggregate to obtain maximum density of the mixture. Common requirements are ¼ to 1 inch and 1 inch to 2½ inches.

The extensive use of graded aggregates impregnated with bituminous material on secondary roads has led to accumulations of fines (minus ⅜-inch) at crushed-stone plants. Several hundred thousand tons of such aggregates were used in concrete construction in Pennsylvania in 1939. The use of low-price materials including field stone, discarded ganister, mine waste, "red dog" (burned shale), and slag on secondary roads in that State has been growing.

[1] Kantor, Harry S., and Saeger, Geoffrey A., Changes in Technology and Labor Requirements in the Crushed-Stone Industry: Mineral Technology and Output-per-Man Studies, Bureau of Mines in cooperation with the W. P. A., 1939, 169 pp.

FOREIGN TRADE [2]

Imports.—Total imports of stone in 1939 dropped 3 percent in value from 1938. Imports of marble increased, those of granite declined, and imports of quartzite and travertine showed little change. The following tables show the quantities and values of stone imports in 1939, by kinds. Imports from Canada were higher in value, whereas those from South America were slightly lower than in 1938.

Stone [1] imported for consumption in the United States in 1939, by classes

Class	Quantity	Value
Marble, breccia, and onyx:		
In blocks, rough, etc. cubic feet	73,737	$236,746
Sawed do	57	362
Slabs or paving tiles superficial feet	188,396	51,864
All other manufactures	--------	44,957
Mosaic cubes of marble or onyx:		
Loose pounds	6,062	167
Attached to paper or other material superficial feet	710	1,600
	--------	335,696
Granite:		
Dressed cubic feet	26,482	126,168
Rough do	25,559	38,999
	52,041	165,167
Quartzite short tons	110,523	$199,454
Travertine stone: Rough cubic feet	28,946	29,211
Stone (other):		
Dressed	--------	3,344
Rough (monumental or building stone) cubic feet	3,733	5,162
Rough (other) short tons	33,004	38,193
Marble chip, or granite short tons	7,624	36,498
	--------	83,197
Grand total	--------	812,725

[1] In addition, 98,217 pounds valued at $1,094 of "Lithographic stones, not engraved" were imported.

[2] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Stone [1] imported for consumption in the United States in 1939, by classes and countries

Country	Marble, breccia, and onyx: Rough: Cubic feet	Marble, breccia, and onyx: Rough: Value	Marble, breccia, and onyx: Manufactures (value)	Granite: Cubic feet	Granite: Value	Other building or monumental stone (value)	Other stone, n. e. s. (value)	Quartzite: Short tons	Quartzite: Value	Travertine: Cubic feet	Travertine: Value	Total value
North America:												
Canada	510	$2,041	$142	5,350	$7,761	$634	$37,483	110,510	$199,100			$247,161
Cuba	775	1,261	300									1,561
Mexico	11,802	46,612	139			118						46,869
West Indies (French)			20									20
Total North America	13,087	49,914	601	5,350	7,761	752	37,483	110,510	199,100			295,611
South America:												
Argentina	5,662	54,955						3	93			55,048
Brazil			48	173	1,685							1,733
Total South America	5,662	54,955	48	173	1,685			3	93			56,781
Europe:												
Belgium	7,186	16,794	15,951				7,315	2	30	581	$554	40,644
Finland				35,124	130,064							130,064
France	6,467	17,834	10,481	6	44	106						28,465
Germany			465	11	76	40	234					815
Italy	40,340	94,862	65,627	12	80	6,747	29,183			28,365	28,657	225,156
Sweden			5	10,686	21,944		339	8	231			22,519
United Kingdom	207	631	1,729	327	1,874	305	131					4,670
Other Europe	788	1,756	1,523	316	1,473	348						5,100
Total Europe	54,988	131,877	95,781	46,482	155,555	7,546	37,202	10	261	28,946	29,211	457,433
Asia:												
China			265			136						401
India, British			269									269
Other Asia			1,963	36	166	72	6					2,207
Total Asia			2,497	36	166	208	6					2,877
Africa			23									23
Grand total	73,737	236,746	98,950	52,041	165,167	8,506	74,691	110,523	199,454	28,946	29,211	812,725

[1] In addition, 98,217 pounds valued at $1,094 of "Lithographic stones, not engraved," were imported as follows: Canada, 95,715 pounds valued at $660; Germany, 2,502 pounds valued at $434.

Exports.—The export trade in stone is relatively small, and two-thirds of it is with Canada. The following table shows exports by country of destination during 1939.

Stone exported from the United States in 1939, by countries

Country	Marble and other building and monumental stone: Cubic feet	Marble and other building and monumental stone: Value	Other manufactures of stone (value)	Country	Marble and other building and monumental stone: Cubic feet	Marble and other building and monumental stone: Value	Other manufactures of stone (value)
Canada	72,773	$108,304	$241,065	Newfoundland and Labrador	541	$3,339	$534
Chile			14,770	Philippine Islands	568	6,883	6,256
Cuba	1,862	6,620	9,741	United Kingdom	335	791	6,253
Mexico	37	503	15,124	Other countries	1,031	7,976	64,618
Netherland India			7,643		77,147	134,416	366,004

SLATE

By Oliver Bowles and M. S. Jensen

SUMMARY OUTLINE

Sales of slate as dimension stone increased 25 percent in quantity and 30 percent in value in 1939 compared with 1938. The quantity sold was the highest since 1929 and the value the greatest since 1931. In general, unit prices were higher than in 1938.

The quantity of roofing slate sold was the highest since 1929 and the value the greatest since 1930. The average value per square in 1939 was $7.18 whereas in 1938 it was $6.98. Sales in the Pennsylvania district advanced 21 percent in quantity and 24 percent in value over 1938. In the New York-Vermont district sales increased 26 percent in quantity and 29 percent in value. Virginia sales made a substantial gain of 46 percent in quantity and 49 percent in value. Unusual residential building activity in and near Washington, D. C., has stimulated the Virginia industry. This is the seventh consecutive year that Virginia sales have increased.

An increase of 37 percent in the value of mill stock compared with a gain of only 13 percent in the quantity indicates marked improvement in the prices of most products. Whereas total building construction advanced from 64 percent of the 1923–25 average in 1938 to 72 percent in 1939, sales of structural and sanitary slate advanced 19 percent in quantity and 33 percent in value. Thus slate is regaining to some extent its former place in interior construction. Sales of electrical slate, which declined so drastically in 1938 that it seemed evident that synthetic products were being substituted for it to an increasing extent, recovered remarkably in 1939. Sales of blackboards, bulletin boards, and billiard-table tops made large gains, while those of vaults and covers declined moderately. Owing chiefly to disruption of foreign markets the quantity of school slates sold dropped to little more than half the 1938 figure. Sales of slate for flagging, cross walks, and stepping stones increased moderately, but average prices were considerably lower than in 1938.

Statistics on slate granules and flour are included in this chapter, although these products have little connection with the dimension-slate industry. Most of the slate used for their manufacture is unsuitable for other slate products. Sales of granules increased slightly, whereas sales of flour declined. The average sales value of granules, f. o. b. mill, was $8.70 per short ton in 1939 compared with $8.57 in 1938. Figures for sales of granules made of rock other than slate are given in the Stone chapter of this volume.

The following table gives the principal statistical data for the slate industry during 1938 and 1939 and is arranged to permit ready comparison for the 2 years.

Salient statistics of the slate industry in the United States, 1938–39

	1938			1939				
	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* 322, 040	119, 590	$2, 247, 910	*Squares* 399, 320	149, 410	$2, 868, 961	+24.0	+27.6
Mill stock:	*Sq. ft.*			*Sq. ft.*				
Electrical slate	221, 140	1, 830	162, 793	324, 590	2, 710	237, 001	+46.8	+45.6
Structural and sanitary slate	861, 520	7, 220	245, 741	1, 022, 510	8, 020	327, 882	+18.7	+33.4
Grave vaults and covers	274, 640	2, 070	64, 821	255, 080	2, 390	60, 813	−7.1	−6.2
Blackboards and bulletin boards	1, 637, 570	4, 220	347, 486	2, 065, 830	7, 470	500, 809	+26.2	+44.1
Billiard-table tops	60, 150	440	19, 582	100, 310	740	36, 397	+66.8	+85.9
School slates	[1] 520, 200	530	13, 179	[1] 276, 210	380	5, 769	−46.9	−56.2
Total mill stock	3, 575, 220	16, 310	853, 602	4, 044, 530	21, 710	1, 168, 671	+13.1	+36.9
Flagstones, etc.[2]	1, 046, 530	7, 790	63, 839	1, 194, 320	8, 480	63, 493	+14.1	−.5
Total slate as dimension stone		143, 690	3, 165, 351		179, 600	4, 101, 125	+25.0	+29.6
Granules and flour		349, 000	2, 489, 962		351, 780	2, 581, 089	+.8	+3.7
Grand total domestic production		492, 690	5, 655, 313		531, 380	6, 682, 214	+7.9	+18.2
Foreign trade:								
Imports for consumption			6, 688			1, 017		−84.8
Exports:[3]	*Squares*			*Squares*				
Roofing	660		5, 070	569		5, 244	−13.8	+3.4
Other dimension slate			58, 852			51, 815		−12.0
Granules and flour		11, 229	93, 675		13, 316	120, 731	+18.6	+28.9

[1] Number of pieces: 1938, 972,780; 1939, 516,280; square feet approximate.
[2] Includes walkways, stepping stones, and miscellaneous slate.
[3] Figures obtained by the Bureau of Mines from shippers.

SALES

Dimension slate.—The following table shows sales of dimension slate for several years, that is, slate sold in blocks or slabs cut to specified sizes and shapes. Such a classification excludes granules and flour.

Figure 1 compares sales of slate, except granules and flour, with the value of contracts awarded for residential building and total building from 1930 to 1939. Sales of slate followed closely the trends in building construction until 1938, when they declined drastically. Although the recovery in 1939 is encouraging the value of slate sales is only slightly higher than the point reached in 1937.

Slate (other than granules and flour) sold by producers in the United States, 1935–39

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
1935	221,630	83,290	$1,456,041	15,580	$849,796	4,820	$35,333	103,690	$2,341,170
1936	336,130	138,190	2,607,402	20,100	1,175,668	6,820	55,358	165,110	3,838,428
1937	365,800	137,400	2,728,109	21,480	1,225,645	8,670	73,554	167,550	4,027,308
1938	322,040	119,590	2,247,910	16,310	853,602	7,790	63,839	143,690	3,165,351
1939	399,320	149,410	2,868,961	21,710	1,168,671	8,480	63,493	179,600	4,101,125

[1] Includes flagstones, walkways, stepping stones, and miscellaneous slate.

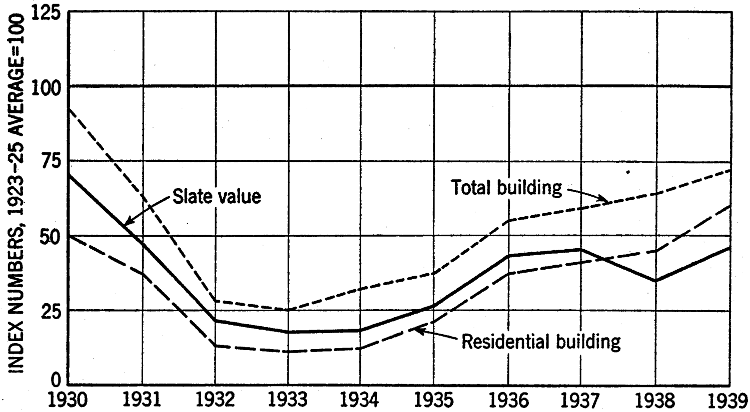

FIGURE 1.—Sales of slate compared with residential building and total building, 1930–39. Data on building from F. W. Dodge Corporation.

Trends in roofing slate.—Roofing slate is used chiefly in residential building for new construction and reroofing. No figures are available as to the proportion used for each, but new construction is the

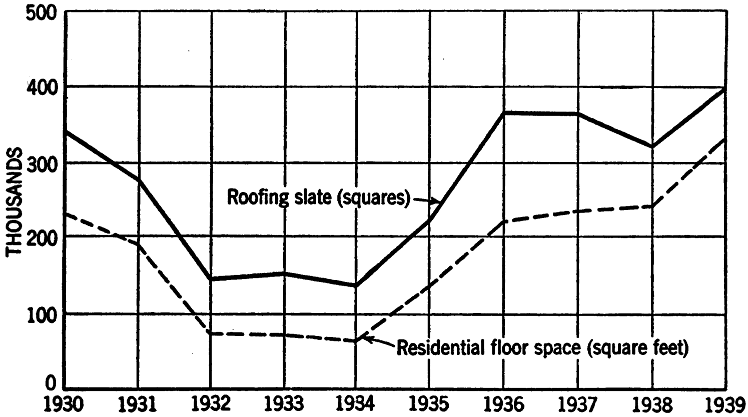

FIGURE 2.—Sales of roofing slate compared with new residential floor space, 1930–39. Statistics on floor space from F. W. Dodge Corporation.

principal market. Statistics are lacking on the roof area of new residential construction; but roof area bears a fairly definite relation to floor space, for which data are compiled. Floor space may therefore be regarded as a rough index of the area covered with roofing.

Figure 2 compares sales of roofing slate in squares with residential floor space of new construction from 1930 to 1939. The declining trend in sales of roofing slate during 1937 and 1938 was reversed in 1939. Residential building made rapid gains in 1939, and slate sales almost kept pace with it.

Granules and flour.—Sales of granules, which are used extensively for surfacing prepared roofing, increased slightly in 1939, and sales of slate flour, which is used as a filler, decreased slightly compared with 1938. There were small gains in the average selling price of both products. The following table shows sales of granules and flour by producers from 1935 to 1939.

Crushed slate (granules and flour) sold by producers in the United States, 1935–39

Year	Granules		Flour		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1935	166, 520	$1, 112, 081	59, 990	$196, 264	226, 510	$1, 308, 345
1936	202, 730	1, 372, 095	86, 920	274, 685	289, 650	1, 646, 780
1937	193, 950	1, 309, 549	83, 060	268, 465	277, 010	1, 578, 014
1938	258, 930	2, 220, 306	90, 070	269, 656	349, 000	2, 489, 962
1939	265, 830	2, 312, 177	85, 950	268, 912	351, 780	2, 581, 089

PRICES

The average price of roofing slate f. o. b. quarry or mill, as reported to the Bureau of Mines, advanced 20 cents a square in 1939 compared with 1938. In Pennsylvania and in the New York-Vermont area the price increased 18 cents a square and in Virginia 20 cents a square.

Mill-stock prices, which had maintained an average of 29 cents a square foot for several years, dropped to 24 cents in 1938 but rose again to 29 cents in 1939. Average values of blackboards and bulletin boards, billiard-table tops, and structural and sanitary slate

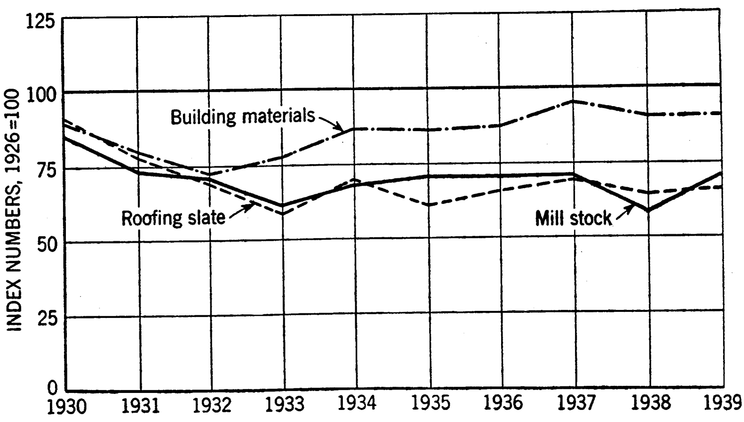

FIGURE 3.—Prices of slate compared with commodity prices of building materials in general, 1930–39. Commodity prices are from the Bureau of Labor Statistics.

each advanced 3 cents a square foot; those for electrical slate declined 1 cent; and those for vaults and covers and school slates remained virtually unchanged.

Trends in recent years.—Figure 3 shows the trend of slate prices over a 10-year period compared with prices of building materials in general. The price of slate increased more from 1938 to 1939 than that of building materials as a whole.

REVIEW BY STATES AND DISTRICTS

The following table gives sales of slate in 1939 by States and uses.

Slate sold by producers in the United States in 1939, by States and uses

State	Operators	Roofing		Mill stock		Other uses[1] (value)	Total value
		Squares (100 square feet)	Value	Square feet	Value		
Arkansas	1	------	------	------	------	(2)	(2)
California	2	------	------	------	------	(2)	(2)
Georgia	1	------	------	------	------	(2)	(2)
Maine	3	3,840	$32,768	(2)	(2)	(2)	$215,951
Maryland	1	------	------	------	------	(2)	(2)
New York	12	2,020	15,740	(3)	(3)	[3] $450,097	465,837
Pennsylvania	27	236,710	1,607,929	3,648,690	$888,571	560,353	3,056,853
Tennessee	1	------	------	(2)	(2)	(2)	(2)
Vermont	44	106,500	763,846	162,470	96,506	1,087,963	1,948,315
Virginia	5	50,250	448,678	------	------	(2)	(2)
Undistributed[4]	------	------	------	233,370	183,594	546,169	995,258
	97	399,320	2,868,961	[3] 4,044,530	[3] 1,168,671	[3] 2,644,582	6,682,214

[1] Flagging and similar products, granules, and flour.
[2] Included under "Undistributed."
[3] A small amount of mill stock in New York included under "Other uses."
[4] Includes output of States entered as "(2)" above.

Maine.—The principal product of the Maine quarries is electrical slate, for which it is unusually well-adapted. Sales of electrical slate suffered a serious decline in 1938 and although there was a decided recovery in 1939, the quantity of this product now used is still far below that employed a decade ago. The value of slate sales in Maine in 1939 was below the 1935 level.

New York-Vermont.—Sales of the attractively colored roofing slates of the New York-Vermont area that are popular with architects and builders increased 26 percent in quantity over 1938. The quantity of mill stock sold in Vermont advanced 20 percent and the value of other products, chiefly granules and flour, was 4 percent over 1938. The value of all slate products sold in Vermont in 1939 was 13 percent higher than in 1938 and in New York 5 percent higher.

Peach Bottom district.—Granules, slate flour, and roofing slate are manufactured in the Peach Bottom district on the Maryland-Pennsylvania border near Delta, Pa. Some development work has been done on a southern extension of the slate belt in Frederick County, Md.

Lehigh district.—The Lehigh district, comprising Lehigh and Northampton Counties, Pa., is the most productive slate area in the United States. All types of slate products are manufactured in this district. As separate figures cannot be shown for York County, it is included with Northampton County in the accompanying table.

The value of total sales of slate products in the area was 22 percent higher in 1939 than in 1938. Sales of roofing slate increased 21 percent in quantity and 24 percent in value, and sales of blackboards and bulletin boards increased 26 percent in quantity and 44 percent in value. Sales of electrical slate were virtually double those of 1938, and sales of structural and sanitary products (including vaults and covers) increased 10 percent in quantity and 19 percent in value. Sales of school slates showed a large decline, and sales of other products, chiefly granules and including billiard tables, increased 6 percent.

Slate sold by producers in Pennsylvania in 1939, 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	10	14,730	$99,438	29,720	$14,261	9,750	$2,796	(1)	(1)
Northampton and York [2]	17	221,980	1,508,491	14,250	5,785	912,340	268,629	[1] 240,280	[1] $54,125
	27	236,710	1,607,929	43,970	20,046	922,090	271,425	240,280	54,125

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	437,250	$101,602			276,210	$5,769	(3)	[1 3] $223,866
Northampton and York [2]	1,628,580	399,207	100,310	$36,397			[3] $560,353	[1 3] 2,832,987
	2,065,830	500,809	100,310	36,397	276,210	5,769	560,353	3,056,853

[1] Small amount of slate for grave vaults and covers produced in Lehigh County included under Northampton and York Counties.
[2] York County produced roofing slate, granules, and flour only.
[3] Small amount of flagging produced in Lehigh County included under Northampton and York Counties.

Virginia.—Roofing slate is the principal product of the Buckingham County area. Small quantities of flagging are sold, but no mill-stock products are manufactured. Granules are made at Esmont, Albemarle County, and New Canton, Buckingham County.

Other districts.—Small quantities of granules alone, or granules and slate flour, are manufactured 16 miles southeast of Mena, Polk County, Ark.; at Placerville, Eldorado County, and near Jamestown, Tuolumne County, Calif.; and in Bartow County, Ga., near Fair Mount. Structural and sanitary products and flagging are made at Chilhowee, Blount County, Tenn.

NEW DEVELOPMENTS

Parsons Bros. Slate Co., Pen Argyl, Pa., has designed a new method of applying slate to roofs. It simplifies the process, reduces the weight, requires only half as much slate for a given area as the old method, and utilizes small sizes that accumulate around quarries and ordinarily are difficult to market. The small slates are placed edge to edge with no side lap but with a 3-inch head lap. Between the slates and the sheathing are strips of heavy asphalt-impregnated felt with an asphalt coating which also have a 3-inch head lap. Such low-cost roofs are said to be enduring.

Further tests by the Eastern Experiment Station of the Bureau of Mines indicate that waste slate is suitable for making lightweight aggregate. When calcined at a carefully controlled temperature, the slate will expand to more than five times its original volume and still have a fairly high compressive strength.

FOREIGN TRADE [1]

Imports.—The value of slate imported for consumption in the United States in 1939 dropped to less than one-sixth the 1938 figure. The drastic decline doubtless is due chiefly to war conditions. Imports are relatively unimportant even when trade is normal. The following table shows the value of imports in 1938 and 1939 by countries.

Slate imported for consumption in the United States, 1938–39, by countries

Country	1938	1939	Country	1938	1939
Canada	$543	$570	Italy	$994	$356
China	3	26	Japan	68	61
Czechoslovakia	1,037		United Kingdom	3,089	
France	895				
Hong Kong	59	4		6,688	1,017

Exports.—The following table lists exports of slate products from 1937 to 1939, as reported to the Bureau of Mines by shippers. Exports in 1939 fluctuated greatly from those in 1938, some items increasing and others declining, but there was a net gain of 13 percent in the value of foreign sales.

Slate exported from the United States, 1937–39, by uses [1]

Use	1937		1938		1939	
	Quantity	Value	Quantity	Value	Quantity	Value
Roofing squares	1,025	$9,382	660	$5,070	569	$5,244
School slates cases [2]	4,434	35,011	4,642	35,717	[3] 2,151	[3] 17,739
Electrical square feet	3,986	2,356	1,885	1,239	2,672	1,726
Blackboards do	26,033	6,853	46,253	10,400	28,201	8,448
Billiard tables do	30,443	16,580	17,788	10,182	37,326	18,111
Structural [4] do	26,462	4,393	18,188	1,314	15,202	5,791
Slate granules and flour short tons	11,184	77,576	11,229	93,675	13,316	120,731
		152,151		157,597		177,790

[1] Figures collected by Bureau of Mines from shippers of products named.
[2] Cases weigh 130 to 165 pounds each; average is 135 pounds. They contain 8 to 18 dozen slates, depending on size. Sizes run from 5 by 7 to 9 by 13 inches (inside frame).
[3] Value includes slate used for pencils and educational toys; quantity not available.
[4] Includes slate for floors and walkways.

[1] Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

SAND AND GRAVEL

By H. Herbert Hughes and G. E. Tucker

SUMMARY OUTLINE

Despite an 11-percent drop in concrete-pavement contract awards in 1939, the quantity of sand and gravel sold or used by producers for all uses increased substantially over 1938. Virtually the entire advance was due to a 12-percent increase in output of commercial operations, as Government-and-contractor [1] production rose only 1 percent. The slight gain in tonnage at plants operated by or for States, counties, municipalities, and other Government agencies halted the recent sharp upward trend in output of this material. The continuous rise in total production and value from the low of 1933 has been interrupted only in 1938. (See fig. 1.)

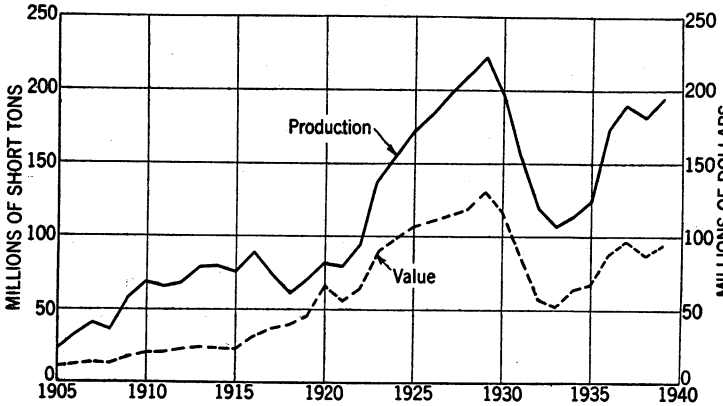

Figure 1.—Principal trends in the sand and gravel industry, 1905–39.

Except for concrete paving, the construction industry in 1939 showed moderate improvement over 1938. According to the F. W. Dodge Corporation, the total value of construction contracts awarded was 11 percent above 1938. Engineering News-Record data indicated a 7-percent gain in engineering construction. Of especial significance was the 23-percent increase in privately financed construction, whereas public contracts showed no gain. Residential construction was particularly active—35 percent above that in 1938.

Salient statistics of the sand and gravel industry in 1938 and 1939 are summarized in the following table.

[1] Formerly classified as "noncommercial"; details of change in designation given in section headed "Government-and-contractor operations."

Sand and gravel sold or used by producers in the United States, 1938–39, by commercial and Government-and-contractor operations and by uses

	1938			1939				
	Short tons	Value		Short tons	Value		Percent of change in—	
		Total	Average		Total	Average	Tonnage	Average value
COMMERCIAL OPERATIONS								
Sand:								
Glass	2,109,462	$3,601,734	$1.71	2,468,290	$4,280,936	$1.73	+17.0	+1.2
Molding	2,319,902	2,651,779	1.14	3,728,389	4,039,082	1.08	+60.7	−5.3
Building	22,939,683	12,888,823	.56	26,406,323	14,166,111	.54	+15.1	−3.6
Paving	16,755,634	9,388,865	.56	19,468,018	10,205,641	.52	+16.2	−7.1
Grinding and polishing [1]	502,328	754,805	1.50	668,027	895,989	1.34	+33.0	−10.7
Fire or furnace	108,093	124,343	1.15	172,348	197,500	1.15	+59.4	-------
Engine	1,378,450	786,639	.57	1,469,562	854,939	.58	+6.6	+1.8
Filter	93,711	137,283	1.46	173,013	195,142	1.13	+84.6	−22.6
Railroad ballast [2]	672,829	195,469	.29	1,259,367	332,715	.26	+87.2	−10.3
Other [3]	1,453,162	1,142,205	.79	1,799,537	1,417,617	.79	+23.8	-------
Total commercial sand	48,333,254	31,671,945	.66	57,612,874	36,585,672	.64	+19.2	−3.0
Gravel:								
Building	19,014,937	13,283,044	.70	21,106,812	13,785,942	.65	+11.0	−7.1
Paving	29,180,197	17,391,259	.60	27,387,327	16,791,795	.61	−6.1	+1.7
Railroad ballast [4]	7,271,502	2,179,462	.30	9,972,259	3,094,013	.31	+37.1	+3.3
Other [5]	1,959,896	490,168	.25	2,313,848	925,136	.40	+18.1	+60.0
Total commercial gravel	57,426,532	33,343,933	.58	60,780,246	34,596,886	.57	+5.8	−1.7
Total commercial sand and gravel	105,759,786	65,015,878	.61	118,393,120	71,182,558	.60	+11.9	−1.6
GOVERNMENT-AND-CONTRACTOR OPERATIONS [6]								
Sand:								
Building	2,157,501	890,224	.41	4,183,505	1,565,613	.37	+93.9	−9.8
Paving	6,623,073	1,373,556	.21	5,281,681	1,411,053	.27	−20.3	+28.6
Total Government-and-contractor sand	8,780,574	2,263,780	.26	9,465,186	2,976,666	.31	+7.8	+19.2
Gravel:								
Building	7,299,822	2,454,783	.34	9,818,748	4,905,420	.50	+34.5	+47.1
Paving	59,480,051	16,188,406	.27	57,141,479	16,159,403	.28	−3.9	+3.7
Total Government-and-contractor gravel	66,779,873	18,643,189	.28	66,960,227	21,064,823	.31	+0.3	+10.7
Total Government-and-contractor sand and gravel	75,560,447	20,906,969	.28	76,425,413	24,041,489	.31	+1.1	+10.7
COMMERCIAL AND GOVERNMENT-AND-CONTRACTOR OPERATIONS								
Sand	57,113,828	33,935,725	.59	67,078,060	39,562,338	.59	+17.4	-------
Gravel	124,206,405	51,987,122	.42	127,740,473	55,661,709	.44	+2.8	+4.8
Grand total	181,320,233	85,922,847	.47	194,818,533	95,224,047	.49	+7.4	+4.3

[1] Includes blast sand as follows: 1938, 205,753 tons valued at $509,178; 1939, 220,240 tons, $542,915.
[2] Includes ballast sand produced by railroads for their own use as follows: 1938, 128,079 tons valued at $25,806; 1939, 152,723 tons, $21,998.
[3] Includes some sand used by railroads for fills and similar purposes as follows: 1938, 113,606 tons valued at $17,466; 1939, 137,158 tons, $21,366.
[4] Includes ballast gravel produced by railroads for their own use as follows: 1938, 3,590,684 tons valued at $645,133; 1939, 4,617,468 tons, $752,670.
[5] Includes some gravel used by railroads for fills and similar purposes as follows: 1938, 922,742 tons valued at $75,893; 1939, 824,959 tons, $80,090.
[6] By States, counties, municipalities, and other Government agencies directly or under lease.

Sand and gravel sold or used by commercial producers in 1939 for all purposes except gravel for paving increased substantially over 1938. The largest advances were in railroad-ballast, filter, molding, and fire or furnace sand. Sales of railroad-ballast gravel also were appreciably higher.

In general the average value per ton of sand and gravel sold or used by commercial producers in 1939 was slightly below 1938, indicating somewhat lower prices.

PRODUCTION

Except for small supplies to meet seasonal peaks, stocks are of little consequence in the sand and gravel industry, and the quantity of materials sold or used by producers is virtually equivalent to production. Throughout this report sales and production are used interchangeably.

Because of the drop in production of paving gravel the increase in relative importance of gravel was interrupted in 1939. It comprised only 66 percent of the total tonnage compared with 69 percent in 1938 and 67 percent in 1937. Although a large part of the rise in gravel output in recent years represents Government-and-contractor production used in low-type roads there also is evidence that gravel is being used increasingly as coarse aggregate, particularly in bituminous-highway construction.

Complete production data for 1939 are included in this report. Statistics of sand and gravel sold or used by commercial and Government-and-contractor producers from 1935 to 1939 are summarized in the following table.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States, 1935–39

Year	Sand		Gravel (including railroad ballast)		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1935	40,433,559	$25,867,222	83,490,364	$36,110,157	123,923,923	$61,977,379
1936	60,303,394	35,926,994	118,026,420	54,380,758	178,329,814	90,307,752
1937	63,385,071	40,412,497	126,275,352	57,060,500	189,660,423	97,472,997
1938	57,113,828	33,935,725	124,206,405	51,987,122	181,320,233	85,922,847
1939	67,078,060	39,562,338	127,740,473	55,661,709	194,818,533	95,224,047

New York, California, Illinois, Ohio, and Michigan were the leading States in output of sand and gravel by commercial producers in 1939. Pennsylvania, however, ranked second in value because of its large production of glass and other relatively high priced industrial sands.

Details of production in 1939 by States and uses are given in the following tables.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1939, 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			80,140	$69,924	173,148	$81,369	4,616	$2,898
Alaska					(1)	(1)		
Arizona					16,991	15,986	108,757	16,002
Arkansas	(1)	(1)	(1)	(1)	142,633	74,638	295	330
California	(1)	(1)	35,483	89,565	4,040,854	1,882,534	63,201	13,120
Colorado			(1)	(1)	222,641	113,607	(1)	(1)
Connecticut					365,342	231,314	202,500	22,500
Delaware			600	350	29,644	18,041		
Florida					519,208	343,186	1,781	665
Georgia	9,344	$7,475	(1)	(1)	165,513	55,724	75	55
Idaho					16,485	9,089	5,483	3,760
Illinois	(1)	(1)	486,490	467,955	1,405,244	585,234	(1)	(1)
Indiana			189,043	122,872	1,115,715	495,575	4,023	2,191
Iowa			(1)	(1)	494,149	253,211	(1)	(1)
Kansas					653,772	284,046	19,822	3,720
Kentucky			5,242	11,470	70,235	56,825	300	300
Louisiana					342,503	119,412	75	55
Maine					7,013	5,714	1,300	65
Maryland	(1)	(1)			924,794	622,320	400	600
Massachusetts			(1)	(1)	799,121	402,299	11,003	1,129
Michigan	(1)	(1)	907,438	230,651	727,039	296,084	106,797	27,430
Minnesota	(1)	(1)	12,791	14,480	770,214	299,720	895,804	56,698
Mississippi					121,336	51,304	44,252	11,648
Missouri	(1)	(1)	34,900	22,694	882,742	505,580	35,131	5,746
Montana					84,860	53,114	2,857	2,976
Nebraska					230,392	69,116	5,400	320
Nevada	(1)	(1)	7,840	14,549	22,007	20,637	7,927	14,535
New Hampshire					13,941	5,348	2,061	300
New Jersey	239,215	337,519	584,075	863,221	1,023,053	569,611		
New Mexico					(1)	(1)	6,636	1,659
New York			354,113	578,110	4,700,137	2,412,146	(1)	(1)
North Carolina					138,850	45,759	563	515
North Dakota					9,868	5,119	378	310
Ohio	(1)	(1)	494,421	837,443	1,347,031	893,698	57,661	21,286
Oklahoma	(1)	(1)	(1)	(1)	202,905	98,612	628	490
Oregon					202,594	154,304	14,220	14,120
Pennsylvania	(1)	(1)	265,085	413,168	1,429,983	1,309,300	400	1,800
Rhode Island			(1)	(1)	67,523	25,367	13,500	15,000
South Carolina					107,886	48,966	14,402	1,485
South Dakota					27,973	14,283	100,482	5,811
Tennessee	(1)	(1)	51,336	87,807	367,913	340,143	141,224	73,175
Texas	(1)	(1)	5,496	8,474	597,428	355,575	134,886	58,985
Utah			(1)	(1)	127,526	57,662	11,243	6,146
Vermont					(1)	(1)	2,375	983
Virginia	(1)	(1)	6,530	4,250	338,508	173,987	7,447	955
Washington			1,081	1,761	364,814	157,727	1,741,406	1,046,776
West Virginia	(1)	(1)	(1)	(1)	269,185	263,042	1,651	818
Wisconsin			76,600	48,078	694,332	264,028	259,778	79,008
Wyoming					7,341	7,901	9,074	9,154
Undistributed [2]	2,219,731	3,935,942	129,685	152,260	23,937	17,854	141,691	40,094
	2,468,290	4,280,936	3,728,389	4,039,082	26,406,323	14,166,111	4,183,505	1,565,613

See footnotes at end of table.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1939, by States and uses—Continued

State	Sand—Continued							
	Paving				Grinding and polishing [3]		Fire or furnace	
	Commercial		Government-and-contractor					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	163,005	$83,833	166,046	$70,712	(1)	(1)		
Alaska	(1)	(1)	398	885				
Arizona	38,224	26,788	91,515	35,128				
Arkansas	123,031	97,434	2,777	1,062				
California	1,475,201	603,727	224,172	42,841	10,252	$24,702	(1)	(1)
Colorado	39,386	16,482	(1)	(1)	1,743	1,421		
Connecticut	195,117	115,593	445,756	37,783	(1)	(1)		
Delaware	(1)	(1)			3,218	6,436	2,530	$1,847
Florida	130,705	107,409	13,684	2,136				
Georgia	89,745	39,435	1,849	812	(1)	(1)		
Idaho	(1)	(1)	86,396	30,810				
Illinois	879,337	383,288	(1)	(1)	(1)	(1)	(1)	(1)
Indiana	660,182	352,001	311	185			50,000	15,000
Iowa	368,522	147,534	(1)	(1)	(1)	(1)		
Kansas	495,271	199,351	36,629	11,805	1,252	796		
Kentucky	400,284	274,562	200	50				
Louisiana	242,012	156,585	184	136	(1)	(1)		
Maine	6,716	1,003	22,748	17,450				
Maryland	735,968	504,564	9,700	970	(1)	(1)	(1)	(1)
Massachusetts	896,681	382,494	57,700	8,377	428	290		
Michigan	1,621,071	538,114	96,956	24,346	94,467	13,178		
Minnesota	289,932	110,278	144,425	17,937	440	1,100	310	930
Mississippi	359,106	158,065	405	300	(1)	(1)		
Missouri	511,491	277,536	15,893	4,816	(1)	(1)	(1)	(1)
Montana	6,546	6,460	4,804	4,795				
Nebraska	143,274	40,976	146,340	38,762	484	141	1,350	405
Nevada	375	267	284	53	312	744		
New Hampshire	40,207	14,581	600,263	38,444				
New Jersey	1,272,599	670,994	3,367	314	51,269	104,284	24,167	32,262
New Mexico			108,590	108,218				
New York	2,289,535	1,008,178	(1)	(1)	(1)	(1)		
North Carolina	351,408	124,379	1,275,345	332,869				
North Dakota	(1)	(1)	2,735	1,146				
Ohio	1,469,120	850,604	705	274	(1)	(1)	(1)	(1)
Oklahoma	109,523	42,012	53,844	13,155				
Oregon	42,427	30,272	12,548	6,447				
Pennsylvania	1,504,760	1,423,115	1,300	1,150	190,564	182,944	15,593	25,220
Rhode Island	(1)	(1)	46,651	39,070				
South Carolina	84,151	29,431	72,970	20,067	(1)	(1)		
South Dakota	35,869	19,304	41,225	24,940				
Tennessee	349,199	288,842	596	446	29,478	49,254	133	147
Texas	776,495	401,674	26,456	25,237	(1)	(1)		
Utah	48,939	28,154	89,588	51,399				
Vermont	12,377	11,087	10,443	4,872	51,772	3,766		
Virginia	256,405	119,099	224,888	44,911			2,700	1,080
Washington	163,649	90,547	76,568	33,577	750	288		
West Virginia	238,711	189,241	2,332	1,073	(1)	(1)		
Wisconsin	477,076	203,610	324,471	94,007	29,486	57,654		
Wyoming			61,965	52,612				
Undistributed [2]	74,386	36,738	675,659	164,674	202,112	448,991	75,565	120,609
	19,468,018	10,205,641	5,281,681	1,411,053	668,027	895,989	172,348	197,500

See footnotes at end of table.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1939, by States and uses—Continued

State	Sand—Continued							
	Engine		Filter		Railroad ballast [4]		Other [5]	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(1)	(1)						
Alaska								
Arizona	4,588	$2,758	(1)	(1)	386	$193	4,890	$2,014
Arkansas	(1)	(1)						
California	22,019	7,880	(1)	(1)	(1)	(1)	61,002	35,069
Colorado	16,937	14,511	325	$1,101	(1)	(1)	38,316	11,746
Connecticut	(1)	(1)	(1)	(1)			(1)	(1)
Delaware	40,100	13,325	2,390	4,780			1,702	1,191
Florida	(1)	(1)			10,117	2,000		
Georgia	18,590	4,832	1,677	5,031			4,483	2,242
Idaho	(1)	(1)					927	298
Illinois	66,518	33,145	(1)	(1)	(1)	(1)	122,477	201,861
Indiana	62,971	23,745	(1)	(1)	(1)	(1)	39,554	14,224
Iowa	32,919	17,547	(1)	(1)	5,649	1,014	(1)	(1)
Kansas	27,119	13,208	(1)	(1)	(1)	(1)	17,423	5,339
Kentucky	27,567	20,954						
Louisiana	14,616	4,422	4,777	764	(1)	(1)	(1)	(1)
Maine	1,721	513						
Maryland	(1)	(1)						
Massachusetts	(1)	(1)	2,231	817			141,166	57,008
Michigan	(1)	(1)			(1)	(1)	136,886	24,382
Minnesota	29,946	5,867	750	2,062	(1)	(1)	38,138	12,330
Mississippi	17,867	6,468			(1)	(1)	5,260	2,613
Missouri	24,289	13,028			50,269	21,500	50,522	55,341
Montana	720	72			49,237	6,148	54,283	10,439
Nebraska	39,683	11,782	1,400	250	(1)	(1)	8,719	1,205
Nevada					(1)	(1)	(1)	(1)
New Hampshire							(1)	(1)
New Jersey	(1)	(1)	53,191	63,505			(1)	(1)
New Mexico	(1)	(1)						
New York	96,296	44,493	(1)	(1)	(1)	(1)	251,291	91,535
North Carolina	28,500	14,100	2,000	2,000			32,785	15,061
North Dakota							1,733	859
Ohio	(1)	(1)	5,758	8,413	(1)	(1)	174,852	405,596
Oklahoma	23,223	11,456			(1)	(1)	(1)	(1)
Oregon	(1)	(1)			4,489	1,040	9,074	5,212
Pennsylvania	215,603	229,755	(1)	(1)			139,767	143,251
Rhode Island			(1)	(1)				
South Carolina	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
South Dakota								
Tennessee	19,891	17,778					(1)	(1)
Texas	43,931	20,152	(1)	(1)	112,701	23,748	94,582	65,333
Utah	(1)	(1)					(1)	(1)
Vermont	(1)	(1)			(1)	(1)		
Virginia	61,519	24,906			360	144	63,316	38,602
Washington	22,562	3,267			1,603	456	41,447	15,160
West Virginia	190,484	148,627	174	701	(1)	(1)	(1)	(1)
Wisconsin	55,584	9,310	(1)	(1)	47,445	13,080	(1)	(1)
Wyoming							3,822	1,365
Undistributed [2]	263,799	137,038	98,340	105,718	977,111	263,392	261,120	198,341
	1,469,562	854,939	173,013	195,142	1,259,367	332,715	1,799,537	1,417,617

See footnotes at end of table.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1939, 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	Vaue	Short tons	Value
Alabama	209, 643	$107, 109	42, 139	$7, 093	318, 955	$211, 911	58, 850	$20, 458
Alaska	(1)	(1)	-----	-----	(1)	(1)	41, 934	22, 227
Arizona	(1)	(1)	263, 205	99, 828	39, 037	30, 434	25, 741	13, 482
Arkansas	55, 702	39, 253	22, 957	8, 478	149, 459	113, 153	1, 551, 802	443, 986
California	3, 689, 401	1, 940, 781	191, 357	66, 064	1, 972, 440	1, 051, 647	1, 369, 041	496, 024
Colorado	207 334	151, 907	(1)	(1)	78, 843	40, 983	(1)	(1)
Connecticut	326, 217	269, 168	236, 250	26, 250	41, 064	22, 840	120, 670	18, 981
Delaware	5, 515	5, 100	-----	-----	(1)	(1)	-----	-----
Florida	(1)	(1)	246	137	(1)	(1)	11, 045	3, 545
Georgia	445	636	246	137	1, 299	928	24, 516	15, 460
Idaho	(1)	(1)	90, 365	22, 190	42, 279	13, 947	1, 228, 174	498, 017
Illinois	1, 489, 468	726, 724	(1)	(1)	1, 739, 703	748, 526	(1)	(1)
Indiana	861, 114	566, 924	39, 684	21, 877	1, 996, 421	1, 281, 591	401, 086	92, 873
Iowa	273, 194	227, 107	(1)	(1)	1, 061, 374	507, 109	(1)	(1)
Kansas	85, 640	53, 385	486	54	270, 428	144, 860	315, 993	96, 915
Kentucky	(1)	(1)	-----	-----	388, 962	289, 412	25, 000	6, 250
Louisiana	677, 475	374, 474	246	137	560, 224	412, 585	38, 045	5, 545
Maine	(1)	(1)	8, 100	7, 500	17, 969	10, 776	3, 080, 519	803, 184
Maryland	773, 743	853, 097	-----	-----	668, 191	772, 996	166, 800	20, 476
Massachusetts	504, 008	354, 814	57	6	603, 793	346, 173	230, 233	34, 933
Michigan	956, 057	557, 579	621, 872	178, 462	1, 847, 062	832, 649	2, 912, 762	922, 364
Minnesota	504, 214	505, 366	456, 748	128, 627	638, 598	297, 027	3, 693, 752	309, 446
Mississippi	48, 998	23, 758	69, 427	33, 368	927, 521	459, 881	587, 405	24, 032
Missouri	423, 111	209, 269	5, 144	2, 862	866, 023	435, 474	538, 404	275, 417
Montana	375, 332	162, 507	67, 620	59, 541	94, 594	62, 177	2, 475, 457	1, 047, 312
Nebraska	439, 695	168, 461	14, 850	2, 500	811, 965	294, 605	640, 396	244, 345
Nevada	(1)	(1)	42, 171	28, 567	78, 986	30, 361	1, 141, 411	284, 142
New Hampshire	19, 657	17, 380	3, 511	420	58, 658	41, 978	1, 317, 611	99, 045
New Jersey	492, 806	325, 653	-----	-----	488, 742	340, 322	5, 118	569
New Mexico	(1)	(1)	219, 280	434, 313	-----	-----	1, 498, 227	587, 614
New York	2, 520, 181	1, 505, 028	(1)	(1)	2, 222, 875	1, 302, 435	(1)	(1)
North Carolina	(1)	(1)	246	137	262, 640	258, 096	86, 375	41, 582
North Dakota	(1)	(1)	352	215	39, 954	23, 411	1, 081, 238	47, 147
Ohio	1, 024, 902	737, 644	53, 125	7, 036	2, 484, 264	1, 648, 845	344, 256	65, 077
Oklahoma	49, 935	43, 974	2, 205	1, 040	137, 041	65, 989	236, 492	70, 344
Oregon	321, 112	197, 736	74, 233	42, 609	494, 945	268, 047	1, 684, 532	393, 356
Pennsylvania	1, 063, 890	952, 811	-----	-----	1, 308, 685	1, 173, 396	112, 251	18, 418
Rhode Island	31, 572	17, 739	28, 485	30, 165	47, 864	19, 773	91, 572	68, 437
South Carolina	99, 421	102, 614	516	937	78, 108	77, 119	11, 045	3, 545
South Dakota	15, 146	14, 439	15, 715	1, 540	43, 344	14, 565	2, 182, 633	618, 240
Tennessee	248, 436	211, 595	117, 352	84, 106	643, 905	487, 906	352, 719	95, 753
Texas	723, 398	569, 097	277, 147	100, 769	1, 506, 743	1, 178, 604	2, 219, 779	354, 583
Utah	166, 298	78, 853	38, 201	19, 417	86, 806	47, 405	1, 532, 979	772, 622
Vermont	414	104	15, 385	302	(1)	(1)	336, 639	180, 303
Virginia	405, 112	351, 491	100, 649	76, 426	382, 126	350, 387	697, 561	145, 618
Washington	420, 915	207, 751	4, 936, 918	2, 963, 815	385, 195	260, 120	3, 244, 291	1, 218, 793
West Virginia	252, 321	232, 867	-----	-----	329, 076	253, 613	122, 889	31, 743
Wisconsin	703, 573	337, 658	179, 935	63, 483	1, 009, 489	445, 381	2, 144, 588	792, 951
Wyoming	3, 316	2, 072	14, 412	11, 596	97, 020	47, 445	1, 150, 682	560, 887
Undistributed [2]	638. 101	582, 017	1, 567, 911	373, 416	64, 657	74, 913	16,008,966	4, 293, 362
	21, 106, 812	13, 785, 942	9, 818, 748	4, 905, 420	27, 387, 327	16, 791, 795	57, 141, 479	16, 159. 403

See footnotes at end of table.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1939, by States and uses—Continued

State	Gravel—Continued				Sand and gravel			
	Railroad ballast [6]		Other [7]		Total commercial		Total Government-and-contractor	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	----------	----------	(1)	(1)	1,011,926	$586,104	271,651	$101,161
Alaska	----------	----------	----------	----------	(1)	(1)	42,332	23,112
Arizona	(1)	(1)	4,615	$5,888	165,937	96,876	489,218	164,440
Arkansas	502,068	$145,579	(1)	(1)	1,068,962	576,414	1,577,831	453,856
California	331,577	50,905	75,698	56,499	11,813,635	6,093,165	1,847,771	618,049
Colorado	----------	----------	(1)	(1)	627,306	361,747	(1)	(1)
Connecticut	(1)	(1)	6,373	2,028	983,757	667,649	1,005,176	105,514
Delaware	----------	----------	----------	----------	102,850	61,556	----------	----------
Florida	(1)	(1)	----------	----------	988,383	773,225	26,756	6,483
Georgia	----------	----------	----------	----------	301,487	129,891	26,686	16,464
Idaho	46,008	3,252	50,878	5,469	207,438	67,463	1,410,418	554,777
Illinois	1,369,190	492,037	125,145	46,786	8,755,193	4,686,487	(1)	(1)
Indiana	680,443	329,822	96,977	48,125	5,804,065	3,271,171	445,104	117,126
Iowa	177,333	59,490	(1)	(1)	2,503,988	1,299,449	(1)	(1)
Kansas	7,100	3,950	1,873	2,070	1,561,829	709,811	372,930	112,494
Kentucky	(1)	(1)	----------	----------	1,075,915	771,002	25,500	6,600
Louisiana	231,477	110,421	(1)	(1)	2,107,243	1,189,176	38,550	5,873
Maine	114,032	30,949	(1)	(1)	199,497	60,447	3,112,667	828,199
Maryland	----------	----------	----------	----------	3,134,129	2,805,222	176,900	22,046
Massachusetts	53,378	7,650	199,738	66,354	3,263,105	1,674,484	298,993	44,445
Michigan	306,792	110,104	135,772	49,617	7,009,620	2,934,906	3,738,387	1,152,602
Minnesota	745,637	126,051	144,437	22,438	3,310,482	1,429,722	5,190,729	512,708
Mississippi	82,760	18,539	62,277	18,150	1,635,353	741,585	701,489	69,348
Missouri	127,384	67,939	(1)	(1)	3,262,834	2,022,154	594,572	288,841
Montana	904,774	237,581	184,469	24,976	1,754,815	563,474	2,550,738	1,114,624
Nebraska	(1)	(1)	3,671	4,029	1,687,156	592,439	806,986	285,927
Nevada	(1)	(1)	----------	----------	138,017	125,750	1,191,793	327,297
New Hampshire	----------	----------	(1)	(1)	144,548	81,087	1,923,446	138,209
New Jersey	----------	----------	46,616	33,594	4,310,812	3,361,072	8,485	883
New Mexico	(1)	(1)	----------	----------	(1)	(1)	1,832,733	1,131,804
New York	2,165	740	75,363	60,536	12,608,128	7,050,104	(1)	(1)
North Carolina	(1)	(1)	----------	----------	1,021,243	626,266	1,362,529	375,103
North Dakota	183,743	14,901	108,180	10,944	380,035	79,461	1,084,703	48,818
Ohio	675,374	319,360	121,303	93,423	8,204,738	6,501,810	455,747	93,673
Oklahoma	----------	----------	626	279	565,891	315,449	293,169	85,029
Oregon	262,700	114,067	(1)	(1)	1,359,384	776,788	1,785,533	456,532
Pennsylvania	----------	----------	57,050	47,493	6,665,641	6,730,854	113,951	21,368
Rhode Island	----------	----------	(1)	(1)	203,349	112,959	180,208	152,672
South Carolina	26,318	5,264	(1)	(1)	447,495	287,724	98,933	26,034
South Dakota	63,368	7,672	13,662	1,252	199,362	71,515	2,340,055	650,531
Tennessee	(1)	(1)	(1)	(1)	2,077,953	1,713,876	611,891	253,480
Texas	981,023	366,734	89,041	70,788	4,964,041	3,130,849	2,658,268	539,574
Utah	74,120	22,527	807	181	546,667	250,429	1,672,011	849,584
Vermont	73,879	15,906	----------	----------	164,406	51,772	364,842	186,460
Virginia	35,175	21,599	(1)	(1)	1,609,245	1,157,798	1,030,545	267,910
Washington	387,150	33,391	129.868	15,190	1,919,034	785,658	9,999,183	5,262,961
West Virginia	(1)	(1)	52,951	43,495	1,841,980	2,002,386	126,872	33,634
Wisconsin	775,257	146,298	225,861	47,304	4,115,950	1,586,755	2,908,772	1,029,449
Wyoming	327,488	52,990	----------	----------	438,987	111,773	1,236,133	634,249
Undistributed [2]	424,546	178,295	300,597	148,228	129,309	104,804	18,394,227	4,871,546
	9,972,259	3,094,013	2,313,848	925,136	118,393,120	71,182,558	76,425,413	24,041,489

[1] Included under "Undistributed."
[2] Includes, in addition to items entered as "1," estimate for sand and gravel produced on W. P. A. projects.
[3] Includes 220,240 tons of blasts and valued at $542,915.
[4] Includes 152,723 tons of ballast sand valued at $21,998, produced by railroads for their own use.
[5] Includes 137,158 tons of sand valued at $21,366, used by railroads for fills and similar purposes.
[6] Includes 4,617,468 tons of ballast gravel valued at $752,670, produced by railroads for their own use.
[7] Includes 824,959 tons of gravel valued at $80,090, 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 1939, by States

State	Short tons	Value	State	Short tons	Value
Alabama	1,283,577	$687,265	Nevada	1,329,810	$453,047
Alaska	[1] 42,332	[1] 23,112	New Hampshire	2,067,994	219,296
Arizona	655,155	261,316	New Jersey	4,319,297	3,361,955
Arkansas	2,646,793	1,030,270	New Mexico	[1] 1,832,733	[1] 1,131,804
California	13,661,406	6,711,214	New York	[2] 12,608,128	[2] 7,050,104
Colorado	[2] 627,306	[2] 361,747	North Carolina	2,383,772	1,001,369
Connecticut	1,988,933	773,163	North Dakota	1,464,738	128,279
Delaware	102,850	61,556	Ohio	8,660,485	6,595,483
Florida	1,015,139	779,708	Oklahoma	859,060	400,478
Georgia	328,173	146,355	Oregon	3,144,917	1,233,320
Idaho	1,617,856	622,240	Pennsylvania	6,779,592	6,752,222
Illinois	[2] 8,755,193	[2] 4,686,487	Rhode Island	383,557	265,631
Indiana	6,249,169	3,388,297	South Carolina	546,428	313,758
Iowa	[2] 2,503,988	[2] 1,299,449	South Dakota	2,539,417	722,046
Kansas	1,934,759	822,305	Tennessee	2,689,844	1,967,356
Kentucky	1,101,415	777,602	Texas	7,622,309	3,670,423
Louisiana	2,145,793	1,195,049	Utah	2,218,678	1,100,013
Maine	3,312,164	888,646	Vermont	529,248	238,232
Maryland	3,311,029	2,827,268	Virginia	2,639,790	1,425,708
Massachusetts	3,562,098	1,718,929	Washington	11,918,217	6,048,619
Michigan	10,748,007	4,087,508	West Virginia	1,968,852	2,036,020
Minnesota	8,501,211	1,942,430	Wisconsin	7,024,722	2,616,204
Mississippi	2,336,842	810,933	Wyoming	1,675,120	746,022
Missouri	3,857,406	2,310,995	Undistributed [3]	18,523,536	4,976,350
Montana	4,305,553	1,678,098			
Nebraska	2,494,142	878,366		194,818,533	95,224,047

[1] Output of commercial producers included under "Undistributed."
[2] Output of Government-and-contractor operations included under "Undistributed."
[3] Includes items covered by "1" and "2."

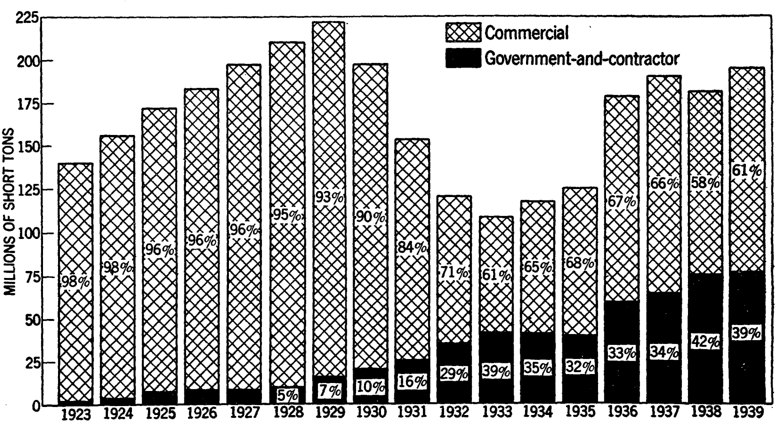

FIGURE 2.—Sand and gravel sold or used by commercial and Government-and-contractor producers, 1923–39.

Government-and-contractor production.—Production of sand and gravel by State highway departments and other similar Government agencies has been largely a development of the depression. (See fig. 2.) Before 1929 less than 5 percent of the total tonnage of sand and gravel reported to the Bureau of Mines was from such operations. By 1931, however, this material had increased to 16 percent of the total tonnage, and in the canvass for 1932 it received special attention. As a result there is some upward bias in the "noncommercial" figure for 1932. Since then, however, the coverage has been reasonably comparable from year to year. The growth of the material included in this category seems to parallel the development of portable plants for production of sand and gravel. It also has been allied closely with secondary-roads programs throughout the United States and various phases of work relief. Production of road materials from wayside sources has been one of the most common forms of relief activity.

This so-called "noncommercial" production comprised 42 percent of the total tonnage in 1938 and 39 percent in 1939. The somewhat astonishing quantity in 1938 brought to a head the growing realization that "noncommercial" is not the proper term to classify this material. In 1939, 52 percent of the material was reported to have been produced directly by construction and maintenance crews of State highway departments, county road supervisors, municipal street departments, and agencies of the Federal Government such as the Forest Service, National Park Service, Bureau of Public Roads, Bureau of Reclamation, and others. The remaining 48 percent, although reported to the Bureau of Mines by these same agencies, actually was produced by contractors for use on specific jobs being done for the State highway departments or other units of local or Federal Governments. It is evident that this contractor production should not be included in a category labeled "noncommercial," even though it represents sand and gravel business that is not a part of the established commercial industry.

In this report the term "noncommercial" has been eliminated, and material formerly included in this category is referred to as "Government-and-contractor." Considerable thought has been given to the possibility of a direct canvass of contractor-producers, but it is impossible with funds now available to make this enlargement in the scope of the canvass. It is believed, however, after careful scrutiny of the 1938 and 1939 figures, that the reports from the State highway departments are accurate and reasonably complete. The same may be said of the reports from various Federal agencies, although for 1939 it was necessary to include estimates for material produced on W. P. A. projects. The greatest weakness of the coverage is in the county figures, but for the most part it is believed that activities of counties not reporting are limited to production of low-grade pit-run material that possibly should not even be considered part of the sand and gravel industry. As a matter of fact, of the 76,425,413 tons of sand and gravel reported by Government-and-contractor operations in 1939 only 23 percent was washed or screened. The rest was unprepared material having an average reported value of only 26 cents per ton. On the other hand, only 12 percent of the 118,393,120 tons reported by commercial operations was unprepared. The complete record of Government-and-contractor production is summarized in the following table:

Sand and gravel sold or used by Government-and-contractor producers in the United States, 1924–39, by uses

Year	Sand				Gravel				Total Government-and-contractor sand and gravel	
	Building		Paving		Building		Paving			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1924	80,634	$54,616	263,444	$211,352	55,045	$28,357	2,996,704	$1,927,517	3,395,827	$2,221,842
1925	[1]11,626	[1]15,896	1,189,860	383,781	4,200	4,527	5,805,913	3,164,576	7,011,599	3,568,780
1926	69,741	60,250	615,568	393,617	103,753	27,793	7,070,662	3,579,387	7,859,724	4,061,047
1927	28,436	16,435	790,465	472,683	5,304	2,981	7,322,457	4,397,088	8,146,662	4,889,187
1928	19,705	22,913	940,135	405,440	152,347	95,381	8,487,044	5,091,554	9,599,231	5,615,288
1929	9,889	5,914	2,253,854	819,179	42,273	19,967	14,047,155	6,910,775	16,353,171	7,755,835
1930	4,800	3,939	1,899,875	824,254	106,284	16,057	18,160,661	6,963,814	20,171,620	7,808,064
1931	24,276	7,491	2,096,907	1,156,772	49,799	37,993	22,369,373	8,606,311	24,540,355	9,808,567
1932	147,636	97,283	2,204,564	1,013,337	1,000,702	253,931	31,395,919	8,668,487	34,748,821	10,033,038
1933	163,257	84,131	1,972,692	751,201	650,873	253,529	38,862,055	12,589,022	41,648,877	13,677,883
1934	334,946	213,304	3,440,830	1,069,773	655,914	441,838	36,857,090	11,157,491	41,288,780	12,882,406
1935	543,457	272,053	2,114,112	497,781	822,525	352,346	35,836,358	9,611,223	39,316,452	10,733,403
1936	810,196	410,686	4,897,922	872,904	1,251,901	896,454	51,449,400	15,895,317	58,409,419	18,075,361
1937	1,540,280	595,953	4,704,764	1,157,162	2,961,360	1,396,202	55,111,541	15,209,362	64,317,945	18,358,679
1938	2,157,501	890,224	6,623,073	1,373,556	7,299,822	2,454,783	59,480,051	16,188,406	75,560,447	20,906,969
1939	4,183,505	1,565,613	5,281,681	1,411,053	9,818,748	4,905,420	57,141,479	16,159,403	76,425,413	24,041,489

[1] Includes a small quantity of filter sand.

The quantity of material reported by State highway departments in 1939 was 47 percent of the total Government-and-contractor output, and 63 percent of it was produced by contractors. Counties reported 21 percent of the total, of which only 27 percent was produced by contractors. Municipalities reported only about 3 percent of the total, and the remaining 29 percent was supplied largely by various Federal agencies. For the most part this material was produced on work projects of all types, reclamation projects, and road construction in the national parks, national forests, and elsewhere in relatively remote localities. Further details are given in the following table:

Sand and gravel sold or used by Government-and-contractor producers in the United States, 1936–39, by types of producers

Type of producer	1936		1937		1938		1939	
	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	31,206,204	$0.23	38,637,673	$0.21	44,745,693	$0.21	40,143,981	$0.25
Contractors	27,203,215	.40	25,680,272	.40	30,814,754	.37	36,281,432	.39
	58,409,419	.31	64,317,945	.29	75,560,447	.28	76,425,413	.31
States	33,004,590	.34	34,501,864	.29	38,434,738	.31	35,769,724	.29
Counties	20,869,867	.23	20,903,014	.22	23,892,718	.19	16,588,377	.24
Municipalities	2,126,985	.27	1,616,489	.29	2,232,786	.33	2,093,406	.26
Other agencies	2,407,977	.56	7,296,578	.42	11,000,205	.34	21,973,906	.41
	58,409,419	.31	64,317,945	.29	75,560,447	.28	76,425,413	.31

The State break-down of sand and gravel production in 1938 shows that the largest centers of production were in the Northeastern and Great Lakes States and that California, Texas, and Washington also were large producers. (See fig. 3.) Government-and-contractor

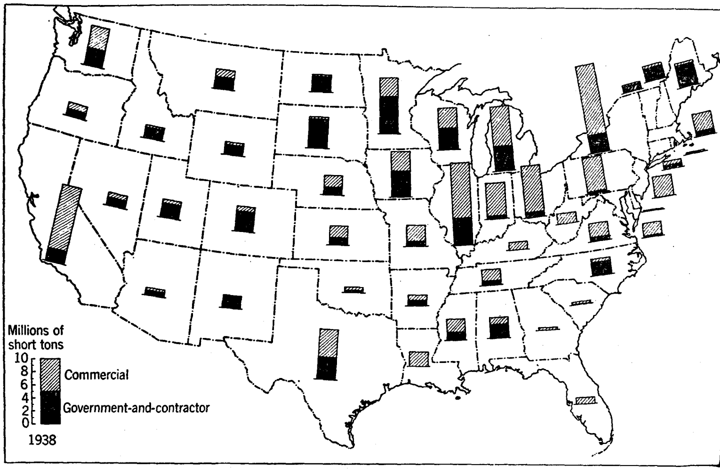

FIGURE 3.—Sand and gravel sold or used by commercial and Government-and-contractor producers in 1938, by States.

production is concentrated in northern New England, the Middle West, and the Rocky Mountain and Pacific Coast States, plus North Carolina and Alabama in the South. In only a few States—Michigan, Wisconsin, Minnesota, Iowa, Illinois, Texas, and Washington—is

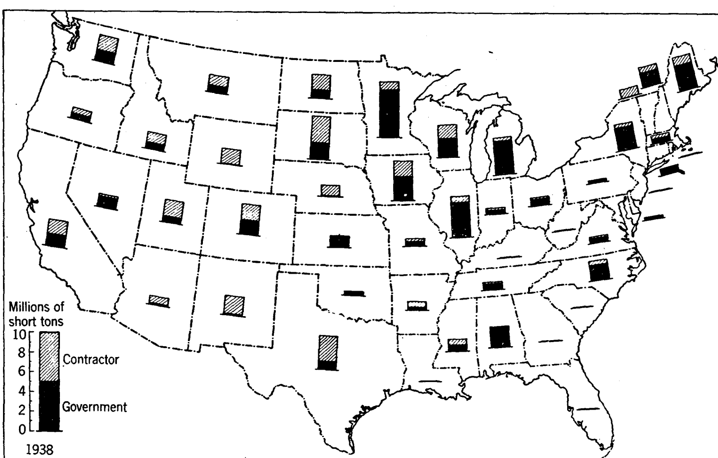

FIGURE 4.—Sand and gravel sold or used by Government and contractor producers in 1938, by States.

both commercial and Government-and-contractor production large. Commercial production predominates in the East and South and Government-and-contractor output in northern New England and the Rocky Mountain States.

Of even greater significance, perhaps, is the break-down between Government and contractor output. (See fig. 4.) Actual production by Government agencies on a large scale seems to be confined to relatively few States and is concentrated largely in the Middle West. This area, with Texas and the Rocky Mountain and Pacific Coast States, has witnessed the greatest development of contractor production. In general, data for 1939 show a similar relationship.

Method of transportation.—Shipments of sand and gravel originating on class I railroads in 1939 were 28,990,146 short tons, an increase of only 2 percent over the 28,383,925 tons shipped in 1938. This quantity was only 29 percent of the total commercial production reported in 1939, exclusive of glass and molding sand and nonrevenue railroad ballast, and indicates a continuing gain in sand and gravel moved by other means than rail, as rail shipments were equivalent to 31 percent of commercial production in 1938 and 36 percent in 1937.

Direct reports of methods of transporting sand and gravel were received from producers responsible for 90 percent of the total commercial output. These figures substantiate the drop in rail shipments and show a corresponding increase in shipments by truck. Details of shipments, by methods of transportation, follow.

Sand and gravel sold or used by commercial producers in the United States, 1938–39, by methods of transportation [1]

Method of transportation	1938		1939	
	Short tons	Percent of total reported	Short tons	Percent of total reported
Truck	39,142,876	43.0	48,040,422	45.2
Rail	37,675,155	41.3	42,118,042	39.6
Waterway	14,278,779	15.7	16,208,607	15.2
Total reported	91,096,810	100.0	106,367,071	100.0
Percent of total commercial production		86.1		89.8

[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 as follows—1938: Truck 69 percent, rail 23 percent, and waterway 8 percent; 1939: Truck 68 percent, rail 23 percent, and waterway 9 percent.

Preparation.—The average value per ton of sand and gravel reported by commercial producers is characteristically much higher than that of Government-and-contractor output. This difference is a direct result of the cost of washing, screening, or other preparation, as 88 percent of the commercial production in 1939 was prepared material compared with only 23 percent of the Government-and-contractor output.

Sand and gravel (prepared or unprepared) sold or used by producers in the Unite States, 1938–39, by commercial and Government-and-contractor operations

	1938			1939		
	Quantity		Average value per ton	Quantity		Average value per ton
	Short tons	Percent		Short tons	Percent	
Commercial operations:						
Prepared	92,825,363	88	$0.66	103,771,791	88	$0.64
Unprepared	12,934,423	12	.29	14,621,329	12	.31
	105,759,786	100	.61	118,393,120	100	.60
Government-and-contractor operations:						
Prepared	13,833,539	18	.49	17,430,070	23	.51
Unprepared	61,726,908	82	.23	58,995,343	77	.26
	75,560,447	100	.28	76,425,413	100	.31
Grand total	181,320,233		.47	194,818,533		.49

EMPLOYMENT AND OUTPUT PER MAN

Employment in the commercial sand and gravel industry, as well as output per man per hour, fluctuated only moderately from 1933 to 1938, inclusive. Available data for operations reporting about four-fifths of the total production of sand and gravel indicate that employment in the industry averaged about 19,000 men from 1936 to 1938. Before 1936 the total was somewhat lower because of curtailed output.

Production per man per hour likewise has not varied widely from year to year, although there was a definite upward trend from 2.8 tons in 1933 to 3.3 in 1937. The slight recession to 3.2 tons in 1938 apparently was due directly to the drop in production.

The average working day remained fairly constant throughout the period, dropping from 8.7 in 1933 to 8.1 in 1934, then increasing after the demise of the N. R. A. to 8.6 in 1936 and 1937 and 8.5 in 1938. The number of actual working days has fluctuated widely, however, in direct ratio to volume of production. In 1933, the low point of sand and gravel output, the average employee worked only 155 days compared with 215 in 1937.

Employment in the commercial sand and gravel industry, sand and gravel produced at plants included in the study, and average output per man in the United States, 1933–38 [1]

Year	Employment					Production			Percent of commercial industry represented
	Average number of men	Time employed				Commercial sand and gravel, short tons	Average per man, short tons		
		Average number of days	Total man-shifts	Man-hours			Per shift	Per hour	
				Average per man per day	Total				
1933	12,536	155	1,947,225	8.7	16,937,862	47,215,123	24.2	2.8	71.4
1934	14,611	168	2,452,835	8.1	19,897,633	59,018,238	24.1	3.0	78.4
1935	11,926	197	2,351,453	8.3	19,578,368	60,826,691	25.9	3.1	75.4
1936	16,127	207	3,332,532	8.6	28,672,615	95,219,468	28.6	3.3	83.8
1937	16,062	215	3,458,994	8.6	29,754,746	97,113,001	28.1	3.3	81.8
1938	14,971	201	3,001,796	8.5	25,578,807	81,742,896	27.2	3.2	81.1

[1] Does not include plants operated by or directly for States, counties, municipalities, and other Government agencies.

In general the output of sand and gravel per man-hour of employment ranges from a relatively low figure in the Eastern and Southeastern States to much higher production in the Middle Western and Far Western States. The unusually high productivity in region 16 comprising Montana, Washington, Oregon, and Idaho apparently is due largely to the highly mechanized operations in connection with dam construction.

Complete details by regions from 1935 to 1938 are summarized in the following table. Comparable data for 1934 were published in Minerals Yearbook, 1936 (p. 844), and for 1933 in Minerals Yearbook, 1935 (p. 942).

Employment in the commercial sand and gravel industry, sand and gravel produced at plants included in the study, and average output per man in the United States, 1935–38, by regions [1]

Region	Employment					Production			Percent of commercial industry represented
	Average number of men	Time employed				Commercial sand and gravel (short tons)	Average per man (short tons)		
		Average number of days	Total man-shifts	Man-hours					
				Average per man per day	Total		Per shift	Per hour	
1935									
1. Maine, New Hampshire, Vermont, Rhode Island, Massachusetts, and Connecticut	250	199	49, 851	9. 1	454, 989	1, 328, 577	26. 7	2. 9	75. 2
2. New York	839	182	152, 565	8. 3	1, 260, 704	4, 575, 589	30. 0	3. 6	45. 5
3. Pennsylvania, New Jersey and Delaware	1, 593	212	337, 681	8. 7	2, 942, 240	6, 378, 727	18. 9	2. 2	92. 6
4. West Virginia, Virginia, Maryland and District of Columbia	674	221	148, 604	8. 9	1, 326, 504	2, 489, 703	16. 8	1. 9	51. 2
5. South Carolina, Georgia, Alabama, Florida, and Mississippi	317	183	58, 136	8. 5	495, 281	1, 289, 006	22. 2	2. 6	58. 5
6. North Carolina, Kentucky and Tennessee	427	266	113, 694	8. 0	911, 327	1, 762, 399	15. 5	1. 9	83. 8
7. Arkansas, Louisiana, and Texas	1, 136	215	244, 147	8. 4	2, 053, 169	4, 141, 870	17. 0	2. 0	77. 9
8. Ohio	1, 062	194	206, 129	8. 5	1, 760, 309	4, 280, 653	20. 8	2. 4	92. 0
9. Illinois and Indiana	1, 498	194	290, 628	8. 3	2, 409, 357	9, 588, 083	33. 0	4. 0	83. 0
10. Michigan and Wisconsin	798	169	135, 125	8. 6	1, 157, 527	5, 451, 883	40. 3	4. 7	84. 9
11. North Dakota, South Dakota, and Minnesota	271	146	39, 651	8. 5	335, 432	1, 382, 514	34. 9	4. 1	67. 2
12. Nebraska and Iowa	549	170	93, 146	7. 9	732, 301	3, 040, 840	32. 6	4. 2	78. 1
13. Kansas, Missouri, and Oklahoma	660	215	141, 838	7. 8	1, 108, 868	3, 585, 586	25. 3	3. 2	86. 1
14. Wyoming, Colorado, New Mexico, Utah, and Arizona	220	154	33, 984	8. 1	275, 546	866, 623	25. 5	3. 1	97. 2
15. California and Nevada	784	216	169, 014	7. 9	1, 328, 579	4, 208, 512	24. 9	3. 2	71. 0
16. Montana, Washington, Oregon, and Idaho	848	162	137, 260	7. 5	1, 026, 235	6, 456, 126	47. 0	6. 3	81. 6
Total United States	11, 926	197	2, 351, 453	8. 3	19, 578, 368	60, 826, 691	25. 9	3. 1	75. 4
1936									
1. Maine, New Hampshire, Vermont, Rhode Island, Massachusetts, and Connecticut	497	161	79, 775	8. 4	668, 403	2, 285, 735	28. 7	3. 4	81. 7
2. New York	1, 428	215	307, 700	8. 3	2, 544, 173	8, 952, 087	29. 1	3. 5	81. 6
3. Pennsylvania, New Jersey and Delaware	2, 176	212	461, 065	8. 8	4, 049, 180	8, 825, 112	19. 1	2. 2	91. 6
4. West Virginia, Virginia, Maryland, and District of Columbia	880	240	211, 540	9. 0	1, 902, 953	4, 444, 613	21. 0	2. 3	61. 4
5. South Carolina, Georgia, Alabama, Florida, and Mississippi	665	181	120, 233	9. 3	1, 115, 537	2, 285, 308	19. 0	2. 0	71. 4
6. North Carolina, Kentucky and Tennessee	805	224	180, 043	8. 8	1, 589, 406	2, 871, 476	15. 9	1. 8	93. 7
7. Arkansas, Louisiana, and Texas	1, 365	214	291, 819	8. 6	2, 504, 615	6, 284, 440	21. 5	2. 5	85. 7
8. Ohio	1, 287	199	256, 642	8. 9	2, 274, 122	7, 203, 707	28. 1	3. 2	95. 2
9. Illinois and Indiana	2, 104	207	436, 529	8. 3	3, 638, 942	16, 853, 798	38. 6	4. 6	94. 2
10. Michigan and Wisconsin	1, 134	180	204, 067	9. 2	1, 872, 606	9, 152, 742	44. 9	4. 9	86. 2

[1] Does not include plants operated by or directly for States, counties, municipalities, and other Government agencies.

Employment in the commercial sand and gravel industry, sand and gravel produced at plants included in the study, and average output per man in the United States, 1935–38, by regions—Continued

Region	Employment: Average number of men	Time employed: Average number of days	Time employed: Total man-shifts	Man-hours: Average per man per day	Man-hours: Total	Production: Commercial sand and gravel (short tons)	Average per man (short tons): Per shift	Average per man (short tons): Per hour	Percent of commercial industry represented
1936—Continued									
11. North Dakota, South Dakota, and Minnesota	317	155	49,245	8.4	413,814	1,872,325	38.0	4.5	68.2
12. Nebraska and Iowa	407	212	86,204	9.2	795,830	2,778,412	32.2	3.5	62.9
13. Kansas, Missouri, and Oklahoma	955	210	200,364	8.3	1,669,717	5,308,553	26.5	3.2	89.9
14. Wyoming, Colorado, New Mexico, Utah, and Arizona	161	194	31,216	8.4	263,614	842,099	27.0	3.2	74.6
15. California and Nevada	1,103	237	261,724	8.2	2,156,404	7,941,188	30.3	3.7	76.8
16. Montana, Washington, Oregon, and Idaho	843	183	154,366	7.9	1,213,299	7,317,873	47.4	6.0	83.8
Total United States	16,127	207	3,332,532	8.6	28,672,615	95,219,468	28.6	3.3	83.8
1937									
1. Maine, New Hampshire, Vermont, Rhode Island, Massachusetts, and Connecticut	445	173	77,000	8.6	662,510	2,637,040	34.2	4.0	83.6
2. New York	1,414	195	275,865	8.5	2,331,200	9,233,174	33.5	4.0	85.2
3. Pennsylvania, New Jersey, and Delaware	2,270	222	503,289	8.7	4,383,893	10,475,070	20.8	2.4	92.2
4. West Virginia, Virginia, Maryland, and District of Columbia	817	255	208,201	8.7	1,805,294	3,536,230	17.0	2.0	56.4
5. South Carolina, Georgia, Alabama, Florida, and Mississippi	689	218	150,219	9.5	1,423,711	3,661,903	24.4	2.6	76.2
6. North Carolina, Kentucky, and Tennessee	827	200	164,987	9.0	1,478,480	2,900,233	17.6	2.0	92.4
7. Arkansas, Louisiana, and Texas	1,077	212	227,827	8.8	1,997,357	4,998,502	21.9	2.5	65.7
8. Ohio	1,470	254	372,701	8.5	3,182,330	7,949,568	21.3	2.5	93.4
9. Illinois and Indiana	1,580	211	333,597	8.5	2,834,360	12,203,143	36.6	4.3	73.0
10. Michigan and Wisconsin	1,110	201	223,509	8.9	1,991,101	8,916,382	39.9	4.5	83.3
11. North Dakota, South Dakota, and Minnesota	280	171	47,855	8.4	402,423	1,683,971	35.2	4.2	63.1
12. Nebraska and Iowa	589	168	98,679	9.1	900,934	3,868,850	39.2	4.3	70.8
13. Kansas, Missouri, and Oklahoma	874	233	203,620	8.5	1,724,734	5,182,965	25.5	3.0	86.0
14. Wyoming, Colorado, New Mexico, Utah, and Arizona	283	205	58,056	8.1	470,507	1,919,598	33.1	4.1	85.3
15. California and Nevada	1,400	241	337,174	8.2	2,778,888	9,372,063	27.8	3.4	97.4
16. Montana, Washington, Oregon, and Idaho	937	188	176,415	7.9	1,387,024	8,574,309	48.6	6.2	89.3
Total United States	16,062	215	3,458,994	8.6	29,754,746	97,113,001	28.1	3.3	81.8
1938									
1. Maine, New Hampshire, Vermont, Rhode Island, Massachusetts, and Connecticut	477	159	75,712	8.5	644,048	3,050,951	40.3	4.7	84.8
2. New York	1,310	196	257,037	8.4	2,161,059	7,830,356	30.5	3.6	72.7
3. Pennsylvania, New Jersey, and Delaware	1,954	213	415,613	8.6	3,561,565	8,250,247	19.9	2.3	95.6

Employment in the commercial sand and gravel industry, sand and gravel produced at plants included in the study, and average output per man in the United States, 1935–38, by regions—Continued

Region	Employment: Average number of men	Time employed: Average number of days	Time employed: Total man-shifts	Man-hours: Average per man per day	Man-hours: Total	Production: Commercial sand and gravel (short tons)	Average per man (short tons): Per shift	Average per man (short tons): Per hour	Percent of commercial industry represented
1938—Continued									
4. West Virginia, Virginia, Maryland, and District of Columbia	839	244	204, 818	8. 8	1, 810, 840	3, 138, 453	15. 3	1. 7	55. 2
5. South Carolina, Georgia, Alabama, Florida, and Mississippi	669	239	159, 563	9. 1	1, 459, 781	3, 876, 320	24. 3	2. 7	83. 7
6. North Carolina, Kentucky and Tennessee	748	217	162, 166	8. 8	1, 433, 921	3, 190, 138	19. 7	2. 2	95. 1
7. Arkansas, Louisiana, and Texas	882	210	185, 104	8. 8	1, 625, 423	4, 012, 442	21. 7	2. 5	60. 7
8. Ohio	1, 363	220	300, 367	8. 4	2, 518, 027	6, 497, 022	21. 6	2. 6	91. 0
9. Illinois and Indiana	1, 658	189	313, 279	8. 5	2, 661, 992	11, 069, 241	35. 3	4. 2	85. 1
10. Michigan and Wisconsin	1, 059	180	190, 345	8. 8	1, 668, 762	7, 559, 898	39. 7	4. 5	86. 6
11. North Dakota, South Dakota, and Minnesota	471	123	58, 161	8. 4	486, 957	1, 668, 338	28. 7	3. 4	69. 2
12. Nebraska and Iowa	605	167	101, 203	9. 4	951, 042	3, 589, 801	35. 5	3. 8	77. 7
13. Kansas, Missouri, and Oklahoma	797	219	174, 502	8. 3	1, 443, 941	3, 748, 558	21. 5	2. 6	79. 0
14. Wyoming, Colorado, New Mexico, Utah, and Arizona	318	188	59, 852	7. 7	462, 726	1, 484, 134	24. 8	3. 2	83. 7
15. California and Nevada	1, 116	221	246, 967	8. 0	1, 966, 950	8, 359, 573	33. 8	4. 3	84. 0
16. Montana, Washington, Oregon, and Idaho	705	138	97, 107	7. 4	721, 773	4, 417, 424	45. 5	6. 1	86. 2
Total United States	14, 971	201	3, 001, 796	8. 5	25, 578, 807	81, 742, 896	27. 2	3. 2	81. 1

Analysis by the Bureau of Labor Statistics[2] of the records of 24 sand and gravel plants indicated that the production and distribution of 100 tons of sand and gravel required 94.5 man-hours of labor, distributed as follows:

	Man-hours per 100 tons
Production labor:	
Dry-pit	25. 4
Wet-pit	26. 3
Marine:	
Processing on dredge	41. 2
Processing on land	57. 9
Weighted average of all types	31. 0
Fuel and power	1. 6
Haulage to construction site	61. 9
Total labor requirements	94. 5

[2] Ball, J. A., Labor Requirements in Production and Distribution of Sand and Gravel: Bureau of Labor Statistics Serial R. 944, 1939, 13 pp.

PRICES

The general trend of sand and gravel prices continued slightly downward in 1939. The average value per ton, f. o. b. plant, of all sand and gravel reported by commercial producers dropped only 1 cent per ton—from $0.61 in 1938 to $0.60 in 1939—but that of material sold for major uses fluctuated more widely. Building sand declined from $0.56 to $0.54 per ton in average value, paving sand from $0.56 to $0.52, and building gravel from $0.70 to $0.65, whereas paving gravel and railroad-ballast gravel each increased 1 cent. Slightly higher average values were reported for glass and engine sand in 1939, but the values of other industrial sands dropped, the decline of 23 percent for filter sand being the most pronounced. The increase in value per ton of material reported by Government-and-contractor producers is due directly to the higher percentage of prepared material included in this category (18 percent in 1938 and 23 percent in 1939) rather than to actual higher valuation.

Wholesale price indexes for sand and gravel, compiled by the Bureau of Labor Statistics from returns of representative plants throughout the United States, confirm the decreases indicated by reports of commercial producers to the Bureau of Mines. The price index of building sand (1926=100) declined from 102.1 in 1938 to 99.7 in 1939, and that of gravel from 93.2 to 91.4. These decreases are especially significant because the index for all building materials was virtually the same—90.3 in 1938 and 90.5 in 1939. The composite index for all commodities dropped from 78.6 to 77.1 despite the sharp upturn in prices in the last 4 months of 1939 following outbreak of war in Europe.

NEW DEVELOPMENTS

Although the only huge new sand and gravel plant built in 1939 was one to supply aggregates for construction of a large dam, it was reported that producers were spending more money on improvements than at any time in the past decade.[3] The research program of the National Sand and Gravel Association was continued actively, and contacts with the University of Maryland were strengthened through establishment of the Stanton Walker fellowship available to graduate students in engineering. Of particular significance was the exemption early in 1940 of the northern branch of the sand and gravel industry from the maximum-hours provisions of the Fair Labor Standards Act.[4] Various phases of labor relations assumed increasing importance in the affairs of the industry during 1939.

The trend in plant construction in 1939, as in recent years, was toward medium and small plants designed for efficiency and flexibility of operation and for serving relatively small market areas. The problem of meeting seemingly ever-changing specifications was possibly the outstanding technical topic of the annual convention of the association.[5] In view of this interest in preparation of aggregates to meet rigid and varying specifications a series of articles begun in 1939

[3] Pit and Quarry, 1939 in Review—Sand and Gravel: Vol. 32, No. 7, January 1940, pp. 60–69.
[4] Pit and Quarry, Sand and Gravel Industry Gets Provisional Seasonal Exemption: Vol. 32, No. 8, February 1940, pp. 44–46.
[5] Pit and Quarry, Sand and Gravel Convention Draws Hundreds of Producers to St. Louis: Vol. 32, No. 8, February 1940, pp. 29–40, 53.
Rock Products, Changing Conditions Call for New Methods: Vol. 43, No. 2, February 1940, pp. 34–47, 72.

by Shaw [6] on washing and classifying sand has proved to be most timely. A new plant in Illinois using a sand-dewatering wheel is designed for blending any gradation of sand and gravel desired, as well as for ample storage.[7] Two types of sand and two grades of gravel are produced simultaneously for direct loading into barges by a Diesel-electric dredge operating in Maryland.[8] Methods of refining and grading sands have been changed completely at a large plant in Ohio.[9] At another Ohio plant masons' sand and concrete sand are produced as independent operations through a single blade-type sand washer.[10] Two plants featuring unusual flexibility have been described by Trauffer.[11] Nordberg [12] described a rather unique plant designed to receive pit-run material using large earth movers powered by tractors and to take care of intraplant handling by the same power units fitted with "dozing" attachments. The ingenious use of a suspended flume to dispose of excess fines when the river is below normal is an interesting feature of a Kansas plant.[13]

Problems of labor relations, research, and Federal and State legislation occupied producers of industrial sands during the year.[14] A combination of desliming and tabling methods has reduced the iron content of glass sand at a Texas plant to 0.06 percent.[15]

The eleventh annual accident-prevention contest, conducted by the Bureau of Mines in cooperation with the National Sand and Gravel Association, revealed an accident-frequency rate in 1939 of 26.132 accidents per million man-hours of exposure for the 77 participating plants. This was an improvement of 2 percent compared with the 1938 rate of 26.715. The Van Sciver lake plant, Tullytown, Bucks County, Pa., operated by the Warner Co., worked 142,982 man-hours without a disabling injury and won the trophy for the group of plants operating 100,000 or more man-hours. The trophy for the group operating less than 100,000 man-hours was won by the Oxford dry-bank plant, Oxford, Oakland County, Mich., operated by Ray Industries, Inc., which had a record of 59,655 man-hours without a disabling injury.

FOREIGN TRADE [16]

Except for 23,690 tons of glass sand (30 percent less than in 1938 and virtually all from Belgium consigned to the Pacific coast glass industry) imports of sand and gravel in 1939 were largely movements

[6] Shaw, Edmund, Washing-classifying Sand: Rock Products, vol. 42, No. 5, May 1939, pp. 23–24; vol. 42, No. 6, June 1939, pp. 41–42, 48; vol. 42, No. 7, July 1939, pp. 34–35; vol. 42, No. 8, August 1939, pp. 65–66; vol. 42, No. 9, September 1939, pp. 35–36; vol. 42, No. 10, October 1939, pp. 43–44; vol. 42, No. 11, November 1939, p. 37; vol. 42, No. 12, December 1939, pp. 39–41; vol. 43, No. 1, January 1940, pp. 27–28; vol. 43, No. 2, February 1940, pp. 27–28; vol. 43, No. 3, March 1940, pp. 39–40; vol. 43, No. 4, April 1940, p. 51; vol. 43, No. 5, May 1940, pp. 49–50.

[7] Torgerson, R. S., Sand Dewatering Wheel in This New Plant: Rock Products, vol. 42, No. 5, May 1939, pp. 26–28.

[8] Nordberg, Bror, Produce Two Sand Sizes on Diesel-electric Dredge: Rock Products, vol. 42, No. 4, April 1939, pp. 41–42.

[9] Welch, F. M., Change Grading Methods: Rock Products, vol. 42, No. 8, August 1939, pp. 25–27.

[10] Nordberg, Bror, Sand Drag Does Double Duty: Rock Products, vol. 42, No. 7, July 1939, pp. 24–25.

[11] Trauffer, W. E., An Outstanding Southern California Gravel Plant: Pit and Quarry, vol. 32, No. 8, February 1940, pp. 41–43, 46; Missouri Portland Cement Co. Builds Outstanding Gravel Plant at Memphis: Pit and Quarry, vol. 32, No. 9, March 1940, pp. 33–40.

[12] Nordberg, Bror, A "Push-over": Rock Products, vol. 42, No. 12, December 1939, pp. 32–34.

[13] Small, M. M., Suspended Flume Used to Eliminate Excess Fines: Rock Products, vol. 42, No. 6, June 1939, pp. 36–37, 51.

[14] Nordberg, Bror, More Research in Sand: Rock Products, vol. 42, No. 7, July 1939, pp. 46–47. Pit and Quarry, Producers of Industrial Sand Discuss New Laws, Research, Labor Relations: Vol. 32, No. 1, July 1939, pp. 31–32, 81.

[15] Trauffer, W. E., Iron, Other Silica-sand Impurities Removed by Concentrating Tables: Pit and Quarry, vol. 32, No. 9, March 1940, pp. 41–43.

[16] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

of construction materials from Canada. As they are important only locally, the 61-percent drop in total imports is of no especial significance to the sand and gravel industry.

Exports of sand and gravel also declined, but the quantity of material involved is so small that they too are of little consequence.

Sand and gravel imported for consumption in the United States, 1937–39, by classes

Class	1937		1938		1939	
	Short tons	Value	Short tons	Value	Short tons	Value
Glass sand [1]	51,090	$79,112	33,889	$68,315	23,690	$33,604
Other sand [2]	319,134	134,430	611,468	157,992	192,106	79,272
Gravel	163,406	36,193	55,619	22,902	60,147	8,399
	533,630	249,735	700,976	249,209	275,943	121,275

[1] Classification reads "Sand containing 95 percent silica and not more than 0.6 percent oxide of iron and suitable for manufacture of glass."
[2] Classification reads "Sand, n. s. p. f."

Sand and gravel imported into the United States, 1937–39, by countries

Country	1937		1938		1939	
	Short tons	Value	Short tons	Value	Short tons	Value
North America:						
Canada	474,394	$142,828	655,742	$160,707	246,894	$65,726
Mexico			22	220		
Other North America	32	53			435	493
Europe:						
Belgium	55,371	80,248	34,444	68,810	23,979	34,185
Denmark					1,820	200
France	269	1,774	585	1,477	517	1,291
Germany	1,101	12,640	2,503	10,219	1,243	14,791
Netherlands	302	3,224	(1)	28	111	1,249
United Kingdom	1,655	8,506	7,572	6,827	940	3,197
Asia:						
Japan	2	12			1	55
Other Asia					3	88
Oceania: Australia	504	450	108	921		
	533,630	249,735	700,976	249,209	275,943	121,275

[1] Less than 1 ton.

Sand and gravel exported from the United States, 1935–39

Year	Short tons	Value	Year	Short tons	Value
1935	37,393	$26,369	1938	35,572	$30,303
1936	49,906	58,453	1939 [1]	27,746	31,931
1937	67,141	80,197			

[1] Classification reads: "Gravel and building stone."

BLAST-FURNACE SLAG

The principal material competing with gravel is crushed stone, statistics for which appear in the Stone chapter of this and previous volumes of the Minerals Yearbook and Mineral Resources series. Blast-furnace slag is also important in the same markets in some areas.

The National Slag Association continued the canvass inaugurated in 1938 and reported that 36 companies operating 72 plants sold or used 7,920,281 short tons of air-cooled slag valued at $6,122,718 in 1939. This output represents an 8-percent increase in quantity but a 1-percent decrease in value from the 7,321,259 tons valued at $6,167,892 reported by 34 companies operating 70 plants in 1938. In addition, 1,188,094 tons of granulated and foamed slag valued at $122,017 were reported in 1939 and 656,807 tons valued at $78,723 in 1938. Details are given in the following tables.

Air-cooled blast-furnace slag sold or used by producers in the United States, 1938–39, by States [1]

State	1938			1939		
	Quantity		Value	Quantity		Value
	Short tons	Percent of total		Short tons	Percent of total	
Alabama	1,852,236	25.3	$1,173,890	2,285,317	28.9	$1,399,612
Ohio	2,533,088	34.6	2,403,341	2,560,748	32.3	2,205,144
Pennsylvania	1,247,101	17.0	1,237,616	1,125,748	14.2	1,014,859
Other States [2]	1,688,834	23.1	1,353,045	1,948,468	24.6	1,503,103
	7,321,259	100.0	6,167,892	7,920,281	100.0	6,122,718

[1] National Slag Association.
[2] Colorado, Illinois, Kentucky, Maryland, Michigan, New York, Tennessee, and West Virginia.

Blast-furnace slag sold or used by producers in the United States in 1939, by uses [1]

Use	Air-cooled				Granulated and foamed	
	Unscreened		Screened			
	Short tons	Value per ton	Short tons	Value per ton	Short tons	Value per ton
Concrete (pavements, buildings, bridges, etc.)			1,336,792	$0.82	23,432	$0.74
Roads other than concrete	203,322	$0.59	3,884,052	.87		
Railroad ballast	395,325	.39	1,155,554	.56		
Mineral wool			64,836	.93		
Roofing			66,312	1.30		
Fill and sub-base cushion courses, etc	185,595	.44	119,870	.86	1,003,077	.07
Sewage trickle filter			64,121	1.06		
Airport runways			23,224	1.00		
Water filtration	(2)	(2)				
Roofing granules			(2)	(2)		
Agricultural purposes			(2)	(2)	30,053	.94
Cement manufacture					(2)	(2)
Other uses	(2)	(2)	118,008	.96	(2)	(2)
Use not given			264,744	.91		
Total: 1939	812,220	.45	7,108,061	.83	1,188,094	.10
1938	1,202,754	.47	6,118,505	.92	656,807	.12

[1] National Slag Association.
[2] Concealed to avoid revealing data of individual company; figures included in total.

GYPSUM

By Forrest T. Moyer

SUMMARY OUTLINE

Consumption of gypsum and gypsum products in 1939 recovered strongly from the mild set-back in 1938 and resumed the progressive rise that had persisted from 1934 through 1937. Largely because of the high level of residential building construction throughout the year, the value of all gypsum products sold or used in the United States rose to $45,928,239, representing by a wide margin the highest annual volume of business for the industry in the decade just ended. The total value in 1939 was 27 percent above 1938 and, after adjustment for comparability, surpassed the total value in 1930, the next largest of the past decade, by 19 percent. However, the improvement in 1939 does not apply to all parts of the gypsum industry but is derived entirely from an advanced rate of consumption of calcined products, particularly gypsum lath, in building. Sales of uncalcined products in 1939, although the highest in recent years and 15 percent above 1938 were far below sales in 1930. This decline reflects the reduced activity of the portland-cement industry, which was about one-fourth lower in 1939 than in 1930. In contrast to the lower proportion of sales of uncalcined products in 1939, the tonnage of calcined building products surpassed that of 1938 by 26 percent and, after adjustments for canvass changes, was 11 percent over 1930. The net gain in this group more than overcame the decreased consumption of industrial gypsum plasters, so that the tonnage of all calcined products in 1939 was 7 percent higher than the comparable figure for 1930.

The outstanding feature of the gypsum business in 1939 was the spectacular gain in sales of lath, which increased 41 percent over the previous record volume, set in 1938. The increment amounted to 327,944 M square feet, a gain that was larger than the sales of this product in any year from 1930 through 1935. On the comparable base used to compile the chart published as figure 1 in the Gypsum chapter of Minerals Yearbook, 1939 (p. 1184), the index of the record square footage for 1939 was 319 (1928=100). The remarkable increase in demand in recent years, which has made gypsum lath the dominant lathing material, is illustrated best by comparison with the index of sales for the low year, 1933, which was 32.

There was a strong revival in consumption of gypsum tile, block, and plank in 1939, when sales (square feet) increased 51 percent over 1938. This group of related products, used chiefly in nonresidential construction, constituted a more important proportion of the total sales of the industry during the 1920's than in recent years. Although sales in 1939 still were well below those 10 to 15 years ago, the substantial gain over 1938 is encouraging when compared with the 4-percent decline in floor area of nonresidential building reported by the F. W. Dodge Corporation.

Salient statistics of the gypsum industry in the United States, 1935–39

	1935	1936	1937	1938	1939
Active establishments [1]	81	84	92	90	92
Crude gypsum:					
Mined...short tons	1, 903, 880	2, 712, 510	3, 058, 166	2, 684, 205	3, 226, 737
Imported...do	450, 250	676, 990	897, 484	789, 429	1, 308, 078
Apparent supply...do	2, 354, 130	3, 389, 500	[2] 3, 955, 650	[2] 3, 473, 634	[2] 4, 534, 815
Calcined gypsum produced:					
Short tons	1, 383, 093	(3)	[4] 2, 411, 362	[4] 2, 252, 878	[4] 2, 881, 269
Value	(3)	(3)	[4] $11, 076, 205	[4] $10, 989, 626	[4] $14, 620, 597
Gypsum products sold: [5]					
Uncalcined:					
Short tons	595, 130	830, 683	[4] 860, 825	[4] 756, 565	[4] 867, 782
Value	$1, 329, 140	$1, 865, 673	[4] $1, 920, 706	[4] $1, 681, 371	[4] $1, 927, 415
Calcined:					
Short tons	1, 552, 968	2, 210, 338	[4] 2, 643, 075	[4] 2, 556, 296	[4] 3, 224, 216
Value	$22, 358, 005	$31, 088, 885	[4] $36, 879, 814	[4] $34, 574, 937	[4] $44, 000, 824
Total value	$23, 687, 145	$32, 954, 558	[4] $38, 800, 520	[4] $36, 256, 308	[4] $45, 928, 239
Gypsum and gypsum products:					
Imported for consumption	$719, 593	$891, 932	$1, 167, 872	$1, 002, 001	$1, 364, 867
Exported	$186, 196	$255, 903	$271, 142	$282, 782	$309, 453

[1] Each mine, plant, or combination mine and plant is counted as 1 establishment; beginning in 1937 plants utilizing byproduct gypsum are included.
[2] To avoid revealing confidential data, byproduct gypsum is excluded. [3] Data not collected.
[4] Includes byproduct gypsum. [5] Gypsum products from domestic and imported crude.

Technologically, 1939 may become an important landmark of the industry in that it marks the first commercial utilization in this country of heated hammer mills in a gypsum-processing plant. During the year two units of this revolutionary type were installed in a California plant. These mills grind and calcine the crude gypsum in one operation, replacing the fine-grinding mills and calcining kettles in the usual flow sheet of a gypsum plant. The economies effected by their use are reported to be substantial.

The apparent supply of crude gypsum, which normally approximates closely actual annual consumption, was nearly one-third greater in 1939 than 1938. However, anomalous conditions caused by the outbreak of the war in Europe distorted the normal situation with respect to imported crude. Data compiled from records of the Bureau of Foreign and Domestic Commerce show that imports during the first three quarters of 1939 were closely in line with current activity but increased markedly in the fourth quarter, when they were more than double those of the similar period of 1938. The total for the year was two-thirds greater than in 1938. This disproportionate gain compares with a 20-percent rise in domestic mine production, which more nearly represents the increased consumption over 1938. A slightly greater than proportional gain in importations of crude had been expected because two newly constructed calcining plants using Canadian crude started operations early in 1939, but the exceptional gain noted indicates that operators of calcining plants on tidewater along the Atlantic coast apparently have built up large stocks of crude as a precaution against any immediate shortage of Canadian gypsum. A study of the somewhat similar situation during the World War shows that shipments of crude to this country, mostly from Canada, declined about one-third from 1914 to 1917, but in 1918, after the United States entered the war, total importations dropped to 50,653 short tons—86 percent below those of 1914. This rapid decline in 1918 was caused entirely by shipping difficulties, as most of the gypsum boats were commandeered by the Government to transport coal from Middle Atlantic ports to the New England States.

Although the effect of continuation of the present European war upon consumption of gypsum in this country cannot be foreseen, it is interesting to note that during the World War annual consumption, as measured by the apparent supply of crude, continued from 1914 through 1917 at approximately the same average level as from 1910 to 1913 but declined about one-fourth in 1918 after the United States began hostilities.

Thus far the current war has had no appreciable effect on building construction, and the trend early in 1940 has followed that of 1939.

DOMESTIC PRODUCTION

Domestic supplies of crude gypsum in 1939, which were the highest for any year since 1930, were obtained from 28 underground mines, 27 open quarries, and 5 combinations of mines and quarries in 16 States; New York, Michigan, Iowa, and Texas were the leading producers. The tonnage from New York (which with Iowa had the largest number of operations) was 22 percent of the total. In Michigan, mining activity increased more than in the other States, with the result that its production in 1939 comprised 20 percent of the total, contrasted with 18 percent in 1937 and 1938. The average estimated value of the domestic crude produced in 1939 was $1.37 per ton, a reduction of 22 cents per ton from the 1938 figure. This value, as returned by the producers, is essentially a bookkeeping figure because run-of-mine material is not bought and sold in open market. Data in the following table apply only to natural crude gypsum and do not include byproduct gypsum.

Crude gypsum mined in the United States, 1937–39, by States

State	1937			1938			1939		
	Active mines	Short tons	Value	Active mines	Short tons	Value	Active mines	Short tons	Value
California	5	186,158	$355,834	5	162,056	$334,208	5	188,364	$306,350
Colorado	3	28,586	50,034	3	21,591	41,080	3	24,013	40,694
Iowa	8	387,255	533,162	8	364,920	495,856	9	430,712	510,120
Michigan	5	553,242	896,947	5	483,324	775,908	5	643,180	834,856
Nevada	3	160,347	268,638	3	168,515	366,869	4	205,762	484,621
New York	10	700,357	1,107,175	10	601,394	941,744	9	709,495	971,229
Oklahoma	4	159,639	266,091	3	141,341	231,910	3	161,748	207,503
Texas	5	280,807	313,563	5	246,990	260,094	6	283,912	266,265
Utah	3	46,197	46,197	3	43,144	45,823	4	58,146	65,269
Other States [1]	12	555,578	944,862	11	450,930	778,182	12	521,405	744,098
	58	3,058,166	4,782,503	56	2,684,205	4,271,674	60	3,226,737	4,431,005

[1] 1937: 1 active mine each in Arizona, Idaho, South Dakota, and Wyoming; 2 each in Kansas, Montana, Ohio, and Virginia. 1938: 1 active mine each in Idaho, South Dakota, and Wyoming; 2 each in Kansas, Montana, Ohio, and Virginia. 1939: 1 active mine each in Arizona and South Dakota; 2 each in Kansas, Montana, Ohio, Virginia, and Wyoming.

PROCESSING PLANTS AND EQUIPMENT

Production of calcined gypsum in 1939 exceeded that in 1938 by 28 percent, a gain that compares favorably with a 20-percent increase over 1938 in the floor area of residential and nonresidential building reported by the F. W. Dodge Corporation. The 1939 tonnage was produced in 56 calcining plants operating in 25 States; 42 plants processed domestic crude, 13 imported crude, and 1 byproduct crude gypsum.

Although three newly constructed calcining plants, one each in California, Florida, and Georgia, began operations in 1939, the total number of active kettles was nine less than in 1938 because a number of kettles in old plants were withdrawn from service. Moreover, two less rotary kilns were active owing to abandonment of a plant in New York during the latter part of 1938. In the accompanying table the new type of grinding-calcining equipment—the heated-hammer mill—is classed arbitrarily with the rotary kilns because its operation is continuous.

Active calcining plants and equipment in the United States, 1937–39, by States

State	1937				1938				1939			
	Calcining plants	Equipment			Calcining plants	Equipment			Calcining plants	Equipment		
		Kettles	Beehive kilns	Rotary kilns		Kettles	Beehive kilns	Rotary kilns		Kettles	Beehive kilns	Rotary kilns
California	3	10			3	10			4	10		[1] 2
Iowa	5	19			6	21			6	20		
Michigan	5	22			5	22			5	21		
New York	8	24		8	8	26		8	7	21		6
Texas	4	30			4	29			4	25		
Utah	3	6	[2] 5		3	6	[2] 5		4	8	5	
Other States [3]	26	68	4	10	25	63	4	8	26	63	4	8
	54	179	[2] 9	18	54	177	[2] 9	16	56	168	9	[1] 16

[1] Includes 2 grinding-calcining units. [2] Revised figures.
[3] 1937: 1 calcining plant each in Arizona, Connecticut, Florida, Illinois, Indiana, Massachusetts, Nevada, New Hampshire, Pennsylvania, South Dakota, Vermont, and Wyoming; 2 each in Colorado, Kansas, Montana, New Jersey, Ohio, Oklahoma, and Virginia. 1938: 1 calcining plant each in Arizona, Connecticut, Florida, Illinois, Indiana, Massachusetts, Nevada, New Hampshire, Oklahoma, Pennsylvania, South Dakota, Vermont, and Wyoming; 2 each in Colorado, Kansas, Montana, New Jersey, Ohio, and Virginia. 1939: 1 calcining plant each in Arizona, Connecticut, Georgia, Indiana, Massachusetts, Nevada, New Hampshire, Oklahoma, Pennsylvania, South Dakota, Vermont, and Wyoming; 2 each in Colorado, Florida, Kansas, Montana, New Jersey, Ohio, and Virginia.

According to returns from the producers, 33 gypsum-board and 20 automatic tile machines were active in the country in 1939. The productive capacity of individual board machines, which is determined by the capacity of the board drier, varies considerably. Capacity of machines of recent construction commonly ranges between 105,000 and 115,000 square feet of ⅜-inch lath and 90,000 to 100,000 square feet of ⅜-inch wallboard in 8 hours. Older machines operate at a slower rate, so that the average capacity of all active machines in the country is estimated by several technical experts at about 87,500 and 75,000 square feet, respectively, of ⅜-inch lath and wallboard in 8 hours.

The automatic machine for perforating gypsum lath that was introduced in 1938 evidently has been successful; in 1938 three board machines were equipped with it, and in 1939 five additional units were installed. The machine is placed near the discharge end of the board machine and replaces the old method of bundling the lath and drilling the holes with a battery of augers.

DISTRIBUTION OF SALES

Sales of uncalcined gypsum products in 1939 exceeded those in 1938 by a substantial margin but were only slightly higher than in 1937. Indicated consumption for portland-cement retarder was 15 percent above 1938, a gain that correlates closely with the increased activity in the portland-cement industry. Sales of agricultural gypsum in 1939 gained 10 percent over 1938 compared with a 5-percent increase reported for total cash farm income. Approximately 60 percent of the 1939 total was consumed in the peanut-growing region of southern Virginia. Tonnages of pulverized raw gypsum sold or used as a fertilizing agent formerly were much larger than at present but declined slowly as the use of superphosphate expanded. The latter commodity, made by treating phosphate rock with sulfuric acid to convert the contained phosphorus into a more available plant food, contains approximately 50 percent by weight of precipitated gypsum formed in the process. As a result, the contained gypsum greatly reduced the agricultural market for natural gypsum, which in recent years has been confined largely to sales for fertilizing certain legume crops and for correcting black alkali soils. During the past few years the use of highly concentrated phosphate fertilizers that contain little or no sulfur or sulfate plant foods has expanded somewhat because the Federal Government has offered this newly developed type of fertilizer to farmers in lieu of cash benefit payments. Should use of this material become more widespread, as appears likely, consumption of natural gypsum in agriculture probably would increase. In addition to supplying an essential plant food, gypsum has several beneficial effects upon soil, and recently investigators [1] have shown that gypsum increases the moisture content of clover and is effective during droughts.

Sales of all groups of calcined building products in the Bureau of Mines classification in 1939 showed gains of varying proportions over 1938 except "Prepared finishes," which declined appreciably in quantity. Consumption of base-coat plasters increased 22 percent in 1939, and that of gaging and molding plasters, used for finish-coat work, rose 24 percent over 1938. The slightly higher than proportional gain for finishing plasters is caused chiefly by the increased use of gypsum lath, which effects a saving in the required quantity of base-coat plasters by furnishing a smooth plastering surface and tending to eliminate droppings. It is claimed that 1 ton of base-coat plaster mixed with 2 tons of sand will plaster 225 square yards of gypsum lath but only 180 square yards of wood lath. In other words, 100 square yards of gypsum lath requires 889 pounds of gypsum plaster for a base coat of proper thickness, whereas a similar area of wood lath requires 1,111 pounds. The gypsum-lath requirements represent a reduction of 20 percent for any given area. In connection with consumption of base-coat plasters, it is interesting to note the development of a 2-inch-thick building partition constructed by applying sanded plaster

[1] Krugel, C., Dreyspring, C., and Heinrich, F., The Importance of Sulfate as Plant Food: Commercial Fertilizer, vol. 58, No. 5, May 1939, pp. 11-15.

to each side of gypsum or metal lath supported by steel channels. This type of solid partition is used extensively in the low-cost housing projects being built by the United States Housing Authority. This Federal agency recently estimated [2] that its entire construction program would require approximately 800,000 tons of gypsum plaster.

Gypsum products (made from domestic, imported, and byproduct crude gypsum) sold or used in the United States, 1938–39, by uses

Use	1938		1939	
	Short tons	Value	Short tons	Value
Uncalcined:				
Portland-cement retarder	674, 062	$1, 238, 715	774, 982	$1, 406, 129
Agricultural gypsum	68, 470	318, 620	75, 091	364, 711
Other uses [1]	14, 033	124, 036	17, 709	156, 575
Total uncalcined	756, 565	1, 681, 371	867, 782	1, 927, 415
Calcined:				
For building uses:				
Plasters:				
Base-coat	1, 161, 762	10, 400, 557	1, 413, 291	12, 768, 526
Sanded	106, 355	606, 060	116, 459	662, 211
To mixing plants	16, 917	102, 821	19, 485	119, 391
Gauging and molding	120, 933	1, 442, 511	150, 175	1, 923, 109
Prepared finishes	26, 424	488, 307	14, 136	491, 788
Insulating and roof-deck	16, 233	143, 877	24, 798	214, 397
Other [2]	12, 843	359, 309	14, 169	486, 710
Keene's cement	23, 496	366, 813	27, 191	424, 341
Lath [3]	594, 659	10, 287, 935	850, 768	14, 598, 868
Wallboard [4]	269, 949	7, 921, 400	308, 569	8, 871, 833
Tile [5]	112, 477	1, 300, 830	174, 780	2, 066, 086
Total for building uses	2, 462, 048	33, 420, 420	3, 113, 821	42, 627, 260
For industrial uses:				
To plate-glass and terra-cotta works	21, 918	144, 845	35, 777	242, 671
To pottery works	16, 981	219, 071	18, 121	234, 725
Orthopedic and dental plasters	8, 114	270, 691	9, 586	313, 930
Other industrial uses [6]	47, 235	519, 910	46, 911	582, 238
Total for industrial uses	94, 248	1, 154, 517	110, 395	1, 373, 564
Total calcined	2, 556, 296	34, 574, 937	3, 224, 216	44, 000, 824
Grand total value	----------	36, 256, 308	----------	45, 928, 239

[1] Includes uncalcined gypsum sold for use as filler and rock dust, in paint manufacturing, and for minor purposes.
[2] Includes joint filler, patching and painter's plaster, and unclassified building plasters.
[3] 1938: 809,471 M square feet; 1939: 1,137,415 M square feet.
[4] 1938: 371,767 M square feet; 1939: 410,876 M square feet.
[5] 1938: 19,942 M square feet; 1939: 30,191 M square feet.
[6] Includes statuary, industrial casting and molding plasters, dead-burned filler, and miscellaneous sales.

Sales of gypsum lath (square feet) were 41 percent above the previous annual record set in 1938. Because of the large volume of sales, the value of the lath, which commands a relatively higher price than most other gypsum products owing to the greater degree of fabrication, was the most important single item in the classification shown in the preceding table and, together with the value of wallboard sales, comprised more than half the total of all gypsum products. Shipments of wallboard during 1939 were well above those in 1938 but were still far below annual sales in the late 1920's. Although this product is meeting stiffer competition each year from several other prefabricated materials, such as fiberboard and steel paneling, apparently it is holding its proportional share of the market.

[2] U. S. Housing Authority, Federal Works Agency, Public Housing Weekly News: Vol. 1, No. 31, March 12, 1940, p. 3.

Consumption of gypsum tile (square feet) in 1939 showed the remarkable increase of 51 percent over 1938. Contributing to this gain, the square footage of partition tile sold was nearly one-half higher than in 1938, and the volume of all other tile, including roof, shoe, and soffit tiles and gypsum plank, rose more than two-thirds over 1938.

Total shipments of industrial plasters in 1939 were well above the tonnages in 1938 but did not equal those in 1937 when industrial activity was at a higher level. In 1939 consumption increased in all classified groups except "other industrial uses," in which it remained at the same level as in 1938.

PRICES

Values of gypsum products requested by the Bureau of Mines in its annual survey of the industry are net sales values, including containers, at the producing plants. Although the average values per sales unit do not represent selling prices, they indicate price trends of the various products in the country as a whole. The slight increase in average values in 1939 over 1938 for most of the products shown in the following table suggests a slight stiffening of prices from the general downward trend of the last 4 or 5 years. Values of several important products were lower in 1939 than in 1929, when competition forced prices to the lowest point since before the World War. From values of the few products for which data are available it may be inferred that present prices generally are below those of 1925. A similar inference may be drawn from the wholesale prices of the Bureau of Labor Statistics for plaster and ⅜-inch plasterboard, f. o. b. cars at destination, which in 1939 were 91.5 and 82.4 percent, respectively, of the prices in 1926.

Average values, f. o. b. plant, of gypsum products sold or used in the United States, in selected years, 1925–39 [1]

Use	1925	1929	1933	1935	1937	1938	1939
Uncalcined:							
Portland-cement retarder..per short ton..	$2.66	$1.94	$1.78	$1.82	$1.90	$1.84	$1.81
Agricultural gypsum..do....	5.92	4.84	4.78	4.78	4.43	4.65	4.86
Calcined:							
Building uses:							
Base-coat plasters..do....	(2)	(2)	8.85	9.86	9.02	8.95	9.03
Sanded plasters..do....	7.20	5.85	7.12	6.59	5.80	5.70	5.69
Keene's cement..do....	13.75	14.67	14.37	12.42	15.50	15.61	15.61
Lath..per M sq. ft..	(2)	13.15	14.19	15.00	13.00	12.71	12.84
Wallboard..do....	(2)	17.08	26.10	26.39	21.67	21.31	21.59
Partition tile..per short ton..	10.34	6.50	6.70	7.44	7.56	7.81	7.87
Industrial plasters..do....	(2)	7.07	9.60	9.79	10.83	12.25	12.44

[1] Includes products from domestic crude only in 1925; from domestic and imported crude in 1929, 1933, and 1935; and from domestic, imported, and byproduct crude, 1937–39.
[2] Data not available.

RECENT DEVELOPMENTS

Standard specifications [3] for gypsum plastering and requirements for lathing and furring were approved by the American Standards Association. The specifications cover all materials and operations necessary to complete a gypsum plaster job.

[3] American Standards Association, Standard Specifications for Gypsum Plastering: No. A42.1–1938, September 29, 1938, 11 pp.

New products of gypsum developed in 1939 or recent years include a vermiculite plaster designed particularly for use as a fire-protective covering for steel columns and beams. The most practical mix appears to be 3 parts of neat gypsum plaster to 1 part of fine expanded vermiculite by weight. In Georgia a lime manufacturer [4] utilizes calcined gypsum in making a prepared masonry mortar to control the setting time of the finished product. The gypsum is added just before grinding in a tube mill and comprises about 2 percent by weight of the mixture. A new supersulfate cement made from a mixture of blast-furnace slag, slaked lime, and as much as 15 percent gypsum or anhydrite has been developed in Belgium. It has several desirable properties that may expand its use and thus enlarge the market for gypsum. In 1939 a specially processed, high-strength gypsum plaster that can be used as an oil-well cement was made available commercially.

A grand-jury investigation of the gypsum industry was begun early in 1940 by the Antitrust Division of the Department of Justice as part of its Nation-wide investigation of the reportedly high cost of abor and materials for building.

FOREIGN TRADE [5]

Imports.—The import situation in 1939 was disturbed by the greatly increased quantities of crude gypsum imported during the fourth quarter of the year on account of the present European war. Virtually the entire gain was in crude from Canada and was distributed to the calcining plants along the Atlantic coast as far south as Florida. In contrast to the marked gain in the tonnage of crude, imports of gypsum products remained at essentially the same negligible level as in 1938.

The value of alabaster manufactures imported for consumption during each of the past 5 years is included in the following table for the first time. The major part, by far, of the annual imports reported in this classification is from Italy in which are situated the famed alabaster deposits near Volterra and Castellina. In addition to these imports of manufactured alabaster, a small tonnage of crude alabaster blocks is brought from Italy for working into lamp bases and other objects.

Gypsum and gypsum products imported for consumption in the United States, 1935–39

Year	Crude		Ground		Calcined		Keene's cement		Alabaster manufactures [1]	Other manufactures n. e. s.	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value			
1935	450,250	$463,050	1,241	$15,440	601	$11,364	64	$1,290	$207,491	$20,958	$719,593
1936	[2] 676,990	[2] 657,125	1,374	16,937	450	8,778	20	816	173,554	34,722	891,932
1937	[2] 897,484	[2] 854,835	1,711	22,165	353	7,917	25	675	203,824	78,456	1,167,872
1938	[2] 789,429	[2] 772,026	1,486	17,674	372	7,649	9	223	159,551	44,878	1,002,001
1939	[2] 1,308,078	[2] 1,174,117	1,475	17,606	302	6,551	4	1,045	110,136	55,412	1,364,867

[1] Includes imports of jet manufactures, which are reported to be negligible.
[2] Includes anhydrite.

[4] Nordberg, Bror, Masonry Mortar Offers a New Outlet for Lime Plants: Rock Products, vol. 42, No. 8, August 1939, pp. 22–23.
[5] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Canada customarily supplies 95 percent of the total imports of crude gypsum. The quantity from Mexico represents approximately the normal proportion of imports to total consumption in the Pacific Coast States.

Crude gypsum (including anhydrite) imported for consumption in the United States, 1937–39, by countries

Country	1937		1938		1939	
	Short tons	Value	Short tons	Value	Short tons	Value
Canada	838,106	$797,157	739,172	$723,780	1,243,390	$1,112,967
China	-----	-----	-----	-----	(1)	18
Italy	207	4,337	124	2,943	116	2,942
Mexico	59,166	53,146	50,133	45,303	58,955	53,341
United Kingdom	5	195	-----	-----	5,617	4,849
	897,484	854,835	789,429	772,026	1,308,078	1,174,117

[1] Less than 1 ton.

Exports.—The total value of exports of crude gypsum and gypsum products in 1939 gained slightly over 1938 and continued the gradual rise that has persisted since 1933. Exports do not form an appreciable part of the domestic industry.

Gypsum and gypsum products exported from the United States, 1935–39

Year	Crude, crushed, or ground		Plasterboard and wallboard		Plaster, calcined, and manufactures		Other manufactures, n. e. s.	Total value
	Short tons	Value	Square feet	Value	Short tons	Value		
1935	4,528	$15,473	1,929,348	$42,465	[1] 4,717	$128,258	(2)	$186,196
1936	(3)	(3)	(3)	(3)	(3)	(3)	(3)	255,903
1937	4,777	26,692	4,360,404	96,019	2,847	61,383	$87,048	271,142
1938	2,844	17,762	3,658,647	88,822	3,833	71,914	104,284	282,782
1939	10,342	41,012	5,258,249	130,073	2,913	69,577	68,791	309,453

[1] Includes "Other manufactures, n. e. s."
[2] Not separately classified before 1937; included with "Plaster, calcined, and manufactures."
[3] Data not available; value reported as follows: "Crude, crushed, calcined, or ground," $107,732; "Plasterboard, wallboard, plaster, and manufactures, n. e. s.," $148,171.

WORLD PRODUCTION

In the following table total world production of gypsum is not given because data of several countries that annually produce large quantities are not available for any of the years shown.

In 1939 Germany resumed production [6] of sulfuric acid from a mixture of gypsum or anhydrite, with coke and clay as a substitute for pyrite. This method, developed during the World War when supplies of Spanish pyrite were stopped in a similar manner by the British blockade, has been perfected and is being applied at the Wolfen works of the I. G. Farbenindustrie A. G. Annual capacity of this plant is reported to be 80,000 metric tons of sulfuric acid and 75,000 tons of cement, a byproduct of the process.

[6] Bureau of Mines, Mineral Trade Notes: February 1940, p. 15.

World production of gypsum, 1935–39, by countries, in metric tons

[Compiled by M. T. Latus]

Country [1]	1935	1936	1937	1938	1939
Algeria	56,710	45,265	46,175	33,325	(2)
Anglo-Egyptian Sudan	----------	2,997	----------	----------	(2)
Argentina [3]	49,773	55,706	68,220	70,813	(2)
Australia:					
New South Wales	1,722	4,390	9,300	12,712	(2)
South Australia	103,909	108,871	117,985	148,943	(2)
Victoria	8,852	7,581	21,197	13,596	(2)
Western Australia	5,450	6,768	9,219	13,645	(2)
Brazil [4]	2,000	2,000	2,000	2,000	2,000
Canada	510,262	763,044	1,044,222	915,169	(5)
Chile	26,151	22,674	24,080	(2)	22,209
China	68,000	68,800	(2)	(2)	(2)
Cyprus [6]	14,851	16,603	13,576	9,729	(2)
Egypt	190,666	256,211	253,641	212,088	(2)
Eire	----------	6,096	11,647	13,364	(2)
Estonia	6,238	13,849	12,748	13,915	(2)
France	1,275,000	1,376,150	1,320,400	(2)	(2)
Germany	[7] 855,000	(2)	(2)	(2)	(2)
Austria [8]	46,000	47,000	47,000	(2)	(2)
Greece	3,612	13,779	17,924	16,609	(2)
India, British	46,045	55,277	46,830	70,944	(2)
Italy	471,167	324,789	416,198	425,299	(2)
Japan	127,633	137,677	(2)	(2)	(2)
Latvia [6]	98,935	123,503	196,911	196,964	(2)
Luxemburg	29,474	29,110	19,722	19,901	(2)
Mexico	54,514	61,711	(2)	(2)	(2)
New Caledonia	----------	----------	984	1,070	(2)
Palestine	4,543	6,209	3,934	3,984	4,524
Peru	9,056	12,560	12,895	14,026	(2)
Portugal	4,800	6,850	11,390	9,036	(2)
Rumania	62,018	53,603	70,620	(2)	(2)
Sweden	170	93	108	95	(2)
Tunisia	11,000	11,200	22,800	(2)	(2)
Union of South Africa	21,590	31,962	33,186	38,849	(2)
United Kingdom	997,673	1,018,562	1,111,669	1,109,928	(2)
United States	1,727,162	2,460,735	2,774,307	2,435,057	2,927,231

[1] In addition to the countries listed, gypsum is produced in Chosen, Cuba, French Morocco, Poland, Spain, Switzerland, U. S. S. R., and Yugoslavia, but production data are not available.
[2] Data not yet available. [3] Rail and river shipments. [4] Approximate production.
[5] Data for crude gypsum mined not available. Shipments of crude (lump, crushed, and ground) and calcined gypsum amounted to 1,277,480 tons.
[6] Exports of crude and calcined gypsum.
[7] Figures supplied by Deutscher Gips-Verein, E. V., Berlin, Germany. Figures are exclusive of rock gypsum from their own quarries used by cement, paint, and other factories.
[8] Estimate furnished by Bundesministerium für Handel und Verkehr.

LIME

By Forrest T. Moyer and A. T. Coons

SUMMARY OUTLINE

Recovering sharply from the relatively low rate of 1938, consumption of lime in 1939, as indicated by total sales of 4,254,348 short tons, was the highest of any year since 1929. The total quantity sold was 27 percent higher than in 1938 and was only 7 percent below the record volume for 1925 (4,580,823 tons). Sales of quicklime rose 35 percent above 1938, a larger proportional gain than the increase of 13 percent for hydrated lime which customarily is subject to lesser fluctuations in demand than quicklime.

Generally, demand for lime by most consuming industries was low during the first 6 to 8 months of 1939 but increased materially in the latter part of the year. The improvement was marked in all but a few States in which the apparent consumption was about the same or slightly lower than in 1938. Owing to the probable excess of production over demand in the beginning of the year, prices fluctuated downward and by midyear were well below the averages of 1938. However, with improved demand, they became stable and at the end of the year were slightly above the low point. The average value at producing plants of all lime sold or used in 1939 was $7.06 per ton, a decline of 15 cents from 1938 and of $2.24 from the value of $9.30 received in 1925. According to the operators, production costs in many States were higher than in 1938 owing to higher prices for some fuels and increased wages for labor. Southern operators found the increased labor costs particularly burdensome.

The quantity of lime used in agriculture declined slightly from 1938, despite the reduction in price and a reported increase of 5 percent in total cash farm income. Sales of hydrated lime for this purpose, approximately 60 percent of the total, fell below those of 1938, while the tonnage of agricultural quicklime consumed increased nearly one-fifth. Although hydrated lime is admittedly the best liming agent for soils, the cheaper materials, especially pulverized limestone, have become increasingly popular with farmers.

In contrast to the general conditions in other sections of the industry demand for building lime was good throughout 1939, and the average value at the plant increased 18 cents per ton. The total quantity of lime sold for construction was the highest of any year since 1930 and surpassed that of 1938 by 17 percent, a gain that correlates fairly well with the increased activity reported in the building industry. Hydrated lime comprised more than two-thirds of all building lime sold during 1939. A further loss of the mason's lime market to prepared masonry mortars was reported by some operators. The prepared mortars containing 10 to 50 percent of lime are made by only a few lime producers who have entered this business to protect their market. The greater part of the annual production of these mortars is said to be made by mixing companies, which purchase the required raw materials, and by cement companies.

Salient statistics of the lime industry in the United States, 1938–39

	1938			1939				
	Short tons	Value		Short tons	Value		Percent of change in—	
		Total	Average		Total	Average	Tonnage	Average value
Lime sold or used by producers:								
Quicklime	2,177,150	$15,026,063	$6.90	2,936,295	$19,925,153	$6.79	+34.9	−1.6
Hydrated lime	1,169,804	9,111,575	7.79	1,318,053	10,124,241	7.68	+12.7	−1.4
Total lime	3,346,954	24,137,638	7.21	4,254,348	30,049,394	7.06	+27.1	−2.1
By uses:								
Agricultural	364,312	2,376,108	6.52	362,335	2,214,759	6.11	−.5	−6.3
Building	854,461	7,163,165	8.38	1,000,498	8,563,792	8.56	+17.1	+2.1
Chemical and industrial	1,761,555	11,503,010	6.53	2,219,954	13,823,289	6.23	+26.0	−4.6
Refractory (dead-burned dolomite)	366,626	3,095,355	8.44	671,561	5,447,554	8.11	+83.2	−3.9
Imports for consumption:								
Quicklime and hydrated lime	6,818	66,203	9.71	7,694	71,902	9.35	+12.8	−3.7
Dead-burned dolomite [1]	2,875	67,340	23.42	186	4,260	22.90	−93.5	−2.2
Exports	13,222	121,662	9.20	21,477	236,497	11.01	+62.4	+19.7

[1] Dead-burned basic refractory material containing 6 percent or more lime and consisting chiefly of magnesia and lime.

Total sales of lime for chemical and industrial uses in 1939 surpassed those of 1938 by 26 percent and set an all-time record, exceeding the previous high of 1937 by 68,510 short tons. According to the Bureau of Mines classification, metallurgical-lime consumption, which depends largely on activity in the steel industry, was more than 50 percent greater than in 1938 and reached a new high—8 percent above the previous record of 1937. The sole disturbing factor in the strong lime market for this purpose after July was the marked reduction in price during the second quarter of the year. Sales to the paper industry, the second largest consumer of chemical-grade lime, were higher in 1939 than in any other year. Lime sold for purifying water (municipal and industrial) increased materially over sales in 1938 and, like the other two principal chemical uses, reached a new record. Sales in 1939 for nearly all other chemical and industrial uses of lime were higher than in 1938 and compared favorably with those for 1937.

The heavy demand for refractory lime (dead-burned dolomite) was due to the high level of operations in the steel industry and to the reconditioning of the refractory linings in idle furnaces necessitated by rapid expansion in utilization of open-hearth capacity from 54 to 95 percent between July and December. This demand, coupled with an average price decline of 33 cents per ton, pushed sales of refractory lime in 1939 to a new high, surpassing those of 1938 by 83 percent and 1937 (the former record), by 9 percent. In this chapter data on dead-burned dolomite do not represent the entire consumption in the United States, as some steel companies calcine their own refractory material from dolomite purchased raw or obtained from their quarries. Such tonnages of raw dolomite, which are included in the chapter on Stone in this volume, totaled 824,930 short tons, a threefold increase over 1938.

Exports of lime in 1939 were notably higher than in 1938 and exceeded those of any year since 1916. The total tonnage brought into the country declined from 1938 chiefly because imports of dead-burned basic refractory from Canada virtually ceased.

PRODUCTION

As quicklime is a semiperishable commodity and many plants have only small storage facilities, stocks of lime are said to be inconsequential. In this chapter the tonnages of lime sold or used by the producers are considered equivalent to production and are used interchangeably.

The lime industry in 1939, reviving strongly from the recession of 1938, resumed the uptrend in sales that had persisted from 1933 through 1937. The average value per ton was the lowest since 1933.

Lime sold or used by producers in the United States, 1935–39

Year	Plants in operation	Short tons [1]	Value [2]	
			Total [1]	Average
1935	301	2,987,133	$21,748,655	$7.28
1936	301	3,749,383	26,933,719	7.18
1937	314	4,124,165	30,091,168	7.30
1938	321	3,346,954	24,137,638	7.21
1939	311	4,254,348	30,049,394	7.06

[1] Includes lime used by producers (captive tonnage) as follows—1935: 143,716 tons, valued at $750,155; 1936: 224,693 tons, $1,179,820; 1937: 270,192 tons, $1,388,052; 1938: 168,245 tons, $985,003; 1939: 270,087 tons, $1,454,285.

[2] Value given represents value of bulk lime f. o. b. at point of shipment and does not include cost of barrel or package.

Production by States.—The total tonnage of lime marketed in 1939 was produced at 311 plants (10 less than in 1938) in 37 States and 2 Territories. Production increased in most States, and the output of the ranking States—Ohio, Pennsylvania, Missouri, and West Virginia—aggregated 60 percent of the total, Ohio alone contributing 26 percent. Production in Missouri, which had been severely curtailed during 1938 by labor difficulties, gained sharply in 1939.

Lime sold or used by producers in the United States, 1938–39, by States

State	1938			1939		
	Active plants	Short tons	Value	Active plants	Short tons	Value
Alabama	9	151,937	$911,033	8	176,513	$1,004,785
Arizona	3	39,568	353,224	3	57,233	448,860
Arkansas	2	(1)	(1)	2	(1)	(1)
California	7	71,596	712,388	8	87,407	833,326
Colorado	3	9,564	95,207	4	10,699	103,097
Connecticut	1	(1)	(1)	1	(1)	(1)
Florida	3	19,638	185,286	4	22,843	215,472
Georgia	1	7,046	54,150	1	6,815	57,663
Hawaii	2	(1)	(1)	2	(1)	(1)
Idaho	1	(1)	(1)	1	(1)	(1)
Illinois	8	135,256	965,836	8	147,729	1,064,154
Indiana	6	102,054	581,922	5	94,741	534,688
Kentucky	1	(1)	(1)	1	(1)	(1)
Maine	2	(1)	(1)	2	(1)	(1)
Maryland	19	62,479	446,013	18	59,504	396,201
Massachusetts	6	91,453	741,975	6	111,734	1,005,485
Michigan	4	45,848	339,324	4	45,180	324,765
Minnesota	2	(1)	(1)	2	(1)	(1)
Missouri	10	298,151	1,724,140	11	516,988	2,800,379
Montana	2	(1)	(1)	2	(1)	(1)
Nevada	2	(1)	(1)	2	(1)	(1)
New Jersey	4	19,940	145,076	4	22,636	148,605
New Mexico	2	(1)	(1)	2	(1)	(1)
New York	8	39,439	302,360	6	42,225	314,457
North Carolina	1	(1)	(1)	1	(1)	(1)
Ohio	22	836,589	6,658,853	22	1,106,250	8,907,195
Oklahoma	1	(1)	(1)	1	(1)	(1)
Oregon	2	(1)	(1)	----------	----------	----------
Pennsylvania	99	532,066	3,784,462	93	691,460	4,744,197
Puerto Rico	3	2,953	23,554	1	(1)	(1)
Rhode Island	1	(1)	(1)	1	(1)	(1)
South Dakota	2	(1)	(1)	2	(1)	(1)
Tennessee	10	162,661	901,460	10	163,006	893,161
Texas	7	49,352	429,664	9	62,048	524,748
Utah	7	25,748	184,390	8	38,437	268,557
Vermont	5	58,149	415,846	5	63,316	452,045
Virginia	24	161,687	1,014,607	23	166,542	990,796
Washington	5	34,025	348,332	5	47,485	484,667
West Virginia	12	163,064	1,003,559	11	249,987	1,461,002
Wisconsin	12	55,993	483,111	12	64,290	541,787
Undistributed [2]	----------	170,698	1,331,866	----------	199,280	1,529,302
	321	3,346,954	24,137,638	311	4,254,348	30,049,394

[1] Included under "Undistributed."
[2] Includes items entered as "(1)."

Hydrated lime.—Despite the reduced number of active plants in 1939 (11 less than the record number in 1937), production of hydrated lime was higher than in any year since 1930. The average value per ton, following the general downward trend in lime prices during the year, was 11 cents below the 1938 figure. Production in the important producing States was substantially higher than in 1938 and more than offset the small declines reported in more than half of the 34 producing States. The combined output from the ranking States—Ohio, Pennsylvania, and Missouri—comprised 60 percent of the total for the country.

Hydrated lime sold or used by producers in the United States, 1935–39

Year	Plants in operation	Short tons	Value	
			Total	Average
1935	167	1,005,619	$7,939,513	$7.90
1936	168	1,225,829	9,529,743	7.77
1937	170	1,301,333	10,344,470	7.95
1938	165	1,169,804	9,111,575	7.79
1939	159	1,318,053	10,124,241	7.68

Hydrated lime sold or used by producers in the United States, 1938–39, by States

State	1938		1939	
	Short tons	Value	Short tons	Value
Alabama	26,266	$190,567	26,148	$186,133
California	16,255	170,990	17,142	175,504
Florida	9,952	95,784	12,260	117,643
Georgia	7,046	54,150	6,815	57,663
Illinois	24,598	189,937	26,417	208,580
Indiana	32,845	206,290	32,368	206,262
Maryland	31,124	229,053	25,615	182,005
Massachusetts	34,111	233,748	39,757	294,758
Michigan	10,035	82,340	8,757	63,655
Missouri	92,090	602,472	135,663	776,977
New York	14,299	110,870	12,809	94,825
Ohio	391,364	3,247,112	463,786	4,015,450
Pennsylvania	178,180	1,363,343	187,228	1,387,578
Tennessee	44,336	331,734	41,331	297,403
Texas	24,264	235,445	23,735	221,476
Virginia	52,683	368,290	59,499	389,987
West Virginia	43,776	290,095	54,003	300,579
Wisconsin	13,814	112,086	12,040	94,726
Other States [1]	122,766	997,269	132,680	1,053,037
	1,169,804	9,111,575	1,318,053	10,124,241

[1] 1938: Arizona, Arkansas, Colorado, Connecticut, Hawaii, Kentucky, Maine, Minnesota, Montana, Nevada, New Jersey, North Carolina, Oregon, Rhode Island, South Dakota, Utah, Vermont, and Washington. 1939: Arizona, Arkansas, Colorado, Connecticut, Hawaii, Kentucky, Maine, Minnesota, Montana, Nevada, New Jersey, Oklahoma, Rhode Island, South Dakota, Utah, Vermont, and Washington.

SHIPMENTS

Total shipments.—Sales, shipments, and supplies of lime available for consumption in continental United States by States and groups of States that comprise approximate freight zones are listed in the two following tables. Reshipments beyond the original destination from the producing plants are disregarded. These data do not include a small quantity of lime (about 1 percent of the total) produced in Hawaii and Puerto Rico, foreign shipments, and tonnage for which distribution is not recorded.

Lime supplies available in continental United States in 1939, by States, in short tons

State	Sales by producers	Shipments from State[1]	Shipments into State	Supply		
				Hydrated	Quicklime	Total
Alabama	176,513	59,508	29,211	13,653	132,563	146,216
Arizona	57,233	22,897	1,430	1,496	34,270	35,766
Arkansas	(2)	(2)	(2)	4,254	10,207	14,461
California	87,407	9,967	27,989	24,010	81,419	105,429
Colorado	10,699	240	6,377	3,182	13,654	16,836
Connecticut	(2)	(2)	(2)	11,413	19,669	31,082
Delaware			35,441	13,097	22,344	35,441
District of Columbia			17,042	15,148	1,894	17,042
Florida	22,843		32,568	28,041	27,370	55,411
Georgia	6,815	1,495	49,382	28,146	26,556	54,702
Idaho	(2)		(2)	1,246	1,079	2,325
Illinois	147,729	72,563	209,965	80,994	204,137	285,131
Indiana	94,741	62,258	132,118	34,228	130,373	164,601
Iowa			55,473	13,975	41,498	55,473
Kansas			19,472	8,754	10,718	19,472
Kentucky	(2)		(2)	14,975	55,588	70,563
Louisiana			59,174	10,634	48,540	59,174
Maine	(2)	(2)	(2)	8,556	50,675	59,231
Maryland	59,504	14,269	86,710	54,199	77,746	131,945
Massachusetts	111,734	84,798	32,924	28,983	30,877	59,860
Michigan	45,180	22,108	178,553	63,068	138,557	201,625
Minnesota	(2)	(2)	(2)	14,725	25,875	40,600
Mississippi			15,374	4,431	10,943	15,374
Missouri	516,988	413,820	16,024	52,194	66,998	119,192
Montana	(2)		(2)	2,926	10,545	13,471
Nebraska			8,470	6,254	2,216	8,470
Nevada	(2)	(2)	(2)	26,337	3,688	30,025
New Hampshire			8,359	2,705	5,654	8,359
New Jersey	22,636	6,357	111,917	89,754	38,442	128,196
New Mexico	(2)		(2)	1,771	15,582	17,353
New York	42,225	5,675	267,445	132,093	171,902	303,995
North Carolina	(2)		(2)	32,537	38,459	70,996
North Dakota			4,763	4,501	262	4,763
Ohio	1,106,250	792,226	151,438	115,361	350,101	465,462
Oklahoma	(2)		(2)	10,960	28,380	39,340
Oregon			9,164	2,108	7,056	9,164
Pennsylvania	691,460	250,170	261,003	161,613	540,680	702,293
Rhode Island	(2)	(2)	(2)	5,871	5,773	11,644
South Carolina			22,155	14,026	8,129	22,155
South Dakota	(2)		(2)	2,955	3,484	6,439
Tennessee	163,006	133,057	13,067	23,990	19,026	43,016
Texas	62,048	10,404	2,811	22,955	31,500	54,455
Utah	38,437	567	844	3,909	34,805	38,714
Vermont	63,316	55,313	972	1,329	7,646	8,975
Virginia	166,542	111,903	66,681	42,527	78,793	121,320
Washington	47,485	9,347	1,898	3,804	36,232	40,036
West Virginia	249,987	220,743	152,522	27,639	154,127	181,766
Wisconsin	64,290	25,522	59,468	29,268	68,968	98,236
Wyoming			1,467	1,087	380	1,467
Undistributed[3]	189,854	55,498	273,174			
	4,244,922	[1] 2,440,705	2,422,845	1,301,682	2,925,380	4,227,062

[1] Includes 17,860 tons exported or unclassified as to destination. [2] Included under "Undistributed."
[3] Includes items entered as "(2)."

Apparent consumption of lime in the leading consuming States—Pennsylvania, Ohio, New York, Illinois, and Michigan—represented nearly half of the total for the country. Of these ranking States, only in Ohio was production greater than consumption. In Pennsylvania consumption usually is slightly greater than production during years of high-capacity operations in the steel industry and slightly lower than production during years of low-capacity operations. Shipments of lime from Ohio and Missouri in 1939 were considerably higher than from any other State.

Lime shipped (supply) in continental United States in 1939, by origin and destination of shipments, in short tons

Destination	Illinois, Indiana, Michigan, Ohio			Maryland, New Jersey, New York, Pennsylvania, West Virginia			Connecticut, Maine, Massachusetts, Rhode Island, Vermont			Florida, Georgia, North Carolina, Virginia			Alabama, Kentucky, Tennessee		
	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total
Illinois, Indiana, Michigan, Ohio	241, 782	553, 907	795, 689	6, 507	55, 925	62, 432	-------	4	4	1, 750	12, 490	14, 240	1, 246	13, 062	14, 308
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	162, 400	212, 250	374, 650	278, 317	646, 391	924, 708	27, 215	60, 984	88, 199	16, 013	53, 486	69, 499	451	4, 224	4, 675
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	20, 432	785	21, 217	1, 220	30, 060	31, 280	36, 950	86, 544	123, 494	130	2, 707	2, 837	-------	-------	-------
Florida, Georgia, North Carolina, South Carolina, Virginia	44, 056	2, 996	47, 052	11, 293	28, 844	40, 137	-------	155	155	60, 056	50, 523	110, 579	29, 294	94, 881	124, 175
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	23, 576	58, 288	81, 864	113	79	192	-------	-------	-------	275	20	295	36, 478	160, 083	196, 561
Arkansas, Kansas, Nebraska, Oklahoma, Texas	4, 136	442	4, 578	-------	-------	-------	-------	-------	-------	-------	-------	-------	22	-------	22
Iowa, Minnesota, Missouri, Wisconsin	31, 943	29, 927	61, 870	-------	23	23	-------	-------	-------	-------	-------	-------	-------	-------	-------
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	2, 452	1, 853	4, 305	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Destination	Arkansas, Oklahoma, Texas			Minnesota, Missouri, Wisconsin			Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, South Dakota, Utah, Washington			United States		
	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total
Illinois, Indiana, Michigan, Ohio	88	-------	88	42, 278	187, 780	230, 058	-------	-------	-------	293, 651	823, 168	1, 116, 819
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	51	275	326	9, 096	29, 525	38, 621	-------	-------	-------	493, 543	1, 007, 135	1, 500, 678
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	-------	-------	-------	125	198	323	-------	-------	-------	58, 857	120, 294	179, 151
Florida, Georgia, North Carolina, South Carolina, Virginia	-------	-------	-------	578	1, 908	2, 486	-------	-------	-------	145, 277	179, 307	324, 584
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	2, 485	11, 443	13, 928	4, 756	36, 747	41, 503	-------	-------	-------	67, 683	266, 660	334, 343
Arkansas, Kansas, Nebraska, Oklahoma, Texas	34, 837	63, 741	98, 578	14, 182	18, 838	33, 020	-------	-------	-------	53, 177	83, 021	136, 198
Iowa, Minnesota, Missouri, Wisconsin	755	295	1, 050	77, 464	173, 094	250, 558	-------	-------	-------	110, 162	203, 339	313, 501
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	964	986	1, 950	9, 301	7, 620	16, 921	66, 615	231, 997	298, 612	79, 332	242, 456	321, 788

Lime shipped to noncontiguous Territories of the United States, 1938–39

Territory	1938		1939	
	Short tons	Value	Short tons	Value
Alaska			117	$2,651
American Samoa	(1)	$7		
Hawaii	1,770	26,071	1,102	14,336
Puerto Rico	895	9,643	1,560	19,270
Virgin Islands	97	1,902	43	527
	2,762	37,623	2,822	36,784

1 Less than 1 ton.

Hydrated lime.—More than one-third of the hydrated lime produced in 1939 was consumed in the Middle Atlantic States. Shipments from all plants and from Ohio plants into various groups of States are shown in the following table.

Shipments of hydrated lime from plants in continental United States and in Ohio in 1939, by destinations

Destination	From all plants		From Ohio plants		
	Short tons	Distribution (percent)	Short tons	Distribution (percent)	Percent of total shipments
Illinois, Indiana, Michigan, Ohio	293,651	22.4	191,077	41.2	65.1
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	493,543	37.6	161,440	34.8	32.7
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	58,857	4.5	20,417	4.4	34.7
Florida, Georgia, North Carolina, South Carolina, Virginia	145,277	11.1	44,056	9.5	30.3
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	67,683	5.2	19,885	4.3	29.4
Arkansas, Kansas, Nebraska, Oklahoma, Texas	53,177	4.1	4,136	.9	7.8
Iowa, Minnesota, Missouri, Wisconsin	110,162	8.4	20,469	4.4	18.6
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	79,332	6.0	2,025	.4	2.6
Undistributed and exports	9,122	.7	281	.1	3.1
	1,310,804	100.0	463,786	100.0	35.4

SALES BY USES

The only major uses for which the average value of lime increased in 1939 over 1938 were in the building and sugar-refining industries. Prices for lime sold for metallurgical and water-purification purposes showed the largest declines—45 and 49 cents per ton, respectively. Consumption of hydrated lime, which is more stable than that of quicklime, represented a slightly smaller proportion of the total in 1939 than in 1938.

Lime sold or used by producers in the United States, 1938–39, by uses

Use	1938				1939			
	Quantity		Value		Quantity		Value	
	Per-cent of total	Short tons	Total	Average	Per-cent of total	Short tons	Total	Average
Agricultural	10.9	364,312	$2,376,108	$6.52	8.5	362,335	$2,214,759	$6.11
Building	25.5	854,461	7,163,165	8.38	23.5	1,000,498	8,563,792	8.56
Chemical and industrial:								
Glassworks	3.8	126,840	859,937	6.78	3.5	148,102	1,003,843	6.78
Metallurgy	14.7	493,522	3,073,625	6.23	17.6	748,853	4,328,564	5.78
Paper mills	12.0	402,021	2,562,317	6.37	10.9	464,224	2,904,160	6.26
Sugar refineries	.7	22,506	185,280	8.23	.4	18,831	167,480	8.89
Tanneries	1.8	59,853	411,374	6.87	1.7	70,446	475,841	6.75
Water purification	5.6	186,211	1,273,491	6.84	5.9	251,193	1,594,214	6.35
Other uses [1]	14.0	470,602	3,136,986	6.67	12.2	518,305	3,349,187	6.46
	52.6	1,761,555	11,503,010	6.53	52.2	2,219,954	13,823,289	6.23
Refractory lime (dead-burned dolomite)	11.0	366,626	3,095,355	8.44	15.8	671,561	5,447,554	8.11
Total lime	100.0	[2] 3,346,954	[2] 24,137,638	7.21	100.0	[2] 4,254,348	[2] 30,049,394	7.06
Hydrated lime (included in above totals)	35.0	1,169,804	9,111,575	7.79	31.0	1,318,053	10,124,241	7.68

[1] Details of distribution shown in a following table.
[2] Includes lime used by producers (captive tonnage) as follows—1938: 168,245 short tons, valued at $985,003; 1939: 270,087 tons, $1,454,285.

Agricultural lime and other liming materials.—Pulverized limestone, by reason of its low price and availability, is by far the most important liming agent. Its effectiveness, however, is not as rapid or subject to as close control as that of lime.

Agricultural lime and other liming materials sold or used by producers in the United States, 1938–39, by kinds

Kind	1938				1939			
	Short tons		Value		Short tons		Value	
	Gross	Effective lime content [1]	Total	Average	Gross	Effective lime content [1]	Total	Average
Lime from limestone:								
Quicklime	126,539	106,000	$666,550	$5.27	149,903	126,000	$753,325	$5.03
Hydrated	237,773	166,000	1,709,558	7.19	212,432	149,000	1,461,434	6.88
Lime from oyster shells [2]	14,789	12,000	93,338	6.31	(3)	(3)	(3)	(3)
Oysters shells (crushed) [2]	63,832	27,000	223,986	3.51	(3)	(3)	(3)	(3)
Limestone	4,367,410	1,878,000	5,637,485	1.29	5,459,260	2,347,000	6,592,827	1.21
Calcareous marl	23,572	10,100	40,270	1.71	22,114	10,000	38,492	1.74

[1] Estimated by method described in Mineral Resources of the United States, 1921, pt. II, p. 164.
[2] Bureau of Fisheries.
[3] Data not yet available.

Building lime.—Total sales of building lime in 1939 (1,000,498 short tons) reported by operators for the important uses of lime in construction include: Finishing lime, 393,668 short tons; mason's lime, 435,216 short tons; for manufacture of prepared masonry mortars, 72,032 short tons; and unspecified uses, 99,582 short tons.

Average values per ton for these classifications are \$9.37, \$8.10, \$6.73, and \$8.70, respectively. Finishing lime produced in Ohio comprised 87 percent of the total for this purpose. The combined production of mason's lime in the ranking States—Ohio, Massachusetts, and Pennsylvania—was 40 percent of the total.

Chemical and industrial lime.—The quantities and average values of metallurgical lime sold or used in 1939 are reported by the producers as follows: Fluxing lime in open-hearth steel furnaces, 558,678 short tons, \$5.54; fluxing lime in electric steel furnaces, 11,344 short tons, \$7.22; fluxing lime in smelting nonferrous metals, 12,029 short tons, \$6.13; wire drawing, 12,666 short tons, \$8.08; mold paints, foundry uses and unspecified, 1,475 short tons, \$6.29; ore concentration (including cyanidation), 152,661 short tons, \$6.33. In production of fluxing lime for steel furnaces Pennsylvania, West Virginia, Missouri, and Alabama led all other States, and Arizona and Utah outranked other States in production of lime for ore concentration.

The quantity and value of chemical-grade lime, designated as "Other uses" in a previous table, are reported by uses in 1939 as follows:

Chemical and industrial lime sold or used by producers in the United States for "Other uses" in 1939

Use	Short tons	Value
Alcohol	943	\$5,878
Alkalies (ammonium, potassium, and sodium compounds)	7,837	45,684
Asphalts and other bituminous materials	1,415	10,489
Bleach, liquid and powder (excludes bleach for paper manufacture)	10,573	57,002
Brick, sand-lime and slag	25,367	158,974
Brick, silica (refractory)	10,946	80,894
Calcium carbide and cyanamide	85,218	418,061
Calcium carbonate, precipitated	5,600	46,736
Coke and gas (gas purification and plant byproducts)	13,229	82,612
Food products:		
Creameries and dairies	682	12,210
Gelatin	6,585	46,181
Phosphate baking powders	5,046	32,396
Unspecified	1,910	18,880
Glue	6,931	44,859
Grease, lubricating	3,076	23,974
Insecticides, fungicides, and disinfectants	46,911	\$349,113
Magnesia	31,023	213,984
Paints (calcimine, pigments, etc.)	26,879	138,747
Petroleum refining	27,999	195,533
Polishing and buffing compounds	3,496	88,662
Rubber	1,357	10,123
Salt refining	6,562	36,383
Sewage and trade-wastes treatment	16,922	119,881
Soap and fat	9,561	43,366
Textiles	1,253	9,390
Tobacco	4,526	21,421
Varnish	654	4,577
Wood distillation	1,477	10,438
Undistributed [1]	28,071	175,337
Unspecified	126,256	847,402
	518,305	3,349,187

[1] Includes acid neutralization, bromine, cement, chemicals (unspecified), chromates and bichromates, citric acid, depilatories, explosives, ice, medicines and drugs, oxygen, pulp, retarder, starfish control, and sulfur.

Lime sold or used by producers in the United States in 1939, by States and uses

State	Agricultural		Building		Chemical and industrial												Total	
					Metallurgical		Paper mills		Refractory		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)	46,185	$290,118	69,799	$350,831	43,626	$253,161	(1)	(1)	------	------	1,857	$12,810	3,210	$20,830	176,513	$1,004,785
Arizona	(1)	(1)	10,612	136,241	(1)	(1)	(1)	(1)	------	------	------	------	------	------	(1)	(1)	57,233	448,860
Arkansas	------	------	(1)	(1)	(1)	(1)	(1)	(1)	------	------	------	------	(1)	(1)	(1)	(1)	(1)	(1)
California	1,311	$11,468	24,776	273,458	22,828	223,794	2,288	17,752	------	------	629	$6,002	1,282	12,124	34,293	288,728	87,407	833,326
Colorado	(1)	(1)	3,589	36,029	(1)	(1)	------	------	------	------	------	------	(1)	(1)	(1)	(1)	10,699	103,097
Connecticut	(1)	(1)	(1)	(1)	------	------	------	------	------	------	------	------	------	------	(1)	(1)	(1)	(1)
Florida	(1)	(1)	8,018	78,435	------	------	------	------	------	------	------	------	9,107	84,200	(1)	(1)	22,843	215,472
Georgia	------	------	6,815	57,663	------	------	------	------	------	------	------	------	------	------	------	------	6,815	57,663
Hawaii	------	------	(1)	(1)	------	------	------	------	------	------	------	------	------	------	(1)	(1)	(1)	(1)
Idaho	------	------	(1)	(1)	------	------	------	------	------	------	------	------	------	------	------	------	(1)	(1)
Illinois	(1)	(1)	24,840	197,900	51,256	326,746	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	14,778	102,772	147,729	1,064,154
Indiana	1,364	8,776	6,289	41,285	16,151	85,876	(1)	(1)	------	------	(1)	(1)	18,627	109,953	33,901	188,158	94,741	534,688
Kentucky	(1)	(1)	(1)	(1)	------	------	------	------	------	------	------	------	(1)	(1)	------	------	(1)	(1)
Maine	(1)	(1)	(1)	(1)	------	------	(1)	(1)	------	------	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Maryland	47,413	291,788	(1)	(1)	------	------	(1)	(1)	------	------	------	------	------	------	(1)	(1)	59,504	396,201
Massachusetts	8,647	65,047	69,595	671,375	(1)	(1)	6,872	58,465	------	------	9,965	80,880	(1)	(1)	11,869	91,661	111,734	1,005,485
Michigan	(1)	(1)	3,737	30,377	(1)	(1)	(1)	(1)	------	------	(1)	(1)	(1)	(1)	3,744	28,620	45,180	324,765
Minnesota	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	------	------	------	------	(1)	(1)	(1)	(1)	(1)	(1)
Missouri	------	------	42,724	288,469	75,794	360,624	75,295	369,105	(1)	(1)	(1)	(1)	98,402	522,898	166,784	844,188	516,988	2,800,379
Montana	(1)	(1)	(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)	22,636	148,605
New Mexico	------	------	(1)	(1)	------	------	------	------	------	------	------	------	------	------	------	------	(1)	(1)
New York	6,199	42,541	(1)	(1)	(1)	(1)	(1)	(1)	------	------	(1)	(1)	(1)	(1)	(1)	(1)	42,225	314,457
North Carolina	------	------	(1)	(1)	------	------	------	------	------	------	------	------	------	------	------	------	(1)	(1)
Ohio	28,353	185,132	424,448	3,750,403	47,738	276,046	26,775	156,584	399,362	$3,325,382	------	------	14,302	83,497	165,272	1,130,151	1,106,250	8,907,195
Oklahoma	(1)	(1)	------	------	------	------	(1)	(1)	------	------	------	------	(1)	(1)	(1)	(1)	(1)	(1)
Pennsylvania	182,012	1,113,361	85,389	696,963	169,587	1,005,582	52,071	351,251	(1)	(1)	23,437	156,679	12,425	100,656	(1)	(1)	691,460	4,744,197
Puerto Rico	------	------	------	------	------	------	------	------	------	------	------	------	(1)	(1)	(1)	(1)	(1)	(1)
Rhode Island	(1)	(1)	(1)	(1)	------	------	------	------	------	------	------	------	------	------	(1)	(1)	(1)	(1)
South Dakota	------	------	(1)	(1)	(1)	(1)	------	------	------	------	------	------	------	------	------	------	(1)	(1)
Tennessee	(1)	(1)	38,291	286,432	21,004	85,346	64,724	313,032	------	------	3,118	18,344	16,118	86,441	(1)	(1)	163,006	893,161
Texas	(1)	(1)	31,009	280,592	(1)	(1)	9,825	54,888	------	------	(1)	(1)	10,550	87,277	10,213	98,083	62,048	524,748
Utah	(1)	(1)	5,425	59,575	32,369	200,434	------	------	------	------	------	------	(1)	(1)	(1)	(1)	38,437	268,557
Vermont	9,942	55,836	13,377	108,767	(1)	(1)	(1)	(1)	------	------	(1)	(1)	(1)	(1)	26,719	191,036	63,316	452,045
Virginia	29,914	170,472	38,359	265,171	28,244	126,901	8,629	48,717	------	------	735	4,509	7,425	49,966	53,236	325,060	166,542	990,796
Washington	(1)	(1)	11,088	130,952	5,099	53,962	26,602	257,250	------	------	------	------	(1)	(1)	(1)	(1)	47,485	484,667
West Virginia	12,675	63,161	11,216	67,996	80,751	401,614	23,500	129,649	(1)	(1)	10,200	57,276	8,894	47,981	(1)	(1)	249,987	1,461,002
Wisconsin	1,441	8,820	30,232	241,412	(1)	(1)	17,400	127,706	------	------	(1)	(1)	1,286	10,178	13,446	150,028	64,290	541,787
Undistributed [2]	33,064	198,357	64,484	574,179	128,233	830,808	106,617	766,600	272,199	2,122,172	22,362	152,151	50,918	386,233	147,773	1,061,195	199,280	1,529,302
	362,335	2,214,759	1,000,498	8,563,792	748,853	4,328,564	464,224	2,904,160	671,561	5,447,554	70,446	475,841	251,193	1,594,214	685,238	4,520,510	4,254,348	30,049,394

[1] Included under "Undistributed."

[2] Includes items entered as "(1)."

Hydrated lime.—Sales of hydrated lime in 1939 were substantially higher than in 1938 for all major uses except agriculture and sugar refining.

Hydrated lime sold or used by producers in the United States, 1938–39, by uses

Use	1938		1939	
	Short tons	Value	Short tons	Value
Agricultural	237,773	$1,709,558	212,432	$1,461,434
Building	598,981	4,947,957	694,919	5,849,189
Chemical and industrial:				
Glassworks	867	5,949	1,780	10,904
Metallurgy	35,296	249,652	48,656	317,766
Paper mills	21,790	161,371	37,986	251,386
Sugar refineries	14,379	121,515	12,454	119,412
Tanneries	26,075	182,762	30,336	218,516
Water purification	94,972	694,103	108,188	727,151
Other uses	139,671	1,038,708	171,302	1,168,483
	333,050	2,454,060	410,702	2,813,618
Total hydrated lime	1,169,804	9,111,575	1,318,053	10,124,241

SIZE OF PLANTS

Studies of groups of active commercial companies, arranged by volume of annual sales, indicate that those selling 25,000 to 49,999 short tons each year are growing in number and thus contribute an increasing proportion to total annual sales by the industry. Sales by the smaller groups, although fairly persistent, represent a lower percentage of total sales in 1939 than in 1929. The number of plants in these groups is declining. Sales in the groups over 50,000 tons are the most sensitive to prosperity and depression periods. According to Bowles and Coons,[1] the number of active lime companies, plants, and kilns declined appreciably from 1910 to 1938, individual kiln capacity increased, and production by the industry from 1917 to 1938 averaged about 51 percent of capacity.

Sales of lime (including dead-burned dolomite) by producers in the United States, 1929, 1934, and 1939, by size of companies

Size group (short tons per year)	1929			1934			1939		
	Companies	Sold or used		Companies	Sold or used		Companies	Sold or used	
		Short tons	Percent of total		Short tons	Percent of total		Short tons	Percent of total
Less than 1,000	131	33,751	0.8	131	35,720	1.5	84	24,836	0.6
1,000 to 4,999	79	213,383	5.0	67	149,805	6.3	79	202,130	4.8
5,000 to 9,999	37	274,481	6.4	40	275,627	11.5	29	213,479	5.0
10,000 to 24,999	47	754,600	17.7	27	457,989	19.1	36	575,000	13.5
25,000 to 49,999	19	677,935	15.9	20	669,516	27.9	28	1,019,512	24.0
50,000 to 99,999	16	1,058,103	24.8	5	371,713	15.5	10	741,141	17.4
100,000 and over	9	1,257,515	29.4	4	436,717	18.2	8	1,478,250	34.7
	338	4,269,768	100.0	294	2,397,087	100.0	274	4,254,348	100.0

[1] Bowles, Oliver, and Coons, A. T., Graphic Survey of the Lime Industry, 1910–38: Bureau of Mines Inf. Circ. 7088, 1939, 8 pp.

TRENDS IN PRINCIPAL USES

Largely because of the record consumption of metallurgical lime and dead-burned dolomite in 1939, sales of chemical-grade and refractory lime represented 68 percent of total sales by the industry as

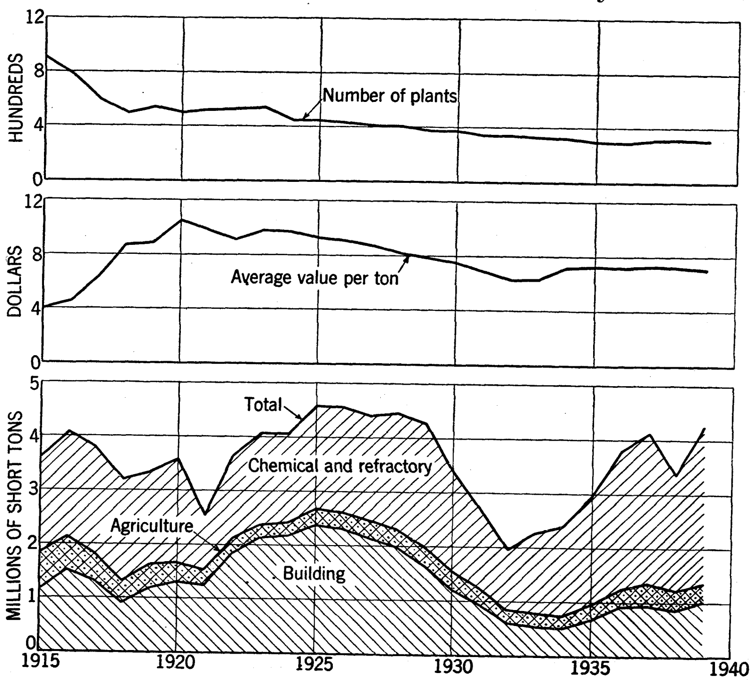

FIGURE 1.—Trends in the number of active plants, average value per ton, and principal uses of lime, 1915–39.

contrasted with 64 percent in 1938. Although sales of building lime increased considerably in 1939, they represented a slightly smaller proportion of the total than in 1938.

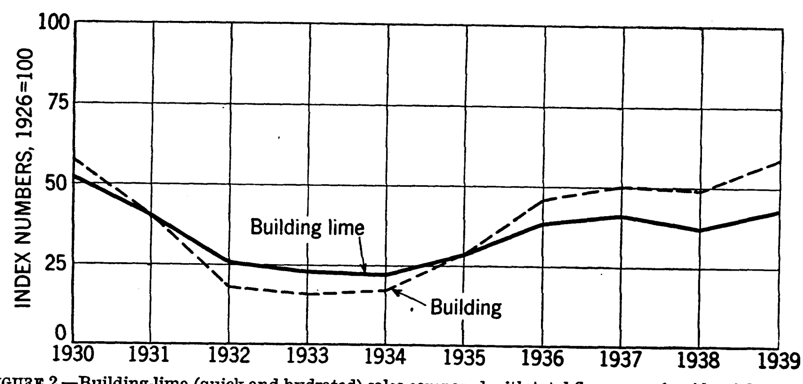

FIGURE 2.—Building-lime (quick and hydrated) sales compared with total floor area of residential and nonresidential building, 1930–39. Index numbers on building computed from F. W. Dodge Corporation data.

The disproportionate gain in consumption of refractory lime in 1939 compared to steel-ingot production probably resulted from extensive repairs required to condition furnaces that had been idle for some time and from substitution of this refractory for other higher-price materials. Dead-burned dolomite is readily available, as the producing plants are close to the important steel-producing centers of the country.

NEW DEVELOPMENTS

The methods of making and the properties of quicklime and hydrated lime for use in important consuming industries are discussed in a general symposium [2] on lime by the American Society For Testing Materials. Plasticity studies [3] show no correlation between Emley plasticity values and particle-size distribution down to 1 or 2 microns in masonry mortars made with hydrated lime and quicklime putties. Quicklime putties prepared with an excess of water were very much finer than commercial hydrated limes.

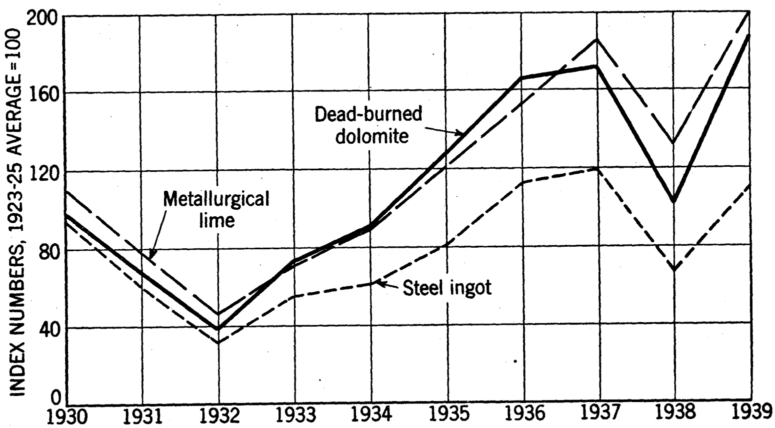

FIGURE 3.—Metallurgical lime and dead-burned dolomite sales compared with steel-ingot production, 1930–39. Index numbers on steel ingots computed by Federal Reserve Board from data of American Iron and Steel Institute.

Quantity requirements of lime in the paper and pulp industry are given by Rowley [4] as follows: 150 to 200 pounds per ton of pulp made by the sulfite process; 600 to 785 pounds per ton by the soda process; 500 to 550 pounds per ton by the sulfate process; 120 to 250 pounds per ton of rags in pulp; and about 500 pounds for pulping straw. However, new lime requirements are much lower in mills where the calcium carbonate sludge from the causticizing step is recovered and recalcined. For example, new lime requirements in a sulfate-process mill in southern United States are only 85 pounds per ton of pulp produced, although the process needs a total of 540 pounds.

The treatment of waste sulfite liquors from paper mills by the Howard process,[5] a three-stage precipitating treatment with lime, has resulted in a number of valuable byproducts such as vanillin and lignin plastics and should provide an expanding market for lime. Other newly developed uses for lime are in the manufacture of synthetic fibers of the nylon and polyvinyl acetal resin types and as a control of the starfish invasion, which seriously threatens continuance of the New England oyster beds.

[2] American Society for Testing Materials, Symposium on Lime: Philadelphia, 1940, 118 pp.
[3] Bishop, Dana L., Particle Size and Plasticity of Lime: Nat. Bureau of Standards Jour. Research, 1939, vol. 23, No. 2, pp. 285–292.
[4] Rowley, H. J., Limestone in the Pulp and Paper Industry: Trans. Canadian Min. Met. Inst., vol. 42, December 1939, pp. 599–607.
[5] Skinner, Hervey J., Waste Problems in the Pulp and Paper Industry: Ind. Eng. Chem., November 1939, vol. 21, No. 11, p. 1331.

The 41 lime plants that entered the fifth annual safety competition [6] conducted by the Bureau of Mines in cooperation with the National Lime Association, showed a marked decline in the severity rate of accidents and a slight improvement in frequency rate over the 1938 data.

FOREIGN TRADE [7]

Imports.—The marked decline in imports of dead-burned dolomite, composed largely of impure Canadian magnesite, from 13,928 short tons in 1936 to only 186 in 1939, is attributed to the reported manufacture of a similar refractory in the United States from dolomite with additions of brucite and serpentine. Imports of other types of lime in 1939 increased slightly over 1938.

Lime imported for consumption in the United States, 1935–39

Year	Hydrated lime [1]		Other lime [1]		Dead-burned dolomite [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1935	1,030	$10,571	3,413	$36,032	7,519	$189,714	11,962	$236,317
1936	1,345	12,212	7,859	74,946	13,928	349,678	23,132	436,836
1937	1,174	13,885	7,614	76,720	9,083	231,084	17,871	321,689
1938	858	10,001	5,960	56,202	2,875	67,340	9,693	133,543
1939	1,148	11,242	6,546	60,660	186	4,260	7,880	76,162

[1] Includes weight of immediate container.
[2] Classification changed in 1936 to "Dead-burned basic refractory material containing 6 percent or more of lime and consisting chiefly of magnesia and lime."

Lime imported for consumption in the United States, 1938–39, by countries and customs districts [1]

Country	Customs district	1938		1939	
		Short tons	Value	Short tons	Value
Belgium	Florida			22	$101
	New York			228	1,052
	San Antonio	6	$53	22	103
Canada	Chicago	1	13		
	Los Angeles			268	2,590
	Maine and New Hampshire	51	280		
	Michigan			1	7
	St. Lawrence			19	174
	San Francisco	2,052	19,392	3,383	33,360
	Washington	4,618	43,914	3,653	32,541
Germany	New York	16	1,543	7	596
	Pittsburgh	(2)	65	(2)	66
Japan	Washington	(2)	10	(2)	12
Mexico	San Antonio	44	108	43	108
Norway	Los Angeles			1	38
Sweden	do			6	288
	New York	7	173		
Switzerland	do	(2)	23	(2)	25
United Kingdom	do	23	629	41	841
		[3] 6,818	66,203	[3] 7,694	71,902

[1] Exclusive of dead-burned basic refractory material.
[2] Less than 1 ton.
[3] Includes weight of immediate container.

[6] Bureau of Mines, The National Lime Association Safety Competition, 1939: Health and Safety Statistics Ser. No. 269, 1940, 9 pp.
[7] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Exports.—Larger shipments of lime to several of the Central American countries and Canada resulted in a substantial gain in total quantity of lime exported in 1939.

Lime exported from the United States, 1935–39

Year	Short tons	Value	Year	Short tons	Value
1935	3,927	$63,672	1938	13,222	$121,662
1936	4,601	71,109	1939	21,477	236,497
1937	11,300	122,895			

Lime exported from the United States, 1938–39, by countries

Country	1938		1939	
	Short tons	Value	Short tons	Value
Argentina	41	$1,481	130	$2,613
Australia			30	444
Canada	6,940	37,255	8,714	74,261
Colombia	250	5,615	281	7,252
Costa Rica			1,001	10,067
Ecuador	63	1,641	62	1,645
France	27	881	36	1,113
Guatemala	800	6,516	2,434	21,673
Honduras	2	45	3,146	27,096
Japan	171	4,599	1,386	32,042
Mexico	2,457	21,516	1,374	9,719
New Zealand	65	846	30	391
Nicaragua	417	5,124	276	4,096
Panama	155	2,728	278	5,261
Peru	602	10,077	859	10,526
Philippine Islands	51	1,993	1	32
Salvador	45	607	57	784
Saudi Arabia			100	1,856
Sweden	82	3,550	117	4,162
Union of South Africa	59	700	123	2,013
United Kingdom	101	3,510	290	9,719
West Indies:				
British	310	5,617	247	3,111
Cuba	390	4,612	148	1,908
Haiti	67	832	246	2,445
Netherland	93	1,131	32	296
Other countries [1]	34	786	79	1,972
	13,222	121,662	21,477	236,497

[1] Includes entries of 25 tons and under.

CLAYS

KAOLIN (CHINA CLAY AND PAPER CLAY), BALL CLAY, FIRE CLAY, BENTONITE, FULLER'S EARTH (BLEACHING CLAYS), AND MISCELLANEOUS CLAY

By PAUL M. TYLER AND A. LINN [1]

SUMMARY OUTLINE

Sales of domestic china clay and paper clay, ball clay, and bentonite attained new high records in 1939. Fire-clay sales, on the other hand, although more than 50 percent above those in 1938, fell below those of several earlier years, including 1937, and failed to pace recovery in iron and steel manufacture, the principal consuming industry. Discouraging, too, was a further decline in the consumption of natural bleaching clays or fuller's earth, which has persisted since 1930 owing to competitive bleaching materials and changes in oil-refining technique. The tonnage of miscellaneous clay sold was only a trifle higher in 1939 than in 1938, and the total value was much lower. Sales of all kinds of clay, as reported to the Bureau of Mines, totaled 3,927,764 tons valued at $17,046,773 in 1939 compared with 2,901,713 tons valued at $13,483,441 in 1938 and 4,463,551 tons valued at $18,004,158 in 1937.

Imports of clay were somewhat higher in 1939 than in 1938 but were less in quantity or value than in any other year since 1934. Total imports of clay of all kinds were 151,420 tons valued at $1,378,735 in 1939 compared with 113,059 tons and $1,127,462 in 1938 and 205,304 tons and $1,950,043 in 1937. During the 5-year period 1925–29 imports averaged 420,310 tons valued at $3,841,462 annually.

Exports of fire clay, fuller's earth, and other clays totaled 136,480 tons valued at $1,873,110 in 1939, 132,147 tons valued at $1,565,567 in 1938, and 168,810 tons valued at $1,948,425 in 1937. Comparable figures for 1925–29 were 109,344 tons and $1,217,769 annually.

There were outstanding gains in sales of domestic clay for paper, whiteware pottery, rubber, and high-grade tile, and minor gains in sales of clay for other uses. Compared with 1937, sales for refractory uses show the same unfavorable trend as sales of fire clay alone.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce. Domestic figures for fuller's earth compiled by R. W. Metcalf, of the Bureau of Mines.

These decreases were the principal cause of the decline in the total quantity and value of sales of all clays in 1939 compared with 1937 and a few earlier years, although substantial losses also occurred in apparent consumption of oil-well drilling mud and bleaching clays and minor losses in a few other outlets.

The consumption of paper-filler clay has increased greatly but not as spectacularly as that of domestic paper-coating clays. After exceeding 10,000 tons in only one previous year, 1922 (10,243 tons), sales of domestic paper-coating clays jumped to 33,034 tons in 1929, advanced fairly steadily to 91,146 tons in 1937, and after a slight drop in 1938 rose to 116,980 tons in 1939. The record sales of 94,057 tons of rubber clay in 1939 may be compared with less than 30,000 tons in any year before 1927. The consumption of clay in paint is less now than in the late 1920's, but consumption in the manufacture of oilcloth and linoleum has increased by a large percentage.

Salient statistics of the clay industry in the United States, 1930–34 (average) and 1936–39

	1930–34 (average)	1936	1937	1938	1939
Domestic clay sold by producers:					
Kaolin, china clay .... short tons..	431,932	638,939	732,282	595,054	780,804
Ball clay .... do....	70,299	101,324	121,470	94,968	128,601
Fire clay (including stoneware clay) short tons..	1,487,364	2,471,575	2,785,344	1,458,941	2,222,295
Bentonite .... do....	84,762	177,807	194,768	192,183	219,720
Fuller's earth .... do....	259,354	230,814	226,165	170,852	167,070
Miscellaneous clays .... do....	305,973	392,783	403,522	389,715	409,274
Total domestic:					
Quantity .... do....	2,639,684	4,013,242	4,463,551	2,901,713	3,927,764
Value	$10,977,776	$15,688,434	$18,004,158	$13,483,441	$17,046,773
Imports:					
Kaolin or china clay .... short tons..	140,888	139,797	146,523	84,180	114,696
Common blue and Gross-Almerode short tons..	11,306	32,166	38,549	20,404	28,872
Fuller's earth .... do....	4,708	2,733	2,286	1,506	1,818
Other clay .... do....	24,713	21,183	17,946	6,968	6,034
Total imports:					
Quantity .... do....	181,615	195,879	205,304	113,058	151,420
Value	$1,595,101	$1,896,642	$1,950,043	$1,127,462	$1,378,735
Exports:					
Fire clay .... short tons..	39,709	65,874	77,330	55,764	57,317
Other clay (including fuller's earth) short tons..	68,978	90,569	91,480	76,383	79,163
Total exports:					
Quantity .... do....	108,687	156,443	168,810	132,147	136,480
Value	$1,323,744	$1,844,038	$1,948,425	$1,565,567	$1,873,110

Terminology on clays has been notoriously loose. To remedy this lack of uniformity a Committee on Geological Surveys, under the active leadership of H. Ries, has recommended a series of 58 definitions for adoption by the American Ceramic Society.[2] An Illinois State report shows that a clay from the Goose Lake area, Grundy County, Ill., formerly thought to be bentonite or beidellite, is composed of a distinctive clay mineral of the illite group which is unique in that it combines good oil-bleaching, high bonding, and excellent mud-forming properties. Like bentonite, it is used for rebonding foundry molding sand, for oil-well drilling muds, for setting casing in oil wells, and for special adhesives, and like fuller's earth it is used for refining mineral and edible oils.

[2] Bull. Am. Ceram. Soc., vol. 18, No. 6, June 1939, pp. 213–215.

CHINA CLAY OR KAOLIN

Sales of kaolin or china clay by domestic miners in 1939 totaled 780,804 short tons valued at $6,200,606, a gain of 31 percent over the quantity shipped in 1938 (595,054 tons, $4,740,880) and 7 percent above the previous all-time record of 732,282 tons valued at $5,349,636 in 1937. Imports recovered moderately to 114,696 short tons having a nominal value of $1,015,813 compared with 84,180 tons valued at $753,858 in 1938 and 146,523 tons valued at $1,211,266 in 1937.

As usual Georgia contributed nearly two-thirds of the national output, but South Carolina's share increased to more than 20 percent of the total in 1939 compared with 17 percent in 1938. The Georgia output exceeded the 1937 record, and that of South Carolina was greater than ever before. Pennsylvania, the third ranking State, also managed to break previous records, and California produced more than twice as much as in any previous year. Because of better demand for domestic pottery clays, sales of North Carolina clay likewise rose to an all-time high.

Largely as a result of work done by Frank L. Hess, of the Bureau of Mines, the major residual kaolin deposits of North Carolina are now believed to have been derived from large alaskite granite bodies rather than from pegmatite veins as previously thought. These deposits probably are far greater than was previously estimated, approximating 51 million tons in the Spruce Pine district of Avery, Mitchell, and Yancey Counties. The clay is notably low in iron and contains only a trace of titanium. High-grade kaolin for ceramic use is now being produced in the district by two modern plants [3] and several older plants, and the clay is used to an increasing extent also for various fillers and in special products. According to Hunter,[4] 50 geologically separate kaolin deposits are associated with the Spruce Pine alaskite. The outcrops range in size up to 100 acres or more. Residual quartz, muscovite mica, and some unkaolinized feldspar accompany the kaolin, but the mixture is easily mined by mechanical methods or hydraulicking. One deposit near the town of Spruce Pine was mined to a depth of 100 feet before the percentage of unaltered feldspar increased enough to discourage mining. The percentage of recoverable kaolin varies, and many deposits yield 10 percent or more. Mica is recovered as a joint product and is used chiefly for roofing but also as filler. The quartz is milky white and might be employed as high-grade glass sand.

By using a micronizer, it is claimed not only that clay can be ground finer than was previously possible, but also that undesirable accessory minerals can be eliminated.[5]

Clay drying and grinding may be conducted simultaneously. At some plants in the South rotary driers remove only part of the moisture, and the drying is completed in the milling equipment. This method is advantageous in preparing paper clays because, when drying is completed before grinding, the temperature may rise too

[3] Grant, J. R., Jr., Better China Clay: Eng. and Min. Jour., vol. 138, No. 7, July 1937, p. 341; New Process North Carolina Kaolin Refining: Bull. Am. Ceram. Soc., vol. 16, No. 10, October 1937, pp. 387–390.
Trauffer, W. E., Processes Kaolin by Foreign Method: Pit and Quarry, vol. 32, No. 6, December 1939, pp. 41–44.

[4] Hunter, C. E., Residual Alaskite Kaolin Deposits of North Carolina: Bull. Am. Ceram. Soc., vol. 19, No. 3, March 1940, pp. 98–103.

[5] Wolfram, H. G., An Interesting New Grinding Process: Bull. Am. Ceram. Soc., vol. 18, No. 10, October 1939, pp. 374–375.

high or the clay may remain very hot for too long a period, thereby impairing the quality of the product.

Further progress has been made in the use of air separators to remove silica sand or other impurities from clay. Wet centrifugal fractionation methods also are employed to separate ultrafine particles from Georgia kaolins used as special paper coatings. The coarser fractions are sold to the ceramic industries.

Kaolin sold by producers in the United States, 1937-39, by States

State	1937		1938		1939	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama					(1)	(1)
California	6,674	$62,959	7,057	$50,771	19,481	$111,719
Delaware	(1)	(1)	(1)	(1)	(1)	(1)
Florida	(1)	(1)	(1)	(1)	(1)	(1)
Georgia	503,732	3,546,059	412,632	3,314,918	512,214	4,135,727
Maryland	(1)	(1)	(1)	(1)	(1)	(1)
Missouri	(1)	(1)				
North Carolina	(1)	(1)	(1)	(1)	11,308	165,896
Pennsylvania	45,916	152,996	44,312	146,289	49,657	164,562
South Carolina	129,120	1,053,805	98,924	865,177	158,629	1,297,813
Tennessee					(1)	(1)
Utah	(1)	(1)	(1)	(1)	(1)	(1)
Vermont					(1)	(1)
Virginia	(1)	(1)	(1)	(1)	(1)	(1)
Washington			(1)	(1)	(1)	(1)
Undistributed [2]	46,840	533,817	32,129	363,725	29,515	324,889
	732,282	5,349,636	595,054	4,740,880	780,804	6,200,606

[1] Included under "Undistributed."
[2] Includes States indicated by "(1)."

Prices.—Prices were nominally unchanged in 1939, but during the first 8 months there was some softening with the result that virtually all producers reported a lower average realization per ton from their sales than in 1938. In anticipation of an increase of 50 cents a ton on January 1, 1940, the prices of most varieties of clay were firmer during the last quarter, but the average price of all domestic sales throughout 1939 dropped to $7.94 a ton compared with $7.97 in 1938 and $7.31 in 1937. Corresponding figures for South Carolina, where most of the output is paper-filler and rubber clays, were $8.18, $8.75, and $8.16, respectively. These figures do not cover as wide a variety of products, but they fail to measure the actual decline in unit values because the South Carolina clays are much better prepared now than they were even in 1937. In Georgia the average sales realization was $8.07 in 1939 compared with $8.03 in 1938, but this average is a composite of clays ranging from the cheapest refractory kaolins worth less than $2 a ton to the highest-grade paper-coating clays worth $30 or more a ton. Paper-filler clay, produced principally in Georgia and South Carolina, ranged in price from less than $6 to $8 a ton f. o. b. mines, whereas coating clays ranged as high as $20 and even $30 or more a ton. The average values as reported by producers were approximately $7 and $12 for filler and coating clays, respectively, in 1939 compared with $8 and $12 in 1938 and $7 and $11 in 1937; however, the comparability of these figures for different years also may be questioned because of the steady improvement in average quality. Sales of rubber clays during 1939 ranged from about $6 to $10 a ton f. o. b. Georgia or South Carolina shipping points and averaged $9.65 compared with $9.75 in 1938 and $8.80 in 1937. North Carolina potting clays were sold at $13 to $15 a ton, Florida clays were slightly cheaper, and Delaware clays somewhat more expensive, f. o. b. mines. Shipments of Georgia and South Carolina clays for ceramic use increased in 1939, but they brought only $5.50 to $8.50 a ton, about the same price range as paper-filler or rubber clays. These clays are not white burning, as they contain not only iron and a little titanium but also, as recently discovered, up to 0.08 percent vanadium oxide.

Georgia kaolin sold by producers, 1935–39, by uses

Year	China clay, paper clay, etc.			Refractory uses			Total kaolin		
	Short tons	Value		Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton		Total	Average per ton
1935	298, 275	$2, 251, 785	$7. 55	41, 383	$95, 192	$2. 30	339, 658	$2, 346, 977	$6. 91
1936	367, 463	2, 764, 065	7. 52	51, 932	131, 813	2. 54	419, 395	2, 895, 878	6. 90
1937	423, 065	3, 332, 851	7. 88	80, 667	213, 208	2. 64	503, 732	3, 546, 059	7. 04
1938	367, 612	3, 199, 169	8. 70	45, 020	115, 749	2. 57	412, 632	3, 314, 918	8. 03
1939	450, 121	3, 956, 344	8. 79	62, 093	179, 383	2. 89	512, 214	4, 135, 727	8. 07

BALL CLAY

Production of domestic ball clay exceeded by a wide margin the 1937 all-time record, advancing to 128,601 short tons valued at $935,721 in 1939 compared with 94,968 tons worth $739,691 in 1938. Imports classified as "common blue and ball clay" totaled 28,540 short tons valued at $233,094 compared with 20,199 tons valued at $199,523 in 1938, and much larger amounts in earlier years. Virtually all of these imports were ball clay, and all but 1,208 tons (from Germany) were English clay. An increasing number of American potters are substituting Kentucky and Tennessee clays for imported ball clays that they formerly used. The domestic clays are of good quality, carefully prepared, uniform, and much cheaper than English clays.

Ball clay sold by producers in the United States, 1937–39, by States

State	1937		1938		1939	
	Short tons	Value	Short tons	Value	Short tons	Value
California			(1)	(1)		
Illinois	(1)	(1)	(1)	(1)		
Kentucky	58, 118	$441, 316	45, 494	$362, 094	66, 461	$507, 938
Maryland	(1)	(1)	(1)	(1)	(1)	(1)
Missouri	(1)	(1)	(1)	(1)	(1)	(1)
New Jersey	9, 061	52, 142	3, 496	23, 202	3, 245	21, 651
Tennessee	49, 196	362, 179	40, 207	295, 587	47, 971	365, 810
Undistributed [2]	5, 095	35, 068	5, 771	58, 808	10, 924	40, 322
	121, 470	890, 705	94, 968	739, 691	128, 601	935, 721

[1] Included under "Undistributed."
[2] Includes States indicated by "(1)."

Seventy-four percent of the shipments of domestic ball clay in 1939 was used in white pottery or cream-color ware, 12 percent in high-grade tile, and the remaining 14 percent in a variety of products, including architectural terra cotta, linoleum, refractory brick, enamels, and miscellaneous articles.

FIRE CLAY

The output of fire clay from American mines, which lagged slightly behind recovery in iron and steel manufacture, the main consuming industry, rose to 2,222,295 short tons valued at $5,801,993 in 1939 compared with 1,458,941 tons valued at $4,060,160 in 1938. As shown in figure 1, the sales of domestic clay for refractories, chiefly fire clay, after following closely the trends in the iron and steel industry for many years, began to run ahead about 1934 and rose much higher in 1937 but fell back in step in 1938 and 1939. Variable factors are the longer life of modern clay refractories, the substitution of nonclay refractories, and variations in the relative requirements of consumers other than steel makers.

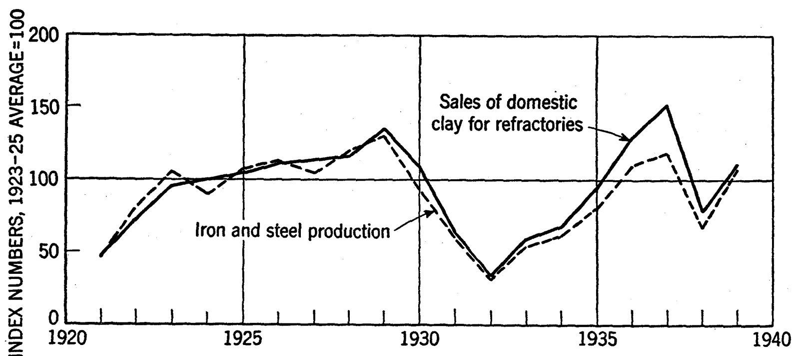

FIGURE 1.—Sales of domestic clay for refractories compared with iron and steel production (Federal Reserve Board Index), 1921-39.

Imports.—Imports of Gross-Almerode glass-pot clay in 1939 did not recover significantly from the sharp decline in 1938, aggregating only 332 short tons valued at $4,684 compared with 205 tons and $2,470 in 1938, 1,737 tons and $21,645 in 1937, and 2,145 tons and $26,852 in 1936. Imports of miscellaneous clays decreased further, totaling only 5,330 short tons valued at $69,056 in 1939 compared with 5,683 tons and $83,384 in 1938, 15,558 tons and $203,383 in 1937, and 18,034 tons and $281,592 in 1936. This group includes imports of specializedproducts such as pipe clays, pencil clays, emery-wheel clays, and enamel clay (other than kaolin and ball clay), but the largest item probably is fire clay, which includes (among other items) Klingenberg clay, a highly plastic clay produced since 1742 in Bavaria and shipped by barge down the Main River and thence on the Rhine to tidewater. In midyear of 1939 this clay cost $38.50 a metric ton for No. 1 grade delivered at United States Atlantic ports, exclusive of the 25-percent extra duty recently applied to all imports from Germany into the United States. This grade is considered essential by American graphite-crucible makers. A second grade, which cost $25 a ton on the same basis, has been used principally for graphite-clay ladle-stopper heads. During the World War, English (Dorset) bond clay and various domestic clays were substituted for Klingenberg clay, but virtually all crucible makers returned to the German clay as soon as it became available again, even though the price was raised much higher. The main advantage of this clay for making crucibles, especially brass crucibles, seems to be that it becomes dense at a comparatively low temperature, thus sealing the carbon grains and protecting them from oxidation. Consumption has dropped with the decline in production of graphite crucibles and apparently averages only about 1,000 tons a year.

Fire clay, including stoneware clay, sold by producers in the United States, 1937–39, by States

State	1937		1938		1939	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	66, 714	$94, 054	22, 871	$38, 885	27, 715	$51, 133
California	206, 674	433, 405	146, 296	338, 072	162, 244	389, 448
Colorado	59, 828	93, 587	48, 702	65, 678	52, 310	72, 644
Illinois	156, 674	306, 891	89, 743	203, 582	124, 778	267, 254
Indiana	31, 345	58, 612	13, 852	30, 172	40, 393	67, 669
Kentucky	282, 003	750, 505	102, 836	304, 466	181, 286	495, 818
Maryland	23, 634	55, 047	13, 189	40, 977	24, 091	83, 541
Missouri [1]	519, 369	1, 525, 519	258, 656	904, 522	384, 567	1, 171, 643
New Jersey	88, 890	462, 529	69, 944	358, 876	92, 884	499, 720
New Mexico	3, 959	8, 523	3, 927	6, 923	(2)	(2)
Ohio	446, 999	988, 963	254, 719	566, 439	445, 610	898, 429
Pennsylvania	779, 745	2, 038, 524	338, 864	927, 370	572, 191	1, 478, 729
Tennessee	18, 303	73, 166	12, 149	51, 448	13, 836	58, 943
Texas	7, 576	82, 583	5, 113	33, 414	5, 837	34, 196
Utah	9, 269	19, 256	12, 520	26, 103	20, 441	42, 137
Washington	28, 787	46, 161	27, 082	51, 469	20, 356	47, 734
West Virginia	48, 619	94, 413	31, 658	68, 687	46, 758	93, 426
Other States [3]	6, 956	49, 200	6, 820	43, 077	6, 998	49, 529
	2, 785, 344	7, 180, 938	1, 458, 941	4, 060, 160	2, 222, 295	5, 801, 993

[1] Includes diaspore and burley clay as follows—1937: 49,769 tons, valued at $245,395; 1938: 33,408 tons, $151,623; 1939: 40,495 tons, $174,144.
[2] Included under "Other States."
[3] Includes State indicated by "(2)" and Arkansas, Connecticut, Idaho, Iowa, Massachusetts, Minnesota, Montana, Nebraska, New York, North Carolina, North Dakota, Oregon, South Carolina, and Virginia.

BENTONITE

Further expansion in consumption of bentonite for miscellaneous uses and recovery in demand for foundry uses boosted sales to new records in 1939. As compiled from producers' reports to the Bureau of Mines, the output of American mines in 1939 rose to 219,720 short tons valued at $1,702,393 compared with 192,183 tons and $1,373,182 in 1938 and the previous record of 194,768 tons and $1,500,758 in 1937. Of the 1939 sales more than 43 percent was used for filtering and decolorizing oils, chiefly after activation with acid; another 16 percent was used by the petroleum and natural-gas industries in rotary-oil-well drilling muds; and almost 25 percent was employed in foundries and steel works, chiefly as a conditioning or revivifying agent for molding sands. Increasing quantities of bentonite are used for sealing dams and reservoirs, in soap making, and for various other purposes.

The largest increase in production was in the Black Hills area of Wyoming and South Dakota. The output in Mississippi also has increased, but outside of Mississippi, which furnishes most of the subbentonite used in the manufacture of acid-treated bleaching clays (activated earths), it would seem that type 2 bentonite has tended to give way to the swelling type of bentonite. On the other hand the American Colloid Co., which has been a leading producer in Wyoming, has begun to produce Mississippi bentonite. It is claimed that this bentonite may supplement the Wyoming type; and for certain foundry uses, particularly small iron castings and cores,[6] may be even better.

Recently a 40-inch layer of high-grade bentonite has been traced a considerable distance in Clarke County, Ala. The deposit is the first one of size and quality suitable for commercial exploitation that has been found in the State.[7] Quality Earths, Inc., operating a mill near Thomasville, formerly treated local fuller's earth but is now using this bentonite and producing therefrom a satisfactory bonding clay.

The following notes on the Wyoming industry are digested from a report by Heathman: [8]

> Bentonite seams occur in all the Upper Cretaceous rocks in Wyoming, but the best grade and the largest quantities are in the lower formations of the series. As a rule the seams thicken and thin from place to place so that one that may be prominent in one area may not be found in another; nevertheless, there is one thick seam at the top of the Mowry formation that is present throughout more than half of the area of the State. The Black Hills and Bighorn Basin areas are likely to continue to be the principal producing areas in Wyoming because of low mining costs and proximity to railroads. An example of a bentonite area presenting favorable conditions is found around Newcastle, Wyo., where the bentonite is of the best grade, the seam averages 30 inches in thickness, the dips are less than 5°, there are large tonnages of bentonite with less than 15 feet of overburden, and transportation costs are low because of good roads and short hauls to the mills on the railroad. In the Newcastle area the overburden (average not over 7 feet) is cleared away by bulldozers and the bentonite loaded into trucks by power shovels. In some cases the bentonite is hauled 25 miles to mills. In the Greybull area there is no overburden, and the material is shoveled into trucks or sacks by hand. This bentonite is hauled approximately 18 miles. As the crude clay freezes in winter, all mining is done in the summer, and large stock piles are accumulated so the mills can run all winter.

According to findings of the Wage and Hour Division, United States Department of Labor, most of the production of bentonite in the Wyoming-Dakota area is furnished by the American Colloid Co., the Wyodak Chemical Co., and the Silica Products Works of the National Lead Co. The first two companies engage in both excavating and milling, but the third buys crude bentonite and engages in milling only. An application for seasonal exemption from the maximum-hours provisions of the Fair Labor Standards Act of 1938 was denied.

The Wyoming type of bentonite is still used principally in manufacturing synthetic molding sand and rebonding old sand. A new development, however, is the use of southern (nonswelling) bentonites for rebonding molding sands, for which purpose, as previously stated, they may be even better than the Wyoming type. Another new use for bentonite is as a coagulant in the white water at paper mills. The bentonite clarifies the water so that it can be used again, and some of it adheres to the fiber and improves the paper. Bentonite is used

[6] Bechtner, Paul, Manufacturers Record Facts Result in Factory: Manuf. Rec., vol. 108, No. 8, August 1939, p. 54.
[7] Bowles, E., Bentonite in Southern Alabama: Jour. Alabama Acad. Sci. vol. 11, June 1939, p. 39.
[8] Heathman, J. H., Bentonite in Wyoming: Wyoming Geol. Survey Bull. 28, June 1939, 20 pp.

for oil-well drilling mud; for bleaching petroleum products; in the manufacture of cement and ceramic products, soaps, refractory materials, paper, cosmetics, water softeners, sealing agents, paints, medicinal emulsions, and roofing; for deinking newsprint and clarifying dry-cleaner fluids; as the core of earth-fill dams; and as lining for irrigation ditches. Grit-free bentonite (all under 5 microns and 90 percent minus 0.2 micron) may be included in the new National Formulary owing to its important uses in pharmaceuticals. By using bentonite to seal the expansion joints serious leakage was averted in a 10,000,000-gallon municipal water reservoir at Corpus Christi, Tex.

Further work at the Massachusetts Institute of Technology on Alsifilm, the proposed substitute for mica, has given much fundamental information as to the general nature of colloids and the action of electrolytes and elevated temperatures on bentonite films.[9] A new and simple device for measuring the yield point of clay suspensions used for oil-well drilling muds and other purposes has been developed by A. George Stern, of the Eastern Experiment Station, Bureau of Mines, College Park, Md.[10] Among the more important functions of an oil-well drilling mud, many of which depend on the "gel" characteristics that can now be measured with the aid of this novel instrument, are: (1) To plaster the sides of the hole to prevent caving of the walls, (2) to prevent loss of fluid by seepage, (3) to carry out sand and cuttings, and (4) to form a gel that will prevent the cuttings from falling down and packing at the bottom of the hole even if circulation stops owing to a shut-down or other unavoidable cause.

Imports and exports.—Imports of bentonite, which have been insignificant since 1930, increased slightly to 62 short tons valued at $895 in 1939 compared with 8 tons valued at $228 in 1938. Exports, as reported by producers to the Bureau of Mines, exceeded 20,000 tons, excluding shipments by dealers and the large quantities of acid-treated bentonites shipped to oil refineries throughout the world.

Prices.—Prices have remained virtually unchanged for several years. Processed bentonite sells for $10.50 a short ton f. o. b. Wyoming mills. In dried, coarsely crushed form shipped in carloads in bulk, quotations run $7.50 a ton or less, whereas the clay prepared for oil-well drilling brings higher prices than bentonite milled and sold for other purposes. As reported to the Bureau of Mines, crude sales ranged from $4 to $8 a ton, and the average returns on all sales ranged from less than $7 in South Dakota to nearly $12 a ton in California.

The most widely used bentonite is 200-mesh powder, which currently is worth $10.25 per ton f. o. b. Black Hills shipping point in 100-pound bags, carload lots. However, Wyoming-type bentonite is prepared also in pellet form (30- to 40-mesh), and a dried and finely crushed product (mostly 4- to 20-mesh) is sold in carload lots at $7 a ton in bulk and $8.75 in bags. Bentonite producers, in common with shippers in other industries, had some difficulty in getting bags, as the cost of burlap and kraft paper increased 50 percent or more.

[9] Hauser, E. A., and Le Beau, D. S., Studies in Gelatin and Film Formation: Jour. Phys. Chem., vol. 43, No. 8, November 1939, pp. 1037-1048 (also vol. 42, No. 7, October 1938, pp. 961-969).
[10] Stern, A. G., The Eykometer: Bureau of Mines Rept. of Investigations 3495, 1940, 20 pp.

Bentonite sold by producers in the United States, 1930–39 [1]

Year	Short tons	Value	Year	Short tons	Values
1930	[2] 82,593	[2] $827,912	1935	157,445	$1,047,600
1931	[2] 52,293	[2] 429,842	1936	177,807	1,367,420
1932	[2] 57,743	[2] 489,803	1937	194,768	1,500,758
1933	[2] 84,993	[2] 719,345	1938	192,183	1,373,182
1934	146,187	977,208	1939	219,720	1,702,393

[1] Included under "Miscellaneous clay" before 1930. [2] Revised figures.

Bentonite sold by producers in the United States, 1936–39, by States

State	1936		1937		1938		1939	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama							(1)	(1)
Arizona	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
California	12,294	$144,863	15,561	$204,672	15,703	$166,998	11,699	$143,314
Mississippi	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
New Mexico			(1)	(1)	(1)	(1)	(1)	(1)
Oklahoma	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
South Dakota	(1)	(1)	(1)	(1)	20,565	155,821	31,528	217,622
Texas	22,647	154,216	19,910	144,661	21,744	207,084	18,132	148,139
Utah	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Wyoming	55,090	520,852	67,958	659,111	58,911	530,834	76,133	777,722
Undistributed [2]	87,776	547,489	91,339	492,314	75,260	312,445	82,228	415,596
	177,807	1,367,420	194,768	1,500,758	192,183	1,373,182	219,720	1,702,393

[1] Included under "Undistributed." [2] Includes States indicated by "(1)."

FULLER'S EARTH

After declining almost steadily for 9 years, the production of fuller's earth or natural bleaching clays in the United States dropped further in 1939 to 167,070 short tons valued at $1,691,855 compared with 170,852 tons worth $1,707,869 in 1938 and a peak of 335,644 tons worth $4,326,705 in 1930. Until 1930 the output had increased almost in direct proportion to the rapid expansion in petroleum refining, occasional minor set-backs never lasting more than a year; but in 1930, the trends began to diverge and in 1939, when sales of fuller's earth again dropped, the Federal Reserve Board index of petroleum refining rose to 214 compared with 200 in 1938 and only 161 in 1930. Expressed as percentages of the 1930 figures, the domestic output of fuller's earth apparently had fallen 50 percent whereas petroleum refining, once the leading barometer of demand for bleaching clay, had risen 33 percent.

In recent years imports of fuller's earth have amounted to only 1 or 2 percent of domestic production. In 1939 they totaled 1,818 short tons valued at $22,215, a small increase over the 1938 total of 1,506 tons valued at $18,951 but less than imports in any other year since statistics were first available in 1897.

Exports likewise increased. Shipments to foreign countries are not reported separately in the Department of Commerce statistics, but reports to the Bureau of Mines by producers show exports of 11,090 short tons valued at $90,117 in 1939 compared with 10,046 tons valued at $81,175 in 1938 and 8,104 tons valued at $70,985 in 1937.

The decline in the use of fuller's earth is due partly to new methods of oil refining and partly to the substitution of other bleaching and clarifying agents. Activated earths, made by acid treatment of suitable bentonites, have made deep inroads into the market for natural bleaching clays; although more expensive they are much more efficient. Bauxite came into use in 1937 and has the advantage that it can be reused indefinitely, whereas fuller's earth deteriorates after too many burnings. In 1939 another competitor appeared in the form of Magnesol, a patented product having the composition of a magnesium silicate. The original company making this synthetic product has been acquired by the Westvaco Chlorine Products Corporation (Chrysler Building, New York, N. Y.) and the process is patented (U. S. Patent 2,183,590, Ernest Wayne Rembert, December 19, 1939). Magnesol, in addition to being used in oil refining, is being marketed as a continuous clarification and purification agent for all solvents used by dry-cleaning establishments.

The average value per ton of the fuller's earth produced in the United States in 1939 ($10.13) was virtually the same as in 1938 ($10.00) and 1937 ($10.15). Prices vary according to particle size. Fine material, such as that used in contact-refining processes, is much cheaper than the carefully sized particles used in percolation processes. Recently, however, at least two companies have been converting part of their fines into a granular product that is claimed to be superior to the grains produced by ordinary crushing and screening.

Technologic developments in the fuller's earth industry have been summarized in a previous review as follows: [11]

According to Schroter,[12] bleaching clays may be divided into (1) naturally adsorptive, (2) activable, and (3) natural semiadsorptive clays. The first class comprises natural bleaching clays, which hitherto have been classed as "fuller's earth," a term rapidly losing favor because it is not precise. The second group consists mainly of bentonites whose latent adsorptive capacity is increased or improved by drastic chemical treatment (usually leaching with mineral acids). The third class comprises common bauxite. Natural and activable bleaching clays consist mainly of montmorillonite. This mineral may be replaced by saponite or beidellite, but the kaolinite group of minerals is usually absent.

Owing to the wider use of colored fuel the use of bleaching clays to produce water-white gasoline has declined, but the big outlet is still in the petroleum-refining industry for percolation or contact processes. Naturally adsorptive clays have been used widely in percolation treatment, and percolation pellets have been made recently from fine fuller's earth by a simple extrusion method that forces the moist clay through perforated dies in spaghettilike strands, which are cut into short lengths and dried. The other principal method of treating petroleum is contact filtration, wherein finely ground clay is agitated with the oil and later removed in a filter press. This method is used not only for lubricating oils but for all manner of edible and nonedible oils, fats, hydrogenated shortening compounds, some oleomargarine, and even inorganic substances. Both methods are being used outside of the oil or fats industry—especially for decolorizing and recovering chemical-plant solvents and dry cleansers' liquids.

Finely ground activated adsorbent clay recently has been used in a patented method of combined fractional distillation and contact filtration, the oil-and-clay slurry being subjected to normal fractionation and the various fractions that pass off through the tower being decolorized and purified on the way. Perhaps the latest and most spectacular application of adsorbent clays is in the catalytic refining of petroleum oils, whereby the heavier hydrocarbons are broken up so as to increase the gasoline yield. With the addition of activated adsorptive clays cracking takes place at slightly lower temperatures and at much lower pressure, and about 50 percent of the heavy residues that would remain in thermal cracking may be converted into gasoline of a natural octane rating equivalent to that of the best premium motor fuels.

[11] Tyler, Paul M., and Bowles, Oliver, Nonmetallic Mineral Industries in 1939: Bureau of Mines, Inf. Circ. 7106, 1940, pp. 10–11.

[12] Schroter, G. A., Bleaching Clays Find Increasing Use: Eng. and Min. Jour., vol. 140, No. 11, November 1939, pp. 35–38, 40.

Although most activable clays are bentonites, some definitely are not because they have not been formed by devitrification of ash or tuff. Most activable clays are of the nonswelling type and do not form stable clay-water gels; however, they are soapy and seldom contain under 25 percent free moisture. The structure of the best types reminds one of yeast cake, and the color is commonly white, yellow, or some light pastel tint.[13]

Another comprehensive review of bleaching-clay technology was published by Schroter.[14]

Fuller's earth sold by producers in the United States, 1937–39, by States

State	1937		1938		1939	
	Short tons	Value	Short tons	Value	Short tons	Value
Florida and Georgia	131,100	$1,441,588	91,031	$987,391	91,947	$1,035,066
Nevada	4,485	51,718	5,984	57,499	(1)	(1)
Texas	49,500	473,408	37,998	358,980	38,338	359,058
Other States [2]	41,080	329,380	35,839	303,999	36,785	297,731
	226,165	2,296,094	170,852	1,707,869	167,070	1,691,855

[1] Included under "Other States."
[2] 1937–38: California, Colorado, Illinois, Mississippi, and Tennessee; 1939: California, Colorado, Illinois, Nevada, and Tennessee.

MISCELLANEOUS CLAY

Although more than half the output of "miscellaneous clays," as reported by the Bureau of Mines in some years, is used in the manufacture of heavy-clay products, the clay utilized for making common brick, sewer pipe, and other clay products ordinarily is not included in statistics either of the Bureau of Mines or the Bureau of the Census. However, the census of mines and quarries for 1939 is expanding its canvass to include this material. Such clay often comprises 90 percent of the clay dug, but only when it is sold to another company or shipped from place to place has it seemed feasible to report the tonnage. Rotary-drilling mud is another important item in this miscellaneous category, for several fine-grained clays are used alone or admixed with bentonite for this purpose. Additional tonnages of unclassified clays are employed in cement manufacture, in foundries and steel works, and for various minor uses. Most of these clays or shales are not worth more than $1 a ton, but the average value of the tonnage so classified in recent years has been much higher, occasionally exceeding $2 a ton. The items that increase the average value are specially prepared clays or shales used for mortar mix and drilling mud that may be worth $8 to $10 a ton. This classification also includes slip clay and a few other relatively high-priced specialities.

Miscellaneous clay, including slip clay and shale, sold by producers in the United States, 1930–39

Year	Short tons	Value	Year	Short tons	Value
1930	[1] 719,118	[1] $1,556,128	1935	207,718	$268,657
1931	[1] 410,268	[1] 462,639	1936	392,783	686,819
1932	[1] 165,777	[1] 248,266	1937	403,522	786,027
1933	[1] 117,515	[1] 153,243	1938	389,715	861,659
1934	206,277	264,296	1939	409,274	714,205

[1] Revised figures.

[13] Schroter, G. A., and Campbell, Ian, Geological Features of Some Deposits of Bleaching Clays: Am. Inst. Min. and Met. Eng. Tech. Pub. 1139, Metals Technol., January 1940, 31 pp.
[14] Schroter, George, Present-Day Technology of Adsorbent Clays: Bull. Am. Ceram. Soc., vol. 18, No. 7, July 1939, p. 240.

Miscellaneous clay, including slip clay[1] *and shale, sold by producers in the United States, 1936–39, by States*

State	1936		1937		1938		1939	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
California	149,152	$239,277	153,315	$217,938	135,923	$374,166	117,286	$250,328
Colorado	53,381	47,643	65,190	58,916	54,115	49,249	76,081	78,159
Indiana	12,980	10,593	10,024	6,405	3,089	1,692	17,402	12,024
Iowa			(2)	(2)	6,055	36,725	4,655	40,081
Nebraska	(2)	(2)	(2)	(2)	16,009	7,532	19,567	8,910
Ohio	(2)	(2)	5,259	12,380	47,226	28,751	23,542	14,351
Pennsylvania	43,211	109,228	50,208	53,481	39,196	23,136	45,292	31,728
Washington	26,831	52,920	21,071	45,118	11,901	10,638	8,272	5,744
Other States [3]	107,228	227,158	98,455	391,789	76,201	329,770	97,177	272,880
	392,783	686,819	403,522	786,027	389,715	861,659	409,274	714,205

[1] Includes slip clay as follows: 3,617 short tons (valued at $23,058) in 1936 from New York and Pennsylvania; 6,087 tons ($39,889) in 1937, 2,227 tons ($13,955) in 1938, and 2,564 tons ($17,654) in 1939 from Michigan and New York.
[2] Included under "Other States."
[3] Includes States indicated by "(2)," and Alabama, Arkansas, Connecticut, Georgia, Illinois, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Montana, Nevada, New Jersey, New Mexico, New York, North Dakota, Oklahoma, Tennessee, Texas, and Utah.

HEAVY-CLAY PRODUCTS

Monthly statistics of shipments and employment at brick, tile, and terra-cotta works in the United States indicate an improvement of 15 to 20 percent in production and sales of heavy-clay products in 1939 compared with 1938 but perhaps not enough to equal the 1937 figures.

The Bureau of the Census reports that in 1938 the value of all clay products made in the United States, exclusive of pottery and nonclay refractories, was $117,176,038 compared with $159,008,896 in 1937 and an all-time record of $317,930,245 in 1926. The value of common brick alone declined to $28,373,292 in 1938 from $34,009,775 in 1937, and the quantity decreased to 2,730 million from 3,253.

A brief survey of the structural-clay-products industry was published in 1939 by the Department of Commerce,[15] and a comprehensive review of the entire burned-clay-products field with special emphasis on marketing was issued by the Bureau of Business Research Staff, Ohio State University.[16]

Clay-products manufacturers recently have become increasingly interested in *pH* control as a means of improving the workability, strength, and other properties of their raw materials. This interest is due partly to sales pressure from concerns having for sale materials reputedly superior to the usual sodium compounds employed for *pH* control and partly to an increase in the use of sodium carbonate and sodium chloride for improving the properties of clays that usually require reasonably close *pH* control to give satisfactory results.

On the other hand, deairing appears to be on the wane. Some clay-products plants have discontinued deairing entirely, and others are operating with less vacuum than they originally used.

[15] Palmer, J. J. W., Structural Clay Products: Bureau of Foreign and Domestic Commerce, Trade Inf. Bull. 842, 1939, 19 pp.
[16] Chute, A. H., Marketing Burned-clay Products: Ohio State Univ., June 1939, 374 pp.

Figure 2 shows graphically the value of pottery and other clay products produced in the United States, 1920–39, compared with contract awards for construction and indices of industrial production. Figure 3 shows the domestic output of specified heavy-clay products, 1920–38.

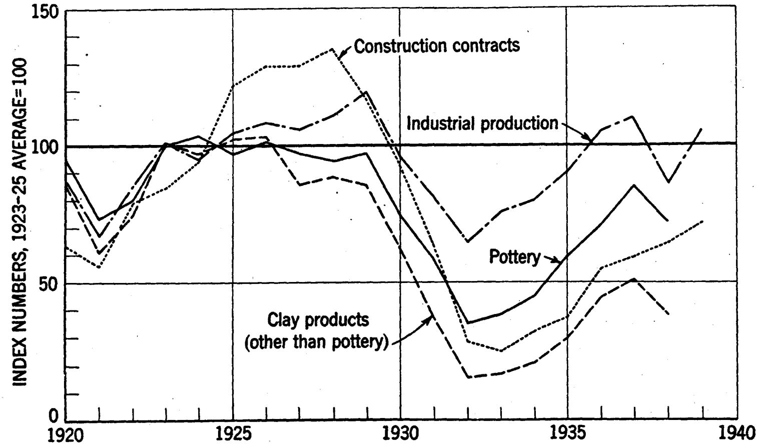

FIGURE 2.—Values of domestic production of pottery and clay products other than pottery compared with construction contract awards and indices of general industrial production, 1920–39. Indexes of industrial production and construction contracts are from the Federal Reserve Board; construction calculated from data of the F. W. Dodge Corporation.

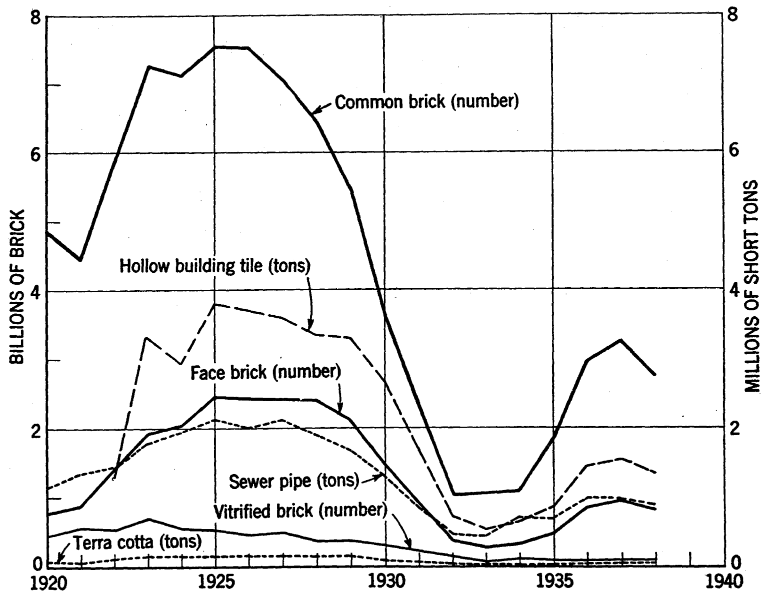

FIGURE 3.—Production of specified heavy-clay products in the United States, 1920–38. Data are from Bureau of the Census.

Light-weight aggregates, weighing only 6¾ pounds to a cubic foot, have been produced in the laboratory from clay, and the manufacture of processed clay products is becoming increasingly important commercially.

On November 15, 1939, application to the Wage and Hour Division of the United States Department of Labor for exemption from the maximum-hour provisions of the Fair Labor Standards Act was granted to brick manufacturers of Maine, New Hampshire, and Vermont because open-air drying yards and scove kilns could not be operated in freezing weather, but it was found that important plants in southern New England manufactured brick throughout the year.

POTTERY [17]

During the last decade the value of the pottery produced in the United States has fluctuated between 40 and 112 million dollars annually. In total value the most important classes are earthenware (so-called semivitreous china type), table and kitchen articles, vitreous china sanitary ware, electrical porcelain, and vitreous china tableware and kitchenware for hotel and restaurant use.

In the 10-year period 1929–38 imports, which are mainly household table and kitchen articles, were about 12 percent of domestic production of all products and about 20 percent of domestic production of tableware and kitchenware only. These percentages are based upon foreign valuations of imports; if based upon values of the imported goods in the United States, imports of table and kitchen articles would correspond to about 40 percent of the domestic output of similar classes.

During the same 10-year period exports, which comprise preponderantly electrical porcelain and sanitary articles, were about 3 percent of production.

Value of production, imports, and exports of pottery in the United States, 1929–39 [1]

Year	Production	Imports [2] (foreign value)	Exports
1929	$112,019,000	$18,538,000	$5,036,000
1931	66,582,000	7,853,000	2,150,000
1933	44,024,000	5,449,000	955,000
1937	97,365,000	9,911,000	2,704,000
1938	82,631,000	6,511,000	2,488,000
1939	(3)	6,736,000	2,668,000

[1] Compiled by U. S. Tariff Commission from reports of the Bureau of the Census and the Bureau of Foreign and Domestic Commerce.
[2] Class or kind provided for in pars. 210, 211, and 212 of Tariff Act of 1930.
[3] Data not yet available.

CONSUMPTION AND USES

The accompanying tables, which give sales of specified domestic clays by kinds and uses in 1939, continue a series begun in 1921. Figure 4 shows graphically data for total clay used by major uses or industrial groups. These figures, however, do not include imported clays, and, as domestic clays have displaced imported clays to an increasing extent, the data for certain items may exaggerate the apparent gain in consumption. This is especially true for china clay used in hotel china, sanitary ware, electrical porcelain, and other whiteware and in coating paper—the industries in which English

[17] Abstracted from pamphlet of U. S. Tariff Commission, Pottery and Reciprocal Trade Agreement April 1940, 15 pp.

clays have been chiefly used. Minor displacements have taken place in other items, such as clays used for refractories and plotted against iron and steel production in figure 1, but these are probably too small to affect general conclusions. Exports likewise are not large enough to affect most items. Exports of fire clay may represent as much as 10 percent of the clay for refractory uses in some years, but a correction of the figures to show domestic consumption alone would have no perceptible effect on apparent trends. Rubber clays also are exported, but domestic demand is so much larger that variations in

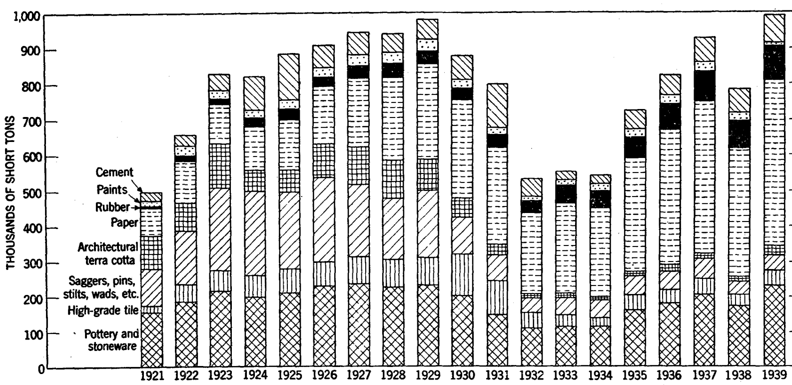

FIGURE 4.—Sales of domestic clay for specified uses, 1921–39.

the percentages of exports would have little effect upon the comparability of figures for different years.

Leading items in the list of miscellaneous uses during the past few years have been oil-well drilling muds, which reached a peak of 171,706 tons in 1937, and filtering clays (essentially type 2 bentonites for acid treatment) which reached a peak in 1939 after fluctuating between 82,000 and 91,000 tons annually during the preceding 5 years.

Sales of fuller's earth are shown in a separate table because the quantities used for uses other than refining oils and fats are relatively small.

Clay (excluding fuller's earth) sold by producers in the United States in 1939, by kinds and uses, in short tons

Use	Kaolin	Ball clay	Fire clay and stoneware clay	Bentonite	Miscellaneous clay including slip clay	Total
Pottery and stoneware:						
Whiteware, etc	59,428	95,522	1,682			156,632
Stoneware, including chemical stoneware		1,530	41,603			43,133
Art pottery	419	1,322	881		64	2,686
Flowerpots			4,076		5,618	9,694
Slip for glazing		375			829	1,204
	59,847	98,749	48,242		6,511	213,349
Tile, high-grade	17,932	15,261	8,643		777	42,613
Kiln furniture, etc.:						
Saggers, pins, stilts	1,944	98	36,033			38,075
Wads			6,260			6,260
	1,944	98	42,293			44,335

Clay (excluding fuller's earth) sold by producers in the United States in 1939, by kinds and uses, in short tons—Continued

Use	Kaolin	Ball clay	Fire clay and stoneware clay	Bentonite	Miscellaneous clay including slip clay	Total
Architectural terra cotta		3,985	21,517			25,502
Paper:						
Filler	346,037	1,000	653			347,690
Coating	116,980					116,980
	463,017	1,000	653			464,670
Rubber	90,287		3,770			94,057
Linoleum and oilcloth	6,284	3,428	9,178			18,890
Paints:						
Filler or extender	6,018				110	6,128
Calcimine	3,642		1,506			5,148
	9,660		1,506		110	11,276
Cement manufacture	41,913		3,552	811	32,590	78,866
Refractories:						
Firebrick and block	53,015	800	1,148,271			1,202,086
Bauxite, high-alumina brick	50		12,249			12,299
Fire-clay mortar, including clay processed for laying fire brick	1,403		193,550			194,953
Clay crucibles		200	1,075			1,275
Glass pots		167	698			865
Other glass refractories	511		586			1,097
Zinc retorts and condensers			12,696			12,696
Foundries and steel works	2,397		451,654	53,872	35,267	543,190
	57,376	1,167	1,820,779	53,872	35,267	1,968,461
Miscellaneous:						
Rotary-drilling mud			946	35,880	94,046	130,872
Filtering and decolorizing oils (activated earths)				95,247	(1)	[1] 95,247
Artificial abrasives		42	832		1,735	2,609
Asbestos products	1,599		254			1,853
Chemicals	3,459		18,446			21,905
Enameling		3,306	7,583			10,889
Plaster and plaster products	3,846		505			4,351
Heavy-clay products	445		221,432		208,977	430,854
Other uses	23,195	1,565	12,164	33,910	[1] 29,261	[1] 100,095
	32,544	4,913	262,162	165,037	334,019	798,675
Grand total: 1939	780,804	128,601	2,222,295	219,720	409,274	3,760,694
1938	595,054	94,968	1,458,941	192,183	389,715	2,730,861

[1] Miscellaneous clay used for filtering and decolorizing oils included under "Other uses."

Fuller's earth sold or used by producers in the United States, 1935–39, by uses

Year	Bleaching, clarifying, decolorizing, or filtering—				Other uses		Total	
	Mineral oils		Vegetable oils and animal fats					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1935	202,525	$1,977,056	21,496	$223,458	3,724	$29,715	227,745	$2,230,229
1936	202,809	1,977,825	22,489	238,354	5,516	48,799	230,814	2,264,978
1937	200,705	2,046,331	20,404	211,982	5,056	37,781	226,165	2,296,094
1938	150,062	1,542,459	12,214	106,187	8,576	59,223	170,852	1,707,869
1939	148,032	1,544,824	10,534	88,704	8,504	58,327	167,070	1,691,855

ABRASIVE MATERIALS

By Robert W. Metcalf

SUMMARY OUTLINE

The marked recovery of the natural abrasives industry from 1938 levels ran far ahead of the 22-percent increase in general industrial activity and almost matched the 44-percent increase in the automobile industry. The total value of its products rose about 40 percent over 1938, although unit values for the most part declined. Virtually all classes of natural abrasive materials shared the improvement; the rate of increase in values of production in 1939 over 1938 ranged from 35 percent for ground sand and sandstone to nearly 200 percent for millstones. Sales of pumice and pumicite set an all-time record. The value of exports and imports increased 32 and 117 percent, respectively.

The output of crude artificial abrasives showed a small gain in 1939 only because of an increase in steel shot and grit. Shipments of crude silicon carbide and aluminum oxide were smaller in 1939 than in 1938 and much smaller than in 1937, but the tonnages of these items actually consumed in 1939 increased 55 and 56 percent, respectively, over 1938. Stocks of all three classes of crude artificial abrasives were reduced considerably in 1939.

Salient statistics of the abrasives industries in the United States, 1938–39

	1938	1939	Percent of change in 1939
Domestic production (sold or used by producers):			
Natural silica abrasives:			
Diatomite	[1] $1,459,118	(2)	----------
Tripoli	329,081	$466,380	+41.7
Quartz	88,197	153,038	+73.5
Ground sand and sandstone	1,425,445	1,930,301	+35.4
Special silica-stone products:			
Grindstones and pulpstones	240,006	426,375	+77.7
Oilstones and related products	130,277	115,805	−11.1
Millstones	3,743	11,084	+196.1
Flint lining and grinding pebbles	(2)	(2)	----------

[1] Average for 1936–38, and not included in totals given; Bureau of Mines not at liberty to publish annual figures.
[2] Bureau of Mines not at liberty to publish figures.

Salient statistics of the abrasives industries in the United States, 1938–39—Continued

	1938	1939	Percent of change in 1939
Domestic production (sold or used by producers)—Continued.			
Natural silicate abrasives:			
Pumice and pumicite	$312,886	$424,780	+35.8
Garnet	191,658	278,534	+45.3
Natural alumina abrasives:			
Emery		6,828	
Total natural abrasives	[3] 2,721,293	[3] 3,813,125	+40.1
Total artificial abrasives [4]	6,238,034	6,504,403	+4.3
Foreign trade:			
Imports	4,727,004	10,246,945	+116.8
Exports	1,075,070	1,415,589	+31.7

[3] Excludes value of diatomite and flint lining and grinding pebbles, which the Bureau of Mines is not at liberty to publish.
[4] Includes some material produced in Canada; Bureau of Mines not at liberty to publish United States data separately.

This chapter includes most of the materials used chiefly as abrasives, although certain oxides, clays, and other substances mentioned later under "Miscellaneous abrasive materials" are not included in the statistics given herein. Some commodities listed as abrasives for which data are presented also have important nonabrasive uses.

Hardness, particle shape, bulking power, and purity are important factors in selection of the proper abrasive for use in soaps and scouring powders. Abrasives used in the soap industry include pumice, pumicite, feldspar, diatomaceous earth, talc, silica, bentonite and other clays, chalk, powdered or dust marble, and sawdust. The properties and suitability of each of these are discussed briefly by Roley.[1] Other ingredients added to soap formulas to aid in keeping the abrasive elements from settling include glue, gelatin, albumen, various carbohydrates, glycerin, petrolatum, sodium alginate, sodium silicate, trisodium phosphate, bentonite, and colloidal kaolin.

Collingridge [2] has discussed the trend in composition of metal polishes; the kinds of abrasives used; and the introduction of and changes in type of other ingredients employed as detergents, emulsifying agents, and mechanical buffers to modify abrasive action, as suspending vehicles, and as coloring or perfuming agents.

Liquid polishes are more in favor now than the once-popular pastes and "putz creams" or pomades; and the older brass polishes, which contained relatively coarse abrasives, have been largely displaced by finer and more carefully graded polishes suitable for chromium, silver, stainless steel, aluminum, and glass. Historically, the trend has been from the earlier tripoli-pumice-oxalic polishes to the diatomite-soap types, thence to ferric oxide and "putz-oil" polishes, and finally to the paraffin-abrasive mixtures and naphtha-soap-abrasive suspensions of the present day.

According to Collingridge [3] the following abrasives have been used in metal polishes: Pumice, emery, diatomite, silica flour, amorphous silica, tripoli, precipitated and prepared chalks or whiting, putty

[1] Roley, Richard J., Abrasives—Their Use in Soaps and Scouring Powders—Their Occurrence and Characteristics: Soap and Sanitary Chemicals, vol. 15, No. 12, December 1939, pp. 24–26, 70; abs. in Canadian Chem. and Process Industries, vol. 24, No. 1, January 1940, p. 16.
[2] Collingridge, George S., Progress in Metal Polishes and Their Raw Materials: Chem. Age (London), vol. 40, No. 1042, June 17, 1939, pp. 448–450.
[3] Collingridge, George S., Work cited in footnote 2.

powder, fuller's earth, china clay, aluminum oxide, chrome oxide, tin oxide, common salt, calcium phosphate, rouges, and heavy magnesium carbonate. The abrasives most used are the silicas and pumicite. Heavy water-base pine-oil polishes require a sharp silica, usually ground quartz. Neutral naphtha-type polishes must use a milder form of silica because they contain nothing to act as a "buffer." Next in popularity to silica flour and pumice as abrasives in metal polishes are tripoli, emery, calcite, and china clay. Precipitated chalk, whiting, rouge, fuller's earth, and diatomite are considered satisfactory for the finer grades of polishes, such as those used for silver and chromium ware. Four leading brands of American silver polishes contained 15 to 19 percent of diatomite as the sole abrasive.

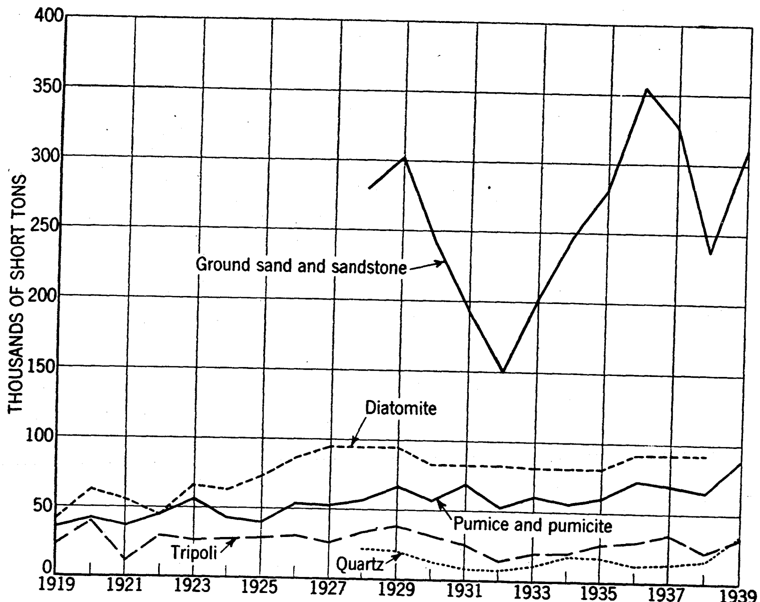

FIGURE 1.—Trends in production of diatomite, tripoli, pumice and pumicite, quartz, and ground sand and sandstone, 1919–39.

The properties of mechanically polished metallic surfaces compared with those of electrolytically polished surfaces were studied by Jacquet.[4] Mechanically polished surfaces show no crystalline properties and, aside from a surficial, probably amorphous layer, have a zone of microcrystals that bear no resemblance to the crystals of the metal. Electrolytic polishing, however, etches the metallic crystal faces and permits study of their properties.

NATURAL SILICA ABRASIVES

Diatomite.—The Bureau of Mines has not been at liberty to publish annual production figures on diatomite since 1926. Production (sales) for 3-year periods, however, may be shown, and these 3-year averages since 1926 are plotted in figure 1. From an all-time peak in 1929

[4] Jacquet, P. A., Comparative Properties of Metallic Surfaces Polished Mechanically and Electrolytically: Jour. Iron and Steel Inst., vol. 136, No. 2, 1937, p. 42A; Ceram. Abs., vol. 18, No. 7, July 1939, p. 169.

sales fell during the following years but totaled 279,645 short tons in the period 1936–38. Sales in 1939, although much higher than in 1938, did not quite equal the 1937 figure.

The principal States producing diatomite are California and Oregon. Other Western States where diatomite was produced in 1939 were Idaho, Nevada, and Washington. Eastern States reporting output of diatomite were Florida, Massachusetts, and New York. Although interest was revived in the Maryland deposits along the Patuxent River, no sales were reported to the Bureau of Mines during 1939. The following table presents such recent data on diatomite sales as the Bureau of Mines may publish.

Diatomite sold or used by producers in the United States, 1933–38 [1]

Year	Short tons	Value	Year	Short tons	Value
1933 / 1934 / 1935	244,342	$3,618,428	1936 / 1937 / 1938	279,645	$4,377,353

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

Diatomaceous earths are used principally in polishes and insulation products and as fillers, admixtures, and filter aids. The use of the finely sculptured silica skeletons of diatoms as critical test objects for determining the quality of microscope lenses,[5] although minor, is important to laboratory workers. Uses of diatomaceous earth and patents covering many of its special applications have been listed in the trade press.[6]

The behavior of diatomite as a filter aid was investigated by Carman,[7] who worked with a filter cake of rigid quartz particles and determined that, as with compressible filter cake, increase in permeability after the addition of higher proportions of diatomaceous earth is due solely to the resulting greater porosity of the cake. Efficient filtering action therefore requires that high porosity, the chief property of a filter aid, should not be sacrificed by attempting to obtain high absorptive or high coagulating power.

According to Cummins,[8] the use of diatomaceous earth as a filler in synthetic plastics, a relatively new development, increased nearly 100 percent in 1939 over the average of the previous 4-year period. The material mixes readily with plastic compositions and can be handled satisfactorily in molding operations. It is available as natural or calcined powders of different degrees of fineness and chemical purity. The density of the powder may also be varied, ranging from those that are very light to those of 25 pounds per cubic foot, loose weight. The high resistance to heat, chemical inertness, low moisture absorption, excellent electrical properties, and surface finish imparted by diatomaceous earth make it suitable for use as a filler in many products, including battery boxes, electrical parts, closures, rubber products, parts requiring a good durable surface finish, phonograph records, and sulfur plastics.

[5] Science News Letter, vol. 36, No. 27, December 30, 1939, p. 421.
[6] Oil, Paint, and Drug Reporter, vol. 136, No. 9, August 28, 1939, p. 28; No. 10, September 4, 1939, p. 63; No. 11, September 11, 1939, p. 61; No. 12, September 18, 1939, p. 63.
[7] Carman, P. C., Action of Filter Aids: Ind.Eng. Chem., vol. 31, No. 8, August 1939, pp. 1047–1050.
[8] Cummins, A. B., Fillers: Asbestos and Diatomaceous Silica: Modern Plastics, vol. 17, No. 2, October 1939, pp. 51–52.

Tripoli.—Sales of tripoli (including Pennsylvania rottenstone) in 1939 nearly reached those of 1937; the value of sales, however, was 4 percent higher than in 1937. Sales in 1939 totaled 33,474 short tons valued at $466,380 compared with 22,188 tons worth $329,081 in 1938, an increase over 1938 of 51 percent in tonnage and 42 percent in value. In 1939, as in 1938, tripoli was produced in Arkansas, California, Illinois, Missouri, Oklahoma, and Tennessee. In addition, output was reported from Texas in 1939. Production for many years has centered largely in two small areas—one in Newton County, Mo., and adjacent Ottawa County, Okla., and the other principally in Alexander County, southern Illinois. Pennsylvania produced only rottenstone. Figure 1 shows the trend in sales of tripoli since 1919.

Tripoli (including Pennsylvania rottenstone) sold or used by producers in the United States, 1935–39

Year	Illinois		Other States [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1935	10,001	$113,484	17,374	$269,932	27,375	$383,416
1936	10,981	138,063	17,506	253,815	28,487	391,878
1937	11,647	151,154	23,289	299,416	34,936	450,570
1938	8,141	117,107	14,047	211,974	22,188	329,081
1939	11,134	148,310	22,340	318,070	33,474	466,380

[1] 1935: Arkansas, California, Georgia, Missouri, Oklahoma, and Pennsylvania; 1936: Arkansas, California Missouri, Oklahoma, and Pennsylvania; 1937-38: Arkansas, California, Missouri, Oklahoma, Pennsylvania, and Tennessee; 1939: Arkansas, California, Missouri, Oklahoma, Pennsylvania, Tennessee, and Texas.

Tripoli sold for abrasive uses in 1939 represented 33 percent of the total sales compared with 36 percent in 1938 and 59 percent in 1936. Sales for filler (the second largest use) increased 61 percent over 1938 and were considerably higher than in 1937. Sales of concrete admixture dropped in volume during 1939, but nearly doubled in realization over 1938. Other uses of tripoli include fair-size tonnages for foundry facing and oil-well drilling mud.

Tripoli (including Pennsylvania rottenstone) sold or used by producers in the United States, 1937–39, by uses

Use	1937		1938		1939	
	Short tons	Value	Short tons	Value	Short tons	Value
Abrasives	15,235	$228,373	8,097	$138,807	10,953	$169,370
Concrete admixture	2,126	21,627	2,170	12,634	1,653	24,580
Filler	8,363	108,285	5,584	78,900	9,016	120,284
Other uses [1]	9,212	92,285	6,337	98,740	11,852	152,146
	34,936	450,570	22,188	329,081	33,474	466,380

[1] 1937: Filter block, filtration, foundry facing, oil-well drilling mud, pottery and enameling, and unspecified; 1938: Filter block, foundry facing, and unspecified; and 1939: Foundry facing, oil-well drilling mud, and unspecified.

The Barnsdall Tripoli Corporation, Seneca, Mo., in 1939 replaced its plant, which was destroyed by fire in 1938, with a modern, all-steel 200-ton mill erected at a reported cost of $100,000.[9] Tripoli is obtained from two quarries owned by the company and from purchases in the district.

[9] Pit and Quarry, vol. 31, No. 10, April 1939, p. 23, and vol. 32, No. 7, January 1940, p. 100.

Quartz.—Sales of crude, crushed, and ground quartz from pegmatite deposits, veins, and quartzite beds in 1939 jumped to 34,959 short tons valued at $153,038, an increase of 88 percent in tonnage and 74 percent in value over 1938. The volume of sales was the largest for any year since 1920; however, the average value per ton declined to $4.38 in 1939 compared with $4.74 in 1938 and $5.08 in 1937, continuing a steady downward trend in average realization since 1929 which was broken only in 1934 and 1936. Crude quartz sold or used in 1939 more than tripled, and crushed quartz increased by more than half over 1938. The greater relative importance of sales of crude and crushed quartz in 1939 may be due as much to a growing tendency of consumers to purchase crude or semicrude quartz and grind it with their own equipment as to increased demand from sandpaper manufacturers, metallurgical plants, and other large consumers of the unground product.

Quartz (crude, crushed, and ground)[1] sold or used by producers in the United States, 1935–39

Year	Crude		Crushed		Ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1935	[2] 7,586	[2] $26,807	(2)	(2)	9,592	$84,977	17,178	$111,784
1936	[2] 6,281	[2] 24,971	(2)	(2)	6,705	71,621	12,986	96,592
1937	3,252	10,096	5,891	$24,652	3,869	31,293	13,012	66,041
1938	4,493	17,023	9,930	27,941	4,188	43,233	18,611	88,197
1939	13,739	45,785	15,504	49,186	5,716	58,067	34,959	153,038

[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] "Crushed" included under "Crude."

Quartz was mined in the same States in 1939 as in 1938, except that no sales were reported from New Hampshire in 1939. All States for which comparisons are available show large increases in sales for 1939 over 1938, especially Arizona-California and North Carolina-Virginia. Other States with consistent production records are Maine, Maryland, New York, Ohio, and Tennessee.

Quartz (crude, crushed, and ground)[1] sold or used by producers in the United States, 1937–39, by States

State	1937		1938		1939	
	Short tons	Value	Short tons	Value	Short tons	Value
Arizona	(2)	(2)	(2)	(2)	8,442	$37,410
California	746	$6,072	1,494	$20,809		
Maine	67	168	243	663	644	1,725
New Hampshire	29	75			------	------
Maryland	410	5,850	377	6,000	515	8,010
Massachusetts	------	------	140	840	442	2,652
North Carolina	792	6,261	763	9,390	3,702	22,824
Virginia	369	1,063				
Oregon	------	------	(2)	(2)	910	5,600
Undistributed [3]	10,599	46,552	15,594	50,495	20,304	74,817
	13,012	66,041	18,611	88,197	34,959	153,038

[1] To avoid duplication, the ground material included is only that ground by the original producers of the crude quartz or by grinders who purchase from small miners not reporting their production.
[2] Included under "Undistributed."
[3] 1937: Arizona, New York, Ohio, and Tennessee; 1938: Arizona, New York, Ohio, Oregon, Tennessee, and Wisconsin; 1939: New York, Ohio, Tennessee, and Wisconsin.

Ground sand and sandstone.—Sales of ground sand and sandstone increased 31 percent in 1939 over 1938 to 310,512 short tons valued at $1,930,301—only slightly below 1937 sales. Illinois, New Jersey, Ohio, and Pennsylvania continued to be the chief producing States.

Ground sand and sandstone sold or used by producers in the United States, 1935–39

Year	Short tons	Value	Year	Short tons	Value
1935	281,665	$1,678,295	1938	237,167	$1,425,445
1936	356,423	2,146,464	1939	310,512	1,930,301
1937	328,156	1,996,528			

Ground sand and sandstone sold or used by producers in the United States, 1938–39, by States

State	1938		1939	
	Short tons	Value	Short tons	Value
Illinois	66,583	$418,881	91,645	$543,761
Massachusetts	1,234	4,102	1,374	6,220
New Jersey	63,968	338,195	88,946	577,811
Ohio	28,540	177,876	36,950	223,965
Other States[1]	76,842	486,391	91,597	578,544
	237,167	1,425,445	310,512	1,930,301

[1] California, Missouri, Pennsylvania, Virginia, West Virginia, and Wisconsin.

The largest outlet for sales of ground sand and sandstone for several years has been the pottery, porcelain, and tile industry, which in 1939 absorbed 40 percent of the material reported by the producers according to use (89 percent of the total sales). Cleansing and cleaning preparations and other abrasive use comprised 19 percent, followed by foundry consumption with 17 percent. Sizable tonnages also are consumed in enamel manufacture and for fillers.

Ground sand and sandstone sold or used by producers in the United States in 1939, by uses [1]

Use	Short tons	Value	
		Total	Average per ton
Abrasive:			
Cleansing and scouring compound	52,942	$276,468	$5.22
Other	958	5,790	6.04
Enamel	10,416	57,256	5.50
Filler	5,071	36,797	7.26
Foundry	46,546	269,300	5.79
Glass	1,696	9,075	5.35
Pottery, porcelain, and tile	109,417	730,601	6.68
Other uses	48,380	320,596	6.63
Total reported by uses	275,426	1,705,883	6.19

[1] Data represent 89 percent of the industry.

Abrasive sand.—Abrasive sands have a high silica content and include all natural sands used for abrasive purposes, such as sawing stone, grinding glass, sandpaper manufacture, and sandblasting. Sales dropped sharply in 1938 to 502,328 short tons valued at $754,805 compared with 1,067,178 tons valued at $1,440,736 in 1937. Included in the total for 1938, and undoubtedly contributing largely to the 11-percent increase in average value per ton, were 205,753 tons of blast sand valued at $509,178. Statistics for abrasive sand in 1939 are shown under the classification "grinding and polishing sand" in the chapter on Sand and Gravel in this volume.

SPECIAL SILICA-STONE PRODUCTS

Grindstones and pulpstones.—The total sales value of grindstones and pulpstones made from quarried stone rose in 1939 to $426,375, an increase of $186,369 over 1938. Sales of grindstones increased 70 percent in tonnage and 73 percent in value over 1938, and pulpstones 62 and 86 percent, respectively. Grindstones were quarried in Ohio and West Virginia and pulpstones in Washington and West Virginia in 1939.

Grindstones and pulpstones sold by producers in the United States, 1935–39

Year	Grindstones		Pulpstones		
			Quantity		Value
	Short tons	Value	Pieces	Equivalent short tons	
1935	11,476	$342,864	948	3,111	$162,514
1936	10,703	334,363	685	2,472	163,634
1937	11,617	352,377	761	2,924	220,331
1938	4,653	149,019	417	1,553	90,987
1939	7,917	257,350	672	2,517	169,025

Oilstones and related products.—Sales of natural sharpening stones of various types, including oilstones, whetstones, hones, scythestones, and rubbing stones, were 21 percent higher than in 1938 but were lower than in 1936 and 1937 by a substantial margin. Various States contributed to the total as follows: Arkansas, oilstones and whetstones; Indiana, rubbing stones; New Hampshire, scythestones; Ohio, whetstones, scythestones, lathestones, and holystones.

Oilstones and other whetstones, hones, scythestones, and rubbing stones sold by producers in the United States, 1935–39

Year	Short tons	Value	Year	Short tons	Value
1935	439	$105,589	1938	511	$130,277
1936	752	121,196	1939	620	115,805
1937	810	112,841			

Millstones.—The value of sales of millstones, chasers, and dragstones in 1939 was $11,084—more than triple the low established in 1938. Although this value is the highest since 1930, it is much below the levels of the preceding 50 years. New York, North Carolina, and Virginia were the only States from which millstones were obtained in 1939; no output from North Carolina was reported from 1936 to 1938. In 1939 millstones were produced in the following localities: Ulster County, N. Y. (the "Esopus" stone from the Shawangunk conglomerate); Brush Mountain, Montgomery County, Va. (supplying a fine-grain quartzite known as "Brush Mountain" stone); and Rowan County, N. C., near Salisbury (furnishing granite millstones).

Value of millstones, chasers, and dragstones sold by producers in the United States, 1935–39

Year	New York		Other States [1]		Total	
	Producers	Value	Producers	Value	Producers	Value
1935	8	$4,645	3	$4,885	11	$9,530
1936	6	5,458	3	5,151	9	10,609
1937	6	(2)	2	(2)	8	8,305
1938	4	(2)	2	(2)	6	3,743
1939	6	2,584	3	8,500	9	11,084

[1] 1935 and 1939: North Carolina and Virginia; 1936–38: Virginia.
[2] Bureau of Mines not at liberty to publish figures.

Flint lining and grinding pebbles.—Although steel balls have largely replaced flint pebbles in grinding ores and other materials, a moderate continuous domestic demand for noncontaminating grinding and lining mediums for pulverizing ceramic raw materials in which a minimum of iron is essential has been supplied partly by one or two domestic producers and partly by imports.

Production of domestic flint liners nearly doubled in 1939 but was still considerably below the 1937 level. The average value per ton also increased. In 1939, as in recent years, the only supplier of domestic mill liners in the United States known to the Bureau of Mines was the Jasper Stone Co., Sioux City, Iowa. The material used is quartzite obtained near Jasper, Minn. Sales of quartzite grinding pebbles by this company in 1939 doubled in volume and increased somewhat in average value compared with 1938; they topped 1937 shipments by a wide margin. The King Solomon Mines Co., Black Bear (near Yreka), Calif., again reported the use of local granite pebbles in ball mills at its gold mill.

Flint liners have been imported largely from Belgium, whereas flint grinding pebbles are imported largely from Denmark and France, although at one time a fair supply was obtained from crude chalk formerly imported in considerable quantities for grinding into whiting. Importations under the classification of "flint, flints, and flint stones unground" were larger in 1939 than in 1938, but shipping and production difficulties occasioned by the present war may curtail future receipts. In addition to the quartzite pebbles and liners quarried by the Jasper Stone Co., near Jasper, Minn., small quantities of true flints were also recovered in former years at Encinitas Beach near San Diego, Calif. Certain companies have utilized pebbles of quartzose ore, granite, or other local rock, and it seems possible that some such natural or artificially rounded material may provide satisfactory substitutes for imported grinding pebbles.

NATURAL SILICATE ABRASIVES

Pumice and pumicite.—Sales of pumice and pumicite in 1939 totaled 89,159 short tons valued at $424,780, a 36-percent rise in both tonnage and value over 1938. The 1939 sales set an all-time high both in tonnage and value; the tonnage was 22 percent greater than in 1936 (72,915 short tons), the previous record year, while the total value was 20 percent greater than in 1929 ($353,064), hitherto the record year in sales realization.

Pumice and pumicite sold or used by producers in the United States, 1935–39

Year	Short tons	Value	Year	Short tons	Value
1935	60,000	$247,076	1938	65,742	$312,886
1936	72,915	328,406	1939	89,159	424,780
1937	71,007	301,936			

Production of pumice in 1939 was reported in California, Kansas, Nebraska, New Mexico, Oklahoma, and Oregon, and that of pumicite or volcanic ash in Kansas, Nebraska, Nevada, and Oklahoma.

Consumption of pumice and pumicite showed large gains for all uses. Cleansing and scouring compounds and hand soaps, still by far the most important outlet, increased consumption to 52,521 short tons, a 12-percent gain over 1938. Sales for concrete admixture and concrete aggregate expanded to 20,719 tons, nearly 175 percent above 1938 and about 50 percent over 1936 and 1937. Sales for acoustic plaster were 77 percent higher than in 1938. (See fig. 2.)

Pumice and pumicite sold or used by producers in the United States, 1937–39, by uses

Use	1937		1938		1939	
	Short tons	Value	Short tons	Value	Short tons	Value
Abrasive:						
Cleansing and scouring compounds and hand soaps	48,608	$193,559	47,013	$188,807	52,521	$227,447
Other abrasive uses	1,442	17,369	938	8,499	(1)	(1)
Acoustic plaster	3,641	54,459	3,080	54,055	5,444	97,181
Concrete admixture and concrete aggregate	13,839	23,650	7,596	18,297	20,719	24,852
Other uses [2]	3,477	12,899	7,115	43,228	10,475	75,300
	71,007	301,936	65,742	312,886	89,159	424,780

1 Included under "Other uses."
2 1937: Asphalt, grading roads, chicken litter, filtering, rock gardens and landscaping, building tiles, floor sweep, and some unspecified uses; 1938: Asphalt, filtering, rock gardens and landscaping, building tiles, and some unspecified uses; 1939: Asphalt, heat or cold insulation, or other abrasive use, insecticide, building tile and blocks, roofing, stucco, and unspecified uses.

Nordberg [10] described the use of lightweight concrete "Basalite" units made from California pumice for residential construction. Pumice also was utilized for acoustical veneer in the walls and for shingles. Trauffer [11] described the pumicite plant of the California Industrial Minerals Co., Friant, Calif., giving a detailed account of

10 Nordberg, Bror, Fair Boosts Concrete House: Rock Products, vol. 43, No. 1, January 1940, pp. 117, 120–121.
11 Trauffer, W. E., Compact California Plant Processes Pumicite for Many Industrial Uses: Pit and Quarry, vol. 32, No. 10, April 1940, pp. 42–44.

the recovery and processing of this material. The Calsilco Corporation is said to have installed a four-roll Williams mill to prepare pumicite from a new deposit about 40 miles north of Mojave, Calif., for acoustic plaster and insulation material.[12] The Barnsdall Tripoli Corporation also has installed new equipment, including a 6-foot

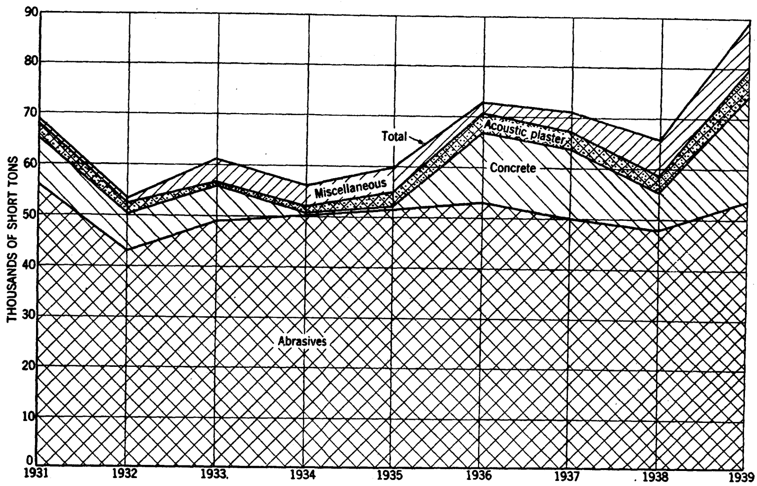

FIGURE 2.—Trend, by uses, of pumice and pumicite sold or used by producers in the United States, 1931–39.

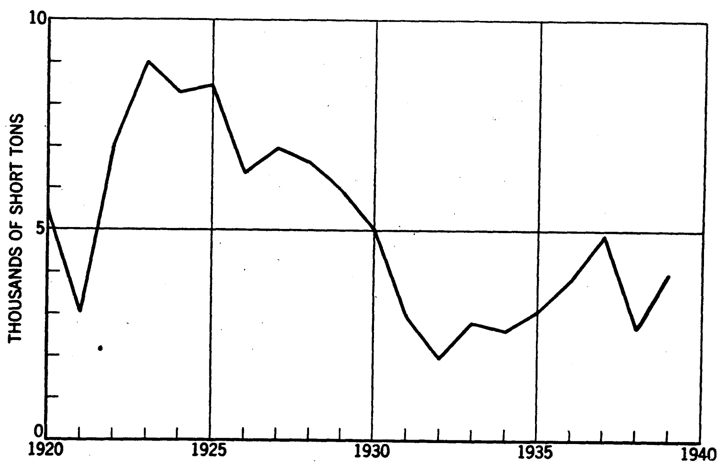

FIGURE 3.—Marketed production of abrasive garnet in the United States, 1920–39.

double-whizzer mechanical air separator, at its Grants (N. Mex.) plant.[13] A compilation of data on pumice and pumicite from California Division of Mines publications was published in 1939.[14]

Garnet.—Paralleling general business activity in 1939 sales of garnet increased moderately, but neither in quantity nor total value were they as high as in 1937 (fig. 3). The Barton Mines Corporation,

[12] Pit and Quarry, vol. 32, No. 6, December 1939, p. 23.
[13] Pit and Quarry, vol. 32, No. 7, January 1940, p. 102.
[14] California Division of Mines, Pumice and Volcanic Ash: Mineral Abs., San Francisco, Calif., 1939, 47 pp.

North Creek, Warren County, N. Y.; Davenport Garnet Co., South Danbury, Merrimack County, N. H.; and Celo Mines, Inc., Burnsville, Yancey County, N. C., reported sales during the year. The mines of the Warren County Garnet Mills, Wevertown, N. Y., were idle. Total sales include a small tonnage of combined quartz and garnet produced and sold by the Green Mountain Mica Corporation, Gassett, Windsor County, Vt., for use as an abrasive in sawing marble. No imports of garnet were reported for 1939.

Abrasive garnet sold or used by producers in the United States, 1935–39

Year	Short tons	Value	Year	Short tons	Value
1935	3,060	$256,520	1938	2,669	$191,658
1936	3,820	315,913	1939	4,056	278,534
1937	4,863	382,535			

NATURAL ALUMINA ABRASIVES

Corundum.—No corundum has been mined in the United States in recent years. Imports of corundum ore, largely from the Union of South Africa, totaled 1,964 short tons valued at $104,724, slightly less in tonnage than in 1938 and 1937 and nearly one-fourth less in value. Most of the corundum and emery is imported crude and crushed and graded in this country for domestic consumption. Newly discovered deposits of corundum and garnet are reported in the Union of South Africa.[15]

Emery.—Sales of emery in 1939 were 765 short tons valued at $6,828, the highest in any year since 1933. No sales of domestic emery were made in 1938. Four producers were active in 1939 in the emery district near Peekskill, Westchester County, N. Y., the only locality reporting production in recent years. From the property formerly mined by Smith & Ellis, operated by Gaetano DiRubbo during the first part of 1939 and by the partnership of DiRubbo & Ellis the latter part of the year, shipments were made to the Hamilton Emery & Corundum Co., Chester, Mass. DiRubbo also shipped a carload from another location to the same mill. Joe DeLuca shipped 2 carloads of emery to the Washington Mills Emery Manufacturing Co., North Grafton, Mass., from two locations, one of which was the McCoy mine, well-known as a producer of high-grade emery in former years. The Howard Emery Corporation also mined and sold emery during the year.

Emery sold or used by producers in the United States, 1935–39

Year	Short tons	Value	Year	Short tons	Value
1935	176	$1,606	1938	----------	----------
1936	325	2,900	1939	765	$6,828
1937	320	2,780			

[15] Consul General H. Earle Russell, Johannesburg, November 17, 1938, reported in Bureau of Mines Mineral Trade Notes, vol. 8, No. 2, January 20, 1939, p. 30.

Discovery of an emery vein 50 feet wide and nearly a mile long about 3 miles south of Peekskill was reported by Zodac.[16] The outcrop at one point is 60 feet wide and 30 feet high, and a short distance away it is 60 feet wide and 15 feet high. This is the first large vein located in the Peekskill district where, until the recent discovery of underground veins,[17] all deposits were held to be comparatively small, scattered surface occurrences.

Figure 4 shows trends in domestic sales and imports of emery and corundum since 1924.

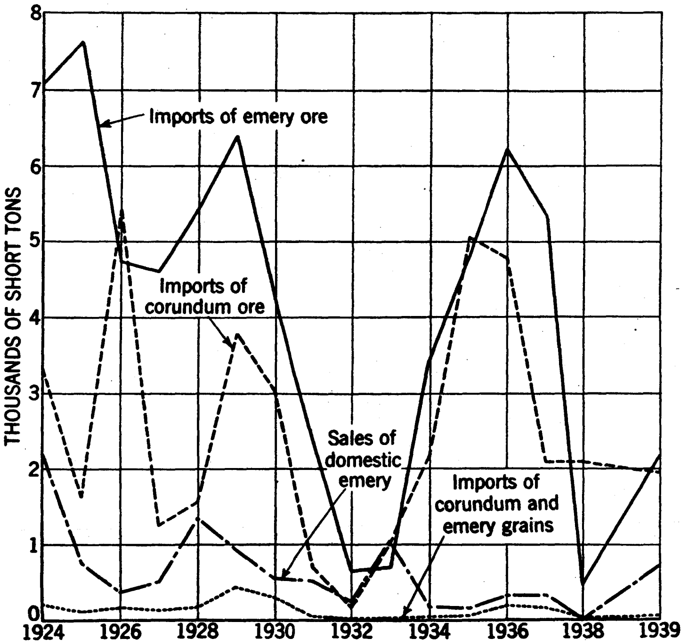

FIGURE 4.—Comparison of sales of domestic emery with imports of emery and corundum in the United States, 1924–39.

NATURAL CARBON ABRASIVES

Abrasive or industrial diamond.—World production of diamonds in 1939, as in 1938, approximated 11 million metric carats, but notwithstanding firmer prices the value of the output declined to about 40 million dollars owing to the larger proportion of industrial stones.

The demand for industrial or abrasive diamonds in the United States is supplied entirely by imports of black diamonds (carbonados), largely from Brazil, and bort, chiefly from the Union of South Africa. The total value of imports of abrasive diamonds in 1939 increased $5,468,875 to $9,764,579. Imports of "glaziers' and engravers', unset, and miners'" diamonds, by far the most important classification, rose

[16] Zodac, Peter, Huge Emery Vein Found Near Peekskill: Rocks and Minerals, vol. 15, No. 1, January 1940, p. 13.

[17] Zodac, Peter, New Emery Strike in Peekskill: Rocks and Minerals, vol. 12, No. 12, December 1937, pp. 372–374.

to 3,568,730 carats worth $9,725,683, more than twice the quantity and value reported for 1938 and 89 percent greater in quantity and 49 percent greater in value than 1937 receipts. Imports of bort increased 20 percent in quantity and 80 percent in value. The average value of bort in 1939 rose sharply to $25.07 a carat compared with $16.67 in 1938, although the average value of "glaziers, and engravers', unset, and miners'" diamonds declined to $2.73 a carat from $3.02 in 1938 and $3.47 in 1937.

The substitution of borts for carbonados and the use of smaller and smaller diamonds for industrial purposes continues. One innovation is the employment of beryllium-copper, under the trade name Vankolite, for cast-setting diamond core bits and reaming shells. Drill bits using this tougher and harder metal have increased tensile strength and improved qualities owing to the close bond between the metal and the diamonds. Before the advent of mechanical setting methods diamonds had to be placed in the crown laboriously by hand. The newer technique permits proper spacing of several hundred small stones over a comparatively small circular area at negligible cost.

It is claimed that small borts would be preferable to large stones, even if they were more expensive, as small crystals are said to be sounder and harder than large ones. A typical drilling bit contains 178 stones having an aggregate weight of 7 carats or, roughly, 25 stones to a carat. Abrasive wheels are now made by adding even smaller diamonds to powdered metal or bonded compositions and sintering to a solid mass. Because of the wider use of the extremely hard alloys that are difficult to shape, diamond-bearing tools and grinding wheels are much more in demand. Weslow [18] describes the use of a tungsten carbide and cobalt matrix impregnated with bort diamonds for drilling crowns.

In the South African fields high-intensity magnetic separators were introduced early in 1939 to remove garnet and other feebly magnetic minerals from the gravity concentrates, thereby facilitating subsequent treatment on grease tables.

ARTIFICIAL ABRASIVES

Owing to a 63-percent gain in sales of metallic abrasives in 1939, the artificial-abrasives industry increased its total sales to 116,689 short tons valued at $6,504,403, a gain in tonnage of 12 percent and in value of 4 percent over 1938. Production of both silicon carbide and aluminum oxide, however, showed small declines in 1939 compared with 1938.

[18] Weslow, W. C., Use of Diamond-impregnated Cemented Carbide for Core Bits: Am. Inst. Min. and Met. Eng. Tech. Pub. 1172, New York, 1940.

Crude artificial abrasives sold, shipped, or used, from manufacturing plants in the United States and Canada, 1935–39 [1]

Year	Silicon carbide [2]		Aluminum oxide [2]		Metallic abrasives		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1935	24, 266	[3] $2, 164, 728	49, 990	[3] $3, 784, 726	14, 593	$741, 633	88, 849	$6, 691, 087
1936	29, 342	2, 139, 919	69, 825	3, 913, 155	24, 667	1, 221, 912	123, 834	7, 274, 986
1937	[4] 30, 365	[4] 2, 215, 318	[4] 86, 401	[4] 4, 749, 497	28, 031	1, 399, 772	144, 797	8, 364, 587
1938	[4] 25, 346	[4] 1, 904, 925	[4] 53, 220	[4] 3, 098, 132	25, 771	1, 234, 977	104, 337	6, 238, 034
1939	[4] 24, 206	[4] 1, 713, 207	[4] 50, 468	[4] 3, 047, 337	42, 015	1, 743, 859	116, 689	6, 504, 403

[1] Bureau of Mines not at liberty to publish data for United States separately.
[2] Includes also material used for refractories and other nonabrasive uses.
[3] Includes value of some grain.
[4] Production.

Production of silicon carbide in the United States centers in the Niagara Falls region in New York and that of aluminum oxide in the Niagara Falls region and at Anniston, Ala. Metallic abrasives are manufactured in several Northern States from New Hampshire to Michigan.

Since 1937 producers of silicon carbide and aluminum oxide have been requested to indicate the approximate percentages of their products consumed for refractory or other nonabrasive uses. Estimates based upon these percentages indicate that about 29 percent of the output of silicon carbide in 1937 was employed for nonabrasive purposes, about 26 percent in 1938, and about 29 percent in 1939; about 4 percent of the output of aluminum oxide in each year was used for nonabrasive purposes.

MISCELLANEOUS ABRASIVE MATERIALS

Besides the materials already discussed many others have abrasive uses. Several oxides, including tin oxide, ferric oxide in the form of rouge and crocus, chromium oxide, magnesium oxide, manganese oxide, and lime, as well as clay, talc, and whiting are used as polishing agents. Silt, clay, and feldspar and other mineral substances also are used as abrasives.

FOREIGN TRADE [11]

The increased consumption of smaller diamonds for industrial uses, chiefly as a result of more efficient drilling made possible with the mechanical, cast-set, and diamond-impregnating methods of preparing drilling and grinding agents is reflected in the much larger imports of diamonds in the last 2 or 3 years, particularly of "glaziers' and engravers', unset, and miners'" diamonds which constitute by far the greater part of the total value of abrasive materials imported.

[11] Figures on exports and imports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Imports of most types of abrasive materials increased in volume, although receipts of hones, oilstones and whetstones, corundum ore, tripoli and rottenstone, and diamond dust decreased. Imports of tripoli and rottenstone were the lowest since the present classification (excluding diatomaceous earth) was adopted in 1930.

Abrasive materials imported for consumption in the United States, 1937–39, by kinds

Kind	1937		1938		1939	
	Quantity	Value	Quantity	Value	Quantity	Value
Millstones and burrstones:						
Rough or unmanufactured short tons	----------	----------	11	$894	(1)	$52
Bound up into millstones do	29	$2,896	15	1,318	31	1,678
Grindstones, finished or unfinished do	963	32,445	657	22,431	838	26,059
Hones, oilstones, and whetstones do	69	43,470	101	44,142	68	48,261
Emery:						
Ore do	5,357	87,557	477	7,796	2,191	29,318
Grains, ground, pulverized, or refined pounds	(2)	(2)	(2)	(2)	(2)	(2)
Paper and cloth of emery or corundum	(3)	31,937	(3)	67,062	(3)	72,966
Wheels, files, and other manufactures of emery or corundum or garnet pounds	123,106	72,925	6,503	3,221	10,604	5,043
Corundum (see also "Emery"):						
Ore short tons	2,085	134,574	2,098	138,629	1,964	104,724
Grains, ground, pulverized, or refined pounds	[2] 329,121	[2] 29,445	[2] 65,608	[2] 6,155	[2] 129,237	9,793
Garnet in grains, or ground, pulverized, etc. pounds	----------	----------	3,696	193	----------	----------
Tripoli and rottenstone short tons	871	12,207	498	9,826	218	2,769
Pumice:						
Crude or unmanufactured do	8,771	57,563	5,943	34,486	6,656	36,463
Manufactures of, or of which pumice is the component material of chief value	(4)	34,855	(4)	20,809	(4)	29,221
Diamond:						
Bort carats	4,203	73,069	1,151	19,187	1,381	34,618
Dust	(4)	145,036	(4)	63,105	(4)	4,278
Glaziers' and engravers', unset, and miners' carats	1,885,970	6,542,365	1,396,247	4,213,412	3,568,730	9,725,683
Flint, flints, and flint stones, unground short tons	13,428	117,828	8,169	74,338	11,987	116,019
	----------	7,418,172	----------	4,727,004	----------	10,246,945

[1] Less than 1 ton. [2] Emery included with corundum; not separately classified.
[3] 3,276 reams in 1937; 2,205 reams in 1938, 2,479 reams in 1939; weight not recorded.
[4] Quantity not recorded.

The value of exports of natural abrasive materials in 1939 rose 32 percent over 1938 to $1,415,589; all classes of abrasives shared in the upturn. Although the value of exports of grindstones increased 41 percent, the largest absolute gain in value was in the classification, "all other natural abrasives," which increased to $1,116,711, $280,817 more than in 1938 and 35 percent higher than in 1937. Both grindstones and abrasive wheels (emery and corundum) showed lower values in 1939 than in 1937, the highest year since 1930.

Value of domestic abrasive materials exported from the United States, 1935–39

Material	1935	1936	1937	1938	1939
Grindstones	$148,943	$140,614	$193,112	$122,720	$173,575
Abrasive wheels, emery and corundum	116,376	124,471	140,022	116,456	125,303
All other natural abrasives, hones, whetstones, etc.	250,228	277,463	826,955	835,894	1,116,711

SULFUR AND PYRITES

By ROBERT H. RIDGWAY AND A. W. MITCHELL [1]

SUMMARY OUTLINE

World production of sulfur declined further in 1939 despite war in Europe and improved business conditions in the United States. World markets are supplied largely from American and Italian mines, and in both countries output was at a lower level than in the preceding year. Italian production, which was relatively low during the early months of the year owing to fires in the Sicilian mines, did not meet the planned program for the fiscal year. Although the Italians encountered further American competition in world markets, stocks of mined sulfur in Italy at midyear reached a new low for this century. The controlling provisions of the international agreement between the Sulphur Export Corporation (American) and the Central Sulfur Sales Bureau (Italian) is inoperative because of war conditions. Spain, Japan, and Norway were the largest producers of pyrites in 1939; but operations in Spain, the largest source, were hampered by the civil war. Of interest in 1939 was the large increase in production and exports of pyrites from Canada.

The domestic sulfur industry reacted to the stimulus of unprecedented expansion of the domestic industry during the last quarter of 1939. This improvement in business conditions, which coincided with the outbreak of war in Europe, was felt in both the domestic and foreign sulfur markets; but as the change came near the end of the year, its effect on the sulfur industry was demonstrated to a greater extent in the rate of shipments rather than in the rate of production. This was due partly to large producers' stocks and partly to the method of extracting sulfur, which is not readily susceptible to change conforming to the market pattern. Thus, although shipments in 1939 increased one-third over 1938, production dropped 13 percent. Most of the increase in shipments went to domestic consumers; but, even though exports of sulfur were only slightly higher in 1939 than in 1938, there was a substantial increase in our foreign business after hostilities were begun abroad. Domestic production for the first three-quarters of 1939 held at the lower rate reached during the latter half of 1938, but in the last quarter there was a sizable increase.

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

Salient statistics of the sulfur industry in the United States, 1925–29 (average) and 1936–39

	1925–29 (average)	1936	1937	1938	1939
Sulfur:					
Production of crude sulfur..long tons..	1, 951, 034	2, 016, 338	2, 741, 970	2, 393, 408	2, 090, 979
Shipments of crude sulfur:					
For domestic consumption...do....	1, 397, 411	1, 421, 621	1, 791, 215	1, 049, 740	1, 605, 998
For export..........do....	707, 175	547, 199	675, 297	579, 107	627, 819
Total shipments..........do....	2, 104, 586	1, 968, 820	2, 466, 512	1, 628, 847	2, 233, 817
Imports:					
Ore..........do....	1, 896	530	398	51	35
Other..........do....	295	199	230	2, 552	13, 941
Exports of treated sulfur..........do....	11, 956	19, 708	13, 533	12, 707	25, 005
Producers' stocks at end of year..do....	2, 413. 000	3, 100, 000	3, 400, 000	4, 200, 000	4, 000, 000
Price of crude sulfur f. o. b. mines, per long ton..........	$17. 50	$18	$18	$16–$18	$16
Pyrites:					
Production..........long tons..	273, 936	547, 236	584, 166	555, 629	516, 408
Imports..........do....	372, 958	429, 313	524, 430	334, 234	482, 336
Price of imported pyrites c. i. f. Atlantic ports....cents per long-ton unit..	12–13	12–13	12–13	12–13	12–13
Sulfuric acid: Production of byproduct sulfuric acid (60° B.) at copper and zinc plants..........short tons..	1, 118, 453	732, 620	833, 994	687, 176	(1)

[1] Figures not yet available.

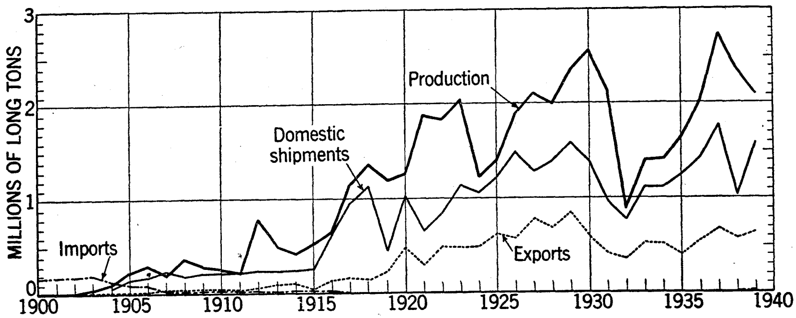

FIGURE 1.—Domestic production, domestic shipments, exports, and imports of crude sulfur, 1900–1939.

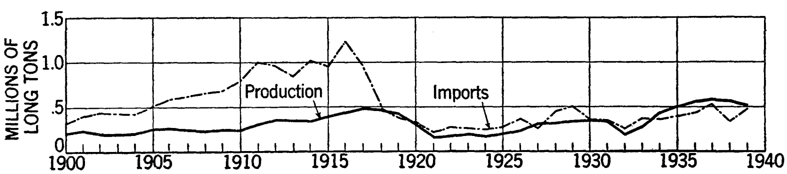

FIGURE 2.—Domestic production and imports of pyrites, 1900–1939.

In connection with its studies on the concentration of economic power the Temporary National Economic Committee held hearings on the sulfur industry on March 14, 1939.[2] During the year the United States Department of Justice, with the full cooperation of the two leading sulfur companies, conducted an investigation of the sulfur industry in connection with its general inquiry into fertilizers and their constituent ingredients. Early in 1940 the Department announced "that in view of certain commitments made by the two principal domestic sulfur companies, the public interest requires no prosecution by the Antitrust Division in the sulfur industry at this time."

[2] Temporary National Economic Committee Hearings; Part 5. Investigation of Concentration of Economic Power: Washington, 1939, pp. 1983–2009, 2200–2275.

The production of native sulfur in the United States up to and including 1939 has totaled more than 45 million long tons. Virtually the entire output has been produced since 1900. The principal trends in the sulfur and pyrites industries are shown in figures 1 and 2.

SULFUR

Domestic production.—Production of sulfur in the United States in 1939 decreased 13 percent from 1938; however, shipments from the mines increased 37 percent over 1938, were only 9 percent below the record total in 1937, and were the third largest of record. About a hundred tons of sulfur-bearing ore used for agricultural purposes were produced in 1939 but are not included in the total for 1939. None of this material was reported in 1938.

Sulfur produced and shipped in the United States, 1935–39

Year	Produced (long tons)	Shipped		Year	Produced (long tons)	Shipped	
		Long tons	Approximate value			Long tons	Approximate value
1935	1,632,590	1,634,990	$29,300,000	1938	2,393,408	1,628,847	$27,300,000
1936	2,016,338	1,968,820	35,400,000	1939	2,090,979	2,233,817	35,500,000
1937	2,741,970	2,466,512	44,300,000				

Eighty percent of the domestic output of sulfur reported for 1939 came from Texas and the remainder principally from Louisiana. California and Utah produced only 2,979 long tons. Thus the first two States produced more than 99 percent of the domestic output. Active mines in 1939 are listed in the following table.

Mines that produced sulfur in the United States in 1939

Operating company	Name of mine	Location of mine
California: Various companies	Crater Group	Bigpine, Inyo County.
	Gulch Group	Do.
Louisiana: Freeport Sulphur Co.	Grande Ecaille	Port Sulphur, Plaquemines Parish.
Texas:		
Duval Texas Sulphur Co.	Boling Dome	Boling, Wharton County.
Do	Orchard Dome	Orchard, Fort Bend County.
Freeport Sulphur Co.	Hoskins Mound	Freeport, Brazoria County.
Jefferson Lake Oil Co., Inc.	Clemens Dome	Brazoria, Brazoria County.
Texas Gulf Sulphur Co.	Boling Dome	Newgulf, Wharton County.
Utah: Utah Sulphur Industries	Utah Sulphur Industries	Beaver, Beaver County.

Recovery as byproduct.—Treatment of copper and zinc ores yields large quantities of sulfur, which is recovered at the mills as a pyrites concentrate or at the smelters as sulfuric acid. Production of pyrites concentrate is discussed in the pyrites section of this report. In the smelting of copper and zinc concentrates, sulfur is driven off as sulfur dioxide gas, which is used at many smelters in the manufacture of sulfuric acid. The equivalent of about 155,000 long tons of sulfur was recovered as sulfuric acid annually from this source during the 5 years ended in 1938. Such sulfur is not included in the sulfur-production figures for the United States, but the following table shows the output of byproduct acid at both copper- and zinc-smelting plants. The acid reported is only that made from the sulfur content of sulfide ores but does include the relatively small amount of acid made from pyrites concentrate in Wisconsin.

Byproduct sulfuric acid (expressed as 60° B.) produced at copper and zinc plants in the United States, 1934–38, in short tons [1]

	1934	1935	1936	1937	1938
Copper plants	168,676	160,151	226,738	[2] 291,638	[2] 220,297
Zinc plants	406,984	443,476	505,882	542,356	466,879
	575,660	603,627	732,620	[2] 833,994	[2] 687,176

[1] Figures for 1939 not yet available.
[2] Includes a small amount of sulfuric acid produced as a byproduct in the roasting of high-sulfide gold and silver concentrates.

Purification of manufactured gases—that is, the removal of hydrogen sulfide—has long been accomplished by passing the gases through trays of iron hydroxide, which resulted in the formation of iron sulfide, known as spent oxide. Although this material has been used as a source of sulfur in Europe, it has not been to any great extent a source of sulfur in the United States and has been discarded. During the last decade, however, the removal and recovery of sulfur as a useful byproduct from coke-oven gas, water gas, refinery-still gas, natural gas, and other fuel gases have been expanding in this country as a result of developments in various liquid-purification processes. All such processes are not designed to permit recovery of sulfur as a byproduct, but those that do may be divided into two classes, those that recover elemental sulfur and those that give hydrogen sulfide as an end product. The latter has received increasing attention in recent years. Typically, processes that recover elemental sulfur operate on manufactured fuel gases, while those that recover hydrogen sulfide are applied to refinery-still gas and natural gas, and usually these gases are under high pressure. However, investigation has indicated that the phenolate process, at least, is adapted to the removal and recovery of sulfur from low-pressure, low-sulfur gases,[3] such as coke-oven gas, and commercial application to such gases may be made in the near future.

Most of the elemental sulfur recovered from gas purification results from operations using the Thylox process; only relatively minor amounts are recovered from Ferrox-process or Nickel-process operations. Production in 1939 (reduced to 100-percent sulfur) totaled 4,307 long tons, of which 3,144 tons valued at $115,000 was shipped. Output came from Illinois, Maryland, Missouri, New Jersey, New York, Washington, West Virginia, and Wisconsin, with New York the principal producer. The sulfur is produced and marketed either as a paste containing 30- to 57-percent sulfur or as dried, relatively pure sulfur. The fine particle size of the sulfur makes it valuable as a fungicide and insecticide for agricultural purposes, which absorb most of the shipments; some has been exported for such use. Of the 1939 shipments, 1,740 tons was in the form of paste and the remainder dried sulfur.

The hydrogen sulfide gas resulting as the end product in the second class of sulfur recovery is converted to sulfuric acid or burned for

[3] Powell, Alfred R., Recovery of Sulfur from Fuel Gases: Ind. Eng. Chem., vol. 31, No. 7, July 1939, p. 795.

fuel. The hydrogen sulfide recovered as a source of sulfur in 1939 came from plants using the phenolate and phosphate processes, while that recovered by the Girbotol process is wasted or burned as fuel. In 1939 the output of sulfur in the form of hydrogen sulfide, which was sold or used in the manufacture of sulfuric acid, was 13,000 long tons and came from California, Indiana, and Pennsylvania.

The figures on the byproduct yield of sulfur from gas purification are not included in the sulfur-production figures for the United States.

Stocks.—As shipments exceeded production in 1939, stocks at the mines decreased during the year. Such stocks, however, are still large and on December 31 totaled 4,000,000 long tons.

Price.—Sulfur is not quoted on any commodity exchange, and the sellers issue no list prices or statements of similar character; however, the average quoted contract price for sulfur as reported by trade journals was unchanged at $16 a ton f. o. b. mines throughout 1939. The ex-vessel quotation along the Atlantic seaboard was $20.50 a long ton. According to the Department of Justice actual prices for various grades, as shown by sales invoices, were substantially lower. Higher prices in foreign markets show the result of increased transportation costs.

Consumption.—The apparent domestic consumption of sulfur in 1939 increased 53 percent over 1938 but was 10 percent below the record level in 1937.

Apparent consumption of sulfur in the United States, 1935–39, in long tons

	1935	1936	1937	1938	1939
Shipments	1,634,990	1,968,820	2,466,512	1,628,847	2,233,817
Imports	1,978	729	628	2,603	13,976
	1,636,968	1,969,549	2,467,140	1,631,450	2,247,793
Exports:					
Crude	402,383	547,199	675,297	579,107	627,819
Refined	10,916	19,708	13,533	12,707	25,005
	413,299	566,907	688,830	591,814	652,824
Apparent consumption	[1] 1,223,669	[1] 1,402,642	[1] 1,778,310	[1] 1,039,636	1,594,969

[1] Revised figures.

The consumption of sulfur in various industries from 1935 through 1939 has been estimated by Chemical and Metallurgical Engineering as follows:

Sulfur consumed in the United States, 1935–39, by uses, in long tons [1]

Use	1935	1936	1937	1938	1939
Chemicals	555,000	620,000	777,000	484,000	695,000
Fertilizer and insecticides	239,000	266,000	415,000	220,000	370,000
Pulp and paper	204,000	260,000	302,000	174,000	240,000
Explosives	42,000	53,000	68,000	50,000	64,000
Dyes and coal-tar products	39,000	46,000	49,000	40,000	40,000
Rubber	33,000	39,000	37,000	29,000	49,000
Paint and varnish	48,000	54,000	64,000	50,000	49,000
Food products	4,000	4,500	6,000	5,500	6,000
Miscellaneous	68,500	78,000	82,000	47,500	82,000
	1,232,500	1,420,500	1,800,000	1,100,000	1,595,000

[1] Figures for 1937 and 1938 are not truly representative of consumption but rather of shipments to these specified industries. In 1938 consumers carried over large stocks from 1937, so that actual consumption in 1937 was less than the figures indicate and consumption in 1938 was larger than the above total.

Production of sulfuric acid, the chief use of sulfur in the United States, rose in 1939 owing to increased industrial activity during the latter half of the year. Consumption of acid by the largest consumers, the fertilizer and petroleum-refining industries, increased moderately (about 10 percent) over 1938. Production of superphosphate was up moderately in 1939 accounting for the increased consumption of acid in fertilizers. The Tennessee Valley Authority continued its work on calcium metaphosphate, and operation of the first full-size unit was continued during part of the year. The plant yielded a product containing about 60 percent P_2O_5. The unit uses lump rock phosphate, or agglomerated fines, and phosphorus condensed from electric furnace gases. A second process that has been carried through the pilot-plant stage uses phosphate fines instead of prepared agglomerates or the less available rock. Continued progress is being made in the use of electric furnaces in supplying phosphorus for phosphate fertilizers.[4] During 1939 activities in the petroleum-refining industry the second largest consumer of sulfuric acid, increased about 6 percent over 1938 and explained some of the increase in consumption of acid. Use of the alkalation process, which employs sulfuric acid as a catalyst, may reverse the long-time trend toward reduction of requirements in the refining industry. On the other hand, through application of reversible absorbents, the hydrogen sulfide removed in the purification of oil refinery products is being recovered and converted to sulfuric acid. Continued increase in output of titanium dioxide accounted for a large increase in the use of acid in paints and pigments.

Chemical and Metallurgical Engineering has estimated the consumption of sulfuric acid, by industries, from 1935 through 1939 as follows:

Sulfuric acid (expressed as 50° B.) consumed in the United States, 1935–39, by industries, in short tons

Industry	1935	1936	1937	1938	1939
Fertilizer	1,720,000	1,987,000	2,230,000	1,920,000	2,100,000
Petroleum refining	980,000	1,100,000	1,100,000	1,100,000	1,210,000
Chemicals	940,000	955,000	1,020,000	800,000	975,000
Coal products	625,000	770,000	865,000	585,000	740,000
Iron and steel	630,000	770,000	1,100,000	590,000	980,000
Other metallurgical	520,000	560,000	625,000	350,000	570,000
Paints and pigments	400,000	450,000	525,000	430,000	500,000
Explosives	175,000	222,000	180,000	140,000	190,000
Rayon and cellulose film	303,000	330,000	380,000	318,000	400,000
Textiles	90,000	108,000	112,000	90,000	116,000
Miscellaneous	342,000	380,000	450,000	355,000	400,000
	6,725,000	7,632,000	8,587,000	6,678,000	8,181,000

Foreign trade.—Exports of crude sulfur in 1939 were 8 percent above those in 1938 and, except for 1937, the largest since 1929. Exports of treated sulfur in 1939, while relatively minor, were nearly double the 1938 figure. Movement was slow during the first half of the year, but there was a substantial rise during the closing months.

Imports, though small, were higher in 1939 and were received in the Northwestern States from Canada.

[4] Tennessee Valley Authority, Annual Report for the Fiscal Year Ended June 30, 1939: Washington, D. C., 1939, pp. 25–26.

Sulfur imported into and exported from the United States, 1935–39

Year	Imports: Ore: Long tons	Imports: Ore: Value	Imports: In any form, n. e. s.: Long tons	Imports: In any form, n. e. s.: Value	Exports: Crude: Long tons	Exports: Crude: Value	Exports: Crushed, ground, refined, sublimed, and flowers of: Long tons	Exports: Crushed, ground, refined, sublimed, and flowers of: Value
1935	1,763	$26,164	215	$30,975	402,383	$7,582,293	10,916	$418,532
1936	530	10,141	199	27,437	547,199	10,147,038	19,708	746,985
1937	398	4,724	230	38,171	675,297	12,155,253	13,533	509,133
1938	51	562	2,552	71,903	579,107	10,378,991	12,707	469,773
1939	35	445	13,941	250,422	627,819	10,771,751	25,005	909,974

Sulfur exported from the United States, 1938–39, by countries

Country	Crude: 1938: Long tons	Crude: 1938: Value	Crude: 1939: Long tons	Crude: 1939: Value	Crushed, ground, refined, sublimed, and flowers of: 1938: Pounds	Crushed, ground, refined, sublimed, and flowers of: 1938: Value	Crushed, ground, refined, sublimed, and flowers of: 1939: Pounds	Crushed, ground, refined, sublimed, and flowers of: 1939: Value
North America:								
Canada	82,651	$1,486,463	142,437	$2,315,336	5,236,975	$107,157	6,686,536	$144,304
Central America	118	3,632	108	3,328	282,469	7,083	284,818	6,594
Mexico	5,946	124,435	7,053	140,354	1,556,482	32,216	1,879,576	36,683
Newfoundland and Labrador	2,989	53,802	4,983	79,728	4,000	163	3,000	122
West Indies	8,575	160,837	9,163	170,718	211,715	5,290	254,411	7,691
	100,279	1,829,169	163,744	2,709,464	7,291,641	151,909	9,108,341	195,394
South America:								
Argentina	16,102	288,969	29,051	513,310	81,529	2,777	367,373	13,182
Brazil	4,106	82,715	10,882	193,382	359,867	6,805	2,738,603	48,359
Colombia	-------	-------	-------	-------	443,427	12,041	803,125	17,306
Other South America	-------	-------	-------	-------	242,905	4,118	936,824	18,117
	20,208	371,684	39,933	706,692	1,127,728	25,741	4,845,925	96,964
Europe:								
Belgium	6,032	113,387	7,057	131,630	101,798	1,390	126,069	1,840
Denmark	-------	-------	-------	-------	1,361,579	17,090	1,066,998	13,775
France	98,751	1,826,896	39,811	699,326	522,049	6,807	591,918	8,220
Germany	32,817	610,750	8,702	148,409	454,148	5,919	157,722	2,079
Greece	-------	-------	-------	-------	-------	-------	18,739,160	252,516
Netherlands	21,663	418,980	12,515	232,283	1,009,701	12,672	972,605	12,867
Sweden	5,993	106,199	13,097	230,803	676,783	8,499	1,223,140	15,495
United Kingdom	99,135	1,615,032	112,810	1,745,164	4,935,464	65,730	5,001,073	75,099
Other Europe	8,400	149,800	11,678	192,558	2,089,286	27,439	1,364,243	19,186
	272,791	4,841,044	205,670	3,380,173	11,150,808	145,546	29,242,928	401,077
Asia	8,832	180,468	33,217	666,391	2,986,877	46,917	7,987,532	118,798
Africa:								
Algeria	14,057	261,903	5,500	98,999	-------	-------	-------	-------
Mozambique	-------	-------	-------	-------	359,267	6,444	1,019,840	18,877
Union of South Africa	11,298	203,364	19,911	358,415	1,250,551	24,803	1,822,980	33,823
Other Africa	10	250	750	18,069	189,595	2,942	559,949	7,951
	25,365	465,517	26,161	475,483	1,799,413	34,189	3,402,769	60,651
Oceania:								
Australia	108,465	1,928,755	109,341	1,952,859	3,805,520	56,529	1,142,501	29,501
New Zealand	43,167	762,354	49,753	880,689	299,768	8,924	282,039	7,589
Other Oceania	-------	-------	-------	-------	1,200	18	-------	-------
	151,632	2,691,109	159,094	2,833,548	4,106,488	65,471	1,424,540	37,090
	579,107	10,378,991	627,819	10,771,751	28,462,955	469,773	56,012,035	909,974

Shipments to Canada, normally the principal market for American crude sulfur, showed the largest quantitative increase, while those to Germany, formerly a large market, dropped to only 8,702 long tons. Australia and the United Kingdom again were large takers of American sulfur. Noticeable in 1939 was the large movement of refined sulfur to Greece, which purchased more than any other nation. The foregoing table shows the distribution of exports by countries of destination for 1938 and 1939.

THE INDUSTRY IN 1939, BY STATES

California.—Several operators, all in Inyo County, reported production in 1939. The output consisted of relatively pure sulfur and concentrates containing about 85 percent sulfur. The largest output came from the Crater Group of claims.

The sulfur deposits in Inyo County have been described by Lynton.[5]

Louisiana.—Production of sulfur in Louisiana in 1939 totaled 422,600 long tons and was made by the Freeport Sulphur Co. from its operations at Grande Ecaille, Plaquemines Parish.

Texas.—Texas supplied 80 percent of the domestic sulfur output in 1939. Five operations contributed to the total, but by far the largest output came from the Boling Dome property of the Texas Gulf Sulphur Co. The following table, compiled from information issued by the Texas State Comptroller's Office, shows the quarterly production of sulfur in Texas for 1939.

Sulfur produced in Texas in 1939, by companies, in long tons

Company	First quarter	Second quarter	Third quarter	Fourth quarter	Total
Texas Gulf Sulphur Co.	200,210	152,191	146,123	319,799	818,323
Freeport Sulphur Co.	89,790	95,030	91,565	91,970	368,355
Duval Texas Sulphur Co.	59,800	72,080	81,129	58,122	271,131
Jefferson Lake Oil Co., Inc.	55,463	38,519	53,838	60,156	207,976
	405,263	357,820	372,655	530,047	1,665,785

The Freeport Sulphur Co., the second largest producer, continued operations at Hoskins Mound. Output at Clemens Dome, Brazoria County, which was begun in 1937 by the Jefferson Lake Oil Co., Inc., continued in 1939 but at a lower rate than in 1938. This company explored, by drilling, certain leases on Long Point Dome during the year but was unsuccessful in developing commercial quantities of sulfur. The Duval Texas Sulphur Co. continued production at Orchard Dome, Fort Bend County, and at Boling Dome, Wharton County.

Utah.—Sulfur production in Utah in 1939 came from the Utah Sulphur Industries plant at Beaver, Beaver County.

WORLD PRODUCTION

World production of sulfur in 1939, including elemental sulfur recovered in the treatment of pyrites and as a byproduct from the treatment of gas and gasoline in Germany, is estimated at 2,900,000 long tons. The following table shows the output of native sulfur for the world from 1935 through 1939.

[5] Lynton, Edward D., Sulfur Deposits of Inyo County, Calif.: California Jour. Mines and Geol. Division of Mines, Dept. of Natural Resources, State of California, vol. 34, No. 4, October 1938, pp. 563–590.

World production of native sulfur, 1935–39, in long tons [1]

[Compiled by R. B. Miller]

Country	1935	1936	1937	1938	1939
Argentina	7				(2)
Bolivia (exports)	4,183	935	1,712	1,632	2,126
Chile	[3] 19,792	[3] 25,525	[3] 16,766	20,959	(2)
Ecuador	118	59	54	68	(2)
France (content of ore)	64	123	157	140	(2)
Greece	23	150	67	75	(2)
Guatemala		16	11	15	12
Italy (crude) [4]	307,024	322,396	338,101	374,339	(2)
Japan [5]	162,341	172,545	(2)	(2)	(2)
Mexico	[6] 3,206	[6] 1,272	(2)	49	(2)
Netherland East India	9,492	11,311	12,474	15,986	(2)
Palestine	561	79	494	1,196	829
Peru	2,117	1,696	1,551	1,975	(2)
Taiwan	1,054	1,207	(2)	(2)	(2)
Turkey	2,144	3,139	2,229	3,684	(2)
United States	1,632,590	2,016,338	2,741,970	2,393,408	2,090,979

[1] Sulfur is also believed to be produced in China, Spain, and the U. S. S. R., but the amount produced is unknown.
[2] Data not available.
[3] In addition, the following quantities of sulfur rock are reported: 1935, 4,785 tons (77.5 percent sulfur); 1936, 11,612 tons (40–80 percent sulfur); and 1937, 1,050 tons.
[4] In addition, the following quantities of sulfur rock are reported: 1935, 18,738 tons; 1936, 20,743 tons; 1937 19,793 tons; and 1938, 16,545 tons.
[5] In addition, the following quantities of sulfur rock are reported: 1935, 20,764 tons; and 1936, 31,576 tons. Similar data are not available for 1937–39.
[6] Crude sulfur product.

Canada.—Elemental sulfur is being produced in the treatment of base-metal smelter gas at Trail, British Columbia, by the Consolidated Mining & Smelting Co. The plant has a reported capacity of 150 tons of sulfur per day. Late in 1938 the Aldermac Copper Corporation, Ltd., was reported to have begun construction of a plant for the production of elemental sulfur from pyrite concentrates by the Westcott process. Imports of sulfur into Canada increased to 135,907 long tons in 1939 from 83,658 tons in 1938.

Chile.—Chile is the principal sulfur producer in South America. Production data in 1939 are not yet available, but exports for the first 11 months were 7,135 long tons compared with 9,227 for the same period in 1938. The development of sulfur deposits has been listed by the Government as one of the items to be considered in the general plan of national economic development.

Germany.—Germany does not produce native sulfur, but in recent years the output of byproduct sulfur has been making such rapid progress that the country soon may be self-sufficient. Data on production for 1939 are not available, but increased output is coming from coking plants, low-temperature carbonization plants, and gasoline hydrogenation plants. In the past, nearly the entire German output of elemental sulfur came from desulfurization at coke plants, but most of the gain in production recently has resulted from installation of improved recovery methods at gasoline hydrogenation plants, now the main source of supply. Imports of sulfur into Germany for the first 6 months of 1939 were 25,323 long tons (63,856 tons for 6 months in 1938), of which 23,059 tons came from Italy. Much of the sulfur imported into Germany is transshipped to nearby countries; exports for the first 6 months of 1939 were 23,154 tons. A plant for producing sulfuric acid from gypsum was completed and put into operation at Wolfen in 1939. The annual capacity is reported to be 80,000 tons of acid.

Italy.—Italy, including Sicily, is the world's second largest producer of sulfur, and the output is subsidized with minimum prices to mine operators guaranteed by a central Government sales bureau. The production quota established for the fiscal year ended July 31, 1939, was 393,682 long tons, but only 349,400 tons were placed at the disposal of the sales office; 64 percent came from 99 mines in Sicily and 36 percent from 6 mines in continental Italy. Although continental mines fulfilled their quota, output in Sicily was restricted by the outbreak of fires in several important mines. The guaranteed prices on the grades of sulfur produced in Italy are as follows:

Gialla superiore (guaranteed 99.5 percent of sulfur) 350 lire per metric ton.
Gialla inferiore (guaranteed 99.25 percent of sulfur) 340 lire per metric ton.
Buona (guaranteed 98 percent of sulfur) 328 lire per metric ton.
Corrente (guaranteed 97 percent of sulfur) 318 lire per metric ton.

Prices increased 20 lire per metric ton for the second quarter of 1939

Exports for the first 7 months of 1939 were 144,623 long tons, compared with 135,061 tons for the same period in 1938.

Japan.—Data on the production and exports of sulfur in Japan in 1939, the third largest producer, are not available. Exports were 31,012 long tons in 1938.

Norway.—Production of sulfur in Norway results from the treatment of cupriferous pyrites at the Thamshavn plant of the Orkla Metal Co.; output in 1939 was reported [6] to be about 108,263 long tons. Exports in 1939 were 82,422 long tons compared with 75,425 tons in 1938. Although Norway has exported sulfur since 1932, it continues to import sulfur; imports in 1939 were 9,481 long tons.

Portugal.—Production of elemental sulfur from pyrites at the San Domingos mine was begun in 1935. Output during 1939 was 11,221 long tons compared with 11,059 in 1938; imports in 1939 were 3,157 long tons compared with 3,408 in 1938.

Spain.—The output of native sulfur in Spain is supplemented by elemental sulfur obtained in the treatment of pyrites. Figures for recent years are not available.

Sweden.—Elemental sulfur recovered as a byproduct of smelter gases by the Boliden Co. at Ronskar in North Sweden is the only sulfur produced in Sweden. Output at this plant was 17,512 long tons in 1938. Imports of sulfur for the first 9 months of 1939 were 36,241 long tons compared with 27,531 for the same period in 1938.

PYRITES

Domestic production.—Production of pyrites (ores and concentrates) in the United States in 1939 dropped 7 percent from 1938, but the sulfur content was higher—42.2 percent in 1939 compared with 39.4 percent in 1938—with the result that the available sulfur was nearly the same. Of the 1939 total, only 30,579 tons were lump and the remainder fines; most of the fines were flotation concentrates.

[6] Mining Journal (London), Norway in 1939: Vol. 208, No. 5455, March 9, 1940, p. 147.

Pyrites (ores and concentrates) produced in the United States, 1935–39

Year	Quantity: Gross weight (long tons)	Quantity: Sulfur content (percent)	Value	Year	Quantity: Gross weight (long tons)	Quantity: Sulfur content (percent)	Value
1935	514, 192	39. 5	$1, 583, 074	1938	555, 629	39. 4	$1, 685, 766
1936	547, 236	39. 6	1, 666, 194	1939	516, 408	42. 2	1, 550, 449
1937	584, 166	39. 7	1, 777, 787				

The quantity of pyrites (ores and concentrates) sold or consumed by producing companies totaled 511,739 long tons in 1939 compared with 524,120 tons in 1938. In 1939, 188,712 tons were sold by producers compared with 163,711 tons in 1938. All sales in both years were to domestic consumers. Prices quoted by the trade journals are for imported pyrites and are given in cents per long-ton unit of sulfur, c. i. f. Atlantic ports; quotations, which are nominal, were unchanged at 12–13 cents per long-ton unit throughout the year.

Tennessee was the principal producing State in 1939; other States producing were California, Colorado, Illinois, Indiana, Kansas, Missouri, Montana, New York, Virginia, and Wisconsin.

THE INDUSTRY IN 1939, BY STATES

California.—The Mountain Copper Co., was the only producer of pyrites in California in 1939; output came from the Hornet mine in Shasta County.

Colorado.—The Minnesota Mines, Inc., was the only producer of pyrites in Colorado in 1939. The material is recovered by flotation as an auriferous sulfide concentrate, which is shipped to Denver for manufacture of acid after the gold content has been recovered by cyanidation.

Illinois.—One operator, the Midland Electric Coal Corporation, produced and shipped 13,950 long tons of pyrites (coal brasses) from its coal-cleaning operations at the Atkinson mine in Henry County. The product, which contained about 46 percent sulfur, was shipped to Indiana for the manufacture of sulfuric acid.

Indiana.—The Snow Hill Coal Corporation produced and shipped 4,403 long tons of pyrites (coal brasses) containing 40 percent sulfur from its Talleydale mine in Vigo County in 1939. The product moved to acid plants in the Chicago area. A considerable additional tonnage was wasted.

Kansas.—The Mineral Products Co. produced 9,838 long tons of pyrites (coal brasses) in 1939 at West Mineral, Cherokee County. Shipments averaging 47 percent sulfur were consigned to St. Louis, Mo., where they were used in acid making.

Missouri.—In 1939 three operations produced 32,496 long tons of pyrites containing 47 percent sulfur, the total for Missouri. The largest producer was the Moselle No. 10 mine in Phelps County, operated by Thomas & Williams. Other output came from Cherry Valley mine in Crawford County operated by H. H. Lark and from the Kelsey mine in Franklin County operated by Roy C. Libhart. Shipments moved to acid plants in the St. Louis area.

Montana.—The pyrites produced in Montana in 1939 came from the Anaconda Copper Mining Co. at Anaconda, where it is recovered as a flotation concentrate in copper-plant operation.

New York.—During 1939 the St. Joseph Lead Co. produced 71,176 long tons of pyrites concentrate at its Balmat mill in St. Lawrence County. The pyrites, which ran 49.85 percent sulfur, was produced as a flotation concentrate in the treatment of zinc-bearing ore.

Tennessee.—The pyrites output in Tennessee during 1939 came from the Tennessee Copper Co., Ducktown Basin, Polk County. It is produced as a flotation concentrate but does not enter the market, as all of it is used by the company in the manufacture of acid.

Virginia.—The only pyrites mined in Virginia in recent years has come from the Gossan mine at Cliffview, Carroll County, and the entire output is concentrated by means of air tables for the manufacture of sulfuric acid in the company plant at Pulaski. The new mill, which was placed in operation late in 1938, has increased the tenor of the product shipped.

Wisconsin.—The one company reporting production in Wisconsin in 1939 was the Vinegar Hill Zinc Co. in Grant County which has been recovering pyrites by selective flotation since the latter part of 1938; previously, magnetic separation was employed. The ore is produced from several mines in the Platteville district.

FOREIGN TRADE

Imports of pyrites in 1939 increased 44 percent over 1938. Receipts from Spain, normally by far the principal source, dropped moderately, but the striking increase in shipments from Canada made up the difference. Greece, a new source, also supplied a substantial quantity in 1939.

Pyrites, containing more than 25 percent sulfur, imported into the United States, 1935–39, by countries

Country	1935		1936		1937		1938		1939	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Belgium	------	--------	5,290	$29,756	------	--------	------	--------	------	--------
Canada	9,888	$45,965	55,105	200,184	20,558	$74,946	30,064	$135,659	176,804	$470,336
Greece	------	--------	------	--------	------	--------	------	--------	22,800	106,271
Mexico	85	430	------	--------	549	1,473	202	522	------	--------
Portugal	------	--------	59,804	286,974	21,725	109,395	------	--------	------	--------
Spain	387,140	1,266,606	309,114	913,820	481,598	1,158,671	303,968	709,983	282,732	738,439
	397,113	1,313,001	429,313	1,430,734	524,430	1,344,485	334,234	846,164	482,336	1,315,046

Most of the imports of pyrites move into Philadelphia and Baltimore where it is used in the manufacture of sulfuric acid.

Pyrites, containing more than 25 percent sulfur, imported into the United States, 1935–39, by customs districts, in long tons

Customs district	1935	1936	1937	1938	1939
Buffalo	94	140	584	5,130	21,940
Chicago	2,704	----------	----------	----------	----------
Georgia	4,002	2,500	4,795	----------	----------
Los Angeles	848	----------	----------	----------	----------
Maryland	182,333	172,290	220,430	113,838	176,982
New York	56,725	60,041	64,621	55,830	46,170
Ohio	----------	----------	----------	----------	2,000
Philadelphia	129,793	158,088	194,680	130,703	189,727
San Diego	85	----------	549	202	----------
South Carolina	7,681	9,429	9,519	5,265	4,396
Vermont	6,242	17,449	19,974	15,713	31,433
Virginia	6,606	9,376	9,278	7,553	8,885
Washington	----------	----------	----------	----------	803
	397,113	429,313	524,430	334,234	482,336

WORLD PRODUCTION

The following table shows world production of pyrites and its sulfur content. The figures are taken principally from official sources of the countries concerned, supplemented by information from publications of the Imperial Institute and other reliable sources.

World production of pyrites (including cupreous pyrites), 1937–39, in metric tons

[Compiled by M. T. Latus]

Country [1]	1937		1938		1939	
	Gross weight	Sulfur content	Gross weight	Sulfur content	Gross weight	Sulfur content
Algeria	38,760	17,830	44,150	19,430	(2)	(2)
Australia (Tasmania)	41,282	(2)	51,084	(2)	(2)	(2)
Canada	108,370	54,595	40,464	20,300	209,098	103,305
Chosen	79,500	(2)	(2)	(2)	(2)	(2)
Cyprus (exports)	395,076	193,587	523,574	256,551	(2)	(2)
Czechoslovakia	18,361	7,712	(2)	(2)	(2)	(2)
Finland	91,311	39,264	102,979	44,281	(2)	(2)
France	145,820	65,027	147,208	65,655	(2)	(2)
Germany	447,345	193,050	465,267	200,064	(2)	(2)
Greece	206,650	100,295	244,000	118,605	(2)	(2)
Italy	914,524	402,391	930,312	386,079	(2)	(2)
Norway	1,048,300	452,709	1,027,776	446,939	(2)	(2)
Poland	82,263	36,195	92,209	36,883	(2)	(2)
Portugal	604,132	283,986	558,327	251,247	(2)	(2)
Rumania	10,717	6,717	11,205	7,061	(2)	(2)
Southern Rhodesia	20,342	8,128	27,065	10,900	27,386	(2)
Sweden	172,968	75,337	186,390	84,390	(2)	(2)
Union of South Africa	28,915	12,931	31,017	13,947	29,822	(2)
United Kingdom	4,701	(2)	4,351	(2)	(2)	(2)
United States	593,542	235,520	564,547	222,612	524,696	221,559
Uruguay	----------	----------	70	(2)	(2)	(2)
Yugoslavia	133,985	60,253	150,402	67,681	127,039	(2)

[1] In addition to countries listed Belgium, China, Japan, Spain, and the U. S. S. R. produced pyrites, but production data are not available.
[2] Data not available.

Canada.—There was a pronounced increase in Canadian production of pyrites in 1939. Of the year's output, 113,464 metric tons containing 55,249 tons of sulfur came from Quebec and 95,634 metric tons containing 48,056 tons of sulfur from British Columbia. Output in Quebec came from the Aldermac mine in western Quebec and at Eustis in the eastern townships; operations at the latter property ceased in July 1939 after nearly three-quarters of a century. The output of

British Columbia came from the Britannia mill, where pyrites concentrate is produced in the treatment of ores for the extraction of copper. Other deposits in British Columbia and northwestern Ontario attracted attention during the year. Exports from Canada rose sharply in 1939, amounting to 99,919 metric tons (sulfur content) compared with 20,057 tons (sulfur content) in 1938.

In addition, sulfuric acid is made from smelter gases at the Trail (British Columbia) and Copper Cliff (Ontario) smelters, and elemental sulfur is recovered at Trail. In 1939, 87,842 metric tons of sulfur were recovered as sulfur or in sulfuric acid manufactured from smelter gases.

Japan.—Japan is one of the principal producers of pyrites, but data on production are not available, owing to a ban on information pertaining to domestic production and consumption. The entire output is consumed locally in the manufacture of sulfuric acid, and Japan is said to be nearly self-sufficient as regards this material.

Norway.—Production of pyrites is one of the principal mining industries in Norway, and in 1939 output exceeded 1,000,000 metric tons for the fourth successive year. Exports were slightly lower in 1939, totaling 653,962 metric tons compared with 654,956 in 1938. Some of the Norwegian pyrites is used locally for the production of elemental sulfur.

Portugal.—Output was at a high rate in 1939, totaling 673,200 metric tons. Exports in 1939 were 432,895 metric tons compared with 456,786 in 1938.

Spain.—Spain is the principal world producer of pyrites, but war conditions undoubtedly affected operations during 1939. Official data for recent years are not available, but unofficial reports indicate that shipments of pyrites from the ports of Huelva, Seville, and La Laja were 2,256,800 metric tons in 1937, 2,331,200 in 1938, and 1,635,200 in 1939. Underground mining methods at Rio Tinto have been described by Julian.[7]

[7] Julian, C. R., Underground Mining at Rio Tinto, Spain: Bull. Inst. Min. and Met., No. 421, October 1939, pp. 1–43.

PHOSPHATE ROCK

By Bertrand L. Johnson and K. G. Warner

SUMMARY OUTLINE

Domestic demand for phosphate rock improved slightly in 1939 over 1938, a little more than enough to offset the decline in exports caused partly by the blockade of Germany after the outbreak of war in September. Total shipments of domestic phosphate rock in 1939 (3,757,067 long tons, valued at $12,294,042), although a little greater in tonnage, were less in value than in 1938. Part of the slight gain in mine production over 1938 was added to stocks, which were greater at the end of 1939 than a year earlier. The output in Tennessee and the Western States was greater than in any previous year; but in Florida, by far the leading producing State, it was less than in 1937 or 1938. Imports were even smaller than usual.

Salient statistics of the phosphate rock industry in the United States, 1938–39

	1938			1939		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
Production (mined)	3,860,476	(1)	(1)	3,987,970	(1)	(1)
Sold or used by producers:						
Florida:						
Land pebble [2]	2,528,808	$7,993,665	$3.16	2,547,782	$7,353,567	$2.89
Soft rock	53,479	178,093	3.33	41,906	128,435	3.06
Hard rock	125,048	601,922	4.81	89,096	411,455	4.62
Total, Florida	2,707,335	8,773,680	3.24	2,678,784	7,893,457	2.95
Tennessee [2 3]	899,298	3,725,601	4.14	938,448	3,856,505	4.11
Idaho	66,014	296,595	4.49	95,451	431,938	4.53
Montana	66,491	155,917	2.34	44,384	112,142	2.53
South Carolina	100	350	3.50			
Virginia	(3)	(3)	(3)	(3)	(3)	(3)
Total, United States	3,739,238	12,952,143	3.46	3,757,067	12,294,042	3.27
Imports	7,006	[4] 80,539	[4] 11.50	3,500	[4] 23,625	[4] 6.75
Exports	1,140,841	[5] 6,637,638	[5] 5.82	949,006	[5] 5,233,104	[5] 5.51
Apparent consumption [6]	2,605,403			2,811,561		
Stocks in producers' hands, Dec. 31:						
Florida	1,285,000	(1)	(1)	1,504,000	(1)	(1)
Tennessee [3 7]	224,000	(1)	(1)	247,000	(1)	(1)
Other	3,000	(1)	(1)	2,000	(1)	(1)
Total stocks	1,512,000	(1)	(1)	1,753,000	(1)	(1)

[1] Figures not available. [2] Includes sintered matrix. [3] Virginia included with Tennessee.
[4] Market value (or price) at port and time of exportation to the United States.
[5] Value at port of exportation.
[6] Quantity sold or used by producers plus imports minus exports.
[7] Includes brown-rock matrix of sinter grade and sintered brown rock.

On February 27, 1939, the Department of Justice began a Nation-wide investigation of the fertilizer industry.

The report of the hearings of the Joint Congressional Committee to Investigate the Adequacy and Use of Phosphate Resources of the United States, pursuant to Public Resolution No. 112, was published early in the year.[1] The findings and recommendations of the joint congressional committee were reviewed in a pamphlet entitled "The Facts About the Adequacy and Use of Our National Phosphate Resources," published in April 1939 by the Phosphate Rock Institute of New York City.

Just before the close of Congress in August, the phosphate investigators were granted a $5,000 appropriation to complete their work of determining the extent of domestic resources of phosphate rock and related minerals.

A general paper on phosphate, by F. S. Lodge, of the National Fertilizer Association, presented at the meeting of the Division of Fertilizer Chemistry, American Chemical Society, held at Boston, Mass., September 11 and 12, 1939, was published later in the American Fertilizer.[2]

Production.—Mine production of phosphate rock in the United States in 1939 increased about 128,000 tons over 1938 but did not recover to the 1937 peak. Phosphate rock was mined in Florida, Tennessee, Idaho, and Montana, and apatite was recovered from nelsonite in Virginia. Phosphate rock operations in South Carolina, which had been resumed in 1938 after a lapse of many years, were inactive in 1939.

Phosphate rock mined in the United States, 1930–39, by States, in long tons

Year	Florida	Tennessee	Western States	United States	Year	Florida	Tennessee	Western States	United States
1930	3,361,786	607,814	66,597	4,036,197	1935	2,598,337	[1] 493,501	67,490	3,159,328
1931	2,155,903	393,925	116,681	2,666,509	1936	2,645,819	[1] 737,866	79,152	3,462,837
1932	1,500,891	[1] 152,533	44,724	1,698,148	1937	3,179,588	[1] 942,158	139,670	4,261,416
1933	2,039,531	[1] 296,441	23,663	2,359,635	1938	2,722,927	[2] 999,551	137,998	3,860,476
1934	2,464,969	[1] 394,311	38,958	2,898,238	1939	2,791,360	[1] 1,057,570	139,040	3,987,970

[1] Includes small quantity of apatite from Virginia.
[2] Includes small quantity of apatite from Virginia and phosphate rock from South Carolina.

Sales.—The quantity of domestic phosphate sold or used by producers in 1939 was slightly greater than in 1938, but the value of the shipments declined more than half a million dollars from the 1938 figure.

Phosphate rock sold or used by producers in the United States, 1935–39

Year	Long tons	Value at mines		Year	Long tons	Value at mines	
		Total	Average			Total	Average
1935	3,042,381	$10,951,723	$3.60	1938	3,739,238	$12,952,143	$3.46
1936	3,351,857	11,406,132	3.40	1939	3,757,067	12,294,042	3.27
1937	3,956,189	12,975,268	3.28				

[1] Hearings before the Joint Committee to Investigate the Adequacy and Use of Phosphate Resources of the United States: 75th Cong., 3d sess., pursuant to Public Res. 112, A Joint Resolution to Create a Joint Congressional Committee to Investigate the Adequacy and Use of the Phosphate Resources of the United States: June 18, 20, and 21; July 20, 21, and 22; November 21, 22, 24, 25, 28, and 29, 1938; Washington, 1939, 1,182, pp.

[2] Lodge, F. S.; Phosphates and Their Utilization: Am. Fertilizer, vol. 91, No. 8, October 14, 1939, pp. 9–11; No. 9, October 26, 1939, pp. 9–11, 26.

Distribution of sales.—Shipments of phosphate rock fall into two distinct groups according to grade—one below 60 percent B. P. L. (bone phosphate of lime) and the other above 68 percent B. P. L. The latter is the larger group, and most of the sales are of the grades between 72 and 75 percent B. P. L. The manufacture of acidulated superphosphate is still the major outlet for domestic rock; however, with development of the use of low-grade material in the production of elemental phosphorus by the electric furnace method, the retreatment of land-pebble wastes by flotation, and the utilization of the low-grade, hard-rock, waste-pond phosphates, the consumption of grades containing less than 60 percent B. P. L. is becoming increasingly important.

The following table, showing the distribution of sales by grades, uses, and classes of consumers, is compiled from reports of domestic producers of phosphate rock.

Phosphate rock sold or used by producers in the United States, 1938–39, by grades, uses, and classes of consumers

	1938			1939		
	Quantity		Value	Quantity		Value
	Long tons	Percent of total		Long tons	Percent of total	
Grades—B. P. L.[1] content (percent):						
Below 60	450,858	12	(2)	395,709	11	(2)
60 to 66	100	(3)	(2)	18,818	1	(2)
68 basis, 66 minimum	378,847	10	(2)	356,512	9	(2)
70 minimum	387,501	10	(2)	383,483	10	(2)
72 minimum	904,701	24	(2)	1,227,806	33	(2)
75 basis, 74 minimum; 75 minimum	914,664	25	(2)	769,360	20	(2)
77 basis, 76 minimum; 77 minimum	327,951	9	(2)	328,784	9	(2)
Above 85 (apatite)	(4)	(4)	(2)	(4)	(4)	(2)
Undistributed [5]	374,616	10	(2)	276,595	7	(2)
	3,739,238	100	$12,952,143	3,757,067	100	$12,294,042
Uses:						
Domestic:						
Superphosphates	2,074,779	56	(2)	2,192,779	58	(2)
Phosphates, phosphoric acid, ferrophosphorus	443,086	12	(2)	479,020	13	(2)
Direct application to soil	83,069	2	(2)	95,667	3	(2)
Fertilizer filler	24,746	1	(2)	30,994	1	(2)
Stock and poultry feed	5,904	(3)	(2)	1,794	(3)	(2)
Undistributed [6]	7,748	(3)	(2)	10,423	(3)	(2)
Exports	1,099,906	29	4,478,266	946,390	25	3,747,608
	3,739,238	100	12,952,143	3,757,067	100	12,294,042
Classes of consumers:						
Affiliated companies	959,717	26	3,182,569	948,640	25	3,035,268
Other domestic consumers	1,679,615	45	5,291,308	1,862,037	50	5,511,166
Export [7]	1,099,906	29	4,478,266	946,390	25	3,747,608
	3,739,238	100	12,952,143	3,757,067	100	12,294,042

[1] Bone phosphate of lime. [2] Figures not available. [3] Less than 0.5 percent.
[4] Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.
[5] Includes grades of B. P. L. content between 68 and 70; 69/66; 68/70; 71; 73/74; 73; 76.55; 78/76; 78; and above 85 percent; also dust, B. P. L. content not known.
[6] Includes some calcined phosphate and phosphatic material used in pig-iron blast furnaces, concrete aggregates, in the manufacture of concentrated fertilizers, as filler in asphalt mixtures, and as foundry facings.
[7] As reported to the Bureau of Mines by producers (exclusive of exports by dealers, etc.).

Consumption.—The apparent domestic consumption of phosphate rock in 1939 (2,811,561 long tons) was about 200,000 tons above the figure for 1938 and 100,000 tons below the 1937 peak. Figure 1 shows a logistic curve fitted to the consumption of phosphate rock in the United States since 1867, the consumption for 1938 and 1939 being added to the same curve shown on page 1171 of Minerals Yearbook, 1938. The data for 1938 and 1939 tend further to confirm the decreasing rate of increase and the sidewise trend in domestic consumption of phosphate rock forecast by the logistic curve, with no indication of greatly increased consumption in the future.

Prices.—Trade-journal quotations for various grades of domestic phosphate rock were changed in January 1939. For Florida land

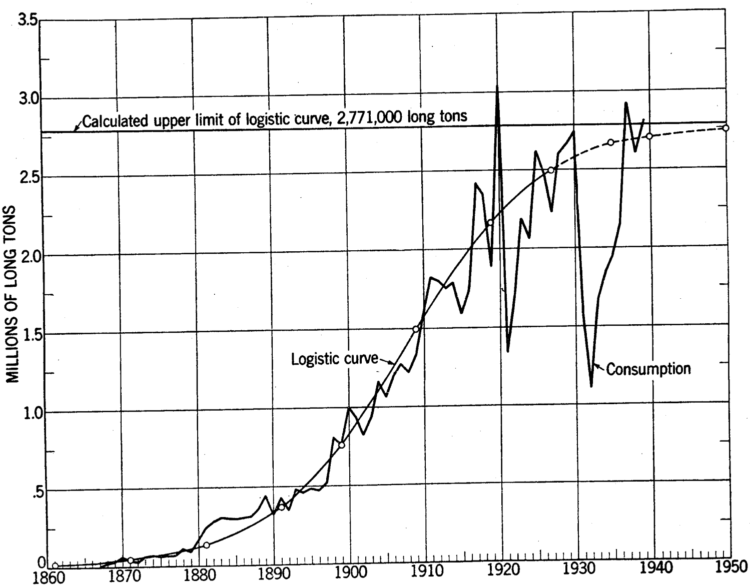

FIGURE 1.—Consumption of phosphate rock in the United States, 1867–1939.

pebble containing 68 percent B. P. L. prices increased slightly ($1.85 to $1.90), but for higher grades quotations were substantially lower. The price of the 70-percent grade was dropped from $2.35 to $2.15, of the 72-percent grade from $2.85 to $2.40, and of the 75-percent grade from $3.85 to $2.90. No further changes occurred during the year.

Reserves.—Mansfield has discussed the phosphate rock reserves of the United States in two recent papers.[3] As of January 1940, he estimated reserves as at least 13,291,543,000 long tons, including all the different grades considered in his study. Of this quantity, 5,306,651,-000 tons are in the Eastern States and 7,984,892,000 tons in the Western States.

REVIEW BY STATES

Florida.—The total tonnage of Florida rock shipped in 1939 was a little less than in 1938, and its value decreased by nearly $900,000. A

[3] Mansfield, George R., Phosphate Deposits of the United States: Econ. Geol., vol. 35, No. 3, May 1940, pp. 405–429; Recent Studies of Reserves of Domestic Phosphate: Amer. Inst. Min. and Met. Eng., Min. Technol., Tech. Pub. 1208, 1940, 10 pp.

slight gain in shipments of land-pebble rock was more than offset by a decline of 22 percent for soft rock and 29 percent for hard rock. Total stocks in hands of Florida producers were higher at the end of 1939 than on December 31, 1938.

In 1939 seven companies produced land-pebble phosphate rock, three companies hard rock, and several small concerns soft rock.

The following seven companies produced land-pebble phosphate rock in 1939:

American Cyanamid Co., 30 Rockefeller Plaza, New York, N. Y. Plant at Brewster.
The American Agricultural Chemical Co., 50 Church Street, New York, N. Y. Plant at Pierce.
Coronet Phosphate Co., 19 Rector Street, New York, N. Y. Plant at Coronet, near Plant City.
International Agricultural Corporation, 61 Broadway, New York, N. Y. Plant at Prairie, near Mulberry.
The Phosphate Mining Co., 110 William Street, New York, N. Y. Plant at Nichols.
Southern Phosphate Corporation, Baltimore Trust Building, Baltimore, Md. Plant at Ridgewood.
Swift & Co. Fertilizer Works, R. F. D. 1, Bartow, Fla. Plant at Agricola.

The following companies mined hard rock in 1939:

J. Buttgenbach & Co., Lakeland, Fla.
C. & J. Camp, Ocala., Fla.
Dunnellon Phosphate Mining Co., Savannah, Ga.

The following companies were reported to have produced soft phosphate rock in 1939:

Colloidal Phosphate Sales Co., Dunnellon, Fla.
The Dixie Phosphate Co., Ocala, Fla.
Lakeland Phosphate & Fertilizer Co., 225 East Main Street, Bartow, Fla.
Loncala Phosphate Co., Ocala, Fla.
M. R. Porter Co., Ocala, Fla.
Soil Builders, Inc., Dunnellon, Fla.
Superior Phosphate Co., Dunnellon, Fla.

Florida phosphate rock sold or used by producers, 1935–39, by kinds

Year	Hard rock			Soft rock [1]		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1935	116,483	$500,526	$4.30	36,430	$125,129	$3.43
1936	138,859	579,202	4.17	31,769	103,352	3.25
1937	64,151	342,202	5.33	60,256	200,271	3.32
1938	125,048	601,922	4.81	53,479	178,093	3.33
1939	89,096	411,455	4.62	41,906	128,435	3.06

Year	Land pebble			Total		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1935	2,269,891	$7,751,954	$3.42	2,422,804	$8,377,609	$3.46
1936	2,454,272	7,845,969	3.20	2,624,900	8,528,523	3.25
1937	[2] 2,872,413	[2] 8,600,512	2.99	[2] 2,996,820	[2] 9,142,985	3.05
1938	[2] 2,528,808	[2] 7,993,665	3.16	[2] 2,707,335	[2] 8,773,680	3.24
1939	[2] 2,547,782	[2] 7,353,567	2.89	[2] 2,678,784	[2] 7,893,457	2.95

[1] Includes material from waste-pond operations. [2] Includes sintered matrix.

The United States Circuit Court of Appeals, sitting at Philadelphia, Pa., in the spring of 1939, in litigation between the Phosphate Recovery Corporation, of New York, and the Southern Phosphate Corporation, of Baltimore, Md., sustained patents owned by the Phosphate Recovery Corporation, an affiliate of the International Agricultural Corporation, on a process for recovery of phosphate rock, at the same time ruling invalid a similar patent owned by the Southern Phosphate Corporation. A cash settlement was made by the Southern Phosphate Corporation, and it again became a licensee of the Phosphate Recovery Corporation.

The Phosphate Mining Co. is reported to have installed in 1939, at Nichols, Fla., a second bowl mill with gravity discharge and a 12-foot mechanical air separator for closed-circuit grinding of pebble phosphate rock, duplicating an installation made late in 1937.

On May 28, 1939, an investigation was ordered by the Secretary of the Interior, Harold L. Ickes, as to the advisability of reserving to the United States the undeveloped phosphate rock deposits in many parts of the public domain of Florida. More than 66,000 acres in 16 Florida counties are reported as already included in the Federal Phosphate Reserve. The new order instructed the Geological Survey to determine the possibilities of additional workable deposits of phosphate rock before the General Land Office disposes of the land under the present public land laws.

Mansfield's[4] study of Florida reserves largely substantiates the figures for land-pebble and river-pebble rock recently given before the joint congressional investigating committee, considerably lowers the figure for hard rock, and points out that the data now available as to the reserves in the Hawthorn formation and certain phosphate marls "are insufficient to justify their present inclusion in reserves, though it is recognized that they are worthy of further consideration and study." He estimates total phosphate reserves in Florida, of all grades, as exceeding 5 billion tons, of which over 2 billion is classified as known, 1¼ billion as probable, and 1¾ billion as possible.

Tennessee.—The quantity of phosphate rock shipped in Tennessee in 1939, including a small amount of apatite from Virginia, was 938,448 long tons, 4 percent greater than the previous all-time high attained in 1938. The shipments consisted almost entirely of brown rock, although a small quantity of blue rock went to the Tennessee Valley Authority. Stocks of phosphate rock in the hands of the producers at the end of 1939 were larger than at similar periods in 1937 or 1938.

Tennessee phosphate rock sold or used by producers, 1935–39

[Includes apatite from Virginia]

Year	Long tons	Value at mines		Year	Long tons	Value at mines	
		Total	Average			Total	Average
1935 [1]	550,284	$2,323,536	$4.22	1938 [2]	899,298	$3,725,601	$4.14
1936 [1]	643,822	2,598,279	4.04	1939 [1] [2]	938,448	3,856,505	4.11
1937 [1] [2]	825,099	3,343,108	4.05				

[1] Separate figures for brown rock and blue rock cannot be given without disclosing confidential data regarding blue-rock production.
[2] Includes sintered matrix.

[4] Mansfield, George R., Work cited in footnote 3.

In 1939, as in previous recent years, almost the entire output of the State was mined by six companies—Armour Fertilizer Works, Charleston Mining Co., Federal Chemical Co., Hoover & Mason Phosphate Co., International Agricultural Corporation, and the Monsanto Chemical Co.—together with the T. V. A.

The two privately owned electric furnace plants, the Victor Chemical Works, Mount Pleasant, Tenn., and the Monsanto Chemical Co., Columbia, Tenn., and the T. V. A. plant, Muscle Shoals, Ala., were operated during 1939. The elemental phosphorus produced by the Victor Chemical Works and the Monsanto Chemical Co. was shipped in tank cars to Nashville, Tenn., Anniston, Ala., and elsewhere for the manufacture of phosphate chemicals. The elemental phosphorus produced by the T. V. A. was used to make concentrated superphosphate and calcium metaphosphate at Muscle Shoals. Two electric furnaces at the Monsanto plant are reported to have been shut down for a short time in the fall.

The Monsanto Chemical Co., the Charleston Mining Co., and the T. V. A. are reported to have increased their phosphate land holdings during the year. A small washing plant, which was built during 1938 near Gallatin in the Sumner County phosphate rock field for the preparation of phosphate rock for T. V. A. use, began operations late in 1939.

The Victor Chemical Works added two new electric furnaces to its elemental phosphorus plant at Mount Pleasant, Tenn., and a nodulizing plant of sufficient capacity for all three electric furnaces. The company is reported to own large tracts of phosphate-rock land in Tennessee which it has never developed. In recent years it has obtained its supplies of phosphate rock from the Charleston Mining Co. Both its electric-furnace plant at Mount Pleasant, Tenn., and its blast-furnace plant at Nashville, Tenn., were operated during 1939. Several illustrations of these plants, with flow sheets and descriptions, were given in articles published in 1939.[5] A plant for continuous oxidation of elemental phosphorus to phosphoric acid was built by the company at Chicago Heights, Ill.

The plant of the Federal Chemical Co. at Ridley, 1 mile north of Mount Pleasant, was largely rebuilt early in 1939; almost the entire steam plant was replaced with electric motors, and the washer plant was reconstructed. A large four-roll low-side mill is also reported to have been installed for grinding phosphate rock. Operations were resumed late in the summer.

The three completed electric furnaces of the T. V. A. were operated throughout the fiscal year except during the annual shut-down in August, according to the T. V. A. annual report.[6] Output approximated 69,000 tons of concentrated superphosphate, with an average available P_2O_5 content of about 47 percent. Construction of a new electric furnace, different in design and method of handling the gas produced, was nearly completed. Another small experimental electric furnace was operated from time to time to obtain data regarding various operations. The first full-size calcium metaphosphate unit was operated part of the fiscal year ended June 30, 1939, yielding

[5] Chemical and Metallurgical Engineering, How Victor Makes Its Phosphates: Vol. 46, No. 5, May 1939, pp. 269–272; Phosphate Plants Continue Growth: Vol. 46, No. 11, December 1939, p. 684.

[6] Tennessee Valley Authority, Annual Report for the Fiscal Year Ended June 30, 1939; Washington, D. C., 1940, 478 pp.

approximately 4,600 tons of "metaphos" with an average content of about 60 percent available P_2O_5. This unit uses lump-rock phosphate, or agglomerated fines, and phosphorus condensed from electric furnace gases. A second process that has been carried through the pilot-plant stage uses phosphate fines directly instead of prepared agglomerates or the less available rock. A large-scale experimental plant for this process has been designed and partly built.

Work has been done on another material, fused-rock phosphate, which is not so concentrated but is considered promising because T. V. A. studies show that the processing should be relatively economical. After completion of laboratory and pilot-plant tests a full-size unit was built and operated during the fiscal year. Work continued on improvements in the production of concentrated superphosphate by the electric-furnace method, that is, by treating ground phosphate rock with concentrated phosphoric acid resulting from the smelting of phosphate ores in the electric furnace. Improvements were also made in the methods of agglomerating raw phosphate ore for use in the electric furnace which enabled the Authority to process a much larger proportion of its ore than formerly.

Other investigations included blast-furnace studies and research with elemental phosphorus and high-strength phosphoric acids; small-scale experimental work and pilot-plant operations on the production of potassium-calcium metaphosphate; studies to reduce the cost of phosphate fertilizer by greater and more efficient recovery of byproducts such as fluorine and ferrophosphorus; chemical studies of the curing of superphosphate and the elimination of its fluorine; and studies of the corrosion of apparatus. Studies were also made of the phosphate rock from the T. V. A. reserves to determine the most favorable site for a field plant to prepare phosphate rock for furnace use.

Options to purchase were taken on 11 tracts, and commitments were made to acquire 2 in fee simple and to purchase mineral rights on the other 9. The 11 tracts totaled 660 acres. During the fiscal year purchases were consummated on seven properties in Maury and Giles Counties; interests acquired were fee simple title in one instance and mineral rights in the other six, a total of 968 acres. All but two of the Authority's leases on phosphate property were permitted to lapse; one of these was in Maury County and the other in Sumner County.

Several articles were published in 1939 covering T. V. A. phosphate operations.[7]

T. V. A. fertilizers were tested by land-grant colleges in 40 States, by the United States Department of Agriculture in 3 additional States, and on approximately 25,700 farms in 20 States. More than 50,000 tons of T. V. A. concentrated fertilizers were also distributed by the Agricultural Adjustment Administration. In the fiscal year

[7] Elmore, K. L., and Farr, T. D., Equilibrium in the System CaO-P_2O_5-H_2O: Presented before Am. Chem. Soc., Baltimore, Md., April 3-7, 1939.
Copson, R. L., and Frear, G. L., Progress in Phosphate Fertilizers: Abs. in Jour. Alabama Acad. Sci., vol. 2, June 1939, pp. 36-37; presented before Alabama Acad. Sci., Montgomery, Ala., April 14-15, 1939.
Newton, R. H., and Ardern, D. B., Electric Furnace Smelting of Rock Phosphate: Abs. in Jour. Alabama Acad. Sci., vol. 2, June 1939, pp. 37-38; presented before Alabama Acad. Sci., Montgomery, Ala., April 14-15, 1939.
Tarbutton, Grady, T. V. A. Processes for Concentrated Superphosphate and Metaphosphate Fertilizers: Abs. in Jour. Alabama Acad. Sci., vol. 2, June 1939, pp. 38-39; presented before Alabama Acad. Sci., Montgomery, Ala., April 14-15, 1939.
Junkins, J. N., and Newton, R. H., Instrumentation of T. V. A. Electric Furnace Phosphoric Acid Plant: Instruments, vol. 12, June 1939, pp. 161-165; presented at Carnegie Inst. Technol., Pittsburgh, March 2-3, 1939.

1939 appreciable quantities of metaphosphate entered the test demonstration program, and nearly 4,000 tons were distributed.

During the fiscal year 1938–39 fertilizer having a content of 32,786 tons of available P_2O_5 was shipped from the experimental large-scale production plant. These shipments comprised 30,457 tons (available P_2O_5) of concentrated superphosphate and 2,329 tons (available P_2O_5) of calcium metaphosphate. Most of the concentrated superphosphate was sold to the A. A. A., whereas most of the calcium metaphosphate was used in tests and demonstrations.

Early in 1939 a report by C. R. Ball,[8] describing the work done by the land-grant colleges of the Tennessee Valley in cooperation with the Tennessee Valley Authority, was published.

The estimates of reserves of phosphate rock in Tennessee, as presented in 1938 by the phosphate rock industry to the Joint Congressional Committee to Study the Adequacy and Use of the Phosphate Resources of the United States (totaling more than 5 billion tons, largely phosphatic limestone), were reviewed critically during the year by G. I. Whitlatch,[9] associate geologist, Tennessee Division of Geology, Nashville, Tenn., who concluded, in regard to blue rock that

> Phalen's estimate of approximately 84,000,000 tons of blue-rock phosphate, made in 1916 still remains as the most acceptable current reserve figure, because additional data necessary for its revision are lacking.

He states in regard to the white rock that

> The white fields have never been fully explored, and any estimate of reserves based on present meager data is apt to be in serious error. Barr's figure of 23,000,000 tons, as reported in the Webster estimates of 1938, cannot therefore be accepted without reservations.

Regarding the brown rock reserves Whitlatch says:

> Brown phosphate reserves today are actually and potentially greater than at any time in the history of the industry, owing to the development of processes in which phosphate of grades lower than ever heretofore acceptable can be used. Of chief importance in this phase of development are the sintering and nodulizing processes of the electrothermal phosphorus manufacture introduced in 1937. On the basis of such widened conception of commercial reserves, Webster's figures of 1938 indicate that Tennessee has approximately 100,000,000 tons of available and usable brown phosphate, and this reserve figure is essentially confirmed by data compiled by the writer and by a third independent survey.

The great increase in the phosphate rock industry's 1938 estimate of Tennessee's reserves was in the figure submitted for phosphatic limestone; regarding these, Whitlatch states:

> Phosphatic limestones are, admittedly, a potential future source of phosphate, but present data are too meager to warrant full acceptance of Webster's 1938 estimate of 5,000,000,000 tons of highly phosphatic limestone.

Mansfield [10] places the reserves of phosphate rock in Tennessee at 195,151,000 tons, accepting Whitlatch's figures of 96,918,000 tons for the brown-rock reserves but adding 83,233,000 tons for blue rock and 15,000,000 tons for white rock in accordance with data supplied by the State geologist.

Western States.—In 1939, as in 1938, Idaho and Montana were the only Western States to produce phosphate rock. In Idaho there were

[8] Ball, Carleton R., A Study of the Work of the Land-grant Colleges in the Tennessee Valley Area in Cooperation with the Tennessee Valley Authority: Special comm. on Land-grant College Data and Sub-comm. on Exp. Sec. Data, 1939, 76 pp.

[9] Whitlatch, G. I., Phosphate Rock Reserves in Tennessee: Paper presented at the Tuscaloosa Meeting, Ind. Minerals Div., Am. Inst. Min. and Met. Eng., November 3, 1939, 29 pp.

[10] Mansfield, G. R., Work cited in footnote 3.

at least two known producers—the Anaconda Copper Mining Co., which operated its No. 3 mine at Conda, Caribou County, Idaho, shipping more phosphate rock than in any previous year, and the Vassar Produce Co., of Caldwell, Idaho, which shipped phosphate rock from Bennington, Bear Lake County, Idaho. Two other companies, recently organized, hold phosphate rock deposits in Bear Lake County, Idaho—the Teton Phosphate Co., Boise, Idaho, incorporated in 1939 with a reported capitalization of 50,000 shares of $1 each, and the Idaho Grange Phosphate Cooperative, of Nampa, Idaho. No production in 1939 was reported by either company. Montana had two producers—one large and one small. The larger one, the Montana Phosphate Products Co., of Trail, British Columbia, operated the Anderson mine near Garrison, Powell County, Mont., and United States Government Leases Great Falls 076740 and 081920, supplying the requirements of the Consolidated Mining & Smelting Co. of Canada, Ltd., at Trail. The Anderson mill at Garrison, which prepares ground phosphate rock for direct application to the soil, is not known to have been operated during the year. The Mineral Hill Mining Co. shipped less than 2,000 tons from its mines near Avon, in Powell County, Mont.

The Western Phosphate Conference held symposia on reserves, technology, and uses of phosphate rock at the University of Idaho, August 31 to September 2, 1939. The delegates to the conference also visited some of the phosphate rock deposits of the Western States.

Much information regarding the phosphate rock deposits of the Western States and the phosphate industry of that region is contained in the recently published hearings of the joint congressional committee on phosphate.[11]

Mansfield[12] discusses the phosphate reserves of the Western States in detail. As of January 1940, he estimates reserves at 7,984,892,000 long tons, at least in the areas so far studied, with Idaho listed as 5,736,335,000 tons; Utah (including grades down to 40 percent),[13] 1,741,480,000 tons; Montana, 391,323,000 tons; and Wyoming, 115,754,000 tons.

Western States phosphate rock sold or used by producers, 1935–39

Year	Idaho			Montana			Total		
	Long tons	Value at mines		Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average		Total	Average
1935	41,796	$176,877	$4.23	27,497	$73,701	$2.68	69,293	$250,578	$3.62
1936	47,113	203,264	4.31	36,022	76,066	2.11	83,135	279,330	3.36
1937	83,436	356,037	4.27	50,834	133,138	2.62	134,270	489,175	3.64
1938	66,014	296,595	4.49	66,491	155,917	2.34	132,505	452,512	3.42
1939	95,451	431,938	4.53	44,384	112,142	2.53	139,835	544,080	3.89

Virginia.—The Southern Mineral Products Corporation (a subsidiary of the Vanadium Corporation of America) operated its milling plant at Piney River, Nelson County, Va., recovering apatite from nelsonite ore from its mines in Amherst County, Va.

[11] See footnote 1.
[12] Mansfield, G. R., Work cited in footnote 3.
[13] Williams, J. Stewart, Phosphate in Utah: Utah Agr. Exp. Sta. Bull. 290, 1939.

FOREIGN TRADE [14]

Imports.—Imports of phosphate rock into the United States in 1939 dwindled to only 3,500 tons compared with 7,006 tons in 1938 and 13,400 tons in 1937. All imports in 1939 came from Curaçao in the Netherland West Indies and entered the United States in May. No further imports from this source were received during the year, reportedly because of increased costs and shipping difficulties. Customarily phosphate rock is imported from French Oceania, but no imports were recorded in 1939. No apatite was imported from the U. S. S. R. or Brazil.

Phosphate rock and phosphatic fertilizers imported for consumption in the United States, 1935–39

Fertilizer	1935		1936		1937		1938		1939	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Apatite	3,599	$28,829	3,100	$17,187			2	$5		
Phosphate rock, crude	100	900			(1)	(1)	(1)	(1)	(1)	(1)
Phosphates, crude, not elsewhere specified	(2)	(2)	(2)	(2)	13,400	$115,926	7,004	80,534	3,500	$23,625
Ammonium phosphates, used as fertilizer	10,812	401,431	13,383	475,483	27,253	1,089,657	29,028	1,286,935	34,995	1,627,608
Bone dust, or animal carbon, and bone ash, fit only for fertilizing	18,388	354,900	23,215	465,585	37,341	857,349	19,581	393,808	40,530	979,179
Guano	16,219	311,645	22,804	457,209	13,104	375,650	15,199	717,817	5,151	211,941
Slag, basic, ground or unground	1,078	15,136	758	9,758	714	7,339	691	9,547	405	5,168
Precipitated bone, fertilizer grade	472	11,613	3,817	96,166	4,414	120,225	3,385	98,725	2,314	68,611

[1] Not shown separately; included with "Phosphates, crude, not elsewhere specified" beginning January 1, 1937.
[2] New classification beginning January 1, 1937.

The United States Treasury Department order of February 9, 1928 (T. D. 42577), a finding of dumping with respect to Morocco phosphate rock, was reversed by the Department on September 18, 1939. On the basis of undisclosed new evidence the Treasury Department became convinced that the original order was not justified, and it was vacated as of February 9, 1928, the original date of issue. (T. D. 49964.)

Late in 1939 the Interstate Commerce Commission granted authority for railroads to establish rail rates of not less than $4.70 per ton of 2,000 pounds on carload lots of imported phosphate rock from New Orleans and other Gulf ports to Quincy, Ill., for the duration of the next open season of navigation, from March 1 to November 30, 1940.[15]

Exports.—Exports in 1939 totaled only 949,006 long tons compared

Phosphate rock exported from the United States, 1935–39

Year	Long tons	Value		Year	Long tons	Value	
		Total	Average			Total	Average
1935 [1]	1,104,394	$5,773,506	$5.23	1938	1,140,841	$6,637,638	$5.82
1936 [1]	1,208,951	6,776,917	5.61	1939	949,006	5,233,104	5.51
1937	1,052,802	5,818,231	5.53				

[1] Includes sintered matrix.

[14] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.
[15] Interstate Commerce Commission, Phosphate Rock from Gulf Ports to Quincy, Ill.: 4th Sec. Application 17796, Opinion 22920, 1939, pp. 204–206.

with 1,140,841 tons in 1938 and 1,052,802 tons in 1937. Their value was nearly 1½ million dollars less in 1939 than in 1938. Not only was a smaller quantity exported, but also the average value declined to $5.51 per ton in 1939 compared with $5.82 in 1938. Most of the exports were from Florida, but some were from the Western States.

The quantity and value of exports of both high-grade hard rock and land-pebble rock were less in 1939 than in 1938. The quantity and value of exports of other phosphatic material, including sintered matrix, were also less. The following tables show total exports of high-grade hard rock and land-pebble phosphate rock, as well as shipments of each type of rock to various countries from 1935 to 1939, inclusive.

Phosphate rock exported from the United States, 1935–39, by countries

HIGH-GRADE HARD ROCK

Country	1935		1936		1937		1938		1939	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Belgium	------	------	4,300	$30,100	4,250	$29,750	4,000	$28,000	------	------
British Malaya	------	------	------	------	------	------	507	5,000	1,200	$12,000
British West Indies ("Other")	2	$40	------	------	------	------	------	------	------	------
Canada	28,907	121,686	39,271	274,934	49,970	305,865	67,134	406,463	45,162	276,372
Germany [1]	49,880	349,160	72,400	507,950	31,457	216,016	57,250	369,787	55,246	345,290
Italy	------	------	------	------	------	------	3,000	18,750	2,000	12,500
Japan	------	------	------	------	1	11	------	------	------	------
Lithuania [1]	6,000	42,000	------	------	12,150	85,050	------	------	------	------
Netherlands	19,575	137,025	15,050	115,350	1,800	12,600	14,450	94,420	14,750	92,188
Panama	4	31	------	------	50	812	4	48	------	------
Poland and Danzig [1]	------	------	7,700	53,900	------	------	2,900	18,125	------	------
Sweden	25,700	169,075	25,225	174,350	20,800	145,600	32,675	219,425	14,625	102,375
	130,068	819,017	163,946	1,156,584	120,478	795,704	181,920	1,160,018	132,983	840,725

LAND PEBBLE

Country	1935		1936		1937 [2]		1938 [2]		1939 [2]	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Austria	3,000	$15,750	3,001	$15,005	7,397	$42,308	[3] 5,781	[3] $32,301	------	------
Belgium	3,293	16,794	77,972	478,384	88,050	546,730	96,073	588,299	36,729	$221,107
Canada	29,562	160,028	37,853	165,166	60,174	267,983	59,275	250,465	68,386	319,829
Czechoslovakia [1]	------	------	5,983	30,114	29,494	185,867	26,238	155,987	2,498	16,612
Denmark	36,186	159,242	------	------	7,331	34,404	7,495	33,503	------	------
France	3,671	20,374	------	------	------	------	------	------	------	------
Germany [1]	211,179	1,157,410	278,404	1,660,508	189,603	1,104,534	358,077	2,181,869	271,801	1,623,330
Haiti	------	------	------	------	------	------	------	------	3,877	12,794
Hungary [1]	------	------	4,852	24,163	26,266	135,330	10,017	69,107	2,500	15,750
Italy	60,643	359,123	65,813	393,657	69,012	426,094	49,911	305,718	86,375	562,533
Japan	222,110	952,974	281,797	1,176,953	278,155	1,153,910	159,270	664,392	225,527	875,804
Mexico	------	------	------	------	------	------	39	200	------	------
Netherlands	147,769	812,060	142,432	904,135	98,850	628,370	103,666	675,249	27,517	178,283
Norway	1,499	11,243	------	------	------	------	------	------	------	------
Poland and Danzig [1]	28,499	176,781	16,654	93,428	17,586	115,975	2,993	19,821	2,800	18,814
Rumania	11,298	56,490	12,852	64,260	------	------	------	------	------	------
Spain	140,329	668,454	28,720	151,789	------	------	------	------	------	------
Sweden	29,738	165,491	45,664	291,870	48,608	306,412	66,113	412,948	71,479	455,332
Switzerland	------	------	------	------	4,814	37,068	6,620	46,316	------	------
United Kingdom	28,659	126,776	43,008	170,901	5,488	28,940	7,353	41,445	13,531	71,921
Yugoslavia	16,891	95,499	------	------	1,496	8,602	------	------	3,003	20,270
	974,326	4,954,489	1,045,005	5,620,333	932,324	5,022,527	958,921	5,477,620	816,023	4,392,379

[1] For statistical purposes, trade with the Sudeten area, as far as ascertainable, is included with Germany, while trade with the other Czechoslovak Provinces occupied by Germany, Hungary, and Poland has been included with these countries since March 18 or 19, 1939. After November 16, 1939, trade with Danzig and that part of Poland occupied by Germany has been included with Germany and trade with that part of Poland occupied by U. S. S. R. has been included with U. S. S. R.

[2] Excludes sintered matrix. [3] Figures cover period January 1 to May 5.

Other phosphate materials [1] *exported from the United States, 1935–39*

Year	Long tons	Value	Year	Long tons	Value
1935	3,984	$154,429	1938 [2]	32,581	$208,550
1936	3,489	165,385	1939 [2]	29,080	192,306
1937 [2]	55,665	466,850			

[1] Includes bone ash, dust, and meal; animal carbon for fertilizer; basic slag; etc.
[2] Includes sintered matrix.

The following table shows exports of high-grade hard rock from the various customs districts. In 1939 most rock of this type went from the hard-rock district of Florida to European countries, but a considerable quantity of phosphate rock from the Western States was shipped from the Montana-Idaho customs district to Canada.

High-grade hard-rock phosphate exported from the United States, 1938–39, by customs districts

Customs district	1938		1939	
	Long tons	Value	Long tons	Value
Buffalo	2	$30	2	$25
Dakota	14	120	23	260
Florida	114,782	753,507	87,821	564,353
Michigan	70	812	251	2,595
Montana and Idaho	67,042	405,445	44,873	273,373
New Orleans	4	48		
St. Lawrence	2	16	13	119
Washington	4	40		
	181,920	1,160,018	132,983	840,725

Exports of phosphate rock have decreased since the British blockade of Germany was established. Shipments for the last 4 months of

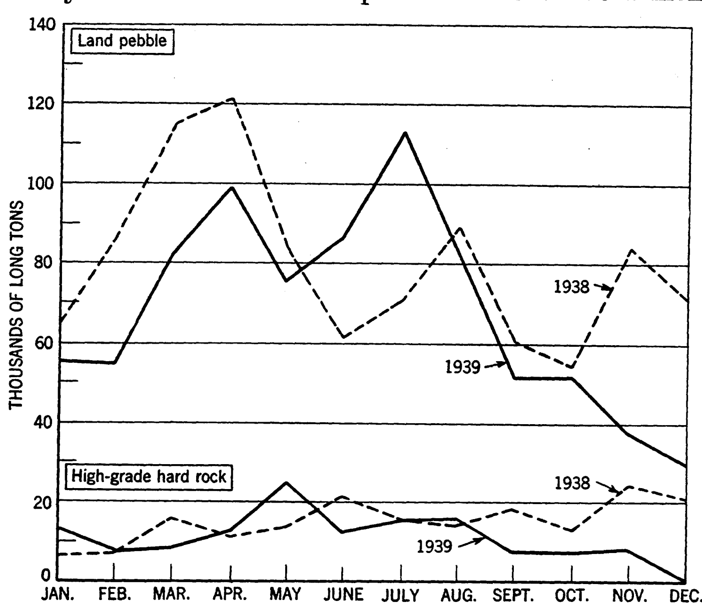

FIGURE 2.—Exports of phosphate rock from the United States, 1938–39. Note drop in exports after outbreak of war in September 1939.

1939, after war broke out in Europe, were below those for the same period in 1938. The last 1939 shipment of Florida high-grade hard rock from the United States to Germany was in August and of Florida land pebble in September. The monthly exports of phosphate rock for 1938 and 1939 are shown in figure 2.

The first seizure of a cargo of phosphate rock as contraband by the British Navy was reported by the British Government on September 14, 1939. The shipment comprised 5,900 tons of Florida land-pebble phosphate, intended for Germany and German-owned, on the American-owned freighter *Warrior*, of the Waterman Steamship Corporation, Mobile, Ala.

Figure 3 gives the sources of Germany's supplies of phosphate rock

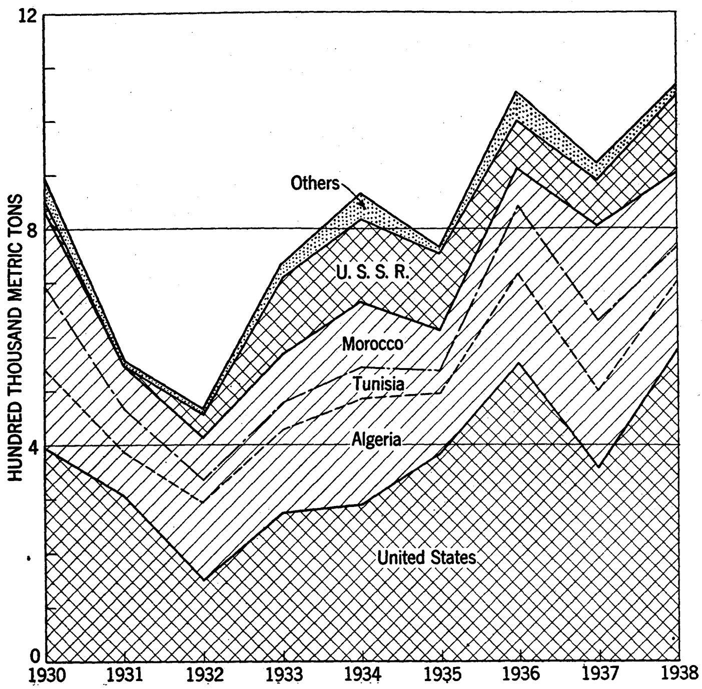

FIGURE 3.—Sources of Germany's supplies of phosphate rock, 1930–38. Data from Phosphate Export Association.

in recent years, based upon reports of the Phosphate Export Association, of New York City.

Figure 4 shows similar data for Japan.

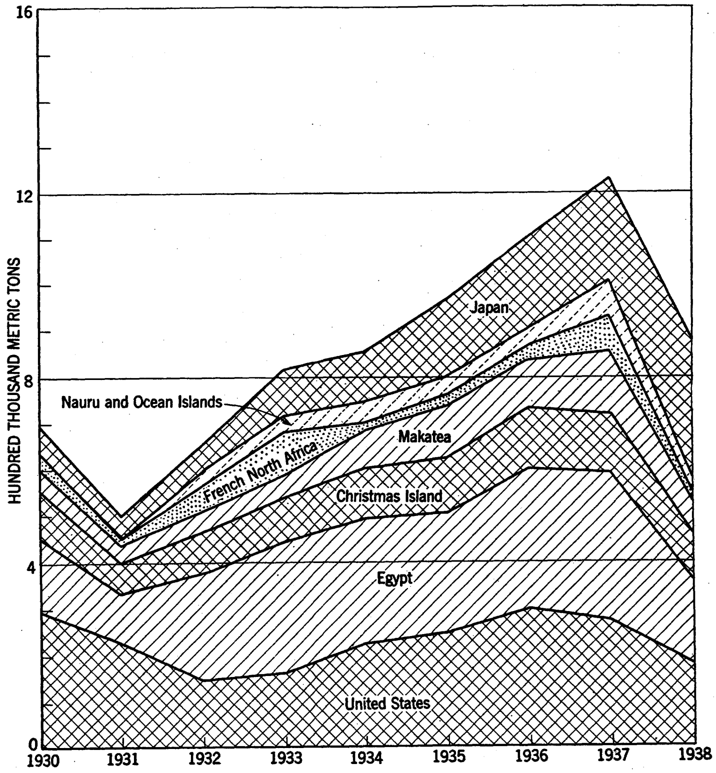

FIGURE 4.—Sources of Japan's supplies of phosphate rock, 1930–38. Data from Phosphate Export Association.

WORLD PRODUCTION

World production of phosphate rock from 1935 to 1939 is given in the following table.

World production of phosphate rock, 1935–39, by countries, in metric tons

[Compiled by M. T. Latus]

Country	1935	1936	1937	1938	1939
Algeria	603,863	530,998	631,148	584,452	[1] 450,000
Angaur Island (exports)	78,112	89,226	90,652	105,578	(2)
Australia: New South Wales	239	178	20	244	(2)
Belgium	173,360	16,090	----------	----------	(2)
Brazil	----------	----------	----------	100	(2)
Canada	169	476	91	189	142
China [3]	8,000	8,000	8,000	8,000	8,000
Christmas Island, Straits Settlements (exports)	149,341	157,564	154,378	162,425	(2)
Egypt	473,896	531,031	517,002	458,404	(2)
Estonia	11,642	11,408	10,112	13,012	(2)
France	49,600	55,000	103,600	(2)	(2)
Germany	180	1,060	3,314	3,221	(2)
Austria	440	120	----------	----------	(2)
India, British	104	130	169	23	(2)
Indochina	5,888	10,336	20,252	37,341	(2)
Italy	500	----------	200	----------	(2)
Japan	91,248	113,102	(2)	(2)	(2)
Madagascar	6,000	5,349	4,290	5,699	(2)
Makatea Island (exports)	130,353	122,936	166,726	102,941	(2)
Morocco, French (shipments) [4]	1,303,182	1,257,796	1,501,767	1,447,544	1,491,754
Nauru and Ocean Islands [5]	707,051	965,349	1,024,168	1,184,816	1,244,170
Netherland India	11,553	12,072	26,167	33,113	(2)
Netherland West Indies: Curaçao (exports)	90,709	78,131	101,837	99,283	(2)
New Caledonia	11,855	4,877	307	5,000	(2)
Philippine Islands	1,309	497	750	(2)	(2)
Poland	11,641	12,497	(2)	(2)	(2)
Rumania	2,784	1,039	950	(2)	(2)
Seychelles Islands (exports)	10,082	23,942	9,594	21,703	(2)
Sweden (apatite)	2,960	6,140	4,917	6,192	(2)
Taiwan	91	213	(2)	(2)	(2)
Tanganyika Territory	194	----------	104	69	(2)
Tunisia	1,500,000	1,488,000	1,771,439	1,934,200	(2)
U. S. S. R.[6]	767,900	920,000	(2)	(2)	(2)
United States (sold or used by producers)	3,091,211	3,405,654	4,019,686	3,799,253	3,817,368

[1] Estimated. [2] Data not available. [3] Estimated (Imp. Inst., London).
[4] Including exports as follows: 1935, 1,296,052 tons; 1936, 1,247,923 tons; 1937, 1,484,562 tons; 1938, 1,427,643 tons; 1939, 1,465,673 tons.
[5] Exports during fiscal year ended June 30 of year stated.
[6] Apatite concentrates. Production of apatite ore in 1936 amounted to 2,000,000 tons. In addition, low-grade phosphate rock is produced, but production data are not available.

German trial exploitation of the phosphate deposits in Nassau, in the Lahn River Basin, were abandoned in 1939, the operations being much too costly, even under German conditions of closed national economy, because of the low grade of the deposits and their pockety nature. According to Redecker, the best grades of the phosphate rock in the Lahn region contained only 10 to 13 percent phosphorus.[16] The phosphate rock situation in Germany is described in considerable detail in another report by Redecker.[17]

TECHNOLOGY

The design of a 5,500-kw. electric furnace for smelting phosphate rock is described by Curtis and Heaton [18] of the T. V. A. One of the furnaces now in use is described in detail.

[16] Redecker, S. B., American consul, Frankfort on the Main, Germany, June 7, 1939: Bureau of Mines Mineral Trade Notes, vol. 9, No. 1, July 1939, p. 23.
[17] Redecker, S. B., American consul, Frankfort on the Main, Germany, October 4, 1939: Bureau of Mines Mineral Trade Notes, vol. 9, No. 6, December 1939, pp. 17–20.
[18] Curtis, H. A., and Heaton, R. C., Design for a Phosphate Furnace: Chem. and Met. Eng., vol. 45, No. 10, October 1938, pp. 536–540.

The determination of fluorine in natural phosphates and phosphatic fertilizers is described in considerable detail in a paper by Reynolds and Hill,[19] of the Bureau of Chemistry and Soils, United States Department of Agriculture.

Emmett and Shultz,[20] also of the Bureau of Chemistry and Soils, United States Department of Agriculture, have studied the utilization of carbon dioxide in the oxidation of elemental phosphorus.

The results obtained by a comparative study of methods of determining available phosphoric acid are given in a paper by J. R. Adams,[21] of the Bureau of Chemistry and Soils, United States Department of Agriculture. Ross and Adams [22] present the results of further studies on phosphoric acid.

The development of dipotassium phosphate for use in wool processing has been announced.[23] Cleansing of raw wool now requires large quantities of olive oil, which must be imported. It is reported that the olive oil can be replaced by domestic dipotassium phosphate.

A British patent [24] describes a method for the production of the alkaline phosphates, such as trisodium phosphate, direct from phosphate rock by the treatment of mixtures of crude phosphates and alkalies.

The determination of phosphoric acid in basic slag and in superphosphate is the subject of two articles by W. Spengler.[25]

A new plant has been opened for the manufacture of sodium tetraphosphate by the Rumford Chemical Works at Rumford, R. I.[26] The use of this chemical as a water softener, in cleansing compounds, and in drilling oil wells is reported to be increasing. Ranshaw [27] describes the use of trisodium phosphate in laundries.

The growing scarcity of sulfuric acid for use in the production of superphosphate in Germany, because of its employment for other purposes, has stimulated research to develop improved processes for making phosphate fertilizers with less sulfuric acid or none at all. Four main types of phosphatic fertilizers using less sulfuric acid than before have been developed. These are described in a recent report.[28]

MacIntire and Hardin in a recent article [29] presented the results of a study of the development of citrate insolubility through the formation of fluorphosphate by the reaction between the fluorides of superphosphate and calcined rock phosphate in mixtures of these two compounds.

The results of a study to determine the nature and composition of the products of the reaction of potassium chloride with phosphoric

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[19] Reynolds, D. S., and Hill, W. L., Determination of Fluorine, with Special Reference to Analysis of Natural Phosphates and Phosphatic Fertilizers: Ind. Eng. Chem., Anal. Ed., vol. 11, No. 1, 1939, pp. 21–27.

[20] Emmett, P. H., and Shultz, J. F., Oxidation of Phosphorus to a Pentavalent Form by Carbon Dioxide: Ind. Eng. Chem., vol. 31, No. 1, 1939, pp. 105–111.

[21] Adams, J. R., A Comparison of the Official and MacIntire-Shaw-Hardin Methods for Determining Available Phosphoric Acid: Jour. Assoc. Official Agr. Chem., May 1939, pp. 397–400.

[22] Ross, W. H., and Adams, J. R., Report on Phosphoric Acid: Jour. Assoc. Official Agr. Chem., May 1939, pp. 254–263.

[23] Ind. Eng. Chem., News Ed., vol. 17, No. 7, April 10, 1939, p. 229.
Chem. Ind., vol. 44, No. 6, June 1939, p. 614.

[24] Chemische Fabrik Budenheim Akt.-Gesellschaft, Phosphates Direct from Rock. British Patent 449,566 (1938): Chem. Ind., vol. 44, No. 5, May 1939, p. 512.

[25] Spengler, W., Determination of Phosphoric Acid in Basic Slag: Ztschr. anal. Chem., vol. 117, 1939, pp. 161–168; Determination of Phosphoric Acid in Superphosphate: Ztschr. anal. Chem., vol. 117, 1939, pp. 169–176.

[26] Chem. Ind., vol. 44, No. 3, March 1939, p. 309.

[27] Ranshaw, G. S., Textile Applications of the Phosphates. Laundry Uses for Trisodium Phosphate: Chem. Age (London), vol. 41, No. 1061, October 28, 1939, pp. 299–300.

[28] Redecker, S. B., American consul, Frankfort on the Main, Germany, October 4, 1939: Bureau of Mines Mineral Trade Notes, vol. 9, No. 6, December 1939, pp. 17–20.

[29] MacIntire, W. H., and Hardin, L. J., Fluoride-induced Reversion in Mixtures of Superphosphates and Calcined Rock Phosphate: Ind. Eng. Chem. (Ind. Ed.), vol. 32, No. 1, January 1940, pp. 88–94.

acid at temperatures higher than those reported by previous investigators and some physical properties of the high-temperature, insoluble, crystalline form of potassium metaphosphate are presented in a recent article by Madorsky and Clark.[30]

SUPERPHOSPHATES

The following table gives the salient features of the superphosphate industry in the United States, 1936–39.

Salient statistics of the superphosphate industry in the United States, 1936–39

	1936	1937	1938	1939
Production: [1]				
Bulk superphosphate____short tons__	3,412,486	4,429,767	3,575,588	3,801,194
Wet base and wet mixed goods____do____	142,459	122,680	156,730	152,500
Shipments: [1]				
All superphosphate, to consumers____do____	997,011	1,046,334	902,490	897,749
All superphosphate, to others____do____	1,672,049	2,130,860	1,817,293	2,073,123
Base and mixed goods [2]____do____	1,480,719	1,723,590	1,537,491	1,526,026
Stocks in manufacturers' hands, Dec. 31: [1]				
Bulk superphosphate____do____	1,133,640	1,313,327	1,361,127	1,233,297
Base and mixed goods [2]____do____	657,828	784,532	669,503	701,649
Exports of superphosphates [3]____long tons__	68,368	78,949	90,237	95,224
Imports of superphosphates [3]____do____	18,395	57,930	18,753	17,238
Sales of phosphate rock by producers for superphosphate production____long tons__	1,768,677	2,391,245	2,074,779	2,192,779

[1] Bureau of the Census, Monthly Statistics Superphosphate Industry; 16 percent available phosphoric acid.
[2] Includes wet and dry bases and wet and dry mixed goods.
[3] Bureau of Foreign and Domestic Commerce.

The following table shows the source of imports of superphosphates and the destination of exports of domestic superphosphates for 1938 and 1939.

Superphosphates (acid phosphates) imported into and exported from the United States, 1938–39, by countries

Country	Imports				Exports			
	1938		1939		1938		1939	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Argentina					500	$16,070		
Belgium	2,540	$77,198	4,619	$142,510				
Bolivia							5,136	$70,933
Canada	7,333	125,426	10,536	172,519	73,649	770,677	71,665	694,217
Chile					240	2,235	15	1,192
Cuba					12,282	102,822	16,594	197,122
Dominican Republic					32	1,173	58	2,303
Jamaica							294	5,862
Mexico					186	9,946	238	12,027
Netherlands	8,880	121,769	1,885	22,724				
Philippine Islands					246	3,575	(1)	16
Salvador							57	1,613
Union of South Africa					2,955	34,296	500	5,550
Venezuela					52	2,280	185	8,305
West Indies, "Other British"					61	844	281	3,841
Other countries			198	2,124	34	1,433	201	7,355
	18,753	324,393	17,238	339,877	90,237	945,351	95,224	1,010,336

[1] Less than 1 ton.

[30] Madorsky, S. L., and Clark, K. G., Potassium Metaphosphate. A Potential High-analysis Fertilizer Material: Ind. Eng. Chem., vol. 32, No. 2, February 1940, pp. 244–248.

Statistics for 1937 covering international trade in superphosphates and production of superphosphates in various countries were published early in 1939.[31]

A revised definition of superphosphate was adopted in 1939 by the Association of Official Agricultural Chemists at its 55th annual meeting but does not become final until its next meeting. It would include as superphosphate a product made by mixing concentrated phosphoric acid with limestone. This product lacks the gypsum content of ordinary superphosphate. The new definition reads:

Superphosphate is a commercial phosphate, the phosphoric acid content of which is due chiefly to monocalcium phosphate.[32]

In October 1939 the price of superphosphate was advanced from $7.50 to $8.50 a short ton (basis, 16 percent for run-of-pile, in bulk, f. o. b. Baltimore) because of reported increases in the cost of production. The Temporary National Economic Committee[33] calls attention to the absence of any change in the price of either phosphate rock or sulfuric acid, the basic raw materials for the production of superphosphate.

BASIC SLAG

Basic slag is an important competitor of phosphate rock and superphosphate as a source of fertilizer phosphorus in European countries, where most of it is produced and used. The demand in the United States is limited and is met by importation of a small quantity and the annual production of a few thousand tons in the Birmingham iron district of Alabama. Less than 1 percent of the world production comes from the United States.

Production of basic slag, 1935–38, by countries, in metric tons [1]

Country	1935	1936	1937	1938
Europe:				
Belgium [2]	569,000	605,000	825,000	857,000
Czechoslovakia	125,000	145,000	162,562	162,000
Eire		1,250	1,481	1,682
France	940,000	1,035,000	1,218,000	860,000
Germany	2,025,000	2,277,000	2,312,000	2,550,000
Italy	1,731	1,113	840	(3)
Luxemburg	396,000	431,076	532,458	319,600
Poland	1,000	(3)	4,000	8,100
Sweden	15,000	15,713	15,442	(3)
U. S. S. R.	41,000	(3)	(3)	(3)
United Kingdom [4]	276,000	302,000	410,000	471,000
	4,389,731	[5] 4,813,152	[6] 5,481,783	(3)
North America: United States [2]	25,000	35,600	35,600	35,600
	4,414,731	[5] 4,848,752	[6] 5,517,383	(3)

[1] Adapted from figures as published by Imperial Institute, London.
[2] Estimated. [3] Data not available.
[4] Estimated amount ground and used as fertilizers.
[5] Exclusive of Poland and U. S. S. R. [6] Exclusive of U. S. S. R.

The characteristics of various Alabama iron ores have been summarized recently by Burchard.[34]

[31] Gray, A. N., Phosphate Rock and Superphosphate Statistics for 1937; B, Superphosphate; Superphosphate (London), vol. 12, No. 2, 1939, pp. 21–27.
[32] Oil, Paint and Drug Reporter, vol. 136, No. 19, November 6, 1939, pp. 3, 61.
[33] Business Week, December 2, 1939, p. 15.
[34] Burchard, E. F., Iron Ore Available to Alabama Blast Furnaces: Min. and Met., vol. 19, No. 376, April 1938, pp. 183–184.

Basic Bessemer slags supply about 70 percent of the phosphorus for the German fertilizer industry and a considerable proportion comes from German ores. That country has very few phosphate deposits and, in operating the basic Bessemer process, must consider the need of producing a phosphatic slag suitable for fertilizer use along with other metallurgical problems.[35]

Sauchelli [36] discusses the composition of superphosphate and Mehring [37] the various grades of superphosphate sold in the United States.

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[35] Trömel, G., Phosphate Slag Problems: Stahl u. Eisen, vol. 57, 1937, pp. 1213–1216.

[36] Sauchelli, Vincent, 20 Percent Superphosphate: What's the Other 80 Percent: Am. Fertilizer, vol. 90, No. 12, June 10, 1939, pp. 12, 13, 26.

[37] Mehring, A. L., Grades of Superphosphate Sold to Farmers in the United States: Fertilizer Rev., January-February 1939, pp. 3, 11–12.

TALC, PYROPHYLLITE, AND GROUND SOAPSTONE [1]

By Bertrand L. Johnson and K. G. Warner

SUMMARY OUTLINE

Sales of talc, pyrophyllite, and ground soapstone attained a new high in 1939, exceeding the previous 1937 peak by 24,000 tons. (See fig. 1.) Total sales were 253,976 short tons valued at $2,700,834.

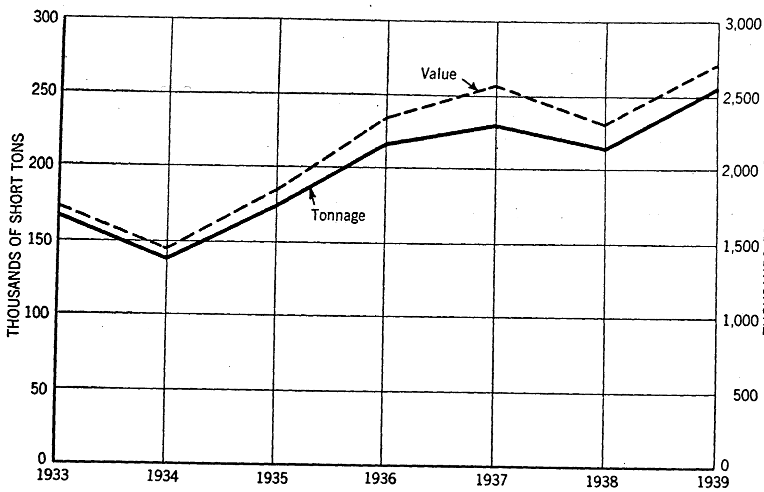

Figure 1.—Sales of domestic talc, pyrophyllite, and ground soapstone, 1933–39.

Sales of crude, sawed and manufactured, and ground materials increased over 1938, but by far the greatest part of the increase—over 38,000 tons—was in sales of the ground products. Imports of crude materials were much smaller than in 1938, but those of manufactured products were appreciably larger. Exports of all classes were greater in 1939 than in 1938.

Pyrophyllite is included in this discussion with talc solely because the custom was established many years ago in these annual reports of the Bureau of Mines. Although pyrophyllite resembles talc in certain physical properties, it is a hydrous aluminum silicate

[1] Soapstone sold in slabs or blocks is included in the chapter on Stone.

($Al_2Si_4O_{10}(OH)_2$) instead of a hydrous magnesium silicate like talc ($Mg_3Si_4O_{10}(OH)_2$). Authorities who have classified pyrophyllite as one of the kaolin minerals were cited in Minerals Yearbook, 1939 (p. 1273). Several analyses of North Carolina pyrophyllite have been assembled by Trice.[2]

Salient statistics of the talc, pyrophyllite, and ground-soapstone industry in the United States, 1938–39

	1938		1939	
	Short tons	Value	Short tons	Value
Sales by producers:				
Crude	13,498	$72,845	15,722	$82,188
Sawed and manufactured	1,729	70,268	1,871	77,915
Ground	197,548	2,159,447	236,383	2,540,731
	212,775	2,302,560	253,976	2,700,834
Imports for consumption:				
Crude and unground steatite and French chalk	337	5,956	133	2,392
Manufactures (except toilet preparations) wholly or partly finished	21,790	385,242	26,134	450,227
	22,127	391,198	26,267	452,619
Exports:				
Talc, steatite, and soapstone, crude and ground	7,118	124,194	9,047	162,426
Powder—talcum (in packages), face, and compact	(1)	978,100	(1)	1,115,176
		1,102,294		1,277,602

1 Quantity not recorded.

In 1939, as in 1938, nine States produced talc, pyrophyllite, and ground soapstone. Seven of these States, which contribute most of the output, are in the East; the other two are California and Washington. Talc, pyrophyllite, and soapstone were reported as produced in California; talc and soapstone in Georgia, Maryland, Virginia, and Washington; talc and pyrophyllite in North Carolina; talc in New York and Vermont; and soapstone in Pennsylvania.

PRODUCTION

The following producers of talc, pyrophyllite, and soapstone in the United States reported to the Bureau of Mines in 1939.

Producers of talc, pyrophyllite, and soapstone in the United States in 1939

Producer	Material	Product	Location	
			County	Nearest town
CALIFORNIA				
J. A. Barnett, Shingle	Soapstone	Crude	Eldorado	Shingle.
W. H. Binder, 25 East Palm St., Altadena.	do	do	Los Angeles	Saugus.
Blue Star Mines, Ltd., 840 San Julian St., Los Angeles.	Talc, soapstone, pyrophyllite.	Ground	Inyo	Bigpine.
Wm. Bonham & W. V. Skinner, Lone Pine.	Talc	Crude	do	Keeler.
Lew A. McEachran, 2652 Harrison St., San Francisco.	Soapstone	do	Butte	Isaiah.
Moorhouse Talc Co., 3215 West 6th St., Los Angeles.	Talc	do	San Bernardino	Shoshone, Inyo County.

2 Trice, M. F., Pyrophyllite Dust—Its Effect and Control: Am. Inst. Min. and Met. Eng., Tech. Pub. 1179, 1940, 13 pp.

Producers of talc, pyrophyllite, and soapstone in the United States in 1939—Contd.

Producer	Material	Product	Location: County	Location: Nearest town
Pacific Coast Talc Co., 2149 Bay St., Los Angeles.	Talc	Ground	Inyo	Darwin.
Do	do	Crude, ground	San Bernardino	Silver Lake.
Pacific Minerals Co., Ltd., 337 10th St., Richmond.	Soapstone	do	Eldorado	Shingle.
Sierra Talc Co., 428 Union League Building, Los Angeles.	Talc	do	Inyo	Darwin.
Southern California Minerals Co., 320 South Mission Road, Los Angeles.	do	Ground	San Bernardino	Kingston.
Western Talc Co., 1901 East Slauson Ave., Los Angeles.	do	Crude, ground	do	Tecopa, Inyo County.
GEORGIA				
Cohutta Talc Co., Dalton	Talc, soapstone	Crayons, ground	Murray	Chatsworth.
Georgia Talc Co., Asheville, N. C.	Talc	do	do	Do.
Southern Talc Co., Chatsworth	do	Sawed, ground	do	Do.
Thompson, Weinman & Co., Inc., Cartersville.	do	Ground	Pickens	Jasper.
MARYLAND				
Clinchfield Sand & Feldspar Co., 430 Hearst Tower Building, Baltimore.	Soapstone	do	Carroll	Marriottsville, Howard County.
Harford Talc & Quartz Co., Bel Air.	Steatite	Crude, ground	Harford	Dublin.
Herbert I. Oursler, Marriottsville.	Soapstone	do	Howard	Marriottsville.
NEW YORK				
Carbola Chemical Co., Inc., Natural Bridge.	Talc	Ground	Lewis	Natural Bridge.
International Pulp Co., 41 Park Row, New York.	do	do	St. Lawrence	Gouverneur.
W. H. Loomis Talc Corporation, 223 East Main St., Gouverneur.	do	do	do	Do.
NORTH CAROLINA				
Carolina Pyrophyllite Co., Staley	Pyrophyllite	do	Randolph	Staley.
Nantahala Talc & Limestone Co., Andrews.	Talc	Crude, crayons	Cherokee	Andrews.
Pyrophyllite Talc Products, Inc., Glendon.	Pyrophyllite	Ground	Moore	Glendon.
Standard Mineral Co., Inc., 230 Park Ave., New York, N. Y.	do	do	do	Hemp.
Victor Mica Co., Inc., Spruce Pine.	Talc	do	Mitchell	Spruce Pine.
PENNSYLVANIA				
C. K. Williams & Co., 640 North 13th St., Easton.	Soapstone	Crude	Northampton	Easton.
VERMONT				
Eastern Magnesia Talc Co., Inc., Burlington.	Talc	Crude, ground	Lamoille	Johnson.
Do	do	Crude, crayons, ground.	Washington	Waterbury.
Vermont Talc Co., Chester	do	Crude, ground	Windham	Windham.
Vermont Mineral Products, Inc., Chester.	do	Ground	Windsor	Chester.
VIRGINIA				
Alberene Stone Corporation of Virginia, Schuyler.	Soapstone	Sawed, ground	Nelson	Schuyler.
Blue Ridge Talc Co., Inc., Henry	do	Crushed, ground	Franklin	Henry.
Bull Run Talc Co., Llanerch, Pa.	Talc	Ground	Fairfax	Clifton Station.
WASHINGTON				
Asbestos-Talc Products of Washington, Inc., Burlington.	do	do	Skagit	Burlington.
Skagit Talc, Inc., Sedro Woolley	Soapstone	Ground, sawed	do	Rockport.

SALES

Sales of talc, pyrophyllite, and ground soapstone by producers increased 19 percent in quantity in 1939, totaling 253,976 short tons valued at $2,700,834 compared with 212,775 tons valued at $2,302,560 in 1938. The output exceeded the previous peak of 1937 by 10 percent. Only in 1928, 1929, and 1936–39 have sales of these commodities exceeded 200,000 tons annually. Sales of crude, sawed and manufactured, and ground materials increased in 1939 over 1938. The greatest increase—38,835 short tons or 94 percent of the total increase (41,201 tons)—was in sales of ground products. Sales of ground materials alone in 1939 were greater than total sales of all classes of talc, pyrophyllite, and ground soapstone in any previous year.

Talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1935–39, by classes

Year	Crude		Sawed and manufactured		Ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1935	10,725	$57,259	841	$63,211	161,150	$1,727,585	172,716	$1,848,055
1936	10,910	59,556	618	90,542	204,663	2,193,073	216,191	2,343,171
1937	11,087	52,750	1,101	111,680	217,811	2,397,323	229,999	2,561,753
1938	13,498	72,845	1,729	70,268	197,548	2,159,447	212,775	2,302,560
1939	15,722	82,188	1,871	77,915	236,383	2,540,731	253,976	2,700,834

Sales by States.—In 1939 increased sales of talc, pyrophyllite, and ground soapstone were reported in all States for which figures can be given. Sales showed the greatest advances in New York and North Carolina and established all-time highs in California, North Carolina, and Georgia. In North Carolina sales gained 34 percent and in Georgia 33 percent. The greatest percentage increase was in Virginia where sales were 58 percent greater in 1939 than 1938. About 39 percent of the total sales in 1939 came from New York.

Talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1938–39, by States

State	1938		1939	
	Short tons	Value	Short tons	Value
California	30,059	$391,456	33,796	$483,839
Georgia	15,117	130,595	20,090	177,881
New York	86,423	1,110,024	99,880	1,252,525
North Carolina	27,460	241,337	36,772	283,789
Vermont	35,126	329,084	39,393	378,492
Washington	174	894	190	1,225
Other States [1]	18,416	99,170	23,855	123,083
	212,775	2,302,560	253,976	2,700,834

[1] Maryland, Pennsylvania, and Virginia.

MARKETS [3]

The largest markets for talc, pyrophyllite, and ground soapstone are in northeastern United States and along the Pacific coast. Many industries use these minerals, but they are employed principally in paint, ceramics, rubber, roofing, and paper.

Talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1938–39, by uses

Use	1938		1939	
	Short tons	Percent of total	Short tons	Percent of total
Paint	53,506	25	67,859	27
Ceramics	29,590	14	38,407	15
Rubber	25,374	12	31,078	12
Roofing	27,607	13	30,516	12
Paper	27,329	13	30,177	12
Toilet preparations	5,970	3	9,672	4
Foundry facings	2,511	1	3,986	2
Other uses [1]	20,732	10	12,918	5
Use not reported	20,156	9	29,363	11
	212,775	100	253,976	100

[1] Includes crayons, bleaching, insecticides, plaster, textile, and other minor uses.

As indicated by reports from the producers to the Bureau of Mines, the paint industry—the leading consumer of these materials—increased its share of the market to 27 percent in 1939, taking nearly twice as much as the ceramic industry, the next largest user. All industries specified in the foregoing table absorbed larger quantities in 1939 than in 1938; the tonnage increases in consumption were especially notable in the paint, ceramics, and rubber industries.

Most of these materials are sold ground. There are no generally accepted standard specifications, but the largest quantity of talc is sold on the basis of previously satisfactory material or plant tests.[4] Chemical analyses are of interest, but physical tests pertinent to the particular trade, such as size and shape of grain, color, slip, retention, oil-absorption index, bonding strength, melting point, and vitrification range, usually are more significant.

Freight rates on soapstone and talc in the United States were fixed by the Interstate Commerce Commission in 1939 in the widely publicized Southern Governors' case.[5] The findings in this case, as far as soapstone and talc are concerned, are that the rate on higher-grade talc in carload lots shall be 16 percent of the first-class rate and on lower-grade talc 13 percent of the first-class rate. These rates are to apply from points in the South to points in the North. From points in the North to points in the South the carload rate on higher-grade talc is to be 22½ percent and on the lower-grade talc 19 percent of the first-class rate.

[3] *See also* Johnson, Bertrand L., Marketing Talc, Pyrophyllite, and Ground Soapstone: Bureau of Mines Inf. Circ. 7080, 1939, 13 pp.

[4] Norman, J. E., O'Meara, R. G., and Baumert, F. X., Froth Flotation of Talc Ores from Gouverneur, New York: Am. Ceram. Soc. Bull. vol. 18, No. 8, August 1939, pp. 292–297.

[5] Interstate Commerce Commission, *State of Alabama et al.* v. *N. Y. C. R. R. Co. et al.*: Docket 27,746—embracing also I. and S. docket 4,400. Soapstone and Talc Between Southern and Official Points—Decided Nov. 22, 1939.

PRICES

The selling price of domestic talcs—except grades suitable for toilet preparations, lava, and crayons—usually is between $4 and $20 a ton. The average value of sales of all grades of talc, pyrophyllite, and ground soapstone, as reported to the Bureau of Mines by producers, has been about $11 a ton, ranging between $12.50 per ton, as in 1928, and $10.43, as in 1933; in 1939 it was $10.63. The average values for the past 5 years are given in the following table.

Average value per short ton of talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1935–39

1935	$10.70	1938	$10.82
1936	10.84	1939	10.63
1937	11.14		

Quotations on finely ground domestic talcs, f. o. b. works, carload lots, in April 1940 were as follows: California, $17 to $20; New York, $11 to $19; Vermont, $9 to $14; Georgia, $6 to $8; Virginia, $4.50 to $7. Crude Virginia talc was quoted at $4 a ton. Prices of imported talc ranged from $11.50 to $13 for Canadian, $23 to $60 for French, and $64 to $78 for Italian.

Prices of pyrophyllite are reported to have gained in 1939, but trade-journal quotations in April 1940 for ground pyrophyllite still showed a range from $7.50 to $12 a ton, as in 1938.

DEVELOPMENTS IN THE INDUSTRY

The leading development in the talc industry is its growing use in wall tile and other ceramic bodies, for which purposes New York and Canadian talcs are said to have found favor.[6] Lime-free talcs are reported as wanted for use in highly absorptive bodies employed for electrical heater plates, but for porcelain and particularly for bodies maturing at low temperature talcs containing definite amounts of lime are desired.

The present froth-flotation plant of the Eastern Magnesia Talc Co., at Johnson, Vt., has been described in detail by Trauffer.[7] This company began experiments with froth flotation in 1934 and in cooperation with the Bureau of Mines developed a reclamation process to recover talc from waste material. The present plant is reprocessing both accumulated and current wastes at the rate of 30 tons a day. Froth flotation now makes possible the economical recovery of 95-percent-pure talc from the dry-plant waste, which comprises about 55 percent talc, 35 percent magnesite, and 10 percent other impurities. About 150 pounds of nickel concentrates also are being recovered daily. Recently a market has been found for the high-iron magnesite (breunnerite) which at first was being wasted.

Pyrophyllite originally was utilized mainly as a substitute for talc, and considerable quantities still are used as a filler in various products. Consumption of pyrophyllite in ceramic bodies, however, has been increasing rapidly. According to Tyler,[8] probably 90 percent of the

[6] Tyler, Paul M., Talc: Bureau of Mines Mineral Trade Notes, January 1939, p. 33.
[7] Trauffer, W. E., Froth Flotation Economically Recovers Valuable Material from Talc Waste: Pit and Quarry, vol. 32, No. 4, October 1939, pp. 28–30.
[8] Tyler, Paul M., Pyrophyllite: Bureau of Mines Mineral Trade Notes, January 1939, pp. 32–33.

makers of wall tile have adopted pyrophyllite-talc mixtures to eliminate the crazing that hitherto had been accepted as more or less unavoidable; one formula for wall tile contains 40 percent pyrophyllite and 12 percent magnesia talc (New York or Canadian). Still more recent is the use of pyrophyllite-talc mixtures for dinnerware bodies, a typical formula being 19 percent pyrophyllite and 6 percent talc.

In July 1939 the North Carolina Division of Industrial Hygiene announced pyrophyllite dust as a new industrial hazard. In February 1940 M. F. Trice [9] of that organization presented before the American Institute of Mining and Metallurgical Engineers a detailed study of pyrophyllite dust and its effects, together with suggested methods of control. Thirty-five percent of the workers exposed to the dust for 2 years showed evidence of lung damage. The effective control of dust underground results from the adoption of wet methods and improved ventilation. On the surface, tight housings for machinery and exhaust ventilation have eliminated hazardous concentrations of dust.

Trice [10] has also described some of the present uses of pyrophyllite. He states that it is an excellent refractory, as pure crystalline specimens have a pyrometric cone equivalent of 29; moreover, associated impurities such as quartz and sericite do not appear to affect this coefficient appreciably, as this value has been found to be a fair average for many run-of-mine specimens. Virtually all floor and wall-tile bodies now produced are said to contain pyrophyllite. It reduces the coefficient of expansion and moisture expansion of the tile body and prevents crazing of the glaze, which usually results from the absorption of moisture. Pyrophyllite is also employed in the production of electrical and other porcelains and in the manufacture of tiny insulation elements, such as are used in radios. One company manufactures dry-press pyrophyllite brick for use as refractory furnace lining. Pyrophyllite is employed to some extent in the manufacture of enamels for porcelain enamel products for stoves and refrigerators, and its use in this connection is increasing. Promising results have been obtained from experiments utilizing pyrophyllite, ground to 1,250-mesh, as an extender for paints and as a surfacer for cardboard. An original use for pyrophyllite, which is still important, is for talcum powder. It is also used as a filler in several industries.

Schünemann [11] found that pyrophyllite from Indian Gulch, Calif., on heating to 400° was unchanged; above that temperature H_2O was evolved continuously but was not reabsorbed on cooling. The lattice remained unchanged to 500°; above that there was some indication of a new form, but the scaly structure continued. Pyrophyllite resists attack by NaOH or HCl unless previously heated above 500° and then is affected only slightly unless the heating has exceeded 1,000°. With $MgCl_2$ cordierite is formed; with $CoCl_2$, spinel; with LiF, products of varying composition; and with $NiCl_2$, a bright-green substance of doubtful composition.

Studies by the Bureau of Mines in cooperation with the W. H. Loomis Talc Co. on the fibrous and foliated talc ores of the Gouverneur (N. Y.) district show that these ores may be improved by froth

[9] Trice, M. F., Work cited in footnote 2.
[10] Trice, M. F., Work cited in footnote 2.
[11] Schünemann, H., Effect of Heat on Pyrophyllite and Its Decomposition Products with Magnesium and Cobalt Chlorides: Univ. Berlin Inaug. Diss., 1937, 34 pp.; Neues Jahrb. Mineral., Geol. Ref. I, 1938, pp. 309–310; Chem. Abs., vol. 33, No. 8, April 20, 1939, p. 2849.

flotation.[12] Three types of ores were tested—tremolite talc, limy talc, and green talc. The ores are said to have differed in type of talc—foliated and fibrous—and in proportion and kind of impurities—calcite, tremolite, serpentine, diopside, and quartz—and each represented a separate problem in flotation. The ores containing fibrous talc and those containing tremolite and calcite were difficult to separate, whereas those containing foliated talc and quartz were easy to float. Different flotation agents were required for the various ores. Pine oil was suitable for foliated talc, but reagents of the amine type proved more suitable for the fibrous talc. The results indicate that a product of high talc content may be separated from each of the ores. In the talc-tremolite ores nothing need be wasted in consequence of beneficiation, as the tailing, enriched in tremolite, is stated to be suitable for wall tile as it is or blended with the feed.

From values listed by manufacturers and standard references Thurnauer [13] has tabulated the mechanical and electrical properties of porcelain, steatite, cordierite, TiO_2, and lava materials.

Meyer [14] found that ground soapstone pressed to shape and burned to 1,400° gave satisfactory results when used for gas-meter valves, remaining tight in tests lasting 1½ years.

Esme [15] discussed the occurrence and properties of talc and its use in papermaking.

Hendricks [16] treated the crystal structure of both talc and pyrophyllite as determined by X-ray data.

Charrin [17] presented a general discussion of talc.

d. Moraes and Leinz [18] described the occurrence of deposits of pyrophyllite suitable for ceramic use in the Province of Minas Geraes, Brazil. They conclude that the pyrophyllite deposits have been formed from kyanite-rich schists through the agency of pneumatolytic-hydrothermal emanations from the associated granitic bodies.

The mining and milling of pyrophyllite are described briefly by Milliken,[19] who points out that pyrophyllite as a substitute for Cornwall stone in wall-tile bodies gives equal absorption, shrinkage, and modulus of rupture, greater uniformity over the firing range, and lower moisture expansion.

Webb and Ratcliffe [20] discussed the use of talc as an anticraze material.

Attention is called by Tyler and Bowles [21] to a new use of pyrophyllite for a refractory known as "pyroplastic," employed chiefly to patch disintegrated firebrick, thereby obviating costly shut-downs and lengthening the life of furnace linings. They also report that the platy or schistose variety of pyrophyllite is claimed, as a result of recent tests, to make a satisfactory paint filler.

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[12] Norman, J. E., O'Meara, R. G., and Baumert, F. X., Work cited in footnote 4.

[13] Thurnauer, Hans. Properties of Ceramic Materials: Electronics, vol. 12, No. 3, 1939, p. 33.

[14] Meyer, George (Gas-meter Valves of Soapstone): Gas-u.-Wasserfach., vol. 82, 1939, pp. 501–502.

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Ralston and others [22] note that the separation of the earthy minerals—talc, pyrophyllite, and clay—has been benefited by attrition scrubbing before flotation. It is thought that attrition produces cleaner concentrates by rubbing off "smears" of the soft mineral from the gangue material.

Flotation tests on two talc ores from California were described by Engel and Shelton.[23]

FOREIGN TRADE [24]

Imports.—Both the quantity and value of total imports of talc, steatite or soapstone, and French chalk were greater in 1939 than in 1938 but did not quite reach the 1937 levels. Imports of crude and unground steatite and French chalk dropped markedly in 1939, but this decline was much more than counterbalanced by the increase in "manufactures."

Talc, steatite or soapstone, and French chalk imported for consumption in the United States, 1935–39

Year	Crude and unground steatite and French chalk		Manufactures (except toilet preparations) wholly or partly finished		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1935	298	$5,856	23,598	$486,418	23,896	$492,274
1936	188	2,915	24,332	453,752	24,520	456,667
1937	324	7,644	26,552	465,175	26,876	472,819
1938	337	5,956	21,790	385,242	22,127	391,198
1939	133	2,392	26,134	450,227	26,267	452,619

Talc, steatite or soapstone, and French chalk imported for consumption in the United States, 1938–39, by countries

Country	1938		1939	
	Short tons	Value	Short tons	Value
Austria	[1] 1	[1] $69		
Belgium	1	60		
Canada	6,438	65,968	6,116	$64,506
China	1,767	42,479	2,593	50,359
Egypt	55	1,039	110	2,519
France	4,244	64,693	5,543	80,539
Germany			1	68
Greece			3	55
Hong Kong	2	306	(2)	70
India, British	287	4,514	892	11,057
Italy	7,842	192,146	8,617	209,888
Japan	1,325	16,915	2,305	32,034
Kwantung	34	330		
Norway	131	2,647	62	588
Sweden	(2)	26		
Union of South Africa			25	936
United Kingdom	(2)	6		
	22,127	391,198	26,267	452,619

[1] Figures cover period Jan. 1 to May 5. [2] Less than 1 ton.

[22] Ralston, O. C., and others, Annual Report of the Nonmetals Division, Fiscal Year 1939: Bureau of Mines Rept. of Investigations 3473, 1939, p. 35.

[23] Engel, A. L., and Shelton, S. M., Progress Reports—Metallurgical Division. 36. Ore Testing Studies, 1938–39; Bureau of Mines Rept. of Investigations 3484, 1940, pp. 17–19.

[24] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Imports from many countries increased. Italy was again the leading source of supply, with Canada second, France third, China fourth, and Japan fifth. Figure 2 shows imports of these materials by countries during the past 3 years.

Exports.—Both the quantity and value of exports of "talc, steatite, and soapstone, crude and ground" were greater in 1939 than in recent

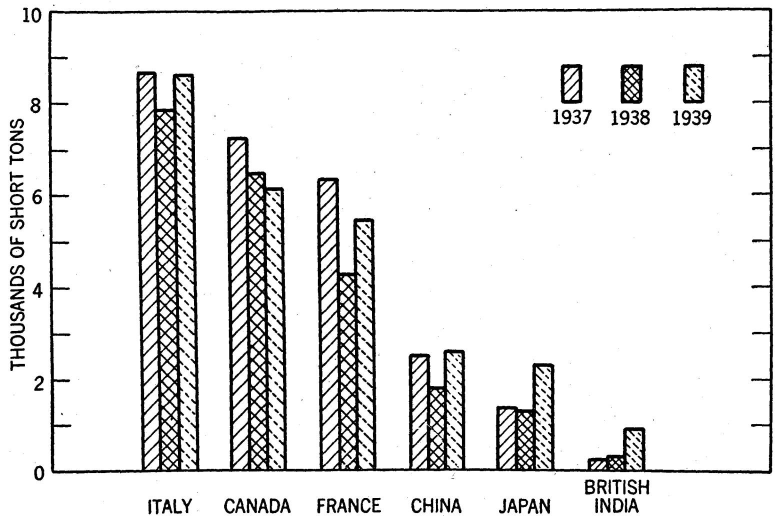

FIGURE 2.—Imports of talc, steatite or soapstone, and French chalk for consumption in the United States, 1937–39, by leading countries.

years; likewise the value of "powders—talcum (in packages), face, and compact" was greater, continuing the upward trend begun in 1935 for material of this type.

Talcum and other powders exported from the United States, 1935–39

Year	Description	Short tons	Value
1935	Talc, crude, in bulk	5,814	$ 101,290
	Powders—talcum (in packages), face, and compact	(1)	711,383
1936	Talc, steatite, and soapstone, crude and ground	6,670	115,434
	Powders—talcum (in packages), face, and compact	(1)	803,571
1937	Talc, steatite, and soapstone, crude and ground	8,878	149,625
	Powders—talcum (in packages), face, and compact	(1)	966,473
1938	Talc, steatite, and soapstone, crude and ground	7,118	124,194
	Powders—talcum (in packages), face, and compact	(1)	978,100
1939	Talc, steatite, and soapstone, crude and ground	9,047	162,426
	Powders—talcum (in packages), face, and compact	(1)	1,115,176

1 Quantity not recorded.

A shipload of talc, consigned to London, England, by the Sierra Talc Co., Los Angeles, Calif., was reported sunk by a German mine.[25]

WORLD PRODUCTION

Although few figures are yet available on the production of talc, pyrophyllite, and soapstone in foreign countries in 1939, the data at hand, coupled with established production trends in the principal

25 Pit and Quarry, vol. 32, No. 8, February 1940, p. 23.

producing countries, indicate that the United States was by far the leading producing nation and that its output exceeded greatly that of other important producers, such as China, France, Italy, British India, Germany, Canada, Norway, and Sweden.

World production of talc and soapstone, 1935–39, by countries, in metric tons

[Compiled by M. T. Latus]

Country [1]	1935	1936	1937	1938	1939
Argentina	176	177	208	80	(2)
Australia:					
New South Wales	511	520	526	597	(2)
South Australia	954	1,003	991	973	(2)
Tasmania		3			(2)
Bulgaria	15				(2)
Canada [3]	12,522	13,161	11,301	9,846	11,924
China (Manchuria)	69,818	80,326	(2)	(2)	(2)
Egypt	366	351	2,266	1,251	(2)
Finland	2,185	1,683	881	(2)	(2)
France	59,500	51,550	56,300	(2)	(2)
Germany:					
Austria (exports)	20,951	19,975	14,089	5,625	(2)
Bavaria	7,163	9,589	7,790	6,805	(2)
Greece	552	864	1,838	1,293	(2)
India, British	12,798	10,128	13,249	18,888	(2)
Indochina		630	428		(2)
Italy	41,692	43,938	45,714	53,511	(2)
Morocco, French (exports)	720	1,368	841	(2)	(2)
Norway	27,782	29,714	24,701	(2)	(2)
Rumania	1,999	2,529	1,976	1,913	(2)
Sweden	6,063	7,146	7,937	6,797	(2)
Tanganyika Territory				38	(2)
Union of South Africa (Transvaal)	303	413	376	1,554	450
United States [4]	156,685	196,124	208,650	193,025	230,402
Uruguay (exports)	1,200	772	437	952	(2)

[1] In addition to the countries listed talc is produced in Brazil, Newfoundland, Spain and the U. S. S. R., but data of production are not available.
[2] Data not available.
[3] Excludes soapstone, which is reported only by value and was as follows: 1935, $32,053; 1936, $32,770; 1937, $40,513; 1938, $35,038; 1939, $41,471. Soapstone is sold in the form of both blocks and powder.
[4] Talc, pyrophyllite, and ground soapstone sold or used by producers.

FLUORSPAR AND CRYOLITE

By H. W. Davis and M. E. Trought

SUMMARY OUTLINE

FLUORSPAR

Greatly increased demand for fluorspar by all the chief consuming industries was indicated by the consumption of 176,800 short tons of fluorspar in 1939 compared with 115,100 tons in 1938. As a result of this improved demand, operations were resumed at some inactive mines and operating schedules at many others were increased. In consequence, domestic mine production and shipments were 75 and 127 percent, respectively, higher than in 1938. In fact, so great was the demand for fluorspar that shipments from domestic mines in 1939 were the largest since 1920 and the fourth highest on record. Shipments from Arizona, Kentucky, and Nevada established all-time highs. However, shipments of fluorspar far exceeded consumption, and as a result consumers' stocks at the end of 1939 were abnormally high. Sales of imported fluorspar in the United States were 7 percent less than in 1938.

Much prospecting and development work was done in 1939, which led to discovery of additional ore bodies and the opening of several new properties. In 1939 new mills came into operation at seven mines, and two new plants were under construction. Improvements and refinements were made in the flow sheets at several mills. Additional new mills are contemplated for 1940.

Total sales of fluorspar to consumers in the United States were 198,198 short tons in 1939 (179,795 tons from domestic mines and 18,403 tons from foreign sources) compared with 99,478 tons in 1938 (79,615 tons from domestic mines and 19,863 tons from foreign sources). Total sales to the steel industry increased to 139,060 tons in 1939 (62,196 tons in 1938), while sales to manufacturers of hydrofluoric acid advanced to 31,966 tons (20,976 tons in 1938) and those to makers of glass and enamel increased to 22,018 tons (12,902 tons in 1938).

Despite the improved demand for fluorspar in 1939, the average composite selling price of all grades of fluorspar (both domestic and foreign) delivered to consumers in the United States was 32 cents a ton less than in 1938. The average selling price f. o. b. Illinois-Kentucky mines of fluorspar shipped to steel plants was $18.24 a short ton ($18 in 1938), of that shipped to manufacturers of hydrofluoric acid \$27.34 (\$25.29 in 1938), and of that to makers of glass and enamel \$26.87 (\$27.90 in 1938). The average selling price at seaboard (duty paid) of imported fluorspar shipped to steel plants was \$20.64 a short ton in 1939 (\$20.56 in 1938) and of that shipped to manufacturers of hydrofluoric acid \$29.76 (\$27.54 in 1938).

Salient statistics of the fluorspar industry in the United States, 1938–39

	1938		1939	
	Short tons	Value	Short tons	Value
Domestic shipments:				
Gravel	59,199	\$1,065,960	144,149	\$2,725,510
Lump	7,907	182,860	15,367	371,047
Ground	13,297	350,846	23,255	608,402
	80,403	1,599,666	182,771	3,704,959
Stocks at mines or shipping points Dec. 31:				
Ready-to-ship	[1] 34,996	(2)	38,619	(2)
Crude	[1] 48,474	(2)	26,746	(2)
	[1] 83,470	(2)	65,365	(2)
Imports for consumption:				
Containing more than 97 percent CaF_2	9,216	192,469	3,351	79,088
Containing not more than 97 percent CaF_2	10,406	95,174	12,951	97,603
	19,622	287,643	16,302	176,691
Exports	788	9,061	2,976	74,443
Consumption (by industries):				
Metallurgical	81,400	(2)	128,600	(2)
Ceramic	14,800	(2)	21,900	(2)
Chemical	18,900	(2)	26,300	(2)
	115,100	(2)	176,800	(2)
Stocks at consumers' plants Dec. 31:				
Metallurgical	57,800	(2)	73,000	(2)
Ceramic	2,800	(2)	3,300	(2)
Chemical	11,200	(2)	14,100	(2)
	71,800	(2)	90,400	(2)

[1] Revised figures.
[2] Figures not available.

Because of the interest that has centered lately on strategic, critical, and essential minerals from a military standpoint, as well as the fact that fluorspar has been classed by the Army and Navy Munitions Board as an essential mineral, it seems fitting at this time to present historic tables comprising data on production and imports.

The total quantity of fluorspar shipped and imported into the United States from about 1870 through 1939 was about 5,333,000 short tons, including about 80 percent from domestic mines and 20 percent from foreign sources.

The total shipments since the beginning of commercial production (about 1870) in the United States through 1939 was approximately 4,294,000 short tons. Illinois has contributed 57, Kentucky 35, and Colorado 5 percent; most of the remaining 3 percent was supplied by New Mexico. Imports of fluorspar into the United States from 1910 (the first year for which complete data are available) through 1939 were 882,360 short tons and imports before 1910 are estimated at 157,000 tons; thus, total imports have been about 1,039,000 tons, of which the United Kingdom has contributed about 51, Germany 20, and France 12 percent. Africa, 7, and Spain, 4 percent, have furnished the greater part of the remainder.

Fluorspar shipped[1] *from mines in the United States, 1880–1939, by States*[2]

Year	Arizona		Colorado		Illinois		Kentucky		Nevada		New Hampshire		New Mexico		Tennessee		Utah		Other States		Total	
	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	Short tons	Value	Short tons	Value
1880–1909 [3]	718	$7,280	5,807	$27,766	330,120	$1,965,288	203,929	$1,188,477	------	------	------	------	710	$3,728	1,020	$6,920	------	------	------	------	542,304	$3,199,459
1910	------	------	268	1,608	47,302	277,764	17,003	124,574	------	------	------	------	4,854	26,250	------	------	------	------	------	------	69,427	430,196
1911	------	------	721	4,226	68,817	481,635	12,403	96,574	------	------	800	$6,400	4,307	22,612	------	------	------	------	------	------	87,048	611,447
1912	------	------	1,639	9,834	103,937	695,467	10,473	61,186	------	------	300	1,500	196	1,176	------	------	------	------	------	------	116,545	769,163
1913	100	800	4,432	26,592	85,854	550,815	19,622	113,903	------	------	200	1,200	5,372	42,976	------	------	------	------	------	------	115,580	736,286
1914	------	------	1,978	12,992	73,811	426,063	19,077	128,986	------	------	250	2,000	------	------	------	------	------	------	------	------	95,116	570,041
1915	------	------	247	1,482	116,340	624,040	19,219	129,873	------	------	650	5,200	485	3,880	------	------	------	------	------	------	136,941	764,475
1916	199	2,587	8,669	42,457	126,369	746,150	19,698	123,596	------	------	800	7,864	------	------	------	------	------	------	------	------	155,735	922,654
1917	135	1,080	17,104	196,633	156,676	1,373,333	43,639	697,566	------	------	1,274	19,110	------	------	------	------	------	------	------	------	218,828	2,287,722
1918	364	5,537	38,475	416,780	132,798	2,887,099	87,604	2,069,185	------	------	1,059	21,243	3,437	64,348	------	------	20	$465	[4] 60	[4] $824	263,817	5,465,481
1919	45	450	9,687	150,739	92,729	2,430,361	32,386	883,171	400	$5,600	531	12,826	2,346	37,643	------	------	166	4,784	------	------	138,290	3,525,574
1920	181	3,264	12,852	251,308	120,299	3,096,767	46,091	1,246,942	532	8,672	202	4,040	6,353	101,460	------	------	268	6,094	------	------	186,778	4,718,547
1921	------	------	3,143	39,907	12,477	315,767	15,266	294,513	------	------	567	13,721	3,507	60,186	------	------	------	------	------	------	34,960	724,094
1922	------	------	2,309	20,169	83,855	1,493,188	52,484	970,059	------	------	690	15,353	2,180	30,992	------	------	78	1,404	------	------	141,596	2,531,165
1923	------	------	6,044	59,710	65,045	1,443,490	45,441	945,402	------	------	142	3,160	4,328	50,861	------	------	188	3,196	------	------	121,188	2,505,819
1924	------	------	12,301	135,411	62,067	1,288,310	47,847	988,940	------	------	------	------	2,580	35,178	------	------	184	3,292	------	------	124,979	2,451,131
1925	------	------	11,776	153,707	54,428	1,024,516	44,826	833,794	------	------	------	------	2,639	40,325	------	------	------	------	------	------	113,669	2,052,342
1926	------	------	10,440	128,211	53,734	1,012,879	62,494	1,167,129	------	------	------	------	1,989	33,058	------	------	------	------	------	------	128,657	2,341,277
1927	------	------	6,432	82,503	46,006	863,909	57,495	1,040,338	------	------	------	------	2,613	47,978	------	------	------	------	------	------	112,546	2,034,728
1928	------	------	1,815	18,040	65,884	1,154,983	69,747	1,426,766	455	6,603	------	------	2,589	50,162	------	------	------	------	------	------	140,490	2,656,554
1929	------	------	4,808	56,607	67,009	1,284,834	70,827	1,390,603	1,357	23,400	------	------	2,438	35,682	------	------	------	------	------	------	146,439	2,791,126
1930	------	------	9,248	101,758	44,134	836,473	39,181	763,370	974	14,267	------	------	2,312	30,775	------	------	------	------	------	------	95,849	1,746,643
1931	------	------	529	5,921	28,072	468,386	23,462	437,642	395	5,697	------	------	1,026	13,629	------	------	------	------	------	------	53,484	931,275
1932	------	------	333	3,330	9,615	156,279	14,725	225,052	49	882	------	------	529	6,956	------	------	------	------	------	------	25,251	392,499
1933	------	------	742	6,778	36,075	543,060	34,614	469,451	505	6,639	------	------	994	13,250	------	------	------	------	------	------	72,930	1,039,178
1934	------	------	6,537	83,132	33,234	567,396	43,163	690,990	631	8,817	------	------	2,040	39,020	------	------	------	------	[5] 181	[5] 2,050	85,786	1,391,405
1935	------	------	6,978	88,454	44,120	685,794	68,679	1,017,451	1,040	(6)	12	(6)	2,726	(6)	6	116	180	(6)	------	------	123,741	1,860,638
1936	40	(6)	9,412	109,411	82,056	1,525,606	80,241	1,409,433	2,126	(6)	257	(6)	2,045	(6)	------	------	700	(6)	------	------	176,877	3,119,668
1937	610	(6)	7,883	98,493	78,664	1,730,585	87,296	1,710,122	2,544	(6)	478	(6)	3,324	(6)	------	------	431	(6)	------	------	181,230	3,666.629
1938	1,093	(6)	1,704	(6)	35,368	751,227	34,803	678,094	2,909	(6)	90	(6)	4,066	(6)	------	------	370	(6)	------	------	80,403	1,599,666
1939	(6)	(6)	7,569	107,459	75,257	1,638,693	89,563	1,773,063	3,520	(6)	------	------	(6)	(6)	------	------	385	(6)	------	------	182,771	3,704,959
	(6)	(6)	211,882	(6)	2,432,152	34,340,157	1,513,298	25,096,245	17,437	(6)	8,302	(6)	(6)	(6)	1,026	7,036	2,970	(6)	241	2,874	4,269,255	63,541,841

[1] Figures for 1880–1905 represent production.

[2] Figures on production not recorded for Colorado before 1905, for Illinois before 1880, and for Kentucky before 1886 and for 1888–95; total unrecorded production, chiefly from Illinois, estimated at 25,000 short tons.

[3] Figures by years for 1880–1909 are given in Mineral Resources of the United States, 1925, pt. 2, p. 13

[4] Washington.

[5] California.

[6] Bureau of Mines not at liberty to publish figures.

Fluorspar imported into the United States, 1910–39, by countries [1]

Year	Africa		Canada		France		Germany		Italy		Newfoundland		Spain		United Kingdom		Other countries [2]		Total	
	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	Short tons	Value
1910	------	------	------	------	------	------	142	$1,386	------	------	------	------	------	------	42,335	$133,716	11	$50	42,488	$135,152
1911	------	------	------	------	------	------	198	1,919	------	------	------	------	------	------	32,566	78,673	------	------	32,764	80,592
1912	------	------	------	------	------	------	256	2,444	------	------	------	------	------	------	25,920	69,172	------	------	26,176	71,616
1913	------	------	------	------	------	------	320	3,073	------	------	------	------	------	------	22,362	68,390	------	------	22,682	71,463
1914	------	------	------	------	------	------	184	1,818	------	------	------	------	------	------	10,021	37,125	------	------	10,205	38,943
1915	------	------	------	------	------	------	127	1,154	------	------	------	------	------	------	7,040	21,724	------	------	7,167	22,878
1916	------	------	------	------	------	------	------	------	------	------	------	------	------	------	12,323	54,000	------	------	12,323	54,000
1917	------	------	618	$3,813	------	------	------	------	------	------	------	------	------	------	12,998	110,785	------	------	13,616	114,598
1918	------	------	913	21,973	------	------	------	------	------	------	------	------	------	------	11,659	147,391	------	------	12,572	169,364
1919	------	------	902	13,532	------	------	------	------	------	------	------	------	------	------	6,041	94,099	------	------	6,943	107,631
1920	30	$1,080	7,068	110,532	------	------	407	9,450	------	------	------	------	------	------	17,096	144,142	11	426	24,612	265,630
1921	------	------	4,370	52,855	------	------	215	4,420	------	------	------	------	------	------	1,644	12,031	------	------	6,229	69,306
1922	486	8,415	2,877	$2,679	------	------	5,804	49,196	------	------	------	------	------	------	23,836	206,950	105	1,948	33,108	299,188
1923	10,380	157,625	(3)	5	------	------	8,580	67,595	268	$2,471	------	------	------	------	22,862	202,548	136	2,075	42,226	432,319
1924	11,125	147,977	213	3,216	232	$2,782	6,834	69,357	1,585	14,804	------	------	------	------	29,365	298,391	1,689	19,115	51,043	555,642
1925	7,906	108,647	------	------	2,537	20,887	11,680	103,845	4,278	32,208	------	------	------	------	21,635	195,229	664	8,031	48,700	468,847
1926	8,506	136,502	1,109	10,310	11,163	90,737	20,465	171,769	1,379	15,434	------	------	2,948	$33,915	29,407	281,735	694	6,835	75,671	747,237
1927	7,069	90,966	560	4,250	11,711	86,279	31,829	230,821	449	5,969	------	------	978	3,650	18,449	168,840	470	4,410	71,515	595,185
1928	2,661	36,471	------	------	15,072	141,434	17,601	150,872	1,033	9,600	------	------	680	5,178	9,360	56,585	776	8,560	47,183	408,700
1929	6,387	75,856	------	------	16,850	159,059	16,488	140,860	1,258	10,528	------	------	7,168	52,039	4,828	30,580	1,366	12,053	54,345	480,975
1930	2,712	31,069	------	------	23,313	184,238	23,797	189,587	1,802	17,198	------	------	6,784	53,612	5,756	60,995	739	7,957	64,903	544,656
1931	3,672	40,375	280	2,313	4,462	33,646	6,491	77,067	1,523	24,267	------	------	4,068	31,786	------	------	213	1,981	20,709	211,435
1932	1,587	14,809	------	------	1,578	9,588	5,842	70,294	1,457	11,848	------	------	2,659	24,881	[4] 1	[4] 378	112	867	13,236	132,665
1933	712	12,449	------	------	204	1,247	4,333	54,836	533	4,533	320	$2,646	4,262	28,690	17	229	27	413	10,408	105,043
1934	1,997	31,872	187	2,962	------	------	8,224	98,565	60	587	745	10,460	4,914	35,316	466	2,534	112	990	16,705	183,286
1935	1,347	23,739	1	14	------	------	9,843	119,275	55	589	------	------	5,094	35,432	------	------	------	------	16,340	179,049
1936	947	19,424	------	------	1,595	16,039	12,944	160,937	------	------	4,317	28,497	5,701	31,365	------	------	------	------	25,504	256,262
1937	1,194	19,479	------	------	14,158	80,816	14,501	219,393	1,124	5,752	5,520	67,723	566	4,464	------	------	------	------	37,063	397,627
1938	3,359	56,298	------	------	7,411	67,097	3,062	51,304	------	------	4,752	103,909	309	3,535	644	4,237	85	1,263	19,622	287,643
1939	------	------	------	------	13,094	100,769	19	603	------	------	2,268	61,775	168	2,542	56	650	697	10,352	16,302	176,691
	72,077	1,013,053	19,098	258,454	123,380	994,618	210,186	2,051,840	16,804	155,788	17,922	275,010	46,299	346,405	368,687	2,481,129	7,907	87,326	882,360	7,663,623

[1] Imports Aug. 1 to Dec. 31, 1909, 6,971 short tons valued at $26,377; not separately recorded before Aug. 1, 1909. Imports before Aug. 1, 1909, virtually all from the United Kingdom, estimated at 150,000 short tons.
[2] Argentina, Australia, Austria-Hungary, Belgium, China, Czechoslovakia, Mexico, Netherlands, Norway, Tunisia, and Soviet Russia in Asia.
[3] Quantity not recorded. [4] Optical fluorspar.

Production and shipments.—Fluorspar was known to have been produced in 1939 at 106 mines and prospects, and small quantities were recovered at an undetermined number of other prospects and reclaimed from millponds, waste dumps, and old workings of abandoned mines. All operations yielded about 173,000 short tons of merchantable fluorspar compared with about 99,000 tons in 1938. However, in spite of the large number of properties worked in 1939, 28 mines produced 87 percent of the total output.

Shipments of fluorspar from domestic mines in 1939 aggregated 182,771 short tons valued at $3,704,959, increases of 127 percent in quantity and 132 percent in total value over 1938. Shipments in 1939 were equivalent to 146 percent of the average annual tonnages shipped in the 5-year period 1926–30. Of the 1939 shipments, 48,648 tons (an all-time high) were shipped by river or by river-rail for delivery to consumers in Illinois, Kentucky, New Jersey, Ohio, and Pennsylvania. In 1938, 20,862 tons were so shipped.

In 1939, mines operated by or for consumers shipped 36,335 short tons of fluorspar for use in their own plants compared with 13,226 tons in 1938.

The average value of all grades of domestic fluorspar shipped was $20.27 ($0.37 more than the 1938 average). The value recorded for domestic fluorspar is the price paid f. o. b. mine shipping point and excludes cost of containers.

In 1939, an undetermined quantity of optical fluorspar from Illinois was sold for $25.

The following table shows shipments of fluorspar by States and by kinds for 1938 and 1939.

Fluorspar shipped from mines in the United States, 1938–39, by States and kinds

State	1938			1939		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Illinois	35,368	$751,227	$21.24	75,257	$1,638,693	$21.77
Kentucky	34,803	678,094	19.48	89,563	1,773,063	19.80
Arizona	1,093					
New Mexico	4,066	142,802	17.70	6,477	132,408	20.44
Nevada	2,909			3,520	53,336	13.66
Utah	370			385		
Colorado	1,704	27,543	12.73	7,569	107,459	14.20
New Hampshire	90			------	------	------
	80,403	1,599,666	19.90	182,771	3,704,959	20.27

Kind	1938			1939		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Gravel [1]	59,199	$1,065,960	$18.01	144,149	$2,725,510	$18.91
Lump	7,907	182,860	23.13	15,367	371,047	24.15
Ground [2]	13,297	350,846	26.39	23,255	608,402	26.16
	80,403	1,599,666	19.90	182,771	3,704,959	20.27

[1] Includes flotation concentrates shipped to hydrofluoric acid, steel, and cement plants and run-of-mine fluorspar shipped to steel plants.
[2] Includes flotation concentrates shipped to glass and enamel trades.

Shipments, by uses.—The predominance of the steel industry as a purchaser of fluorspar is evident from the following table.

Fluorspar shipped from mines in the United States, 1938–39, by uses

Use	1938				1939			
	Quantity		Value		Quantity		Value	
	Percent of total	Short tons	Total	Average	Percent of total	Short tons	Total	Average
Steel	64.67	51,991	$912,111	$17.54	68.59	125,371	$2,234,996	$17.83
Foundry	2.54	2,041	33,755	16.54	1.31	2,391	42,428	17.74
Glass	10.82	8,702	224,315	25.78	11.97	21,884	569,349	26.02
Enamel	5.10	4,100	109,165	26.63				
Hydrofluoric acid	14.28	11,484	285,274	24.84	15.03	27,463	730,383	26.60
Miscellaneous	1.61	1,297	25,985	20.03	1.47	2,686	53,360	19.87
	99.02	79,615	1,590,605	19.98	98.37	179,795	3,630,516	20.19
Exported	.98	788	9,061	11.50	1.63	2,976	74,443	25.01
	100.00	80,403	1,599,666	19.90	100.00	182,771	3,704,959	20.27

Uses.—As shown graphically in figure 1, the steel industry is the chief consumer of fluorspar in the United States, followed in order by the hydrofluoric acid, glass, and enamel industries. Comparatively small quantities of fluorspar are used in a number of miscellaneous operations, such as production of the finer grades of iron castings,

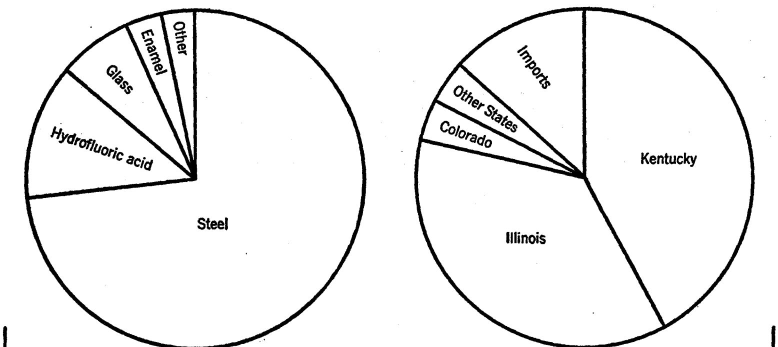

FIGURE 1.—Average annual fluorspar sales in the United States, 1935–39, by consuming industries and by sources.

nickel and Monel metal, cement, ferro-alloys, carbon electrodes, and calcium carbide and cyanamid; reducing aluminum; refining lead and silver; extracting various rare metals from their ores; smelting refractory ores of gold, silver, and copper; as a paint pigment; and as a binder in abrasives.

Chief commercial grades of fluorspar

Name	Chief use	Form	Specifications, in percent		
			CaF_2 (minimum)	SiO_2 (maximum)	Fe_2O_3 (maximum)
Metallurgical	Basic open-hearth steel.	Washed gravel, less than 1 inch and not more than 15 percent of fines.	85	5	
Ceramic	Glass and enamel	Ground: coarse, fine, and extra fine	95	3	0.12
Acid	Hydrofluoric acid	Lump, gravel, and ground	98	1	

Consumption and consumers' stocks.—The following tables give data on consumption and stocks of fluorspar.

Fluorspar (domestic and foreign) consumed and in stock in the United States, 1938–39, by industries, in short tons

[Partly estimated by Bureau of Mines]

Industry	1938		1939	
	Consumption	Stocks at consumers' plants Dec. 31	Consumption	Stocks at consumers' plants Dec. 31
Basic open-hearth steel	73,600	55,000	116,200	69,900
Electric furnace steel	4,000	1,000	7,600	1,400
Foundry	2,000	800	2,400	800
Ferro-alloys	800	400	1,100	400
Hydrofluoric acid	18,900	11,200	26,300	14,100
Enamel	4,000	900	21,400	3,100
Glass	10,500	1,600		
Miscellaneous	1,300	900	1,800	700
	115,100	71,800	176,800	90,400

Consumption and stocks of fluorspar (domestic and foreign) at basic open-hearth steel plants, 1935–39

	1935	1936	1937	1938	1939
Production of basic open-hearth steel ingots and castings long tons	30,447,000	43,615,000	46,361,000	25,868,000	43,368,000
Consumption of fluorspar in basic open-hearth steel production short tons	99,600	133,900	138,900	73,600	116,200
Consumption of fluorspar per ton of steel made pounds	6.5	6.1	6.0	5.7	5.4
Stocks of fluorspar on hand at steel plants at end of year short tons	47,500	59,200	71,400	55,000	69,900

The quantity of fluorspar used by individual plants per ton of basic open-hearth steel produced ranges from 1 to 50 pounds—a relatively small proportion of the furnace charge. The average is generally 5 to 8 pounds, but it decreased to 5.36 pounds in 1939 from 5.69 pounds in 1938. It is noteworthy that since 1921—the first year for which these data were collected—the average consumption of fluorspar per ton of basic open-hearth steel made has declined almost steadily from 8.2 to 5.4 pounds. The following table shows the variation in average consumption of fluorspar per ton of basic open-hearth steel over a 5-year period in certain plants that make about 88 percent of the total.

Average consumption of fluorspar (domestic and foreign) per ton of steel, 1935–39, in pounds

1935	1936	1937	1938	1939	1935	1936	1937	1938	1939
13.243	13.187	13.867	12.548	14.079	7.048	6.734	7.360	8.420	6.337
4.182	4.792	5.623	4.457	3.623	9.347	10.495	6.623	11.984	8.506
4.803	4.541	4.376	3.845	3.793	8.168	5.104	4.358	3.831	3.171
8.452	10.519	8.795	8.297	8.095	5.236	5.027	6.619	6.448	6.551
7.027	4.105	3.550	6.843	6.814	6.764	6.357	8.895	8.340	9.370
5.658	5.160	5.275	3.694	3.709	5.257	5.917	5.236	6.195	4.578
6.857	7.416	6.404	6.806	4.958	7.115	6.789	6.816	6.097	6.896

Quoted prices.—In 1939 the quoted price f. o. b. Illinois-Kentucky for fluxing gravel fluorspar ranged from $17 to $22 a short ton for rail delivery and $18 to $22 a ton for barge delivery at Ohio River and tributary landings. Imported fluxing gravel fluorspar (at seaboard, duty paid) was quoted at $21.50 to $27 a short ton.

Stocks at mines or shipping points.—According to reports of producers the total quantity of fluorspar in stock at mines or shipping points at the close of 1939 was 65,365 short tons, or about 22 percent less than in 1938. These stocks comprised about 26,700 tons of crude fluorspar (calculated to be equivalent to 15,000 tons of ready-to-ship fluorspar) and 38,619 tons of ready-to-ship fluorspar.

Stocks of fluorspar at mines or shipping points in the United States, Dec. 31, 1938 and 1939, by States, in short tons

State	1938			1939		
	Crude [1]	Ready-to-ship	Total	Crude [1]	Ready-to-ship	Total
Arizona					209	209
California	50		50	150		150
Colorado	260		260	565	329	894
Illinois	35,157	10,182	45,339	17,667	17,163	34,830
Kentucky	12,207	24,486	36,693	4,570	20,333	24,903
New Mexico	[2] 692	[2] 328	[2] 1,020	3,686	585	4,271
Texas	48		48	48		48
Utah	60		60	60		60
	[2] 48,474	34,996	[2] 83,470	26,746	38,619	65,365

[1] The greater part of this crude (run-of-mine) fluorspar must be beneficiated before it can be marketed.
[2] Revised figures.

Technologic developments.—Further interest in flotation of fluorspar was apparent in 1939. Four new plants—two at Rosiclare, Ill., and one each at Salida, Colo., and Deming, N. Mex.—were completed and put into operation, a new plant is being built at Duncan, Ariz., and two new plants—one each at Lordsburg, N. Mex., and Skyline, Mont.—are planned. The output of flotation concentrates was 22,450 tons in 1939 compared with 10,321 tons in 1938.

The commercial production of fluorspar flotation concentrate for use in the manufacture of hydrofluoric acid, glass, and enamel, which require a finely divided material of high purity, was begun about 11 years ago. The middling product of the flotation process, however, which is not pure enough for the chemical and ceramic trades, is objectionable to steel makers because of its particle size, as such fine material would blow out of the furnace or would not sink into the molten charge. Consequently, during recent years experimenting on agglomeration has been under way; and the Mahoning Mining Co., in cooperation with the Dwight & Lloyd Sintering Corporation, has carried on considerable test work on sintering of fluorspar. In the summer of 1938, 150 tons of minus 100-mesh fluorspar concentrates were sintered on a commercial machine under regular plant conditions. The resulting 150 tons of sinter were divided among three open-hearth steel plants, which found the sinter as satisfactory as the metallurgical gravel fluorspar used ordinarily. Although the sintering of fluorspar has been successfully demonstrated, the Mahoning Mining Co. has not felt justified in installing a sintering plant, because its output of metallurgical-grade concentrates comprises only a small proportion of its total production.

The flotation concentrates produced by the Hillside Fluor Spar Mines will, it is reported, be briquetted and then crushed to gravel size for use in steel plants.

A method of sintering finely divided fluorspar is the subject of United States Patent 2,184,078. According to this patent—

* * * Fluorspar concentrate offers difficulties to sintering for the purpose of increasing its particle size. These difficulties are due to the physical character of the fluorspar concentrates which are of a "sandy" nature. Ordinary moistening and pelletizing processes are ineffective and the charge of concentrate would, therefore, make a dense bed on a sintering machine through which air could not be drawn at a rate sufficient to produce a sintering temperature. This condition is aggravated by the fact that fluorspar has a relatively high fusion temperature so that a higher sintering temperature is required than in the sintering of ordinary materials. Owing to the sandy character of the fluorspar, any pellets formed solely of fluorspar in a pelletizing machine would break down as soon as the charge is exposed to the ignition heat, thus destroying the permeability given to the charge by pelletizing.

In my present invention these difficulties are overcome by forming the fluorspar concentrates into pellets by means of a plastic bonding material which is sufficiently stable during the sintering operation to maintain the pellets of fluorspar concentrates against breakdown until sintered, and which is neutral or unobjectionable in the later metallurgical operations.

In my invention I admix with the fluorspar concentrates, either during or previous to pelletizing, a small quantity of an inorganic bonding material of plastic nature. Such a bonding agent may, for example, be freshly hydrated lime (fresh mason's hydrate), ferrous hydrate, or some ferrous salt, which will form ferrous hydrate in alkaline solution, plaster of Paris, sodium silicate, clay or similar plastics, or any hydrated metal compound compatible with the metallurgical operations in which the fluorspar is to be employed, and having plastic properties such as those of lime or ferrous hydrate. The amount of material thus added may amount, for example, to 5% of the total quantity of fluorspar. During the pelletizing operation in which the fluorspar and the plastic bonding agent in a moistened condition are admixed and tumbled about or otherwise subdivided into pellets, the action of the bonding agent is primarily mechanical, serving to bond and hold the finely divided particles of fluorspar in stable pellet form. A small quantity of fuel may be added either admixed in the interior of the pellets or as a surface coating. This fuel will also be in finely divided condition as, for example, coke breeze or powdered or finely divided coal. In forming the pellets, returns may be employed as is customary in sintering operations.

The pellets are then laid in a bed on a sintering machine to a suitable thickness as, for example, from about 5 inches to 8 inches, and burned with a strong blast of air. As is usual in sintering operations, a down blast of air is used. During the sintering operation the cementing or bonding material may combine or flux with the fluorspar. In the event that lime is employed, the lime will be available for fluxing purposes in the later metallurgical operation. In the event that iron oxide, such as that produced from ferrous sulfate or mill scale, is employed it may also flux with the fluorspar during the sintering, or with impurities such as lime or silica contained in the fluorspar. Inasmuch as the fluorspar is to be used in steel making, the iron oxide thus added may be reduced in the open hearth furnace and replaced by silica or other slag material.

Examples of my invention are as follows:

Example I

Fluorspar concentrate, containing 98% CaF_2, and of the following size—

	Percent
Minus 40 plus 60 mesh	6.8
Minus 60 plus 80 mesh	7.7
Minus 80 plus 100 mesh	19.3
Minus 100 mesh	66.2
	100.0

was mixed with 10% of coke breeze, moistened and mixed in a pelletizer mixer with 5% of freshly hydrated lime and formed into pellets. It was then discharged into a sintering machine on a bed of 5½ inches depth. When ignited and burned with a down draft of air, an excellent sintered product was obtained in about 15 minutes.

Example II

100 pounds of fluorspar concentrate of the characteristics described in example I were mixed with 5 pounds of ferrous sulfate crystals, 2 pounds of freshly hydrated lime and 10 pounds of coke, then moistened and pelletized to form pellets, and sintered on a sintering machine in a bed of 5 inches depth. It ignited readily and sintered in about 10 minutes to an excellent sintered product.

Example III

Fluorspar concentrate such as described in example I was mixed with freshly hydrated lime (mason's hydrate), iron oxide and return sinter fines in the following proportions—

	Pounds
Fluorspar concentrate	100
Mason's hydrate	5
Iron oxide (fine ore)	5
Return sinter fines	40
Coke	10

The mixture was then moistened and pelletized and sintered on a sintering machine as described above. It ignited readily and made an excellent sintered product in about 15 minutes burning time.

The term "pellets" as used herein is not limited to rounded particles or nodules only, but is meant to include also small irregularly shaped masses composed of a number of fine individual particles bonded lightly together in such form that a mass of the pellets, when charged on a sintering machine, will form a bed with interstices between the pellets through which gases may be caused to flow readily. * * *

Engel and Shelton[1] have recorded data obtained in applying flotation to fluorspar mill tailings from Illinois. The results of both batch and pilot-plant tests are given. The object of these tests was to produce "acid-grade" concentrates containing 98 percent fluorspar, less than 1 percent silica, and nearly free from metal sulfides.

United States Patent 2,168,762 covers "improvements in the concentration of ores by flotation and is especially directed to the recovery of fluorspar of a high degree of purity from ores in which it is accompanied by calcareous substances, such as calcite and other forms of calcium carbonate, and/or various mineral sulfides such as galena (PbS) and sphalerite (ZnS)."

Improvements in or relating to methods of extracting fluorine values from fluorspar ores are covered in British Patent 512,005.

[1] Engel, A. L., and Shelton, S. M., Progress Reports—Metallurgical Division. 36. Ore-Testing Studies, 1938-39: Bureau of Mines Rept. of Investigations 3484, 1940, pp. 20-24.

INDUSTRY IN 1939, BY STATES

Arizona.—Production in Arizona in 1939 came chiefly from mines and prospects near Duncan, Greenlee County, and most of it was shipped to the flotation plants at Deming and Lordsburg, N. Mex. Some, however, was shipped to steel plants. Figures on shipments for Arizona in 1939 have been combined with those for New Mexico. The flotation concentrates recovered from the fluorspar, instead of the run-of-mine material produced, have been credited to Arizona in the statistics. Considerable development work was done at the Polly Ann mine in 1939. A flotation plant is being built at Duncan.

California.—At the Big Horn mine in San Bernardino County, some fluorspar was mined in the course of development work, but none was shipped. Some Nevada fluorspar was ground at the grinding plant at West Berkeley and shipped to the ceramic trade in 1939. The ground fluorspar has been credited to Nevada in the statistics.

Colorado.—The effect of reopening the Wagon Wheel Gap mine in Mineral County and of several properties in Chaffee County is shown in the shipments of 7,569 short tons of fluorspar from Colorado in 1939 compared with 1,704 tons in 1938. Most of the 1939 shipments went to steel plants, but some went to iron foundries and to ferroalloy, cement, glass, and hydrofluoric acid plants. Production in 1939 came from Boulder, Chaffee, Jackson, Jefferson, Mineral, and Park Counties, but mines in Chaffee and Mineral Counties supplied 93 percent of the total for Colorado.

A crushing plant was installed at the mines of the American Fluorspar Corporation near Salida. The Colorado Fluorspar Corporation, Salida, completed its new 125-ton combination flotation and jig mill the latter part of 1939. It was operated a short time and produced a small quantity of flotation concentrates. The mill is described and illustrated in a recent article.[2] Fluorspar for the ceramic trade was ground in the mill of the Western Feldspar Milling Co., Denver.

Illinois.—Approximately 128,000 short tons of fluorspar-bearing rock, equivalent to 71,000 tons of merchantable fluorspar, were mined at 25 mines or prospects in 1939 compared with about 75,000 tons, equivalent to 46,000 tons of merchantable fluorspar, mined at 30 mines or prospects in 1938. Of the merchantable fluorspar produced in 1939, 43,000 tons were from mines where the fluorspar occurs in veins, chiefly in fault fissures, and 28,000 tons from mines where the fluorspar occurs in flat-lying tabular masses, locally called blanket formations. Virtually all the output in 1939 came from Hardin County.

Fluorspar-bearing material milled in Illinois in 1939 totaled 147,000 tons, from which 82,000 tons of fluorspar were recovered—a ratio of 1.793:1.

Shipments from Illinois were 75,257 tons in 1939 compared with 35,368 tons in 1938. Of the total, 23,989 tons were shipped by river or river-rail to consumers compared with 13,572 tons in 1938. In 1939, an undetermined quantity of optical fluorspar was sold for $25.

The Argo, Boundary, Crystal, Daisy, W. L. Davis, Hamp, Humm, Lee, Midway, Spar Mountain, Stewart, and Victory mines supplied about 92 percent of the total merchantable fluorspar produced in Illinois in 1939. Most of the remainder came from the Cave in Rock, Dimick, Eureka No. 5, Lacey, and Lead Hill mines.

[2] Pit and Quarry, vol. 32, December 1939, pp. 48-50.

At the Crystal mine near Cave in Rock, a new shaft (No. 3) was sunk 110 feet, and a steam plant was installed at this shaft. In the mill a trommel screen was replaced by a double-decked vibrating screen. The barge loading station at Cave in Rock of the Benzon Fluorspar Co. was purchased by the Crystal Fluorspar Co. in 1939.

The Hillside Fluor Spar Mines completed a flotation plant at Rosiclare. This plant will, it is reported, treat the large tonnage of fluorspar fines from the Hillside mill that have been accumulated over a period of years. The flotation concentrate will, it is understood, be briquetted and then crushed to gravel size for use in steel plants.

The Benzon Fluorspar Co., operators of the Spar Mountain mines, ceased operations in 1939 because its ore reserves virtually were exhausted. The mining property was acquired by a local purchaser. A considerable tonnage of ore was recovered by contractors in mining the remaining pillars. The Spar Mountain mines were opened in 1918 by the Spar Mountain Mining Co., which operated them until 1925, when they were acquired by the Benzon Fluorspar Co. These mines have been important producers of fluorspar in the Cave in Rock district; the output from 1918 through 1939 was about 140,000 short tons.

At the Victory mine, 2,039 feet of diamond core drilling were done; 600 feet of development drifts were driven; a hoist engine was installed at the Carlos shaft; a change house for employees was constructed; and an underground gravity drainage system, consisting of 1,000 feet of ditching, was excavated through the lowest part of the mine to drain the water to the surface through a side hill adit.

Development work was continued by the Rosiclare Lead & Fluorspar Mining Co. on the 800-foot levels on the Daisy and Blue Diggings veins. Although these two veins did not intersect at this level, as was believed, they approach each other closely, being 30 to 40 feet apart. Additional fluorspar was located on the Daisy fault by diamond drilling. The new power plant of the company was completed during the summer of 1939. It consists of two 600-horsepower boilers and a 1,250-kilowatt and a 1,000-kilowatt turbine generator. A stand-by 750-kilowatt generator remains in the old power plant. To dewater the Rosiclare mine, flooded since January 1924, a pump with a 600-horsepower motor and a 620-foot lift and having a capacity of 3,200 gallons per minute will be installed. A 3,000-gallon-per-minute pump was installed in the Rosiclare shaft in 1938.

Core and churn drilling was in progress at the mine of the Cave in Rock Spar Co. In addition to production from its Cave in Rock mine, the company treated considerable purchased ore in its mill on Peters Creek. This company is increasing the capacity of its present mill and building a mill at Cave in Rock.

At the Humm mine near Rosiclare considerable development work was done, and a mill was built on Grand Pierre Creek.

In June the Mahoning Mining Co. put its new flotation plant into operation at Rosiclare. It produces fluorspar, lead, and zinc concentrates by selective flotation. The mill feed comprised tailings from the Benzon mill and ore from the company W. L. Davis mine, which made its initial production in 1939. The ore at this mine occurs in a bedded deposit similar to other Cave in Rock ore bodies, but in addition to fluorspar it carries appreciable quantities of lead and zinc.

Kentucky.—Production of merchantable fluorspar in Kentucky was about 81,000 short tons in 1939 compared with 43,000 tons in 1938; and shipments, which established an all-time high, were 89,563 tons compared with 34,803 tons in 1938. Of the 1939 shipments, 24,659 tons were shipped by river or river-rail to consumers compared with 7,290 tons in 1938.

The output of fluorspar in Caldwell County in 1939 was from the Walker, Eureka, and Crook mines. The Hollowell & Hobby mine, which has been the chief producing mine in Caldwell County in recent years, was nonproductive in 1939. However, the stock of crude ore previously mined was washed, and some was sold.

Production in Crittenden County, amounting to 53,000 tons, came chiefly from the Bachelor, Davenport, Keystone, Lafayette, Pigmy, Pogue, Two Brothers, and Watson (Eagle) mines, which contributed 91 percent of the county output. Production was 15,000 tons in 1938.

At the Watson (Eagle) mine, a fluorspar ore body of high purity was opened during 1939. The Two Brothers mine, inactive for some time, was reopened. The Ada Florence mine, adjacent to the Keystone, was acquired by the Hillside Fluor Spar Mines. A prospect shaft followed by crosscutting and drift driving developed a new ore body at the Pigmy mine. At the Davenport mine, No. 3 shaft was sunk to 260 feet, and a crosscut was driven to the east vein, where a 7-foot ore body was found. A power plant was built and machinery installed at this shaft.

In Livingston County, 28,000 tons of merchantable fluorspar were produced in 1939 compared with 24,000 tons in 1938. The chief producing mines were the C. R. Babb, Klondike, and Nancy Hanks, which supplied 90 percent of the 1939 output of the county.

A jig plant to treat tailings from the Klondike mill was completed and put into operation by John Hughett & Son during 1939.

In 1939 the Faircloth mine near Wilmore, Woodford County, and the Twin Chimney mine near Mundys Landing, Mercer County, shipped small quantities of fluorspar. The fluorspar from the Twin Chimney mine was recovered from an old dump. Veins containing fluorspar and fluorspar associated with barite are being opened in Woodford County.

Montana.—At the Boeing prospect near Austin, Lewis and Clark County, development work was continued, and flotation tests on the ore were in progress. The building of a mill at Skyline is under consideration.

Nevada.—Shipments of fluorspar from Nevada, which were 3,520 short tons in 1939 compared with 2,909 tons in 1938, established an all-time record. Most of the 1939 shipments went to steel mills, but some went to iron foundries and to ceramic and hydrofluoric acid plants.

The chief producing mine in Nevada in 1939 was the Baxter, in Mineral County, which shipped 2,505 tons. The other active mine was the Daisy, in Nye County, which shipped 1,015 tons. Development work at the Baxter mine consisted of sinking the main shaft to 200 feet, drifting 200 feet, and installing a power plant.

New Mexico.—Shipments of fluorspar from New Mexico and Arizona were 6,477 short tons in 1939 compared with 5,159 tons in 1938.

Shipments in 1939 comprised flotation concentrates, which went to ceramic and hydrofluoric acid plants, and metallurgical grade, which went to steel plants.

Production in 1939 was from Catron, Grant, Luna, Sierra, and Valencia Counties. Several new properties were opened and some mines were reopened in New Mexico in 1939. P. L. Grattan completed a flotation mill 1 mile east of Deming to treat ore from the Sadler mine. As a result of mill tests, a small quantity of concentrates was produced. The capacity of the mill is being increased to 50 tons daily. A flotation plant at Lordsburg with a capacity of 75 tons per 24 hours is contemplated by the Fluorspar Milling Co. to treat ore from the reopened Great Eagle mine and purchased ores. Improvements were made in the flotation plant of the Indian Metals Co. at Lordsburg. The flotation plant of General Chemical Co. at Deming operated throughout the year on fluorspar purchased from local producers.

Utah.—Shipments of fluorspar from Utah were 385 short tons in 1939 compared with 370 tons in 1938, all from the Monarch claims in Beaver County; they were consigned to steel plants and iron foundries.

IMPORTS AND EXPORTS [3]

Imports of fluorspar for consumption in the United States in 1939 totaled 16,302 short tons (3,351 tons containing more than 97 percent and 12,951 tons containing not more than 97 percent calcium fluoride) valued[4] at $176,691, compared with 19,622 tons (9,216 tons containing more than 97 percent and 10,406 tons containing not more than 97 percent calcium fluoride) valued[4] at $287,643 in 1938. The value assigned to the foreign fluorspar in 1939 averaged $10.84 a ton. The cost to consumers in the United States also includes duty, loading charges at the docks, ocean freight, insurance, consular fee, and freight from docks to consuming points. The duty on fluorspar containing not more than 97 percent calcium fluoride is $7.50 a short ton and on fluorspar containing more than 97 percent calcium fluoride $3.75 a short ton.

Of the 1939 imports, 73.8 percent was metallurgical gravel fluorspar, 0.8 percent ceramic ground fluorspar, and 25.4 percent acid lump fluorspar. Virtually all the metallurgical gravel fluorspar was imported from France; the ceramic ground fluorspar from France and Germany; and the acid lump fluorspar from Mexico, Newfoundland, Spain, Tunisia, and the United Kingdom. Imports were equivalent to 9 percent of the total shipments of domestic fluorspar in 1939 compared with 24 percent in 1938.

[3] Figures on imports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce; those on exports supplied by the producers. No exports of fluorspar recorded by the Bureau of Foreign and Domestic Commerce.

[4] 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 1939, by countries and customs districts

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
France:						
Buffalo			2,339	$17,482	2,339	$17,482
Maryland	77	$1,834	1,196	8,704	1,273	10,538
New York	45	968			45	968
Philadelphia	22	379	9,415	71,402	9,437	71,781
	144	3,181	12,950	97,588	13,094	100,769
Germany:						
New York	(1)	33			(1)	33
Philadelphia	19	570			19	570
	19	603			19	603
Mexico:						
New York	430	7,080			430	7,080
Philadelphia	35	338			35	338
	465	7,418			465	7,418
Newfoundland: Philadelphia	2,268	61,775			2,268	61,775
Norway: Ohio			1	15	1	15
Spain: Philadelphia	168	2,542			168	2,542
Tunisia: Philadelphia	231	2,919			231	2,919
United Kingdom: Philadelphia	56	650			56	650
Total: 1939	3,351	79,088	12,951	97,603	16,302	176,691
1938	9,216	192,469	10,406	95,174	19,622	287,643

[1] Less than 1 ton.

The following table, compiled from data furnished the Bureau of Mines by importers, shows the quantities of imported fluorspar delivered to consumers in the United States in 1938 and 1939 and the selling price at tidewater (duty paid), irrespective of the year of importation into the United States; it differs from the preceding table, which shows the quantities received in the United States during 1938 and 1939. The quantities in the following table are based upon the actual outturn weights ascertained by sworn weighers and represent the weights on which duty was paid and entries were liquidated. Stocks of foreign fluorspar in the hands of importers in the United States were 466 short tons at the close of 1939 compared with 1,165 tons in 1938.

Imported fluorspar delivered to consumers in the United States, 1938–39

Industry	1938			1939		
	Short tons	Selling price at tidewater, including duty		Short tons	Selling price at tidewater, including duty	
		Total	Average		Total	Average
Steel	10,205	$209,801	$20.56	13,689	$282,487	$20.64
Glass	11	418	38.00	134	5,240	39.10
Enamel	89	2,254	25.33			
Hydrofluoric acid	9,492	261,399	27.54	4,503	134,014	29.76
Miscellaneous	66	1,546	23.42	77	1,597	20.74
	19,863	475,418	23.93	18,403	423,338	23.00

Producers of fluorspar reported exports of 2,976 short tons of fluorspar valued at $74,443 in 1939 compared with 788 tons valued at $9,061 in 1938. In 1939 all the exported fluorspar went to Canada and the greater part of it was shipped from the Illinois-Kentucky district by rail to Chicago, thence by water over Lakes Michigan, Huron, Erie, and Ontario and the St. Lawrence and Saguenay Rivers to Quebec. Of the 1938 exports, 247 tons went to Canada and 541 tons to Japan.

Fluorspar reported by producers as exported from the United States, 1935–39

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1935	313	$4,651	$14.86	1938	788	$9,061	$11.50
1936	240	4,079	17.00	1939	2,976	74,443	25.01
1937	456	9,091	19.94				

WORLD PRODUCTION

The following table shows the world production of fluorspar by countries from 1935 to 1939, insofar as statistics are available. Although complete returns for 1938 and 1939 are not yet available, it is evident that the upward trend in world production, which began in 1933, was arrested in 1938 but was resumed in 1939. The greatly increased world production in recent years has been due chiefly to gains in the output of steel and aluminum in many European countries. Despite the fact that fluorspar is produced in about 20 countries, 5—United States 32 percent, Germany 29 percent, U. S. S. R. 13 percent, United Kingdom 9 percent, and France 7 percent—contribute 90 percent of the world total.

World production of fluorspar, 1935–39, by countries, in metric tons [1]

[Compiled by M. T. Latus]

Country	1935	1936	1937	1938	1939
Argentina [2]	403	450	350	1,406	(3)
Australia:					
New South Wales	420	339	55	----	(3)
Queensland	185	487	1,410	2,479	(3)
South Australia	91	23	----	----	(3)
Victoria	----	----	----	804	(3)
Canada	68	68	136	197	218
Chosen	9,722	8,740	11,000	(4)	(3)
France	22,750	30,600	51,430	(4)	(3)
Germany:					
Anhalt	8,068	11,225	13,662	10,462	(3)
Baden	3,941	7,359	13,637	21,350	(3)
Bavaria	31,277	49,153	62,455	59,919	(3)
Prussia	24,618	36,271	30,514	22,956	(3)
Saxony	6,938	7,990	8,074	12,063	(3)
Thuringia	23,572	18,792	16,117	22,405	(3)
Italy	8,424	11,437	13,385	12,186	(3)
Mexico [5]	900	900	900	1,000	1,300
Newfoundland (shipments)	4,082	8,498	8,479	8,944	11,227
Norway	1,067	1,014	1,692	(4)	(3)
South-West Africa	----	----	----	585	(3)
Southern Rhodesia	----	----	----	156	----
Tunisia	----	----	1,676	2,060	(3)
Union of South Africa	1,980	3,123	3,615	4,736	10,322
U. S. S. R.	47,859	65,000	[5] 70,000	(4)	(3)
United Kingdom	31,646	33,491	42,837	33,866	(3)
United States (shipments)	112,255	160,459	164,409	72,940	165,806
	340,000	455,000	516,000	415,000	(3)

[1] In addition to countries listed, China and Spain produce fluorspar but data of output are not available.
[2] Railway shipments. [3] Data not available. [4] Estimate included in total. [5] Estimated.

Argentina.[5]—Production of fluorspar in Argentina, under the stimulus of demand from Japan, increased from 350 metric tons in 1937 to 1,406 in 1938, of which 1,300 tons were exported to Japan and 10 to Brazil.

Production of fluorspar is confined almost entirely to the Province of Córdoba. It is also mined in the Province of San Luis, but production is small by comparison with that of Córdoba. It is understood that the fluorspar generally averages 97 to 98 percent calcium fluoride, although little sorting or refining is done. The Argentina ceramic industries annually use about 250 or 300 metric tons of the domestic output.

Newfoundland.—Shipments of fluorspar from Newfoundland in 1939 were 12,376 short tons, of which 3,569 tons of acid grade went to the United States and 4,838 tons of special-grade lump (93 to 95 percent CaF_2) and 3,969 tons of fluxing grade went to Canada. Shipments were 9,859 tons in 1938.

The fluorspar deposits in Newfoundland have been described in a recent article by Howse and Fischer.[6]

Union of South Africa.—Production of fluorspar in the Union of South Africa advanced to 11,378 short tons in 1939 from 5,221 tons in 1938. The greater part of the 1939 production was exported to Japan.

At present very little acid-grade fluorspar is available in the Union of South Africa.[7] In the past, fluorspar of this grade has been obtained from freak deposits, but they are now exhausted. A lower grade fluorspar is being mined, however, for metallurgical purposes. The feasibility of raising fluorspar to acid grade by concentration is now under investigation, but the process is still in the experimental stage.

U. S. S. R.—The fluorspar deposits of the U. S. S. R. have been described by the Institute of Economic Mineralogy.[8] Except for a two-page summary in English, from which the following is quoted, the text is in Russian.

> * * * In the geological part particular attention is paid to questions relating to the fluorspar deposits of Eastern Transbaikalia, where such large deposits as the Abagaitui and the Kalangui and a number of much smaller ones are located; they are distinguished by a particularly simple mineralogical composition and relatively low temperature conditions of formation. These deposits of the Turga and Argun groups are characterized by the presence in the ore veins of nearly exclusively fluorspar with the addition of varying relative amounts of quartz, and by the absence of sulfide minerals.
>
> To the same group of deposits belongs the Onon group, including relatively small deposits, of which the Sedlovoie is located near the station of Sedlovaia.
>
> The Solonechnoie deposit, located about 250 km. from those of the Turga and Argun groups, is of a different nature. The fluorspar veins here are composed partly also of very pure fluorite with a greater or lesser amount of quartz; it is characterized as a higher-temperature deposit than the preceding one, according to data of geological and mineralogical investigations.
>
> Mention is made also of the deposits of the Far East region.
>
> The Suenga and other deposits located in Western Siberia have been as yet little studied, both from the mineralogical and petrographical, and from the geological standpoint.
>
> A brief description is given of the deposits located within the region of Southern Kazakhstan and Middle Asia. They are usually distinguished by a complex mineralogical composition which makes their utilization rather difficult. Thus, the Badam deposit is characterized by the content, along with fluorspar, also of

[5] Davis, M. B., American consul general, Buenos Aires, Argentina, July 20, 1939.
[6] Howse, C. K., and Fischer, R. P., Newfoundland Ships Fluorspar: Eng. and Min. Jour., vol. 140, July 1939, pp. 42–45.
[7] South African Mining and Engineering Journal, vol. 1, pt. 1, April 22, 1939, p. 224.
[8] All-Union Scientific Research Institute of Economic Mineralogy, Fluorspar in U. S. S. R.: Trans. 119, Moscow, U. S. S. R., 1937, 335 pp.

barite, their separation being difficult. The large Khaidarkan fluorspar deposit in Kirghizia is rich in sulfides, among which cinnabar plays the predominant part. The utilization of this large fluorspar deposit is also hampered by the absence of sufficiently developed technological methods.

A characteristic of the Aurakhmat deposit in Kazakhstan is also given; this is distinguished by a relatively low sulfide content and a favorable mode of occurrence of fluorspar ores among limestones, the reserves being large.

Of a quite different nature, as seen from the occurrence in the form of a large thick vein in granite, is the Takob fluorspar deposit in Tadjikistan. The vein intersecting the granite is distinguished by the content of sulfides, mainly galena, partly zinc blende, and—which is characteristic of this deposit—also of products of oxidation of these minerals.

This deposit, as shown by the prospecting works carried out by the Institute of Economic Mineralogy and by the Middle Asia Geological Trust, possesses vast reserves of fluorspar. As a result of the technological works conducted by the Institute simultaneously with prospecting, the deposit has become now one of great economic importance.

In the monograph a brief description is given also of the explored and developed large Kuli-Kolon deposit of optical fluorite, located on the shore of Lake Kuli-Kolon in Tadjikistan.

In addition to a geological description, detailed mineralogical and petrographical characteristics are given for all of the deposits, the chief attention being paid to those studied by the Institute of Economic Mineralogy and to those studied by this Institute but partly, as for example, the large Amderma deposit near the island of Vaigach, etc.

In the technological part of the monograph the results are cited of a study of the methods of concentration of the fluorspar ores from the deposits described in the geological part, chiefly those of Eastern Siberia, of the Amderma deposit and of a number of those in Middle Asia and Kazakhstan. Of particular interest are the results which were obtained in the course of the works of the Institute of Economic Mineralogy dealing with the study of the possibility of concentrating fluorspar ores, containing oxides of lead and zinc, from the Takob deposit. Eng. Eigheles who conducted this work succeeded in obtaining positive results and in establishing the possibility of fluorspar concentration even in the presence of lead and zinc oxides, and of the utilization of particularly poor ores as well.

Data are also presented concerning the lines along which the works are to be conducted on the concentration of fluorspar from different deposits and of diverse mineralogical composition, structure, and origin.

In the third, economic, part of the monograph a discussion is presented of the technical requirements which fluorspar should satisfy, and of its standards, and the questions are summed up concerning the utilization of fluorspars in different industries. The problems of mining, exports and imports of fluorspar by different countries, and the treatment of fluorite ores in various industries, subsequent to their concentration, are also discussed. A detailed review is given of the condition of the fluorspar industry in USSR and in foreign countries.

CRYOLITE

Cryolite occurs in commercial quantity and is mined at only one place—Ivigtut, Greenland. It is used in the metallurgy of aluminum, in the manufacture of glass and enamels, and in insecticides.

Gibbs [9] has described the mine at Ivigtut, grades of ore produced, methods of processing and purification, and various uses of cryolite.

The cryolite mine at Ivigtut is owned by the Danish State, and the mining concession formerly belonged to the A/S Kryolith Mine og Handels Selskabet, Copenhagen, which divided all the raw material between the Pennsylvania Salt Manufacturing Co., Philadelphia, Pa., and the Oresunds Chemiske Fabriker, Kommanditselskake, ved C. F. Jarl, Copenhagen. The mining concession previously in force expired at the end of 1939. The industry has been reorganized and consolidated into a stock company controlled jointly by the State and the private interests concerned.[10] The merger and the formation of the new company, which will be known as the Kryolithselskabet Øresund A/D (Øresund Cryolite Co., Inc.), has been approved by the Parliamentary Financial Committee and will go into effect on January 1, 1940. It is understood the reorganization will not alter the existing world marketing arrangements.

Imports.—The following table shows imports of cryolite into the United States in 1938 and 1939. As cryolite is mined only in Greenland, it is evident that importations credited to countries other than Greenland probably include artificial cryolite.

Cryolite (natural and artificial) imported for consumption in the United States, 1938–39, by countries

Country	1938		1939	
	Long tons	Value	Long tons	Value
Canada			39	$7,426
Denmark			(1)	21
France	74	$11,579	140	21,499
Germany	333	63,027	731	125,150
Greenland	11,708	711,000	9,300	558,000
	12,115	785,606	10,210	712,096

1 Less than 1 ton.

9 Gibbs, A. E. (technical director, Pennsylvania Salt Manufacturing Co.), Cryolite as a Chemical Raw Material: Chem. Ind., vol. 38, May 1936, pp. 471–476.

10 Bureau of Foreign and Domestic Commerce, Minerals Circular 21: December 29, 1939, pp. 18–20.

FELDSPAR

By Robert W. Metcalf

SUMMARY OUTLINE

The output of crude feldspar in the United States rose sharply in 1939, exceeding in quantity that of any year except 1937, but the value was less than that in several earlier years; however, a substantial output of feldspathic material, known as "aplite," produced in Virginia, might have been included in the 1939 totals if it had been possible to do so without revealing confidential information. Even excluding this material, which virtually made its commercial debut in 1939, the average value of the output ($4.39) was less than in 1938, continuing a steady downtrend begun in 1936, when the average sales realization reported by producers was $5.32 a long ton.

Salient statistics of the feldspar industry in the United States, 1938–39

	1938	1939	Percent change in 1939
Crude feldspar:			
Domestic sales:			
Long tons	196, 119	253, 466	+29. 2
Value	$895, 081	$1, 112, 857	+24. 3
Average per long ton	$4. 56	$4. 39	−3. 7
Imports:			
Long tons	7, 651	7, 460	−2. 5
Value	$56, 126	$52, 141	−7. 1
Average per long ton	$7. 34	$6. 99	−4. 8
Ground feldspar sold by merchant mills:			
Short tons	214, 514	259, 194	+20. 8
Value	$2, 466, 252	$2, 862, 278	+16. 1
Average per short ton	$11. 50	$11. 04	−4. 0

Sales of ground feldspar (excluding aplite) advanced to 259,194 short tons valued at $2,862,278 compared with 214,514 tons valued at $2,466,252 in 1938 and the all-time peak of 279,272 tons valued at $3,486,741 in 1937. Although the tonnage was exceeded only in 1937, the value of the 1939 output, while 16 percent higher than in 1938, was less than that in both 1936 and 1937.

Imports of crude spar in 1939, all from Canada, were slightly less than in 1938 and much less than in other recent years except the depression years 1932 and 1933.

Nearly all the States producing crude feldspar shared in the increased activity in 1939. There were increases of approximately 35 percent in Connecticut, New Hampshire, and North Carolina. Output in California and Wyoming in 1939, although still comparatively small, showed large percentage gains over 1938.

DOMESTIC PRODUCTION

In accordance with the usual practice in the industry, crude feldspar is reported in long tons of 2,240 pounds and ground spar in net (short) tons of 2,000 pounds.

Crude feldspar.—Crude feldspar sold or used in 1939 increased to 253,466 long tons valued at $1,112,857 compared with 196,119 tons valued at $895,081 in 1938 and 268,532 tons valued at $1,383,249 in 1937, the all-time record year.

Crude feldspar sold or used by producers in the United States, 1935–39

[Value at mine or nearest shipping point]

Year	Long tons	Value		Year	Long tons	Value	
		Total	Average			Total	Average
1935	189,550	$1,005,021	$5.30	1938	196,119	$895,081	$4.56
1936	244,726	1,303,090	5.32	1939	253,466	1,112,857	4.39
1937	268,532	1,383,249	5.15				

Crude feldspar sold or used by producers in the United States, 1937–39, by States

[Value at mine or nearest shipping point]

State	1937		1938		1939	
	Long tons	Value	Long tons	Value	Long tons	Value
Arizona	(1)	(1)	(1)	(1)	(1)	(1)
California	1,836	$9,660	1,396	$7,675	2,076	$12,655
Colorado	42,221	178,148	27,452	104,673	29,995	107,536
Connecticut	(1)	(1)	7,461	45,153	10,033	53,120
Maine	20,191	110,928	13,764	68,047	18,109	74,165
Maryland	(1)	(1)			(1)	(1)
New Hampshire	28,831	155,925	25,555	135,760	34,414	161,968
New York	(1)	(1)	(1)	(1)	(1)	(1)
North Carolina	94,595	538,567	56,795	295,800	76,738	397,631
Pennsylvania	(1)	(1)	(1)	(1)	(1)	(1)
South Dakota	41,392	158,976	42,297	122,467	48,328	133,893
Virginia	22,175	125,396	9,766	52,037	18,544	100,299
Wyoming			1,168	4,343	6,726	25,008
Undistributed [2]	17,291	105,649	10,465	59,126	8,503	46,582
	268,532	1,383,249	196,119	895,081	253,466	1,112,857

[1] Included under "Undistributed." [2] Includes States indicated by "1."

In 1939 feldspar was mined in 13 States, 1 more than in 1938. After a lapse of a year, Maryland again reported a small output. Wyoming, which first reported sales in 1938, increased its shipments sixfold to a total of 6,726 tons. North Carolina, notwithstanding a 35-percent gain in tonnage over 1938, produced only 30 percent of the national total compared with 29 percent in 1938 and 35 percent in 1937. South Dakota raised its output to 48,328 tons, 14 percent more than in 1938. A 35-percent increase over 1938 ranked New Hampshire ahead of Colorado, which, despite a 9-percent gain over

1938, failed by a wide margin to equal its output in 1937, when it was the second largest producing State. Virginia ranked fifth as a producer of feldspar in 1939.

The downtrend in average values continued in 1939; in several States the decline was caused by larger shipments of lower-grade spar, and in a few States the averages actually increased. A further decline in average values of standard grades is indicated. Sales realizations in South Dakota and Colorado were \$2.77 and \$3.59, respectively, as against \$2.90 and \$3.81 in 1938. In certain Eastern States sales realizations in 1939 were as follows: Maine, \$4.10; New Hampshire, \$4.71; and North Carolina, \$5.18—compared with \$4.94, \$5.31, and \$5.21, respectively, in 1938.

Ground feldspar.—Sales of ground feldspar increased sharply compared with 1938, the tonnage rising 21 and the value 16 percent; however, sales were 7 percent lower in quantity and 18 percent lower in value than in 1937, the all-time record year. Colorado and South Dakota mills furnished 35 percent of the total ground feldspar sold or used in 1939 and 1938 compared with 30 percent in 1937. North Carolina and Tennessee mills, after suffering more than those in other States in the 1938 slump, increased their sales by more than 14,000 tons in 1939 when they supplied 29.2 percent of the total compared with 28.7 percent in 1938 and 32.5 percent in 1937. Three mills grinding imported Canadian feldspar shipped 4 percent of the total sales of spar from United States mills in both 1938 and 1939. In 1937, 6 percent of the total tonnage ground was imported spar.

Shipments of ground spar, from South Dakota, the leading producer in 1939, rose to 49,497 short tons, a record for the State and 16 percent higher than in 1938, the previous high year. Tennessee was second in rank, followed by Colorado and North Carolina. Sales from North Carolina and Tennessee mills in 1939 totaled 75,740 tons, 23 percent more than in 1938. Colorado's output also increased 23 percent to 41,176 tons. New Hampshire, Arizona, and Virginia showed substantial gains over 1938. New Jersey's output rose 35 percent to 18,727 tons.

Ground feldspar sold by merchant mills[1] *in the United States, 1935–39*

Year	Active mills	Domestic			Canadian			Total	
		Short tons	Value		Short tons	Value		Short tons	Value
			Total	Average		Total	Average		
1935	29	189,289	\$2,460,073	\$13.00	10,806	\$199,067	\$18.42	200,095	\$2,659,140
1936	30	222,126	2,884,493	12.99	14,764	270,360	18.31	236,890	3,154,853
1937	31	263,387	3,187,185	12.10	15,885	299,556	18.86	279,272	3,486,741
1938	30	206,646	2,314,675	11.20	7,868	151,577	19.26	214,514	2,466,252
1939	31	249,889	2,685,473	10.75	9,305	176,805	19.00	259,194	2,862,278

[1] Excludes potters or others who grind for consumption in their own plants.

The average sales value of ground feldspar shipped by merchant mills in the United States declined further in 1939 to \$11.04 a short ton compared with \$11.50 in 1938 and \$12.49 in 1937, reflecting the larger consumption of graphic granite and other lower-grade spar, as well as further shading in the average prices of standard grades.

Average prices in virtually all States were lower and ranged from $6.42 to $18.01 as against $6.55 to $21.09 in 1938. Sales realizations in the Eastern States were as follows: New Jersey, $18.01; Maine, $12.68; and North Carolina-Tennessee, $12.15, compared with average values for Colorado and South Dakota of $6.42 and $6.88, respectively. Sales of ground spar manufactured from Canadian crude averaged $19 per short ton, a reduction of 26 cents from that reported in 1938.

Ground feldspar sold by merchant mills [1] in the United States, 1937–39, by States

State	1937			1938			1939		
	Active mills	Short tons	Value	Active mills	Short tons	Value	Active mills	Short tons	Value
Arizona	1	(2)	(2)	1	(2)	(2)	1	(2)	(2)
California	3	1,888	$30,427	3	1,263	$17,561	3	2,082	$27,149
Colorado	2	43,618	307,412	2	33,529	219,699	3	41,176	264,153
Illinois	1	(2)	(2)	1	(2)	(2)	1	(2)	(2)
Maine	4	22,090	303,449	4	15,651	196,460	4	15,246	193,352
Minnesota	1	(2)	(2)	1	(2)	(2)	1	(2)	(2)
New Hampshire	2	(2)	(2)	2	(2)	(2)	2	(2)	(2)
New Jersey	3	14,700	287,577	3	13,901	258,123	3	18,727	337,359
New York	4	(2)	(2)	4	(2)	(2)	4	(2)	(2)
Ohio	2	(2)	(2)	1	(2)	(2)	-------	-------	-------
North Carolina	3	90,696	1,239,149	3	61,467	821,686	3	75,740	920,556
Tennessee	2			2			2		
South Dakota	2	40,325	316,834	2	42,489	300,192	2	49,497	340,424
Virginia	1	15,609	229,295	1	8,940	117,874	2	(2)	(2)
Undistributed	-------	50,346	772,598	-------	37,274	534,657	-------	56,726	779,285
	31	279,272	3,486,741	30	214,514	2,466,252	31	259,194	2,862,278

[1] Excludes potters or others who grind for consumption in their own plants.
[2] Included under "Undistributed."

Minerals Yearbook, 1939 (pp. 1301–1302), listed feldspar grinding mills and their locations. In 1939 there were 31 mills in 13 States operated by 25 producing companies, of which 4 were merely subsidiary corporations of major producing companies. In California the American Radiator & Standard Sanitary Corporation succeeded the Standard Sanitary Manufacturing Co. at Campo, and the Kennedy Minerals Co. took over the Los Angeles plant of Chamberlain Co., Inc. The Coors Porcelain Co., Golden, Colo., was added to the list of producers. The Oxford Mining & Milling Co., West Paris, Maine, and the Tennessee Mineral Products Corporation, Spruce Pine, N. C., former subsidiaries of United Feldspar Corporation, were operated after January 1, 1940, as the Oxford Division and Minpro Division, respectively, of the United Feldspar & Minerals Corporation.

CONSUMPTION AND USES

Crude feldspar.—Most crude feldspar is sold to merchant mills, which obtain material from several mines or localities, store and sort it according to grade and source, blend and grind it to required purity and fineness, and sell the ground product. However, at least two sanitary-ware manufacturers mine and grind spar for their own use, and some enamel and pottery manufacturers purchase part of their feldspar requirements crude and process it as needed with their own equipment. Manufacturers of soap, cleansing, and nonskid compounds also buy crude spar, chiefly from mines in New England and the South, and, after grinding or other processing, utilize it as an abrasive in their products. A small tonnage of carefully selected crude material, commanding a substantial premium over No. 1 grade commercial spar, was reported sold for use in the manufacture of artificial teeth.

Ground feldspar.—For several years the glass industry has taken an increasingly large proportion of total sales of ground spar, but in 1939 this industry consumed only 53.4 percent of the gross sales compared with 54.9 percent in 1938 and 50.9 percent in 1937. If consumption of nepheline syenite, aplite, and other competitive sources of alumina were included with the feldspar sales the importance of this outlet would have continued to grow relatively as well as actually in 1939. The increased consumption of glass spar at the apparent expense of the higher-price pottery grades is a contributing factor in the smaller realization per ton for both ground and crude feldspar in recent years. Pottery makers used about 34 percent and enamel plants 11 percent of the ground feldspar sold in 1939. The rest was shipped for use in soap and abrasives and for miscellaneous purposes, largely ceramic.

Ground feldspar sold by merchant mills in the United States, 1937–39, by uses, in short tons

Use	1937		1938		1939	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Ceramic:						
Glass	142,028	50.9	117,800	54.9	138,336	53.4
Pottery	102,346	36.6	74,035	34.5	87,209	33.7
Enamel and sanitary ware	25,111	9.0	19,395	9.0	28,356	10.9
Other ceramic uses	6,442	2.3	2,077	1.0	2,132	.8
Soaps and abrasives	1,653	1.2	1,021	.5	770	.3
Binder for abrasive wheels	242		(1)	(1)	(1)	(1)
Other uses	1,450		186	.1	2,391	.9
	279,272	100.0	214,514	100.0	259,194	100.0

[1] Not separately reported.

The following table, presented for the first time, shows distribution of ground feldspar by chief consuming States, as reported by grinding mills processing 99 percent of the feldspar ground in 1939. According to these data Ohio was the largest market for ground spar, taking 21 percent of the total. Indiana and Pennsylvania each took 15 percent, New

Shipments of ground feldspar from mills into States [1] in 1939, in short tons

State	Short tons	State	Short tons
California	7,590	Pennsylvania	37,466
Illinois	15,948	Tennessee	5,077
Indiana	38,189	West Virginia	19,188
New Jersey	34,309	Wisconsin	5,134
New York	14,995	Other States [2]	25,463
Ohio	53,410		
			256,769

[1] Data include 99 percent of total ground feldspar.
[2] Arkansas, Colorado, Kentucky, Maryland, Mississippi, Oklahoma, South Carolina, and other States for which shipments cannot be segregated. Small shipments to Canada also included.

Jersey 13 percent, West Virginia 7 percent, and Illinois and New York 6 percent each. Included under "Other States" are sizable tonnages shipped to Maryland, Mississippi, Oklahoma, and South Carolina. One grinder reported small sales to Canada.

NEPHELINE SYENITE

Production of nepheline syenite in Ontario, Canada, continued throughout 1939. The largest company, Canadian Nepheline, Ltd., ships most of the tonnage obtained from its Blue Mountain (Peterborough County) quarry to the grinding mill of its subsidiary, the American Nepheline Corporation, Rochester, N. Y. Although the largest part of the company output is consumed by glass manufacturers, a fine-grinding unit has been installed to prepare material for general ceramic uses. The company mill at Lakefield, Ontario, now supplies the Canadian glass trade. A good general review of the operations of this company, which includes a detailed description and flow sheets of its plant with data as to the product and its applications, was published recently.[1]

Two quarries were operated in a coarse nepheline syenite pegmatite in Dungannon Township, Hastings County, during 1939. The product averages higher in nepheline and consequently higher in alumina than the Blue Mountain material. It was shipped to the processing mills of the Golding-Keene Co., Keene, N. H., and the United Feldspar & Minerals Corporation, Oxford Division, West Paris, Maine, and blended with granular glass spar. Late in 1939 development was begun on a third property to furnish raw material to the Rochester mill of the Consolidated Feldspar Corporation.

The only commercial production of nepheline outside of Canada, of which the Bureau of Mines has information, is in the U. S. S. R. on the far-northern Murmansk coast of the Kola Peninsula. Nepheline tailings or waste from the flotation of apatite at Kirovsk are now being concentrated in a new plant recently put in operation.[2] Other byproducts of the apatite wastes will be soda, potash, and portland cement. The concentrates will be shipped to the Volkhov aluminum plant, which is being equipped to use nepheline in place of bauxite in the manufacture of aluminum oxide. A detailed description of the Kola Peninsula deposits and of nepheline syenites and related rocks in the Urals, Siberia, and Central Asia, with chemical analyses and notes as to origin of the rocks and constituent minerals, has been published.[3 4]

Apparently Canadian nepheline syenite has become firmly established as a ceramic raw material. Shipments were begun in 1936, and annual output now greatly surpasses that of feldspar in Canada. The Bureau of Foreign and Domestic Commerce reported imports of nepheline syenite separately for the first time in 1939, when 26,099 long tons of crude material, valued at $95,453, entered the United States, all from Canada. No ground nepheline syenite was imported in 1939.

[1] Nicholson, C. M., Developing Canada's Nepheline Syenite: Canadian Min. Jour., vol. 61, No. 3, March 1940, pp. 135–146.

[2] "Industriya," Moscow, June 6 and June 23, 1939, reported in Russian Economic Notes, vol. 1 (N. S.), No. 14, July 30, p. 14, and No. 15, August 15, 1939, p. 1.

[3 4] Kupletskii, B. M., Nepheline Syenite Formations of the U. S. S. R.; Ser. II, Monographs, Petrograd Inst. Acad. Sci., U. S. S. R., vol. 3, 1937, pp. 1–307; Mineralog. Abs., vol. 7, p. 299; Chem. Abs., vol. 33, No. 17, September 10, 1939, p. 6760.

In addition to increased demand from glass plants, a recent customs decision, if sustained, may encourage importation of nepheline syenite. The United States Customs Court, Third Division, (C. D. 293) set aside an assessment of 30 percent ad valorem under paragraph 214 of the Tariff Act of 1930 and held nepheline syenite, when ground to the consistency of a sand, to be free of duty under paragraph 775 as manufactured sand.[5]

The addition of nepheline syenite to pottery, semivitreous ware, sanitary porcelain, tile, and structural-clay bodies has certain advantages, according to G. A. Bole,[6] professor of research, Engineering Experiment Station, Ohio State University. The syenite increases fluxing action and lowers fusibility, thus conserving time and fuel. It also increases translucency and reduces warpage and crazing. Additions of 3 to 5 percent of nepheline syenite to structural-clay bodies increase their vitrification and mechanical strength, as its active fluxing properties offset somewhat the greater refractoriness of many domestic clays.

In testing the suitability of nepheline syenite for use in heavy-clay products, additions of 3 percent B-grade Lakefield syenite to fire-clay mixtures lowered the absorption 20 percent according to Chilcote and Koenig.[7] Fluxing of wall-tile and floor-tile bodies with nepheline syenite and feldspar alone and with various mixtures of nepheline, talc, feldspar, and pyrophyllite was studied by Koenig.[8] His conclusions, which largely substantiate Bole's claims,[9] were that the lower fusibility and increased fluxing action of nepheline syenite permit the formulation of bodies maturing at lower temperatures and increase the life of refractories. Direct substitution of nepheline syenite for potash feldspar in wall-tile bodies lowers absorption and moisture expansion and increases shrinkage and mechanical strength. The thermal expansion of both the so-called low and high talc wall-tile bodies is reduced by direct substitution of nepheline syenite for potash feldspar, whereas wall-tile bodies singly fluxed with nepheline syenite have a higher thermal expansion than corresponding bodies singly fluxed with potash feldspar. The greater refractoriness of American clays compared to English clays is compensated for by the increased fluxing action of nepheline syenite.

TECHNOLOGIC DEVELOPMENTS

The search for better and more efficient means of separating feldspar from quartz or other impurities still is active. Lower-grade spars, some feldspathic pegmatitic rocks, and even glacial sands are being tested and studied as sources of substitutes for, or competitors to, feldspar hitherto obtained chiefly from pegmatites. Ordinary gravity methods of concentration do not separate feldspar from quartz and certain other associated minerals. In the sand sizes other methods

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[5] Oil, Paint and Drug Reporter, vol. 137. No. 14, April 1, 1940, p. 30.

[6] Bole, George A., Nepheline Syenite: Ceram. Age, vol. 34, 1939, pp. 135–137; Chem. Abs., vol. 34, No. 2, January 20, 1940, p. 600.

[7] Chilcote, J. H., and Koenig, C. J., Use of Nepheline Syenite in Heavy-clay Products: Jour. Canadian Ceram. Soc., vol. 8, 1939, pp. 53–58. Chem. Abs., vol. 34, No. 2, January 20, 1940, p. 599.

[8] Koenig, C. J., Use of Nepheline Syenite in Floor-tile and Wall-tile Bodies: Am. Ceram. Soc. Jour., vol. 23, No. 3, March 1940, pp. 86–91.

[9] Bole, George A., Work cited in footnote 6.

of separating the minerals include various electrostatic and allied processes, but the most promising from a commercial standpoint are wet methods that depend upon surface properties; flotation is suitable for fine material and agglomerate tabling for coarse or sand sizes.

Froth flotation of feldspar to rid it of closely combined quartz has been perfected by members of the staff of the Nonmetals Division, Bureau of Mines. The first commercial installation of the process was the Golding-Keene Co. plant at Keene, N. H., where increasing proportions of quartz were being found in mining. The mill was wrecked by the hurricane in September 1938 but was partly rebuilt the following spring and again placed in operation; however, a new body of high-grade feldspar at the mine, with adequate reserve for several years, has now made operation of the flotation plant unnecessary, at least for the present. A second mill for separating feldspar from quartz has been authorized and soon will be under construction at the Erwin (Tenn.) plant of the Consolidated Feldspar Corporation. Similar plants are contemplated by several other companies, according to Oliver C. Ralston, chief engineer, Nonmetals Division, Eastern Experiment Station, Bureau of Mines.

All natural feldspar and quartz mixtures do not behave the same when treated by agglomerate tabling and flotation. Bureau of Mines investigators found that this was due to alteration of the feldspar. This alteration, even when invisible, may so activate the quartz as to make it float with the feldspar. Details of the processes have been described in a recent paper.[10] Cationic reagents, such as have proved useful in the Bureau's work on other acid minerals (chiefly substituted ammonium compounds and nitrogen bases), are suitable collectors, but other chemical additions were required to supplement mechanical methods of cleaning the mineral particles. Best results were obtained with lauryl amine hydrochloride and fluorine-bearing acids or salts in an acid circuit.

Considerable attention also has been given to the recovery of feldspar from various granites and other feldspathic rocks. Some years ago attempts were made in New Hampshire to salvage the feldspar content of the waste from granite quarrying. Recently similar efforts in Missouri have been reported.[11]

A new material that shows promise of commercial use as an important source of mixed feldspars in pottery manufacture is alaskite, composed essentially of quartz and alkali feldspars. The electrotechnical laboratory of the Bureau of Mines at Norris, Tenn., recently has tested a rock of this type occurring near Spruce Pine, N. C.; it comprises chiefly potash and soda feldspar (in about equal proportions) and quartz. This rock, when ground to a fine powder and treated electromagnetically for removal of a small content of ferromagnesian minerals, gives a satisfactory product for use in china sanitary-ware bodies.

During studies having other objectives the Illinois State Geological Survey found that many deposits of glacial sand in Illinois contain

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[10] O'Meara, R. G., Norman, J. E., and Hammond, W. E., Froth Flotation and Agglomerate Tabling of Feldspars: Bull. Am. Ceram. Soc., vol. 18, No. 8, August 1939, pp. 286–292.

[11] Elliott, Floyd, Concentration and Use of Feldspar Derived from Missouri Granite: Progress Report of cooperative Project of Missouri Geol. Survey, Bureau of Mines, and Missouri School of Mines, presented at fall meeting of St. Louis section, Am. Ceram. Soc., December 1, 1939; Ceram. Ind., vol. 34, No. 1, January 1940, p. 66.

from 10 to 25 percent feldspar.[12] Investigation is under way to determine the composition and purity of this spar, as well as a practicable commercial method of separation.

An improved method of analysis of potash in feldspars and perhaps other silicates is described by Koenig.[13]

IMPORTS [14]

Notwithstanding the reduction in duty on both crude and ground spar under the Reciprocal Trade Agreement with Canada, effective January 1, 1939, imports of crude feldspar for consumption decreased slightly in 1939 to 7,460 long tons valued at $52,141 (all from Canada) compared with 7,651 long tons valued at $56,126 (1 ton valued at $7 from Brazil and the rest from Canada) in 1938. The average value per ton (foreign market value) dropped to $6.99 from $7.34 in 1938 and $7.09 in 1937.

Two short tons of ground feldspar valued at $54 were imported from the United Kingdom in 1939; no ground feldspar was imported in 1937 or 1938.

Feldspar imported for consumption in the United States, 1935–39

Year	Crude		Ground		Year	Crude		Ground	
	Long tons	Value	Short tons	Value		Long tons	Value	Short tons	Value
1935	8,937	$56,175	1	$106	1938	7,651	$56,126		
1936	10,786	68,198	132	1,276	1939	7,460	52,141	2	$54
1937	12,956	91,885							

Cornwall stone.—Imports of unmanufactured (unground) Cornwall stone in 1939 jumped to 1,684 long tons valued at $17,233, or more than triple the 1938 receipts of 513 tons valued at $4,976. Imports of ground Cornwall stone also increased sharply to 348 long tons valued at $3,965 compared with 233 tons valued at $1,797 in 1938. Imports of crude (unmanufactured) and ground material originated in the United Kingdom in both years.

Cornwall stone imported for consumption in the United States, 1935–39

Year	Unmanufactured		Ground		Year	Unmanufactured		Ground	
	Long tons	Value	Long tons	Value		Long tons	Value	Long tons	Value
1935	817	$7,449	242	$3,180	1938	513	$4,976	233	$1,797
1936	2,061	18,402	357	4,730	1939	1,684	17,233	348	3,965
1937	1,899	16,864	323	4,267					

[12] Pit and Quarry, vol. 32, No. 7, January 1940, p. 54.
[13] Koenig, E. W., The Semidirect Determination of Potassium Oxide in Feldspars: Jour. Am. Ceram. Soc., vol. 22, No. 5, May 1939, pp. 164–168.
[14] Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

WORLD PRODUCTION

According to available data, the United States produces far more feldspar than any other country. In normal times important tonnages have come from Norway, Sweden, China, and probably Czechoslovakia. Data for 1939 indicate small decreases both in Canadian output and Norwegian exports. A considerable part of the Canadian spar output is shipped crude to United States grinding mills for processing.

Norwegian and Swedish feldspar generally is exported largely to the United Kingdom, Germany, and other nearby European countries.

Available data on world production of feldspar, 1935–39, appear in the following table.

World production of feldspar, 1935–39, by countries, in metric tons

[Compiled by M. T. Latus]

Country [1]	1935	1936	1937	1938	1939
Argentina (shipments)	495	1,082	1,346	620	(2)
Australia:					
New South Wales [3]	166	101	162	178	(2)
South Australia [3]	315	553	669	502	(2)
Western Australia (exports)	2,703	3,097	3,031	1,906	(2)
Brazil	(2)	(2)	8,400	(2)	(2)
Canada (shipments)	16,095	16,190	19,365	12,753	11,309
China (Manchuria)	-------	1,403	(2)	(2)	(2)
Egypt	72	45	158	199	(2)
Finland (exports)	2,071	2,520	3,232	5,046	(2)
France	-------	-------	8,900	(2)	(2)
Germany (Bavaria)	6,337	9,524	9,986	10,419	(2)
India, British	713	798	495	702	(2)
Italy	7,616	8,620	13,437	13,391	(2)
Norway (exports)	24,228	29,985	32,555	21,761	21,282
Rumania	14,180	1,960	2,587	(2)	(2)
Sweden	48,637	56,799	49,140	45,111	(2)
United States (sold or used)	192,592	248,654	272,842	199,267	257,534

[1] In addition to countries listed, feldspar is produced in Czechoslovakia. Official figures of output are not available, but it is estimated that the annual production is approximately 30,000 metric tons (Stat. Comm. Czechoslovak Ceram. Soc.).

[2] Data not yet available.

[3] Includes some china stone.

ASBESTOS

By Oliver Bowles and K. G. Warner

SUMMARY OUTLINE

Sales of domestic asbestos attained an all-time high of 15,459 tons in 1939, an increase of 48 percent over 1938. Their value was more than double that of 1938. Imports also increased greatly. Consumption of asbestos in the United States was 37 percent greater than in 1938 but still was far below the high point of 1937.

The United States leads all countries in the manufacture of asbestos products but in 1939 produced only 6 percent of the quantity and 5½ percent of the value of its domestic requirements. Large tonnages of the better grades of asbestos, used in fabrics and in making magnesia-asbestos insulation and asbestos-cement products, normally are imported from Africa. Although such shipments may be interrupted to some extent owing to the war, it is unlikely that a serious shortage will result because the extensive deposits in Quebec, Canada, situated only about 80 miles north of the Vermont border, have furnished the United States with its major supplies since the industry was organized and doubtless could furnish larger supplies if necessary.

Domestic production of chrysotile asbestos is centered chiefly in the extensive deposits near Hyde Park in northern Vermont. Although production in this region is expanding, the national situation is essentially the same as heretofore; there have been no new developments, and our dependence on foreign supplies is virtually as great as it has been in the past. The Arizona deposits furnish excellent fiber; but mining costs are high, transportation is difficult, and freight rates to eastern markets are excessive. There is no evidence of increasing activity in Arizona.

Small quantities of amphibole asbestos are produced in several States. It is more resistant to chemicals and high temperatures than chrysotile and accordingly is employed chiefly in making special products, such as acid filters.

Unusual attention has been directed toward asbestos during the past year because it has been classed by the Army and Navy Munitions Board as a critical mineral. Asbestos is so classed because it is the chief constituent of brake-band linings and clutch facings and thus is essential to automotive transport and because only a small percentage of the Nation's requirements is obtained from domestic mines.

Synthetic fibers, such as glass wool, mineral wool, and slag wool, are being refined to an increasing degree in manufacture and are competing with asbestos to some extent in the heat-insulation field. Asbestos generally is regarded as an indispensable constituent of automobile brake bands, but a recent patent covering a brake lining of glass fiber bonded with synthetic resin may be prophetic of future developments.

The following table of salient statistics compares 1939 data with those of 1938. A noteworthy feature is the great increase in unit value of domestic sales in 1939. The average sales value of domestic asbestos in 1938 was $23.68 a ton; in 1939 it was about $33. As price quotations of Vermont fiber were the same in both years, the increase in average price can be explained only by the sale of a larger proportion of the better grades.

Salient statistics of the asbestos industry in the United States, 1938–39

	1938		1939	
	Short tons	Value	Short tons	Value
Domestic asbestos—				
Produced:				
Chrysotile	(1)	(2)	14,686	(2)
Amphibole	(1)	(2)	450	(2)
Total produced	12,901	(2)	15,136	(2)
Sold or used by producers:				
Chrysotile	(1)	(1)	15,043	$503,097
Amphibole	(1)	(1)	416	9,691
Total sold or used by producers	10,440	$247,264	15,459	512,788
Imports (unmanufactured)	179,490	6,160,602	242,561	9,094,538
Exports (unmanufactured)	2,780	288,617	2,473	218,830
Apparent consumption [3]	187,150	6,119,249	255,547	9,388,496
Exports of asbestos products	(2)	2,533,916	(2)	3,354,919

[1] Bureau of Mines not at liberty to publish figures separately for chrysotile and amphibole.
[2] Figures not available.
[3] Quantity sold or used by producers, plus imports, minus exports.

The following table shows the production of asbestos in recent years.

Asbestos sold or used by producers in the United States, 1935–39, by varieties

Year	Chrysotile		Amphibole		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1935	(1)	(1)	(1)	(1)	8,920	$292,927
1936	10,719	$302,301	345	$11,860	11,064	314,161
1937	11,547	332,747	532	11,897	12,079	344,644
1938	(1)	(1)	(1)	(1)	10,440	247,264
1939	15,043	503,097	416	9,691	15,459	512,788

[1] Bureau of Mines not at liberty to publish figures separately for chrysotile and amphibole.

Consumption trends.—The following table shows trends in the asbestos-products industries in the United States during recent years.

Raw asbestos consumed in the United States and asbestos products manufactured in and exported from the United States, 1934–39

Year	Raw asbestos—apparent consumption	Asbestos products—Manufactured [1]	Asbestos products—Exported [2]	Year	Raw asbestos—apparent consumption	Asbestos products—Manufactured [1]	Asbestos products—Exported [2]
	Short tons				*Short tons*		
1934	123,752	(1)	$2,142,514	1937	316,263	$96,347,570	$3,047,078
1935	174,655	$62,420,944	2,261,929	1938	187,150	(1)	2,533,916
1936	250,922	(1)	2,479,273	1939	255,547	(3)	3,354,919

[1] Figures of Bureau of the Census (collected biennially for odd years) include value of certain gaskets, packing, and similar products in which little asbestos was employed.
[2] Compiled from the records of the Bureau of Foreign and Domestic Commerce.
[3] Figures not yet available.

The consumption of asbestos depends chiefly on the manufacture of automobiles, on the building trades, and on industrial activity. As stated, automobiles require large quantities for brake bands and clutch facings. Building construction employs many products in which asbestos is an important constituent, such as asbestos-cement shingles and siding, wallboard, and various heat-insulation and fireproofing materials. Asbestos consumption bears a definite relationship to industrial activity because asbestos is used extensively for packings and gaskets in steam and other machinery, as well as for

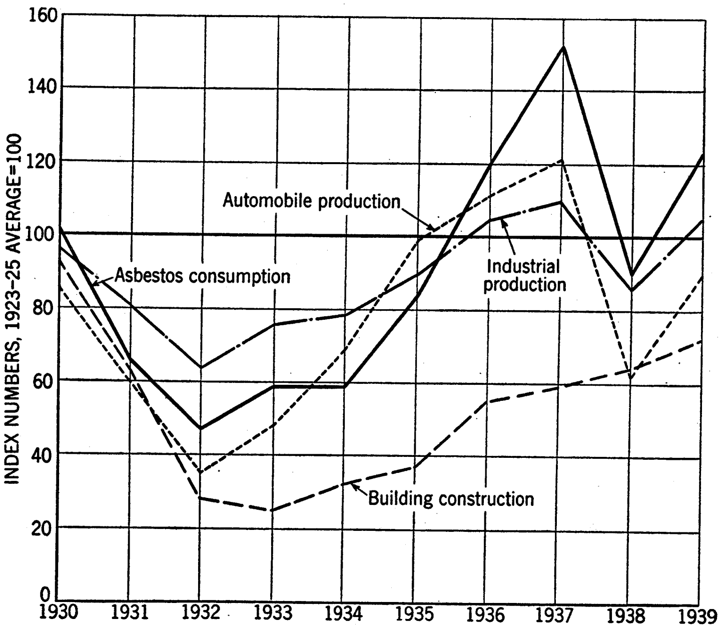

FIGURE 1.—Asbestos consumption compared with automobile production, value of building construction, and industrial production in the United States, 1930-39. Unlike units are reduced to percentages of the 1923-25 average. Statistics on automobiles are from the Bureau of the Census and building contracts and industrial production from the Federal Reserve Board.

boiler lagging and pipe covering. Figure 1 shows the relationship of asbestos consumption to these three major activities for a period of years.

WORLD CONSUMPTION

The following table presents a compilation of data on apparent world consumption of asbestos in 1938, based upon production plus imports minus exports. This table may not give a true picture because stocks held from previous years may be reexported, or material consumed may consist of stocks produced or imported during previous years. The figures are therefore approximate only, but they are the best that can be compiled from the records available. Anomalies are bound to appear in a table compiled upon this basis. For example, the consumption of 3,509 tons by Cyprus, which has virtually no consuming industries, is interpreted as an accumulation of stocks.

World consumption of asbestos in 1938, in metric tons

Continent and country	Production[1]	Imports[2]	Exports[2]	Apparent consumption
Asia:				
China	[3] 300	414		714
Chosen	[3] 70	10,025		10,095
Cyprus	9,177		5,668	3,509
India, British	90	3,633		3,723
Japan	[3] 1,000	28,226	167	29,059
Manchuria	[3] 70	1,716	155	1,631
Netherland India		192		192
Turkey	668			668
Total Asia	11,375	44,206	5,990	49,591
Africa:				
Algeria		6		6
Egypt		175		175
Southern Rhodesia	53,352		53,170	182
Union of South Africa	21,025		19,940	1,085
Total Africa	74,377	181	73,110	1,448
North America:				
Canada	262,894		150,361	112,533
United States	9,471	162,830	2,522	169,779
Total North America	272,365	162,830	152,883	282,312
South America:				
Bolivia	21		21	
Brazil	120	67		187
Chile		4		4
Colombia		52		52
Uruguay		205		205
Total South America	141	328	21	448
Australia	176	11,358		11,534
Europe:				
Austria		4,652	45	4,607
Belgium-Luxemburg		15,919	675	15,244
Bulgaria		6		6
Czechoslovakia	[3] 2,700	5,596	801	7,495
Denmark		1,955		1,955
Estonia		122		122
Finland	[3] 3,000	296	2,314	982
France	[3] 250	17,299		17,549
Germany		28,796	151	28,645
Greece	[3] 2	90		92
Hungary		1,976		1,976
Italy	6,860	7,783	1,791	12,852
Latvia		1,422		1,422
Netherlands		2,192	39	2,153
Norway		1,016		1,016
Poland		2,402	16	2,386
Portugal		575		575
Rumania		145		145
Sweden		5,014	29	4,985
Switzerland		833	10	823
U. S. S. R.	86,000		14,434	71,566
United Kingdom		51,142	343	50,799
Yugoslavia		946		946
Total Europe	98,812	150,177	20,648	228,341
Total by continents:				
Asia	11,375	44,206	5,990	49,591
Africa	74,377	181	73,110	1,448
North America	272,365	162,830	152,883	282,312
South America	141	328	21	448
Australia	176	11,358		11,534
Europe	98,812	150,177	20,648	228,341
Total world	457,246	369,080	252,652	573,674

[1] Compiled by Foreign Minerals Division, Bureau of Mines.
[2] Figures as given in The Mineral Industry of the British Empire and Foreign Countries, Statistical Summary, published by The Imperial Institute, London.
[3] Estimated.

Market conditions.—Markets were disturbed during the spring and summer because of unsettled conditions in Europe and hesitancy of American business. After hostilities were begun the fear of curtailed supplies of asbestos from Africa stimulated a stronger demand for Canadian fibers.

Prices.—All prices for asbestos are quoted on a short-ton basis. Canadian prices are f. o. b. Quebec mines, tax and bags included; Rhodesian, South African, and Russian prices, c. i. f. New York; and Vermont prices, f. o. b. mines, Vermont.

According to quotations in Metal and Mineral Markets, published by the McGraw-Hill Publishing Co., Inc., New York City, prices of Canadian asbestos were constant throughout the year, as follows: Crude No. 1, $700–$750; Crude No. 2 and sundry crudes, $150–$350; spinning fibers, magnesia and compressed sheet fibers, $110–$200; shingle stock, $57–$78; paper stock, $40–$45; cement stock, $21–$25; floats, $18–$20; and shorts, $12–$16.50. Canadian quotations are in American dollars rather than Canadian dollars as formerly.

Rhodesian Crude No. 1 was quoted at $300 and Crude No. 2 at $260 throughout the year.

South African prices were quoted as follows: Amosite: Grade B 1 (white), $140; Grade B 3 (dark), $120. Transvaal Blue: Grade B (long fiber), $450 until August when it dropped to $400 for the remainder of the year; Grade S (short fiber), $140.

Russian Crude AA was quoted at $750; Crude No. 1, $275; Crude No. 2, $240; and shingle stock, $67.50 and up.

Vermont prices were constant throughout the year, as follows: Shingle stock, $57; paper stock, $40; cement stock, $25; and shorts and floats, $12–$18.

NEW DEVELOPMENTS

There were no outstanding new developments in the domestic asbestos industry during 1939, but increasing production in Vermont, a mild revival of activity in anthophyllite production, and a reported occurrence of chrysotile near Lake George, N. Y., are worthy of note. New factors in the asbestos industry abroad include the beginning of production at the important Havelock mine, Swaziland, Africa, initiation of milling on a small scale at the Rahn Lake chrysotile deposit in Ontario, Canada, and development of a deposit of blue asbestos in Western Australia. The year 1939 marked the Diamond Jubilee of asbestos, the seventy-fifth anniversary of the establishment of the organized asbestos industry.

REVIEW BY STATES

Arizona.—Sales of asbestos in Arizona were somewhat smaller in 1939 than in 1938 and were reported by the following companies: Arizona Chrysotile Asbestos Co., Arizona Asbestos Corporation, Emsco Asbestos Co., and Arthur Enders, all of Globe, Ariz.; and Johns-Manville Products Corporation, New York, N. Y. Several other producers sold small quantities to the larger operators.

Georgia.—Limited quantities of anthophyllite were obtained some years ago near Helen, White County, and Hollywood, Habersham County, but recently these districts have been inactive. A small output was reported in 1939 near Dillard, Rabun County, some distance north of the deposits formerly operated.

Maryland.—The Powhatan Mining Co., Woodlawn, Baltimore, Md., continued operation near Pylesville, Harford County. The tremolite obtained is prepared for use chiefly as a filtering medium for chemicals. The company also handles anthophyllite mined in several Southern States. A new mine was opened in this district during 1939.

Montana.—The Montana Asbestos Co. reported small sales of anthophyllite from its property at Gallatin Gateway, Gallatin County.

North Carolina.—A small tonnage of anthophyllite was mined near Greenmountain, Yancey County, in 1939.

South Carolina.—Small shipments of anthophyllite in 1939 from a deposit near Pickens, Pickens County, brought South Carolina for the first time into the list of asbestos-producing States.

Vermont.—Vermont Asbestos Mines, a division of the Ruberoid Co. (address 500 Fifth Avenue, New York, N. Y.), operated continuously with three shifts of workers during the summer of 1939. The extensive deposit worked by the company near Eden, Lamoille County, contains slip-fiber chrysotile in serpentine.

Virginia.—Anthophyllite was mined many years ago near Bedford, Bedford County, and Rockymount, Franklin County. Production of a small quantity of slip fiber was reported in the latter county in 1939.

FOREIGN TRADE [1]

The following table shows imports of unmanufactured asbestos into the United States in 1938 and 1939 by countries and classes. Total imports in 1939 increased 35 percent in quantity and 48 percent in value over 1938. Imports from Africa were nearly twice as great as in 1938 and those from Canada 35 percent greater than in 1938. Substantial shipments of short-fiber chrysotile from Cyprus were renewed, but shipments from the U. S. S. R. declined 50 percent.

Asbestos (unmanufactured) imported for consumption in the United States, 1938–39, by countries and classes

Country	Crude (including blue fiber)		Mill fibers		Short fibers [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1938								
Africa:								
Union of South Africa	3,677	$456,073					3,677	$456,073
Other British	2,745	310,147					2,745	310,147
Australia	21	6,006					21	6,006
Austria [2]					3	$142	3	142
Canada	1,360	321,424	51,141	$2,701,494	113,570	2,043,844	166,071	5,066,762
Finland					89	3,564	89	3,564
Italy	18	12,477			1,551	38,488	1,569	50,965
Malta, Gozo, Cyprus					6	294	6	294
U. S. S. R.	1	479	5,201	258,593	63	1,525	5,265	260,597
United Kingdom	22	5,205			22	847	44	6,052
	7,844	1,111,811	56,342	2,960,087	115,304	2,088,704	179,490	6,160,602

[1] Asbestos, n. e. s., containing not over 15 percent of foreign matter.
[2] Figures cover period Jan. 1–May 5.

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

Asbestos (unmanufactured) imported for consumption in the United States, 1938–39, by countries and classes—Continued

Country	Crude (including blue fiber)		Mill fibers		Short fibers		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1939								
Africa:								
Union of South Africa	6,359	$656,543					6,359	$656,543
Other British	4,836	593,596					4,836	593,596
Australia	53	11,000					53	11,000
Canada	3,068	547,425	73,511	$4,378,887	147,261	$2,650,886	223,840	7,577,198
Finland					46	1,324	46	1,324
Italy	31	23,167			536	12,133	567	35,300
Malta, Gozo, Cyprus					3,940	69,426	3,940	69,426
U. S. S. R.			2,611	109,516	(3)	5	2,611	109,521
United Kingdom	298	40,580					298	40,580
Venezuela					11	50	11	50
	14,645	1,872,311	76,122	4,488,403	151,794	2,733,824	242,561	9,094,538

[3] Less than 1 ton.

The following table shows imports and exports of unmanufactured asbestos for the 5-year period 1935–39.

Asbestos (unmanufactured) imported for consumption in and exported from the United States, 1935–39

Year	Imports		Exports	
	Short tons	Value	Short tons	Value
1935	166,585	$5,125,413	850	$87,896
1936	243,602	7,524,937	3,744	310,197
1937	307,188	10,470,208	3,004	253,734
1938	179,490	6,160,602	2,780	288,617
1939	242,561	9,094,538	2,473	218,830

The following table shows exports of asbestos products in 1938 and 1939.

Manufactured asbestos products exported from the United States, 1938–39, by kinds

Product	1938		1939	
	Quantity	Value	Quantity	Value
Brake lining:				
Molded and semimolded	(1)	$608,970	(1)	$714,679
Not molded ... linear feet	923,672	176,765	886,069	178,393
Clutch facing ... number	448,121	134,209	326,493	129,143
Paper, millboard, and roll board ... short tons	725	100,034	819	122,543
Pipe covering and cement ... do	1,143	128,666	2,213	251,912
Textiles, yarn, and packing ... do	565	611,549	891	965,923
Asbestos roofing ... squares	83,080	225,987	54,634	284,643
Other asbestos manufactures, except roofing ... short tons	1,593	293,272	2,315	398,960
Magnesia and manufactures ... do	1,601	254,464	1,483	308,723

[1] Quantity not recorded.

WORLD PRODUCTION

The following table shows world production of asbestos, by countries, from 1935 to 1939, insofar as figures are available.

World production of asbestos, 1935–39, by countries, in metric tons [1]

[Compiled by M. T. Latus]

Country	1935	1936	1937	1938	1939
Argentina	[2] 13	---	---	---	(3)
Australia:					
South Australia	36	81	123	49	(3)
Tasmania	---	---	2	4	(3)
Western Australia	143	162	43	123	(3)
Bolivia	---	(4)	21	21	(3)
Brazil	---	---	---	120	(3)
Bulgaria	3	---	---	---	(3)
Canada [5]	190,931	273,322	371,967	262,894	330,642
China (Manchuria)	70	69	(3)	(3)	(3)
Chosen	6	69	70	(3)	(3)
Cyprus (exports)	7,634	9,659	11,842	5,668	(3)
Czechoslovakia	2,600	2,700	(3)	(3)	(3)
Finland	1,742	3,963	3,330	(3)	(3)
France	450	405	250	(3)	(3)
Greece	2	1	2	(3)	(3)
India, British	64	57	102	90	(3)
Indochina	---	5	5	---	(3)
Italy	4,320	6,113	6,393	6,860	(3)
Japan (approximate)	1,000	1,000	1,000	1,000	1,000
Kenya Colony	---	---	---	5	(3)
Southern Rhodesia	38,644	51,116	51,722	53,352	52,900
Swaziland	---	---	---	---	7,233
Turkey	104	119	157	668	(3)
Uganda	---	---	---	53	(3)
Union of South Africa	20,600	22,894	25,975	21,025	19,988
U. S. S. R.	95,500	125,117	125,000	86,000	(3)
United States (sold or used by producers)	8,092	10,037	10,958	9,471	14,024
Venezuela	76	71	(3)	(3)	(3)

[1] In addition to countries listed, a small quantity of asbestos is produced in Madagascar.
[2] Rail and river shipments. [3] Data not available. [4] Less than 1 ton.
[5] Exclusive of sand, gravel, and stone (waste rock only), production of which is reported as follows: 1935, 2,744 tons; 1936, 2,815 tons; 1937, 3,611 tons; 1938, 2,975 tons; 1939, 3,535 tons.

CANADA

The value of sales of asbestos in Canada reached an all-time high in 1939, and the quantity sold was the second highest of any year, being exceeded only in 1937. The mines and mills of the well-known Thetford Mines district of Quebec, where almost the entire production of Canada is mined, were working virtually at capacity throughout the year. Johnson's Co. and Bell Asbestos Mines, Ltd., are changing from open-pit to shaft mining and are planning to introduce the block-caving system.

Activity has been renewed at the Rahn Lake deposit, Bannockburn Township, Ontario. A test shipment of chrysotile comprising 18 tons valued at $720 was made in 1939. This material evidently is not included in the following table of Canadian sales taken from the Preliminary Report on the Mineral Production of Canada in 1939, issued by the Dominion Bureau of Statistics.

Sales of asbestos in Canada, 1938–39

	1938			1939		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Grade:						
Crudes	2,911	$955,423	$328.21	3,121	$938,718	$300.68
Fibers	163,097	9,710,899	59.54	193,992	12,049,539	62.12
Shorts	123,785	2,223,873	17.97	167,359	2,870,955	17.15
	289,793	12,890,195	44.48	364,472	15,859,212	43.51
Sand, gravel, and stone (waste rock only)	3,279	2,464	.75	3,897	2,930	.75
Total asbestos and waste rock	293,072	12,892,659		368,369	15,862,142	
Rock mined	5,816,368			6,650,416		
Rock milled	4,874,548			5,548,765		

AFRICA

Southern Rhodesia.—The output of asbestos in Southern Rhodesia in 1939 was a little lower in quantity but a little higher in value than in 1938. The following table shows production during recent years:

Asbestos produced in Southern Rhodesia, 1935–39

Year	Short tons	Value	Year	Short tons	Value
1935	42,598	£646,658	1938	58,811	£1,020,921
1936	56,346	836,469	1939	58,313	1,088,782
1937	57,014	840,025			

Union of South Africa.—The output of the Union of South Africa was 5 percent lower in 1939 than in 1938. The following table lists the output from 1935 to 1939:

Asbestos produced in the Union of South Africa, 1935–39, by sources

Year	Short tons				Total value
	Transvaal	Cape Province	Natal	Total	
1935	[1] 20,167	[1] 2,541		22,708	[2]£226,167
1936	21,188	4,048	(3)	[3] 25,236	[2] 337,229
1937	23,921	4,712	(3)	[3] 28,633	[2] 431,212
1938	16,505	6,484	[3] 187	[3] 23,176	[2] 416,401
1939	15,811	6,143	79	22,033	[2] 509,278

[1] Small quantity of blue fiber from Transvaal included under Cape Province.
[2] Value of local sales plus value of exports.
[3] Small production in Natal in December 1936 and in 1937 included in 1938 figures.

The following table states the tonnage of each variety produced from 1935 to 1939. The decline in chrysotile production in the Transvaal to a mere fraction of its former volume reflects the imminent depletion of the Amianthus mine.

Asbestos produced in the Union of South Africa, 1935–39, by varieties and sources, in short tons

Variety and source	1935 [1]	1936 [1]	1937 [2]	1938 [2]	1939 [2]
Amosite (Transvaal)	4,684	4,823	6,531	8,793	11,378
Chrysotile (Transvaal)	15,483	16,149	16,855	[3] 5,573	[3] 582
Blue (Transvaal)	2,541	216	535	2,326	3,930
Blue (Cape)		4,048	4,712	6,484	6,143
	22,708	25,236	28,633	23,176	22,033

[1] Data from Government Mining Engineer, Union of South Africa, Department of Mines, Annual Report.
[2] Data from Union of South Africa, Department of Mines, Monthly Reports.
[3] Includes 187 short tons in 1938 and 79 tons in 1939 produced in Natal.

Swaziland.—The Havelock mine about 12 miles south-southeast of Barberton, which has been under development since April 1937, began producing in June 1939. The shaft, inclined at an angle of 40°, had attained a depth of 850 feet in May 1939. The mine is connected with the railway station at Barberton by means of an overhead cableway 12.6 miles long with a capacity of 7½ tons of bagged asbestos per hour. Production was started in June, and an output of 7,973 short tons was reported for 1939.

CYPRUS

Short-fiber chrysotile is produced in Cyprus. The following table, compiled from the Annual Report of the Inspector of Mines and Labor, shows exports during recent years.

Asbestos exported from Cyprus, 1935–39

Year	Long tons	Value	Year	Long tons	Value
1935	7,513	£50,174	1938	5,578	£88,290
1936	9,506	80,343	1939	(1)	(1)
1937	11,704	126,371			

[1] Data not available.

U. S. S. R.

The following table presents the most recent available statistics on Russian asbestos.

Asbestos produced in and exported from U. S. S. R., 1935–39, in metric tons

Year	Production	Exports	Year	Production	Exports
1935	95,500	[1] 25,109	1938	86,000	(3)
1936	125,117	[1] 26,147	1939	(3)	(3)
1937	125,000	[2] 27,299			

[1] U. S. Bureau of Foreign and Domestic Commerce, Foreign Trade Notes.
[2] Statistics of the Foreign Trade of the U. S. S. R.
[3] Data not available.

AUSTRALIA

A deposit of blue asbestos has been worked in Western Australia recently, and small shipments have been made to the United States. The material is similar to South African blue asbestos. Samples submitted to the Bureau of Mines comprise strong, flexible, dark-blue fibers having a maximum length of 1¾ inches.

BARITE AND BARIUM PRODUCTS

By Bertrand L. Johnson and K. G. Warner [1]

SUMMARY OUTLINE

In response to the intensified demand for crude barite in 1939 new all-time peaks were attained for domestic production (365,870 short tons), domestic crude barite sold or used (383,609 tons), and reported consumption of domestic and imported crude barite (391,683 tons). The apparent new supply (barite sold or used by producers plus imports), however, was less than in 1937, when an exceptionally large quantity of crude barite was imported. The total value of domestic crude barite sold or used by producers also set a new record ($2,344,103), although the average value per ton declined from $6.47 in 1938 to $6.11 in 1939. Increased demands for crude barite came from the glass, lithopone, and barium-chemical industries, but the greater part of the expansion was a consequence of sharply improved demand from lithopone manufacturers. The consumption of crude barite in the production of ground barite decreased slightly. Imports of crude barite in 1939 were less than half those in 1938; the average value declined from $6.09 in 1938 to $4.83 in 1939, owing to the elimination of barite imports from Germany and the increase in imports of lower-price barite from Cuba.

Total sales of barium products in 1939 likewise established a new record of 354,443 short tons, although the value of the sales was exceeded in several recent years. The quantities of ground barite, lithopone, and artificial barium carbonate sold or used by producers in 1939 were greater than in 1938, but sales of blanc fixe (precipitated barium sulfate) and all other barium chemicals were less.

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

Salient statistics of the barite and barium products industries in the United States, 1935–39

	1935	1936	1937	1938	1939
Crude barite:					
Produced short tons	218, 075	274, 062	360, 877	335, 433	365, 870
Sold or used by producers:					
Short tons	225, 111	283, 160	355, 888	309, 663	383, 609
Value: [1]					
Total	$1, 251, 268	$1, 674, 631	$2, 240, 970	$2, 004, 521	$2, 344, 103
Average	$5. 56	$5. 91	$6. 30	$6. 47	$6. 11
Imports for consumption:					
Short tons	47, 048	33, 843	64, 992	24, 845	11, 588
Value: [2]					
Total	$246, 254	$170, 316	$327, 224	$151, 235	$55, 985
Average	$5. 23	$5. 03	$5. 03	$6. 09	$4. 83
Apparent new supply [3] short tons	272, 159	317, 003	420, 880	334, 508	395, 197
Domestic percent	82. 7	89. 3	84. 6	92. 6	97. 1
Reported consumption (total) short tons	290, 344	303, 449	383, 982	[4] 364, 985	[4] 391, 683
Barium products:					
Sold or used by producers: [5]					
Short tons	268, 652	263, 810	332, 185	[4] 327, 102	[4] 354, 443
Value	$16, 858, 413	$16, 299, 448	$17, 242, 511	$14, 871, 835	$15, 694, 242
Imports for consumption:					
Short tons	11, 672	11, 079	14, 419	8, 334	8, 614
Value	$404, 601	$411, 797	$485, 520	$313, 908	$251, 595
Exports of lithopone:					
Short tons	2, 372	2, 538	2, 671	1, 734	4, 845
Value	$221, 611	$229, 942	$231, 622	$153, 567	$392, 798

[1] F. o. b. mine shipping point.
[2] Declared value f. o. b. foreign market.
[3] Barite sold or used by producers plus imports.
[4] Includes crushed barite as follows: 1938, 7,121 short tons; 1939, 11,678 tons.
[5] To avoid duplication, the barium chemicals reported here do not include the output of firms that make these chemicals from such products as barium chemicals and imported barite and witherite purchased in the open market.

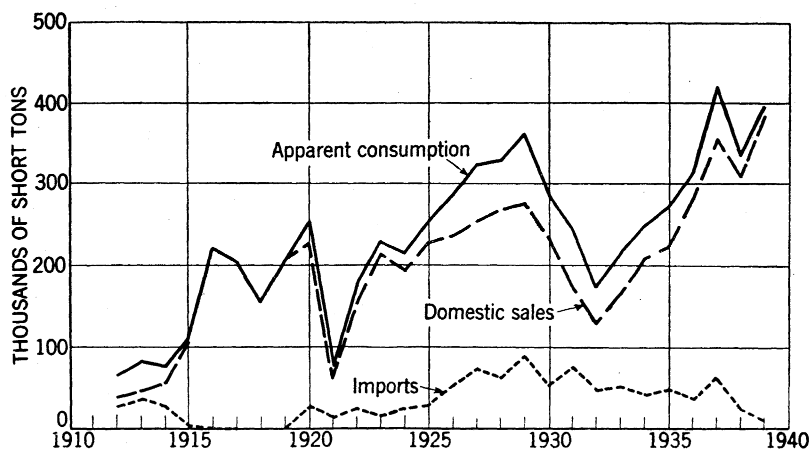

FIGURE 1.—Trends in domestic sales, imports, and apparent consumption of crude barite, 1912–39.

CRUDE BARITE

Production.—Barite was mined in 1939 in 11 States—Alabama, Arizona, California, Colorado, Georgia, Missouri, Montana, Nevada, South Carolina, Tennessee, and Virginia—compared with only 9 States in 1938. No output was reported from Texas in 1939, although this State had produced barite in 1938. Alabama, Colorado, and Montana were among the producing States in 1939, but not in 1938. The California output included witherite as well as barite. Mine production in 1939 totaled 365,870 short tons, a 9-percent increase over that in 1938 (335,433 tons).

Sales.—More domestic crude barite was sold or used by producers in the United States in 1939 than ever before (383,609 short tons), and the total value was higher ($2,344,103).

Missouri continued to be the leading State in sales of crude barite in 1939, with Georgia second; both States reported increases over 1938. The quantity of crude barite sold or used by producers in the nine other producing States was less than half that in Missouri and Georgia combined.

Figure 1 shows trends in domestic sales, imports, and apparent consumption of crude barite since 1912.

Crude barite sold or used by producers in the United States, 1938–39, by States

State	1938		1939	
	Short tons	Value	Short tons	Value
Georgia	64,304	$315,329	86,589	$438,378
Missouri	156,539	1,150,630	171,642	1,163,870
Tennessee	29,898	209,040	57,140	372,348
Other States [1]	58,922	329,522	68,238	369,507
	309,663	2,004,521	383,609	2,344,103

[1] 1938: Arizona, California, Nevada, South Carolina, and Texas; 1939: Alabama, Arizona, California, Colorado, Montana, Nevada, South Carolina, and Virginia.

Prices.—The market quotation for crude barite from Georgia, f. o. b. mines, has remained unchanged at $7 per long ton from 1935 to 1939, inclusive, according to the Engineering and Mining Journal Metal and Mineral Markets. The price of Missouri crude (93 percent barium sulfate, less than 1 percent iron) was $7.50 per short ton during the first half of 1939, dropped to $6.50 to $7.50 f. o. b. mines at the end of June, and remained there until October. Quotations for crude barite (minimum, 90 percent $BaSO_4$) remained at $6 to $6.50 per ton until October, after which only the 95-percent $BaSO_4$ and 93-percent $BaSO_4$ were quoted. Missouri crude (95 percent $BaSO_4$, less than 1 percent iron) was quoted at $6.50 to $7 per ton for the last 3 months of 1939; the 93-percent grade was quoted at $6 to $6.50 per ton for the same period.

The average value, f. o. b. mine shipping point, of crude barite for the entire United States dropped from $6.47 in 1938 to $6.11 in 1939.

Consumption by uses.—Nearly 27,000 tons more crude barite (domestic and imported) were consumed in 1939 than in 1938 by manufacturers of barium products in the United States, raising the reported consumption of crude barite in this country to a new all-time record of 391,683 short tons. The production of crushed barite, lithopone, and barium chemicals required more crude barite than in 1938; the increase was especially marked in the lithopone-manufacturing industry—slightly more than 24,000 tons. About 6,000 tons less crude barite was used in the production of ground barite than in 1938, but the total quantity consumed in this industry remained considerably greater than in the manufacture of lithopone, the leading customer for crude barite before 1938. (See fig. 2.)

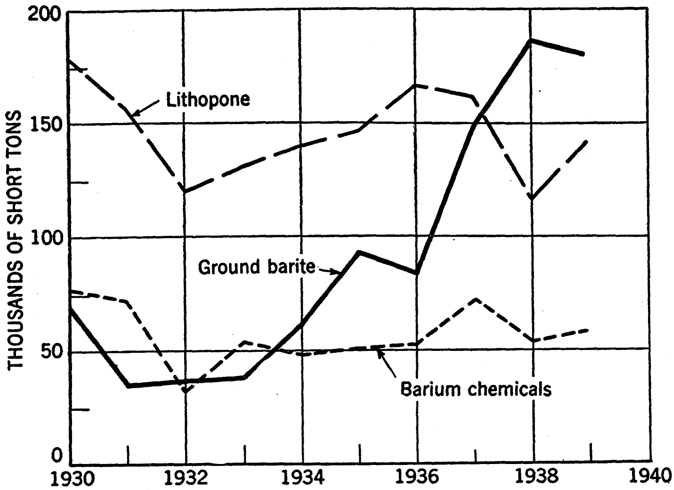

FIGURE 2.—Crude barite (domestic and imported) used in the manufacture of barium products in the United States, 1930–39.

Crude barite (domestic and imported) used in the manufacture of barium products in the United States, 1935–39, in short tons

Year	In manufacture of—			Total	Year	In manufacture of—			Total
	Ground barite	Lithopone	Barium chemicals			Ground barite	Lithopone	Barium chemicals	
1935	93,692	146,164	50,488	290,344	1938	[1] 193,728	117,007	54,250	[1] 364,985
1936	83,990	167,014	52,445	303,449	1939	[1] 192,112	141,556	58,015	[1] 391,683
1937	148,930	162,681	72,371	383,982					

[1] Includes crushed barite as follows: 1938, 7,121 short tons; 1939, 11,678 tons.

Consumption by States.—Crude barite for the production of ground barite, lithopone, and barium chemicals was consumed in 34 plants in 14 States in 1939 as against the same number of plants in 13 States in 1938. The markets for crude barite lie (1) along the Atlantic coast, (2) along the Pacific coast, and (3) in the Mississippi River Valley region where there are three subregions—the West Virginia area, where crude barite is consumed in chemical plants; the Colorado area, where crude barite and witherite are utilized in preparing barium chemicals for use in the sugar industry; and the central valley region of Kansas, Illinois, and Missouri, where ground barite, lithopone, and barium chemicals are produced. Lithopone alone is manufactured in Kansas, ground barite and chemicals in Missouri, and all three products in Illinois. All these products likewise are produced in both the Atlantic and Pacific Coast regions. In the Atlantic Coast region crude barite is utilized for the production of ground barite in Georgia and South Carolina only. In 1939 the Mississippi Valley area was the largest consuming market for crude barite; the Atlantic Coast area ranked second and the Pacific Coast area third.

Crude barite (domestic and imported) used in the manufacture of barium products in the United States in 1939, by States

State	Product manufactured	Plants	Barite used (short tons)
Missouri	Ground barite and chemicals	3	102,218
Delaware, New Jersey, and Pennsylvania	Lithopone and chemicals	5	81,152
California	Ground barite, lithopone, and chemicals	8	57,650
Illinois	do	7	52,761
Colorado	Chemicals	1	
Rhode Island	do	1	
West Virginia	do	2	
Kansas	Lithopone	1	86,224
Maryland	do	1	
Georgia	Ground barite and chemicals	2	
New York	do	2	
South Carolina	Ground barite	1	
		[1] 34	[2] 391,683

[1] A plant producing more than 1 product is counted but once in arriving at State totals.
[2] Includes 11,678 short tons of crushed barite.

Deposits.—A recent report [2] on the Mississippi Valley lead and zinc deposits contains considerable information regarding the distribution and geologic setting of the associated barite deposits of that region. This region, which lies between the southwesterly trending Appalachian Mountains on the east and the southeasterly trending Cordilleras on the west and is bounded on the south by the Southern Highlands, is divided structurally into two parts—the Great Plains and the Central Lowlands—separated by the north-south trending Nemaha-Sioux uplift. The thick Paleozoic and later sediments, which rest on the pre-Cambrian crystalline bedrock, have been flexed into broad domes and basins that constitute the major structural elements of the Mississippi Valley region. Locally, broad, gentle folds are superimposed on the major structural features. Barite deposits occur in both the Great Plains and Central Lowland areas, but only those of the latter region have economic importance at present. In the Great Plains barite has been reported in both the Black Hills uplift of South Dakota and the Llano uplift in Texas. A small quantity of barite has been mined in the latter district.

In the Central Lowland area barite deposits occur on the flanks of the Ozark dome of the Southern Highlands in Missouri; on the Jessamine dome in central Kentucky and the Nashville dome in middle Tennessee—subordinate domes on the Cincinnati geanticline; on the Wisconsin arch of Wisconsin and Illinois; and on a collapsed northeasterly trending dome in the southern part of the Illinois Basin in Illinois and Kentucky. The most important barite-producing district is in Washington County, Mo., on the north flank of the Ozark dome, where the barite is recovered from residual deposits derived from the weathering of barite-bearing veins in the Potosi and Eminence formations of the Cambrian period.

Jewell [3] has described certain barite-bearing veins of probable post-Carboniferous age in the northeastern part of the Central Basin of middle Tennessee. All known veins lie in the Ordovician limestones

[2] Bastin, E. S. (editor), Contributions to a Knowledge of the Lead and Zinc Deposits of the Mississippi Valley Regions: Geol. Soc. America, Spec. Paper 24, 1939, 156 pp.
[3] Jewell, W. B., Barite, Fluorite, Galena, Sphalerite Veins in Middle Tennessee: Am. Inst. Min. and Met. Eng., Paper presented at Tuscaloosa meeting, November 3, 1939, 14 pp.

and range in width from a few inches to 5 or 6 feet, but most of them are 3 feet or less in width. The more persistent have been traced for 2 or 3 miles in length. They strike from N. 30° E. to N. 70° E., and dip 80° to vertical. The vein filling consists mostly of barite, fluorite, calcite, sphalerite, galena, and locally a little pyrite. Alteration products include calamine, limonite, witherite, and greenockite. Jewell, after discussing the possible origin of the veins, concludes that they are hydrothermal veins of the telethermal type, that therefore they will persist in depth, and that, at some unknown distance below the surface, the igneous rocks occur from which the ore solutions were derived. Various attempts have been made to develop and exploit these veins, and small quantities of galena, barite, and fluorite have

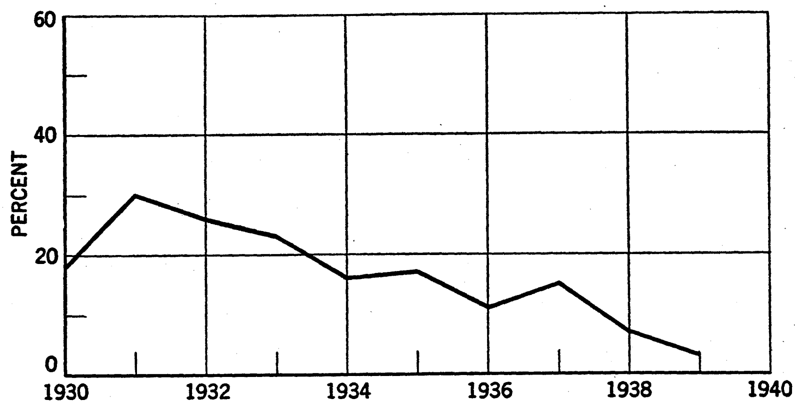

FIGURE 3.—Ratio of imports of crude barite to apparent consumption of crude barite, 1930–39.

been produced. A few carloads of barite were shipped from a deposit in Davidson County in 1934.

Boos [4] describes the occurrence and origin of barite in the form of sand-barite rosettes or "stone roses."

Technologic developments.—The technology of barite is discussed in several recent reports.[5]

Foreign trade.—Imports of crude barite enter the United States chiefly through Atlantic coast ports. In the past imports have consisted largely of German barite that came either from Germany direct or was transshipped from the Netherlands. In 1938, 74 percent of the crude barite imported into the United States originated

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[4] Boos, Margaret Fuller, Sand Barite Rosettes: Mines Mag. (Colorado), vol. 29, No. 12, December 1939, pp. 613–614, 617, 632, 636.

[5] Blyumen, L. M., (Use of Heavy Spar for Introducing Barium Oxide into Glass): Stekolnaya Prom., vol. 4, No. 11, 1938, pp. 8–10.

Noy, J. M., and Bliss, L. G., Witherite in Case Hardening: Foote-Prints, vol. 12, No. 2, December 1939, pp. 15–26.

Kanazawa, Kazuo, (Flotation of Barite): Suiyokwai-Si, vol. 9, 1939, pp. 729–750; Chem. Abs., vol. 33, No. 10, May 20, 1939, p. 3975.

Shreve, R. N., and Toner, R. K., Barium Chloride from Barite and Calcium Chloride: Ind. Eng. Chem., vol. 32, No. 4, April 1940, pp. 568–573.

Engel, A. L., and Shelton, S. M., Progress Reports—Metallurgical Division 36; Ore-testing Studies, 1938–39 (Primarily Ore Dressing): Bureau of Mines Rept. of Investigations 3484, 1940, 34 pp.; *see* pp. 26–28, Sphalerite-Barite Ore from Missouri.

Ralston, O. C., and others, Annual Report of the Nonmetals Division, Fiscal Year 1939: Bureau of Mines Rept. of Investigations 3473, 1939, 40 pp.; *see* p. 33, Electrostatic Separation of Barite and Quartz.

Ralston, O. C., Flotation and Agglomerate Concentration of Nonmetallic Minerals: Bureau of Mines Rept. of Investigations 3397, 1938, 63 pp.; *see* pp. 22–25, Flotation of Barite.

Dean, R. S., Progress Reports—Metallurgical Division 34; Annual Report of the Metallurgical Division, Fiscal Year 1939: Bureau of Mines Rept. of Investigations 3480, 1940, 98 pp.; *see* pp. 69, 71–72, Flotation of Barite Ores.

in Germany; the rest came from Cuba. In 1939, however, there was a complete reversal in relative importance of these sources; no imports were received in that year either from Germany or the Netherlands. Imports of barite from Cuba, on the other hand, nearly doubled those of 1938 and, except for 51 tons from Algeria and 1 ton from Canada, constituted the entire supply from foreign sources. The total quantity of barite imported in 1939 was slightly less than half as great as in 1938, and the average value of the imports dropped from $6.09 per ton in 1938, when German barite was the dominant material imported, to $4.83 per ton in 1939, when virtually all the barite came from Cuba. With the exception of 1921 the total quantity of barite imported in 1939 was the lowest in any year since the World War period. (See fig. 3.)

Half of the world supply of barite is produced in Germany, and normally more than half of the German output is exported, large quantities of crude barite being shipped to the United States, Great Britain, France, Netherlands, and Belgium. Statistical details of the German barite industry, taken from official German sources, are given in a recent publication.[6]

Italy is one of the larger European producers of barite, and its annual output is exceeded only by those of Germany and Great Britain. In 1933 the United States imported 6,493 short tons of barite from Italy, but since then it has taken much smaller quantities (none at all in 1938 and 1939). The most important barite-producing localities are in the Trento, Carrara, and Milan districts in northern Italy and on the Island of Sardinia. Most of the output comes from the Trento district. Details regarding the various occurrences are given in a recent report of the Imperial Institute.[7]

The barite deposits of Greece,[8] formerly a source of barite imports into the United States, are in Melos, Polivos, and Kimolos Islands in the southern part of the Cyclades Archipelago in the Aegean Sea. The barite occurs as the principal gangue mineral of irregular silver-lead bearing deposits in Tertiary or later lavas and probably is of hydrothermal origin, deposited from solutions related to the associated igneous rocks. Operations, which were begun in 1934, have been confined principally to Melos. The other islands have been little explored. Imports of barite into the United States from Greece reached a maximum of 9,026 short tons in 1937 and then stopped.

Cuba has become an important foreign source of barite for the domestic industry. Barite deposits are known to exist in the Provinces of Oriente and Pinar del Rio.[9] The deposits in Oriente are so inaccessible that no effort has been made in recent years to develop them on a commercial scale. In Pinar del Rio most of the deposits are also inaccessible, and cost of development under present economic conditions is too high to justify exploitation. Only two barite deposits in Pinar del Rio are reported as being exploited at present. These are the deposits of San Luis de Managuacos, the property of the Compañia Marmolera e Industrial del Cangre, S. A., and the deposits of

[6] Bureau of Mines Mineral Trade Notes, Barite in Germany: Vol. 8, No. 5, May 1939, pp. 26–27.
[7] Imperial Institute, Barium Minerals: 2d ed., London, 1937, 84 pp.
[8] Siotis, G. J., The Barytes Deposits of Greece: Sands, Clays, and Minerals, vol. 3, No. 1, November 1936, pp. 43–46.
Imperial Institute, Work cited in footnote 7.
[9] Thiel, C. L., American consul, Habana, Cuba, Barite Production in Cuba: Consular Rept., July 26, 1939, 7 pp.; Bureau of Mines Mineral Trade Notes: Vol. 9, No. 3, September 20, 1939, pp. 28–29.

Abraham Perez at Ysabel Maria. The total output of both of these mines is shipped to the United States. Barite production in Cuba was begun in 1936. Imports into the United States have increased each year from 183 short tons in 1936 to 11,536 tons in 1939.

Canada has started a small barite industry, and in 1939 made an output for the first time since 1933.[10] The production—300 short tons—came from a mine near South Porcupine, Ontario, about 400 miles north of Toronto; it is operated by the Canada Barytes Mines, Ltd., which has an option and lease on the mine and mill of the Canada Night Hawk Mines, Ltd. The property was first developed

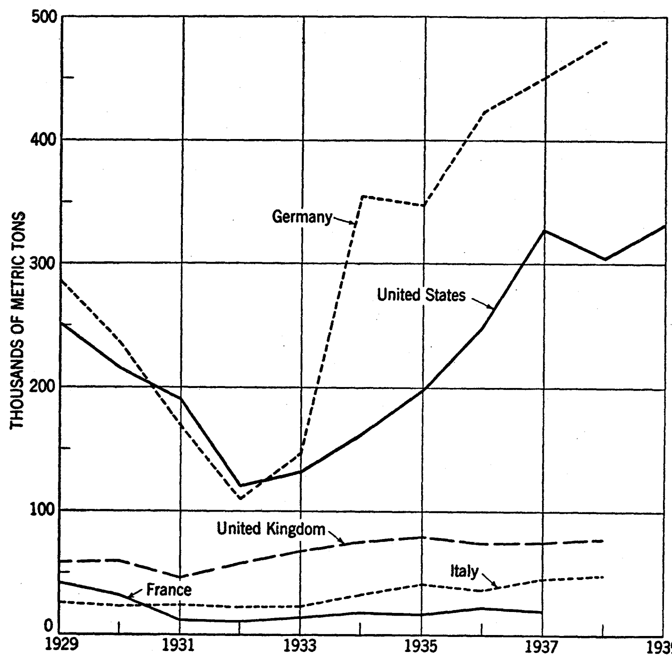

FIGURE 4.—World production of crude barite by countries, 1929–39.

in 1933, when 60 short tons of barite were produced. The shipment of 1 ton to New York, noted in the import statistics, is said to have been a trial order.

Barite has been found in several States of Brazil,[11] particularly in Minas Geraes, where deposits have been exploited to a small extent for local use, largely in paint manufacture. The present output is estimated at about 600 metric tons annually. None has been exported. Development of the barite deposits has been hindered by unfavorable transportation facilities and lack of capital.

Exports of crude barite from the United States are not separately recorded.

[10] Heacock, R. L., American vice consul, Toronto, Canada, Barium Mine Resumes Production: Consular Rept., August 22, 1939, 2 pp.; Bureau of Mines Mineral Trade Notes: Vol. 9, No. 3, September 20, 1939, pp. 27–28.

[11] Winslow, R. R., American consul, Rio de Janeiro, Brazil, Barite in Brazil: Consular Rept., April 5, 1939, 10 pp.; Bureau of Mines Mineral Trade Notes: Vol. 8, No. 5, May 20, 1939, pp. 24–26.

Crude barite imported for consumption in the United States, 1938–39, by countries

Country	1938		1939	
	Short tons	Value	Short tons	Value
Algeria	---	---	51	$161
Canada	---	---	1	7
Cuba	6,367	$27,578	11,536	55,817
Germany	4,200	27,188	---	---
Netherlands	14,278	96,469	---	---
	24,845	151,235	11,588	55,985

World production.—Germany and the United States are by far the leading barite-producing countries of the world. (See fig. 4.) Few figures are available for 1939 regarding the barite production of the various barite-producing countries, but in 1937 and 1938 the United Kingdom, Italy, Greece, France, and British India were also important producing nations.

World production of barite, 1935–39, by countries, in metric tons

[Compiled by M. T. Latus]

Country [1]	1935	1936	1937	1938	1939
Algeria	---	---	2,137	3,069	(2)
Australia:					
New South Wales	207	149	268	322	(2)
South Australia	2,378	2,009	2,736	2,909	3,886
Tasmania	---	34	77	---	---
Victoria	---	---	71	---	---
Brazil (exports)	---	---	600	(2)	(2)
Chosen	11,027	5,113	8,400	(2)	(2)
Cuba	---	---	3,849	---	12,000
Egypt	85	30	51	20	(2)
France	16,900	22,200	19,850	(2)	(2)
Germany:					
Austria	797	1,663	855	373	(2)
Baden	12,445	17,800	21,653	36,305	(2)
Bavaria	7,073	11,175	11,832	26,748	(2)
Prussia [3]	326,950	392,103	410,634	401,906	(2)
Saxony	222	467	432	230	(2)
Thuringia	554	450	6,790	15,315	(2)
Württemburg	(2)	1,000	192	---	(2)
Greece	23,091	31,336	39,343	34,700	(2)
India, British	5,581	5,196	15,941	8,205	(2)
Indochina	---	40	45	50	(2)
Italy	41,152	36,671	45,202	48,169	(2)
Japan	---	3,837	(2)	(2)	(2)
Norway	---	408	70	---	(2)
Portugal	---	10	101	24	(2)
Southern Rhodesia	---	---	---	91	50
Union of South Africa	627	583	570	491	439
United Kingdom	79,386	74,242	74,485	77,543	(2)
United States	197,833	248,624	327,380	304,298	331,910

[1] In addition to the countries listed, barite is produced in Canada, China, Czechoslovakia, Spain, and the U. S. S. R.
[2] Data not available.
[3] Official figures which, it is reported, cover only output of mines included under the mining law.

BARIUM PRODUCTS

Sales.—The quantities of ground or refined barite, lithopone, and artificial barium carbonate sold or used by producers in 1939 were greater than in 1938, in response to marked increases in the demand for all of these barium products. Blanc fixe (precipitated barium sulfate) sold or used by producers, however, decreased for the second consecutive year but did not decline to the 1936 figure. The demand for "other barium chemicals" was less in 1939 than in 1938 but was above that in other recent years. Detailed statistics of barium products during the past 5 years are given in the following table.

Barium products sold or used by producers in the United States, 1935–39 [1]

Product	1935	1936	1937	1938	1939
Ground barite:					
Plants	11	13	12	14	13
Short tons	76,250	69,102	129,777	[2] 161,422	[2] 170,695
Value	$1,407,787	$1,217,818	$2,249,612	[2] $2,786,823	[2] $2,902,973
Lithopone: [3]					
Plants	11	11	11	11	11
Short tons	159,486	158,319	154,771	125,746	142,759
Value	$13,470,274	$12,976,754	$12,069,790	$9,975,012	$10,461,102
Blanc fixe (precipitated barium sulfate):					
Plants	6	6	7	7	6
Short tons	18,067	16,149	28,250	19,428	18,653
Value	$980,191	$890,310	$1,614,764	$921,203	$898,198
Artificial barium carbonate (chemically precipitated):					
Plants	3	3	3	4	5
Short tons	7,329	11,347	10,755	9,543	12,478
Value	$357,585	$515,624	$511,357	$459,901	$617,799
Other barium chemicals: [4]					
Plants	5	7	6	5	7
Short tons	7,520	8,893	8,632	10,963	9,858
Value	$642,576	$698,942	$796,988	$728,896	$814,170
Total barium products:					
Short tons	268,652	263,810	332,185	[2] 327,102	[2] 354,443
Value	$16,858,413	$16,299,448	$17,242,511	[2] $14,871,835	[2] $15,694,242

[1] To avoid duplication, the barium chemicals reported here do not include the output of firms that make these chemicals from such products as barium chemicals and imported barite and witherite purchased in the open market.
[2] Includes crushed barite.
[3] Does not include cadmium lithopones.
[4] Figures cover chemicals, in order of value, as follows: 1935 and 1937: Chloride, dioxide, sulfide, and hydroxide; 1936 and 1938: Chloride, dioxide, sulfide, hydroxide, and oxide; 1939: Chloride, dioxide, hydroxide, sulfide, and oxide.

Lithopone is used principally in the paint industry. Smaller quantities are consumed by the floor-covering, textile, and rubber industries. Sales of lithopone, 1937–39, by consuming industries, are shown in the following table.

Lithopone [1] *sold or used by producers, 1937–39, by consuming industries*

Industry	1937		1938		1939	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Paints, enamels, and lacquers	122,915	79.4	101,924	81.1	113,995	79.9
Floor coverings and textiles	20,194	13.1	15,400	12.2	17,429	12.2
Rubber	4,383	2.8	3,148	2.5	3,189	2.2
Other	7,279	4.7	5,274	4.2	8,146	5.7
	154,771	100.0	125,746	100.0	142,759	100.0

[1] Does not include cadmium lithopone.

Data on ground barite sold or used by producers, classified by consuming industries, are given in the accompanying table; this information is available for 1938 and 1939 only.

Ground or refined barite sold or used by producers, 1938–39, by consuming industries

Industry	1938		1939	
	Short tons	Percent of total	Short tons	Percent of total
Well drilling	126,697	78	125,560	74
Paint	8,227	5	9,750	6
Glass	[1] 7,963	5	[1] 12,586	7
Rubber	2,944	2	3,319	2
Undistributed	15,591	10	19,480	11
	[1] 161,422	100	[1] 170,695	100

[1] Includes crushed barite as follows: 1938, 7,121 short tons; 1939, 11,678 tons.

Prices.—Quotations for ground barite at \$23.65 a short ton in 1939 were the same as in 1938, but by March 1940 they had risen to \$25.65. Prices of ground witherite had a wider range in 1939 (\$41 to \$47 a ton) than in 1938 (\$41 to \$44) and like those of ground barite had risen by March 1940 to \$45 to \$47 a ton. Precipitated barium carbonate quotations remained unchanged from 1938. Lithopone (ordinary) quotations in 1939 showed lower limits than in 1938 (⅜ cent in the lower limits and ½ cent in the upper limits). The upper range in the price of barium chlorate rose to 25 cents a pound in 1939 from 17½ cents in 1938; in March 1940 it was quoted at 20 to 22 cents a pound. Barium chloride prices were unchanged in 1939 from 1938, as were those for barium dioxide. Quotations for high-grade precipitated blanc fixe reached \$80 a ton in 1939 from \$75 a ton in 1938. Pulp-grade blanc fixe quotations were the same in 1939 as in 1938 but in March 1940 had risen from the 1939 quotation of \$40 a short ton to \$50. Barium nitrate quotations also were higher in 1939 than in 1938; in March 1940 they were 9½ to 10½ cents a pound.

Range of quotations on barium products, 1937–39 [1]

	1937	1938	1939
Ground barite, carlots, 350-pound barrels, works short ton	\$23.65	\$23.65	\$23.65
Ground witherite, carlots, bags, works [2] do	\$42.00 - 45.00	\$41.00 - 44.00	\$41.00 - 47.00
Lithopone:			
Domestic, ordinary, delivered, bags pound	.04¼- .04⅝	.04⅛- .04⅝	.03¾- .04⅛
Do barrels do	.04½- .04⅞	.04⅜- .04⅞	.04 - .04⅜
High strength, bags do	.05¾- .06⅛	.05⅝- .06⅛	.05¼- .05⅝
Do barrels do	.06 - .06⅜	.05⅞- .06⅜	.05½- .05⅞
Titanated, bags do	.05¾- .06⅛	.05⅝- .06⅛	.05¼- .05⅝
Do barrels do	.06 - .06⅜	.05⅞- .06⅜	.05½- .05⅞
Barium carbonate, precipitated, 200-pound bags, works short ton	52.50 - 62.50	52.50 - 62.50	52.50 - 62.50
Barium chlorate, 112-pound kegs, New York pound	.16½- .17½	.16½- .17½	.16½- .25
Barium chloride, barrels, delivered zone 1 short ton	74.00 - 92.00	77.00 - 92.00	77.00 - 92.00
Barium dioxide (binoxide or peroxide), 88 percent, 690-pound drums pound	.11 - .12	.11 - .12	.11 - .12
Barium hydrate, 500-pound barrels do	.04¾- .05½	.04¾- .05½	.04½- .05½
Barium nitrate, barrels do	.07 - .08¼	.06¾- .08¼	.06¾- .10½
Barium sulfate, precipitated (blanc fixe), 400-pound barrels, works [3] short ton	40.00 - 75.00	40.00 - 75.00	40.00 - 80.00

[1] Chemical Industries (formerly Chemical Markets), New York (monthly).
[2] 90 percent. [3] Lowest price for pulp grade, highest for high-grade precipitated.

Technology.—Barium-zinc lithopone is the most important single chemical made from barite. A comprehensive description of the process of manufacture of this type of lithopone, with a detailed flow sheet and list of patents, is given in a recent article by Mactaggart.[12] Briefly the process is as follows: Run-of-mine barite is crushed to minus 4-mesh and fed, with coal of similar size, to a rotary furnace heated by gas or pulverized coal. The barite is reduced to barium sulfide. The product ("black ash")—barium sulfide, ash, and unburned coal—is mixed with a weak solution of barium sulfide; the slurry passes into a tube mill and is finely ground; the barium sulfide is leached out of the black ash by a countercurrent leaching system, clarified, and carried to a barium sulfide storage tank. Barium sulfide and zinc sulfate solutions are run separately into a tank and mixed with the help of an agitator. The slurry so formed is treated in a thickener and then passed to a continuous vacuum filter. The filter cake is first dried, then calcined at 750° to 800° C., quenched, and ground in a pebble mill. The ground lithopone passes to classifiers, hydroseparators, thickeners, and filters. This filter cake is dried and disintegrated or ground.

Some cadmium lithopone—that is, lithopone in which the zinc sulfide is replaced by cadmium sulfide—is produced in this country and has been used as a rubber pigment and as a pigment for coloring artificial resin compounds.[13] The cadmium yellows made in the United States are said by Brown [14] to be combinations of cadmium sulfide and barium sulfate, with or without zinc compounds. They are produced in shades ranging from primrose yellow to light chrome orange. Because of their high cost, they are used only for special purposes.

Foreign trade.—Imports of all classes of barium compounds (except barium dioxide, barium hydroxide, witherite, and barium oxide) for consumption in the United States in 1939 decreased in both quantity and value from 1938. Barium dioxide and barium hydroxide imports did not reach the 1936 figures, however, and imports of witherite did not equal those of 1937. There were no imports of precipitated barium carbonate.

Considerable ground barite is exported. An important market is Trinidad, where it is used in oil-well drilling to weight the drilling mud. Imports of barite into Trinidad range from 20,000 to 25,000 tons a year. Germany and the United States have been the principal sources of supplies. Specifications call for barite of not less than 4.25 specific gravity and a fineness of at least 98.75 percent to pass a 300-mesh screen. The barite arriving in Trinidad usually is packed in 120-pound, six-ply paper bags or in double jute sacks. Some of the barite used in the drilling operations is reclaimed from the impregnated mud; the quantity so reclaimed is estimated at about 20,000 tons annually.[15]

The quantity of lithopone exported in 1939 was greater than in any year since 1922—when exports of barium products were first recorded separately—and probably before that date as well, because appreciable quantities of barium products had not been exported; the total value

[12] Mactaggart, E. F., The Manufacture of Lithopone: Industrial Chemist (London), vol. 16, No. 181, February 1940, pp. 72–77; largely reprinted in Canadian Chem. and Process Ind., vol. 24, No. 3, March 1940, pp. 107–111.

[13] Imperial Institute, Mineral Industry of the British Empire and Foreign Countries, Cadmium: London, 1929, 23 pp. (*See* pp. 9, 23.)

[14] Brown, A. F., Chemical Colors: Paint, Oil, and Chem. Rev., vol. 97, No. 8, April 18, 1935, pp. 32–36. (Paper presented at the Symposium on Paint and Paint Materials at the 1935 Regional Meeting of the Am. Soc. Test. Mat. March 5–6 at Philadelphia, Pa.)

[15] Bureau of Foreign and Domestic Commerce, Barytes Used Extensively in Oil Fields—Trinidad: World Trade Notes, vol. 13, No. 35, September 2, 1939, pp. 591–592. Imports into Trinidad by countries for last 3 years also are given.

of the lithopone exported in 1939 ($392,798) was much less than in 1929, when it reached $463,235. The average value of the exports in 1939 ($81.07) was the lowest ever recorded.

Barium compounds imported for consumption in the United States, 1935–39

[Value at port of shipment]

Year	Ground barite		Lithopone		Barium dioxide		Blanc fixe (precipitated barium sulfate)		Barium carbonate (precipitated)	
	Short tons	Value	Short tons	Value	Pounds	Value	Short tons	Value	Short tons	Value
1935	3,354	$28,766	4,603	$256,731	450	$72	141	$9,403	11	$631
1936	2,873	28,397	4,781	273,571	1,392	223	123	6,971	30	889
1937	3,313	35,046	5,601	302,417	229	34	109	7,617	30	848
1938	1,700	15,466	3,932	207,121	100	13	106	5,102	(1)	32
1939	1,590	14,999	2,641	130,893	350	51	38	1,891		

Year	Witherite, crude, unground		Barium chloride		Barium nitrate		Barium hydroxide		Barium oxide		Barium compounds (n. e. s.)	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Pounds	Value	Short tons	Value
1935	2,634	$48,551	392	$17,170	258	$24,412	271	$16,987	33	$26	8	$1,852
1936	2,464	44,475	244	10,355	185	19,107	370	25,423	287	155	8	2,231
1937	4,556	82,341	315	13,761	157	15,836	310	21,004	298	161	28	6,455
1938	2,115	43,568	69	2,351	126	12,061	236	16,874			50	11,320
1939	3,819	64,106	39	1,329	100	11,094	360	19,975	22	13	27	7,244

1 110 pounds.

Lithopone exported from the United States, 1935–39

Year	Short tons	Value: Total	Value: Average	Year	Short tons	Value: Total	Value: Average
1935	2,372	$221,611	$93.43	1938	1,734	$153,567	$88.56
1936	2,538	229,942	90.60	1939	4,845	392,798	81.07
1937	2,671	231,622	86.72				

POTASH

By J. H. Hedges

SUMMARY OUTLINE

During a 20-year period beginning in 1911, various agencies of the Federal Government spent about $2,000,000 searching for sources within the United States from which domestic needs for potash might be economically supplied. Government initiative soon inspired private efforts that led to the founding of a major industry. Now that history is repeating itself in Europe and potash imports again are declining, with the possibility that they may cease altogether, an evaluation of the public benefits derived from this program is in order.

In 1939 American producers supplied 634,000 short tons of potash salts, for which they realized an average of $18.97 per ton at the plants. They may be called upon to deliver an even larger tonnage in 1940, as imports continue to decline. Increased costs may force prices somewhat higher; but no material advance is likely, and any prospective demand can be supplied from domestic sources, if necessary. Contrast this with the situation after the outbreak of the World War. In 1915 the then infant industry produced 4,374 short tons of low-grade potash salts that sold for an average price of $78 per ton f. o. b. plant. In 1916, when importers' stocks were exhausted and imports virtually ceased, the average price obtained at the plant for some 35,700 tons of potash salts produced and sold rose to $119 per ton and did not again drop below $100 until after the war was over. Even at these prices, the maximum output reached was 55,000 tons of K_2O, or about 20 percent of pre-war consumption. At the peak of the potash shortage as much as $500 a ton was paid for muriate on the eastern seaboard. The cost to the ultimate consumer in high prices for certain farm products that cannot be grown successfully without fertilizer was incalculable.

With Europe again at war, no potash shortage now threatens the United States; there is no prospect that the farmer will have to pay exorbitant prices for his potash. This fortunate situation is directly attributable to the foresight that led the Federal Government to pioneer in the search for potash resources and to encourage and foster the building of a domestic industry that now can supply cheaply all the potash required to meet essential needs.

Some measure of the economic significance of these developments may be obtained by applying 1915 prices to prospective 1940 consumption, remembering that with respect to foreign supplies the experience of 1915 is likely to be repeated in 1940. The average price of potash f. o. b. plant was $3.14 a unit of K_2O in 1915 (increased to $4.36 in 1916). In 1939 the average value at the plant was 33 cents a unit, a decrease from the 1915 figure of $2.81 a unit or $281 a ton of K_2O.

Consumption in 1940 may approximate 450,000 tons of K_2O at a total cost approximately $126,000,000 less than for the same quantity in 1915 at the prices then prevailing. Although it would be absurd to claim a direct saving of this amount it is obvious that enormous benefits have accrued to the American people from the discovery and development of domestic resources of potash. By comparison with many other basic industries the potash industry bulks small, but because of its essential character its importance in the national economy is out of all proportion to the dollar value of its products.

Potash is used principally as an ingredient of mixed fertilizers; hence the demand for potash closely follows fertilizer sales, which in turn reflect farm income, although this relationship has been obscured in recent years by farm-benefit payments and crop-control programs. Fertilizer sales continued in 1939 at about the 1938 level; and, if allowance is made for extension of the final delivery date on 1939 discount contracts to January 31, 1940, instead of completing deliveries within the calendar year, as in 1938, a drop of about 3 percent from 1938 sales of potash for consumption in the United States and its possessions is indicated. However, the proportion of total sales that was supplied by American producers rose sharply to establish a new record, although production fell slightly below that in 1938.

During the last 4 months of the year, following the invasion of Poland on September 1 and subsequent events that virtually cut off shipments from Germany, only 52,723 tons of potash fertilizer salts were imported compared with 230,481 tons during the corresponding period in 1938. By virtue of "trading-with-the-enemy" laws the N. V. Export My. was dissolved and its affairs liquidated when war was declared between France and Germany. The French Potash Co., with offices at 30 Rockefeller Plaza, New York City, was incorporated to import and sell French potash salts and the Pioneer Potash Co., with offices at 44 Whitehall Street, New York City, to handle German business. It is reported that all N. V. contracts have been filled from stocks held in this country and at Antwerp and Rotterdam, sizable shipments having been received in January and February 1940; thus the war appears to have had little effect on delivery of the tonnage contracted for during the 1939 discount period, except for delayed completion of some importers' contracts.

Six domestic producers reported a total output in 1939 of 524,986 tons of potash salts equivalent to 307,051 tons of K_2O, a decrease from 1938 of 2 percent in gross tonnage and 3 percent in contained potash. Producers' sales increased 28 percent from 286,437 tons of K_2O in 1938 to 366,287 tons of K_2O in 1939. Sales exceeded production by about 60,000 tons, and stocks were reduced about 66 percent—to 29,440 tons of K_2O. Potash sold by producers and importers for use in agriculture and industry in the United States and its possessions totaled 393,549 tons of K_2O, of which American producers supplied 72 percent (282,487 tons).

Exports of 140,329 tons of salts equivalent to 83,800 tons of K_2O valued at $5,254,840 represented increases from 1938 of 62 percent in bulk, 63 percent in K_2O, and 70 percent in value. Imports of 254,692 tons of salts equivalent to 99,569 tons of K_2O valued at $8,158,334 represented decreases from 1938 of 43 percent in bulk, 49 percent in K_2O, and 40 percent in value. Thus the decline in imports during 1938 continued at an accelerated pace in 1939, influenced in part by the outbreak of hostilities in Europe.

The potential capacity of American producers, without major additions to plants or equipment, has been estimated by the Federal Geological Survey to be approximately 540,000 tons of K_2O per year, considerably more than probable needs. Any deficiency in high-grade salts that might develop can be made up by increased output of manure salts, which can be mined in New Mexico to average around 25 percent K_2O. Some apprehension has been expressed concerning the supply of sulfate, for which this country formerly depended almost entirely on imports; however, this salt now is being produced by three companies at the rate of about 48,000 tons a year, and a new plant for the manufacture of sulfate is expected to begin operations toward the end of 1940. In 1939 approximately 49,000 tons of sulfate of potash and 15,000 tons of sulfate of potash-magnesia were sold for consumption in the United States. Many agronomists believe that sulfate is not essential for some crops to which it customarily has been applied, and its advantages in many instances do not justify farmers in paying the higher price it commands. Hence the demand for sulfate conceivably may decline, and the supply doubtless will be adequate for essential uses. Following the outbreak of war American producers voluntarily restricted export sales of all potash materials to guard against any possibility of a shortage in the American market.

Natural brines and bedded saline deposits were the sources from which nearly 99 percent of the 1939 output of potash was drawn. As in past years, a small tonnage was derived from cement-plant dust and distillery waste. The three major companies (American Potash & Chemical Corporation, Potash Co. of America, and United States Potash Co.) produced 97 percent of the total. Bonneville, Ltd., treating brine from the Salduro marsh at its plant near Wendover, Utah, reported increased production in its second year of operation. As the process employed utilizes solar evaporation, operation of the plant is seasonal, although in that desert region many months of hot, dry weather may be counted upon with considerable assurance. Producers of byproduct potash were the North American Cement Corporation and United States Industrial Chemicals, Inc.

Salient statistics of the domestic potash industry for 1938 and 1939 are summarized in the following table:

Salient statistics of the potash industry (crude and refined potash materials) in the United States, 1938–39

	1938	1939
Production:		
Potassium salts .... short tons	534, 945	524, 986
Approximate equivalent, K_2O .... do	316, 951	307, 051
Sales by producers:		
Potassium salts .... do	498, 189	634, 014
Approximate equivalent, K_2O .... do	286, 437	366, 287
Value at plant	$9, 748, 290	$12, 028, 195
Average per ton	$19. 57	$18. 97
Imports:		
Crude and refined .... short tons	450, 387	254, 692
Approximate equivalent, K_2O .... do	193, 609	99, 569
Value	$13, 512, 110	$8, 158, 334
Exports:		
Fertilizer materials .... short tons	84, 137	136, 750
Approximate equivalent, K_2O .... do	50, 500	82, 000
Value	$2, 599, 772	$4, 446, 853
Other .... short tons	2, 616	3, 579
Approximate equivalent, K_2O .... do	1, 300	1, 800
Value	$485, 672	$807, 987

PRICES

The initial price schedule for the 1939–40 fertilizer season, issued by importers May 26, 1939, offered potash salts for prompt shipment from Europe at the base prices of the previous year c. i. f. Atlantic, Gulf, and Pacific ports, subject to 12-percent discount and guaranteed with respect to price reductions. In later schedules issued in June by the importers and the three major producers the price of sulfate of potash (90 percent K_2SO_4) was reduced from $38 to $36.25 per short ton, sulfate of potash-magnesia (48 percent K_2SO_4) from $25.75 to $24.75 per ton, and kainite (20 percent K_2O) from $12.75 to $12.25 per ton, the prices for other salts remaining the same. Quotations c. i. f. Atlantic, Gulf, and Pacific ports were as follows:

Muriate of potash—all grades	53½ cents per unit K_2O.
Manure salts—30 percent K_2O	58½ cents per unit K_2O.
Kainite—20 percent K_2O	$12.25 per ton.
Sulfate of potash—90 percent K_2SO_4	$36.25 per ton.
Sulfate of potash-magnesia—48 percent K_2SO_4	$24.75 per ton.

These base prices were subject to a discount of 12 percent on all orders placed before July 20, for delivery in approximately equal monthly quantities over the period from August 1, 1939, to January 31, 1940, and of 5 percent on orders placed before October 1, 1939, for delivery in approximately equal monthly quantities from October 1, 1939, to January 31, 1940. From October 1 prices were net for the remainder of the season ending May 31, 1940. The only changes from 1938 were decreases of $1.75, $1.00, and 50 cents per ton, respectively, in list quotations for sulfate of potash, sulfate of potash-magnesia, and kainite and extension of the maximum discount period to July 19 instead of June 30 and of the delivery period to January 31 instead of December 31. Extension of the delivery period into 1940 throws out of balance the record of sales in 1939 in relation to sales reported in 1938. To reach a comparable figure, contract deliveries in January 1940, estimated at about 60,000 tons of K_2O, must be added to deliveries reported in 1939.

The following table shows the monthly average prices prevailing during 1939, in accordance with published schedules and discounts:

Average prices per short ton of potash salts in the United States in 1939, by months

Month	Muriate of potash, 50 percent K_2O, in bulk	Sulfate of potash, 90 percent K_2SO_4, in bags	Sulfate of potash-magnesia, 48 percent K_2SO_4, in bags	Manure salts, 30 percent K_2O, in bulk	Kainite, 20 percent K_2O, in bulk
January to April	$26.75	$38.00	$25.75	$17.55	$12.75
May	26.13	36.81	24.98	17.14	12.37
June	23.54	31.90	21.78	15.44	10.78
July	24.26	32.88	22.50	15.92	11.11
August and September	25.41	34.44	23.51	16.67	11.64
October to December	26.75	36.25	24.75	17.55	12.25

CONSUMPTION AND USES

Producers and importers of potash salts sold and delivered approximately 387,000 short tons of potash in 1939 for consumption in the United States and its possessions; 93 percent was for agricultural and

7 percent for industrial use. For comparison with 1938, when deliveries on contracts were completed December 31, about 60,000 tons—representing estimated deliveries in January 1940 on 1939 contracts—should be added to this figure. Thus sales of potash for domestic use in 1938 and 1939, adjusted to a comparable basis, would be 467,000 and 447,000 tons, respectively, indicating a decline in potash consumption in 1939 of about 20,000 tons of K_2O.

The American Potash Institute reports that deliveries by member companies in the United States and its possessions in 1939 totaled 365,049 tons of potash and that 77,675 tons were exported. Importations and sales of all other primary suppliers amounted to 28,500 tons, indicating a total movement of potash of 471,224 tons from primary sources to buyers. Deducting exports of 83,800 tons leaves 387,424 tons delivered to purchasers for consumption in the United States. Apparent consumption calculated by subtracting exports (83,800 tons) from the sum of domestic sales (366,287 tons) and imports (99,569 tons) was 382,056 tons. Adjustment of the total of reported sales to the basis of completed deliveries reduces apparent consumption as calculated above to 367,000 tons and indicates withdrawal from importers' stocks of salts equivalent to about 23,000 tons of K_2O.

Differences in the methods of reporting to various agencies dealing with the statistical position of the potash industry lead to discrepancies sometimes difficult to explain, although in general these differences are compensating over a period of years. Figures published by the American Potash Institute, for example, represent deliveries of material sold in accord with a very precise definition of "deliveries" that is suited to the purposes of the institute and its members. Sales for any one year reported accurately to the Bureau of Mines may differ in greater or less degree from the record of transactions completed within that year as reported by the institute. In 1939, reported sales exceeded recorded completed transactions by about 15,000 tons of K_2O.

The following table gives as accurate a picture of sales for consumption in the United States and for export as can be drawn by combining information derived from numerous sources adjusted to a comparable basis.

Sales of primary potash in the United States for consumption and export, 1938–39, in short tons of K_2O

	1938	1939
Deliveries by member companies, as reported by American Potash Institute—		
In United States and possessions:		
Agricultural	423,977	340,765
Chemical	15,584	24,284
For export	40,843	77,675
	480,404	442,724
Imports, not included above, plus sales of nonmember producers	38,938	28,500
	519,342	471,224
Total exports	51,800	83,800
Actual sales for consumption in United States	467,542	387,424

PRODUCTION AND SALES

The output of marketable salts by domestic mines and plants leveled off in 1939 and continued at about the 1938 rate, although the aggregate tonnage produced in 1939 fell slightly below that of the previous year. The extra tonnage required to satisfy increased sales was drawn from stocks, and no high-pressure efforts were made to operate plants continuously at full capacity. It is believed that the annual output of refined salts by existing plants could be stepped up at least 20 percent, if necessary.

Potash production decreased 3 percent, from 316,951 tons in 1938 to 307,051 tons in 1939. Increased output of the 50-percent grade of muriate, which for some obscure reason is in considerable demand, lowered the average grade from 59.2 percent K_2O in 1938 to 58.5 percent in 1939. Fertilizer manufacturers appear to prefer lower-analysis salts for certain mixtures, notwithstanding the higher unit cost at inland points.

Sales attained a new high, rising 28 percent from 286,437 tons of K_2O in 1938 to 366,287 tons in 1939. Producers supplied about 72 percent of the home market, and about 23 percent of their sales was exported, either directly or through resale by buyers.

Production and sales of marketable potassium salts and stocks in the hands of producers for the last 5 years are summarized in the following table. Only the final weight of marketable salts after refining or mixing is shown. For similar data from the beginning of the potash-producing industry in 1915 to 1934 see the chapter on Potash in Minerals Yearbook, 1935. Data by States and sources cannot be given without disclosing individual reports.

Potassium salts produced, sold, and in producers' stocks in the United States, 1935–39

Year	Production			Sales				Producers' stocks		
	Operators	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)	Operators	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)	Value f. o. b. plant	Operators	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)
1935	10	357,974	192,793	10	406,922	224,721	$4,993,481	6	47,710	18,060
1936	7	431,470	247,340	7	396,690	222,810	6,969,190	5	73,139	34,000
1937	7	486,090	284,497	7	466,933	266,938	9,019,534	5	105,900	55,620
1938	9	534,945	316,951	9	498,189	286,437	9,748,290	6	158,540	87,440
1939	6	524,986	307,051	6	634,014	366,287	12,028,195	5	54,233	29,440

GOVERNMENT ACTIVITIES

The uncompleted investigation of the potash industry by the Senate Committee on Public Lands, begun in 1936 pursuant to Senate Resolution 274 (agreed to June 18, 1936), was in abeyance throughout 1939. The committee is especially concerned with the extent and implications of foreign ownership or control of American potash companies and the conditions under which deposits belonging to the Government are being exploited. The investigation was pursued vigorously for a year or so, but the committee was not ready to report to the Seventy-fourth Congress as required by the resolution. An extension of 2 years was granted in 1937, and in 1938 the time again was extended to permit submission of the committee's report any time before expiration of the Seventy-sixth Congress at midnight December 31, 1940.

The Department of Justice, which had begun a general investigation of the fertilizer industry in 1936, undertook a special study of the potash industry by its Antitrust Division in February 1939. Material assembled in this investigation was placed before a Federal grand jury in New York, which was reported to have returned a sealed indictment in June that had not yet been officially filed at the end of February 1940. The Department of Justice is understood to be seeking satisfactory ground for a consent decree that would obviate the necessity of prosecuting the reputed indictment and would provide certain changes in pricing and trade practices believed by the Department to be desirable.

In its studies of various industries the Department of Justice on several occasions has sought the advice and assistance of other Departments more intimately acquainted with the organization and functioning of an industry under consideration. Early in 1939, at the suggestion of the Department of Justice, an economic study of the potash industry was undertaken by the Department of Commerce to examine the industry's performance and make such recommendations for changes in practices as might appear necessary in the public interest. Throughout this study the Department of Commerce had the wholehearted cooperation of the three domestic potash companies and the importer. Many conferences were held with the principal executives and attorneys of the companies at which policies and performance of the industry were discussed in detail. Each of the four companies submitted upon request a comprehensive report with subsequent supplementary reports showing full and intimate details of its operations. All data submitted to the Department of Commerce have been made freely available by the companies to the Department of Justice for the information and use of its economic staff. At the close of the year a report was being prepared for submission to the Department of Justice.

Six leases embracing 6,409.6 acres of potash-bearing areas in Searles Lake, San Bernardino County, Calif., were sold to the highest bidders by the General Land Office at public auction in Sacramento, October 19, 1939, at 11 a. m. Four units aggregating 5,969.6 acres were awarded to the American Potash & Chemical Corporation and two units aggregating 440 acres to the West End Chemical Co. For a number of years these two companies have operated plants for the treatment of Searles Lake brines, from which the West End Chemical Co. recovers borax and soda ash and the American Potash & Chemical Corporation extracts directly or prepares by base-exchange methods muriate and sulfate of potash, borax, salt cake, soda ash, and lithium compounds. Bids included bonus payments aggregating $189,156.52. Lessees are required to invest $50,000 each on three of the units in actual development and improvements and $200,000 each on the other three. The Government is to receive a 3-percent royalty on the gross value of all products at the point of shipment and a rental of 25 cents per acre the first year, 50 cents during the next 4 years, and $1 per acre thereafter. It is estimated that royalties from these leases will exceed $50,000 annually.

REVIEW BY STATES

California.—Potash is but one of the products extracted commercially from the complex brine of Searles Lake by the American Potash & Chemical Corporation at Trona. Borax, soda ash, and salt cake likewise are recovered, and in 1938 sodium-lithium phosphate was added to the list. Preparations are now being made to save some of the bromine; the Searles Lake brine contains about 12 times as much as sea water. Brine entering the plant annually carries nearly 10,000,000 pounds of bromine, of which 2,000,000 to 3,000,000 pounds will be recovered in the form of liquid bromine and alkali bromides. Formerly high-grade muriate was the only potash salt produced by this company, but in 1939 the manufacture of sulfate of potash by base exchange with sodium sulfate was begun. The sulfate plant is reported to have a daily capacity of about 100 tons. Leases covering about 6,000 acres of Searles Lake added to the company holdings during the year assure an adequate supply of brine for many years to come.

Maryland.—No new developments relating to potash were reported in operations of the North American Cement Corporation, Hagerstown, or U. S. Industrial Chemicals, Inc., Baltimore, which recover small quantities of potash materials from cement-kiln flue dust and molasses-distillery waste, respectively.

New Mexico.—Operations at the mines of the United States Potash Co. and the Potash Co. of America near Carlsbad continued on approximately the same scale as in 1938. Interruptions incident to unionization of the mines reduced somewhat the total tonnage of ore mined and the output of refined salts. However, stocks sufficed to meet requirements.

A suit filed in 1938 by three Pecos Valley farmers to recover $250,000 from the United States Potash Co. for alleged damage to land and crops by infiltration of brine from the refinery-waste pond into irrigation water was dismissed in June 1939 when it was shown conclusively that owing to structural dip the direction of underground drainage is away from the irrigated areas and the contamination claimed was a physical impossibility.

The Union Potash & Chemical Co., controlled by the International Agricultural Corporation by ownership of nearly 60 percent of the common stock, continued throughout the year development of the potash beds exposed in the shaft that was completed in 1938 to a depth of 925 feet. A large tonnage of commercial-grade material is now assured, and the International Agricultural Corporation has announced plans to invest an additional $2,500,000 in preparing the mine for production and constructing a refinery that will have an annual capacity of 70,000 tons of potassium sulfate and 70,000 tons of 60-percent muriate. It is reported that the mine will be equipped to handle up to 2,000 tons daily and that production will begin late in 1940.

Utah.—Bonneville, Ltd., 540 West Seventh South, Salt Lake City, produced an increased tonnage of potassium chloride from Salduro marsh brine at its plant near Wendover. Solar evaporation is utilized to concentrate the brine, which is then treated to separate potassium chloride from the other constituents. The product is a high-grade salt that appears to find a ready market. No other production was reported from Utah in 1939.

FOREIGN TRADE

Imports.—The drastic decline in imports of potash salts during 1938 continued in 1939 to the lowest point reached since normal shipments from Europe were resumed in 1922 following the World War. Much of the decrease in 1939 doubtless was due to war conditions that disrupted shipping during the last 4 months of the year, when potash imports normally are heaviest. Fertilizer salts contained 94.1 percent of the potash imported and salts for industrial use the remaining 5.9 percent.

The quantity, average grade, and total declared value of the various potash salts imported in 1938 and 1939, the countries from which shipments were made in 1939, and the approximate K_2O equivalent of imports for the past 5 years are shown in the following tables.

Potash materials imported for consumption in the United States, 1938–39

Material	Approximate equivalent as potash (K_2O) (percent)	1938				1939			
		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:									
Kainite	14.0	402	56	------	$2,528	301	42	------	$1,923
	20.0	59,811	11,962	6.2	523,229	20,591	4,118	4.1	153,233
Manure salts	31.4	9,169	2,879	1.5	112,713	2,078	652	.6	22,216
Muriate (chloride)	56.4	223,542	126,078	65.1	5,371,600	94,417	53,251	53.5	2,313,574
Potash-magnesia sulfate	27.0	13,158	3,553	1.8	281,691	12,610	3,405	3.4	270,563
Potassium nitrate, crude	40.0	14,648	5,859	3.0	680,602	9,463	3,785	3.8	401,111
Potassium-sodium nitrate mixtures, crude	14.0	44,493	6,229	3.2	971,646	55,164	7,723	7.8	1,235,078
Sulfate	50.0	59,855	29,928	15.5	1,910,819	41,343	20,672	20.8	1,353,326
Other potash fertilizer material [1]	60.0	184	110	.1	1,373	149	89	.1	1,201
Total fertilizer	------	425,262	186,654	96.4	9,856,201	236,116	93,737	94.1	5,752,225
Used chiefly in chemical industries:									
Bicarbonate	46.0	103	47		17,334	121	56		19,456
Bitartrate:									
Argols	20.0	15,873	3,175		2,471,892	8,685	1,737		1,216,940
Cream of tartar	25.0	18	5		5,226	3	1		828
Bromide	39.6	(2)	(2)		30	------	------		------
Carbonate	61.0	292	178		30,981	217	132		24,106
Caustic	80.0	486	389		79,128	332	266		61,930
Chlorate and perchlorate	36.0	6,848	2,465		808,151	5,978	2,152		662,618
Chromate and dichromate	40.0	(2)	(2)	3.6	163	------	------	5.9	------
Cyanide	70.0	42	29		29,751	51	36		35,886
Ferricyanide (red prussiate)	42.0	98	41		42,814	210	88		90,063
Ferrocyanide (yellow prussiate)	44.0	70	31		12,780	28	12		4,885
Iodide	28.0	(2)	(2)		90	(2)	(2)		14
Nitrate, refined	46.0	1,042	479		100,509	2,604	1,198		191,446
Permanganate	29.0	49	14		10,168	91	26		17,547
All other	50.0	204	102		46,892	256	128		80,390
Total chemical	------	25,125	6,955	3.6	3,655,909	18,576	5,832	5.9	2,406,109
Grand total	------	450,387	193,609	100.0	13,512,110	254,692	99,569	100.0	8,158,334

[1] Chiefly wood ashes from Canada.
[2] Less than 1 ton.

Approximate equivalent as potash (K_2O) of potash-bearing materials imported for consumption in the United States, 1935–39, in short tons

1935	241, 510	1938	193, 609
1936	211, 752	1939	99, 569
1937	351, 445		

Potash materials imported for consumption in the United States in 1939, by countries, in short tons

[Figures in parentheses in column headings indicate in percent approximate equivalent as potash (K_2O)]

Country	Muriate (chloride) (56.4)	Sulfate (50)	Potash-magnesia sulfate (27)	Manure salts (31.4)	Kainite		Bitartrate		Caustic (80)
					(14)	(20)	Argols or wine lees (20)	Cream of tartar (25)	
Algeria							2, 715		
Argentina							79		
Belgium	6, 648	2, 894				453			
Canada	449		31				4		
Chile							246		
China									
Denmark									
Finland									
France	33, 815	8, 867				13, 469	1, 953		
Germany	31, 976	23, 324	12, 579	1, 501	301	5, 809			243
Hong Kong									
Italy							2, 220	3	
Japan									
Morocco							80		
Netherlands	11, 030	6, 258		577		860			
Palestine	10, 498								
Portugal							1, 197		
Sweden	1								89
Switzerland									
Tunisia							185		
U. S. S. R.									
United Kingdom							6		
	94, 417	41, 343	12, 610	2, 078	301	20, 591	8, 685	3	332

Country	Carbonate (61)	Cyanide (70)	Nitrate (saltpeter), crude		Chlorate and perchlorate (36)	All other (48)	Total	
			(14)	(40)			Short tons	Value
Algeria							2, 715	$363, 614
Argentina							79	11, 943
Belgium						8	10, 003	267, 514
Canada				684	1	148	1, 317	38, 405
Chile			55, 164				55, 410	1, 269, 798
China	4			[1]		1	5	714
Denmark						[1]	[1]	14
Finland					23		23	2, 033
France		1		355	175	535	59, 170	1, 545, 444
Germany	163	46		8, 424	3, 337	2, 361	90, 064	2, 940, 343
Hong Kong	1						1	145
Italy						14	2, 237	362, 545
Japan					52	[1]	52	4, 603
Morocco							80	7, 914
Netherlands	48	4				164	18, 941	558, 838
Palestine							10, 498	337, 470
Portugal							1, 197	123, 318
Sweden	1				1, 329		1, 420	165, 749
Switzerland					1, 061	22	1, 083	105, 896
Tunisia							185	14, 403
U. S. S. R.						163	163	11, 060
United Kingdom						43	49	26, 571
	217	51	55, 164	9, 463	5, 978	3, 459	254, 692	8, 158, 334

[1] Less than 1 ton.

Exports.—A greater quantity of fertilizer salts was exported in 1939 than ever before, and exports of chemical salts likewise approached in quantity and exceeded in value the previous high record established in 1935. Exports totaled 140,329 tons of material equivalent to approximately 83,800 tons of K_2O, an increase of about 32,000 tons of K_2O (62 percent) from 1938. About 4,000 tons of K_2O were exported by customers of the producers and importers who originally sold this material for consumption in the United States. Japan and Canada, the principal customers for American potash for a number of years, increased their purchases materially, and for the first time substantial sales were made to the United Kingdom.

Potash fertilizer materials exported from the United States, 1938–39, by countries

Country	1938		1939	
	Short tons	Value	Short tons	Value
Argentina			28	$848
Belgium	13,101	$331,292	9,257	300,320
Canada	21,368	567,859	24,874	695,425
Canary Islands	560	7,500		
Ecuador			11	213
Honduras	2	67	207	5,333
Japan	35,045	1,221,827	59,098	2,136,908
Liberia			20	819
Mexico	20	805	183	8,663
Mozambique	3	116	56	2,596
Netherlands	1,856	66,360	4,386	156,827
Norway	4,740	153,050	4,389	143,361
Philippine Islands	657	21,428	678	21,177
Sweden	4,035	136,350	8,501	352,762
Union of South Africa	248	9,693	242	9,052
United Kingdom	822	30,207	17,211	345,314
Venezuela	112	4,497	223	8,358
West Indies:				
British:				
Barbados	239	8,723	3,870	149,760
Other British	168	6,085	158	5,999
Cuba	1,100	32,007	3,348	102,549
Haiti	56	1,745		
Other countries [1]	5	161	10	569
	84,137	2,599,772	136,750	4,446,853

[1] Includes countries to which less than 10 tons was exported in both years.

Potassium salts (not fertilizer) exported from the United States, 1935–39

Year	Short tons	Value	Year	Short tons	Value
1935	3,641	$637,473	1938	2,616	$485,672
1936	2,333	487,347	1939	3,579	807,987
1937	2,094	484,450			

WORLD PRODUCTION

Publication of production statistics by European governments virtually ceased in the summer of 1939, and no adequate data are available for the latter half of the year. However, reports of production and sales of potash fertilizer salts during the first 6 months of 1939 indicate a definite upward trend in every major producing country except Germany, where output declined slightly owing to labor shortage and transportation difficulties. Mobilization and concentration of civilian manpower in war industries preparatory to and following the outbreak of war virtually closed the French potash mines for a time and doubtless resulted in further curtailment of German production. Rehabilitation of the Spanish mines was in progress; but there was little or no production by the end of the year, and the output of Polish mines, following the German occupation, probably was negligible. Increased operations in Palestine were not significant with respect to world production. The over-all result doubtless was a drop in world output of potash salts that might be as much as 10 percent of the 1938 production figure.

Available official figures of world production for 1935–38 are shown in the following table.

World production of potash minerals and equivalent K_2O, *1935–38, by countries, in metric tons*

[Compiled by R. B. Miller]

Country and mineral [1]	1935		1936		1937		1938	
	Output	Equivalent K_2O	Output	Equivalent K_2O	Output	Equivalent K_2O	Output	Equivalent K_2O
North America: United States, potassium salts	324,747	174,898	391,421	224,382	440,971	258,090	485,291	287,532
Europe:								
France (Alsace), crude potassium salts	2,027,200	[2] 347,270	2,123,540	[2] 368,880	2,883,502	489,801	3,374,811	581,790
Germany, crude potassium salts:								
Carnallite [3]	1,371,604	139,057	1,415,731	145,160	1,672,417	170,550	1,874,375	1,861,000
Kainite, sylvinite, and hartsalz	10,300,905	1,457,915	10,348,821	1,477,490	12,787,735	1,797,866	14,567,896	
Italy, alunite	2,092	251	3,976	477	3,500	420	2,778	333
Poland, crude potassium salts:								
Kainite	81,593	8,159	89,187	8,919	111,357	11,136	120,100	12,010
Sylvite	288,091	63,380	336,317	73,990	395,885	87,095	427,200	93,984
Langbeinite	13,914	1,670	8,553	1,026	14,241	1,709	19,644	2,358
Spain, crude potassium salts	776,873	121,372	(4)	(4)	(4)	(4)	(4)	(4)
U. S. S. R., crude potassium salts	1,319,000	173,000	1,800,000	225,000	2,400,000	266,000	(4)	(4)
Asia:								
China, potassium carbonate [5]	38	(4)	68	(4)	(4)	(4)	(4)	(4)
Chosen, alunite	81,510	(4)	114,569	(4)	149,000	(4)	(4)	(4)
India (British), nitrate of potash [6]	9,800	4,500	8,800	4,200	9,000	4,300	8,200	4,000
Palestine, crude potassium salts [7]	17,201	8,601	23,456	11,727	36,467	18,234	58,118	29,059
Africa: Eritrea, niccoli salts [8]	------	------	300	80	(4)	(4)	(4)	(4)
Australia, alunite	579	(4)	758	(4)	339	(4)	445	(4)

[1] In addition to countries listed, Chile and Iran are reported to produce a small quantity of potash salts, but statistics of production are not available.
[2] Content of merchantable products.
[3] Includes some natural kieserite.
[4] Data not available.
[5] Exports.
[6] Estimated production (Imperial Institute, London).
[7] Extracted from waters of the Dead Sea.
[8] Extracted from waters of the Red Sea.

FOREIGN DEVELOPMENTS

France.—Production of the French potash mines for the first 8 months of 1939 was reported by the American commercial attaché, Paris, to total 428,100 tons of K_2O, an increase of 45,400 tons compared with the corresponding period in 1938. Production figures for the rest of the year are not available; but it is known that, although the mines are close to the Maginot line, they have continued to operate. Disruption of the administrative and operating staffs by mobilization slowed production for a time, but reorganization soon was accomplished and by the end of the year output was reported approaching the maximum previously attained. Success of the educational campaign to increase the use of potash fertilizers, in which motion pictures have played a prominent part, was indicated by the rise of domestic sales, in spite of firmer prices decreed by the State Potash Mines Administration.

Since the beginning of the war special efforts have been made to continue exports to the United States as a means both of protecting the American market and providing dollar exchange. Potash for export, formerly transported by barge down the Rhine, now must be shipped by rail to Belgian or French ports at much higher cost. The cost is increased further by labor shortage at the mines and by higher ocean freight and war-risk-insurance rates. This situation may hasten development of the deposits in the Department of Landes in southwestern France, less than 100 miles from Bordeaux. Formation of a company with a capital of 16 million francs to develop and equip these properties was announced in 1936, and it was stated at that time that about 5 years would be required to prepare them for production.

French Potash Co., Inc., 30 Rockefeller Plaza, New York City, was organized shortly after the outbreak of war to import and sell French potash in the United States.

Germany.—The following comments on the potash industry in Germany are abstracted from comprehensive reports by Sydney B. Redecker, American consul, Frankfort on the Main.

The virtual cessation of overseas trade as a result of the naval blockade of Germany has limited potash sales to the extensive domestic market and to nearby European countries not cut off from Germany by the war, together with such overseas trade as it may be possible to carry on through neutral countries. Aside from loss in trade for the industry itself, the interruption of shipments of potash to overseas countries is a financial blow to Germany, depriving the nation of badly needed foreign exchange yielded by overseas potash exports, especially as potash is one of the few raw materials of which the country has a large exportable surplus.

To offset losses in export trade the industry has turned its attention to intensive cultivation of the domestic market, especially the recently annexed regions of Greater Germany, and to trade with nearby neutral countries in accordance with the national policy of supplying German products in exchange for foreign foodstuffs and industrial raw materials. The newly annexed territories of Austria, Czechoslovakia, and Poland are believed to offer an excellent field for expansion, as potash fertilizers have been consumed in these regions at a very much lower rate per hectare than in the Old Reich and must be increased to attain the maximum agricultural production essential to the national autarchic program. It is also believed that the countries of southeastern Europe, as well as Italy, Scandinavia, and the Baltic States, are capable of consuming notably increased quantities of German potash and other fertilizers, deliveries of which can be applied toward payment for increased receipts of agricultural products by Germany.

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Remarkable gains have been attained in consumption of potash fertilizer in Germany (Old Reich) in the past few years, stimulated especially by drastic price reductions enforced by the Government in the spring of 1937 for expanding national agricultural production. Consumption rose to 1,156,000 metric tons of K_2O in 1937–38 and is believed to have exceeded this figure in 1938–39. For many years, before 1937, when authentic export statistics were available the domestic market absorbed 70 to 75 percent of the total national turn-over.

Germany's production of potash expanded from 1932 to 1938, rising from 871,354 to 1,861,000 metric tons of K_2O, an output far surpassing that in any previous year except 1937. However, beginning in 1938 difficulties began to be experienced in the further expansion of production owing to increasing shortage of miners coupled with other circumstances, such as flooding of mines, break-down of equipment, delayed deliveries of replacements and new equipment, and shortages of railroad rolling stock. These difficulties were intensified in 1939, so that, for the first time in 6 years, production actually declined somewhat, to 1,090,700 metric tons of K_2O in the first 7 months compared with 1,103,900 tons in the corresponding period of 1938. Although statistics for a later period are not available and quite possibly no further ones will be issued during the war, the prospects are that lessened shipments to overseas countries, coupled with labor shortage and other difficulties hampering productive activities under wartime conditions, may cause further decrease in production in the future.

For several years a substantial part of German potash exports has consisted of consignment shipments, made in accordance with the terms of confidential cartel agreements for the account of foreign potash producers (notably the Spanish mines) that were unable to make the deliveries themselves. The conditions governing these consignment shipments are not publicly known, but it is understood that the producer for whom the shipment is made has the right subsequently to supply, within a stipulated period, a correspondingly increased quantity of potash under the terms of the International Cartel Pact, or to receive certain financial indemnification. Deliveries by the German potash industry for the account of foreign producers reached a maximum of 190,000 metric tons K_2O in 1937 and dropped to 80,000 tons in 1938.

After contracting considerably in 1938 from the high levels established in 1937, Germany's exports of potash expanded markedly in the first 7 months of 1939, doubtless indicating the desire of both German producers and foreign importers to effect early delivery in foreign countries of as large a tonnage as possible, in view of the unfavorable international outlook threatening interruption of Germany's overseas trade.

Faced with the loss of the world monopoly enjoyed before 1914, resulting from the loss of the Alsatian mines to France and the development of extensive potash industries in other countries, the German potash companies in recent years have sought active participation in other industrial spheres, notably petroleum and the mining of nonferrous metals and coal, as a means of developing new outlets for profitable investment of their capital and employment of their technical facilities. The extent to which diversification has been carried is indicated by the fact that in 1933 around 95 percent of the personnel of Wintershall A. G. was employed in potash production, whereas in 1938 only 67 percent of the workers were associated with potash activities. During the same period the total number of employees increased fourfold to 13,340 in 1938; the company has attained an outstanding position in Germany's petroleum industry and has become a major producer of magnesium metal and alloys used in the manufacture of aircraft. Other leading members of the potash industry likewise have entered upon extensive programs of diversification and the development of byproducts to supplement the shrinking profits from their potash operations.

Italy.—The American Embassy at Rome reports that the concessionaire for the Marada Basin in Libya completed its first experimental season in the summer of 1939 with an output of 2,100 metric tons of potash salts. Although hampered by transportation obstacles a minimum production of 25,000 tons is contemplated in 1940. A road is being constructed from Maaten Ciofer to Ras Aali to facilitate movement of potash from Marada to the sea.

Japan.—In anticipation of the possible cessation of imports of potash salts from European countries and the United States the Japanese Ministry of Commerce and Industry and the Ministry of Agriculture and Forestry introduced a joint ordinance on October 3, 1939, requiring official approval for all future sales of potash and authorizing the respective ministers to issue orders for distribution of potash for the manufacture of fertilizers. Details concerning stocks of potash are required to be submitted immediately to the ministries. Japan is reported to be negotiating a trade pact with Spain to exchange Japanese raw silk and camphor for Spanish potash and other raw materials. Japanese interests are said to have purchased 10,000 metric tons of sodium-potassium nitrate in Chile. Imports of potash salts from the United States, which contracted sharply in 1938, were expanded in 1939 to 59,000 short tons, approaching the maximum of 63,000 tons imported in 1937.

Palestine.—According to a report from the American consulate general, Jerusalem, the shift in sources of supply for potash brought about by the conflict in Europe has caused Palestine Potash, Ltd., to accelerate production activities. Exports during the first 9 months of 1939 showed an increase of 35 percent over the corresponding period of 1938. Output for the year might reach 80,000 tons of 50-percent muriate. Palestine, where potash is extracted from salts derived by solar evaporation from waters of the Dead Sea, is the only important source of potash in the British Empire.

Poland.—The steadily rising output of potash from the Polish mines reached 84,585 metric tons K_2O in the crude salts mined in 1938, and sales of commercial grades of crude and refined salts totaled 71,412 tons K_2O in salts averaging 20 percent K_2O, as reported by the American commercial attaché, Warsaw, from production and sales figures compiled by the producer. No information is available relating to 1939 operations. The mines are situated in southwestern Galicia, a former Austrian Province that was incorporated in the Polish State following the World War. The greater part of Galicia, including the potash mines at Kalusz, Stebnik, and Holyn, south of the city of Lwow, was ceded to the U. S. S. R. by Germany following the German conquest of Poland and the Soviet-German alliance and is now occupied by the U. S. S. R.

Spain.—Rehabilitation of the Spanish potash mines in Catalonia was undertaken soon after the close of the civil war. It was hoped that production might be resumed before the end of 1939, but it is doubtful whether this objective was achieved, as the mines were reported to have been badly damaged by the retreating Loyalist troops and the railroad connecting the mines with the port of Barcelona destroyed. However, it is believed that productive operations will approach normal in the near future, and strenuous efforts probably will be made to attain maximum output in 1940 to supply in the world market as much as possible of the deficiency that will result from stoppage of German overseas exports by the naval blockade.

It was reported in September 1939 that 10,000 to 12,000 metric tons of potash salts were on hand at Barcelona and about 30,000 tons at the mines. Before the civil war the Spanish mines were producing about 120,000 metric tons K_2O a year, and their full capacity is said to be around 200,000 tons. The pre-war project to establish a Government-controlled sales agency to handle the distribution of all Spanish potash has been revived, and an organization for this purpose has been established under the title "Potasas Espanolas." The three operating companies are the Union Espanola de Explosivos, a Spanish company financed by British capital; Potasas Ibericas, S. A., controlled by French capital; and Minas de Potasa de Suria, S. A., controlled by Belgian Solvay interests and affiliated with Potasas Reunidas, S. A., a selling organization headquartered in Madrid.

U. S. S. R.—The development of the potash deposits at Ozinki and at Okuz-Bulak in central Asia is being urged by Soviet engineers to supplement production from the Solikamsk mines and to avoid the present long hauls from the northern Urals to central Asia and the Ukraine. Ozinki is in the Urals, but a considerable distance south of Solikamsk. The deposits have been prospected only superficially but are believed to be extensive. Soviet chemists are reported to have obtained crystals containing nitrogen, phosphorus, and potash—presumably a composite salt—that have been tested in the experimental flax fields of an agricultural institute near Moscow with very satisfactory results. Construction of a factory for the manufacture of concentrated fertilizer by this new method is planned.

MICA

By Paul M. Tyler and K. G. Warner

SUMMARY OUTLINE

After improving slowly during the first 8 months of 1939 the demand for mica rose rapidly to record proportions following the outbreak of war in Europe. Consumption of sheet mica and splittings during the last quarter of the year probably exceeded even the feverish pace set during the first half of 1937. The total consumption for the year exceeded the total for 1938 but fell short of a record. Domestic production of sheet mica, notwithstanding increases in several States and the greatly increased activity in all the mining districts in the latter part of the year, failed to equal that of 1938.

Mica is a strategic mineral; mica splittings, radio-tube mica, condenser sheet, airplane spark-plug "cigarette" mica and washers, and magneto condenser films are materials especially needful from a military standpoint—to maintain communications as well as to enable airplanes and all modern mechanized equipment to operate. Other kinds of sheet mica required in electrical machinery and in the manufacture of munitions are obtainable domestically, but the items mentioned have been almost wholly imported, principally from British India.

A Bureau of Mines survey in the early summer of 1939 showed that stocks of splittings and other strategic varieties of mica in the United States were equivalent to more than a year's supply at any previous annual consumption rate. As the European war greatly stimulated sales of manufactured mica products, monthly consumption of several of these items rose above any previous requirement, and simultaneously the normal flow of supplies from India was interrupted. Manufacturers who had been buying raw material on a hand-to-mouth basis were threatened with a shortage of supplies. In December one large consumer exhausted its stock of its most important grade of splittings, and no companies could maintain their customary raw-material inventories. At no time was there any dearth of supplies in Calcutta, but the heavy movement of burlap and other commodities caused a shortage of shipping space. This situation, however, began to improve toward the end of the year as more ships were routed from India to the United States. Early in 1940 a new alarm arose, as word came that all exports of block mica from India might be prohibited because of the British Government's munitions needs, but no real curtailment of shipments was apparent by April 1940. Shipments of amber splittings from Madagascar came under French Government control, and not until the end of 1939 were licenses obtainable for even limited quantities for export to this country. A threatened shortage of cigarette mica was averted by employing selected domestic sheet.

Even before these wartime uncertainties developed shipments of South American mica to the United States began to increase, and domestic mines displayed renewed activity.

Late in the year prices paid for domestic mica advanced much more than those for India mica. Those for Argentine and Brazil sheet mica averaged perhaps 10 percent above the relatively high levels reached in 1938. For India splittings and radio mica sterling prices and freight and war-risk insurance rose sharply, but with respect to bulk lines these increases virtually were offset by the decline in exchange. For more expensive grades of splittings, however, prices increased slightly; No. 5 book-packed splittings, for example, advanced from $1.25 to $1.40 a pound.

Salient statistics of the mica industry in the United States, 1935–39

	1935	1936	1937	1938	1939
Domestic mica sold or used by producers:					
Total uncut sheet and punch:					
Pounds	936,633	1,319,233	1,694,538	939,507	813,708
Value	$161,150	$203,879	$285,244	$139,333	$138,963
Average per pound	$0.17	$0.15	$0.17	$0.15	$0.17
Scrap: [1]					
Short tons	18,852	20,955	25,196	20,257	24,672
Value	$243,951	$260,594	$354,737	$256,382	$311,895
Average per ton	$12.94	$12.44	$14.08	$12.66	$12.64
Total sheet and scrap: [1]					
Short tons	19,320	21,615	26,043	20,727	25,079
Value	$405,101	$464,473	$639,981	$395,715	$450,858
Total ground: [1]					
Short tons	18,323	25,585	27,245	27,086	30,924
Value	$542,973	$722,416	$839,812	$924,554	$1,156,333
Consumption of splittings: [2]					
Pounds	2,532,984	3,518,058	4,347,435	1,667,806	3,423,044
Value	$631,065	$846,393	$1,257,645	$612,465	$1,089,683
Imports for consumption:					
Total uncut sheet and punch:					
Pounds	594,443	860,253	1,004,950	391,125	902,598
Value	$192,659	$239,378	$296,235	$113,403	$271,072
Scrap:					
Short tons	2,993	3,893	6,723	4,450	4,279
Value	$18,897	$22,666	$36,355	$28,590	$29,493
Total sheet and scrap:					
Short tons	3,290	4,323	7,226	4,646	4,730
Value	$211,556	$262,044	$332,590	$141,993	$300,565
Manufactured:					
Short tons	1,588	2,355	4,113	1,115	1,550
Value	$696,828	$943,524	$1,735,009	$522,426	$758,745
Total imports:					
Short tons	4,878	6,678	11,339	5,761	6,280
Value	$908,384	$1,205,568	$2,067,599	$664,419	$1,059,310
Export (all classes of mica):					
Short tons	1,499	1,478	1,795	1,772	1,827
Value	$165,385	$170,011	$216,858	$183,889	$226,364

[1] Includes mica recovered from kaolin and mica schists, as follows: 1935, 6,667 short tons valued at $111,345; 1936, 8,258 tons, $127,343; 1937, 10,536 tons, $149,931; 1938, 6,550 tons, $86,602; 1939, 10,011 tons, $108,899.

[2] Exclusive of a nominal quantity of splittings produced in the United States and South America.

DOMESTIC PRODUCTION [1]

Sheet mica.—The output of sheet mica was less in 1939 than in 1938 owing to a sharp reduction in output of punch mica in North Carolina and New Hampshire and of larger sheet in New Hampshire. Substantial increases were reported in Connecticut and South Dakota and minor increases in Maine, Virginia, and other States. A small output of punch mica, with some scrap mica, was shipped in 1939 from a newly opened feldspar property near Edinburg, Saratoga County, N. Y.; this is the first output of mica reported in that State since 1923, when a little sheet mica was produced in St. Lawrence County.

Sheet mica sold or used by producers in the United States, 1908–39 [1]

Year	New Hampshire		North Carolina		Other States [2]		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1908	12,000	$1,200	599,234	$114,540	361,730	$118,281	972,964	$234,021
1909	55,808	12,086	1,296,274	122,246	457,500	100,150	1,809.582	234,482
1910	117,170	26,109	455,020	193,223	1,904,000	64,500	2,476,190	283,832
1911	289,473	35,103	454,653	187,501	1,143,075	87,650	1,887,201	310,254
1912	308,047	32,238	489,599	219,874	47,837	30,711	845,483	282,823
1913	731,478	65,765	803,462	230,674	165,737	57,078	1,700,677	353,517
1914	133,556	39,588	274,121	171,370	149,256	67,582	556,933	278,540
1915	96,685	59,414	281,074	266,650	176,062	52,195	553,821	378,259
1916	125,502	64,386	546,553	380,700	193,808	79,399	865,863	524,485
1917	472,519	159,822	643,476	543,207	160,538	50,845	1,276,533	753,874
1918	376,900	106,200	941,200	460,450	326,100	165,160	1,644,200	731,810
1919	235,724	90,915	1,021,306	331,498	288,679	61,154	1,545,709	483,567
1920	284,862	83,811	1,084,946	405,654	313,672	57,507	1,683,480	546,972
1921	491,743	63,249	230,532	51,851	19,570	3,413	741,845	118,513
1922	475,647	63,240	544,495	119,767	57,826	11,294	1,077,968	194,301
1923	835,751	107,674	1,130,283	188,317	97,145	15,189	2,063,179	311,180
1924	744,133	88,737	597,385	108,656	119,379	14,642	1,460,897	212,035
1925	1,120,857	198,858	592,478	105,376	80,530	17,728	1,793,865	321,962
1926	1,371,890	235,890	700,313	150,362	99,956	13,932	2,172,159	400,184
1927	720,219	78,849	665,360	114,514	126,913	19,119	1,512,492	212,482
1928	774,143	63,470	777,395	129,706	130,239	37,780	1,681,777	230,956
1929	984,778	82,657	894,200	150,293	156,150	53,371	2,035,128	286,321
1930	673,064	53,304	749,074	112,451	43,347	11,552	1,465,485	177,307
1931	441,164	36,368	389,426	51,657	132,363	23,805	962,953	111,830
1932	146,014	17,978	127,696	18,322	65,287	9,582	338,997	45,882
1933	167,464	22,008	162,672	21,107	34,404	10,064	364,540	53,179
1934	161,430	14,423	293,381	38,674	128,717	37,171	583,528	90,268
1935	131,586	13,727	512,590	77,598	292,457	69,825	936,633	161,150
1936	285,822	22,920	730,446	119,653	302,965	61,306	1,319,233	203,879
1937	235,055	20,119	1,044,328	218,176	415,155	46,949	1,694,538	285,244
1938	[3] 282,836	[3] 49,254	632,646	87,879	[4] 24,025	[4] 2,200	939,507	139,333
1939	43.670	3,738	401,170	69,344	368,868	65,881	813,708	138,963

[1] For earlier years see Geol. Survey Mineral Resources of the United States, 1916, pt. II, p. 292.
[2] Alabama, Colorado, Connecticut, Georgia, Idaho, Maine, Maryland, Nevada, New Mexico, New York, Pennsylvania, South Carolina, South Dakota, Texas, Virginia, Wisconsin, and Wyoming.
[3] Connecticut included with New Hampshire.
[4] Exclusive of Connecticut, which is included with New Hampshire.

Production statistics on mica have been published annually since 1880, in which year the output of American mines (all sheet mica) was 81,669 pounds valued at $127,825. After rising to 147,410 pounds valued at $368,525 in 1884 it dwindled rapidly owing to the competition of India mica, which was imported first in 1885. The rapid growth of the electrical industry during the 1890's so increased the demand for sheet mica that in 1898 domestic output once more rose above 100,000 pounds and at the turn of the century jumped to 456,283 pounds valued, however, at only $92,758. By 1906 the output had

[1] Historical tables compiled and readjusted by E. T. Shuey, Bureau of Mines.

grown to 1,423,100 pounds valued at $252,248. In 1910 it attained a peak of 2,476,190 pounds—but this was mostly small mica as the value was only $283,832 whereas the 1,700,677 pounds produced in 1913 was worth $353,517.

In the earlier years some mica miners operated cutting plants; and the value of their finished products, such as stove mica and other more or less standard sizes, was included in the production statistics. Since 1920, however, the production as officially reported is uncut sheet mica alone, although separate figures were also compiled for uncut punch and uncut sheet larger than punch. "Punch mica" is a domestic term not generally used abroad and refers to crystals of book or block mica, usually thumb-trimmed, as opposed to knife- or shear-trimmed, but not large enough to furnish sheets more than about 1½ inches in diameter. Included with punch mica is circle mica, which is somewhat larger, yielding circles up to 2 inches in diameter.

As may be seen in the preceding table of annual production by States from 1908 to 1939, North Carolina has been the leading producing State, although occasionally yielding first place temporarily to New Hampshire and for two years to South Dakota.

Domestic mica, exclusive of scrap and ground, sold or used by producers in the United States, 1924–39

Year	Uncut punch		Uncut larger than punch		Splittings		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1924	1,305,219	$113,285	147,450	$97,282	8,228	$1,468	1,460,897	$212,035
1925	757,314	64,173	1,003,682	246,434	32,869	11,355	1,793,865	321,962
1926	1,799,545	213,718	329,189	172,131	43,425	14,335	2,172,159	400,184
1927	1,311,286	94,856	197,750	117,471	3,456	155	1,512,492	212,482
1928	1,466,773	90,849	213,295	140,025	1,709	82	1,681,777	230,956
1929	1,731,096	97,344	283,084	187,332	20,948	1,645	2,035,128	286,321
1930	[1] 1,252,887	[1] 61,194	211,703	116,077	[1] 895	[1] 36	1,465,485	177,307
1931	749,632	32,786	205,306	78,513	8,015	531	962,953	111,830
1932	258,512	7,976	80,485	37,906	------	------	338,997	45,882
1933	246,408	8,574	111,297	42,980	6,835	1,625	364,540	53,179
1934	423,740	16,049	158,372	74,172	1,416	47	583,528	90,268
1935	665,385	28,051	266,306	132,763	4,942	336	936,633	161,150
1936	1,013,733	48,103	300,773	155,493	4,727	283	1,319,233	203,879
1937	1,300,978	69,552	381,638	214,751	11,922	941	1,694,538	285,244
1938	674,204	35,832	165,386	93,767	99,917	9,734	939,507	139,333
1939	[1] 665,755	[1] 39,207	147,953	99,756	(1)	(1)	813,708	138,963

[1] Small amount of splittings included with punch.

Scrap mica.—Scrap mica may be defined as material suitable for conversion into ground mica with little or no additional purification. Production from domestic sources in 1939 totaled 24,672 short tons valued at $311,895, of which 10,011 tons worth $108,899 were recovered in washing kaolin or kyanite or by milling schists and the remainder was mine scrap.

Separate statistics covering domestic mine production of scrap mica have been available continuously since 1893, when an output of 156 tons was recorded. In 1900 the output soared to 5,497 tons valued at $55,202, but this was abnormal; the average for the 5-year prewar period, 1909–13, was only 4,043 tons valued at $55,296. Beginning in 1916, mica recovered from schist has been reported first to the Geological Survey and since 1925 to the Bureau of Mines; and in 1925 byproduct mica from kaolin operations first became prominent. For several years these items were not reported in the mica statistics; they were grouped merely as "miscellaneous minerals" or miscellaneous mineral production in summary tables. By 1935, however, the contributions from these sources had become so important that it seemed best to include them in the production figures for "scrap mica" and also those for "ground mica." Readjusted data for earlier years have not been published hitherto and are inserted in the following table for the first time. The revised figures for all years are believed now to be on a comparable basis, as they include available data on mine scrap; production from muscovite, sericite, and chlorite schists; and byproduct mica from china clay and kyanite operations.

Since sales of scrap mica may increase the revenues of sheet-mica mines substantially, it has been contended that mine scrap should be separated from mica of similar use obtained from other sources. Accordingly, the Bureau of Mines in recent years has recorded separately the total mica from other sources, usually in a footnote to the production tables.

Scrap mica [1] and mica recovered from kaolin and schists [2] sold or used by producers in the United States, 1908–39

Year	New Hampshire		North Carolina		Other States [3]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1908	10	$150	1,308	$13,330	1,099	$20,424	2,417	$33,904
1909	412	4,094	2,607	26,178	1,071	15,775	4,090	46,047
1910	409	6,090	3,074	37,237	582	9,938	4,065	53,265
1911	719	9,824	2,347	29,798	446	5,928	3,512	45,550
1912	264	5,100	2,492	36,675	470	7,298	3,226	49,073
1913	692	13,906	2,729	37,239	1,901	31,398	5,322	82,543
1914	600	8,249	1,789	23,900	1,341	19,267	3,730	51,416
1915	516	7,557	2,840	33,943	603	9,010	3,959	50,510
1916	724	10,853	2,755	41,880	2,104	39,023	5,583	91,756
1917	680	9,229	2,180	34,134	569	9,545	3,429	52,908
1918	530	7,040	1,046	12,930	716	13,160	2,292	33,130
1919	738	13,356	1,639	32,338	881	12,390	3,258	58,084
1920	435	12,877	2,823	91,653	2,465	62,487	5,723	167,017
1921	537	10,613	1,353	30,496	1,887	53,002	3,777	94,111
1922	238	5,838	4,205	65,923	3,111	65,441	[4] 7,554	[4] 137,202
1923	1,078	25,871	5,005	[4] 95,128	3,476	74,180	[4] 9,559	[4] 195,179
1924	492	9,498	6,641	115,774	1,005	18,124	8,138	143,396
1925	1,953	47,525	7,095	124,818	3,312	65,738	12,360	238,081
1926	1,738	38,213	5,314	124,048	2,425	44,382	9,477	206,643
1927	1,284	22,909	5,409	93,670	2,844	51,899	9,537	168,478
1928	1,291	25,232	8,739	132,119	3,048	55,516	13,078	212,867
1929	1,657	35,977	8,346	153,722	3,980	62,391	13,983	252,090
1930	449	8,743	5,904	98,400	2,562	47,988	8,915	155,131
1931	295	5,465	6,872	84,818	2,181	31,854	9,348	122,137
1932	344	5,585	6,237	71,842	4,085	44,730	10,666	122,157
1933	532	9,563	8,968	102,830	3,980	47,046	13,480	159,439
1934	537	9,529	7,255	101,985	4,145	55,108	11,937	166,622
1935	394	5,335	11,831	153,553	6,627	85,063	18,852	243,951
1936	250	3,610	10,840	131,138	9,865	125,846	20,955	260,594
1937	306	4,397	12,988	209,212	11,902	141,128	25,196	354,737
1938	[5] 927	[5] 16,189	11,959	161,598	[6] 7,371	[6] 78,595	20,257	256,382
1939	105	1,592	13,913	184,377	10,654	125,926	24,672	311,895

[1] For earlier years see Mineral Resources of the United States, 1916, pt. II, p. 292.
[2] Mica recovered from schists first reported in 1916 and from kaolin in 1925.
[3] Alabama, Arizona, California, Colorado, Connecticut, Georgia, Idaho, Maine, Maryland, Massachusetts, New Mexico, New York, Pennsylvania, South Carolina, South Dakota, Texas, Utah, Vermont, Virginia, and Wyoming.
[4] Revised figures.
[5] Connecticut included with New Hampshire.
[6] Exclusive of Connecticut, which is included with New Hampshire.

Ground mica.—The quantity of ground mica sold by domestic producers in 1939 was 30,924 short tons valued at $1,156,333, exceeding by a wide margin the previous record of 27,245 tons valued at $839,812 in 1937. The trend toward increased consumption in wallpaper, paint, and miscellaneous uses, noted in previous Yearbook chapters, continued in 1939, and the increase in sales to the rubber industry was notable. More mica was consumed in roll roofing—still the principal use—than in 1938 but less than in 1937; the percentage of total sales used for this purpose declined to 62 percent compared with 70 percent in 1938 and 79 percent in 1937.

Data for 1923 to 1934 have been adjusted to permit comparison with those for 1935 and later years as now reported; the production of ground mica includes the product made from mine scrap, factory scrap, byproduct mica, and schist mica of all kinds.

Ground mica [1] sold by producers in the United States, 1923–39,[2] by methods of grinding

Year	Dry-ground [1]		Wet-ground		Total [1]	
	Short tons	Value	Short tons	Value	Short tons	Value
1923	4,335	$188,934	2,102	$250,170	6,437	$439,104
1924	6,021	157,854	2,868	331,410	8,889	489,264
1925	5,186	166,224	2,402	279,940	7,588	446,164
1926	4,810	168,290	2,490	206,370	7,300	374,660
1927	5,851	149,307	3,199	332,511	9,050	481,818
1928	8,190	175,596	3,317	358,458	11,507	534,054
1929	9,549	196,218	2,697	328,332	12,246	524,550
1930	8,139	236,666	1,575	161,623	9,714	398,289
1931	8,090	191,505	2,444	267,653	10,534	459,158
1932	8,879	165,094	2,452	184,126	11,331	349,220
1933	11,168	196,458	3,392	263,503	14,560	459,961
1934	11,042	222,877	2,723	247,284	13,765	470,161
1935	15,178	341,825	3,145	201,148	18,323	542,973
1936	20,800	457,042	4,785	265,374	25,585	722,416
1937	21,150	457,879	6,095	381,933	27,245	839,812
1938	19,757	466,959	7,329	457,595	27,086	924,554
1939	23,222	547,539	7,702	608,794	30,924	1,156,333

[1] Includes mica recovered from kaolin and schists. [2] Figures for ground mica not available before 1923.

Ground mica sold by producers in the United States to various industries, 1938–39

Industry	1938			1939		
	Quantity		Value	Quantity		Value
	Short tons	Percent of total		Short tons	Percent of total	
Roofing [1]	18,795	70	$402,671	19,255	62	$406,522
Wallpaper	2,926	11	232,870	3,586	12	265,359
Rubber	1,187	4	82,809	2,539	8	204,977
Paint	1,666	6	117,595	1,916	6	144,235
Miscellaneous [2]	2,512	9	88,609	3,628	12	135,240
	27,086	100	924,554	30,924	100	1,156,333

[1] Includes mica from kaolin and schist.
[2] Includes mica used for molded electric insulation, house insulation, Christmas-tree snow, manufacture of axle greases and oil, annealing, pipe-line enamel, plastic specialties, textiles, coating levee mattresses, and other purposes.

MICA SPLITTINGS

Reflecting the increased activity in the factories producing built-up mica during the last few months of the year, the consumption of mica splittings in the United States was virtually twice as large in 1939 as in 1938, although, owing to the slow recovery during the earlier months the total for the year fell far short of the 1937 peak and failed even to equal the quantities used in 1929 or 1936.

Of the 1939 total (1,712 short tons valued at $1,089,683) 88 percent was India muscovite splittings, 9 percent amber splittings from Madagascar, and 3 percent amber splittings from Canada. An increasing amount of South American mica is being sent to Calcutta to be split and is reexported as "India splittings." Both domestic and imported mica may be converted into splittings in the United States, but the quantity seldom has constituted as much as 2 percent of the domestic consumption and in many years has been virtually negligible.

Stocks of splittings in consumers' hands at the end of 1938 had reached an all-time high, exceeding consumption for any previous 12 months and about 3 years' supply at the 1938 consumption rate; but as imports did not pace withdrawals the total stocks at the end of 1939 were reduced to less than 9 months' supply, and several companies had no more than enough to last them a few weeks when deliveries from India began arriving in substantial volume after November.

Consumption and stocks of mica splittings in the United States, 1935–39, by sources, as reported by the consumers

Year	India		Canada		Madagascar		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Consumption:[1]								
1935	2, 150, 593	$492, 161	129, 272	$42, 897	253, 119	$96, 007	2, 532, 984	$631, 065
1936	3, 051, 824	649, 982	102, 766	44, 566	363, 468	151, 845	3, 518, 058	846, 393
1937	3, 721, 594	965, 418	98, 618	51, 960	527, 223	240, 267	4, 347, 435	1, 257, 645
1938	1, 446, 349	511, 674	41, 100	20, 401	180, 357	80, 390	1, 667, 806	612, 465
1939	2, 995, 626	905, 763	107, 101	44, 065	320, 317	139, 855	3, 423, 044	1, 089, 683
Stocks in consumers' hands Dec. 31:								
1935	1, 011, 864	259, 201	139, 019	57, 286	213, 421	82, 908	1, 364, 304	399, 395
1936	1, 280, 517	304, 036	52, 014	19, 048	223, 357	101, 711	1, 555, 888	424, 795
1937	3, 920, 730	1, 094, 414	77, 130	33, 722	444, 762	195, 976	4, 442, 622	1, 324, 112
1938	4, 057, 681	1, 128, 075	55, 827	24, 378	631, 119	273, 926	4, 744, 627	1, 426, 379
1939	2, 754, 748	857, 656	52, 523	17, 697	673, 354	273, 465	3, 480, 625	1, 148, 818

[1] Exclusive of a nominal quantity of splittings produced in the United States and South America.

BUILT-UP MICA

In 1939 the Bureau of Mines made its first compilation of production of various kinds of built-up mica as part of its investigation of the strategic uses of mica. However, the total output of these products in the United States in certain specified years had been reported by the United States Tariff Commission, as follows:[2]

[2] U. S. Tariff Commission, The Mica Industry: Rept. 130, 2d ser., 1938, pp. 63-64.

	Pounds		Pounds
1927	2,925,941	1933	1,308,924
1929	4,042,478	1934	1,839,888
1931	1,702,938	1935	2,385,623
1932	922,936	1936 (6 months)	1,452,734

Additional data compiled by the Commission for 1935 and 1936 show the quantity and value of major classes of built-up mica produced in the United States, separated according to the type of mica used, and also the percentage of binder used in such products:

Built-up mica produced in the United States in 1935 and January–June 1936, by kinds [1]

Product and type of mica used	1935			January-June 1936			Percent binder [2]
	Pounds	Value		Pounds	Value		
		Total	Average		Total	Average	
Molding plate:							
Muscovite	817,995	$703,688	$0.86	481,810	$414,388	$0.86	12.9
Phlogopite							
Segment plate:							
Muscovite	541,784	528,652	.98	328,408	316,903	.96	4.6
Phlogopite	242,086	406,002	1.68	133,766	225,439	1.69	4.6
Heater plate:							
Muscovite	159,123	184,916	1.16	95,548	110,790	1.16	3.2
Phlogopite	35,048	66,586	1.90	28,852	54,818	1.90	3.2
Flexible (cold):							
Muscovite	176,345	183,026	1.04	114,161	119,035	1.04	16.5
Phlogopite							
All other (tape, etc.):							
Muscovite	375,470	790,685	2.11	249,630	528,006	2.12	19.4
Phlogopite	37,772	84,987	2.25	20,559	46,257	2.25	19.4
	2,385,623	2,948,542	1.24	1,452,734	1,815,636	1.25	10.8

[1] U. S. Tariff Commission. [2] Weighted average for both periods combined.

In American factories splittings are assembled on paper or fine-mesh screen and held together with shellac, glyptol, or other suitable binder, which is sprayed or painted over each layer of splittings as formed until the desired thickness is attained up to ⅝ inch. Individual plates, usually 3 feet square, are put into an oven, heated at 250° F. to dry the varnish, and then inspected over a strong light in a darkened room or occasionally by X-ray. Imperfections or thin spots are touched with additional binder or covered with additional splittings as required; if the sheet cannot be repaired the defective part is cut out. The sheets are then put in a press, subjected to a pressure of 1,000 pounds per square inch and a temperature of about 300° for several minutes, and then chilled quickly. When removed from the press they are milled or sanded and finally ground perfectly smooth and to exact thickness. Several plants employ more mechanized methods; the flakes of mica, instead of being dabbed on by hand, fall from a "snowing" tower onto a suction drum or moving screen upon which one or at most three layers are built up before the binder is sprayed over the sheet.

Domestic production of built-up mica comes almost entirely from six companies, although at least two other concerns produce minor amounts. Roughly, half the built-up mica made in the United States is manufactured by large electrical companies for use in their own motors, generators, and all sorts of electrical equipment and appliances. Several other companies, about equally prominent as producers, are not so integrated, although they generally carry their fabricating processes beyond the point of making board, tape, etc. Most of them manufacture tubing, tape strips, V-rings, and—most important from a quantity standpoint—segment plates for the commutators of generators and starting motors of automobiles.

Molding plate is used largely in making commutator V-rings and cones; when heated it becomes flexible enough to be molded into these shapes or bent into troughs or square tubing. As the name implies, flexible plate can be formed cold, although it may be heated slightly when rolled into tubes. Segment plate is used entirely for flatwork, commutator segments (as previously stated) being the chief shapes cut or stamped from it. Heater plate contains even less binder than commutator segments; the bonding material, whether organic or inorganic, must be nonvolatile so that the product can be used in place of pure sheet mica for such purposes as supporting flatiron and toaster heater elements without excessive disintegration. Flexible sheets or ribbons (insulating tapes) are made in a thickness of 0.004 to 0.008 inch, including the paper, cloth, or silk facing; a common form is a "sandwich" made from book-packed splittings between 1-mil layer of Japanese rice paper.

Built-up mica produced in the United States, 1937–39, by kind of product

Product	1937 [1] (pounds)	1938		1939	
		Pounds	Value	Pounds	Value
Molding plate	1,405,056	531,661	$505,000	1,099,066	$1,090,000
Segment plate	1,399,014	479,273	605,000	1,135,555	1,610,000
Heater plate	290,564	209,814	280,000	369,677	815,000
Flexible (cold)	258,620	119,440	160,000	239,582	290,000
All other (tape, etc.)	780,873	417,466	650,000	581,515	925,000
	4,134,127	1,757,654	2,200,000	3,425,395	4,730,000

[1] Figures for value not available.

PRICES

As previously noted, the prices of India mica did not change greatly owing to the break in the English pound sterling from an average exchange value of $4.68 during the summer to less than $4 during the last 4 months of the year.

Trade-journal quotations for domestic mica, after remaining virtually unchanged for about 2 years, began to rise in the early summer and were completely revised before the end of the year. As shown in the following table, the new quotations represented, with fair accuracy, the average prices actually received by producers as reported to the Bureau of Mines. A comparison of the average prices reported shows an increase over corresponding averages for 1938 of 39 percent for clear circle mica and smaller increases for several other items.

Trade-journal quotations and average sales value of domestic uncut sheet mica per pound in 1939

Size	Trade-journal quotations [1]		Average value [2]	
	Dec. 22, 1938	Dec. 14, 1939	Clear	Stained or spotted
Punch	\$0.03-\$0.05	\$0.05-\$0.06	\$0.056	\$0.055
Circle			.143	.188
1½ by 2 inches	.15- .40	.25- .30	.299	.184
2 by 2 inches	.30- .60	.40- .50	.515	.267
2 by 3 inches			.778	.479
3 by 3 inches	.75- 1.20	1.00- 1.20	1.104	.653
3 by 4 inches	1.00- 1.40	1.30- 1.40	1.372	.824
3 by 5 inches	1.25- 1.60	1.60- 1.70	1.767	1.043
4 by 6 inches	2.00- 2.50	2.60- 2.70	2.812	1.284
6 by 8 inches	2.50- 3.50	4.00- 4.50	4.167	1.398
8 by 10 inches	3.50- 5.00	7.50-10.00	7.935	2.071

[1] Engineering and Mining Journal (Metal and Mineral Markets) quotations for No. 1 or No. 2 quality, f. o. b. North Carolina; stained qualities take 25 to 50 percent discount.
[2] Calculated from reports of 1939 sales by domestic producers to the Bureau of Mines.

State geologist H. J. Bryson comments upon the wartime boost to North Carolina mining as follows:[3]

The mica industry is undoubtedly more active in North Carolina now than in the past 10 or 12 years * * * all of the larger mines are operating night and day while more than 200 small mines, many of them little more than holes in the mountain sides, are being operated by the mountaineers, and the mica hauled into washing plants. * * *

Mica that 6 months ago was bringing only \$5 and \$10 a ton is now bringing from \$15 to \$20 a ton and frequently more. The larger mica, large enough for washers and punch purposes, brings from \$150 to \$250 a ton, while mica as much as 4 by 6 inches in size now brings from \$2.50 to \$2.60 a pound.

FOREIGN TRADE [4]

Imports.—The imports of mica in 1939 aggregated 6,280 short tons valued at \$1,059,310 compared with 5,761 tons valued at \$664,419 in 1938 and 11,339 tons valued at \$2,067,599 in 1937. The reduction in imports of scrap and splittings in 1939 was notable compared with 1937.

Imports furnish virtually all the splittings, most of the sheet mica larger than punch, and a variable proportion of the small sheet and scrap mica used in this country. Available data on imports for the period 1909–39 are summarized in the following table compiled by E. T. Shuey, of the Bureau of Mines.

[3] Mining Congress Journal, North Carolina Mining Industry Benefits from Price Advance: Vol. 26, No. 2, February 1940, p. 19.
[4] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Mica imported for consumption in the United States, 1909–39, by classes

Year	Unmanufactured		Manufactured												Total	
			Cut		Splittings		Built-up		Ground		All other manufactured		Total			
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1909	1,678,482	$533,218	(1)	(1)	[1] 168,169	[1] $85,595	(2)	(2)	----------	----------	(2)	(2)	168,169	$85,595	1,846,651	$618,813
1910	1,424,618	460,694	(1)	(1)	[1] 536,905	[1] 263,831	(2)	(2)	(3)	$1,298	(2)	(2)	(3)	265,129	(3)	725,823
1911	1,087,644	346,477	(1)	(1)	[1] 241,124	[1] 155,686	(2)	(2)	(3)	3,389	(2)	(2)	(3)	159,075	(3)	505,552
1912	1,900,500	649,236	(1)	(1)	[1] 88,632	[1] 99,737	(2)	(2)	[4] 343,824	6,611	(2)	(2)	(3)	106,348	(3)	755,584
1913	2,047,571	751,092	(3)	(1)	(3)	[1] 191,926	(2)	(2)	290,757	4,765	(2)	(2)	(3)	196,691	(3)	947,783
1914	360,888	168,591	(3)	(1)	(3)	[1] 456,805	(2)	(2)	404,848	4,088	(2)	(2)	(3)	460,893	(3)	629,484
1915	433,822	240,449	(3)	(1)	(3)	[1] 447,962	(2)	(2)	344,040	3,858	(2)	(2)	(3)	451,820	(3)	692,269
1916	703,832	421,856	(3)	(1)	(3)	[1] 646,080	(2)	(2)	362,000	3,420	(2)	(2)	(3)	649,500	(3)	1,071,356
1917	656,391	414,823	(3)	(1)	(3)	[1] 1,014,181	(2)	(2)	92,963	1,044	(2)	(2)	(3)	1,015,225	(3)	1,430,048
1918	741,429	658,576	(3)	(1)	(3)	[1] 880,906	(2)	(2)	11,587	1,647	(2)	(2)	(3)	882,553	(3)	1,541,129
1919	723,713	726,532	(3)	(1)	(3)	[1] 762,228	(2)	(2)	62	9	(2)	(2)	(3)	762,237	(3)	1,488,769
1920	1,298,537	1,177,943	(3)	(1)	(3)	[1] 2,011,434	(2)	(2)	----------	----------	(2)	(2)	(3)	2,011,434	(3)	3,189,377
1921	328,444	331,219	(3)	(1)	(3)	[1] 758,521	(2)	(2)	134,650	2,166	(2)	(2)	(3)	760,687	(3)	1,091,906
1922	385,653	359,793	[5] 42,579	[5] $18,372	[5] 1,063,306	[5] 371,801	[5] 1,807	[5] $2,860	313,745	4,514	[5] 10,404	[5] $18,039	[5] 1,431,841	[5] 415,586	(3)	[6] 1,330,622
1923	1,044,366	532,375	60,135	49,268	4,301,727	1,730,532	30,032	37,382	1,867,385	28,324	27,208	26,967	6,286,487	1,872,473	7,330,853	2,404,848
1924	671,793	419,154	74,534	69,018	3,619,229	1,681,774	18,205	41,455	1,342,107	22,034	75,283	93,471	5,129,358	1,907,752	5,801,151	2,326,906
1925	604,550	526,292	41,284	63,466	3,239,554	1,113,202	14,639	16,785	950,614	13,120	50,667	65,962	4,296,758	1,272,535	4,901,308	1,798,827
1926	818,381	562,300	46,662	44,621	5,229,858	1,750,434	15,147	15,410	140,732	2,048	67,316	76,021	5,499,715	1,888,534	6,318,096	2,450,834
1927	776,307	399,302	64,075	75,469	2,588,253	1,123,808	8,097	9,211	----------	----------	22,915	22,519	2,683,340	1,231,007	3,459,647	1,630,309
1928	541,635	294,194	49,555	93,964	3,496,353	1,025,790	4,986	4,539	150	53	12,296	7,955	3,563,340	1,132,301	4,104,975	1,426,495
1929	1,283,472	729,158	118,224	201,632	5,052,848	1,277,555	13,655	9,805	1,020	43	6,446	5,215	5,192,193	1,494,250	6,475,665	2,223,408
1930	4,549,461	405,760	72,402	100,498	2,326,780	767,414	6,001	8,499	688	57	2,813	1,388	2,408,684	877,856	6,958,145	1,283,616
1931	4,549,122	132,865	16,707	19,774	1,527,656	463,928	1,787	3,483	1,200	36	1,947	698	1,549,297	487,919	6,098,419	620,784
1932	2,970,742	78,496	23,097	16,824	944,628	184,920	12,956	6,871	111,771	383	1,287	173	1,093,739	209,171	4,064,481	287,667
1933	3,853,906	178,953	39,787	25,609	1,343,329	255,401	15,244	10,795	537,776	1,388	3,441	1,611	1,939,577	294,804	5,793,483	473,757
1934	7,688,458	247,408	68,619	64,498	2,145,950	442,949	7,637	5,651	318,464	907	1,898	1,209	2,542,568	515,214	10,231,026	762,622
1935	6,580,486	211,556	94,237	83,382	3,041,408	584,657	32,495	25,383	----------	----------	7,867	3,406	3,176,007	696,828	9,756,493	908,384
1936	8,646,446	262,044	58,496	51,698	4,467,288	848,518	47,801	38,242	132,712	2,282	2,844	2,784	4,709,141	943,524	13,355,587	1,205,568
1937	14,451,361	332,590	138,773	70,810	7,932,867	1,598,969	67,307	60,240	82,200	1,233	5,639	3,757	8,226,786	1,735,009	22,678,147	2,067,599
1938	9,292,083	141,993	43,938	44,926	1,979,162	445,323	37,516	29,551	169,025	2,626	----------	----------	2,229,641	522,426	11,521,724	664,419
1939	9,461,081	300,565	70,599	41,758	2,683,577	685,157	21,034	22,053	318,895	4,622	4,953	5,155	3,099,058	758,745	12,560,139	1,059,310

[1] Figures for cut included under splittings. [2] Not separately classified before Sept. 22, 1922.
[3] Figures for quantity not available. [4] 6 months, July to December.
[5] Sept. 22–Dec. 31. Not separately classified before change in tariff.
[6] Includes cut and splittings valued at $555,243 for January to Sept. 21.

Mica imported for consumption in the United States in 1939, by kinds and by countries

Country	Unmanufactured									
	Waste and scrap, valued not more than 5 cents per pound				Untrimmed phlogopite mica from which no rectangular piece exceeding in size 1 inch by 2 inches may be cut (duty, 15 percent)		Other			
	Phlogopite (duty, 25 percent)		Other (duty, 25 percent)				Valued not above 15 cents per pound, n. e. s. (duty, 4 cents per pound)		Valued above 15 cents per pound (duty, 4 cents per pound +25 percent)	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Africa:										
Madagascar							220	$26	12,358	$14,388
Union of South Africa			1,333,645	$5,361						
Argentina							75,590	10,195	43,418	17,669
Bolivia							734	89	3,336	1,305
Brazil							113,598	13,209	144,470	54,600
Canada	1,550,827	$7,448	226,280	1,018	61,288	$5,338	29,197	2,247	17,852	7,403
France									704	1,371
India, British	112,000	447	5,335,731	15,219			14,325	1,904	364,326	132,778
Peru									1,415	343
United Kingdom							7,481	829	12,286	7,378
Total: 1939	1,662,827	7,895	6,895,656	21,598	61,288	5,338	241,145	28,499	600,165	237,235
1938	(1)	(1)	[1] 8,900,958	[1] 28,590	100	12	110,706	13,147	280,319	100,244

Country	Manufactured—Films and splittings							
	Not cut or stamped to dimensions				Cut or stamped to dimensions (duty, 45 percent)		Total films and splittings	
	Not above 12 ten-thousandths of an inch in thickness (duty, 25 percent)		Over 12 ten-thousandths of an inch in thickness (duty, 40 percent)					
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Africa: Madagascar	550,882	$123,466					550,882	$123,466
Brazil	2,584	471	2,688	$1,421			5,272	1,892
Canada	62,477	26,584	680	330			63,157	26,914
France	20,407	4,069					20,407	4,069
India, British	1,769,814	391,285	247,000	122,195	16,941	$10,302	2,033,755	523,782
Japan	44	7	50	36			94	43
United Kingdom	6,729	2,520	3,080	2,111	201	360	10,010	4,991
Total: 1939	2,412,937	548,402	253,498	126,093	17,142	10,662	2,683,577	685,157
1938	1,825,520	372,312	146,182	67,828	7,460	5,183	1,979,162	445,323

Country	Manufactured—Cut or stamped to dimensions, shape, or form						Manufactured—Other [2]			
	Cut (duty, 40 percent)		Disks (duty, 40 percent)		Other (duty, 40 percent)		Mica plates and built-up mica (duty, 40 percent)		Ground or pulverized (duty, 20 percent)	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Brazil	5	$173								
Canada	344	267			1,660	$950			318,500	$4,608
Germany	6,892	6,499					16,869	$18,382		
India, British	37,305	19,554	23,022	$11,753			438	999		
Norway									395	14
United Kingdom	459	2,063			912	499	3,727	2,672		
Total: 1939	45,005	28,556	23,022	11,753	2,572	1,449	21,034	22,053	318,895	4,622
1938	30,038	36,880	10,071	5,273	3,829	2,773	[3] 37,516	[3] 29,551	[3] 169,025	[3] 2,626

[1] "Phlogopite" not separately classified before 1939.

[2] In addition, 4,953 pounds valued at $5,155 of "All manufactures of which mica is the component material of chief value (duty, 40 percent)" were imported; no imports of this class are shown in 1938.

[3] Changes in table, Minerals Yearbook, 1939, p. 1350, are as follows: 18,965 pounds valued at $18,500 of "Mica plates and built-up mica" reported as imported from Canada should be reported as imported from Germany; 169,025 pounds valued at $2,626 of "ground or pulverized" reported as imported from Germany should be reported as imported from Canada.

Exports.—Although production in the United States falls far short of domestic requirements, small quantities of sheet mica are exported every year. Ground mica long has comprised the bulk of the mica exported, although not separately recorded in the official statistics before 1937. It has been estimated that only 15 percent of the quantity and 50 percent of the value of exports formerly classified as "mica and manufactures" consisted of manufactures other than ground. Studies made from time to time by the Tariff Commission have indicated that although important but unreported quantities of mica manufactures are included in domestic exports of radio equipment, motors, generators, and household appliances, the exports of manufactured mica other than ground have consisted of repairs and replacement parts for American-made machinery and electrical apparatus. Draw-back statistics published by the Department of Commerce show $20,000 to $30,000 worth of foreign mica contained in exported goods in certain years; but, as the value of mica embodied in most products is small and often difficult to identify for purposes of obtaining a refund on duties, it is believed that the draw-back statistics afford an inadequate measure of the volume of mica consumed in export goods.

Mica and manufactures of mica exported from the United States, 1910–39

Year	Unmanufactured		Manufactured				Total	
			Ground or pulverized		Other			
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1910	(1)	(1)	(1)	(1)	(1)	(1)	(2)	$20,543
1911	415,862	$15,649	(3)	(3)	(2)	[3] $20,267	(2)	35,916
1912	356,601	14,936	(3)	(3)	(2)	[3] 25,876	(2)	40,812
1913	298,711	14,175	(3)	(3)	(2)	[3] 48 009	(2)	62,184
1914	467,451	23,145	(3)	(3)	(2)	[3] 27,751	(2)	50,896
1915	54,183	5,118	(3)	(3)	(2)	[3] 33,915	(2)	39,033
1916	63,168	4,544	(3)	(3)	(2)	[3] 74,127	(2)	78,671
1917	[4] 11,771	3,073	(3)	(3)	(2)	[3] 71,412	(2)	74,485
1918	(1)	(1)	(1)	(1)	(1)	(1)	(2)	74,529
1919	(1)	(1)	(1)	(1)	(1)	(1)	(2)	109,348
1920	(1)	(1)	(1)	(1)	(1)	(1)	(2)	316,169
1921	(1)	(1)	(1)	(1)	(1)	(1)	(2)	153,990
1922	(1)	(1)	(1)	(1)	(1)	(1)	(2)	129,186
1923	(1)	(1)	(1)	(1)	(1)	(1)	(2)	182,162
1924	(1)	(1)	(1)	(1)	(1)	(1)	1,519,636	169,741
1925	(1)	(1)	(1)	(1)	(1)	(1)	2,422,197	198,596
1926	(1)	(1)	(1)	(1)	(1)	(1)	2,326,131	230,511
1927	(1)	(1)	(1)	(1)	(1)	(1)	2,867,798	207,263
1928	(1)	(1)	(1)	(1)	(1)	(1)	3,661,587	229,391
1929	(1)	(1)	(1)	(1)	(1)	(1)	6,187,270	329,322
1930	(1)	(1)	(1)	(1)	(1)	(1)	4,732,864	262,826
1931	(1)	(1)	(1)	(1)	(1)	(1)	5,239,007	258,135
1932	(1)	(1)	(1)	(1)	(1)	(1)	3,098,737	132,755
1933	(1)	(1)	(1)	(1)	(1)	(1)	3,125,873	117,863
1934	(1)	(1)	(1)	(1)	(1)	(1)	3,502,498	188,525
1935	(1)	(1)	(1)	(1)	(1)	(1)	2,998,762	165,385
1936	367,672	6,671	(3)	(3)	[3] 2,587,368	[3] 163,340	2,955,040	170,011
1937	427,381	3,895	3,064,869	$108,171	98,026	104,792	3,590,276	216,858
1938	705,797	4,859	2,787,788	103,651	50,445	75,379	3,544,030	183,889
1939	564,230	6,717	3,000,793	110,568	88,488	109,079	3,653,511	226,364

[1] Figures not available. Separation by classes not recorded.
[2] Figures for quantity not available.
[3] Ground or pulverized not separately classified.
[4] 6 months, January to June.

Mica and manufactures of mica exported from the United States in 1939, by countries

Country	Unmanufactured		Ground or pulverized		Other	
	Pounds	Value	Pounds	Value	Pounds	Value
North America:						
Canada	249,490	$941	609,206	$22,061	30,982	$52,711
Cuba	-	-	12,600	306	604	1,791
Mexico	-	-	16,300	713	1,180	1,855
Other North America	-	-	120	13	432	1,226
South America:						
Argentina	2,000	90	40,224	1,380	957	1,099
Brazil	100,000	600	5,500	198	2,893	4,242
Chile	-	-	50	15	815	2,501
Venezuela	-	-	1,980	48	310	498
Other South America	-	-	12,000	1,420	1,755	1,955
Europe:						
Belgium	-	-	363,816	13,517	438	726
France	2,000	88	44,585	1,475	26	67
Germany	-	-	611,760	22,534	-	-
Netherlands	-	-	98,815	3,729	20,986	18,149
United Kingdom	52,400	2,006	928,127	34,026	3,913	2,561
Other Europe	2,040	80	163,652	5,831	4,987	5,918
Asia:						
China	-	-	-	-	379	758
India, British	26,500	1,900	2,800	122	9,405	5,257
Netherland India	-	-	54,100	2,014	-	-
Other Asia	121,800	782	-	-	4,355	3,119
Africa	8,000	230	28,158	935	970	883
Oceania	-	-	7,000	231	3,101	3,763
Total: 1939	564,230	6,717	3,000,793	110,568	88,488	109,079
1938 [1]	705,797	4,859	2,787,788	103,651	50,445	75,379

[1] Change in Minerals Yearbook, 1939, p. 1352, is as follows: Australia should read Oceania.

DOMESTIC CONSUMPTION OF SHEET MICA

The United States is the largest consumer of mica. Although it normally produces 15 to 35 percent of its requirement of sheet mica, it is virtually 100 percent dependent on imports not only for phlogopite mica and for mica splittings of all kinds but also for condenser mica and certain other specialties. One of the largest uses of sheet mica (excluding splittings) is for radio-tube bridges and supports; and most of such mica is imported, although domestic mica also is used successfully for radio stampings. During the 5 years 1925–29 domestic mines furnished almost 90 percent of the punch and small-sheet mica (1 to 2 square inches) but only 35 percent of the larger sheets and not over 1 or 2 percent of the splittings. In 1939 the percentage contribution of domestic mines was greatly reduced, and the relative importance of foreign mica correspondingly increased even with respect to supplies of punch and circle sizes.

The United States virtually depends on British India for high-grade condenser and spark-plug cigarette mica. An attempt to cover any large proportion of our needs of such mica from domestic or other foreign mines would seem impossible. Even in British India not more than 10 percent of the sheet mica mined satisfies the rigid requirement of such material. Moreover, in India the opportunity for selection is far greater than it would be under American conditions, because in that country the mica is inspected far more carefully at the mines. Skilled labor is cheap, and the small books of mica are handled and examined repeatedly during the laborious process of sorting and manufacturing mica films and splittings. In the splitting operation, as leaf after leaf is removed, stained or spotted laminae are laid bare and can be eliminated and sold separately. In the United States only about one-fifth as much sheet mica is mined as in India, no splitting is done, and even the trimming is far less complete because more irregular pieces can be marketed.

It is almost impossible to account for the total consumption of mica by industries because of the tremendous waste in manufacturing and because block mica from some mines is trimmed much more closely than mica from other mines. Moreover, as imports of uncut block mica are divided according to price rather than size, some assumptions are necessary to calculate apparent supplies of different sizes available each year. However, the Bureau of Mines estimates that the consumption of raw sheet or block mica in the United States in 1937, the most active recent year, totaled about 2,600,000 pounds, which was distributed approximately as shown in the following table.

Estimated consumption of sheet mica in the United States in 1937, by uses

Use	Pounds	Usual quality	Typical size
Transmitter condensers	30,000	Fair-stained or better; films, block.	No. 5½ (mostly), 5, 4.
Trimmer condensers	20,000	Fair-stained films, block	No. 6.
Receiver condensers	105,000	Fair-stained (60 percent); good-stained.	No. 6.
Industrial condensers, magnetos	15,000	Mostly fair-stained	No. 6 (75 percent); 5, 4, 3, 2.
Spark-plug cigarettes and shields	12,600	Fair-stained block, slightly stained films.	No. 4 and larger.
Spark-plug washers—amber	10,000	Phlogopite	No. 5.
Spark-plug washers—muscovite	20,000	Good-stained	No. 5.
Radio-tube parts	750,000	do	No. 6 (85 percent); 5½, 5.
Washers, small stampings	1,127,400	Domestic (75 percent), stained	Punch, circle No. 6.
Electrical appliances, etc	500,000	Domestic (50 percent), stained	Various.
Miscellaneous	10,000	Mostly good-stained or better	Do.
	2,600,000		

Estimates in this table for the first eight items covering most of the high-grade mica are based upon reports from manufacturers and probably are at least 80 percent correct. The last three items are added to account for the total estimated consumption of block mica and thick films as indicated by available data for domestic consumption and imports. Built-up mica and splittings are not covered in this table. In addition, 138,773 pounds of manufactured mica (cut or stamped to dimensions), equivalent to probably 300,000 pounds of block mica, were imported in 1937. In calculating the total apparent consumption as shown by this table the domestic production of punch and circle was reduced by 35 percent and of larger sizes by 10 percent to make it comparable with imports because imported block mica is trimmed more closely.

Of the total apparent consumption of 170,000 pounds of mica in condensers of all kinds, about 40,000 pounds was good-stained (No. 6); the remainder (chiefly fair-stained) comprised 55,000 pounds of No. 6, 35,000 pounds of No. 5½, 30,000 pounds of No. 5, and 10,000 pounds of larger sizes, up to No. 2.

WORLD PRODUCTION

Until 1914 India, the United States, Canada, and German East Africa accounted for virtually all the world output of mica. The World War, by emphasizing the fact that 80 percent of the total supply came from the British Empire, stimulated development elsewhere, but India has managed to maintain its place as the dominant factor; in fact, its position has been better entrenched owing to the greater importance of splittings. In the manufacture of splittings, as previously noted in this chapter, India has a preponderant advantage not only in abundant supplies of mica but also in cheap, experienced labor. Most large consuming countries import supplies; the only important producing countries that consume more than a small fraction of the mica they produce are the United States and the U. S. S. R.

The occurrence and mining of mica in India and in other countries are described in a recent book [5] by Chowdhury, who also discusses marketing and manufacturing.

World production of mica, 1925–34 (5-year averages) and 1937–38, in metric tons

[Compiled by M. T. Latus]

Country	1925–29 (average)	1930–34 (average)	1937	1938
North America:				
Canada (sales)	3,087	864	857	342
Guatemala	10			
United States (sold or used by producers) [1]	11,437	10,197	23,626	18,803
South America:				
Argentina [2]	119	91	225	250
Bolivia [3]	11	6	9	4
Brazil [3]	49	46	330	521
Colombia		3		
Peru			5	24
Europe:				
Italy	[3] 3	7	24	122
Norway [3]	43	96	42	104
Rumania			26	22
Sweden	47	57	68	131
U. S. S. R.	(4)	(4)	(5)	(5)
Asia:				
Ceylon [3]	(6)	1	1	(5)
Chosen	25	39	[7] 70	(5)
India, British [3]	4,868	3,378	15,106	8,896
Japan	[8] 1,082	(5)	(5)	(5)
U. S. S. R.	[9] 923	[10] 5,743	(5)	(5)
Africa:				
Eritrea	1	8	(5)	(5)
Ethiopia	(6)		(5)	(5)
Kenya Colony and Protectorate	(6)			
Madagascar	473	238	583	677
Nigeria				3
Rhodesia:				
Northern	4	2	4	4
Southern	168	50	17	13
Tanganyika Territory	46	17	71	37
Union of South Africa (Transvaal)	1,734	411	1,740	1,161
Oceania:				
Australia:				
New South Wales	1	26		
Northern Territory	11	35	42	49
Queensland	(6)			
South Australia	(6)	(6)	43	
Western Australia	2			

[1] Includes following quantities recovered from kaolin and schists: 1925–29 (average), 4,146 tons; 1930–34 (average), 4,741 tons; 1937, 9,558 tons; 1938, 5,942 tons.
[2] Rail and river shipments. [3] Exports.
[4] Output of U. S. S. R. in Europe included under U. S. S. R. in Asia.
[5] Data not available. [6] Less than 1 ton. [7] Official estimate. [8] Data for 1925 only.
[9] Average for 1925–28 only. [10] Average for 1932–34 only.

[5] Chowdhury, Ramani R., Handbook of Mica: Calcutta (Thacker & Co., London), 1933, 300 pp.

POSSIBLE SUBSTITUTE

In 1939 definite progress was made in the use of Alsifilm as a substitute for mica. This interesting product, made from bentonite, was described in Minerals Yearbook, 1939, p. 1353, which mentioned insulating tapes as a possible field of use in addition to built-up mica. Although Alsifilm of high tensile strength and material that is flexible or even creaseproof can be produced, it has not been possible to obtain a high degree of flexibility without sacrificing other properties that render the material a competitor of mica. Under the cooperative agreement between the Massachusetts Institute of Technology and the Research Corporation, Dr. E. A. Hauser and his associates investigated in 1939 the properties of films from raw materials from many domestic localities and from foreign sources, finally selecting a variety produced by one of the Wyoming companies as best suited for the process—chiefly because of its higher yield of ultrafine colloidal material. The status of the several developments at the end of 1939 has been summarized as follows:[6]

Aside from fundamental laboratory research, quasi-commercial developments are now being conducted under cooperative arrangements with various companies. One of these companies is investigating the production of a cambric-type insulating tape impregnated with Alsifilm; another is working on a combination of Alsifilm with fiber glass, including both felted fibers and woven fabrics; and still other companies are directing their efforts to the production of substitutes for built-up mica sheet or board. Already commutator segments and other stampings have been made that appear to be acceptable substitutes for mica products. Large V-rings may also be produced, although the material does not seem at present to be universally suitable for molding plate. Experiments in the manufacture of heater plate are quite promising but are not far advanced as yet.

The technique of production of Alsifilm is quite simple. The raw bentonite is made into a 2-percent dispersion with water, which is allowed to settle or is centrifuged to remove the coarser particles. The colloidal material is then either evaporated or concentrated in a supercentrifuge to a 6- to 8-percent gel, which has the consistency of smooth paste and so can be spread over a flat surface and then struck off to an even thickness by passing it under a knife. The moist film is next placed under a bank of incandescent electric lamps with infrared reflectors; films up to 4 or 5 mils thick are dried in this way in about 5 minutes, although thicker films cause difficulty. The final treatment is immersion in a hardening bath that renders the material water-resistant. Experiments have been made with both potassium hydroxide and lead acetate baths. The action is one of base exchange, and although the addition of potash yields a product that more nearly duplicates the chemical composition of the muscovite molecule, lead acetate is employed more commonly. The sheets are now made separately in 3-foot lengths and widths of 18 inches or more. Eventually, however, a continuous sheet may be produced and recovered in the form of a roll. In making commutator segments the next step is to paste these sheets together with shellac or other binder and to compress them in a heated press in exactly the same way as ordinary built-up mica sheets are made. Some difficulty has been experienced in cutting the built-up Alsifilm sheets into strips without breakage; but the stamping operations are conducted without difficulty, this operation being, if anything, easier with Alsifilm than with ordinary built-up mica. When shellac binder is used, the Alsifilm sheets are reported to have dielectric strength equivalent to 800 volts per mil, which is quite satisfactory. Although the individual films are rather brittle the laminated sheets are reasonably strong and will stand ordinary handling.

In addition to its use as a possible substitute for mica Alsifilm is being investigated as a substitute for paper, especially for permanent records. It takes ink well, can be strengthened by the addition of asbestos or other noninflammable fiber, and may be opacified with a dispersed pigment.

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[6] Tyler, Paul M., and Bowles, Oliver, Nonmetallic Mineral Industries in 1939: Bureau of Mines. Information Circ., 7106, February 1940, pp. 21–22.

SALT

By A. T. Coons and F. E. Harris

SUMMARY OUTLINE

Total domestic production of salt was the largest ever reported to the Bureau of Mines, aggregating 9,277,911 short tons valued at $24,509,680. This quantity exceeded the nearest previous record (that for 1937) by 36,347 tons and thus more than compensated for the million-ton drop in 1938, when production was only 8,025,768 tons valued at $23,242,561.

All three types—rock salt, evaporated salt, and salt in brine—shared in the increase, but salt in brine contributed by far the greatest part, totaling 4,584,177 tons in 1939 compared with 3,694,807 in 1938; evaporated salt was next—2,658,577 tons compared with 2,429,-100 in 1938; and rock salt was last—2,035,157 tons compared with 1,901,861 in 1938.

Salient statistics of the salt industry in the United States, 1931–35 (average) and 1936–39

	1931–35 (average)	1936	1937	1938	1939
Sold or used by producers:					
Manufactured (evaporated) short tons	2, 245, 512	2, 539, 597	2, 579, 552	2, 429, 100	2, 658, 577
In brine do	3, 357, 222	4, 279, 760	4, 631, 580	3, 694, 807	4, 584, 177
Rock salt do	1, 779, 263	2, 009, 579	2, 030, 432	1, 901, 861	2, 035, 157
Total:					
Short tons	7, 381, 997	8, 828, 936	9, 241, 564	8, 025, 768	9, 277, 911
Value [1]	$21, 697, 327	$23, 306, 177	$24, 131, 733	$23. 242, 561	$24, 509, 680
Average per ton [1]	$2. 94	$2. 64	$2. 61	$2. 90	$2. 64
Imports for consumption:					
For curing fish short tons	20, 723	21, 711	21, 079	21, 010	15, 461
Value	$35, 374	$44. 382	$45, 106	$47, 800	$27, 700
In bags, barrels, etc short tons	1, 850	1, 388	802	654	2, 121
Value	$18, 778	$12, 263	$8, 008	$8, 228	$14, 977
In bulk short tons	16, 573	27, 942	24, 115	17, 849	28, 451
Value	$35, 479	$56, 137	$80, 248	$45, 897	$58, 540
Total:					
Short tons	39, 146	51, 041	45, 996	39, 513	46, 033
Value	$89, 631	$112, 782	$133, 362	$101, 925	$101, 217
Exports:					
Short tons	97, 009	76, 974	70, 111	67, 498	124, 273
Value	$609, 173	$463, 670	$514, 858	$469, 708	$601, 501
Apparent consumption short tons	7, 324, 134	8, 803, 003	9, 217, 449	7, 997, 783	9, 199, 671

[1] Values are f. o. b. mine or refinery and do not include cost of cooperage or containers.

PRODUCTION

Salt production was reported by 79 plants (65 companies) in 1939 compared with 79 plants (63 companies) in 1938. Minerals Yearbook, 1936 (p. 920), listed producing companies in 1935, location of plants, and class of salt produced. Changes since then have been given in subsequent issues of the Minerals Yearbook. Changes in 1939 are as follows: The General Foods Corporation, Diamond Crystal Salt Division, Lyons, Kans., was taken over by the Carey Salt Co. The E. S. Blackmon operation, Freedom, Okla., is now the Eklund-Blackmon Salt Co. In Puerto Rico the works formerly designated as Ernesto H. Lienau now is the Salinas Del Papayo, Inc., Mayaguez, P. R. The Livestock & Milling Co., Redmond, Utah, reported production in 1939. The California Rock Salt Co., of Los Angeles, Calif., has bought the 40 salt claims that it has oper-

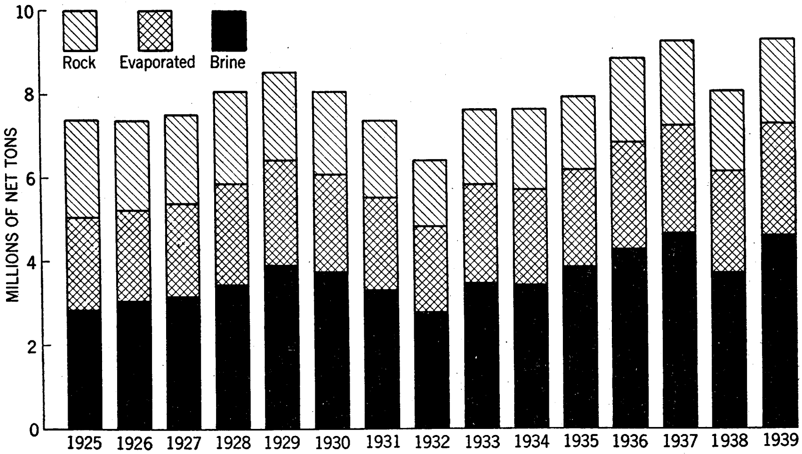

FIGURE 1.—Trends in the quantity of rock salt, evaporated salt, and brine (in terms of salt content) sold or used by producers in the United States, 1925–39.

ated on lease for 18 years at Bristol Dry Lake in the Mojave Desert south of Amboy. The deposits, formerly owned by the Consumers Salt Co., Los Angeles, cover 5,000 acres and are said to have been bought for $50,000. On July 31, 1939, a bill (H. R. 6831) to permit the Metropolitan Water District of Southern California to operate a salt mine on the public domain was passed by the House of Representatives, and to date no other action has been taken. If the bill is passed the water district will obtain from this mine all the salt required in large quantities annually to treat water from the Boulder Reservoir for domestic use. The operations would be confined to the production of salt for water conditioning only and would not permit its output for commercial use or sale. Under the general leasing law a public corporation may not obtain a mineral lease, hence the special bill.

The following tables give statistics on salt sold or used by producers in the United States by States and by methods of manufacture. Because of the small number of producers of salt in brine for chemical manufacture and of rock salt and evaporated salt in some States, it is impossible to show either rock salt or salt in brine separately by States.

Salt sold or used by producers in the United States, 1937–39, by States

State	1937		1938		1939	
	Short tons	Value	Short tons	Value	Short tons	Value
California	370, 911	$1, 817, 830	349, 856	$1, 940, 449	404, 689	$1, 980, 777
Kansas	654, 089	2, 759, 062	597, 909	2, 565, 447	641, 752	2, 591, 934
Louisiana	974, 403	2, 898, 826	958, 186	2, 775, 384	1, 072, 540	2, 830, 331
Michigan	2, 476, 406	6, 506, 120	2, 078, 612	6, 151, 154	2, 408, 872	6, 726, 912
New York	2, 084, 867	5, 795, 551	1, 717, 064	5, 467, 077	2, 041, 492	5, 855, 422
Ohio	1, 733, 875	2, 625, 644	1, 489, 270	2, 562, 620	1, 794, 788	2, 647, 355
Puerto Rico	12, 116	53, 381	12, 508	61, 917	13, 325	57, 707
Texas	364, 780	623, 037	324, 449	624, 096	352, 008	604, 633
Utah	69, 696	205, 328	61, 959	192, 495	68, 100	202, 244
West Virginia	128, 715	713, 421	129, 568	721, 490	144, 727	773, 988
Other States [1]	371, 706	133, 533	306, 387	180, 432	335, 618	238, 377
	9, 241, 564	24, 131, 733	8, 025, 768	23, 242, 561	9, 277, 911	24, 509, 680

[1] 1937: New Mexico, Oklahoma, and Virginia; 1938–39: Colorado, New Mexico, Oklahoma, and Virginia.

Salt sold or used by producers in the United States, 1938–39, by methods of manufacture

Method of manufacture	1938		1939	
	Short tons	Value	Short tons	Value
Evaporated in open pans or grainers	482, 154	$4, 025, 375	499, 331	$4, 225, 088
Evaporated in vacuum pans	1, 479, 806	9, 072, 224	1, 615, 838	9, 434, 587
Solar-evaporated	330, 441	1, 352, 568	391, 287	1, 403, 680
Pressed blocks from evaporated salt	136, 699	1, 116, 272	152, 121	1, 136, 527
Rock	1, 865, 603	5, 970, 972	1, 995, 915	6, 233, 507
Pressed blocks from rock salt	36, 258	281, 109	39, 242	263, 300
Salt in brine (sold or used as such)	3, 694, 807	1, 424, 041	4, 584, 177	1, 812, 991
	8, 025, 768	23, 242, 561	9, 277, 911	24, 509, 680

Evaporated salt.—Evaporated salt aggregating 2,658,577 short tons in 1939 was produced at 58 plants, either from the original brine of wells and ponds or from brine obtained artificially by forcing the water into beds of rock salt and withdrawing it for processing by one of several methods in use. This total includes 152,121 tons of salt blocks for stock, the output of 19 plants. Solar-evaporated salt from 25 plants comprises 15 percent of the evaporated-salt output and in 1939 totaled 391,287 tons. Most of it comes from California and some from Utah, New Mexico, and Oklahoma.

Evaporated salt sold or used by producers in the United States, 1938–39, by States

State	1938		1939	
	Short tons	Value	Short tons	Value
California	343, 008	$1, 912, 637	396, 479	$1, 943, 698
Kansas	217, 918	1, 724, 635	232, 985	1, 717, 995
Michigan [1]	841, 836	4, 672, 529	922, 645	5, 019, 674
New York	340, 137	3, 378, 167	365, 899	3, 496, 414
Ohio	372, 711	2, 307, 949	395, 913	2, 337, 282
Puerto Rico	12, 508	61, 917	13, 325	57, 707
Texas	38, 362	208, 533	39, 096	198, 051
Utah	56, 597	173, 746	62, 177	183, 422
West Virginia [1]	129, 568	721, 490	144, 727	773, 988
Other States [2]	76, 455	404, 836	85, 331	471, 651
	2, 429, 100	15, 566, 439	2, 658, 577	16, 199, 882

[1] Includes a quantity of salt contained in brine for chemical use reported as evaporated salt with value as evaporated salt.
[2] Colorado, Louisiana, New Mexico, and Oklahoma.

Rock salt.—The output of rock salt reported by 21 plants totaled 2,035,157 short tons in 1939, which includes 39,242 tons of blocks produced by 7 plants for consumption by livestock. New York maintained the lead in rock-salt production, followed by Louisiana, Kansas, and Michigan. These four States continue to produce most of the national total.

Rock salt sold by producers in the United States, 1935–39

Year	Short tons	Value	Year	Short tons	Value
1935	1, 759, 242	$5, 510, 413	1938	1, 901, 861	$6, 252, 081
1936	2, 009, 579	6, 003, 054	1939	2, 035, 157	6, 496, 807
1937	2, 030, 432	6, 447, 648			

Salt content of brine.—Notwithstanding the fact that the quantity of salt in brine sold or used by producers was 4,584,177 tons in 1939, 24 percent greater than the 1938 total (3,694,807 tons), production did not reach the peak record of 4,631,580 tons in 1937. Salt in brine was produced at 10 plants in 1939, excluding 2 plants where the product is reported as evaporated salt rather than as salt in brine.

Pressed blocks and salt for livestock.—The quantity of salt consumed by livestock is increasing. Although the sale of pressed-salt blocks slumped in 1935 and 1937, their sale is increasing, as evidenced by the rise in 1938 and 1939. Moreover, not all the salt used by stock is apparent in the production statistics, as a greater quantity (estimated by a Department of Agriculture specialist as two-thirds or three-fourths of total stock salt) is used in the prepared feed for stock and poultry or is added to the feed at the farm. The blocks are suitable for some stock, but others—swine in particular—cannot be allowed to eat it at their discretion, as they are prone to overeat the salt and thus poison themselves. The salt used in the prepared feed is a coarse, granulated size. A convenient way for cattle to get their required salt (and whatever other conditioning mineral is added) is by a newly developed molded plastic dispenser that calls for a cylindrical "block" of salt.

Pressed-salt blocks sold by original producers of the salt in the United States, 1935–39

Year	From evaporated salt		From rock salt		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1935	126, 005	$900, 040	24, 691	$156, 002	150, 696	$1, 056, 042
1936	134, 586	965, 114	34, 489	222, 864	169, 075	1, 187, 978
1937	120, 061	966, 812	28, 981	240, 251	149, 042	1, 207, 063
1938	136, 699	1, 116, 272	36, 258	281, 109	172, 957	1, 397, 381
1939	152, 121	1, 136, 527	39, 242	263, 300	191, 363	1, 399, 827

DISTRIBUTION

The following table was compiled from data furnished by the producers only, with no account of reshipments.

Distribution (shipments) of evaporated and rock salt in continental United States, 1938–39, by States of destination, in short tons

Destination	1938		1939	
	Evaporated	Rock	Evaporated	Rock
Alabama	6, 194	31, 532	7, 174	31, 801
Arizona	7, 387	2, 444	8, 336	2, 179
Arkansas	6, 451	19, 103	6, 900	22, 355
California	218, 599	6, 848	218, 440	8, 210
Colorado	23, 910	11, 330	24, 225	11, 575
Connecticut	13, 234	4, 198	13, 247	4, 930
Delaware	2, 446	34, 330	2, 646	29, 257
District of Columbia	4, 742	1, 053	4, 590	1, 191
Florida	5, 681	18, 271	6, 595	19, 213
Georgia	14, 779	40, 325	15, 250	43, 918
Idaho	10, 411	2, 966	11, 457	1, 316
Illinois	220, 080	127, 751	239, 128	134, 096
Indiana	60, 197	36, 608	64, 293	41, 615
Iowa	68, 435	75, 020	76, 658	83, 354
Kansas	37, 542	120, 527	26, 577	131, 449
Kentucky	32, 841	13, 153	45, 583	15, 106
Louisiana	5, 909	51, 564	5, 809	55, 002
Maine	6, 855	16, 978	8, 189	20, 818
Maryland	24, 744	20, 424	26, 493	20, 953
Massachusetts	47, 667	30, 206	52, 375	34, 871
Michigan	222, 588	42, 652	232, 327	44, 984
Minnesota	80, 438	60, 266	95, 093	62, 547
Mississippi	2, 645	29, 966	3, 293	28, 947
Missouri	56, 717	48, 943	57, 273	52, 471
Montana	13, 378	1, 914	14, 690	2, 077
Nebraska	24, 263	40, 378	25, 254	46, 110
Nevada	2, 054	115	2, 405	216
New Hampshire	3, 552	26, 065	5, 348	30, 448
New Jersey	55, 075	101, 173	74, 776	124, 312
New Mexico	4, 513	10, 741	5, 550	10, 983
New York	182, 528	318, 836	183, 186	316, 316
North Carolina	35, 842	30, 185	37, 227	37, 971
North Dakota	10, 064	4, 550	10, 322	3, 927
Ohio	126, 483	50, 989	133, 817	63, 803
Oklahoma	22, 783	27, 481	25, 278	26, 640
Oregon	21, 633	331	22, 803	464
Pennsylvania	105, 493	72, 205	125, 927	83, 536
Rhode Island	7, 544	6, 272	8, 565	7, 326
South Carolina	6, 982	15, 165	7, 741	15, 485
South Dakota	11, 870	13, 426	14, 195	14, 888
Tennesseee	23, 767	36, 812	26, 089	38, 959
Texas	43, 008	135, 054	49, 580	140, 808
Utah	12, 500	3, 443	13, 602	4, 147
Vermont	4, 673	4, 915	5, 807	5, 793
Virginia	46, 718	28, 829	48, 813	41, 192
Washington	84, 692	500	90, 671	720
West Virginia	135, 754	67, 244	159, 850	41, 772
Wisconsin	95, 801	21, 619	107, 017	27, 207
Wyoming	7, 358	2, 803	7, 434	2, 833
Other [1]	160, 280	34, 358	200, 679	45, 066
	2, 429, 100	1, 901, 861	2, 658, 577	2, 035, 157

[1] Includes production of Puerto Rico (evaporated salt); exports to Australia, Canada, Central America, Cuba, Japan, Mexico, South America, and other countries; and shipments to unspecified destinations, including Alaska, Hawaii, and Puerto Rico.

Salt shipped to noncontiguous Territories of the United States, 1938–39

Territory	1938		1939	
	Short tons	Value	Short tons	Value
Alaska	6, 130	$97, 858	6, 108	$109, 517
American Samoa	4	264	6	289
Canton and Enderbury Islands	(1)	(1)	1	32
Guam	37	1, 287	29	1, 104
Hawaii	2, 144	55, 402	2, 265	61, 153
Midway Island	1	22	1	33
Puerto Rico	1, 282	33, 781	1, 288	35, 241
Virgin Islands	10	603	16	829
Wake Island	1	20	(2)	7
	9, 609	189, 237	9, 714	208, 205

[1] Figures not available before Jan. 1, 1939. [2] Less than 1 ton.

PRICES

New York quotations on rock salt were stable in 1939, but those of vacuum common fine salt fluctuated somewhat. The price of bagged rock salt, delivered at New York, was $13.20–$13.80 a ton in carlots; in less than carlots it was $15–$15.60. Bagged common fine salt in carlots delivered in New York cost $15.30 a ton in the first quarter of 1939; in less than carlots it cost $16.30–$21. At the end of the first quarter the quotations dropped to $14 a ton for carlots and $15–$19.70 a ton for less than carlots. These prices prevailed until the last quarter of 1939, when they were changed to $15.30 a ton for carlots and $16.60–$19.70 a ton for less than carlots—quotations that continued through the first quarter of 1940. At the end of this quarter the price for carlots rose to $15.70, the prices for smaller lots remaining the same.

USES

Salt is one of the minerals about which the United States need have no concern as to an ample supply. It is found abundantly in many parts of the country, and new sources are discovered almost daily. The chief problems therefore are distribution and research to develop new uses and efficient methods for converting it into useful commodities. The ingenious use of salt has been an important factor in attainment by the United States of first place in world production of chemicals. Many chemicals are based upon salt, especially the heavy alkalies so important to process and other industries.

A quantitative break-down of salt production into its ultimate as well as immediate uses would be interesting, but so far the sequence has never been followed through. All that can be said is that there are hundreds of uses of salt, many of which are vital to the respective industries employing it. Some of these industries consume only small quantities of salt, but together their consumption aggregates an important volume.

Of the heavy alkalies made from salt, soda ash and caustic soda are used in large quantities by important industries. According to recent statements,[1] 2,964,000 short tons of soda ash and 970,000 tons of caustic soda were consumed in 1939, increases over 1938. The greatest increase in soda-ash consumption was in the glass, pulp and paper, caustic and bicarbonate soda, and other chemical industries. Textile industries also used more soda ash in 1939 than in 1938, and requirements for water softening and petroleum refining were greater. Production of caustic soda rose because the rayon and cellulose industry consumed more in 1939 than 1938, as did the pulp and paper industry. The soap, petroleum-refining, lye, textile, and rubber-reclaiming industries also took more caustic soda in 1939 than in 1938. Exports of both soda ash and caustic soda were larger in 1939 than in the previous year.

The same source of information stated that the indications were that chlorine gas "slightly exceeded its previous high point in 1937, probably by about 2 percent, although the pressure of excessive chlorine demands was relieved in 1938, and neither that year nor 1939 was an exciting one for chlorine."

[1] Chemical and Metallurgical Engineering, February 1940, pp. 70–71.

The European war influenced the chemical market in no small degree. Some markets were cut off from the United States, but others were substituted that had been deprived of their European supply. Moreover, because of the war, chemical requirements were greater.

The effect of the use of common salt on concrete roadways still engages attention. How the salt honeycombs snow and ice was described.[2] The flaking, spalling, and disintegration of concrete surfaces owing to application of salt in icy weather was discussed,[3] and Swedish investigations were reported.[4] This use of salt has no reference to dirt roads on which the use of salt appears to have been successful. Although reported progress is slow the quantity so employed has been increasing steadily in recent years.

Although aggregating a small total, the use of salt in drinking water for those working in hot places is continuing.[5]

The new plastics and rubberlike fabrics in which salt is used as one of the basic ingredients are still in the public eye and their practical features are being shown.

As a novelty, the ceiling of the Rumanian building at the New York World's Fair of 1939 was built of blocks of rock salt mined in Rumania. The blocks in the center of the ceiling were streaked with wide bands of gypsum, while the large blocks around the edge appeared to be of purer quality. All the blocks were crude (just as mined and cut). From below they resembled polished marble. Fans had to be used to keep the salt blocks dry, otherwise they would begin to deliquesce and drip.

A recent bibliography [6] of published reports of experiments on the effect of various minerals on plant growth includes a number of references to the use of salt; these include determination of the salt requirements of tobacco, the plant uptake of potash as induced by salt, the effect of application of common salt upon the yield and quality of sugar beets and upon the sugar content of melons, and other phases of salt action.

Food is the largest market for dry salt. A new food use, although consuming an insignificant quantity compared to the present total, may be mentioned. The canning of Atlantic crab meat for long keeping, not heretofore attempted, has been begun recently. The process employs sodium chloride in a brine to give the meat a protective salt treatment.[7]

TECHNOLOGIC DEVELOPMENTS

The up-to-date methods of mining rock salt at the Jefferson Island Salt Mining Co. in northern Louisiana were described and illustrated in a magazine article.[8] This salt is pure enough to use without

[2] Toaspern, Arthur C., Salt Breaks Ice Bond: Eng. News-Record, April 11, 1940, p. 73.
[3] Edwards, Dean G., Salt on Concrete Pavement: Eng. News-Record, May 9, 1940, p. 61.
[4] Schutz, F., The Influence of Salt on Concrete: Betong, 1938 (3), pp. 154–161; Building Sci. Abs., vol. 11 (N. S.), No. 11, November 1938, pp. 365–366.
[5] Talbert, R. C., Maintaining Health and Comfort with Salt: Hazards and Safety, July 1939, pp. 14–15, 32.
Explosives Engineer, Salt Cocktails: Vol. 17, No. 10, October 1939, p. 296.
United States Navy, circular letter of July 1934 (still in circulation).
[6] North Carolina Experiment Station Soil Research Laboratory, Wilmington, N. C., Bibliography of References to the Literature on the Minor Elements and Their Relation to Plant and Animal Nutrition: 1st Supp. to 3d ed. (originally compiled by L. G. Willis); pub. by Chilean Nitrate Educational Bureau, Inc., 1940, 82 pp.
[7] Fellers, Carl R., and Harris, Sterling G., Canned Atlantic Crab Meat: Ind. Eng. Chem., vol. 32, No. 4, April 1940, p. 594.
[8] Excavating Engineer, February 1939, pp. 82–85, 118.

further treatment than crushing, screening, and grading to size after mining.

Fine granulated salt has been the form most favored by many textile factories for industrial use in the past because such salt dissolves more readily than other types. Rock salt costs less, but because it dissolves slowly dissolvers must be used if a plant wants a fairly continuous supply of brine. At a textile show in the South, the Myles Salt Co., of Louisiana, exhibited a small rock-salt dissolving unit, the storage tank of which was nickel-lined to prevent not only corrosion but also contamination of the brine.

The International Salt Co., of New York and Pennsylvania, has equipment called the Lixator [9] which supplies saturated brine for such industrial uses as regenerating zeolites; curing meat, fish, and hides; and dyeing textiles. The brine, free from sediment, is produced from cheap rock salt as needed. The equipment is automatic, except for the necessity of refilling the salt hopper and emptying the sediment from the bottom of the cone. It is made of Monel metal.

A method of purifying rock salt "uses silicate to prevent the floating of soluble crystals in a saturated solution and makes clean separation of insoluble dirt from such a substance as common salt by floating the earthy material on a soapy foam; thus certain rock salts can be purified without the expense of dissolving and recrystallizing." [10]

IMPORTS AND EXPORTS [11]

Although foreign trade in salt is small (and has been for a long time), domestic imports and exports were larger in 1939 than in 1938. Imports increased by only 17 percent, but exports advanced 84 percent. Of the imports the greatest tonnage increase was in bulk salt with a substantial rise in salt in bags, barrels, etc., while the total imported for curing fish declined sharply. The largest tonnages exported went to Canada and Japan; both represented gains over 1938 shipments.

Salt imported for consumption in the United States, 1938–39, by countries

Country	1938		1939	
	Short tons	Value	Short tons	Value
North America:				
Canada	8,130	$18,724	7,504	$25,503
West Indies:				
British:				
Jamaica	12,100	26,991	26,230	42,247
Other British	40	529	314	1,741
French			4	41
Netherland	348	765	457	1,164
Europe:				
France	2	32		
Germany	15	612		
Sweden	1	40	1	74
U. S. S. R.	(1)	803	(1)	298
United Kingdom	273	3,775	154	2,559
Africa:				
Egypt			5,034	19,274
Tunisia	18,604	49,654	6,335	8,316
	39,513	101,925	46,033	101,217

1 Less than 1 ton.

9 Chemical and Engineering News, News Edition, vol. 18, No. 4, February 25, 1940, p. 177.
10 Silicate P's & Q's, vol. 19, No. 12, December 1939, p. 2.
11 Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Salt exported from the United States, 1938–39, by countries

Country	1938		1939	
	Short tons	Value	Short tons	Value
North America:				
Bermuda	28	$651	27	$624
Canada	43,593	181,063	54,691	223,312
Central America:				
British Honduras	404	4,395	495	4,979
Guatemala	114	1,785	179	2,565
Honduras	150	3,957	135	2,705
Nicaragua	311	5,155	252	3,618
Panama:				
Republic of	15	545	87	1,259
Canal Zone	687	17,828	924	19,764
Mexico	3,372	48,193	3,220	44,547
Newfoundland and Labrador	442	1,584	307	1,328
West Indies:				
British	36	1,394	656	9,088
Cuba	9,171	97,260	9,037	99,019
Dominican Republic	238	7,791	215	4,984
Haiti	15	613	9	370
Netherland	119	3,952	86	3,451
Other North America	35	606	46	957
South America:				
Argentina	205	2,198	117	1,180
Brazil	70	599	53	493
Colombia	7	221	13	267
Other South America	13	309	36	1,833
Europe:				
Ireland	8	1,597	7	1,500
U. S. S. R.			1,408	5,029
United Kingdom	12	544	17	1,486
Other Europe	6	421	68	2,670
Asia:				
China	5	618	6	834
Hong Kong	18	1,166	20	604
Japan	5,647	21,080	49,669	113,859
Philippine Islands	370	12,873	330	9,658
Other Asia	27	1,597	25	1,559
Africa:				
Liberia			74	2,046
Morocco	8	181	53	994
Other Africa	18	1,375	19	1,146
Oceania:				
British:				
Australia	1,229	22,173	1,234	24,393
New Zealand	926	21,664	523	13,621
French	199	4,320	235	4,759
	67,498	469,708	124,273	610,501

WORLD PRODUCTION

Although production data are still lacking for many countries listed in the accompanying table, doubtless, the United States in 1938 maintained its long-held position as the leading salt producer of the world.

World production of salt, 1934–38, by countries, in metric tons

[Compiled by M. T. Latus]

Country [1]	1934	1935	1936	1937	1938
North America:					
Canada	293,960	324,975	355,486	415,994	398,013
Costa Rica	3,330	3,500	3,500	4,287	4,740
Guatemala	2,913	2,073	8,053	12,610	10,465
Mexico	(2)	57,746	101,628	82,876	107,701
Panama	4,947	5,541	4,385	6,898	3,332
United States:					
Rock salt	1,735,600	1,595,949	1,823,050	1,841,967	1,725,330
Other salt	5,169,921	5,595,173	6,186,384	6,541,795	5,547,321
West Indies:					
British:					
Bahamas [3]	3,175	545	----------	5,003	4,830
Leeward Islands [3]	1,357	----------	----------	----------	----------
Turks and Caicos Islands [3]	18,963	28,803	41,899	50,833	35,578
Cuba	20,964	36,921	34,339	36,287	35,217
Netherland [3]	6,479	3,781	2,285	2,337	2,013
South America:					
Argentina [4]	194,443	234,441	247,433	290,084	264,150
Brazil	280,573	277,583	494,119	708,714	859,222
Chile	31,210	36,453	47,232	36,697	(2)
Colombia	181,052	181,613	171,455	164,636	(2)
Ecuador:					
Rock salt	114	119	138	138	(2)
Other salt	28,902	32,039	16,632	13,800	13,800
Peru	34,343	35,397	36,110	39,010	34,307
Venezuela	28,357	53,225	25,128	26,298	22,658
Europe:					
Bulgaria:					
Rock salt	6,138	5,330	7,008	9,745	10,242
Other salt	48,722	36,629	47,000	43,602	66,258
Czechoslovakia	147,299	163,843	172,647	165,898	174,000
France:					
Rock salt and salt from springs	1,673,280	1,604,660	1,711,060	1,847,179	1,264,230
Other salt	398,070	356,650	202,040	490,906	346,046
Germany:					
Rock salt	2,024,194	2,077,316	2,383,825	2,757,242	2,694,984
Other salt	509,316	561,588	574,489	608,046	585,326
Austria:					
Rock salt	864	1,257	712	908	786
Other salt	163,732	198,209	191,294	169,883	93,576
Greece	107,696	113,980	74,447	102,285	102,057
Italy:					
Rock salt	393,306	483,436	499,798	603,798	613,870
Other salt	576,742	671,084	770,333	952,655	885,205
Malta	2,235	2,032	1,930	1,829	1,523
Netherlands: Rock salt	74,759	70,963	76,271	132,430	164,266
Poland	506,383	515,094	466,525	602,746	642,875
Portugal [3]	56,511	81,965	73,944	4,633	6,096
Rumania:					
Rock salt	308,723	308,921	283,389	308,882	351,723
Other salt	----------	1,542	1,750	2,077	1,842
Spain:					
Rock salt	160,023	(2)	(2)	(2)	(2)
Other salt	602,308	(2)	(2)	(2)	(2)
Switzerland	81,596	79,757	81,177	81,969	84,049
U. S. S. R.	[5] 3,544,000	[5] 4,349,500	(2)	(2)	(2)
United Kingdom:					
Great Britain:					
Rock salt	17,650	16,571	17,569	18,666	19,974
Other salt	2,528,634	2,713,377	2,845,242	3,101,511	2,651,939
Ireland, Northern:					
Rock salt	3,533	3,282	3,175	4,254	2,362
Other salt	10,500	10,199	12,297	8,818	5,757
Yugoslavia	41,922	43,549	45,205	46,323	52,634

See footnotes at end of table.

World production of salt, 1934–38, by countries, in metric tons—Continued

Country [1]	1934	1935	1936	1937	1938
Asia:					
Aden	361,119	345,119	361,098	360,866	282,510
Burma	37,569	40,729	32,790	54,677	39,319
Ceylon	63,449	41,612	40,332	38,815	36,490
China [6]	3,220,000	3,000,000	3,000,000	3,000,000	3,000,000
Chosen [7]	138,000	138,000	138,000	138,000	138,000
Cyprus [7]	3,000	3,000	3,000	3,000	3,000
India:					
British:					
Rock salt	182,047	181,214	175,020	190,103	191,395
Other salt	1,596,531	1,593,593	1,369,861	1,516,984	1,372,979
Portuguese	209,219	160,681	24,047	26,095	29,527
Indochina	160,536	203,210	192,237	193,558	193,050
Iraq	8,000	7,045	2,804	1,810	7,907
Japan:					
Japan proper [8]	676,302	604,442	518,859	535,775	(2)
Taiwan	191,577	149,375	189,777	210,471	(2)
Netherland India	92,370	102,076	107,449	75,780	[9] 74,411
Palestine:					
Rock salt	859	867	755	727	444
Other salt	9,389	10,376	8,058	11,717	8,065
Philippine Islands	(2)	(2)	53,471	48,905	(2)
Syria [7]	10,000	10,000	10,000	10,000	10,000
Thailand [3]	126,565	138,504	44,505	132,899	156,268
Turkey	190,602	214,688	220,500	262,226	247,293
U. S. S. R.	(5)	(5)	(5)	(5)	(5)
Africa:					
Algeria	42,885	67,990	62,400	63,767	74,630
Belgian Congo	888	894	920	1,004	1,013
Canary Islands [7]	2,000	2,000	2,000	2,000	2,000
Egypt [3]	288,470	257,104	237,570	276,735	284,949
Eritrea	96,000	2,380	62,000	(2)	(2)
Ethiopia: Rock salt	10,000	10,000	10,000	10,000	10,000
French West Africa	1,200	381	748	643	51
Kenya Colony	1,760	2,845	-----	-----	3,250
Libya (Italian Africa):					
Cyrenaica [7]	10,000	10,000	10,000	10,000	10,000
Tripolitania [7]	20,000	20,000	20,000	20,000	20,000
Mauritius [7]	1,500	1,500	1,500	1,500	1,500
Morocco, French	1,064	1,194	814	11,207	909
Nigeria [7]	400	400	400	400	400
Portuguese East Africa	1,689	3,436	2,520	2,605	6,448
Portuguese West Africa (Angola) [7]	25,000	25,000	25,000	25,000	25,000
Somaliland:					
British [3]	3,212	2,655	1,509	950	353
French [3]	35,497	76,500	21,985	85,273	(2)
South-West Africa: Rock salt	2,800	5,021	3,822	4,113	5,071
Sudan, Anglo-Egyptian	24,421	26,534	27,027	34,553	37,532
Tanganyika Territory	7,418	6,916	8,574	8,723	10,169
Tunisia	86,966	79,689	129,000	129,708	129,287
Uganda	4,950	1,590	3,405	3,133	3,169
Union of South Africa	83,233	87,261	97,904	106,338	(2)
Oceania:					
Australia:					
South Australia	62,063	79,255	67,391	74,739	76,013
Victoria [10]	46,813	48,356	(2)	(2)	(2)
Western Australia	2,713	(2)	4,295	3,729	3,850

[1] In addition to the countries listed salt is produced in Bolivia, Gold Coast, Madagascar, and Southern Rhodesia, but figures of production are not available.
[2] Data not available. [3] Exports. [4] Railway shipments.
[5] Output of U. S. S. R. in Asia included with U. S. S. R. in Europe.
[6] Includes Manchuria. [7] Estimated annual production.
[8] Year ended March 31 of year following that stated. The figures do not include output from salt beds which, although situated on Government beach lands, have no fixed areas.
[9] Incomplete data. [10] Year ended June 30 of year stated.

Canada.—A substantial quantity of salt is produced annually in Canada for various uses. At present only the preliminary report for 1939 is available.[12] The final annual reports of the Dominion Bureau of Statistics usually give a break-down of total salt production into uses, by quantity. In 1937 the Dominion Bureau began to itemize separately the quantity of salt used on roads in the Dominion; the quantity of highway salt sold in 1938 was 10,174 tons valued at $34,689 compared with 1,969 tons valued at $6,227 in 1937. Canadian salt beds are discussed in an article [13] on the development of mineral resources. Two occurrences of salt 900 and 1,400 feet thick, which were discovered incident to drilling for gas and oil in New Brunswick, were described.[14]

China.—Salt fields have received a great deal of attention from Japan, according to United States Counsul Frederick W. Hinke, Tientsin, China, who has furnished a comprehensive official report on the needs of Japan for an adequate and continuous supply of salt for its industries and military purposes and on Japan's intense efforts to exploit the Changlu field of China to meet a large part of its requirements. Japan's annual consumption totals about 1,900,000 tons, of which it produces 36, Taiwan 4, and foreign countries 60 percent. Because of the growth of industries in the country its requirements have increased by leaps and bounds. The quantity of salt used industrially by Japan in 1912 was only 3 percent of the total; in 1924, 10 percent; in 1932, 35 percent; and in 1933, 46 percent. In the past 6 years salt consumption in Japan has increased 50 percent. Since the outbreak of the conflict in China it has become increasingly imperative for Japan to obtain salt from nearby sources because of exchange and shipping difficulties. The European war has heightened this urgency, as Japan for the past 7 years has imported an annual average of well over 400,000 tons of salt from Africa whence it is difficult now to obtain a supply. Expectations were that the Changlu field would fill the gap, but this does not seem to be the case. Despite the promising yields of salt early in 1939, output from the Changlu field has suffered set-backs owing to typhoons, increased domestic needs, and lack of shipping facilities. An increase of 190,000 tons in Changlu production was anticipated from 1938 to 1939 but did not materialize, and a further estimated increase of 120,000 tons for 1940 cannot be realized because of typhoon damage.

Germany.—Despite a reduction in exports, salt production in Germany has expanded steadily since 1933.[15] Part of the decrease in exports was due to the German Reich's absorption of countries to which salt was exported previously. In 1939 Germany introduced a new denaturant for (tax-free) salt to be used for industrial purposes. Formerly, heliotropine was the chief denaturant used, but as it has to be imported a new denaturant was introduced which is called Nerolin (also known as Bromelia) and is produced from domestic materials.[16]

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12 Bureau of Mines Mineral Trade Notes, vol. 10, No. 4, April 1940.

13 Canadian Chemistry and Process Industries, London (Ont.) as an Industrial Center; Agricultural and Mineral Resources under Chemical Development Produce Growing Enterprises: Vol. 23, No. 5, May 1939, p. 225.

14 Canadian Mining and Metallurgical Bulletin, No. 324, April 1939, p. 122.

15 Bureau of Mines Mineral Trade Notes, July 1939, pp. 26–28.

16 Bureau of Mines Mineral Trade Notes, April 1940, p. 18.

Italy.—Chiefly through the aid of the colonies of the Italian Empire, Italy has been striving to increase its exports of salt.[17] The Italian East African salt industry now exports about 250,000 tons a year, which is more than is being exported from Italy.

Palestine.—Although Palestine has huge resources of salt, much of which is in the Jebel Usdum area, the reported output is not large, and it seems difficult to obtain representative statistics. According to an article [18] that describes operations at the southern plant on the Dead Sea, the brine is pumped up to a series of pans exposed to the intense heat of the sun and arranged for a continuous flow downward to the Dead Sea. Common salt is the first of the dissolved salts to be deposited in the pans.

Spain.—It is reported that Spain is endeavoring to reestablish its salt industry and recapture its former markets.[19] For many years Spain was second in the list of salt-exporting countries, and its shipments averaged more than 500,000 tons a year.

Venezuela.—An extension of the salt works at Araya is included in the program for which an additional 26,099,000 bolivares was allotted by the Government under the 3-year public-works plan in July 1939. This salt field was described in a report in 1938.[20]

[17] Bureau of Mines Mineral Trade Notes, March 1940, p. 16.
[18] Shepstone, Harold G. (F. R. G. S.), The Conquest of the Dead Sea: Sci. American, January 1939, pp. 10–12.
[19] Bureau of Mines Mineral Trade Notes, April 1940, pp. 18–19.
[20] Bureau of Mines Mineral Trade Notes, vol. 6, No. 6, June 1938, pp. 18–20.

MAGNESIUM COMPOUNDS, BROMINE, CALCIUM CHLORIDE, IODINE, SODIUM SULFATE, BORATES, AND MISCELLANEOUS SALINES

By PAUL M. TYLER AND A. T. COONS [1]

SUMMARY OUTLINE

Common salt, the most important saline mineral, and potash are discussed in separate chapters of this volume. Available data on other natural salines and on magnesite and other magnesium compounds are reviewed in this chapter, following the arrangement first adopted in Minerals Yearbook, 1939.

Previous annual reviews have stressed the growing interchangeability of sources of magnesium. In 1939 serpentine was added to the list of minerals mined for their magnesium content. As noted in the Minor Nonmetals chapter of this volume, serpentine is being employed as an admixture in the new dolomite-base refractories, both to increase the magnesia content and to convert the lime into a nonslaking disilicate. Early in 1940 it was reported that the Dow Chemical Co. proposed to build a plant on the Gulf of Mexico, utilizing sea water as the source of additional raw material for metallic magnesium. A process for making either Epsom salt or monohydrated magnesium sulfate from North Carolina olivine was investigated; this process also is discussed briefly in the Minor Nonmetals chapter of this volume.

MAGNESIUM COMPOUNDS

MAGNESITE

Domestic production and imports of magnesite increased sharply in 1939. The apparent new supply of dead-burned magnesite was more than twice as large as in 1938 and larger than in any previous year except 1936 and 1937. It exceeded the 1925–29 average by 25 percent and was well ahead of recovery in iron and steel output, which failed to regain its predepression average, thereby tending to confirm the fact that new outlets for magnesite in other industries are offsetting any losses in demand caused by possible substitution of competitive refractory materials in the iron and steel industry.

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

Salient statistics of the magnesite industry in the United States, 1935–39

	1935	1936	1937	1938	1939
Crude:					
Mined:					
Short tons	177,154	207,119	203,437	[1] 97,000	[1] 198,980
Value [1]	$1,192,052	$1,411,664	$1,483,492	[1] $725,000	[1] $1,465,190
Sold by producers:					
Short tons	1,626	1,669	1,952	919	1,123
Value	$22,345	$24,420	$29,203	$12,332	$15,752
Average per ton [2]	$13.74	$14.63	$14.96	$13.42	$14.03
Imports for consumption:					
Short tons	49	59	34	36	569
Value	$1,084	$1,130	$313	$777	$5,456
Apparent new supply ... short tons	1,675	1,728	1,986	955	1,692
Percent domestic	97.1	96.6	98.2	96.2	66.4
Caustic calcined:					
Sold by producers:					
Short tons	6,049	7,998	10,031	7,400	10,157
Value	$170,326	$221,410	$311,326	$228,498	$310,102
Average per ton [2]	$28.16	$27.68	$31.04	$30.88	$30.53
Imports for consumption:					
Short tons	1,441	2,196	2,798	1,452	2,218
Value	$36,076	$49,674	$62,420	$39,551	$51,884
Apparent new supply ... short tons	7,490	10,194	12,829	8,852	12,375
Percent domestic	80.8	78.5	78.2	83.6	82.1
Dead-burned:					
Sold by producers:					
Short tons	72,438	89,979	83,204	38,738	86,077
Value	$1,361,949	$1,713,527	$1,598,336	$730,978	$1,699,723
Average per ton [2]	$18.80	$19.04	$19.21	$18.87	$19.75
Imports for consumption:					
Short tons	24,674	42,608	56,020	24,990	44,420
Value	$429,830	$662,567	$795,047	$371,669	$800,664
Apparent new supply ... short tons	97,112	132,587	139,224	63,728	130,497
Percent domestic	74.6	67.9	59.8	60.8	66.0

[1] Partly estimated; most of the crude is processed by the mining companies, and very little enters open market.
[2] Average receipts f. o. b. mine shipping point.

Although the use of calcined magnesite is barely one-third as large as during the 1923–25 boom, the apparent new supply was larger than in any other year since 1930 except 1937. More crude magnesite was sold in 1939 than in 1938, and imports were unusually large, but the expense of shipping uncalcined material and competition from other sources of magnesia tend to prevent sales from increasing greatly.

Northwest Magnesite Co. (Farmers Bank Building, Pittsburgh, Pa.) operated two to five of its six kilns at Chewelah, Wash., 11 months and closed 1 month. Both the Finch and Allen-Moss quarries were operated in 1939, as in 1938. An experimental flotation plant has been installed.

In California the new sea-water plant of the Westvaco Chlorine Products Corporation (405 Lexington Avenue, New York, N. Y.) was operated virtually at capacity, and its Red Mountain mine 30 miles south of Livermore was reopened during the summer. Before the completion in November of a new kiln at the mine the material was calcined at Patterson where the product of the Robert Hays Smith mine was treated until it was worked out in 1936. The company also continued mining at the Bald Eagle mine near Gustine and the Western mine above Livermore. Water-soluble magnesium oxide for fertilizer use was added to the list of products made from sea water;

a company brochure stated that "Tonnage into four figures had been used by fertilizer manufacturers prior to September 1939."

The Eastern Magnesia Talc Co., Inc. (206 Bank Street, Burlington, Vt.), made a trial shipment of its high-iron magnesite tailing in 1939 in expectation of a contract for regular deliveries in 1940.

Magnesite has been discovered in the vicinity of Llano, Tex., and a prospect is being currently developed by Meramec Minerals, Inc., a subsidiary of Basic Dolomite, Inc., of Cleveland, Ohio.

Fairly heavy shipments of Austrian magnesite were made early in 1939, but this trade dwindled promptly after April when the extra (countervailing) duty of 25 percent was levied against all shipments from Germany and later became virtually impossible because of the British blockade.

Freight rates even from the Orient advanced greatly after the outbreak of the war in Europe. Cargo rates from Dairen to United States Atlantic ports jumped from $10 to $13 a ton, with $20 mentioned as an early possibility. Imports from Manchukuo, which are credited in the United States import statistics as coming from Kwantung, began to increase markedly 2 years ago. This material is not always uniform, but it is usually low in iron (less than 2 percent) and had begun to displace Austrian material even before war was declared. The inclusion of Austria and Czechoslovakia in Greater Germany gave the German Government almost complete control of the Magnesite Cartel, which had influenced production in Hungary and other parts of the former Austro-Hungarian Empire. Shipments can still be made from Yugoslavia but are subject to the handicaps of moving through the Mediterranean and war-infested parts of the Atlantic Ocean. A little Chinese magnesite has been imported into the United States, apparently from areas not controlled by the Japanese. Large deposits of high-grade magnesite have been reported in Chosen, but so far as is known no magnesite from this source has been exported to the United States.

The magnesite deposits at Tashikkiao (Manchukuo) have an annual output of over 300,000 metric tons and are among the most important in the world. About 60 percent of the output is exported to Europe and America and the remainder to Japan. Reserves are estimated at 5 billion tons. Other extensive magnesite deposits are being worked in Southern Manchukuo, although exploitation in this area is handicapped by transportation difficulties. The leading producer is the Nippon Magnesia Chemical Co., which makes brick and calcined magnesia.[2]

[2] The Chemical Age (London), Foreign News: Vol. 42, No. 1080, Mar. 9, 1940, p. 146.

Magnesite imported for consumption in the United States in 1939, by countries and classes

Country	Crude		Caustic calcined				Dead-burned and grain and periclase	
			Lump		Ground			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Canada							177	$17,254
China							4,341	53,860
Cuba	535	$4,776						
Czechoslovakia[1]							3,567	53,902
Germany[1]					8	$370	21,279	458,814
Hungary[1]							5,081	81,506
India, British	11	133	958	$13,822			11	132
Kwantung							7,024	84,256
Netherlands	23	547			949	28,606		
U. S. S. R.[1]							2,940	50,940
United Kingdom					79	3,320		
Yugoslavia			224	5,766				
	569	5,456	1,182	19,588	1,036	32,296	44,420	800,664

[1] For statistical purposes trade with the Sudeten area, as far as ascertainable, is included with Germany, while trade with the other Czechoslovak Provinces occupied by Germany, Hungary, and Poland has been included with these countries since Mar. 18 or 19, 1939. After Nov. 16, 1939 trade with Danzig and that part of Poland occupied by Germany has been included with Germany and trade with that part of Poland occupied by U. S. S. R. has been included with U. S. S. R.

Price quotations of the Engineering and Mining Journal remained at $22 and $25 a short ton for dead-burned magnesite f. o. b. Chewelah, Wash., and California shipping points, respectively. For other products, its quotations f. o. b. California were nominally: Artificial periclase, 94 percent MgO, $65; 90 percent $35; caustic, 95 percent MgO, white color, $40; 85 percent MgO, no color standard, $37.50 a ton. The base price of magnesite brick (9-inch straight) continued at $67 a ton.

Average values realized on domestic sales in 1939 were somewhat higher on dead-burned magnesite, probably owing to a larger proportion of the more expensive California periclase. The figures for crude, caustic calcined, and dead-burned magnesite, respectively (1938 figures in parentheses), were $14.03 ($13.42), $30.53 ($30.88), and $19.75 ($18.87).

World production of magnesite, 1934–38, by countries, in metric tons [1]

[Compiled by M. T. Latus]

Country	1934	1935	1936	1937	1938
Anglo-Egyptian Sudan	----------	256	(2)	----------	(2)
Australia:					
New South Wales	15,902	15,940	17,459	19,807	19,465
Queensland	42	102	102	----------	----------
South Australia	208	51	118	71	231
Victoria	26	335	219	143	122
Western Australia	----------	----------	----------	----------	10
Canada [3]	27,385	27,112	(4)	(4)	(4)
China (Manchuria)	100,329	225,654	191,568	331,000	(2)
Chosen	3,168	2,410	14,258	37,000	(2)
Czechoslovakia [5]	58,235	70,838	83,270	92,143	74,707
Germany:					
Austria	258,382	300,312	397,776	459,233	[6] 415,000
Prussia	11,010	13,818	15,026	21,091	23,860
Greece	70,388	93,563	116,106	161,676	168,243
India, British	15,215	17,257	15,716	26,586	26,022
Italy	1,100	1,251	3,153	5,392	6,157
Norway	2,500	2,526	3,116	2,096	2,098
Turkey	628	1,092	2,247	1,365	846
Union of South Africa	1,667	1,485	1,694	1,752	2,615
U. S. S. R.	482,000	475,000	500,000	(2)	(2)
United States	91,601	160,711	187,894	184,554	88,000
Yugoslavia (Serbia)	25,086	30,225	39,008	41,967	39,314

[1] Unless otherwise stated quantities in this table represent crude magnesite mined.
[2] Data not available.
[3] Magnesitic dolomite.
[4] Data for production not available; value reported as follows: 1936, $768,742; 1937, $677,207; 1938, $420,261.
[5] Exports, less imports, of crude and sintered magnesite, the sintered being reduced to crude on the basis of 2.1 tons crude to 1 ton sintered.
[6] Estimated production.

DOLOMITE

In 1939 sales of dead-burned dolomite by domestic producers increased to another new record, 671,561 short tons valued at $5,447,554 compared with 366,626 tons valued at $3,095,355 in 1938 and 617,706 tons valued at $5,217,833 in 1937.

As shown in the table on page 1375 of Minerals Yearbook, 1939, imports of dead-burned dolomite, comprising principally impure Canadian magnesite or "Basifrit," rose from 6,051 tons valued at $152,795 in 1931 to a maximum of 13,928 tons valued at $349,678 in 1936. Basic Dolomite, Inc. (845 Hanna Building, Cleveland, Ohio), acquired the American rights to a similar product in 1938 and is reported to be making it from ordinary dolomite admixed with magnesia obtained from brucite and serpentine. In 1939 imports totaled only 186 short tons valued at $4,260 compared with 2,875 tons valued at $67,340 in 1938.

Dead-burned dolomite sold in and imported into the United States, 1935–39

Year	Sales		Imports [1]		Year	Sales		Imports [1]	
	Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
1935	455,258	$3,785,834	7,519	$189,714	1938	366,626	$3,095,355	2,875	$67,340
1936	596,751	4,887,243	13,928	349,678	1939	671,561	5,447,554	186	4,260
1937	617,706	5,217,833	9,083	231,084					

[1] Reported as "dead-burned basic refractory material."

BRUCITE

The production of brucite from the deposit near Luning, Nev., increased further in 1939, but the Bureau of Mines is not at liberty to publish the figures separately and the material is included under "Other magnesium compounds." Basic Ores, Inc., a subsidiary of the principal consumer, Basic Dolomite, Inc., is the only domestic producer.

Commercial deposits of brucite were first discovered in Canada in 1937 at Rutherglen in the Nipissing district, Ontario, by M. F. Goudge of the Dominion Bureau of Mines. Subsequent field work has disclosed other deposits in the same area and in the Bryson and Wakefield areas of Quebec, all within easy reach of transportation. The brucite occurs as small crystals or grains comprising 25 to 30 percent of the surrounding limestone. The Bureau at Ottawa has worked out a process of calcination, hydration, and separation that yields calcined brucite granules analyzing 94.4 percent magnesia and only 0.40 percent CaO, the remainder being chiefly water (4.38 percent) and fractions of 1 percent silica, iron, and alumina.[3]

OTHER MAGNESIUM COMPOUNDS

The output of magnesium compounds other than magnesite and dolomite produced from natural sources and sold or used in the United States totaled 85,754 short tons valued at $1,907,944 in 1939 compared with 70,733 tons valued at $1,588,570 (revised figure) in 1938. The principal item is magnesium sulfate, but magnesium chloride is a close second, and brucite (natural magnesium hydroxide) has become an important factor. These figures include a fair amount of carbonate and a little oxide, but the output of the new sea-water magnesium oxide sold for fertilizer by the California Chemical Co. Division of the Westvaco Chlorine Products Corporation is included in the statistics of sales of caustic calcined magnesite. This product carries three times as much magnesium as kieserite but sells for much less than three times the kieserite price. It is bought by manufacturers of mixed fertilizers, especially fertilizers used in magnesium-deficient areas. Not only is it a magnesium carrier, but also it acts as a soil conditioner and sweetener and is reported to improve the physical characteristics of the fertilizer itself owing to the absorption of free acid and excess moisture.

Magnesium compounds imported for consumption in the United States, 1930–34 (average) and 1935–39

Year	Magnesium chloride (anhydrous and n. s. p. f.)		Magnesium sulfate (Epsom salts)		Calcined magnesium sulfate or calcined kieserite (not fertilizer)		Oxide or calcined magnesia	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1930–34 (average)	430	$8,267	4,179	$51,761	430	$6,544	195	$69,426
1935	25	1,095	1,530	18,495	1,834	30,291	98	36,297
1936	16	584	2,167	25,008	2,720	44,664	119	39,098
1937	32	1,120	1,953	26,771	4,117	71,889	109	35,643
1938	41	1,572	799	12,328	3,193	66,470	46	15,947
1939	28	960	198	3,641	2,472	43,455	38	14,755

[3] Goudge, M. F., A Preliminary Report on Brucite Deposits in Ontario and Quebec and Their Commercial Possibilities: Canadian Bureau of Mines Memorandum Ser. 75, 1939.

Magnesium compounds imported for consumption in the United States, 1930–34 (average) and 1935–39—Continued

Year	Magnesium carbonate, precipitated		Manufactures of carbonate of magnesia		Magnesium silicofluoride or fluosilicate		Magnesium salts and compounds, n. s. p. f.	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1930–34 (average)	291	$26,662	(1)	$15	24	$2,654	(2)	(2)
1935	302	27,935	6	489	49	6,500	(2)	(2)
1936	377	34,396			(3)	(3)	[3] 186	[3] $29,355
1937	521	51,684	7	562	(3)	(3)	[3] 70	[3] 20,462
1938	470	53,151	3	209	(3)	(3)	[3] 48	[3] 17,146
1939	776	68,934			(3)	(3)	[3] 59	[3] 26,288

[1] Less than 1 ton. [2] Not separately classified prior to 1936.
[3] Magnesium silicofluoride or fluosilicate included under "magnesium salts and compounds, n. s. p. f."

Imports of most magnesium compounds declined further in 1939, along with other products imported from Germany; but imports of precipitated carbonate, which come chiefly from the United Kingdom, increased greatly after the reduction in duty under the reciprocal trade agreement on January 1, 1939, from 1½ cents to 1 cent a pound. The following notes on imported items are taken from a recent report: [4]

Kieserite, a hydrous magnesium sulfate ($MgSO_4 \cdot H_2O$), has been produced commercially almost exclusively at Stassfurt, Germany, where it occurs abundantly in the potash mines. Formerly it was calcined and used chiefly as raw material for making Epsom salts ($MgSO_4.7H_2O$). Imports of kieserite were reported in official statistics of the United States for many years, averaging 6,455 long tons annually in 1910–14, after which they dropped off and eventually ceased. Kieserite for fertilizer use is exempt from duty under par. 1706 of the Tariff Act of 1930, but imports were probably small or nonexistent until 1935 when they were included in the official statistics along with imports of "other substances used chiefly for fertilizer," amounting to 11,428 long tons valued at $142,902. In 1937 the imports under the latter classification amounted to 10,781 long tons valued at $99,054, and a study by the Chemical Division of the Bureau of Foreign and Domestic Commerce revealed that this was entirely kieserite. In 1938 kieserite was again listed separately in the official statistics, and imports aggregated 14,221 long tons. About one-third of this was imported into New England for use principally on potato fields in Maine, considerably more than one-third was entered at Florida ports for use on citrus fruits, and the remainder was used mainly by tobacco growers in Virginia and the Carolinas. In 1939 shipments diminished along with those of other German commodities, only 2,245 long tons valued at $14,511 being imported during the first 9 months before war conditions cut off further deliveries.

In 1935 the official statistics showed imports of "calcined magnesium sulfate or calcined kieserite (not fertilizer)" of 1,834 short tons valued at $30,291. This material is dutiable at 25 percent ad valorem under par. 5 of the Tariff Act of 1930 as a chemical compound not specially provided for, and according to a study made by the United States Tariff Commission it is used principally by rayon producers in the coagulation of cellulose solutions into filaments. After rising to 4,117 short tons valued at $71,889 in 1937, imports under this classification declined in 1938 and again in 1939.

Epsom salts, magnesium chloride, magnesium carbonate, and calcined magnesia are provided for at specific rates of duty under par. 49 of the Tariff Act of 1930. Imports of magnesium chloride have been small for several years and were further reduced in 1939. An increase occurred in those of precipitated carbonate which arose to a new record, probably as a result of the reduction in duty under the British Reciprocal Trade Agreement which was extended to all countries except Germany. Domestic production of precipitated carbonate was 7,301 tons

[4] Tyler, Paul M., and Bowles, Oliver, Nonmetallic Mineral Industries in 1939: Bureau of Mines Inf. Circ. 7106, 1940, pp. 18–19.

in 1937 as reported by seven producers to the Bureau of the Census, but most of this was technical or basic carbonate used for pipe coverings or other heat insulation, whereas imports are mainly for medicinal or pharmaceutical use.

A process for making synthetic kieserite or magnesium sulfate from olivine was tested in 1939. Parts of a large deposit of olivine at Webster, N. C., are reported to contain 25 to 35 percent MgO and up to 1½ percent nickel, which can also be recovered.

Magnesol, a synthetic silicate of magnesium, recently has been used as a competitor of bleaching clays in a newly patented process of oil refining.

TECHNOLOGIC TRENDS IN MAGNESIA REFRACTORIES

A trend toward still wider use of dolomite in refractories is forecast by successful experiments in overcoming the tendency of the lime content to slack. Pioneer work in this field in Canada is well-summarized in a recent paper [5] released by the National Research Council (Ottawa). The chief Canadian raw material for making basic refractories is the so-called magnesitic dolomite which occurs in large deposits at Kilmar, Quebec. This material contains only 38 percent MgO and 11 percent CaO and corresponds mineralogically to a mixture of 57 percent magnesite, 35 percent dolomite, and 8 percent serpentine. In the production of thermoplastic refractories for open-hearth furnaces blends of various classes of rock and iron ore are made into a material containing roughly 65 percent periclase and 20 percent dicalcium silicate (both of which are extremely refractory), along with 15 percent low-melting calcium aluminate and ferrites. Such material can be burned-in on furnace hearths in much the same way as mixtures of slag and ordinary dead-burned magnesite, but the resulting lining is claimed to be superior. This development is strategically important, as it relieves the British Empire steel industry of all anxiety from unavailability of Austrian magnesite.

Chemically bonded magnesia-base refractories are now being made for use where high burning-in temperatures (3,000° F.) are not obtainable. Preliminary tests with thermoplastic magnesitic dolomite clinker, liquid sodium silicate, and an additional agent to increase strength resulted in failure, but addition of a new chemical has produced a chemically bonded ramming mixture that has been applied successfully in converters, anode furnaces, and reverberatory furnaces in the copper industry and in open-hearth and electric furnaces in the steel industry.

Another development has been production of unburned brick. Owing to the dicalcium silicate in the magnesitic dolomite a strong chemical bond is obtained with or without chrome ore.

Chrome-ore additions are desirable not only for unburned brick but also for nonspalling burned brick, tap-hole blocks, and linings for kraft furnaces. Although chrome ore has proved of enormous advantage in combination with magnesia-bearing minerals, it also has limitations, according to the afore-mentioned authority. To avoid undue absorption of iron oxide, resultant swelling, and possible failure, a pure magnesia brick may be employed. Recent work with Canadian brucite has produced satisfactory brick of this character.

In making magnesite brick American plants have depended mainly on imported grain magnesite, owing less to technologic than to eco-

[5] Lathe, F. E., Basic Refractories in Canada, 1914 and 1939: Trans. Canadian Inst. Min. and Met., vol. 43, 1940, pp. 83-99.

nomic reasons. The plants are situated on the Atlantic seaboard, where overseas shipments do not have to bear the additional expense of railroad transportation. Moreover, the draw-back on duties paid on imported magnesite can be refunded only in respect to export products in which the imported magnesite is actually used and, since the doctrine of substitution of domestic raw materials (applied to manufactures of nonferrous metals) has not been accepted as applicable to magnesite refractory products exported, this factor is important. As much as one-third of the magnesite now used in refractory brick and other shapes may be domestic, and the proportion probably is larger in magnesite-chrome brick. Even straight magnesite brick can be made from domestic magnesite alone without any impairment of quality, although the trend is to use mixed materials in the manufacture of high-heat-duty brick. Virtually all chrome brick now contain a certain amount of magnesite, and according to at least one authority the most satisfactory mixture for general service is 75 percent chrome ore and 25 percent dead-burned magnesite. Owing to displacement of medium-duty by high-duty refractories the total consumption of straight magnesite, straight chrome, and magnesite-chrome brick has increased, but owing to the preferences for mixed materials about twice as much chrome ore as dead-burned magnesite is now consumed in the manufacture of these high-grade products.

BROMINE

Production of bromine in the United States continued to climb much faster even than motor-fuel demand and soared to 18,941 short tons valued at $7,611,400 in 1939 compared with 16,662 tons (revised figure) valued at $6,610,056 in 1938. The use of bromine in the form of ethylene dibromide for making tetraethyl lead compounds for anti-knock motor fuels was begun in 1923 and has been the principal outlet for bromine since 1928, when total sales were only 1,082 tons valued at $649,475.

Bromine is recovered from salt-well brines by five companies in Michigan and five in the West Virginia-Ohio salt area. By far the largest producer is the Ethyl-Dow Corporation, which recovers bromine from sea water at Kure Beach near Wilmington, N. C. The second largest producer is the Dow Chemical Co., which, in addition to its joint interest in the former corporation, recovers large quantities of bromine from its brine operations at Midland, Mich. The third largest producer is the Westvaco Chlorine Products Co., which not only operates in West Virginia but obtains bromine from sea-water bitterns at Chula Vista and Newark, Calif. According to a recent report [6] the American Potash & Chemical Corporation plans to add bromine to the list of products it recovers from Searles Lake brine. Some concentrated products of this brine carry 100 times as much bromine as sea water, and the quantity of brine treated in 1939 carried 10,000,000 pounds. The proposed installation, however, will recover only 2,000,000 to 3,000,000 pounds annually, using the richer liquors.

The foreign market value of imports of bromine or its compounds was only $38,097 in 1939 compared with $277,527 in 1938. Hereto-

[6] Oil, Paint and Drug Reporter, Bromine to be Made by Potash Concern: Vol. 137, No. 5, January 29, 1940, pp. 3 and 37.

fore imports of ethylene dibromide have been a factor in the domestic market, but in 1938, as noted in Minerals Yearbook, 1939 (p. 1379), a countervailing duty of 3.775 cents a pound was assessed on imports of

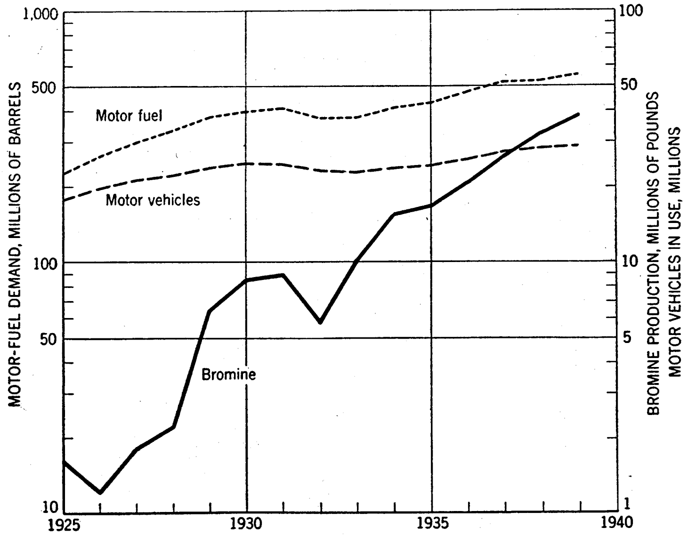

FIGURE 1.—Bromine production compared with motor-fuel demand and motor vehicles in use (July 1) in the United States, 1925–39.

this product, all of which came from Germany, and none was imported in 1939.

Bromine and bromine in compounds sold or used by producers in the United States, 1935–39

Year	Pounds	Value	Year	Pounds	Value
1935	16, 428, 533	$3, 483, 239	1938	[1] 33, 324, 116	$6, 610, 056
1936	20, 609, 025	4, 038, 438	1939	37, 882, 005	7, 611, 400
1937	26, 200, 256	5, 180, 177			

[1] Revised figures.

Bromine and bromine compounds imported for consumption in the United States, 1938–39, by countries

Commodity and country	1938 Pounds	1938 Value	1939 Pounds	1939 Value
Ethylene dibromide: Germany	1, 210, 005	$263, 459		
Potassium bromide: Japan	42	30		
Other bromine compounds:				
France			4	$193
Germany	733	5, 110	2, 011	9, 518
Switzerland	527	8, 611	1, 503	28, 386
United Kingdom	10	317		
	1, 270	14, 038	3, 518	38, 097

CALCIUM CHLORIDE

Production and sales of calcium chloride and mixed calcium-magnesium chloride (basis 75 percent $CaCl_2$) obtained directly from natural brines increased to 108,441 short tons valued at $1,307,717 in

1939 compared with 96,470 tons valued at $1,218,938 in 1938 and 97,142 tons valued at $1,295,403 in 1937. Calcium chloride is also produced as a byproduct of soda ash in the Solvay process, but sales of this material are not included in the Bureau of Mines tables that follow, as the calcium comes from limestone and the chlorine mostly from sodium chloride that is reported elsewhere as salt in brine. The total domestic sales, including byproduct chlorides, have been estimated at 258,000 tons in 1938, of which 39 percent was used for road treatment, 15 percent for dedusting coal and coke, 12 percent for ice

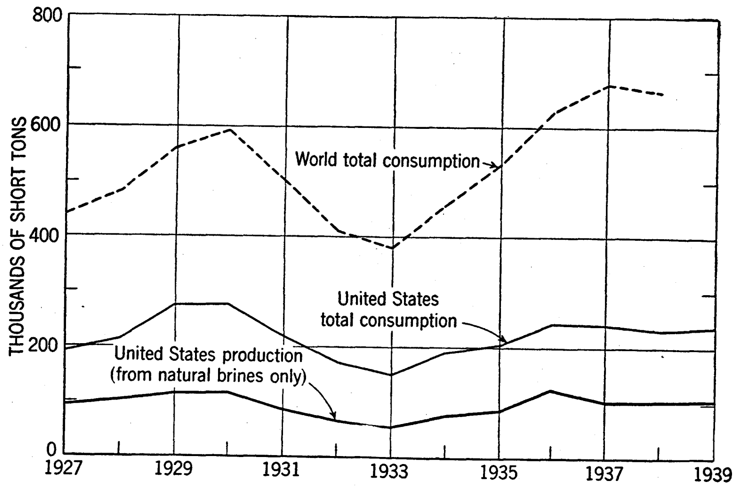

FIGURE 2.—Domestic production of calcium chloride (and mixed calcium-magnesium chloride) from natural brines compared with United States and world consumption, 1927–39.

control, and 6 percent in refrigerating brines; 28 percent was taken by resellers, exports, or minor consuming outlets.

Calcium (calcium-magnesium) chloride from natural brines sold by producers in the United States, 1935–39

Year	Short tons	Value	Year	Short tons	Value
1935	83,546	$1,039,103	1938	[1] 96,470	$1,218,938
1936	125,911	1,909,908	1939	[1] 108,441	1,307,717
1937	[1] 97,142	1,295,403			

[1] Calculated to basis of 75 percent $CaCl_2$.

Calcium chloride imported for consumption in and exported from the United States, 1935–39

Year	Imports		Exports	
	Short tons	Value	Short tons	Value
1935	2,004	$26,987	30,736	$525,179
1936	2,128	25,678	27,831	503,966
1937	2,205	24,908	21,732	415,309
1938	1,642	21,174	24,118	396,981
1939	996	12,314	19,382	318,199

IODINE

Domestic production of iodine increased again in 1939. The Dow Chemical Co. is the leading producer, having taken over the business of its subsidiary Io-Dow Chemical Co. on March 31, 1939. The company plant is at Long Beach, Calif. The only other producer is the Deepwater Chemical Co. (plant at Compton, Calif.) which recently has operated under a process patent controlled by Dow. The General Salt Co., Long Beach, Calif., one of the pioneer domestic producers, has been idle for several years and reported no output in 1939.

Imports of iodine (all crude) totaled 200,000 pounds valued at $168,238 compared with 570,532 pounds valued at $464,303 in 1938 and a record quantity of 1,967,148 pounds valued at $1,784,491 in 1937.

The price of crude iodine, after dropping to 81 cents a pound in 1936, rose to $1.02 in 1938, and the average for 1939 sales remained at approximately that figure.

Chile has been the leading producer of iodine for many years, but substantial quantities have been produced also in France, the United Kingdom, Ireland, Norway, Japan, Netherland Indies, and British India. According to a recent study,[7] Japanese exports dropped from 78,708 kg. in the fiscal year 1932–33 to 4,586 in the fiscal year 1937–38, whereas domestic consumption increased from 34,668 to 40,972 kg. Cost of production has increased above the cost of importation as a result of increased wages, and the supply of kelp on Hokkaido Island has diminished. Two companies produce iodine from subterranean brines, but prospecting has failed to develop additional supplies from this source.

Iodine produced in the United States, 1935–39

Year	Pounds	Value	Year	Pounds	Value
1935	245,696	$248,654	1938	(1)	(1)
1936	233,925	212,635	1939	(1)	(1)
1937	299,286	242,422			

1 Bureau of Mines not at liberty to publish figures.

Crude iodine imported for consumption in the United States, 1935–39

Year	Pounds	Value	Year	Pounds	Value
1935	375,819	$420,793	1938	570,532	$464,303
1936	592,217	558,326	1939	200,000	168,238
1937	1,967,148	1,784,491			

SODIUM SULFATE

Sales of natural sodium sulfate jumped 71 percent to 137,479 short tons valued at $1,027,876 in 1939 compared with 80,210 tons valued at $596,812 in 1938, the previous high record. Census data on total production in 1939, including the output of chemical plants, are not yet available, but imports of salt cake increased slightly, and consumption in the United States is believed to have been as large or

7 Bernard, L. M., Le Marché de l'iode au Japon: Chim. et ind., vol. 43, No. 5, March 5, 1940, pp. 439–443.

larger than in 1937, the record year. For 1937 the Bureau of the Census reported a production of 269,177 tons of salt cake, of which 241,347 tons valued at $2,367,616 were for sale.

Synthetic salt cake, a sintered product of soda ash and sulfur in molecular proportions, is a promising substitute for sodium sulfate in its leading use (kraft paper), especially in the South, according to Walter L. Lovell of the Mathieson Alkali Works, Inc.[8] A large plant is to be erected to produce this new-process salt cake on Lake Charles, La.

The large increase in Canadian output of sodium sulfate in recent years is due to its use in smelting nickel-copper matte and in the manufacture of kraft paper. Production in 1939 is reported officially as 71,453 tons valued at $627,941 compared with 63,009 tons worth $553,307 in 1938—all from Saskatchewan. Not included in these figures were 30 tons valued at $186 shipped from deposits in Alberta.

After reaching a peak of 220,176 short tons in 1937, imports of salt cake dropped to 142,429 tons in 1938 and amounted to only 148,794 tons in 1939. Notwithstanding the European war 26 percent of the total imports for the year came in during the fourth quarter, and receipts from Chile which rose to 26,079 tons in 1938 dropped to 1,503 tons in 1939. Germany supplied 103,259 tons, almost as much as in 1938, and 5,111 tons came from Poland and Danzig (before German occupation) and 25,607 tons from Belgium. Imports from Canada increased from 8,262 tons in 1938 to 9,518 in 1939. As usual virtually all the European salt cake imported was entered at South Atlantic or Gulf ports, principally for use in southern kraft-paper mills, which also are served by the recently expanded salt-cake mining industry in Texas.

Sodium sulfate imported for consumption in the United States, 1938–39, by countries

Country	Crude (salt cake)		Crystallized (Glauber salt)		Anhydrous		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1938								
Belgium					1	$27	1	$27
Canada	8,262	$57,323					8,262	57,323
Chile	26,079	178,416					26,079	178,416
Czechoslovakia			556	$4,496			556	4,496
Germany	104,615	1,059,020	783	4,640	6,458	115,916	111,856	1,179,576
Netherlands	3,473	37,207			23	546	3,496	37,753
Sweden			1	49	1	25	2	74
	142,429	1,331,966	1,340	9,185	6,483	116,514	150,252	1,457,665
1939								
Belgium	25,607	291,619					25,607	291,619
Canada	9,518	66,477					9,518	66,477
Chile	1,503	10,575					1,503	10,575
France					444	7,358	444	7,358
Germany [1]	103,259	931,553	468	2,520	5,047	90,262	108,774	1,024,335
Netherlands	1,552	14,034					1,552	14,034
Poland and Danzig [1]	5,111	55,621					5,111	55,621
United Kingdom	2,244	24,605					2,244	24,605
	148,794	1,394,484	468	2,520	5,491	97,620	154,753	1,494,624

[1] For statistical purposes, after Nov. 16, 1939, trade with Danzig and that part of Poland occupied by Germany has been included with Germany.

[8] Oil, Paint and Drug Reporter, Application of Synthetic Saltcake: Report of meeting of Tech. Assoc. Pulp and Paper Ind., vol. 137, No. 9, February 26, 1940, p. 53.

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Crude sodium sulfate (salt cake) imported for consumption in the United States, 1938–39, by customs districts, in short tons

Customs district	1938	1939	Customs district	1938	1939
Atlantic ports:			Gulf ports—Continued.		
Georgia	25,601	27,533	Mobile	36,067	21,076
Maryland	1,008		New Orleans	2,624	2,844
New York	803	1,503	Pacific ports and Canadian border:		
South Carolina	23,372	33,672	Dakota	7,592	9,094
Virginia	700	901	Duluth and Superior	670	423
Gulf ports:					
Florida	42,780	50,541		142,429	148,794
Galveston	1,212	1,207			

BORATES

Owing to a large increase in domestic consumption the production (shipments) of borates in the United States increased to 249,976 short tons valued at $5,882,302 in 1939 compared with 219,513 tons valued at $4,570,316 in 1935. In 1937, the peak year, production was 358,898 tons valued at $7,232,897, of which 154,052 tons having a declared value of $4,715,691 were exported. In 1938 exports declined sharply to 77,519 tons valued at $2,642,446, and in 1939 they were 91,139 tons valued at $3,230,304.

The production figures for 1939 include borax and kernite (from California) and small quantities of colemanite (from California) and ulexite (from Nevada).

Salient statistics of the boron-mineral industry in the United States, 1935–39

	1935	1936	1937	1938	1939
Sold or used by producers:[1]					
Short tons	272,967	313,759	358,898	219,513	249,976
Value	$5,381,560	$6,156,123	$7,232,897	$4,570,316	$5,882,302
Imports for consumption (refined):					
Pounds	748	1,887	724	631	[2] 774
Value	$181	$457	$176	$131	[2] $170
Exports:					
Short tons	114,447	102,021	154,052	77,519	91,139
Value	$3,242,350	$3,119,850	$4,715,691	$2,642,446	$3,230,304
Apparent consumption:					
Short tons	158,520	211,739	204,846	141,994	158,837

[1] 1935–37: Borax, colemanite, kernite, and boric acid (calculated as borax); 1938: Borax, kernite, and boric acid (calculated as borax); 1939: Borax, colemanite, kernite, ulexite, and boric acid (calculated as borax).
[2] Also 348 pounds of crude valued at $3.

Although borax was used as a flux in fire refining of gold at least as early as the fourteenth century, large tonnages were not employed until new discoveries in California reduced the price to about $30 a ton after 1920. During the last 2 decades the use of borax in the United States has increased approximately three fold, owing partly to its growing employment in enamelware but principally to its use in glass manufacture. Recently boron has been found to be one of the so-called minor elements that stimulate plant growth and inhibit the development of certain plant diseases. Borax already is included in many mixed fertilizers, but the quantities used are so small that only wide recognition of its desirability as a fertilizer constituent will result in any appreciable increase in demand from this source.

Germany, which before 1938 imported as much as 50,000 short tons of crude and refined borax a year, chiefly from the United States, has taken definite steps to reduce consumption, first as a means of conserving foreign exchange and later as a war measure. In April 1939 the use of boron materials was prohibited in the manufacture of leather, finishing agents used by the leather goods and hat industries and in the manufacture of cosmetics, office glue, plywood, casein, and shellac. After war was declared the quantities used in ceramic glazes was limited to a maximum of 10 percent B_2O_3 of the dry mix for primary enamel (and then only for one coat) or to 5 percent for surface enamel. In the glass industry the use of boron was restricted to optical and scientific or technical glass. To replace part of the borax in enamels, which hitherto have been responsible for most of Germany's consumption of imported boron minerals, metallurgical slags have been used successfully, especially those from the smelting of siliceous domestic ores by a newly developed process employing soda ash as a desulfurizing agent.

World reserves of boron minerals are abundant, but known sources are confined to a few countries, chiefly the United States, Chile, Argentina, Peru, Italy, and Turkey, although borax also has been reported in Tibet, Persia, India, and Ceylon. Perhaps the most interesting operations are in Italy where boric acid is a joint product of the utilization of volcanic gases, which also yield ammonia, carbon dioxide, and heat and power from natural steam. The history of the industrial development of the "soffioni" or vapor springs at Laiderello and elsewhere in the Province of Pisa is told in a recent article.[9] A brief but competent review of the industry in the United States, which is by far the leading producer of borax, has been presented in a paper by Kitchen.[10]

SODIUM CARBONATES

Sales of natural sodium carbonates (chiefly soda ash but also bicarbonate and trona) rose in 1939 to an all-time record of 124,743 short tons valued at $1,528,810 compared with 100,010 tons valued at $1,235,328 in 1938 and a previous peak of 104,711 tons valued at $1,191,485 in 1937.

Only a small percentage of the total production of soda ash or sodium sulfate comes from natural resources. According to the annual review in Chemical and Metallurgical Engineering (vol. 47, No. 2, February 1940, pp. 70–71 and pp. 86–87) the total domestic output of soda ash in 1939 was believed to be 2,964,000 short tons, most of which (apart from the small amount of natural soda and 7,000 tons of electrolytic soda produced at pulp mills) was ammonia soda ash. Production of caustic soda in 1939 is estimated as 930,000 short tons, composed of 465,000 tons each of lime-soda caustic and electrolytic caustic, compared with a revised estimate of 420,000 of lime-soda caustic and 415,000 tons of electrolytic caustic in 1938 and the revised census figures of 488,807 tons of lime-soda caustic and 479,919 tons of electrolytic caustic in 1937.

[9] Nigro, S., Utilization of Volcanic Gases in Italy: Mines Mag. (Colorado), vol. 29, No. 4, April 1939, pp. 169–172, 184.

[10] Kitchen, E. M., Borax—Its Manufacture and Uses: Am. Fertilizer, vol. 91, No. 7, pp. 7–9, 24, 26.

Estimated distribution of soda ash consumed in the United States, 1937–39 by industries, in short tons [1]

Consuming industry	1937	1938	1939
Glass	903,000	660,000	830,000
Soap	180,000	187,000	198,000
Caustic and bicarbonate	751,000	655,000	716,000
Other chemicals	650,000	556,000	640,000
Cleansers and modified sodas	140,000	120,000	137,000
Pulp and paper	104,000	85,000	105,000
Water softeners	32,000	27,000	30,000
Petroleum refining	10,000	10,000	11,000
Textiles	38,000	30,000	43,000
Exports	55,000	51,000	84,000
Miscellaneous	184,000	149,000	170,000
	3,037,000	2,530,000	2,964,000

[1] Chem. and Met. Eng., vol. 47, No. 2, January 1940, p. 70.

Domestic production of natural sodium carbonates has been limited almost exclusively to the output at Searles Lake and at Owens Lake, Calif., where borax and other products help to bear the cost of recovery. Common salt, soda ash or sodium bicarbonate, and possibly small amounts of potash salts and borax could be obtained from the waters of Abert Lake or Summer Lake in southeastern Oregon, but a recent study [11] casts doubt upon the commercial feasibility of working these deposits under existing conditions.

The Geological Survey discovered a large deposit of trona at a depth of about 1,600 feet on Government land in Sweetwater County, Wyo., in 1939. The trona beds were found in cores of an oil and gas well being drilled by a commercial company. Associated with the trona were small quantities of two exceedingly rare minerals, northupite and pirssonite, both complex carbonates. A new mineral in these formations was identified by Fahey,[12] who named it "shortite"; it is a double carbonate of sodium and calcium.

OPERATIONS AT OWENS LAKE, CALIF.

Although operations at Searles Lake have been described frequently, less information has been published on Owens Lake. This lake, in Inyo County between the Sierra Nevada on the west and the Inyo Range on the east, covers an area of about 17.2 square miles and has no outlet. The Owens River, before being diverted in 1937 for the municipal water supply of Los Angeles, entered the basin from the north, and the lake waters were a dense brine containing common salt, soda, borax, and other soluble salts. Subsequently the lake has dried and, like Searles Lake, has become a vast bed of solid salt with only its crevices filled with brine, except occasionally in an unusually wet season when it may be flooded. The following notes on technology originally were published in Bureau of Mines Mineral Trade Notes for September 1939:

The Pacific Alkali Co. has a plant on the west shore of Owens Lake at Bartlett, about 10 miles south of Lone Pine (H. S. Mudd, president, George E. White, general manager, George D. Dubb, superintendent). According to a recent report (Tucker, W. B., and Sampson, R. J., Mineral Resources of Inyo County: Calif. Jour. Mines and Geol., State Mineralogist's Report 34, No. 4, October

[11] Stafford, O. F., Preliminary Report Upon Oregon Saline Lakes: Oregon State Dept. of Geol. and Min. Ind., G. M. I. Short Paper 1, 1939, 4 pp.
[12] Fahey, J. J., New Mineral Discovered: Glass Ind., vol. 20, No. 8, August 1939, p. 300.

1938), this company pumps brine through 2½ miles of 14-inch pipe into three vats, which range from 15 to 50 acres in area. After being concentrated by solar evaporation to 12 to 14 percent soda, the brine is run to storage reservoirs and thence is pumped into 16 carbonating tanks, each 6 feet in diameter and 80 feet in height. Carbon dioxide gas made from dolomite is forced into these tanks, thereby precipitating sodium carbonate, which is drawn off from the bottom as a sludge, centrifuged, and then dried and screened for laundry use or calcined in Herreschoff furnaces into soda ash, which is screened and sacked for shipment. After the soda is removed, the mother liquor is chilled to precipitate borax, passed through an Oliver filter, and returned to the lake. The crude borax cake is redissolved and the solution is treated chemically, clarified in Sweetland filters, and chilled again. The purified borax crystals are recovered in a centrifugal drier, and this liquor likewise goes back to the lake. This plant can produce about 1,000 tons of soda and 2,000 tons of borax per season and employs only 50 men.

Early in 1917 the California Alkali Co., an affiliate of the Great Western Electro-Chemical Co., erected a plant at Cartago on the southwest shore of the lake. This plant operated for 2 years and then closed until 1923, the company meanwhile acquiring the Inyo Development Co. In 1924 the two corporations were merged under the name of the Inyo Chemical Co., and the Keeler plant was leased to the Natural Soda Products Co., which subsequently has operated almost steadily at Keeler. The Cartago operations were discontinued in 1932, and the California Alkali Co. and the Great Western Electro-Chemical Co., which controls it, while retaining ownership, have not operated their properties on their own account since that year.

At Bartlett, which lies north of the original California Alkali Co. plant on the northwest shore, the Chemical Products Co. of Denver, Colo., built a wartime plant with a nominal capacity of 20 tons daily, which operated scarcely 2 months in 1918. The process was a failure, and the property, after being optioned to at least two different lessees, was sold to Boston capitalists, who rebuilt the plant completely and operated briefly under the name of the Clark Chemical Co. After producing soda ash and caustic soda liquor in 1927 and early 1928, this company ceased operations on May 8, 1928, and became bankrupt in 1931. In 1926 the Kuhnert Syndicate built an experimental plant to test its process for recovering borax, and in 1928 it was merged into the Pacific Alkali Co., whose present operations at Bartlett have been described and which has reported a substantial output every year since 1928.

On the east side of the lake, just south of Keeler, the Natural Soda Products Co. recently erected a new plant of 100 tons daily capacity, using a new process, details of which are not divulged. It employs 44 men.

Operations were begun near Keeler by Inyo Development Co. in 1885. For many years the treatment consisted essentially of solar evaporation in clay vats 1 to 20 acres in extent. These were filled with from 6 to 8 inches of brine, and the precipitated trona ($Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$) was harvested once a year in the form of crust about three-quarters of an inch thick. The trona was calcined for soda ash in an oil-burning furnace, pulverized in rolls, and sacked. About 3 miles from this site and 2 miles south of Keeler the Natural Soda Products Co. erected a plant about 1915, which produced sodium bicarbonate as well as soda ash and trona. Shortly after the World War this company was making large shipments to Japan and Sweden as well as to domestic consumers, its total output being estimated by the State mineralogist as 10,000 tons of trona a year, employing 100 men and 2,230 horsepower. Carbon dioxide at various times has been obtained from dolomite from the Inyo Marble Co. and from limestone from the Cerro Gordo mine.

Producers of natural salines (other than common salt and potash) in the United States in 1939

Company name and address	Plant site	Product
American Potash & Chemical Corporation, Trona, Calif.	Trona (Searles Lake), San Bernardino County, Calif.	Borax, boric acid, potash (muriate and sulfate), salt cake (also burkeite), soda ash, lithium salts.
Arizona Chemical Co., 30 Rockefeller Plaza, New York, N. Y.	O'Donnell, Lynn County, Tex.	Salt cake.
Do	Brownfield, Terry County, Tex.	Do.
Basic Ores, Inc., 845 Hanna Bldg., Cleveland, Ohio.	Luning (near), Nye County, Nev.	Brucite (magnesium hydroxide).
Deepwater Chemical Co., Box 588, Victoria Avenue, Compton, Calif.	Compton (near Long Beach), Los Angeles County, Calif.	Iodine.
J. Q. Dickinson & Co., Malden, W. Va.	Malden, Kanawha County, W. Va.	Bromine, calcium-magnesium chloride, common salt.
The Dow Chemical Co., Midland, Mich.	Long Beach, Los Angeles County, Calif.	Iodine.
Do	Midland, Midland County, Mich.	Bromine, calcium chloride, common salt, magnesium chloride, magnesium sulfate.
Ethyl-Dow Chemical Co., Wilmington, N. C.	Wilmington, New Hanover County, N. C.	Bromine.
Great Lakes Chemical Corporation, Filer City, Mich.	Manistee, Manistee County, Mich.	Bromine, calcium-magnesium chloride.
Iowa Soda Products Co., Council Bluffs, Iowa.	Rawlins, Natrona County, Wyo.	Glauber's salt.
C. A. Kearney Co., Tonasket, Wash.	Oroville, Okanogan County, Wash.	Magnesium sulfate.
Liverpool Salt Co., Hartford, W. Va.	Hartford, Mason County, W. Va.	Bromine, calcium-magnesium chloride, common salt.
Marine Chemicals Co., Ltd., South San Francisco, Calif.	South San Francisco, San Mateo County, Calif.	Magnesium carbonate, magnesium oxide, magnesium hydroxide.
Michigan Chemical Corporation, Saint Louis, Mich.	Saint Louis, Gratiot County, Mich.	Bromine, calcium-magnesium chloride.
Morton Salt Co., 208 West Washington Street, Chicago, Ill.	Manistee, Manistee County, Mich.	Bromine, common salt, magnesium carbonate.
Natural Soda Products Co., 405 Montgomery Street, San Francisco, Calif.	Keeler (Owens Lake), Inyo County, Calif.	Trona (soda ash and bicarbonate in 1938).
Ohio River Salt Co., Mason, W. Va	Mason, Mason County, W. Va	Bromine, calcium-magnesium chloride, common salt.
Ozark Chemical Co., Tulsa, Okla.	Monahans, Ward County, Tex.	Salt cake.
Pacific Alkali Co., 1206 Pacific Mutual Building, Los Angeles, Calif.	Bartlett (Owens Lake), Inyo County, Calif.	Soda ash, bicarbonate, borax.
Pacific Coast Borax Co., 51 Madison Avenue, New York, N. Y.	Mojave, Kern County, Calif.	Kernite (rasorite).
Do	Death Valley Junction, Inyo County, Calif.	Colemanite.
Do	Wilmington, Los Angeles County, Calif. (refinery).	Borax, etc.
Plant Rubber & Asbestos Works, 537 Brannan Street, San Francisco, Calif.	Redwood City, San Mateo County, Calif.	Magnesium carbonate.
Pomeroy Salt Corporation, Pomeroy, Ohio.	Minersville, Meigs County, Ohio.	Bromine, calcium-magnesium chloride, common salt.
Wm. E. Pratt, Box 738, Casper, Wyo.	Casper, Natrona County, Wyo.	Glauber's salt.
Rademaker Chemical Corporation, Eastlake, Mich.	Manistee (near), Manistee County, Mich.	Bromine, calcium-magnesium chloride.
The Salt Lake Sodium Products Co., 603 Beason Building, Salt Lake City, Utah.	Saltair, Salt Lake County, Utah.	Salt cake.
Stanford Investment Co., 756 South Broadway, Los Angeles, Calif.	Coaldale, Esmeralda County, Nev.	Ulexite.
West End Chemical Co., 608 Latham Square Building, Oakland, Calif.	Westend (Searles Lake), San Bernardino County, Calif.	Soda ash, borax.
Westvaco Chlorine Products Corporation (California Chemical Co. Division), Newark, Calif.	Newark, Alameda County, Calif.	Bromine, sea-water magnesite, other magnesium compounds.
Do	Chula Vista, San Diego County, Calif.	Bromine, magnesium chloride.
Westvaco Chlorine Products Corporation, South Charleston, W. Va.	South Charleston, Kanawha County, W. Va.	Bromine, calcium-magnesium chloride, common salt (brine).

GEM STONES

By Sydney H. Ball[1]

SUMMARY OUTLINE

Retail sales of jewelry in 1939 totaled about $307,000,000, or 10 percent above sales in 1938 ($279,000,000) and only slightly less than those in 1937 ($312,000,000). Diamond rings, watches, and gold jewelry were the principal items. After February sales were better each month than in 1938, and after September monthly sales showed increases over those of 1937. Improvement was progressive in 1939, and the Christmas trade in jewelry was markedly better than that for either of the past 2 years (16 percent over 1938 and 13 percent over 1937); moreover, there was some demand for higher-price articles. Sales in Oregon and Washington and, to a smaller extent, Georgia and South Carolina, made marked progress over 1938. Installment selling is increasing in the trade and is likely to show further gains.

Manufacturers' sales and those of wholesalers were respectively 25 and 20 percent greater than in 1938, and it is evident that both wholesalers and retailers increased their stocks somewhat in 1939 (retailers about 2 percent). Wholesale trade was relatively good, particularly during the last 5 months of the year, and sales of costume jewelry continued to increase.

Fashions in jewels.—Large jewels, flamboyant in color and daring in design, were the mode in 1939. Use of gold (often in two or three colors) and silver, to a smaller extent, gained at the expense of platinum. It is the opinion of many, however, that platinum sets off fine diamonds much more advantageously than gold. The motifs include geometric, classical, Victorian, Georgian, Hindoo, and ancient Egyptian. Jewelry ensembles, each piece set with similar stones, gained in popularity, as did large jewels divisible into several ornaments. Long pendant earrings, rings with large stones, clips, lapel ornaments, and necklaces were much worn. Jeweled flowers increased in popularity.

Colored gems set pavé with countless diamonds are used to a larger extent yearly. The finer gems—diamond (including an unusual number of colored diamonds), ruby, sapphire, and emerald—are most popular; however, aquamarine, moonstone, and topaz are used fre-

[1] One of the consulting engineers, Bureau of Mines. Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

quently and many other colored stones from time to time. For men's wear, star sapphires, cat's-eye, and quartz gems predominate.

As a result of the war "mourning jewelry" is likely to be in demand (jet or black-stained onyx alone or with white stones, such as moonstone).

Domestic production.—From the 1909 peak production of gem stones valued at $534,280, the domestic industry dwindled until in 1934 the value decreased to about $3,000. Since then production has increased markedly and in 1939 was valued at $235,000 to $470,000; the first figure is a rough estimate of the amount used in jewelry and the second an estimate of the total, including that treasured by collectors or sold to tourists, mineral collectors, and rock gardeners. Almost 85 percent of the amount used in jewelry comprises stones of the agate family. Gems are produced largely by individuals or small partnerships, and as there are no official production returns exact figures are not available. The revival of the industry is due to three factors: (1) The purchase by automobile and other tourists of souvenirs, (2) the extraordinary increase in gem cutting as a hobby (particularly in Oregon and Washington), and (3) the use of an increasing variety of colored stones in jewelry.

The war has shut off, at least partly, the country's normal sources of supply of colored gems and has engendered nationalistic sentiments; consequently, gems of American origin, notably turquoise, tourmaline, kunzite, benitoite, and hiddenite, should increase in popularity. An important gem-stone industry cannot, however, arise in this country owing to the lack of gem deposits of the first order and the high cost of cutting in the United States. Unfortunately, some unscrupulous dealers sell to tourists and even to their fellow townsmen "American" gems which actually originated in foreign countries and were cut in Germany.

In the Northwest, especially in Oregon, according to correspondence with H. C. Dake, the number of mineral collectors and lapidaries, both professional and amateur, most of whom collect and cut quartz gems, continues to increase markedly. He estimates the value of the material cut in 1939 as follows: Oregon, $300,000; Washington, $90,000; Idaho, $35,000; Montana, $10,000; and Wyoming, $8,000—a total of $443,000. Much of the material remains in private mineral collections. In Oregon the centers of the industry are Portland and Newport. Some 14 lapidary shops in Newport employ from 2 to 10 persons each. For about 75 miles up and down the beach from Newport agate hunters (both amateur and professional) search for the rough material, particularly from February to the beginning of summer after winter storms have uncovered new sources of supply. The mineralogical societies of Lincoln County have protested against the use of local agate-bearing gravels as road material by the State highway commission. Oregon ships some uncut agates to cutters outside the State. In Washington the largest cutting centers are Seattle and Spokane; the principal stone cut is opalized wood from Miocene lake beds. In Wyoming local gem stones, mostly moss agate, are cut at Rawlins and Cheyenne. In Idaho the production was largely opalized wood from the southwestern part of the State and star garnets from Ruby Creek, Latah County.

Numerous collectors are slowly depleting the supplies of moss agate along the Yellowstone River in southeastern Montana from Huntley to northeast of Glendive, a distance of over 200 miles; however, the supply is partly replenished by the spring floods which rework the gravels. The most satisfactory collecting periods are during low water. Billings is the chief cutting center. The better moss agates are valued at $3 to $5 a pound in the rough.

Nevada yielded turquoise valued at about $17,000 in 1939. The principal producers were the Smith mine, Cortez district, Lander County, the Blue Matrix mine near Tenabo, and the "Royal Blue" mine at Royston. The output of the Smith mine was 7,512 pounds in 1939. Considerable turquoise was also produced at Villagrove Colo., and a little in Mineral Park near Kingman, Ariz. Mines in Utah, some about 5 miles west of Fairfield and others about 10 miles south of Grantsville, yielded 1,000 pounds or more of variscite.

A substantial quantity of sapphire was produced in Montana (perhaps 1,000 pounds), but very little of this was gem material, most of it being of industrial grade.

In 1939 it was reported that nephrite was found in place in California and that some had been cut and was on the market. Considerable prospecting for gems was done in North Carolina in 1939, and the local lapidary trade is increasing, thanks largely to tourist demand. Kunzite crystals were discovered in Mitchell County a few years ago.

Other gem stones produced in the United States in 1939 included agatized wood (private lands surrounding Petrified National Monument, Ariz.); amethyst (Townes County, Ga.; Larimer County, Colo.; and New Hampshire); aquamarine (Black Hills, S. Dak., and Maine); kyanite (Upson County, Ga.); garnet (Washington); oligoclase moonstone (North Carolina); rock crystal (Arkansas and North Carolina); rose quartz (Black Hills, S. Dak., and Albany, Maine); ruby (Macon County, N. C.); rutilated quartz (North Carolina); satin spar (Niagara Falls, N. Y.); topaz (Thomas Ridge, Utah; San Diego, Calif.; and New Hampshire); and tourmaline (green—San Diego, Calif., and Maine; red (rubellite)—Black Hills, S. Dak.).

For 60 years the Potter family has cut satin-spar (gypsum) beads and other souvenirs at Niagara Falls. Some of the material is of local and Canadian origin, but most of it is imported from England.

Marble similar to Mexican onyx was produced near Pelican Point on Utah Lake, Utah, by the Onyx Corporation of America and by the Jay Em Onyx & Gem Co., near Hartville, Wyo.

According to information furnished by A. H. Cornelison, the Hawaiian Islands produce a few gems and several decorative stones. Their output of olivines in 1939 was very small, as information regarding the locality of the best prospect was lost with the death of E. Mott Smith. Some clear plagioclase feldspar, locally known as "Hawaiian golden-yellow topaz," was mined, also an interestingly marked jasper and some common opal. The known deposits of "Hawaiian diamonds" (rock crystal) are almost exhausted. Possibly $1,000 worth of local stones were sold in 1939.

Imports.—According to the Bureau of Foreign and Domestic Commerce, imports of precious and imitation stones (exclusive of industrial diamonds) into the United States in 1939 totaled $40,487,-877, an increase of 43 percent over 1938. Details are shown as follows:

	Carats	Value
Diamonds:		
Rough or uncut (suitable for cutting into gem stones), duty free	153,982	$7,956,397
Cut but unset, suitable for jewelry, dutiable:		
Less than 10 stones per carat	60,332	5,107,173
10 or more stones per carat	427,822	22,310,100
Emeralds:		
Rough or uncut, free	36,946	17,531
Cut but unset, dutiable	17,624	361,345
Pearls and parts, not strung or set, dutiable:		
Natural		249,415
Cultured or cultivated		328,250
Other precious stones:		
Rough or uncut, free		111,830
Cut but unset, dutiable		1,937,479
Imitation, except opaque, dutiable		2,018,134
Imitation, opaque, including imitation pearls, dutiable		30,969
Marcasites, dutiable:		
Real		38,860
Imitation		20,394
		40,487,877

Tariff regulations.—Wars in Europe and the East brought about many changes in tariffs.

As soon as war was declared France decreed that licenses are required for the importation of gems and jewelry, and to conserve the country's gold, licenses doubtless will be difficult to procure. Supplies of gold for use in jewelry are controlled, and to prevent hoarding, jewelry containing an abnormal quantity of gold can no longer be manufactured.

At the outbreak of war the British Government placed an embargo on the export of diamonds to prevent industrial stones from reaching its enemies. Committees were set up in Antwerp, Amsterdam, Paris, and possibly also in New York to assist the British Board of Trade in issuing export licenses. The early delays caused by the embargo are now less exaggerated, but the embargo accounts partly for the fall in American diamond imports of uncut and industrial stones after September 1939.

Germany requires that official approval be obtained before precious and rare metals can be fabricated, and jewelers can only sell gold jewelry made of gold furnished by their clients. When Germany absorbed Czechoslovakia the duty on imitation precious stones immediately was increased 30 to 45 percent, as Czechoslovakia had a favored-nation trade agreement. France is supplying part of the shortage.

In Belgium special authorization from the Department of Economic Affairs is necessary to import or export rough diamonds for the duration of the war. In January 1940, Hungary replaced free imports by a regime of permits, and by May permits were virtually unobtainable.

In May 1939 Japan required all residents to report to the Government all gold held and after June 1 no gold articles could be displayed in shop windows. China nationalized all gold (coins, bars, and jewelry) in August, the owners being compensated at official rates.

Ceylon reduced the import duty on diamonds from 15 to 5 percent, or to that of India and Burma. Precious stones can be exported from

Brazil only by registered buyers or dealers after official appraisal. During the year Palestine removed duties on diamonds and unset precious stones.

Effect of war on jewelry trade.—When war was declared certain panicky dealers feverishly replenished their stocks; this buying, with a certain speculation by those outside the trade, raised the price of small cut diamonds 20 or 30 percent and that of large stones less. In reality the supply of diamonds is adequate, and prices should only have been raised enough to cover increased shipping and insurance costs. The price of colored stones also rose some 20 percent. Later higher cutting costs may have to be taken into consideration. Rather large stocks of costume jewelry were purchased, as the war automatically cut off some important sources of imitation and synthetic precious stones. Platinum prices rose (January 1, 1939, \$34.44; December 30, 1939, \$40 an ounce).

Hereafter jewelry probably will be more expensive, but there is no reason to fear a shortage of supply, even if the war becomes a long-drawn-out affair. Obviously the warring nations need dollar exchange.

The American diamond-cutting industry may be stimulated somewhat by the war, but even under war conditions small diamonds doubtless will continue to be cut in Europe, as American cutting costs on such goods are prohibitive.

War and destruction are synonymous, therefore war must hurt industry. Today the Russian and German markets for gem stones are almost nonexistent; France and England are throttled by high taxation; hence the industry must live on the trade of the United States, India, and South America and on such investment buying of fine gems as the citizens of belligerent countries can accomplish.

Gem publicity.—At the New York World's Fair, jewels will again be attractively exhibited in 1940. The House of Jewels will show the beautiful jewelry of five leading Fifth Avenue jewelers and gorgeous diamonds, uncut and cut, of De Beers & Associated Producing Cos. During 1939 De Beers, in a selected group of periodicals, conducted a campaign advertising the beauty, value, and rarity of the diamond.

DIAMOND

The year 1939 was surprisingly satisfactory in the diamond industry in view of the grave political crises and the two major wars. Trade was far better than in 1938, and in some respects was almost as good as in 1937, admittedly a good year. Production of rough stones, which was virtually equivalent to that in 1938, exceeded sales, and for the second successive year stocks increased. All grades of diamonds increased in price. In Europe increases were as follows: Large rough, slight, and small rough, 25 to 45 percent; large cut, 15 to 20 percent; and small cut, almost 100 percent. In America increases were less. Many stones were bought for investment, notwithstanding attempts by various governments to curtail the practice.

Share dealings.—The shares of diamond-mining companies listed on the London Stock Exchange had a restricted market in 1939. Prices were weak during most of the year, although there were sharp recoveries in the last half of July, owing to activity in Wall Street, and after October, owing to news of good sales by the Diamond Trading Co., and smaller recoveries from mid-February to mid-March, early May to mid-June, and late December. During the year five representative stocks lost 17 percent of their value and at the end of the year were 31 percent of their high (1927) and 307 percent of their low (1932). Of the 12 principal mining shares, 7 paid dividends in 1939.

Market.—In 1939 the Diamond Trading Co., which sells about 95 percent of the world output of diamonds, inaugurated a new sales policy. "Sights" are now held fortnightly; buyers, large and small, are urged to attend, and goods are sorted into standard types that will not vary from "sight" to "sight." Sales in 1939 were about £5,865,000—159 percent of those in 1938 but only 64 percent of those in 1937. First- and fourth-quarter sales were particularly satisfactory. Good-quality stones continue to be scarce.

Sales of polished diamonds, while not satisfactory, showed an appreciable gain over 1938. Small sizes were particularly in demand, fine goods being bought when available and mediocre grades at other times. Fine large stones were in demand as investments. Sales of industrial stones were excellent. The market was quiet until May, after which the improvement was progressive, and by August the market was animated. When war was declared, frantic buyers, fearing that their sources of supply would be cut off, purchased in quantity, but in October the market became normal.

Cutting in 1939.—The cutting trade was even worse in 1939 than in 1938; "masters" made little money, and the men were frequently unemployed. During the year the number of artisans decreased from approximately 27,000 to 23,000, owing largely to the shutting down of German shops at the outbreak of war. Both Antwerp and Amsterdam suffered, the first somewhat more than the second. Cutters' wages were raised 15 percent in October.

Imports.—Diamond imports into the United States in 1939, by countries, were as follows:

Diamonds imported into the United States in 1939, by countries

[Exclusive of industrial diamonds]

Country	Rough, or uncut			Cut, but not set		
	Carats	Value		Carats	Value	
		Total	Average		Total	Average
Africa:						
British East Africa	34	$3,091	$90.91			
Union of South Africa	148,001	7,656,408	51.73	1,488	$187,107	$125.74
Belgium				399,806	21,733,478	54.36
Brazil	5,846	292,854	50.09			
France				4,719	699,239	148.18
Germany				7	419	59.86
Guiana, British	101	4,044	40.04			
Netherlands				77,422	4,454,205	57.53
Palestine				36	2,299	63.86
Switzerland				1,392	69,926	50.23
United Kingdom				3,284	270,600	82.40
	153,982	7,956,397	51.67	488,154	27,417,273	56.17

World production.—World production of diamonds (gem and industrial) in 1939 approximated 11,330,000 carats (2.266 metric tons) worth about $39,270,000. Compared to 1938 this is a decrease of 2 percent (readjusted figure, 11,620,000 carats worth $40,750,000) by weight and 4 percent by value. Of the South African pipe mines only Dutoitspan and Bulfontein operated; world alluvial mines yielded 91 percent of the output by weight and 77 percent by value. The British Empire produced 26 percent by weight and 60 percent by value of the total production; less than one-fifth by weight were gem stones.

The following table gives, as accurately as available statistics permit, world production for the past 5 years.

World production of diamonds, 1935–39, by countries, in metric carats

[Including industrial diamonds]

Country	1935	1936	1937	1938	1939
Africa:					
Angola	481, 615	577, 531	626, 424	651, 265	[1] 682, 000
Belgian Congo	3, 812, 023	4, 634, 266	4, 925, 228	7, 205, 620	[1] 7, 201, 000
French Equatorial Africa	138	1, 550	5, 588	16, 013	[1] 16, 000
French West Africa		18, 897	57, 687	61, 928	56, 314
Gold Coast (exports)	1, 349, 847	1, 414, 677	1, 577, 661	1, 296, 763	1, 087, 652
Sierra Leone	295, 483	616, 200	913, 401	689, 621	[1] 600, 000
South West Africa	128, 464	184, 917	196, 803	154, 856	35, 470
Tanganyika	1, 446	2, 704	3, 234	3, 576	[2] 3, 445
Union of South Africa:					
Mines	274, 317	339, 719	820, 284	979, 460	[1] 1, 062, 670
Alluvial	402, 405	284, 204	207, 359	259, 148	[1] 184, 000
Total Union of South Africa	676, 722	623, 923	[3] 1, 030, 434	1, 238, 608	[1] 1, 246, 670
Brazil	39, 100	136, 462	238, 606	[1] 235, 000	[1] 350, 000
British Guiana	47, 785	41, 067	35, 958	32, 522	32, 491
Other countries [4]	5, 800	6, 000	6, 000	34, 200	19, 000
	6, 838, 400	8, 258, 200	9, 617, 000	11, 620, 000	11, 330, 000

[1] Estimated.
[2] Exports.
[3] Includes 2,791 metric carats recovered from re-treatment of tailings.
[4] 1935: Borneo, India, Nigeria, and Venezuela; 1936: Borneo, India, New South Wales, Rhodesia, United States (California), and Venezuela; 1937: Borneo, India, Liberia, New South Wales, Rhodesia, and Venezuela; 1938–39: Borneo, India, New South Wales, U. S. S. R., and Venezuela.

In South Africa the output of pipe mines increased, whereas that of alluvial mines continued its decline. Production in Brazil and the new fields of the French African colonies increased, but in Southwest Africa and the Gold Coast it was drastically curtailed. As usual, the Belgian Congo contributed 64 percent, by weight, of the world output, largely industrial stones. New discoveries are reported in the U. S. S. R., Kenya, and Uganda.

Tropical hygiene and diamond production.—Diamond output, more than that of any other mineral product, comes from tropical countries—in the past from India, Borneo, and Brazil; today from Central Africa and to a smaller extent Brazil and British Guiana. The richness of the tropics in gems is a matter of chance, but the scientists of the Middle Ages believed that the hot tropical sun ripened the gems. A century ago 100 percent of the production came from the tropics; in those days tropical diseases decimated the workmen, and jewel buyers felt they were risking their lives in visiting the diamond fields. Of the present world output, approximately 88 percent by weight and 51 percent by value are produced in tropical countries, but today the personnel of the larger companies enjoys a health record comparable to that of mining companies operating in temperate climates. The different records of the two centuries "spotlights" the advance of tropical hygiene.

Malaria no longer saps the vitality of the staff and workmen; the dreaded sleeping sickness is being conquered, and dysentery has become rare. Turn-over in the staff is no longer a detriment to efficient operation. The staff lives in modern camps with proper water supply, sewerage systems, electric lights, and golf courses. Many bring their families, and schools are provided for the children. The villages of native laborers serve as models to be imitated by the bush natives. The Forminière Co., operating in the Belgian Congo, realizing that its future labor supply was menaced by the sleeping-sickness plague for some years, has had a large, mobile medical staff examining the natives of the countryside and giving treatment to infected natives. In 1938 the medical staff examined 129,348 natives for the disease. The scourge is now under control. Throughout the Belgian Congo the number of cases of the dread disease has decreased from 11 per 1,000 in 1908–10 to 2.9 per 1,000.

It may be stated safely that if it were not for tropical medical research and present-day knowledge of sanitation, the diamond production of the world would be at least one-third less than it is.

Industrial diamonds.—In 1939 more industrial diamonds were employed than ever before; larger factory use in the United States and munition-plant use in Europe more than offset decreased use of the diamond drill in Canadian prospecting. Striking features of the 1939 advance were the rapid expansion in use of diamond-impregnated wheels and other abrasive tools (particularly those with a powdered-metal bond), the increased use of very small bort in drilling, and the gain of mechanically set over hand-set diamond-drill bits. Diamond drills are now employed extensively, particularly in Canada, for blast-hole work.

The demand for industrial stones was strong throughout 1939. As it has been for 3 years, the scarcity of fine stones required the use of mediocre grades. Prices of all grades registered marked advances.

Imports of industrial diamonds into the United States during the past 5 years were as follows.

Industrial diamonds (glaziers', engravers', and miners') imported into the United States, 1935–39

Year	Carats	Value		Year	Carats	Value	
		Total	Average			Total	Average
1935	954, 589	$4, 293, 611	$4. 50	1938	1, 396, 247	$4, 213, 412	$3. 02
1936	1, 166, 094	4, 328, 603	3. 71	1939	3, 568, 730	9, 725, 683	2. 73
1937	1, 885, 970	6, 542, 365	3. 47				

The 1939 imports are somewhat misleading, as some shipments were sent here for safekeeping by the countries at war; in addition a number of dealers, forced to leave their homelands, brought with them their stocks of industrial diamonds.

EMERALD, RUBY, AND SAPPHIRE

The increased use of colored stones in jewelry during the past 4 years has caused concern over the source from which supplies are to be obtained in the future. With the State-owned Colombian emerald mines closed, the Burma ruby mines worked only by the natives, and the production of world sapphire mines small, little new rough stone is coming on the market. The jewelers are using largely stones recovered from old jewelry, Spain having furnished many fine-colored stones in the past 2 years. Such a situation, however, cannot last, and eventually old mines must be reopened or new mines found.

The Muzo emerald mine in Colombia has been shut down several years, but the property of the Chivor Emerald Mines, Inc., has been operated under lease from September 15, 1937, to date by the Compañía de Esmeraldas de Colombia. From September 15, 1937, to September 1, 1939, 28,841.22 carats of emeralds of all grades and 73,633.4 carats of moralla were produced. About 100 miners were employed. Since September 1, 1939, the output has been unimportant. The property is to be sold to the leasing company on a royalty basis and a cash payment of $10,000.

The emerald deposits of the Murchison Range, Transvaal (*see* bibliography, Kent, L. E., Emeralds, Murchison Range, Transvaal) were discovered in 1927; altogether there have been 15 producers, most of which are now moribund. Production to the end of 1937 was 664,612 carats, worth £84,294, or 2s. 6½d. per carat. Some of the stones are of fine color, but like most emeralds they usually are flawed (owing to movement after deposition) and often include biotite inclusions. Color zoning is common. Cobra Emeralds, Ltd., has been by far the largest producer. Emeralds occur as well-shaped crystals, distributed sporadically in shoots and pockets in biotite schist near pegmatitic intrusions. The pegmatite contains no emerald but does contain beryl. Near later basic intrusions the emerald has been "baked" to a brownish green. The emerald deposits resemble those of Egypt, the Urals, the Salzburg Alps, and North Carolina. The emeralds were deposited during the "hydrothermal phase" following the intrusion of the pegmatite.

Open-cut methods of mining are used, and the emeralds are separated largely by hand methods. The yearly emerald content has ranged from 2.75 to 3.16 carats per load (approximately a cubic yard). The product is sold directly to London gem buyers. In 1938–39 the Cobra Emerald Mines, Ltd., was shut down, owing partly to the depressed state of the precious-stone market and partly to decreased quality of the stones. N. M. Uspensky believes that although some of the emeralds at the Ural emerald mines near Sverdlovsk, crystallized at 500° C., most of them crystallized below 400° C. and some as low as 200° C.

In 1938 the Mogok or Katha workings, Burma, produced 202,483 carats of rubies, a 29-percent increase over 1937 (157,308 carats).

The subcommittee appointed by the Government of Ceylon to report on marketing and cutting gems in Ceylon, recommended (1) that a Government institute to instruct the natives in gem cutting be set up as part of the Department of Mineralogy, and (2) that a Government salesroom be attached thereto. The Singhalese cutter certainly has much to learn from an up-to-date gem cutter. The report of the committee is an interesting document, describing the three trades concerned (the miner, the cutter, and the dealer), the laws relating to gemming, mining methods, marketing, and other phases of the industry. It is understood that the recommendations of the committee will be acted on favorably.

The sapphire production of the Mogok ruby workings, Burma, has been as follows in the past 3 years: 1936, 172 carats; 1937, 4,392 carats; and 1938, 1,344 carats. Judging from the statistics of the Indian Government, the output of the Kashmir sapphire mines was probably less than 10,000 carats in 1938.

In 1938 gems valued at £2,166 were sold from the Anakie (Queensland) sapphire field (£1,410 in 1937). First blues comprised three-fourths of the sales; other sapphires (green and yellow) and zircons were not in demand. Production came from Rubyvale, Reid's Water Hole, and Mt. Laura. In 1939 a new field is said to have been discovered about 6 miles west of Rubyvale, central Queensland. A 412-carat emerald-green sapphire is reported among the finds. No gem sapphires were produced in New South Wales in 1938, but 132 ounces of industrial stones were produced at Sapphire.

At Mtito Andei, Kenya, patches of fine blue sapphire are found in crystalline corundum, encountered in working asbestos. Several small parcels of sapphires have been shipped.

LESSER GEMS

The Smithsonian Institution put on exhibition a huge topaz weighing 153 pounds, or about 350,000 carats, in 1939. It is pale blue, with a sherry-color interior. The Harvard University Mineralogical Museum also added to its collection a large white topaz weighing 225 pounds. Late in the year the American Museum of Natural History, New York, obtained an even larger topaz weighing 596 pounds. All three crystals came from Minas Geraes, Brazil.

In 1937 the output of aquamarine at Daso, Kashmir, was 6,260 carats (no output in 1935 and 1936).

The total value of the opal production of New South Wales to December 31, 1938, has been £1,627,021. The 1938 output was valued at £4,226 (1937, £3,357); Lightning Ridge produced stones valued at £4,132, Grawin £50, and White Cliff £44. No production was reported from Queensland in 1938.

In 1930 a deposit of lapis lazuli was discovered by G. L. Judin at Ovalle, Pamir Mountains, Badakhshan. Like similar occurrences, it is a contact-metamorphic deposit in marble.

The Katanga copper deposits are the most important present-day producers of malachite. The material is used in cheap jewelry and objets d'art. Recent sales are as follows: 1937, 3½ tons; 1938, 2½ tons; and 1939, 1½ tons.

A little turquoise is produced in northern Baja California, Mexico, not far from Ensenada.

The amber mines at Palmnicken, Samland, Prussia, produced 400 metric tons of amber in 1938 (1937, 328 metric tons). Amber is used as an ornament, and considerable amber oil and amber acid are distilled, as they are employed in the German dye and varnish industries. In 1938 Germany exported 16,400 kilos of amber valued at 229,000 reichsmarks. Most of the amber goes to Danzig for processing and reexport, the major trade being with the Balkan States and the Orient. In Germany the use of amber "German gold" has been increased by nationalistic propaganda and the difficulty of buying other types of jewelry. Laws forbid the sale of imitation amber and synthetic resins resembling it in Germany.

Some gem prospecting is being done in the Grenville limestone near Laurel, Quebec. Clear pale-lilac diopside and honey-yellow vesuvianite occurences may have some gem value. Previously minute blue sapphires were found at Kilmar. As Frank D. Adams has pointed out, the geology of the Laurentian rocks is similar to that of the gem-bearing rocks of Ceylon, but owing to recent glaciations there is no concentration of the gems in stream gravels.

The mining and cutting of jet at Whitby, England, was an important industry 75 years ago. Today, only a few score of people are engaged in it. The present war may revive the trade.

In 1938 Brazil exported 746,872 kilos of rock crystal, 2½ times the average for the preceding 14 years (*see* bibliography, Winslow, Rollin R., Quartz Crystal (Brazil)). Japan in particular, Great Britain, Germany, and to a smaller extent the United States are the principal purchasers. The best-quality crystals are sent to the United States for use in scientific instruments. Bahia is the principal producer, followed by Minas Geraes and Goyaz. The crystal occurs in pegmatite dikes or in detrital or placer deposits derived from them. Mining methods are primitive and usually are carried on by "garimpuros," locally called "crystalleiros"; the open pits are rarely more than 5 meters deep. Most of the exporting firms have their own buyers in Brazil. Rough crystal is worth $0.15 to $18.50 per kilo, according to quality. Reserves of crystal are reported to be large. Optical quartz has been discovered recently in the Mtito Andei district, Kenya.

No other gem except the diamond has a wider variety of industrial uses than rock crystal. It is employed for oscillators in radio transmitters; for quartz-plate resonators at cable and long-distance telephone terminals; and for quartz plates in sound-detecting and sound-locating devices of various sorts and in detonator measurers. Quartz is also the basis of fused quartz employed as tubes, flasks, and fibers for precision instruments. It is used widely in the optical trade, in moderate-priced jewelry and objets d'art, in quartz lamps, and as an abrasive. A glass developed in 1939 by the Corning Glass Works may decrease the use of fused quartz. In December the United States Treasury Department bought 14,800 pounds of Brazilian crystals under its strategic-materials buying program. The price was $98,875, or $6.68 per pound.

San Luis and Mendoza Provinces, Argentina, produced, respectively, 325 and 270 metric tons of greenish yellow translucent marble ("onyx") suitable for decorative purposes in 1937. The United States is the principal purchaser; the rough material is worth $140 to $230 per ton. To obviate flaws, the blocks are cut by hand with chisels, no percussion drills or powder being used. The "onyx" deposits at El Marmol, Baja California, Mexico, produce from 3,000 to 25,000 cubic feet a year. The product is trucked to Santa Catarina, whence it is shipped to the United States.

In 1938 Madagascar exported 453,638.037 kilos of gems and industrial stones. Beryl, tourmaline, colored topaz, opal, sapphire, ruby, garnet, and spodumene totaled 6.81 kilos; feldspar, scapolite, amethyst, and other lesser gems, 263.544 kilos; opaque beryl and garnet, 328,979.208 kilos; rock crystal, 4,693.625 kilos; rose quartz, amazonstone, etc., 6,249 kilos; and industrial rock crystal, 111.763 kilos. France was the principal purchaser, although Germany purchased the finer rock crystal and Switzerland and England certain grades of stones.

There were four producers of precious stones in South-West Africa in 1938. The following table gives productions and exports for 1937, 1938, and the first quarter of 1939.

Production and exports of precious stones in South-West Africa, 1937–38 and first quarter of 1939

	Production			Exports		
	1937	1938	1939 (first quarter)	1937	1938	1939 (first quarter)
Semiprecious stones:						
Aquamarine grams	4,970	270	2,000	4,350	200	
Chalcedony do				119,000	70,000	
Rose quartz do			6,720	54,786	9,720	
Topaz do	4,000	500		3,000	1,000	70
Tourmaline do	37,795	26,248	4,300	507,851	59,508	10,666
Iceland spar pounds	873	3,630	250	309	24	

Germany buys virtually the entire output of aquamarine.

With the possible exception of Ceylon, Brazil is the most important producer of the lesser gems, but figures on its 1939 production are not at hand.

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MINOR NONMETALS

CARBON DIOXIDE; GRAPHITE; GREENSAND; KYANITE, ANDALUSITE, AND DUMORTIERITE; LITHIUM MINERALS; MEERSCHAUM; MINERAL WOOL; MONAZITE; OLIVINE; PINITE; SERPENTINE; STRONTIUM MINERALS; TOPAZ; AND VERMICULITE

By PAUL M. TYLER[1]

SUMMARY OUTLINE

CARBON DIOXIDE

According to trade reports, more carbon dioxide was consumed in the United States in 1939 than in any previous year, and the production and use of both solid and liquid products increased more than the general consumption of goods and services. The latest available statistics, however, are for 1937 when, as reported by the Bureau of the Census, the output of dry ice was 156,609 tons valued at $4,618,937 and of liquid or gaseous CO_2, 50,358 tons worth $4,939,508.

The ice-cream industry continues to be the main outlet for dry ice, but in 1939 there seemed to be a marked increase in the production of other frozen foods, a trend that may serve somewhat to level off the seasonal slump in demand during winter months. Gassing strawberries and raspberries for 4 to 7 hours in an atmosphere containing 35 to 40 percent CO_2 is claimed to keep them in good condition at least 2 days longer than normal. A recent patent specifies CO_2 as a means of making soybeans more palatable, removing certain odors and flavor elements. A broad research program for carbon dioxide gas storage of foodstuffs has been projected by the American Institute of Refrigeration.[2]

No new wells producing natural carbon dioxide were reported to the Bureau of Mines in 1939, and although natural dry-ice plants have been built in California, Colorado, New Mexico, Utah, and Washington further expansion is likely to be restricted by the various difficulties and losses attendant upon transportation to large consuming centers. Recovery of byproduct gas from lime, cement, and other process plants likewise is largely a matter of geography. At Neville Island, Pittsburgh, Pa., the Frozen Carbonic Corporation installed a new generator which recovers 3 tons of gas and 4¾ tons of lime from 8 tons of somewhat low grade stone. With a purity of 97 to 99 percent CO_2, the normal gas yield is 90 percent, but 98 percent recovery can be

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

[2] Chemical and Metallurgical Engineering, Carbon Dioxide Research Project Sponsored: Vol. 46, No. 5, May 1939, p. 282.

made if the purity of the gas is lowered.[3] This plant uses Carbofrax retorts and related equipment under the process of the Gillette Kiln Sales Co.

GRAPHITE

Although the graphite needs of the United States still are obtained almost entirely from foreign sources the outbreak of war in Europe in 1939 caused no such serious dislocation as after 1914. During a quarter century the nature of consumption of graphite has altered so that different kinds of graphite are more nearly interchangeable in use. In 1914–18 the most important use was in crucibles, and domestic crucible makers wanted principally Ceylon lump or chip plumbago. In recent years the consumption of graphite in crucibles has declined to rather small proportions, and crucible makers insist upon having Madagascar flake graphite of suitable mesh sizes. Some soft Ceylon lump is required for pencil-lead mixtures, and there are a few other specialties for which Madagascar flake or certain kinds of crystalline Ceylon graphite are desired in preference to qualities obtainable elsewhere. Fortunately, from the standpoint of national security, the tonnage of graphite from these distant sources that can be considered as absolutely essential to military or even to civilian industry is a relatively small fraction of the total now compared to what it was even a dozen years ago.

During the last quarter of 1939 the demand for graphite was unusually active, and the difficulty of getting export licenses for shipment from Madagascar occasioned some inconvenience but no real distress. Supplies of certain grades had to be rationed to discourage speculative purchasing, but prices were held in control and in most instances remained stationary.

There was no revival of graphite mining in the United States in 1939, and apparently the only substantial domestic production of crystalline graphite was by the Long Valley Ore Co., with mines near Pope Mills and a milling plant at Morristown, N. Y. The deposit is said to be extensive and carries 20 to 30 percent carbon. The milling plant probably could furnish 100 tons or more of concentrate a week but has been operated at full capacity only occasionally, owing to market limitations. The product has been used almost exclusively as an addition to foundry facings.

Small amounts of amorphous graphite for paint were produced at Carson City, Nev., by the Carson Black Lead Co. As in former years, some amorphous graphite for foundry facings was shipped from the Rhode Island anthracite mine. A letter to the Bureau of Mines states that it is unlikely that the business will be continued after existing stocks are sold. The mine at Cranston, R. I., has not been worked for a number of years, but equipment is still on the premises and mining could be resumed if demand justified. A moderate tonnage of amorphous graphite was shipped by the Southern Mining & Milling Co., Clarkesville, Ga., as a byproduct of its kyanite operations.

Foreign trade.—Imports of graphite in 1939 totaled 21,950 short tons valued at $425,326, a substantial increase over 17,005 tons valued at $372,039 in 1938 but much less than the 29,593 tons valued at $752,315 in 1937 or even the 24,171 tons valued at $566,662 in 1936.

[3] Trauffer, W. E., Improves Recovery of Carbon Dioxide: Pit and Quarry, vol. 31, No. 12, June 1939, pp. 26–28, 48.

Exports were 976 short tons valued at $109,715 compared with 983 tons valued at $112,443 in 1938 and 1,514 tons worth $163,331 in 1937.

All artificial graphite imported comes from Canada. Recently Mexico has supplied about two-thirds of the imports of natural amorphous graphite. Imports of Ceylon lump and chip have so diminished that they are now included with "dust," imports of which come from Canada and other countries as well as from Ceylon. As usual, most of the flake graphite was from Madagascar or France, the remainder chiefly from Canada.

Graphite imported for consumption in the United States, 1935–39, by kinds

Year	Amorphous				Crystalline					
	Natural		Artificial		Lump and chip		Dust		Flake	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1935	14,477	$302,646	1,916	$74,679	215	$11,606	84	$4,444	1,669	$132,758
1936	20,160	344,499	1,635	63,804	251	18,107	68	4,090	2,057	136,162
1937	25,354	512,162	802	31,562	482	41,499	321	17,600	2,634	149,492
1938	14,676	247,789	500	19,870	41	3,074	168	10,643	1,620	90,663
1939	18,675	269,046	413	15,383	(1)	(1)	1 602	1 30,421	2,260	110,476

1 Lump and chip included with dust.

Graphite exported from the United States, 1935–39

Year	Short tons	Value	Year	Short tons	Value
1935 1	1,480	$234,334	1938 2	983	$112,443
1936 2	816	114,847	1939 2	976	109,715
1937 2	1,514	163,331			

1 Crude, refined, and manufactures.
2 Natural.

Prices.—Prices of graphite in 1939 were about the same as in 1938 and 1937, the quotations being roughly the same as those reported in Minerals Yearbook, 1938. Ceylon quotations for some grades were advanced, and freight rates rose sharply after the outbreak of war; however, these increases were at least counterbalanced by the downward course of exchange. For a year or more Japan has been the chief buyer of high-grade Ceylon plumbago, and anticipated increases in shipments to the United States or Europe were offset by the loss of the German market. Actually it seems doubtful whether the present war has done much to increase the consumption of graphite, and although the tone of the market was buoyant at the end of 1939 there was no expectation of sharp price advances in any leading production centers.

World production.—Assuming that the Soviet output has continued at approximately 84,000 metric tons annually (as in 1935, the last year for which statistics have been published) the world output of graphite is around 200,000 tons annually. On this basis the U. S. S. R. furnishes over 40 percent; Germany (including Austria and Czechoslovakia), 25 percent; Chosen, 20 percent; and Mexico, 5 percent. However, the bulk of the product of these countries is low-priced amorphous graphite, much of the European portion being used only locally. Although the tonnage mined in Ceylon and Madagascar seldom exceeds 15 percent of the world total the value of their combined output is probably at least half the world total.

World production of natural graphite, 1915–34 (5-year averages), 1935–37 (3-year average), and 1938, in metric tons

[Compiled by M. T. Latus]

Country	1915–19 (average)	1920–24 (average)	1925–29 (average)	1930–34 (average)	1935–37 (average)	1938
Argentina	------	------	------	------	14	28
Australia:						
New South Wales	100	18	12	18	10	------
Queensland	------	------	------	------	16	10
South Australia	------	------	------	15	(1)	(2)
Brazil [3]	13	10	4	4	4	(2)
Canada	2,481	1,172	1,756	790	(4)	(4)
Ceylon [3]	21,042	9,088	13,618	8,677	15,174	11,922
Chosen [3]	7,679	15,034	18,484	23,721	42,937	50,348
Czechoslovakia	[5] 26,841	13,751	29,276	4,187	3,313	(2)
France	886	415	734	46	------	(2)
Germany:						
Austria	[6] 19,657	11,557	19,083	14,653	19,786	16,852
Bavaria	31,308	21,696	17,548	21,333	23,166	28,106
Greenland	------	753	------	------	20	(2)
India, British	349	29	8	71	509	465
Indochina [3]	6,160	------	[7] 289	------	3	------
Italy	9,151	5,722	8,487	3,997	5,255	5,485
Japan	1,380	778	578	572	[8] 1,239	(2)
Madagascar [3]	16,776	9,929	14,141	6,111	9,668	13,433
Mexico	3,059	4,340	5,699	3,521	9,480	9,611
Morocco, French [3]	(2)	------	21	108	324	406
Norway	------	2	------	1,206	2,485	3,802
Spain	1,184	1,923	580	------	------	------
Sweden	101	1	------	------	52	48
Union of South Africa	64	50	51	53	63	53
U. S. S. R.	(2)	(2)	3,992	[9] 32,333	(2)	(2)
United States:						
Amorphous	3,999	3,059	2,840	(10)	(10)	(10)
Crystalline	4,494	1,672	2,133	(10)	(10)	(10)
Total [11]	156,724	100,999	139,334	121,416	133,518	140,569

[1] Less than 1 ton.
[2] Data not available.
[3] Exports.
[4] Quantity not available; value reported as follows: 1935, $79,781; 1936, $88,812; 1937, $125,343; 1938, $41,590.
[5] Average based on production of Bohemia and Moravia, which before 1918 formed part of Austria.
[6] Average based on production of Lower Austria and Styria only. Data covering production of Bohemia and Moravia are shown under Czechoslovakia.
[7] Concentrates.
[8] Average for 1935–36; data for 1937 not available.
[9] Average for 1932–34; data for 1930–31 not available.
[10] Bureau of Mines not at liberty to publish figures.
[11] Sum of figures given in table only; probably incomplete.

Domestic consumption.—Although graphite no longer is listed by the military establishments of the United States as a "strategic" mineral, it is considered important enough to the national defense program to be included in the "critical" group. In 1939 the Bureau of Mines investigated the consumption of graphite by industries and obtained replies from 48 dealers and consumers, of which all but about a dozen directly consumed substantial tonnages. A strict accounting is fraught with difficulties, not the least of which is the overlapping among materials "used" by one establishment after being "processed for resale" by another. The total tonnage accounted for, even in 1937, was less than the apparent supply as indicated by the import statistics, but the discrepancy is explained largely by the building-up of inventories and to a minor extent by various shrinkages, possible reexports, and errors in classifying and recording imported merchandise. The Bureau canvass, however, greatly exaggerated the apparent consumption of crystalline at the expense of amorphous graphite. According to Department of Commerce import statistics, only 12 percent of the total new supply of natural graphite in 1937 and 11 percent in 1938 was flake or crystalline grades, whereas the replies from consumers indicated 24 and 32 percent for the respective years. This is accounted for only partly by the larger proportion of amorphous graphite that went into stocks in both years. Many consumers probably classed as "crystalline" blended material mixed with even a small proportion of flake or Ceylon plumbago. Moreover, many of them may not have known that in recent years 95 percent of the imports of Ceylon graphite have been classified as "amorphous," whereas formerly virtually all Ceylon graphite was imported as crystalline lump, chip, or dust.

In 1937 the quantity of graphite consumed in the United States was almost the same as in 1913; yet crucibles, which took 55 percent of the total consumed in 1913, required only 8.3 percent of the total in 1937. The quantity of graphite used in foundry facings, core wash, and similar uses rose from 10 percent in 1913 to 38.5 in 1937. Other features were the decline in the quantities used for stove polish and the increase in graphite lubricants. Notable, too, is the recent jump in consumption for dry batteries. A decade ago several large battery makers began using manufactured graphite instead of natural flake. Concurrently the use of batteries declined, as radios were operated by light-socket power; but during the last few years Mexican graphite has been widely accepted for this purpose, and the demand for dry batteries has revived (owing in part to the growing popularity of portable radios and the increasing use of flashlights), so that by 1937 the consumption of amorphous graphite for this purpose had risen to around 5,000 tons a year.

Consumption of natural graphite in the United States, 1913, 1919, 1923, 1924, 1933, 1937, and 1938, by kinds of graphite and by uses

TOTAL CONSUMPTION, SHORT TONS

	1913 [1]	1919 [2]	1923 [2]	1924 [2]	1933 [3]	1937 [4]	1938 [4]
Amorphous graphite	6,500	12,500	29,500	26,500	5,813	21,000	12,100
Crystalline graphite	21,500	25,000	10,000	6,000	5,716	6,700	5,700
	28,000	37,500	39,500	32,500	11,529	27,700	17,800

PERCENT OF TOTAL CONSUMPTION

	1913 [1]	1919 [2]	1923 [2]	1924 [2]	1933 [3]	1937 [4]	1938 [4]
Used for—							
Foundry facings, etc	10	25	43.5	51.5	38.0	38.5	28.4
Lubricants, etc	5	10	3.0	2.5	11.0	10.9	11.9
Pencils, crayons	10	5	9.0	5.0	12.0	10.6	9.7
Crucibles	55	45	15.0	13.0	17.5	8.3	10.0
Paints, stove polish, etc	15	10	18.5	19.5	12.0	4.0	3.3
Commutator brushes			8.5	5.0	3.5	.6	.8
Unspecified	5	5	2.5	3.5	6.0	27.1	35.9
	100	100	100.0	100.0	100.0	100.0	100.0

1 Estimated by Geological Survey.
2 Compiled by U. S. Tariff Commission; includes some artificial or manufactured graphite.
3 Compiled by National Recovery Administration.
4 Compiled from reports of consumers and dealers to the Bureau of Mines.

Apparent new supply of natural amorphous and crystalline graphite in the United States from domestic and foreign sources, 1910–39 (5-year averages), in short tons

	Amorphous			Crystalline			Grand total
	Domestic	Imported	Total	Domestic	Imported	Total	
1910–14 (ave.)	1,732	6,119	7,851	2,421	16,977	19,398	27,249
1915–19 (ave.)	4,409	7,761	12,170	4,954	23,580	28,534	40,704
1920–24 (ave.)	3,373	7,062	10,435	1,844	8,453	10,297	20,732
1925–29 (ave.)	3,131	9,352	12,483	2,351	9,254	11,605	24,088
1930–34 (ave.)	[1] 800	7,816	[1] 8,600	[1] 150	2,668	[1] 2,800	[1] 11,400
1935–39 (ave.)	[1] 400	18,668	[1] 19,100	(2)	2,494	(2)	(2)

[1] Partly estimated.
[2] Bureau of Mines not at liberty to publish figures.

Market channels.—New York always has been the principal port of entry for foreign graphite, although the tonnage passing through Arizona during the last year or two has exceeded the total even for New York, owing to the large increase of imports of Mexican amorphous graphite. However, as virtually all the higher-priced Ceylon and Madagascar varieties have entered at New York, that port is still far in the lead in values of the material imported. Canadian graphite, of course, comes through border ports, and a portion of the imports from Korea has been landed at San Francisco or Los Angeles. Michigan appears as an outstanding importing point owing to the fact that it is a distributing as well as consuming center for Mexican graphite railed through in bond. Chicago, too, often is listed as the actual port of entry even though much of the consumption in the Middle West is entered, and commonly processed to some extent, in the East. Canadian artificial graphite usually is entered at Buffalo.

The bulk of the graphite imported into the United States passes through the hands of only half a dozen companies, and only three firms import most of the Madagascar flake and Ceylon plumbago received. One of these firms is primarily a consumer of raw graphite, which it uses in making a wide variety of manufactured products. The other concerns, while engaged primarily in the sale of material to other manufacturers, are not merely importers or even merchants, for in addition to carrying extensive stocks for prompt shipment they are processors and blenders. Moreover, as the grinding, sizing, and purification of graphite and blending or otherwise preparing it for use by manufacturers of crucibles, pencils, lubricants, and other commodities result in a great deal of dust and off-grade material, the principal importers have built up manufacturing businesses of their own to utilize these byproduct materials economically in foundry facings and other products. Whereas the Bureau of Mines lists at least 40 companies as buyers of crude graphite, including a dozen or more relatively large consumers, scarcely 5 percent of the crystalline graphite used in this country is handled by ordinary importers. The proportion of amorphous graphite handled by other firms is somewhat larger because most of it requires little or no preliminary processing after arrival in this country, yet much of the amorphous graphite also passes through the same main channels.

Stocks.—The larger importers and dealers generally maintain a year's supply of crystalline graphite, either in warehouse or on order;

there is generally considerably more than a year's supply of Madagascar flake used for crucibles in the hands of manufacturers or their suppliers in this country. Characteristically, purchases are made when material can be bought advantageously. Graphite miners in most countries often are in need of cash; and large American buyers, being well financed, frequently can buy graphite under favorable terms. It follows that on a falling market, when lower prices are anticipated, stocks of graphite in the United States tend to diminish. However, it seldom happens that they dip much below the 12-month margin, and when prices are low the resumption of buying may result in the acquisition of enough graphite to last 18 months or longer.

During the latter part of 1939 the large importers and dealers were faced with the sudden increase in demand, whereas, particularly as regards Madagascar flake, there was difficulty in obtaining deliveries even of graphite that had already been ordered. Notwithstanding this condition, they continued to sell graphite to their regular customers at the old prices.

GREENSAND

In recent years the only commercial production of greensand has been in New Jersey, and it has been consumed almost exclusively in water-softening compounds. A brief review of this industry was published in 1939.[4] Shipments of refined greensand in 1939 totaled 6,466 short tons valued at $150,500 compared with 6,576 tons worth $152,000 in 1938 and an annual average for the 1925–29 period of 12,715 tons valued at $197,200. Valuation figures are partly estimated. The best grade of refined greensand has been quoted nominally at $20 a short ton f. o. b. cars, but most of the output nowadays is processed further by the three leading producers and sold as water softener at prices up to $115 a ton. The yield of finished greensand zeolite averages between 35 and 40 percent of the hand-picked raw glauconite; including overburden, about 5 tons of material have to be moved for each ton of finished product.

Refined greensand produced in New Jersey, 1935–39

Year	Short tons	Value	Year	Short tons	Value
1935	7,589	$219,749	1938	6,576	$152,000
1936	8,368	177,835	1939	6,466	150,500
1937	9,734	210,974			

Processed greensand zeolite comes on the market in the form of hard green granules ranging from 0.25 to 0.8 mm. in diameter—averaging about 0.30 mm. They bulk about 90 pounds per cubic foot, and the exchange capacity usually ranges from about 2,500 to 3,000 grains of $CaCO_3$ per cubic foot, although this can be increased by extra processing. As the softeners can be regenerated indefinitely and the total loss (chiefly mechanical) in active use is only 2 or 3 percent a year, replacement sales are a relatively small factor in this industry.

[4] Tyler, Paul M., Greensand Zeolites: Bureau of Mines Mineral Trade Notes, vol. 9, No. 5, November 20, 1939, pp. 14–17.

KYANITE, ANDALUSITE, AND DUMORTIERITE

Domestic kyanite has become a fairly important refractory material. With at least two new producers entering the field in 1939 the production in the United States for that year is estimated at 2,950 short tons valued at $69,000 f. o. b. mines. Although no figures of domestic output are available for earlier periods, the 1939 output is believed to have been twice as large as that of any preceding year. Most of this was used in glass-house refractories, but small amounts are employed in the glass industry also as a constituent of the melt, as well as in various ceramic products. Imports of kyanite, almost all of Indian origin, were 3,881 short tons having a foreign market value of $38,137 compared with 3,964 tons valued at $32,458 in 1938 and 7,674 tons valued at $79,410 in 1937, the first year for which statistics were recorded separately.

Somewhat like kyanite in composition and potential uses are pinite and topaz, which are discussed later in this chapter.

Celo Mines, the pioneer eastern producer of kyanite, has installed flotation equipment for better cleaning of concentrates from schist at its Burnsville (N. C.) plant. The Phosphate Recovery Corporation has used flotation to supplement tabling almost from the beginning of its work on Baker Mountain near Pamplin, Va. This company has also leased kyanite property near Henry Knob, S. C., owned by B. J. Lachmond. At Clarkesville, Ga., the Southern Mining & Milling Co. has three plants, one of which was idle in 1939. E. C. Noble produced and shipped kyanite concentrates from a new Georgia plant, which later was leased by the A. P. Green Firebrick Co., Mexico, Mo. The Vitrefrax Corporation, Los Angeles, Calif. (mines at Ogilby, Calif.), converts most of its product into mullite grains.

The Champion Sillimanite, Inc., a subsidiary of the Champion Spark Plug Co., Detroit, Mich., produces andalusite from White Mountain, Mono County, Calif., and dumortierite from near Oreana, Nev. The Tillotson Clay Products Co., Los Angeles, Calif. (mines in California and Nevada), also produces andalusite. The production of these minerals has been estimated at 2,000 tons or more a year chiefly for use in ceramic spark-plug cores.

According to Edgar Bowles [5] of the Alabama State Geological Survey, a 2- to 4-foot vein of kyanite has been opened up in Alabama on Turkey Heaven Mountain southeast of Heflin, Cleburne County. Until recently the only known occurrence in Alabama was of float material, which has been found in Coosa, Tallapoosa, Clay, Randolph, Chilton, and Cleburne Counties, often in large blocks but never in commercial quantities. In contrast to the usual pockety nature of vein kyanite, the newly discovered deposit may be more or less regular and continuous over a distance of at least 6 miles. An occurrence of gneiss in Iron County, Wis., containing 8 to 10 percent kyanite has been described by Carl Fries in an unpublished report. The kyanite is relatively free of inclusions and of good quality. Garnet (almandite) and biotite also are present in significant amounts. Several years ago, various kyanite occurrences were being prospected in Wyoming, especially in the Encampment district, but no recent activity has been reported in kyanite developments in this State.

As noted in Minerals Yearbook, 1939, andalusite sands are found in South Africa. Sales of 450 short tons worth £675 were reported

[5] Bowles, Edgar, Kyanite in Eastern Alabama: Bull. Am. Ceram. Soc., vol. 18, No. 8, August 1939, p. 316.

during the third quarter of 1939. Consolidated Minerals, Ltd., of Johnannesburg is the sole producer.

A great deal of domestic kyanite can now be had at $15 a short ton in bulk or $17.50 in bags, f. o. b. cars, to which must be added a freight rate of $5 to $7 a ton to consuming points in the North or Middle West. Very-low-iron concentrates are offered at $25 a ton, with intermediate grades at around $20. An extra-low-iron grade (under 0.1 percent Fe_2O_3, 98 percent kyanite) calcined and ground to 325 mesh sells for $78 a ton f. o. b. Burnsville, N. C.

LITHIUM MINERALS

Of interest in 1939 was the increased use of lepidolite in glass making and of spodumene in general ceramic work. Improved methods of concentrating low-grade spodumene ores, abundant in North Carolina, were worked out by the Bureau of Mines in cooperation with the Tennessee Mineral Products Corporation.[6]

In South Dakota, the Black Hills Keystone Corporation (Ingersoll mine) and the Maywood Chemical Works (Etta mine) shipped lepidolite and spodumene, respectively, from Keystone, Pennington County. A small tonnage of spodumene was shipped also from the Ralph A. Smith property, near Keystone. The Black Hills Tin Co., Tinton, S. Dak., made no shipment. The national output (which includes the total for the three South Dakota producers and also that of the American Potash & Chemical Corporation, Trona, Calif.) was 1,990 short tons valued at $97,000 in 1939 compared with 892 tons worth $47,088 (corrected figure) in 1938.

Lithium compounds shipped from mines in the United States, 1935–39

Year	Producers	Short tons	Value	Year	Producers	Short tons	Value
1935	4	1,154	$26,834	1938	4	892	[1] $47,088
1936	6	1,241	34,273	1939	4	1,990	97,000
1937	7	1,357	36,206				

[1] Corrected figure.

Leading foreign countries producing lithium minerals are South-West Africa and Argentina.

A detailed plane-table survey has been made by the Geological Survey of the spodumene deposits in the Kings Mountain district of North and South Carolina, and a pilot plant has been erected at Spruce Pine, N. C., for beneficiation by flotation of spodumene-bearing rock from this district. Tests indicate that a spodumene-microcline product can be obtained that, when used in place of feldspar in whiteware bodies, will lower the fusion temperature several cones, thus conserving time and fuel.

The Black Hills Tin Co. has perfected a flotation process for separating spodumene from quartz. The company property is said to contain a 90,000-ton deposit of spodumene quartz crystallized so finely that formerly it was thought to be feldspar. The concentrate contains 6 percent or better lithium oxide. After operating experimentally for 6 weeks during the summer of 1939 the company proposed to introduce in its present tin-tantalum concentrating mill a spodumene circuit capable of producing several carloads a week.

[6] Norman, J., and Gieseke, E. W., Beneficiation of Spodumene Rock by Froth Flotation: Am. Inst. Min. and met. Eng. Tech. Pub. 1161, Mining Technol., March 1940, 9 pp.

MEERSCHAUM

Meerschaum, hitherto used exclusively in the manufacture of smokers' articles, has recently shown promise of becoming a useful medicament. Dr. Manfred Kraemer, Newark, N. J., has reported excellent results in both England and the United States from using the powdered mineral as a remedy for stomach ulcers.[7]

World supplies of meerschaum came from Eskishehir, Turkey. Imports into the United States in 1939 were 10,467 pounds valued at $12,191 compared with 3,559 pounds valued at $9,221 in 1938.

MINERAL WOOL

Statistics on mineral wool are not compiled by the Bureau of Mines but are obtained biennially by the Bureau of the Census. Preliminary reports indicate that production in 1939 exceeded that in 1938 but probably failed to reach the 1937 peak; however, there was a boom in the sale of batts and strips, consumption of which has increased rapidly during the last year or two.

The Carney Rock Wool Co., an affiliate of the Carney Cement Co., Mankato, Minn., began producing at a new mineral-wool plant late in 1939. The American Rock Wool Co. is spending $100,000 improving its plant at Wabash, Ind. In August 1939 it was reported that Superior Insulations, Inc., was about to erect a new rock-wool plant at Lagro, Ind. The Kentucky Stone Co. rock-wool plant at Mullins, Ky., was destroyed by fire in February 1939 but it probably will be rebuilt.

No rock wool is manufactured at present in the Southeastern States, and slag-wool plants in this territory are found only in Tennessee and Alabama. According to a recent circular (No. 10) of the State Department of Natural Resources, Division of Mines, Mining, and Geology, Georgia is well-situated geographically, has ample wool-rock resources, and offers other advantages for establishing a plant. Annual consumption of mineral wool in this market is now only 1,000 to 1,500 tons—most of which comes from Indiana, Ohio, and New Jersey—but it might be increased.

MONAZITE

Owing to the declining use of gas mantles as electric lighting became more nearly universal, world production of monazite decreased, slowly at first but later quite rapidly, from the peak of 7,392 short tons in 1909 to less than 100 tons annually. After fluctuating violently for several years a turning point appeared about 1932, and in 1938 the gross output exceeded 6,000 metric tons; owing to the greater purity of recent shipments the actual output in terms of thorium content and perhaps even in content of cerium and other rare metals, may now exceed the pre-war peak.

What actually stimulated the revival in demand for monazite is not generally known. There has been a sizable increase in demand for the metal in radio and X-ray equipment, and there is a small consumption of thoria for highly refractory crucibles and other laboratory utensils. Substantial quantities of monazite are used more or less directly in rare-earth electrodes or carbons for sun lamps and other light-therapy

[7] Science News Letter, vol. 35, No. 20, May 27, 1939, p. 334.

equipment. Nevertheless, these relatively new uses could not begin to offset the decline of around 90 percent in consumption for making gas mantles. Mesothorium is recovered from monazite, but ordinarily only as a byproduct. On the other hand, the manufacture of sparking flints and certain miscellaneous uses for cerium salts have expanded greatly; it is probable, therefore, that some of the increased demand for monazite can be ascribed to an increased demand for cerium and other rare earths. There is the further question, however, since these elements are available in the residues from gas-mantle manufacture, whether current needs cannot still be supplied, at least in part, from accumulated residues. About 100,000 tons of monazite have been consumed in Europe and the United States since 1893, chiefly for gas-mantle making. Roughly 30 percent was cerium oxide, and 30 percent more comprised lanthana, didymia, and other rare-earth oxides. An almost negligibly small fraction of this 60,000 tons of various oxides was needed in the gas-mantle industry. It is not known to what extent these residues have been absorbed by other industries or otherwise dissipated, but it would seem that in the United States the increasing need for cerium salts—chiefly for mothproofing fabrics, for coloring topaz-yellow glass, for opacifying enamels, and for stabilizing the arcs in carbon arc lamps—is being supplied by imports of monazite.

According to Chambers,[8] a recent shipment of Indian monazite from the Quilon area in Travancore analyzed: Thorium dioxide, 8.3; cerium and other rare-earth oxides, 61.7; iron oxide, 0.1; and phosphoric anhydride, about 29.0 percent.

In 1938 British India produced 5,305 metric tons of monazite compared to 3,130 tons in 1937. As recently as 1933 the Indian output was only 141 tons, and in 1930 it dropped to 14. A somewhat similar revival has occurred in Brazil, whose exports virtually ceased after 1933 and were not resumed until 1938 when they were 323 metric tons. Recently the Netherland East Indies has appeared as a new source, furnishing 668 metric tons in 1937 and 393 tons in 1938. Egypt and Ceylon also have produced monazite in the past, although only sporadically and in small amounts. The United States likewise has never been a large producer, and domestic output has been reported in only 1 year (1925) since 1917.

According to an American consular report,[9] the exports of monazite from Brazil totaled 474.68 metric tons in 1938, all from the State of Espirito Santo. Of this quantity, 373.20 tons were shipped to France, 100.02 tons to the United States, and 1.46 tons to Germany. The first discovery of monazite in Brazil was in diamond-bearing river sands of Bahia in 1884, and John Gordon shipped monazite to Europe in 1886. From 1904 to 1910 Brazil shipped an average of 5,000 metric tons annually, but after the Travancore deposits began to be worked in 1910 British India gradually became the leading source of monazite and Brazilian output declined. By 1915 Brazil furnished only 439 tons and India 1,108. It has been stated that monazite sands are found all along the coast of Espirito Santo, but the Guarapary deposits are the only ones worked in recent years. The relative importance of these deposits may be due mainly to their size and to the fact that they are not covered by the sea at high tide, as are so many of the other

[8] Chambers, Gordon H., Zircon, Ilmenite, and Monazite Mining in India: Foote-Prints (Foote Mineral Co.), vol. 12, No. 1, Philadelphia, June 1939, pp. 6–7.

[9] Forsyth, T. Muldrup, American vice consul, Victoria, Brazil, Monazite in the State of Espirito Santo, Brazil: Consular Rept., June 27, 1939, 17 pp. (abstracted in Bureau of Mines Mineral Trade Notes: Vol. 9, No. 2, August 19, 1939, pp. 16–19).

large deposits. Moreover, they are more accessible, since Guarapary has good anchorage for small coastwise vessels. The principal known deposits of monazite in Brazil are on lands belonging to States or to the National Government. Since 1915 the National Government has been adjudicated all deposits situated not more than 33 meters from the mean water level. Contracts for mining on public lands generally have called for a minimum output and payment to the State or to the National Government of a certain percentage of gross income from sales, over and above export taxes. Before 1907, the only concentration was in sluices, the mixed product containing 60 to 65 percent monazite and varying quantities of ilmenite, zircon, garnet, and quartz. Later, however, the Société Minière Franco-Brésilienne installed magnetic separators, which yield a concentrate containing 85 to 92 percent monazite, with zircon and ilmenite as byproducts.

The monazite sand shipped from Espirito Santo to the United States in 1938 was sold for $35 (United States currency) a metric ton f. o. b. Victoria, Brazil. Trade-journal quotations in the United States have remained unchanged at $75 a short ton (basis, 8 percent ThO_2) for several years. This quotation relates to Indian monazite, which is higher grade; a presumably typical analysis of the Guarapary concentrates shows only 6.3 percent ThO_2.

In 1939 the imports of monazite into the United States aggregated 1,560 short tons valued at $52,016; 1,336 tons were imported directly from British India and 54 tons from Brazil. In 1938 the imports were 456 short tons valued at $18,210, of which 339 tons were from British India.

OLIVINE

The North Carolina dunite deposits contain 50 to 100 million tons of olivine and have yielded as much as 600 tons a month. Recently, however, only two quarries have been worked—both in Jackson County, N. C.—and shipments were estimated at 3,000 tons in 1939, only a little more than in 1938. Other domestic deposits of commercial size are found in California and Washington. Those in Norway and the U. S. S. R. (Urals) have been worked on a small scale. Synthetic olivine can be made of talc or serpentine and research along these lines has been done in Germany, Italy, and Japan, as well as Norway.[10]

Magnesium silicate or forsterite refractories do not have a wide market but have become well-established in several specific services. Owing to their remarkable resistance to attack by iron oxide their use in nonferrous metallurgy is broadening, and they are also used to a growing extent in rotary kilns for portland cement and dead-burned dolomite. Relatively small amounts of olivine are used as quarried blocks or cut shapes; the major tonnage goes into manufactured forsterite brick.

Julius R. Gillis and George W. Pawel, Sylva, N. C., have devised a process for making synthetic kieserite or magnesium sulfate from olivine. They propose to employ material from a large deposit at Webster, N. C., which is reported to contain 25 to 35 percent MgO and up to 1½ percent nickel. Southern rayon mills afford the anticipated market for the magnesium sulfate and the nickel also can be recovered.

[10] Mining Journal (London), Development of Refractories: Vol. 208, No. 5445, December 30, 1939, p. 1086.

PINITE [11]

Several secondary minerals derived from alteration of feldspar, nepheline, and certain other silicates are classed as pinite. Essentially a hydrous silicate of alumina and potash, pinite has virtually the same composition as muscovite, and certain varieties resemble sericite in appearance. Massive pinite resembles steatite or pyrophyllite.

A large deposit of pinite on the east side of the Humboldt Range near Rochester, Nev., has been developed, and during the last 2 years approximately 1,200 tons have been shipped to the Stockton Fire Brick Co. at Pittsburg, Calif., for manufacture into firebrick. In a paper presented in August 1939 at the American Ceramic Society meeting in San Francisco, Calif., Page, Raine, and Sullivan of that company listed the important properties of pinite as refractoriness, ease of raw grinding, snow-white color after firing, inversion to mullite at relatively low temperatures (1,125° C.), low and reversible thermal expansion, absence of free silica, extreme hardness and resistance to abrasion of the fired product, low firing shrinkage, high density after firing, and resistance to molten-enamel slags. In the cold zones of rotary kilns and in the coolers that take the discharge from rotary kilns, pinite linings last longer than linings of other materials. It is claimed they have been used in calcining cement clinker, magnesite, and limestone since 1936; in 1939 an installation was made in the new cement plant of the Permanente Corporation at San Jose, Calif.

SERPENTINE

Massive serpentine, neither fibrous (asbestos) nor decorative (verde antique "marble"), has entered the growing list of industrial minerals. Carload shipments were made in 1939 from Nottingham, Pa., for use in dolomite-base refractories.

STRONTIUM MINERALS

The celestite resources of the United States undoubtedly are large; a few domestic occurrences of strontianite have been reported to the Bureau of Mines, but no production of either mineral has been reported since 1918—apart from impure celestite mined near Sweetwater, Tex., and sold by the Mudrite Products Co., of Houston, Tex., for use as oil-well drilling-mud admix.

American manufacturers of strontium nitrate for red flares and other pyrotechnic compounds have employed imported raw materials. As these have come almost exclusively from Germany in recent years the wartime blockade late in 1939 developed some uncertainties, and prices of strontium salts were tending slightly higher.

Strontium minerals and chemicals imported for consumption in the United States, 1935–39

Year	Minerals		Nitrate		Carbonate and oxide	
	Pounds	Value	Pounds	Value	Pounds	Value
1935	2,674,094	$11,595	277,548	$15,716	[1] 21,828	[1] $2,641
1936	3,880,302	14,537	694,696	39,820	52,311	6,056
1937	5,636,570	20,877	609,488	40,243	44,579	4,610
1938	552,868	2,824	364,362	23,921	82,859	8,502
1939	5,645,935	23,136	479,933	32,060	23,148	2,811

[1] Carbonate only; not separately recorded after 1935.

[11] Tyler, Paul M., Pinite—A New Refractory: Bureau of Mines Mineral Trade Notes, vol. 9, No. 5, November 20, 1939, pp. 18–19.

TOPAZ

A carload of fine-grained topaz was shipped in 1939 by the Tennessee Mineral Products Corporation, Spruce Pine, N. C., from the unique deposit at the Brewer gold mine near Jefferson, S. C. The raw material analyzes 50 percent Al_2O_3, 40 percent SiO_2, 0.92 percent Fe_2O_3, and 12.74 percent F_2. (Inasmuch as the analysis totals over 100 percent, it would appear that some of the aluminum is combined with fluorine instead of oxygen.) After calcining, however, it carries 71 percent Al_2O_3 and 29 percent SiO_2, or about the same composition as calcined Indian kyanite. Like kyanite it may be used in special refractories.

VERMICULITE

The production of raw vermiculite in the United States in 1939 was larger than in 1938 but did not attain the 1937 record. Declines in the western output partly canceled an important gain in North Carolina, where there are now two producers, Philip S. Hoyt and Cary Minerals Co., both operating at Franklin, N. C. The latter company is affiliated with expanding plants in Washington, D. C. (Vermiculite Products Co.), and Newark, N. J. (Munn & Steele, Inc.). The two producers at Libby, Mont., merged into a new corporation—Universal Zonolite Insulation Co. (C. W. Kearney, president), Chicago, Ill.—which continues to mine the raw material and to ship cleaned and sized vermiculite to its own and other expanding plants in various cities. The Mikolite Co. (1100 South Mill Street, Kansas City, Kans.), after being optioned to Lehigh Portland Cement Co., resumed operations under the original management, producing—in addition to loose fill—a varied line of insulating, acoustical, and lightweight plasters, cements, and coatings, as well as stucco and textural finishes. Among its newer products is an extender for aluminum paints which, it is claimed, give better results than straight aluminum paint and increase coverage by 25 percent. Vermiculite for this purpose is only 0.00002 inch in diameter, and 1 ounce bulks approximately 5½ ounces by volume. Other uses of this fine powder (98 percent through 325 mesh) are as a coolant and lubricating agent in automobiles, both in the motor and in the transmission and rear end. This company gets its raw material from Wyoming. Vermiculite is mined in Colorado by the Vermiculite Co. of America, 406 Thorpe Building, Minneapolis, Minn.

Vermiculite sold or used by producers in the United States, 1924–39

Year	Short tons	Value	Year	Short tons	Value
1924	2	$68	1932	1,643	$16,950
1925	102	2,818	1933	2,247	21,993
1926	150	3,750	1934	4,746	56,965
1927	51	1,318	1935	7,068	88,445
1928	1,006	38,118	1936	16,933	185,787
1929	982	24,483	1937	26,556	260,664
1930	831	13,682	1938	20,700	192,000
1931	1,256	24,758	1939	21,174	174,587

Freshly exfoliated vermiculite has been reported as being a powerful desiccant, a property that prevented its proposed employment for packing fruit, but a recent investigation [12] indicates that vermiculite that has been exfoliated several months has low capacity and efficiency for the sorption of water vapor. On the other hand, the silica obtained after other oxides are dissolved out with sulfuric and hydrochloric acids has excellent sorbing properties; it has characteristics of a good desiccating agent, although a large volume may be needed owing to its low density.

Retail prices of expanded vermiculite remained firm at 90 cents to $1.35 a 24-pound bag, and prices to building material dealers stiffened. The raw material was worth $7 to $12 a ton, f. o. b. mines.

[12] Hansen, L. A., Samuel, W. S., Jr., and Forni, P. A., Sorption of Water Vapor by Vermiculite and Its Silica: Ind. Eng. Chem., vol. 32, No. 1, January 1940, pp. 116–118.

PART IV. MINE SAFETY

EMPLOYMENT AND ACCIDENTS IN THE MINERAL INDUSTRIES

By W. W. Adams

SUMMARY OUTLINE

Reports from mineral producers to the Bureau of Mines for 1939 reveal widespread recovery of much of the loss in employment noted in 1938. Combined figures covering all main classes of mines and quarries, coke ovens, and metallurgical plants showed more employees working and a larger aggregate number of man-hours worked in 1939 than in 1938.

Increased employment was accompanied by a rise in the number of accidents but not to such an extent as to cause an increase in the accident-frequency rate per million man-hours worked. In fact, as far as may be determined from tentative figures now available, the accident rate for 1939 actually was a little lower than the corresponding rate for 1938.

Reports furnished to the Bureau of Mines are classified into 21 groups; each represents a major branch of the mineral industries and has separate accident and employment figures. Eighteen groups employed more men in 1939 than in 1938, and 18 worked a larger number of man-hours. Nonmetallic-mineral mines reported fewer employees but a gain in man-hours worked, whereas the gold-and-silver group reported a gain in employees but a slight decrease in man-hours. The only two groups reporting a loss both in employees and man-hours worked were those covering miscellaneous metal mines and trap-rock quarries.

This general review of accidents and employment in 1939 is based largely upon reports that had been received from mining companies at the time this chapter was prepared for Minerals Yearbook, 1940. Complete figures are now available for only a few groups—beehive coke ovens, byproduct coke ovens, cement mills and quarries, marble quarries, and slate quarries. Estimates have been made for all other groups.

Figures in the following table show the estimated number of men employed in 1939, the number of men employed in 1938 as shown by reports that are complete and final for all groups except bituminous-coal and metallurgical plants, and the number of men employed in 1937 as shown by complete and final figures for all operations.

Number of men employed in the mineral industries of the United States, 1937–39

	1937	1938	1939
Coal mines:			
Bituminous-coal	490,771	[1] 444,000	[1] 446,000
Pennsylvania anthracite	99,085	96,282	[1] 98,000
	589,856	[1] 540,000	[1] 544,000
Metal mines:			
Iron	22,957	18,006	[1] 20,700
Lead-zinc (Mississippi Valley)	8,466	6,413	[1] 7,000
Copper	21,175	17,582	[1] 18,300
Gold, silver (including lead, zinc, copper)	51,610	47,534	[1] 52,300
Miscellaneous (tungsten, manganese, etc.)	4,204	3,943	[1] 3,800
	108,412	93,478	[1] 102,000
Nonmetallic-mineral mines	10,017	9,526	[1] 9,200
Quarries:			
Cement	27,215	25,520	26,045
Marble	3,647	3,414	3,697
Slate	3,074	2,615	2,833
Trap-rock	2,806	3,141	[1] 2,900
Granite	8,961	8,395	[1] 8,500
Sandstone	3,242	2,907	[1] 2,950
Limestone	24,789	22,352	[1] 22,900
Lime	10,360	9,153	[1] 9,600
	84,094	77,497	[1] 79,000
Coke ovens:			
Byproduct	17,850	12,750	14,852
Beehive	2,192	1,049	1,757
	20,042	13,799	16,609
Metallurgical plants:			
Mills	14,497	[1] 12,400	[1] 13,100
Smelters	17,957	[1] 14,400	[1] 16,300
Auxiliary works	15,076	[1] 12,500	[1] 12,900
	47,530	[1] 39,300	[1] 42,000
Grand total	859,951	[1] 774,000	[1] 793,000

[1] Subject to revision.

The following table shows men employed, man-days and man-hours of employment, and men killed and injured by accidents chargeable to the hazards of their occupations, as well as the yearly fatality and injury rates for mines, quarries, coke ovens, ore-dressing plants, smelters, and auxiliary works connected with ore-dressing plants and smelters.

Employment and accident record of mineral industries of the United States, 1931–39

Year	Men employed	Man-days of employment	Man-hours of employment	Number		Rate per million man-hours	
				Killed	Injured	Killed	Injured
1931	784,347	147,602,799	1,209,270,036	1,707	96,412	1.41	79.73
1932	671,343	110,655,616	900,211,723	1,368	68,717	1.52	76.33
1933	677,722	122,787,658	984,570,160	1,242	72,342	1.26	73.48
1934	739,817	144,566,133	1,081,694,716	1,429	81,660	1.32	75.49
1935	783,139	152,354,170	1,128,808,465	1,495	82,219	1.32	72.84
1936	824,514	177,920,334	1,326,347,029	1,686	92,644	1.27	69.85
1937	859,951	186,790,283	1,381,261,415	1,759	96,484	1.27	69.85
1938 [1]	774,000	144,700,000	1,074,000,000	1,364	73,740	1.27	68.64
1939 [1]	793,000	158,700,000	1,173,000,000	1,359	78,248	1.16	66.69

[1] Subject to revision.

The trends in employment and accidents based upon figures in the foregoing table are shown graphically in figures 1, 2, and 3.

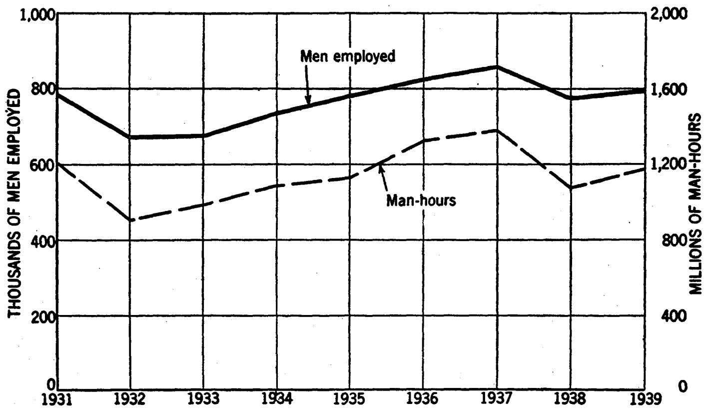

FIGURE 1.—Trend of employment in the mineral industries of the United States, 1931–39.

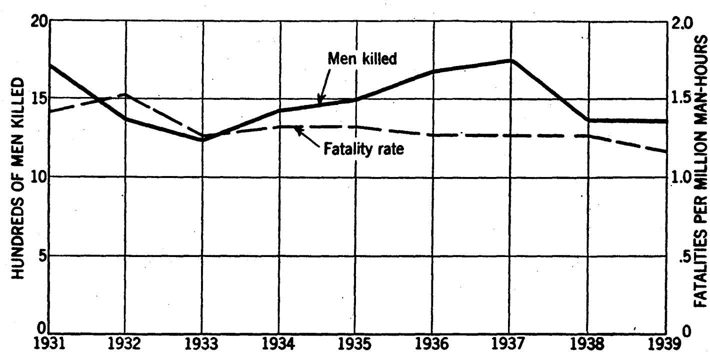

FIGURE 2.—Trend of fatal accidents in the mineral industries of the United States, 1931–39.

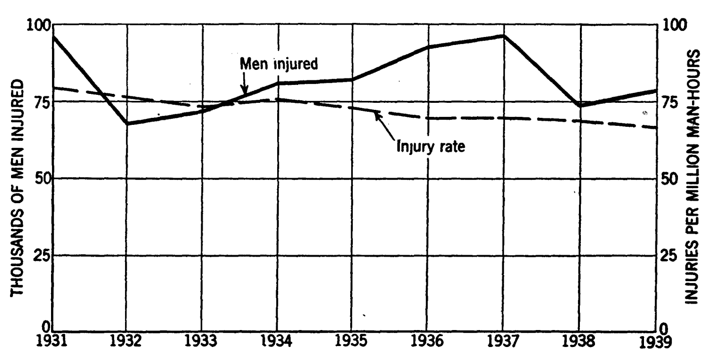

FIGURE 3.—Trend of nonfatal accidents in the mineral industries of the United States, 1931–39.

EMPLOYMENT AND ACCIDENTS

BITUMINOUS-COAL MINES

Employment.—Bituminous-coal mining is by far the largest branch of the mineral industries in the United States. Approximately 60 percent of the total number of men engaged in extracting minerals of all kinds, except oil, sand, gravel, and clay, work in mines that produce bituminous coal. The number of employees at bituminous-coal mines in 1939, as estimated from operators' reports now available, was 446,000 and the total man-hours worked approximately 559 million. The number of employees in 1939 was almost the same as in 1938; however, there was a large increase, amounting to about 10 percent, in volume of labor as measured by man-hours worked. The average working time also increased—from 161 days per man in 1938 to about 176 days per man in 1939.

Accidents.—Accidents increased in number in 1939, but the accident-frequency rate per million man-hours worked was prevented from rising by a proportionately larger gain in man-hours of employment. In fact, information now available indicates that the accident rate probably was a little lower in 1939 than in 1938. The tentative rate, covering both fatalities and injuries, was 75.84 compared with 78.54 in 1938. According to present reports, 890 employees were killed by accidents in 1939. Nonfatal injuries are estimated at 41,500. The tentative fatality rate is 1.59 per million man-hours worked in 1939 compared with 1.72 in 1938. Corresponding rates for nonfatal injuries are 74.25 for 1939 and 76.82 for 1938.

Only one major disaster occurred at bituminous-coal mines in 1939 (a major disaster being defined as an accident causing the loss of five or more lives). The single disaster was a mine explosion on July 14 in Webster County, Ky., in which 28 lives were lost.

ANTHRACITE MINES

Employment.—As referred to in the present discussion, this group of mines covers only the anthracite or hard-coal operations in eastern Pennsylvania. Employment during 1939 was more favorable than in 1938; a few more men were working at the mines, and a notably higher aggregate number of man-hours were worked. Incomplete returns from operating companies indicate a total of 98,000 employees, a slight gain over the 96,282 men employed in 1938. A more significant increase is revealed by the estimated 126 million man-hours worked in 1939 compared with 116 million man-hours worked in 1938. Improvement also was made in 1939 in the number of days of work available per employee; the average was 184, a gain of 12 workdays per man over the average of 172 per employee in 1938.

Accidents.—Accidents were more numerous in 1939 than in 1938. Because of increased employment, however, there was no increase in accident-frequency rate per million man-hours of work done. Tentative figures show a total accident rate of 121.84 per million man-hours for 1939, compared with 127.27 for 1938.

Anthracite mining was free of major disasters in 1939. No such disaster has occurred in an anthracite mine in Pennsylvania since June 2, 1938, when 10 men were killed in a mine explosion in Luzerne County.

IRON-ORE MINES

Employment.—Employment in iron-ore mining recovered sharply to approximately 20,700 men in 1939 from 18,006 men in 1938. Similar recovery was made in man-hours of labor performed, which rose to about 36 million man-hours in 1939 from 28.5 million in 1938. The workyear also was lengthened, as tentative figures indicate 219 workdays per employee in 1939 compared with 197 days in 1938.

Accidents.—Accidents were more numerous in 1939 than in the preceding year, and the accident rate per million man-hours worked also was higher than in 1938. According to present information the death-and-injury rate was 17.68 in 1939 compared with 16.69 in 1938. Although the rate increased in 1939, it was lower and therefore more favorable than the 1939 rate for any other major branch of metal mining in the United States.

COPPER MINES

Employment.—Notable recovery in employment in the copper-mining industry in 1939 compared with 1938 was shown by a 21-percent rise in number of man-hours worked. The number of men employed in and about the mines also increased. Moreover, the average employee had a longer work year in 1939 (285 days per man—a gain of about 39 workdays per man employed), according to reports now available. About 18,300 men were employed in 1939 compared with 17,582 men in 1938. Man-hours worked totaled 41.9 million compared with 34.6 million in 1938.

Accidents.—There was no significant change in the accident-frequency rate for copper mines in 1939 from that reported for 1938, although the actual number of persons injured was larger in 1939. The increase in number of accidents did not cause a rise in the accident-frequency rate owing to the larger number of man-hours worked in 1939. According to preliminary figures, the 1939 accident rate was 60.25 per million man-hours, whereas final reports for 1938 showed a rate of 61.27. Both rates represented an improvement over 1937, when the rate was 95.93.

LEAD AND ZINC MINES (MISSISSIPPI VALLEY STATES)

Employment.—This group includes mines producing lead or zinc in the Mississippi Valley States—including principally Kansas, Missouri, and Oklahoma—and those producing fluorspar in Illinois and Kentucky, where similar accident conditions prevail. The number of men working increased slightly in 1939, and the total man-hours worked gained much more, proportionately. The number of employees was approximately 7,000 compared with 6,413 in 1938. The aggregate man-hours worked at all mines increased about 12 percent in 1939, as reports for the year indicated 11.9 million man-hours worked compared with 10.6 million in 1938. The average employee had 212 days of work, a gain of 5 days over 1938.

Accidents.—Tentative figures based upon reports now available indicate an accident-frequency rate in 1939 of 53.11 injuries and deaths per million man-hours of employment, a more favorable record than that shown by the rate of 58.80 for 1938. Five men were killed by a fall of roof in a mine at Treece, Kans., on January 31, 1939.

GOLD AND SILVER MINES

Employment.—This group includes not only gold and silver mines, but also those producing some copper but operated chiefly for some other metal and those producing lead or zinc elsewhere than in the Mississippi Valley States. Placer as well as lode mines are included.

Mines in this group employed approximately 52,300 men in 1939 compared with 47,534 in 1938. The favorable record shown by the increase in number of employees did not extend to the man-hours worked, which declined from 88.8 million in 1938 to about 87.4 million in 1939.

Accidents.—Accidents increased in 1939 and resulted in higher death and injury rates than in 1938. Tentative figures place the death rate at 0.95 and the injury rate at 105.13 compared with 0.90 and 94.21, respectively for 1938. Reports now available indicate 83 lives lost and 9,187 men injured in accidents at mines in 1939. Final reports for 1938 showed 80 fatal and 8,362 nonfatal injuries.

MISCELLANEOUS METAL MINES

Employment.—This group covers all operations that mine any kind of metallic ores except those produced chiefly for their gold, silver, copper, lead, zinc, or iron; therefore it includes mines that produce ores of tungsten, mercury, manganese, or any of the other metals. The group as a whole contains quite a large number of mines, but many of them are small and employ relatively few men. According to tentative figures now available, the number of employees in 1939 was 3,800, slightly less than the 3,943 men employed in 1938. Total man-hours worked likewise dropped; the total for 1939 was 7.4 million compared with 7.8 million for 1938 and 8.3 million for 1937.

Accidents.—Progress was made in prevention of accidents in 1939, as the tentative accident-frequency rate per million man-hours worked was 51.21 compared with 61.48 for 1938. The 1939 rate was 17 percent below 1938 and 25 percent below 1937.

NONMETALLIC-MINERAL MINES

Employment.—This group covers mines that produce all kinds of nonmetallic minerals except stone, sand, gravel, and clay; therefore it includes mines producing phosphate rock, rock salt, sulfur, gypsum, and many other minerals. The group as a whole employed approximately 9,200 men in 1939, a decrease from 9,526 in 1938. More continuous operation of the mines, however, was reported in 1939, so the aggregate number of man-hours worked increased, the total for 1939 being about 18.4 million and for 1938 17.8 million.

Accidents.—The safety record for nonmetallic-mineral mines as a group was slightly more favorable in 1939 than in 1938. The records for both years, however, were better than in 1937. According to tentative figures the rate for 1939 was 39.20 compared with 41.06 for 1938. The improvement indicated by each of these rates is seen when they are compared with the rate of 48.69 for 1937.

CEMENT MILLS AND QUARRIES

Employment.—A gain in employment was reported for cement quarries and mills in 1939 compared with 1938; the number of men working increased 2 percent and the aggregate number of man-hours worked 7 percent. The total number of workers was 26,045; and man-hours worked, 52 million. An increase of about 17 days per man over the 255 workdays in 1938 was shown.

Accidents.—Accidents were reduced in 1939, notwithstanding an increase in workers and in man-hours of employment. Twelve men were killed and 456 injured in 1939. These figures represent a fatality rate of 0.23 and an injury rate of 8.77 per million man-hours worked by the cement industry as a whole. Corresponding rates for 1938 were 0.29 for fatalities and 9.69 for injuries; thus the record for 1939 was favorable both in accident prevention and employment.

MARBLE QUARRIES

Employment.—More men were employed and more man-hours of employment were available at marble quarries in 1939 than in 1938. The average number of men working at both quarries and finishing plants was 3,697, and the total man-hours worked during the year was more than 7 million. The average number of workdays per employee was 2 more than in 1938, bringing the figure to 236 days per employee in 1939.

Accidents.—No employee was fatally injured in 1939—a favorable record considering that men working at the quarries and finishing plants were exposed to occupational hazards for more than 7 million man-hours. One man was fatally injured in 1938. Nonfatal injuries involving disability of 1 day or more totaled 429 and represented a frequency rate of 60.90 per million man-hours of exposure. This rate was slightly higher than that for 1938.

SLATE QUARRIES

Employment.—Increased employment, both in men working and man-hours of work performed, was reported for the slate-quarrying industry in 1939. Total man-hours worked was 25 percent higher than in 1938 and only 12 percent lower than in 1937. Final figures for 1939 show 2,833 employees and 5.3 million man-hours of work.

Accidents.—Three men were killed and 375 injured by accidents at slate quarries during 1939—more than in either 1938 or 1937. The increase in accidents was proportionately greater than the gain in employment, so that the accident rate for 1939 was higher than for 1938. The rate for 1939 was 70.80 injuries and fatalities per million man-hours worked compared with 57.04 for 1938.

TRAP-ROCK QUARRIES

Employment.—Contrary to the general upward trend in employment in most mineral industries, the number of men employed at trap-rock quarries (about 2,900) was smaller in 1939 than in 1938 but larger than in 1937. The aggregate number of man-hours worked (4.2 million) by the operating plants was less than in either 1938 or 1937.

Accidents.—Although final figures are not available, injuries during 1939 approximated 297, including 4 fatal injuries. The frequency rate, covering both nonfatal and fatal injuries, was 71.46 compared with 62.85 in 1938.

GRANITE QUARRIES

Employment.—The number of men employed in and about granite quarries in 1939 was slightly higher than in 1938, when 8,395 men were employed, but did not differ materially from that figure; however, the aggregate number of man-hours worked in the industry as a whole increased about 5 percent, owing chiefly to a gain of about 14 workdays per man over the average of 214 workdays per man shown by final reports for 1938.

Accidents.—Preliminary data indicate that 592 men were injured, 8 of them fatally. These figures represent an accident-frequency rate of 39.89 per million man-hours of employment or exposure to risk. The rate for 1938 was 42.93.

SANDSTONE QUARRIES

Employment.—About 2,950 men were employed at sandstone quarries in 1939. The number working was a little larger than the 2,907 employees in 1938. During 1939, 4.5 million man-hours of work were performed; the corresponding figure for 1938 being 4.3 million.

Accidents.—From reports so far received, the sandstone-quarrying industry was operated during 1939 without a fatality. Nonfatal injuries totaled 331, a considerable increase over the 252 that occurred during 1938. As a result the accident-frequency rate was higher in 1939, being 73.60 compared with 58.15 in 1938.

LIMESTONE QUARRIES

Employment.—Excluding quarries that produced limestone chiefly for the manufacture of lime, the limestone quarries of the United States employed approximately 22,900 men in 1939, a slight gain over the 22,352 reported for 1938. The number of man-hours of labor performed also increased, from 34 million in 1938 to about 36 million in 1939.

Accidents.—A reduction in accidents, both in number and in relation to man-hours of employment, was shown by operators' reports for 1939. Tentative figures indicate 1,786 injuries in 1939 compared with 1,914 in 1938. The gain in man-hours worked and the more notable reduction in number of injuries lowered the accident-frequency rate to 49.40 in 1939 from 57.12 in 1938.

LIMEKILNS AND QUARRIES

Employment.—Gains in number of workers and in man-hours worked in 1939 compared with 1938 were reported by limekilns and quarries. Tentative figures show 9,600 men employed in 1939 compared with 9,153 in 1938, and total volume of employment was 20.2 million man-hours compared with 18.1 million in 1938.

Accidents.—Tentative figures show that 8 men were killed and 1,054 injured by accidents at quarries and kilns in 1939. The fatality record was better than that for 1938, which included 14 fatal accidents. Nonfatal injuries, on the other hand, were more numerous in 1939 (1,054 compared with 936 in 1938). The accident frequency rate for 1939 was 52.53 compared with 52.51 for 1938. The increase in number of injuries in 1939 did not cause a material rise in the accident rate per million man-hours owing to the increase in man-hours worked during 1939.

BYPRODUCT-COKE OVENS

Employment.—Increased employment in 1939 raised the total number of employees at byproduct-coke ovens to 14,852, a gain of more than 16 percent over 1938 but 17 percent less than in 1937. Volume of employment amounted to 42.2 million man-hours in 1939 compared with 35.5 million in 1938, the gain in 1939 being nearly 19 percent.

Accidents.—Byproduct-coke ovens and one other group, cement mills and quarries, are conspicuous among the various mineral industries for consistently low and favorable accident rates reported from year to year. In 1939 byproduct-coke plants, with an accident-frequency rate of 8.15, established the best safety record of any group canvassed by the Bureau of Mines. The rate for 1939 was not quite as favorable as that for 1938, which was 7.29, but compared favorably with 8.54 for 1937.

BEEHIVE-COKE OVENS

Employment.—Although the number of men working at beehive-coke ovens in the United States has been small in recent years, a marked increase was reported in 1939 compared with 1938. Final reports show a total of 1,757 men working at the ovens, an increase of 67 percent over 1938 when the number was 1,049. Man-hours of work also showed a substantial increase, being 1.54 million in 1939 compared with 1.06 million in 1938.

Accidents.—There were no fatal accidents in 1939 but 62 men were injured, an increase of 33 over 1938. Because injuries increased more in proportion than number of man-hours worked, the accident rate rose to 40.25 in 1939 compared with 27.36 in 1938; however, the rate for 1939 compared favorably with that for 1937—48.49—which represented 158 injuries and 1 fatality that occurred during 3.3 million man-hours of work.

ORE-DRESSING PLANTS

Employment.—At ore dressing and beneficiating plants employees increased about 5 or 6 percent and man-hours worked in 1939, 14 percent compared with 1938. According to tentative figures, 13,100 men were employed and 27.4 million man-hours of work done at all operations in 1939.

Accidents.—Seven fatalities and 745 injuries occurred in 1939. These figures represent an accident-frequency rate of 27.44 per million man-hours worked, which compares favorably with the previous year's rate of 34.93 and the 1937 rate of 35.04, showing the progress in accident prevention during 1939.

SMELTERS

Employment.—The smelting industry, as classified herein, covers the smelting and refining of all metallic ores except iron ore. The smelting of iron ore and the manufacture of steel are not included in accident and employment reports collected by the Bureau of Mines, as such reports have been collected and compiled by the Department of Labor. Reports for all smelters except those treating iron ore show that 16,300 men were employed in 1939. This figure represents a gain over 1938 but a loss compared with 1937. The man-hours worked during 1939 totaled 39.1 million compared with 36.4 million in 1938.

Accidents.—Progress in accident prevention during 1939 was indicated by a reduction in the accident-frequency rate from 19.21 in 1938 to 16.74 in 1939. The rates for both years were more favorable than that for 1937 which was 22.84.

AUXILIARY WORKS AT ORE-DRESSING PLANTS AND SMELTERS

Employment.—Auxiliary works cover all operations at mills and smelters not directly connected with milling and smelting processes. About 12,900 men were so employed in 1939, virtually the same number as in 1938, when the figure was about 12,500. The man-hours worked during 1939 also was virtually the same as in 1938; reports for each year show a total of about 30 million man-hours of labor performed.

Accidents.—Preliminary figures indicate that 523 employees were injured—6 fatally—by accidents during 1939. Based upon this figure, the accident-frequency rate was 17.25 per million man-hours worked, which was nearly identical with the rate of 17.21 in 1938. Each of these rates was considerably better than that of 27.40 reported for 1937.

SUMMARY, 1931–39

Accident and employment data of the Bureau of Mines, except those covering nonfatal injuries at coal mines, first became available for 1911; the figures covered the mining and quarrying industries only. Beginning with 1913, statistics also became available for coke ovens and for ore-dressing plants and smelters, although the early records did not show the number of man-hours worked. After a few years some companies operating metal mines and stone quarries supplied special information, including man-hours worked, and tables based upon these data were prepared from time to time. Nationwide coverage of accidents and employment, including the number of man-hours worked, first became available for coal mines in 1930 and for quarries, coke ovens, metallurgical plants, and all other mines in 1931. Beginning with 1931, therefore, the yearly records of the Bureau of Mines are complete as to fatal and nonfatal injuries, men employed, and man-days and man-hours worked.

The low point of the depression in many branches of mining and quarrying was reached in 1932. In the discussion of accidents and employment in the mineral industry published in Minerals Yearbook, 1939, 1932 was chosen as a base year to show the comparative record of accidents and employment in 1938. However, 1931—the earliest year for which man-hour and other data are complete for all classes of the mineral industry on which annual reports of accidents and employment are compiled—may also be chosen as a base year with which to compare the record in later years, particularly that for 1939.

If, therefore, 1931 is used for purposes of comparison and assigned a base rating of 100, the comparative rating for later years may be clearly seen. Considering the number of men employed in 1931 as being represented by an index of 100, the number of employees fell to its lowest level in 1932 (when the index was 86), reached its highest point with an index of 110 in 1937, dropped to 99 in 1938, and recovered to 101 in 1939. As the trend in employment based upon number of employees does not necessarily parallel that based upon man-hours worked, comparison may be made also on a man-hour basis. With an index of 100 for the number of man-hours worked in 1931, the comparable figure for 1932 (the depression low point) is 74, followed by a rise to a maximum of 114 in 1937, a drop to 89 in 1938, and an increase to 97 in 1939.

The number of fatal accidents in 1931, which was 1,707, also may be represented by an index of 100. Comparative figures show an index of 73 for 1933, the lowest number reported for any year since 1931, and of 80 in both 1938 and 1939. Similarly, if an index of 100 represents the actual number of persons injured in 1931, the smallest number of injuries, which was reported in 1932, may be represented by an index of 71, while the tentative figure for 1938 is 76 and that for 1939 is 81.

The accident-frequency rate per million man-hours of exposure for 1939, covering an estimated 79,607 fatal and nonfatal injuries, was 67.85. The rate was lower and therefore more favorable than the corresponding rate for any year since comparable rates first became available in 1931.

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By M. E. Winslow

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